

Population monitoring for *Lupinus oreganus* (Kincaid's lupine) at Eagle's Rest



20181/1/2018

Report to the Bureau of Land Management,
Eugene District

Report prepared by Denise E. L. Giles and A.
Lisa Schomaker
Institute for Applied Ecology



PREFACE

This report is the result of a cooperative Challenge Cost Share project between the Institute for Applied Ecology (IAE) and a federal agency. IAE is a non-profit organization dedicated to natural resource conservation, 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.



Questions regarding this report or IAE should be directed to:

Matt Bahm

Conservation Research Program Director

Institute for Applied Ecology

563 SW Jefferson Ave

Corvallis, Oregon 97333

phone: 541-753-3099

fax: 541-753-3098

email: mattab@appliedeco.org

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the contributions and cooperation by the Eugene District Bureau of Land Management, retired botanist Cheshire Mayrsohn. In 2018, work was supported by IAE staff and interns: Kristina Lopez, Mary McKean, Michelle Yasutake, Michel Wiman, and Jennifer Thornhill.

Cover photograph: *Rubus armeniacus* at Eagle's Rest *Lupinus oreganus* (Kincaid's lupine) population in 2018.

Suggested Citation

Giles, Denise E. L. and A. Lisa Schomaker. 2018. Population monitoring for *Lupinus oreganus* (Kincaid's lupine) at Eagle's Rest. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Eugene District. Corvallis, Oregon. v + 28.

Contents

PREFACE	II
ACKNOWLEDGEMENTS	III
LIST OF FIGURES	V
LIST OF TABLES	V
LIST OF APPENDICES	V
INTRODUCTION	1
Species status and background information.....	1
Recovery Goals for Kincaid's Lupine in the Eugene East Recovery Zone.....	2
Study site.....	2
Objectives	2
Location of study site	3
Plot layout.....	3
Plot sampling	7
Baseline vegetation data	7
RESULTS	7
Evaluation of cover as an estimate of leaf number	7
Evaluation of cover and inflorescence counts	8
Butterfly eggs.....	10
Vegetation Monitoring 2004, 2012, 2015 and 2018	10
ORV and other use of the site.....	13
CONTRIBUTION OF SITE TO RECOVERY GOALS	13
DISCUSSION AND RECOMMENDATIONS	13
LITERATURE CITED	16
APPENDIX A. DIRECTIONS AND GEAR LIST	17
APPENDIX B. EXAMPLE LUPINE MONITORING DATASHEET	19
APPENDIX C. COMMUNITY DATA	21

LIST OF FIGURES

Figure 1. Layout of monitoring plots for *Lupinus oreganus* at Eagle's Rest. Dashed lines indicate orientation of plot sections used during sampling. Grey Squares represent the Location of the 5m x 5m community plots monitored in 2012,2015 and 2018. 4

Figure 2. The Eagle's Rest *Lupinus oreganus* site in 2003 prior to removal of introduced shrub species (top), after treatment in 2004 (middle) and in 2018 (bottom). Note the increase in cover of shrub species including *Cytisus scoparius* and *Rubus armeniacus* in 2018. 5

Figure 3. Location of Eagle's Rest relative to other Kincaid's lupine sites (highlighted in red). The nearest population of lupine is found 16km to the Southeast at Dorena lake..... 6

Figure 4. The abundance of *L. oreganus* at Eagle's Rest, 2003-2018. Total number of leaves was counted from 2003-2006 and cover was estimated from 2005-2015. The scale between the two y-axes was determined using the ratio between leaves and cover at all *L. oreganus* sites characterized by sun to partial shade: # lvs * 515 = cover (m²). 8

Figure 5. The number of aborted, mature and total *L. oreganus* racemes at Eagle's Rest FROM 2003-2015. *Due to the maturity of the plants, in 2011 we were unable to determine the number of aborted racemes. The site was not monitored in 2013, 2014, 2016 or 2017..... 9

Figure 6. Number of mature racemes per m² of lupine at Eagle's Rest and Oak Basin from 2006 to 2018. 10

Figure 7. Aphids and other insects at Eagle's rest on a lupine raceme. Note the absence of fruits..... 14

LIST OF TABLES

Table 1. Mean data collected on *L. oreganus* at Eagle's Rest 2003-2018 (Lupine was not monitored in every Year). Number of mature racems per m² for Oak Basin are shown for Comparison. 9

Table 2. Count of native and introduced species observed from 2004-2018 at Eagle's Rest..... 11

Table 3. Dominant species in community plots at Eagle's Rest from 2004-2018. 11

Table 4. Site, year of observation, habitat type, scale of observation, sample size, regression coefficient (proportion of variance in leaf number explained by foliar cover, R²) and slope of the relationship between leaf number and cover at eleven sites of *L. oreganus* from Lane and Douglas Counties. "WEW" indicates lupine populations in the West Eugene Wetlands. 15

Table 5. Average percent cover and 95% C.I. for vegetation monitoring plots at Eagle's Rest. Values in Italics represent average values >0, but less than 0.1% cover. 25

LIST OF APPENDICES

Appendix A. Directions and Gear List..... 17

Appendix B. Example lupine monitoring datasheet..... 19

Appendix C. Community data collected in 2004-2018 21

Lupinus oreganus population monitoring at Eagle's Rest

REPORT TO THE BUREAU OF LAND MANAGEMENT, EUGENE DISTRICT
DISTRICT REPORT TO THE BUREAU OF LAND MANAGEMENT, EUGENE DISTRICT

INTRODUCTION

This report documents monitoring for the *Lupinus oreganus* (Kincaid's lupine) population located at Eagle's Rest, managed by the Eugene District of the Bureau of Land Management (BLM). Monitoring at this site provides the BLM with information on population status and long-term trends and supply baseline data to help understand and predict the response of the population to habitat changes caused by natural forces, human-induced threats, and prescribed management actions. Monitoring at this site also provides information on the prairie quality and diversity, and the overall abundance of lupine at this site in the Eugene East Recovery Zone (U.S. Fish and Wildlife Service 2010).

Species status and background information

Lupinus oreganus (cover photo) is native to prairies in southwestern Washington and the Willamette Valley and forest openings and grassy balds in Douglas County, Oregon. Many of the largest and most significant *L. oreganus* populations occur on lands managed by the BLM in western Oregon. Habitat loss and population declines caused by land-use conversion, exotic weed invasion and other threats have led *L. oreganus* to be listed as a threatened species by the Oregon Department of Agriculture (ODA) and the US Fish and Wildlife Service (USFWS). Kincaid's lupine is also of great conservation importance because it is the primary larval host plant for the endangered Fender's blue butterfly (*Icaricia icarioides fenderi*).

Lupinus oreganus is an herbaceous perennial that reproduces by seed. Plants form clumps of basal leaves and produce one or more flowering stems. Although this species is capable of vegetative growth, the extent to which vegetative growth might result in clonal spread remains unknown. *Lupinus oreganus* requires insects for successful fertilization and seed formation (Kaye 1999).

Recovery Goals for Kincaid's Lupine in the Eugene East Recovery Zone

1. Distribution and abundance: At least 2 populations in the recovery zone with a total of at least 5,000m² of foliar cover.
2. Population trend and evidence of reproduction: Foliar cover stable or increasing for at least 15 years. Populations must show evidence of seed-set or presence of seedlings.
3. Habitat quality and management:
 - a. Prairie quality: sites must be managed for high quality prairie habitat which includes a diversity of native, non-woody plant species low frequency of aggressive non-native plant species and encroaching woody species, and essential elements for native pollinators.
 - b. Security of habitat: a substantial portion of the habitat should be either owned or managed by a government agency, a conservation organization or in a long-term conservation easement.
 - c. Management, monitoring and control of threats: Each population must be managed appropriately to ensure the maintenance or restoration of quality prairie habitat for each species and to control threats to the species. Other potential threats include impacts from activities on adjacent land parcels or roads, vandalism, recreational impacts and herbivory/parasitism.
4. Genetic material is stored in a facility approved by the Center for Plant Conservation
5. Post-delisting monitoring plans and agreements are in place at the time of delisting.

Study site

Eagle's Rest is one of the few remaining upland prairie remnants in the Cascade foothills of the southern Willamette Valley that, while containing some non-native species, also contains a substantial native plant community. It is characterized as an isolated forest opening harboring a diverse native upland prairie plant community (Figure 2 and 2). Conservation threats in this small meadow include encroachment of shrubs, invasion by exotic plant species and damage by outdoor recreation vehicle (ORV) use and trampling by recreational visitors. In 2003 management of the site included the removal of *Cytisus scoparius* and *Rubus armeniacus* in the meadow and on the meadow perimeter.

