

Assessing the status and extent of *Lupinus lepidus* var. *cusickii* in Denny Flat, Baker County, Oregon



2015

Report to the Bureau of Land Management, Vale District

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



PREFACE

This report is the result of an agreement between the Institute for Applied Ecology (IAE) and the Bureau of Land Management (BLM). 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

Institute for Applied Ecology

563 SW Jefferson Avenue

Corvallis, Oregon 97333

phone: 541-753-3099

fax: 541-753-3098

email: mattab@appliedeco.org

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Cover photograph: Cusick's lupine habitat at ORV Hill. Inset: Cusick's lupine seedling (*Lupinus lepidus* var. *cusickii*).

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EXECUTIVE SUMMARY

We conducted a full census of the 5 known *Lupinus lepidus* var. *cusickii* sites managed by the Vale District of the Bureau of Land Management. In 2015, we also remonitored permanent monitoring transects and established several new transects to examine plant community and *L. lepidus* var. *cusickii* population trends over time. This species can have high annual variability and our 2014 and 2015 surveys found similar patterns. In 2015, all sites, with the exception of Elms Reservoir 2, had higher plant counts than in 2014. Several sites that had shown decreases between the 2010 and 2014 surveys had higher plant numbers in 2015 compared to 2010. The exception was Denny Flat West, which did have higher counts in 2015, but not as high as the 2010 survey.

Assessing the status and extent of *Lupinus lepidus* var. *cusickii* in Denny Flat, Baker County, Oregon

REPORT TO THE BUREAU OF LAND MANAGEMENT, VALE DISTRICT

INTRODUCTION

Lupinus lepidus var. *cusickii*, Cusick's lupine, is a BLM special status species. In addition, it is listed as endangered by the Oregon Department of Agriculture, and it is considered a Species of Concern by the U.S. Fish and Wildlife Service. The Oregon Biodiversity Information Center (ORBIC) considers *L. lepidus* var. *cusickii* to be threatened or endangered throughout its range (ORBIC 2010). *Lupinus lepidus* var. *cusickii* (Figure 1) is a narrow endemic, restricted to only five small populations in Baker County, Oregon (ODA 2010). These populations are located southeast of the Blue Mountain foothills within Denny Flat, near the town of Unity, Oregon. *Lupinus lepidus* var. *cusickii* is part of the *Lupinus caespitosus-lepidus* complex, a polymorphic species group which is widely distributed throughout western North America (Broich and Morrison 1995). *Lupinus* populations with the epithet *cusickii* have been treated in a variety of ways including as a subspecies, a variety, or a synonym for *Lupinus lepidus* (Broic and Morrison 1995, ODA 2010); we refer to Cusick's lupine as *L. lepidus* var. *cusickii*, consistent with the treatment of Broich (1989) and others (Broich and Morrison 1995, Oregon Flora Project, ODA 2010, ORBIC 2010).



FIGURE 1. LUPINUS LEPIDUS VAR. CUSICKII (CUSICK'S LUPINE) IN FRUIT.

The flowers of *L. lepidus* var. *cusickii*, which bloom in July, are potentially cross-pollinated by a variety of visitors, primarily bumblebees and small solitary bees (R. Meinke, ODA, personal communication). It is not known if *L. lepidus* var. *cusickii* is genetically self-compatible, and no asexual reproduction via vegetative means occurs in the species. The production of large crops of seed may be dependent on well-timed summer rainfall to support ovule development (ODA 2010). No studies have been performed on

germination ecology or seed longevity, but it is suspected that seeds germinate in the winter or spring if seed coat scarification has occurred. Seedlings are present at least as early as May (observed during a preliminary spring visit to sites). As there is no vegetative reproduction in this species, seed production is vital for population maintenance and growth.