Objectives

The objectives of this project are to:

- 1) Document population trends of Kincaid's lupine at Eagle's Rest.
- 2) Document changes in plant community at the site and identify problematic species.
- 3) Assess impacts threats to the site, and evaluate impacts including ORV use.

Location of study site

Eagle's Rest is located in the northwest quarter of Township 20S, Range 1W, Section 1 (). The site is accessed from Eagle's Rest road, off of Highway 58. See Appendix A for directions. The site is found in a small meadow south of Dexter Reservoir, surrounded by second growth timber along a gravel roadside. Eagle's Rest is located in the Eugene East Recovery Zone, and the nearest populations of *L. oreganus* can be found at Dorena Lake (16km), Carmine (20 km) and Creswell (24km) (Figure 3).

Plot layout

Five rectangular monitoring plots were established at Eagle's Rest in July 2003 to include virtually the entire population of *Lupinus oreganus* (Figure 1). The corners of the plots are marked with rebar or red-tipped conduit posts. Plot 1 is 20 x 15 m, plot 2 is 25 x 16 m, plot 3 is 23 x 5 m, plot 4 is 35 x 11 m and plot 5 is 9 x 7 m. In 2005 and 2006, we replaced three and one (respectively) missing pieces of rebar that had marked plot corners generally located in the center of the meadow. The cause of the rebar loss was not determined (possibilities include tampering by the public, mistaken removal by maintenance crews or insecure position in the loose and rocky soil).

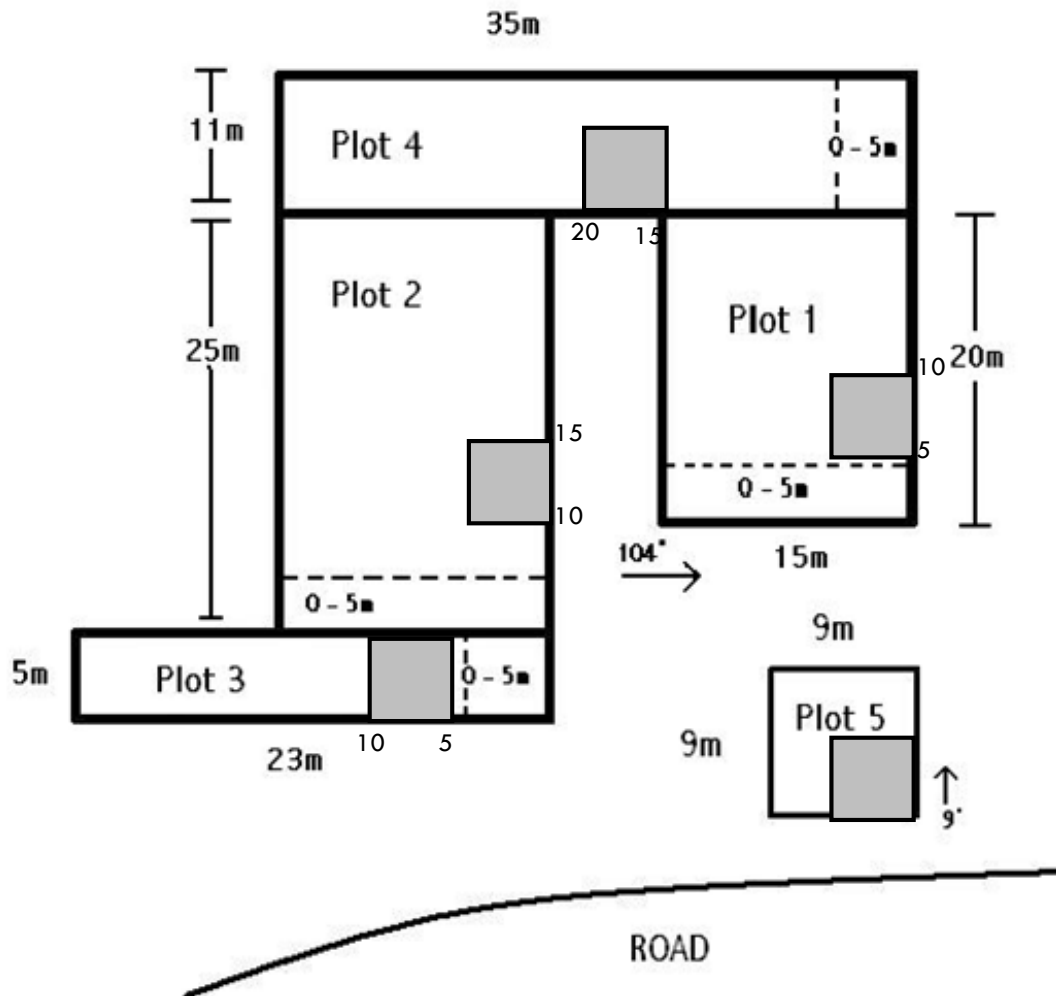


FIGURE 1. LAYOUT OF MONITORING PLOTS FOR *LUPINUS OREGANUS* AT EAGLE'S REST. DASHED LINES INDICATE ORIENTATION OF PLOT SECTIONS USED DURING SAMPLING. GREY SQUARES REPRESENT THE LOCATION OF THE 5M X 5M COMMUNITY PLOTS MONITORED IN 2012, 2015 AND 2018.



FIGURE 2. THE EAGLE'S REST *LUPINUS OREGANUS* SITE IN 2003 PRIOR TO REMOVAL OF INTRODUCED SHRUB SPECIES (TOP), AFTER TREATMENT IN 2004 (MIDDLE) AND IN 2018 (BOTTOM). NOTE THE INCREASE IN COVER OF SHRUB SPECIES INCLUDING *CYTISUS SCOPARIUS* AND *RUBUS ARMENIACUS* IN 2018.

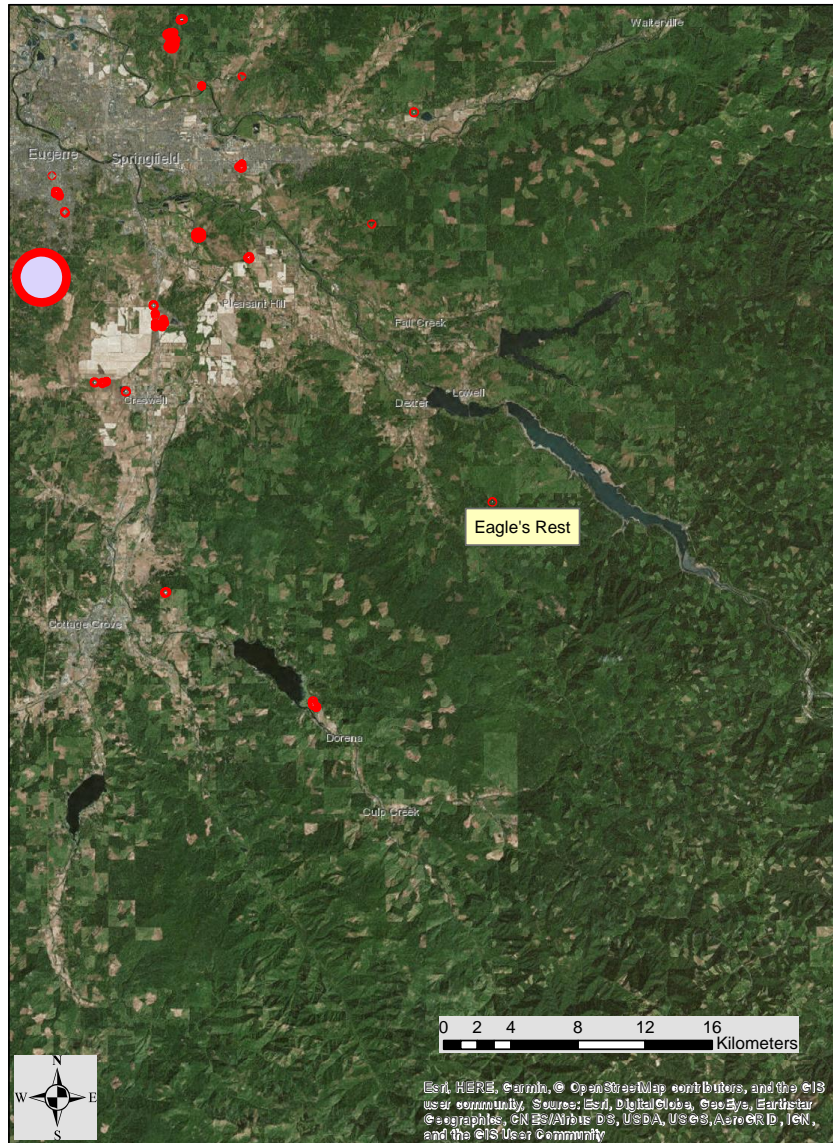


FIGURE 3. LOCATION OF EAGLE'S REST RELATIVE TO OTHER KINCAID'S LUPINE SITES (HIGHLIGHTED IN RED). THE NEAREST POPULATION OF LUPINE IS FOUND 16KM TO THE SOUTHEAST AT DORENA LAKE.

Plot sampling

A complete census of lupine at the site is conducted. Within each plot, we determine the abundance of *L. oreganus* and count the number of mature and aborted inflorescences. The area outside of the established plots is also surveyed for additional lupine plants, which when present are measured following the same protocol. Individual *L. oreganus* plants are often indistinguishable from one another due to the species' rhizomatous growth habit. From 2003 – 2006, we determined abundance of *L. oreganus* by counting leaves (Menke and Kaye 2003; Gisler and Kaye 2004a,b). In 2004 – 2007, we determined abundance by making estimations of foliar cover; each patch of *L. oreganus* was visually manipulated into a rectangular shape, of which we recorded the length and width. We used both leaf and cover measurements in 2005 and 2006. Beginning in 2007, we only used cover to estimate abundance in accordance with the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington (USFWS 2008).

Previous monitoring had included looking for eggs of butterfly species. The size and location of the eggs on the underside of *L. oreganus* leaves was consistent with the behavior of Fender's blue butterfly. Surveys for Fender's conducted by Paul Severns did not find any adults at Eagle's Rest; thus we have a high degree of confidence that eggs at Eagle's Rest on the underside of lupine leaves are likely Columbia silvery blue (*Glaucopsyche lygdamus columbia*) or Bousdauval's blue (*Plebejus icarioides*) (C. Mayrsohn personal communication). Thus, monitoring for eggs was discontinued in 2010.

Baseline vegetation data

IAE collected baseline vegetation data within each of the five population monitoring plots in 2004 (Gisler et al. 2004a). Community composition was measured in 2012, 2015 and 2018 in five 5m x 5m blocks (one per plot see Figure 1).

RESULTS

Evaluation of cover as an estimate of leaf number

The number of leaves and cover were highly correlated across all sites where we monitor *L. oreganus* (Table 2). At Eagle's Rest in 2005, we estimated 606 *L. oreganus* leaves per square meter of cover ($R^2 > 0.94$). In 2006, we determined there to be 404 leaves per square meter of cover ($R^2 > 0.92$; Thorpe and Kaye 2006). This relationship is similar to that determined for three partially shaded populations in Douglas County (China Ditch, Stout's Creek and Dickerson Heights; Menke and Kaye, 2006) and partially shaded patches at Oak Basin in the Coburg Hills of Lane County (Thorpe 2007). We calculated

that there were on average 515 leaves per meter square of foliar cover at sites characterized by sun to partial shade.

Evaluation of cover and inflorescence counts

The cover of *L. oreganus* has generally increased since monitoring began in 2003 when lupine cover was estimated to be 15.6 m² (Figure 4, Table 4). In 2018, cover of *L. oreganus* was 60.6m², an increase from 2015 when 46.8m² were observed. The number of mature racemes increased in 2018 (403 racemes) from 2015 (195 mature racemes) (Table 1). Despite increases in foliar cover and raceme counts, the number of racemes per m² of lupine has decreased at the site since 2011 with 3.7 racemes/m² in 2015 and 6.6 in 2018 (range since 2006: 3.2-28.7 racemes /m²) (Table 1, Figure 6). In 2018, 7% of racemes were aborted (range since 2006: 4%-58%). The density of racemes per m² of lupine at Eagle's Rest over time has followed a very similar pattern to that observed at Oak Basin another lupine population in the Eugene East Recovery Zone indicating that climate could be an important driver in this ratio (Figure 6, Table 1) (Giles et al. 2017).

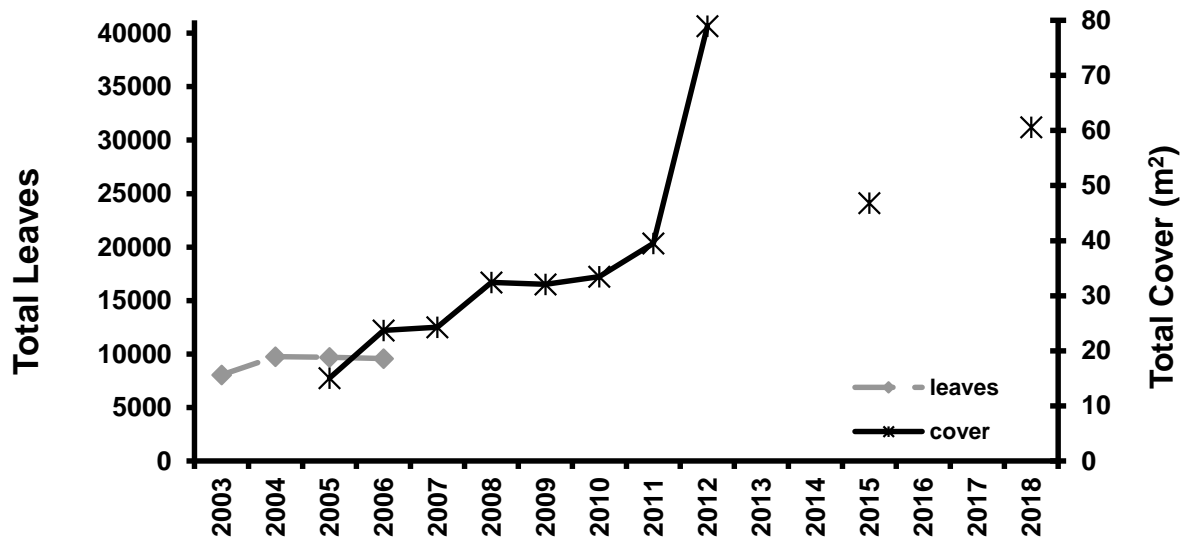


FIGURE 4. THE ABUNDANCE OF *L. OREGANUS* AT EAGLE'S REST, 2003-2018. TOTAL NUMBER OF LEAVES WAS COUNTED FROM 2003-2006 AND COVER WAS ESTIMATED FROM 2005-2015. THE SCALE BETWEEN THE TWO Y-AXES WAS DETERMINED USING THE RATIO BETWEEN LEAVES AND COVER AT ALL *L. OREGANUS* SITES CHARACTERIZED BY SUN TO PARTIAL SHADE: # LVS * 515 = COVER (M²).

TABLE 1. MEAN DATA COLLECTED ON L. OREGANUS AT EAGLE'S REST 2003-2018 (LUPINE WAS NOT MONITORED IN EVERY YEAR). NUMBER OF MATURE RACEMS PER M² FOR OAK BASIN ARE SHOWN FOR COMPARISON.

Year	Eagle's Rest					Oak Basin	
	Number of inflorescences	Mature	Aborted	Total cover (m ²)	% aborted	Mature Racemes per m ² of lupine	
2003	122	51	71	15.6	58%	3.3	
2004	104	100	4	18.9	4%	5.3	
2005	197	136	61	15	31%	9.1	
2006	329	142	187	23.7	57%	6.0	8.0
2007	580	399	181	24.3	31%	16.4	33.0
2008	905	682	223	32.4	25%	21.0	23.1
2009	725	546	179	32.1	25%	17.0	13.4
2010	443	425	18	33.5	4%	12.7	28.7
2011	842	-	-	39.5		21.3	25.0
2012	995	993	2	78.9	0%	12.6	14.2
2013							2.6
2014							13.4
2015	195	175	20	46.8	10%	3.7	4.3
2016							6.5
2017							23.3
2018	435	403	32	60.61	7%	6.6	18.7

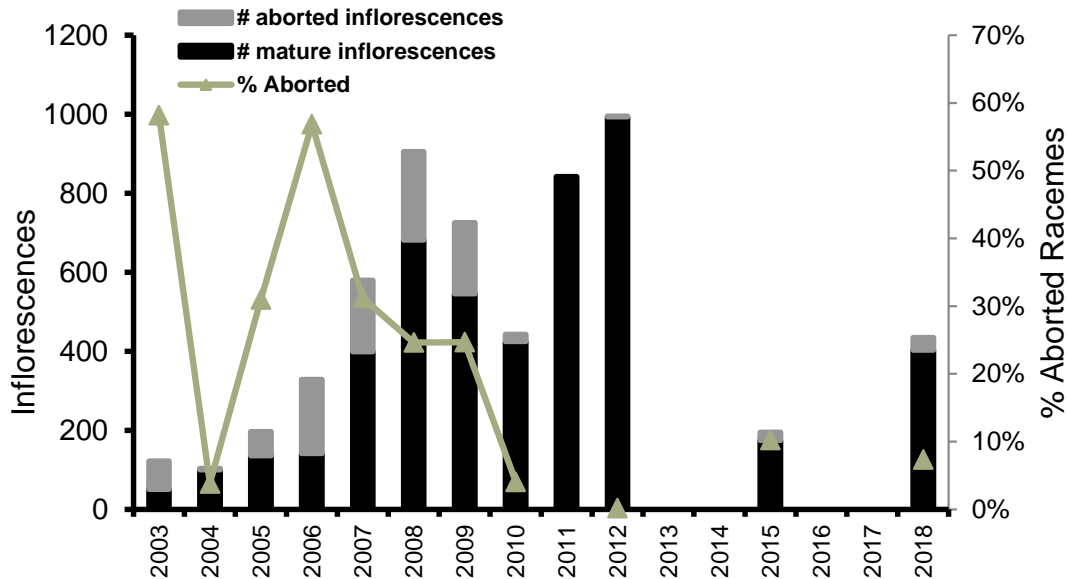


FIGURE 5. THE NUMBER OF ABORTED, MATURE AND TOTAL L. OREGANUS RACEMS AT EAGLE'S REST FROM 2003-2015. *DUE TO THE MATURITY OF THE PLANTS, IN 2011 WE WERE UNABLE TO DETERMINE THE NUMBER OF ABORTED RACEMS. THE SITE WAS NOT MONITORED IN 2013, 2014, 2016 OR 2017.

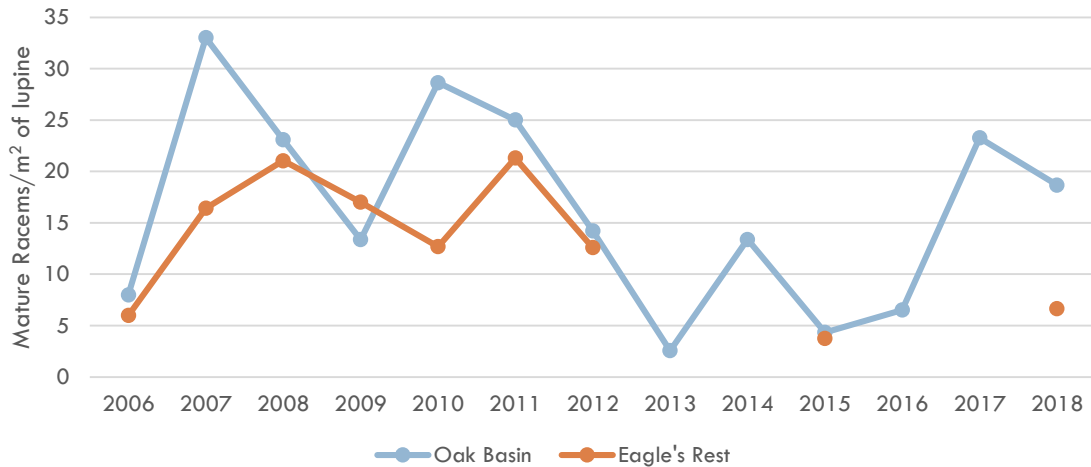


FIGURE 6. NUMBER OF MATURE RACEMES PER M² OF LUPINE AT EAGLE'S REST AND OAK BASIN FROM 2006 TO 2018.

Butterfly eggs

In spring 2010, Paul Severns determined that any butterfly eggs observed at the site were likely from either Columbia silvery blue (*Glaucopsyche lygdamus columbia*) or Bousdauval's blue (*Plebejus icarioides*) (C. Mayrsohn, personal communication). The nearest extant population of Fender's blue butterfly can be found near Coburg, approximately 33 km away. The range for an adult Fender's blue butterfly is approximately 2 km. Based on the absence of Fender's at this site and the distance to the nearest extant population, eggs are no longer counted at Eagle's Rest.

Vegetation Monitoring 2004, 2012, 2015 and 2018

In 2012, 2015 and 2018 vegetation monitoring was performed in five 5m x 5m blocks (one per lupine monitoring plot). Baseline vegetation monitoring for the site occurred in 2004 and included the percent cover of species within each of the five lupine monitoring plots. The exact location of the plots monitored in 2004 was not noted thus community measurements in 2012-2018 should not be considered direct comparisons to the 2004 data. Plot locations in 2012 were selected for both ease of relocation and to be representative of the plot as a whole. These same vegetation plots were surveyed in 2015 and 2018.

Vegetation data recorded in 2004 reflect the high quality of the native upland prairie habitat at Eagle's Rest at that time. Of the 64 plant species present at the site, 50 (78%) were native species and only 14 (22%) were introduced (Table 2, Appendix C). Overall, using summed means, native forb and graminoids had 93.2% cover, whereas non-native forb and graminoids averaged 34.1 % cover (note: total percent cover can exceed 100 percent due to the multi-layered, three-dimensional nature of vegetation growth). In 2012, 39 of the 58 plants observed were native. In 2015, of the 63 species observed 44

(~70%) were native and 19 (30%) were introduced invasive species. The invasive forb *Leucanthemum vulgare* (ox-eye daisy) increased from an average cover of just 0.4% in 2004 to 9.6% in 2012 then decreased to 5.2% cover in 2015, and 1.3% in 2018. The count of native and introduced species remained stable in 2018, with 42 and 19 respectively (Table 2).

TABLE 2. COUNT OF NATIVE AND INTRODUCED SPECIES OBSERVED FROM 2004-2018 AT EAGLE'S REST.

	Count (and %) Native Species	Count (and %) Introduced Species	Total Species Richness	Mean Cover Native Forb and Graminoid Species (95% CI)	Mean Cover Introduced Forb and Graminoid Species (95% CI)	Mean Cover Shrub Species (95% CI)
2004	50 (78%)	14 (22%)	64	93.2 (40.2)	34.1 (34.6)	4.8 (5.6)
2012	42 (69%)	19 (31%)	61	73.2 (22.6)	28.2 (16.1)	9.0 (3.3)
2015	44 (70%)	19 (30%)	63	92.4 (32.0)	34.7 (20.8)	10.1 (5.9)
2018	42 (69%)	19 (31%)	61	61.4 (30.3)	18.5 (16.7)	10.2 (5.9)

In 2004-2018, the dominant introduced graminoid species was *Cynosurus echinatus* with cover ranging from 10-27%. In 2004, no introduced forb species had cover higher than 0.5%, and total introduced forbs of just 1.3%. Introduced forb cover has increased to as high as 16.1% in 2012 and was 3.9% in 2018. From 20012-2018, dominant introduced forb species included *Leucanthemum vulgare*, *Vicia sativa*, and *Linum bienne*. *Vicia sativa* (common vetch) covered 50% of plot 2, this averaged to 10.1% per plot in 2015, but had decreased in 2018 to trace amounts, consistent with observations from previous years.

TABLE 3. DOMINANT SPECIES IN COMMUNITY PLOTS AT EAGLE'S REST FROM 2004-2018.

	Invasive Graminoid	Native Graminoid	Introduced Forbs	Native Forbs	Shrub
2004	<i>Cynosurus echinatus</i>	<i>Festuca californica</i>	No species >0.5% cover	<i>Eriophyllum lanatum</i>	<i>Toxicodendron diversilobum</i>
2012	<i>Cynosurus echinatus</i>	<i>Danthonia californica</i>	<i>Leucanthemum vulgare</i>	<i>Eriophyllum lanatum</i>	<i>Toxicodendron diversilobum</i>
2015	<i>Cynosurus echinatus</i>	<i>Festuca roemeri</i>	<i>Vicia sativa</i> , <i>Leucanthemum vulgare</i>	<i>Eriophyllum lanatum</i>	<i>Toxicodendron diversilobum</i>
2018	<i>Cynosurus echinatus</i>	<i>Danthonia californica</i>	<i>Linum bienne</i> , <i>Leucanthemum vulgare</i>	<i>Eriophyllum lanatum</i> , <i>Wyethia angustifolia</i>	<i>Toxicodendron diversilobum</i>

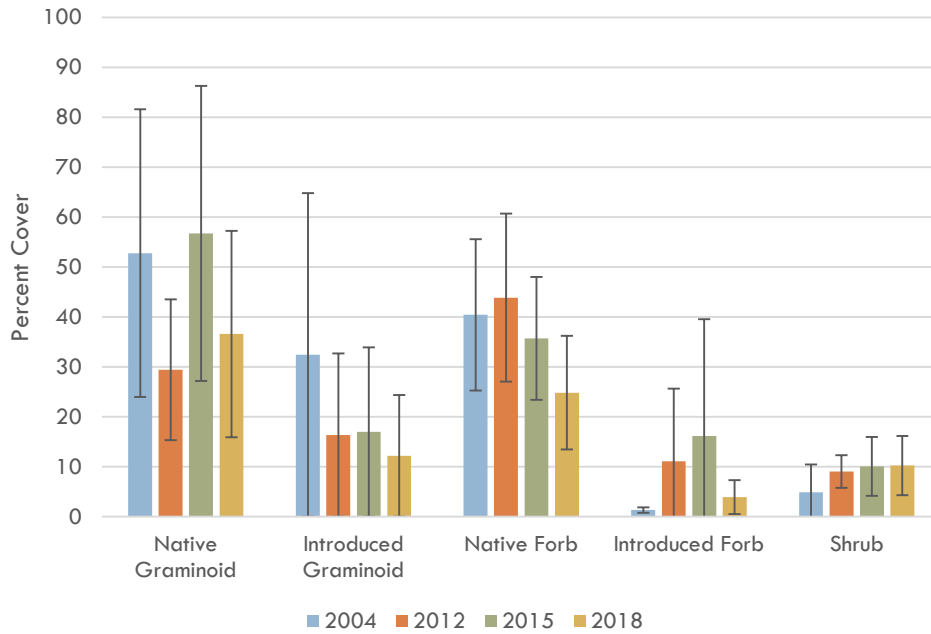


FIGURE 7. THE AVERAGE PERCENT COVER FOR ALL PLOTS AT EAGLE'S REST BY PLANT MANAGEMENT GROUP BY YEAR FOR 2004 - 2018. NOTE: THE EXACT LOCATION OF THE PLOTS MONITORED IN 2004 WAS NOT NOTED THUS COMMUNITY MEASUREMENTS IN 2012 -2018 SHOULD NOT BE CONSIDERED DIRECT COMPARISONS. ERROR BARS REPRESENT 95% CONFIDENCE INTERVALS.

Dominant native species include, *Danthonia californica*, *Eriophyllum lanatum*, *Wyethia angustifolia* and *Toxicodendron diversilobum* (Table 3, Appendix C). A complete list of native and introduced species present at the site and their abundance within the 5 monitoring plots can be found in Appendix C. Average native graminoid cover decreased in 2018 from 57% in 2015 to 37% in 2018, as did native forb cover (from 36% to 25%) (Figure 7, Table 2). The percent cover of introduced graminoids and introduced forbs also decreased (17% to 13% and 23% to 3% respectively). Shrub cover remained relatively stable, at 10% (Table 2).

ORV and other use of the site

Monitoring at Eagle's Rest in 2003 noted off-road vehicle use that damaged some *Lupinus oreganus* (85 leaves and 2 racemes; Gisler et al. 2004). The threat of continued ORV use led to the placement of boulders at the foot of the slope to discourage easy access to the site. No additional evidence of ORV traffic or damage to *L. oreganus* has been observed. In 2018, an informal trail was found to be cutting through the site; two dog collars and leashes were present along the trail indicating that this area is being used at least intermittently for outdoor recreation.

CONTRIBUTION OF SITE TO RECOVERY GOALS

While the increase in total *Lupinus oreganus* cover from 2004 and 2018 suggests a stable and even increasing lupine population, the relatively small size of this site and the population make it susceptible to damage (for example, the ORV damage in 2003), and by invasion of shrubby, and introduced species. We suggest that population monitoring continue on a semi-annual basis in order to detect any population declines. We also suggest that future monitoring efforts include surveying for Fender's blue butterfly.

Plant community surveys in 2003 and 2004 determined the quality of the prairie habitat to be relatively high, however more recent observations suggest that cover of some invasive species (including oxeye daisy [*Leucanthemum vulgare*], exotic grasses and *R. armeniacus*) has increased. Additional assessment of the degree of invasion of *Leucanthemum vulgare*, and other introduced species should also be performed and a specific criterion for management action established.

DISCUSSION AND RECOMMENDATIONS

In addition to plant community information, the vegetation data collected in from 2004 to 2018 demonstrate the short-term efficacy of noxious weed control efforts implemented by the BLM in 2003. Indeed, Scotch broom (*Cytisus scoparius*), which was once common throughout the site was completely absent from the vegetation sampling plots in 2004 and 2012. In 2015 a trace was observed in one plot. Likewise, the infestation of Himalayan blackberry (*Rubus armeniacus*) has been reduced such that it only occupied 0.4 percent cover in 2004 to 2.4% in 2018. Because the community plots are only in areas where lupine is already present, this does not accurately reflect the total cover of *R. armeniacus*

at the site, and cover of this troublesome shrub species is even higher at the top of the meadow, and between plots 3 and 5 (Figure 2).

It is recommended that renewed efforts be made to decrease the cover of these noxious weeds so as to not undermine the progress made in 2003. Manual removal of blackberry should occur when lupine has senesced to decrease impacts on this sensitive species. Manual removal of introduced species should be followed with seeding of native forb or graminoid species to ground disturbed by management actions, and vigilance to keep non-native species at bay in this otherwise dominantly native remnant meadow. The invasive graminoid species, rat-tail fescue (*Vulpia myuros*), appeared for the first time in the community plots in 2015, with 4 percent cover in plot 5, but was not detected in 2018.

We recommend continued plant community survey, following the methods used in 2018,



FIGURE 7. APHIDS AND OTHER INSECTS AT EAGLE'S REST ON A LUPINE RACEME. NOTE THE ABSENCE OF FRUITS.

be performed in conjunction with lupine measurements to detect vegetation changes at the site. Thresholds for habitat management should be established at this site with particular attention given to Himalayan blackberry (*Rubus armeniacus*) and Scotch broom (*Cytisus scoparius*), which were removed in 2003 and have since reinvaded.

Many lupine racemes at this site were noted to have large numbers of aphids and other insects present on the stems, flowers and leaves in 2018. While measurements of seed set were not taken, field observations indicate that very few maturing racemes had maintained any flowers on the stems. When present, fruits appeared small, stunted, and some showed evidence of insect infestation, including holes in fruits, webbing and frass (Figure 7). A formal assessment of seed-set is recommended for this site. Both genetic isolation and insect herbivory could be contributors to the apparent lack of seed-set at this site.

TABLE 4. SITE, YEAR OF OBSERVATION, HABITAT TYPE, SCALE OF OBSERVATION, SAMPLE SIZE, REGRESSION COEFFICIENT (PROPORTION OF VARIANCE IN LEAF NUMBER EXPLAINED BY FOLIAR COVER, R^2) AND SLOPE OF THE RELATIONSHIP BETWEEN LEAF NUMBER AND COVER AT ELEVEN SITES OF *L. OREGANUS* FROM LANE AND DOUGLAS COUNTIES. "WEW" INDICATES LUPINE POPULATIONS IN THE WEST EUGENE WETLANDS.

Site	Year	Habitat	Size of sample unit	n	R^2	Slope (leaves/m ²)
<u>Lane County:</u>						
Fir Butte (WEW)	2004	full sun	200 m ²	36	0.97	986
	2005			36	0.91	767
Oxbow (WEW)	2004	full sun	1 m ²	225	0.93	925
	2005			197	0.87	844
Isabelle (WEW)	2005	full sun	≤2 m ²	154	0.88	907
Turtle Swale (WEW)	2005	full sun	1 m ²	116	0.87	790
Eagles Rest	2005	sun to partial shade	15 - 75 m ²	20	0.97	606
	2006			17	0.94	404
Oak Basin	2007	sun	variable	18	0.89	659
	2007	partial shade		27	0.64	497
<u>Douglas County:</u>						
China Ditch	2005	sun to partial shade	10 to 45 m ²	48	0.623	569
	2006			48	0.74	606
Stout's Creek	2005	sun to partial shade	variable	68	0.623	444
	2006			82	0.81	429
Dickerson Heights	2005	sun to partial shade	10 m ²	28	0.71	424
	2006			34	0.88	521
Loose Laces	2005	partial shade	1 to 40 m ²	76	0.73	415
	2006			37	0.91	357
Letitia Creek	2005	partial shade	100 m ²	22	0.75	380
Callahan Meadows	2005	partial shade	2 m ²	24	0.75	291
	2006			42	0.92	357

LITERATURE CITED

- Giles, D.E.L., M.I. Petix and M.A. Bahm. 2017. Population and habitat monitoring for Kincaid's lupine and Hitchcock's blue eyed-grass at Oak Basin. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Eugene District. Corvallis, OR. vii + 62pp.
- Gisler, S., Kaye, T.N., and A. Brandt. 2004a. Population monitoring for Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*) at Eagle's Rest. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Eugene District. Corvallis, OR. iii + 15.
- Gisler, S., and T.N. Kaye. 2004b. Population monitoring for *Lupinus sulphureus* ssp. *kincaidii* at the Fir Butte and Oxbow West Sites, West Eugene. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Eugene District. Corvallis, OR. iv + 28.
- Kaye, T.N. 1999. Obligate insect pollination of a rare plant, *Lupinus sulphureus* ssp. *kincaidii*. Northwest Science 73:50-52.
- Menke, C.A. and T.N. Kaye. 2003. Population monitoring and survey for *Lupinus sulphureus* ssp. *kincaidii* on the BLM Roseburg District. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Roseburg District. Corvallis, OR. vii + 84.
- Menke, C.A. and T.N. Kaye. 2006. Population monitoring for *Lupinus sulphureus* ssp. *kincaidii* on the BLM Roseburg District. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Roseburg District. Corvallis, OR. vi + 48.
- Thorpe, A.S. and T.N. Kaye. 2006. Population monitoring for *Lupinus sulphureus* ssp. *kincaidii* at Eagle's Rest, 2006 Progress Report. Prepared by the Institute for Applied Ecology for the USDI Bureau of Land Management, Eugene District. Corvallis, OR. iv + 11.
- Thorpe, A.S. 2007. *Lupinus sulphureus* ssp. *kincaidii* (Kincaid's lupine) and *Icaricia icarioides fenderi* (Fender's blue butterfly) at Oak Basin. 2007 Progress Report. Prepared by the Institute for Applied Ecology for the USDA Bureau of Land Management, Eugene District. Corvallis, OR. 32 pp.

APPENDIX A. DIRECTIONS AND GEAR LIST

Directions to Eagle's Rest:

From Corvallis, take I-5 South to Hwy 58. Drive 10.9 miles east on Hwy 58 going through Pleasant Hill. At Dexter Reservoir, turn right (south) onto Lost Creek Road, proceed for 3.7 miles, then turn left (east) onto Eagle's Rest Road (19-1-33.1). Continue 3.8 miles up Eagle's Rest Road (it will turn into Forest Service Road 509 along the way, continue along main road) to the field site, parking at a pullout just east beyond the open meadow. To avoid creating an obvious trail from the main road, enter the site on foot along the forest edge rather than straight up through the meadow (Appendix A).

Gear List:

Bug spray

Tecnu

Last Year's Report

Last Year's Datasheets

Blank datasheets, some write-in-the-rain

Community data from previous years

Community datasheets

Sheet with % cover for 5m x 5m plots

1m² quadrat frame and extra poles

Loppers/clippers for dealing with blackberry around plot markers

Metal detector ("Mr. Beepy")

ID books

Clipboards/pencils

Maps/gazetteer

8 Tapes, at least one 100m (it is best to set up all plots prior to monitoring)

16 Candy canes

Rulers- one per person

Flagging

4-5 rebars, mallet and pin flags to replace lost/bent rebars

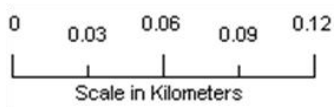
Compass

Health and Safety box

Extra water

Eagle's Rest:

Park at the star and follow the trail through the woods. (Do not walk directly into the meadow from the road! We want to keep people out!)



APPENDIX B. EXAMPLE LUPINE MONITORING DATASHEET

Lupinus oreganus monitoring at Eagle's Rest

Name: _____

Date: _____

Plot	subplot	Leaves	Inflorescences		Eggs	cover	notes
			Mature	Aborted			
1	0-5m						plot measured uphill
1	5-10m						
1	10-15m						
1	15-20m						

2	0-5m						plot measured uphill
2	5-10m						
2	10-15m						
2	15-20m						
2	20-25m						
2	Outside						

Plot	subplot	Leaves	Inflorescences		Eggs	cover	notes
			Mature	Aborted			
3	0-5m						
3	5-10m						
3	10-15m						
3	15-20m						
3	20-23m						
3	Outside						Below plot at 10 m?

4	0-5m						plot measured right to left
4	5-10m						
4	10-15m						
4	15-20m						
4	20-25m						
4	25-30m						
4	30-35m						

5	whole plot						
---	------------	--	--	--	--	--	--

APPENDIX C. COMMUNITY DATA

APPENDIX C. COMMUNITY DATA COLLECTED IN 2004-2018

In 2004 the cover of litter, moss and rock was not recorded (“--“ indicates data was not collected in that year). Because the precise location of the monitoring plots in 2004 is not known, the 2012-2018 community data should not be considered directly comparable. Invasive species are listed in bold.

Plot	1				2				3				4				5			
	Year	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015
Litter	--	30	60	25	--	40	90	30	--	95	95	60	--	80	90	40	--	50	90	50
Moss	--	60	45	40	--	45	0.1	0	--	0.1	2	0	--	10	25	18	--	40	20	10
Rock	--	0.2	0.2	1	--	0.2	0.1	0	--	0	0	0	--	2	2	1	--	2	3	3
Bare Ground	3	2	4	0.1	4	1	1	0	2	0.1	2	0	1	1	2	1	8	1	1	0.1
Basal veg	--	--	--	35	--	--	--	70	--	--	--	40	--	--	--	40	--	--	--	37
Species																				
<i>Achillea millefolium</i>	1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	2	1	0.1	0.1	0.1	0.1	0.1	0.7	3	3	2
<i>Aira caryophylla</i>	4	0.1	0	0.1	1	0	0	0	1	0.2	0	0.1	0	0.1	0.1	0	20	0.1	1	0.1
<i>Arabis</i> sp.	0	0	0	0	0.1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Aster radulinus</i>	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0.5	0.1	0.1	0	0	0	0	0
<i>Berberis aquifolium</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Brodiaea congesta</i>	0.1	0	0	0	0.1	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0.1	0.1
<i>Bromus carinatus</i>	50	10	40	12	70	15	20	16	3	3	4	2	2	25	20	1	15	20	30	10
<i>Bromus hordeaceus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.5	2
<i>Calochortus tolmei</i>	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.2	0.1	0.1	0.1
<i>Carex tumulicola</i>	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0
<i>Castilleja hispida</i>	0.1	0	0.1	0.5	0.1	0	0.1	0	0.1	0.2	0.1	0.1	0	0.2	0.1	0.1	0.1	0.1	0.1	0
<i>Centaureum erythrea</i>	0	0.1	0.1	0	0	0	0.1	0	0	0	0	0	0	0.3	0.1	0.1	0	0	0	0
<i>Cerastium arvense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0
<i>Cirsium callilepis</i>	0.5	0	0.5	0.1	0.1	4	1	0	0	0.5	0.5	0.1	0.1	0	0	0	0	0	0	0
<i>Clarkia</i> sp.	0.1	0	0.1	0.1	1	0	0	0.1	2	0	0	0	0	0.1	0	0	1.5	0.5	0.1	0.1
<i>Collomia heterophylla</i>	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Cryptantha intermedia</i>	8	0	0	0	3	0	0.1	0.1	1	0	0.1	0.1	0.1	0	0	0.1	4	0	0	0

Plot	1				2				3				4				5			
	Year	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015
<i>Cuscuta</i> sp.	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cynoglossum</i> sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	0.2	0.1	0	0	0	0	0
<i>Cynosurus echinatus</i>	3	2	1	0.5	3	0.2	0.1	3	80	50	55	40	0	3	4	3	50	16	6	7
<i>Cytisus scoparius</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1
<i>Danthonia californica</i>	1	2	10	12	8	20	60	50	2	4	8	4	0.5	6	6	3	2	4	1	0.5
<i>Daucus carota</i>	0.1	0	0.2	0	0.1	0	0.5	0.5	0.1	0.2	0.1	0.1	0	0.2	0.2	0.5	0.2	1	0.5	0.1
<i>Daucus pusillus</i>	0	0	0.1	0.1	0	0	0	0	2	0	0.2	0.1	0	0	0	0	2	0	0	0.5
<i>Dianthus armeria</i>	0.1	0	0	0	0.1	0.1	0.1	0.1	0	0.1	0.1	0	0	0.1	0.2	0	0	0	0	0
<i>Dichelostemma congesta</i>	0	0	0	0	0	0.1	0.1	0.1	0	0.1	0.1	0.1	0	0.1	0.1	0.1	0	0.1	0.1	0.1
<i>Elymus glaucus</i>	3	0.1	0.1	0.5	2	10	12	4	0.1	0.1	0	0	0.5	1	0	0	0.1	0.5	1	1
<i>Epilobium</i> sp.	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eriophyllum lanatum</i>	30	45	40	6	12	2	0.5	5	8	12	16	4	3	4	6	6	10	14	15	8
<i>Erodium cicutarium</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0
<i>Euphorbia</i> sp.	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Festuca arundinacea</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	8	12	3
<i>Festuca californica</i>	0	0	0	0	0	0	0	0	0	0	0	0	80	0	30	30	0	0	0	0
<i>Festuca occidentalis</i>	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
<i>Festuca roemerii</i>	4	2	3	2	1	0	0	0	5	4	5	1	0	0	0	1	8	16	45	25
<i>Fragaria vesca</i>	1	0	0.2	0.5	7	12	2	4	0	0	0	0	2	8	12	1	0	0	0	0
<i>Galium aparine</i>	0	0	0	0	0.1	0	0.1	0.1	0	0	0	0	0.1	0	0	0.1	4	0	0.1	0
<i>Galium parisiense</i>	0.1	0	2	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Holodiscus discolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	3	0	0	0	0
<i>Hypericum perforatum</i>	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0	0.2	0.1
<i>Hypochaeris radicata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0
<i>Iris tenax</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.2	0.1	0	0	0	0	0
<i>Koeleria macrantha</i>	2	0	4	1	2	0	0	0	0.5	0.1	0.2	0.1	0	0	0	0.5	2	1	4	4
<i>Lathyrus nevadensis</i>	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Lathyrus sphaericus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
<i>Leucanthemum vulgare</i>	1	40	10	3	1	4	12	3	0	0	0	0	0	4	4	0.5	0.1	0.1	0.1	0.1
<i>Linum bienne</i>	0	0.1	0	0.1	0	0	0	0	0	0.1	0.1	10	0	0	0.1	0	0	0	0	0
<i>Linum perenne</i>	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0
<i>Lomatium utriculatum</i>	0.1	0	0	0.1	0	0	0	0	0.1	0	0	0	0	0	0	0	0.5	0	0	0
<i>Lonicera</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0

Plot	1				2				3				4				5			
	Year	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Lotus micranthus</i>	0.1	0.2	0.2	0	0	0.1	0	0	0.1	0	0	0	0	0.1	0	0.1	1	0.1	0	0
<i>Lupinus sulphureus</i> ssp. <i>kincaidii</i>	7	9	8	16	0.5	0.1	0.1	0.1	2	1	1	1	16	6	5	3	1	1	0.1	0
<i>Luzula comosa</i>	0.1	0	0.1	0	0	2	1	0.1	0	0.1	0	0.1	0	0.1	0.1	0	0	0	0.1	0
<i>Madia glomerata</i> Hook.	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0.1	0	0
<i>Madia gracilis</i>	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	5	0	0	0
<i>Madia</i> sp.	0	0	0	0	0	0	0	0	0	0	0	4	0	0.2	0	0	0	0	0	1
<i>Microseris laciniata</i>	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0.1	0.1	0	0.1	0.1	0.1	0	0	0	0
<i>Osmorhiza chilensis</i>	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Phleum pratense</i>	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Phlox subulata</i>	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0.1	0	0	0	0
<i>Plagiobothrys</i> sp.	0	0.1	0.2	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0
<i>Plectritis congesta</i>	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polystichum</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
<i>Prunella vulgaris</i>	0	0.2	1	0	0	0	0.1	0	0	0	0	0	0	25	4	0.5	0	0	0	0
<i>Ranunculus occidentalis</i>	0.1	1	1	0.1	2	0	0.1	0.5	1	4	2	0.1	0	0.2	0.1	0.1	2	0.5	0.2	0.1
<i>Ranunculus uncinatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rosa gymnocarpa</i>	0	0	0	1	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0
<i>Rubus armeniacus</i>	0	0	0	0	0	0	0.1	0	0	0	0	0	2	4	8	12	0	0	0	0
<i>Rubus ursinus</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Rupertia physodes</i>	0.1	0	0	0	0	0	0.1	0	0	0	0	0	5	8	6	5	0	0	0	0
<i>Sanicula bipinnatifida</i>	0.1	0.2	0.2	0.5	0.1	0	0	0	0.1	6	4	4	0	0.3	0.2	3	0	1	0	0
<i>Sanicula crassicaulis</i>	0	0.1	0	0	0.1	3	1	6	0.1	0	0	0	0.1	0.1	0	0	0.4	0	0	0
<i>Satureja douglasii</i>	0.5	0	0	0.1	2	10	30	4	0	0	0	0	4	5	4	1	0	0	0	0
<i>Senecio jacobaea</i>	0.1	0	0	0	0.1	2	0.5	0.1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene antirrhina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0
<i>Silene</i> sp.	0	0	0.5	0	0.1	0	0	0	0.1	0	0	0	0	0	0.1	0	0	0	0.1	0
<i>Sisyrinchium bellum</i>	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sonchus asper</i>	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1	0	0	0	0	0	0
<i>Symphoricarpos albus</i>	0	0	0	0	0	0	0	4	0	0	0	0	0.1	0	0	0	0	0	0	0
<i>Synthyris reniformis</i>	0	0.1	0.1	0.1	0	4	1	0.1	0	0	0	0	1	0.1	0.1	0	0	0	0	0
<i>Taraxacum officinale</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.1	0	0	0	0
<i>Torilis arvensis</i>	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Plot	1				2				3				4				5			
	Year	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015	2018	2004	2012	2015
<i>Toxicodendron diversilobum</i>	0.5	10	14	3	0	12	3	2	5	12	12	16	12	4	10	4	3	3	3	6
<i>Trifolium microcephalum</i>	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
<i>Triodanis perfoliata</i>	0	0	0	0	0.1	0	0	0	1	0	0	0	0	0	0	0	0.3	0	0	0
<i>Triodanis</i> sp.	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica americana</i>	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0	0	0	0	0	0
<i>Vicia americana</i>	0.1	0	0	0	0.1	0	0.1	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0	0	0
<i>Vicia sativa</i>	0	0.1	0.1	0.1	0	0.1	50	0.1	0.1	0.2	0.1	0.1	0	0.1	0	0.1	0	0.5	0.5	0.1
<i>Vulpia myuros</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
<i>Whipplea modesta</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0.5	0	0	0	0
<i>Wyethia angustifolia</i>	16	0	0	0	16	16	0.5	24	0	0	0	0.2	5	1.5	3	8	0	0	0	0
<i>Zigadenus venenosus</i>	0.1	0	0	0.1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

TABLE 5. AVERAGE PERCENT COVER AND 95% C.I. FOR VEGETATION MONITORING PLOTS AT EAGLE'S REST. VALUES IN ITALICS REPRESENT AVERAGE VALUES >0, BUT LESS THAN 0.1% COVER.

	Plot Year	Average 2004	95% CI 2004	Average 2012	95% CI 2012	Average 2015	95% CI 2015	Average 2018	95% CI 2018
Litter	--			59.0	24.1	85	12.4	41	12.5
Moss	--			31.0	22.0	18	16.1	13.6	14.5
Rock	--			0.9	0.9	1	1.2	1	1.1
Bare Ground		3.6	2.4	1.0	0.6	2	1.1	0.24	0.4
Basal veg	--			--		--		44.4	12.7
<i>Achillea millefolium</i>		0.4	0.4	1.1	1.2	0.9	1.1	0.6	0.8
<i>Aira caryophylla</i>		5.2	7.4	0.1	0.1	0.2	0.4	0.1	0.0
<i>Arabis</i> sp.		0.2	0.4	0.0		0.0		0.0	
<i>Aster radulinus</i>		0.1	0.2	0.0	0.0	0.0	0.0	0.0	
<i>Berberis aquifolium</i>		0.0	0.0	0.0		0.0		0.0	
<i>Brodiaea congesta</i>		0.1	0.0	0.0		0.0	0.0	0.0	0.0
<i>Bromus carinatus</i>		28.0	26.7	9.8	7.0	19.0	14.6	8.2	5.7
<i>Bromus hordeaceus</i>		0.0		0.2	0.4	0.1	0.2	0.4	0.8
<i>Calochortus tolmei</i>		0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0
<i>Carex tumulicola</i>		0.0		0.0		0.4	0.8	0.4	0.8
<i>Castilleja hispidula</i>		0.1	0.0	0.1	0.1	0.1		0.1	0.2
<i>Centaurium erythrea</i>		0.0		0.1	0.1	0.1	0.0	0.0	0.0
<i>Cerastium arvense</i>		0.0	0.0	0.0		0.0		0.0	
<i>Cirsium callilepis</i>		0.1	0.2	0.9	1.5	0.4	0.4	0.0	0.0
<i>Clarkia</i> sp.		0.9	0.8	0.1	0.2	0.0	0.0	0.1	0.0
<i>Collomia heterophylla</i>		0.0	0.0	0.0		0.0		0.0	
<i>Cryptantha intermedia</i>		3.2	2.7	0.0		0.0	0.0	0.1	0.0
<i>Cuscuta</i> sp.		0.0	0.0	0.0		0.0		0.0	
<i>Cynoglossum</i> sp.		0.0		0.2	0.4	0.0	0.0	0.0	
<i>Cynosurus echinatus</i>		27.2	31.7	14.2	18.4	13.2	20.6	10.7	14.5
<i>Cytisus scoparius</i>		0.0		0.0		0.0	0.0	0.0	0.0
<i>Danthonia californica</i>		2.7	2.7	7.2	6.4	17.0	21.3	13.9	18.1
<i>Daucus carota</i>		0.1	0.1	0.3	0.4	0.3	0.2	0.2	0.2
<i>Daucus pusillus</i>		0.8	1.0	0.0		0.1	0.1	0.1	0.2
<i>Dianthus armeria</i>		0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0

	Plot Year	Average 2004	95% CI 2004	Average 2012	95% CI 2012	Average 2015	95% CI 2015	Average 2018	95% CI 2018
<i>Dichelostemma congesta</i>		0.0		0.1	0.0	0.1	0.0	0.1	0.0
<i>Elymus glaucus</i>		1.1	1.1	2.3	3.8	2.6	4.6	1.1	1.5
<i>Epilobium</i> sp.		0.0		0.0	0.0	0.0		0.0	
<i>Eriophyllum lanatum</i>		12.6	9.0	15.4	15.2	15.5	13.3	5.8	1.3
<i>Erodium cicutarium</i>		0.0	0.0	0.0		0.0		0.0	
<i>Euphorbia</i> sp.		0.0	0.0	0.0	0.0	0.0		0.0	
<i>Festuca arundinacea</i>		0.0		1.6	3.1	2.4	4.7	0.8	1.1
<i>Festuca californica</i>		16.0	31.4	5.0		4.0	7.8	6.0	11.8
<i>Festuca occidentalis</i>		0.0		0.0		1.2	2.3	0.0	
<i>Festuca roemerii</i>		3.6	2.8	4.4	5.9	10.6	17.0	5.8	9.4
<i>Fragaria vesca</i>		2.0	2.6	4.0	5.0	2.8	4.5	1.1	1.5
<i>Galium aparine</i>		0.8	1.5	0.0		0.0	0.0	0.0	0.0
<i>Galium parisiense</i>		0.0	0.0	0.0		0.4	0.8	0.0	0.0
<i>Holodiscus discolor</i>		0.0		0.0	0.0	0.0	0.0	0.6	1.2
<i>Hypericum perforatum</i>		0.3	0.4	0.1	0.0	0.1	0.0	0.1	
<i>Hypochaeris radicata</i>		0.0		0.0	0.0	0.0	0.0	0.0	
<i>Iris tenax</i>		0.0	0.0	0.0	0.1	0.0	0.0	0.0	
<i>Koeleria macrantha</i>		1.3	0.9	0.2	0.4	1.6	1.9	1.1	1.5
<i>Lathyrus nevadensis</i>		0.0	0.0	0.0		0.0		0.0	
<i>Lathyrus sphaericus</i>		0.0		0.0		0.0		0.0	0.0
<i>Leucanthemum vulgare</i>		0.4	0.5	9.6	15.0	5.2	4.9	1.3	1.4
<i>Linum bienne</i>		0.0		0.0	0.0	0.0	0.0	2.0	3.9
<i>Linum perenne</i>		0.1	0.0	0.0		0.0		0.0	
<i>Lomatium utriculatum</i>		0.1	0.2	0.0		0.0		0.0	0.0
<i>Lonicera</i> sp.		0.0		0.0	0.0	0.0	0.0	0.0	
<i>Lotus corniculatus</i>		0.0	0.0	0.0		0.0		0.0	
<i>Lotus micranthus</i>		0.2	0.4	0.1	0.1	0.0	0.1	0.0	0.0
<i>Lupinus sulphureus</i> ssp. <i>kincaidii</i>		5.3	5.7	3.4	3.4	2.8	3.1	4.0	6.0
<i>Luzula comosa</i>		0.0	0.0	0.4	0.8	0.3	0.4	0.0	0.0
<i>Madia glomerata</i> Hook.		0.0		0.1	0.1	0.0		0.0	
<i>Madia gracilis</i>		1.0	1.9	0.0		0.0		0.0	
<i>Madia</i> sp.		0.0		0.0	0.1	0.0		1.0	1.5
<i>Microseris laciniata</i>		0.0		0.1	0.0	0.1	0.0	0.1	0.0
<i>Osmorhiza chilensis</i>		0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	Plot Year	Average 2004	95% CI 2004	Average 2012	95% CI 2012	Average 2015	95% CI 2015	Average 2018	95% CI 2018
<i>Phleum pratense</i>		0.0		0.2	0.4	0.2	0.4	0.2	0.4
<i>Phlox subulata</i>		0.6	1.2	0.0		0.0		0.0	0.0
<i>Plagiobothrys</i> sp.		0.0		0.1	0.0	0.0	0.1	0.0	
<i>Plectritis congesta</i>		0.0		0.0		0.0		0.0	0.0
<i>Polystichum</i> sp.		0.0		0.2	0.4	0.2	0.4	0.0	
<i>Prunella vulgaris</i>		0.0		5.0	9.8	1.0	1.5	0.1	0.2
<i>Ranunculus occidentalis</i>		1.0	0.9	1.1	1.4	0.7	0.7	0.2	0.2
<i>Ranunculus uncinatus</i>		0.0		0.0		0.0		0.0	
<i>Rosa gymnocarpa</i>		0.1	0.2	0.0		0.0		0.2	0.4
<i>Rubus armeniacus</i>		0.4	0.8	0.8	1.6	1.6	3.1	2.4	4.7
<i>Rubus ursinus</i>		0.2	0.4	0.0		0.0		0.0	
<i>Rupertia physodes</i>		1.0	2.0	1.6	3.1	1.2	2.3	1.0	2.0
<i>Sanicula bipinnatifida</i>		0.1	0.0	1.5	2.2	0.9	1.5	1.5	1.6
<i>Sanicula crassicaulis</i>		0.1	0.1	0.6	1.2	0.2	0.4	1.2	2.4
<i>Satureja douglasii</i>		1.3	1.5	3.0	3.9	6.8	11.5	1.0	1.5
<i>Senecio jacobaea</i>		0.0	0.0	0.4	0.8	0.1	0.2	0.0	0.0
<i>Silene antirrhina</i>		0.0	0.0	0.0		0.0		0.0	
<i>Silene</i> sp.		0.0	0.0	0.0		0.1	0.2	0.0	
<i>Sisyrinchium bellum</i>		0.0	0.0	0.0	0.0	0.0		0.0	
<i>Sonchus asper</i>		0.0		0.0	0.0	0.0		0.0	0.0
<i>Symphoricarpos albus</i>		0.0	0.0	0.0		0.0		0.8	1.6
<i>Synthyris reniformis</i>		0.2	0.4	0.8	1.5	0.2	0.4	0.0	0.0
<i>Taraxacum officinale</i>		0.0		0.0	0.1	0.0	0.1	0.0	0.0
<i>Torilis arvensis</i>		0.0		0.0		0.0		0.0	0.0
<i>Toxicodendron diversilobum</i>		4.1	4.3	8.2	3.8	8.4	4.5	6.2	5.0
<i>Trifolium microcephalum</i>		0.0	0.1	0.0		0.0	0.0	0.0	
<i>Triodanis perfoliata</i>		0.3	0.4	0.0		0.0		0.0	
<i>Triodanis</i> sp.		0.0		0.0		0.0		0.0	0.0
<i>Veronica americana</i>		0.0		0.0	0.0	0.0		0.0	
<i>Vicia americana</i>		0.1		0.0	0.0	0.0	0.0	0.0	
<i>Vicia sativa</i>		0.0	0.0	0.2	0.2	10.1	19.5	0.1	
<i>Vulpia myuros</i>		0.0		0.0		0.8	1.6	0.0	
<i>Whipplea modesta</i>		0.0		0.4	0.5	0.0		0.1	0.2
<i>Wyethia angustifolia</i>		7.4	7.1	3.5	6.2	0.7	1.1	6.4	9.1

	Plot Year	Average 2004	95% CI 2004	Average 2012	95% CI 2012	Average 2015	95% CI 2015	Average 2018	95% CI 2018
<i>Zigadenus venenosus</i>		0.0	0.0	0.2	0.4	0.0		0.0	0.0
Count Native Species		50		42		44		42	
Count Invasive Species		14		19		19		19	
Total # of Species		64		61		63		61	