Known *L. lepidus* var. *cusickii* populations are found on eroding, tuffaceous hillsides at elevations around 4000 feet. *Lupinus lepidus* var. *cusickii* occurs in areas of sparse vegetation, but is generally associated with occasional junipers and low-growing perennials such as *Eriogonum* spp., *Allium* spp., and *Lomatium* spp. Associated annual species include *Mimulus nanus*, *Phacelia lutea*, *Spraguea umbellata*, and *Camissonia* sp. (ODA 2010). Other species sometimes observed with *L. lepidus* var. *cusickii* include *Artemisia tridentata*, *Astragalus* sp., *Phlox* sp., and *Silene* sp. (Broich 1989). The average annual precipitation in the area is 30-40 cm. All populations of the species fall within the Blue Mountains physiographic province (Franklin and Dyrness 1984).

Although *L. lepidus* var. *cusickii* was first located in Oregon in 1886, relatively little is known about the species (ODA 2010). Despite previous studies, which have identified taxonomic problems (Broich 1989, Broich and Morrison 1995), inventoried for additional populations, and described natural history of the species (ODA 2010), we are only now beginning to gain an understanding of the species' population dynamics and long-term trends. Population monitoring was initiated by the Institute for Applied Ecology (IAE) in 1993 and conducted annually until 1998, and in 2009 and 2012. Monitoring was initiated to determine impacts of OHV traffic and livestock grazing to Cusick's lupine. Monitoring conducted in 2009 and 2012 was used to update current information on the status of the species and assess any possible long-term impacts of OHV and/or livestock use on the taxon's populations. Though these plots have documented long-term impacts of OHV and/or livestock use, there is increased need to expand the long-term population monitoring to incorporate un-sampled subpopulations to yield a more representative understanding of long-term trends across the entire population.

In addition to monitoring long-term plots, IAE has worked with the BLM to conduct surveys to gain understanding of the current status and extent of the species. In 1990 and 1992, surveys were conducted on approximately 2500 acres near Unity Reservoir and Denny Flat and 1500 acres in the vicinity of Stinkingwater Creek. In 2010, our activities focused on determining the distribution of *L. lepidus* var. *cusickii* populations in the Denny Flat region of Baker County, estimating the size of populations, and determining potential threats to these populations. In 2010 surveys, a partial census was completed as the area in the vicinity of permanent monitoring transects was not surveyed. In 2014, we resurveyed extant subpopulations in Denny Flat (those surveyed in 2010), to yield updated information on the status and extent of this population. In total, approximately 152 acres of *L. lepidus* var. *cusickii* habitat were surveyed. Surveyed areas included sites with and without long-term monitoring plots, conducting a complete census at all sites. In 2015 we surveyed the same areas as in 2014, and also collected data at long-term monitoring plots focused on capturing large-scale population dynamics and the surrounding plant community. This information will provide the BLM with important information to assess management plans for the conservation of this sensitive species.

METHODS

Population Surveys

Field surveys were conducted June 30 – July 1, 2015. Sites were identified using information gathered from 2010 and in previous surveys, where potential habitat was identified using aerial photos and topographic maps. Seven sites were surveyed using the Intuitive Controlled survey method (Whiteaker et al. 1998) to document sub-populations of *L. lepidus* var. *cusickii* within potential habitat. Sites included Elms Reservoir 1, Denny Flat East 1, Denny Flat East 2, Denny Flat West, Amphitheater East and West, ORV Hill 1 & 2, and Elms Reservoir 2 (Figure 3). On each site, areas likely to have *L. lepidus* var. *cusickii* were identified through a combination of topography and soil color. Tuffaceous soil, the primary component of *L. lepidus* var. *cusickii* habitat, is very light in color and found mainly on eroding hillsides. With these characteristics in mind, additional areas were identified over the course of the surveys and



FIGURE 2. SMALL REPRODUCTIVE *L. LEPIDUS* VAR *CUSICKII*.

were extended in any case that potential habitat was found. A complete census of *L. lepidus* var. *cusickii* was conducted within these sites. We counted individuals in the following categories: reproductive, vegetative, and seedling (less than 5 cm diameter if not reproductive). Dead plants were not counted in 2015, as there were many dead plants present that we were unable to confirm as *L. lepidus* var. *cusickii*. Reproductive plants were in fruit and flower simultaneously and many were extremely small but still producing flowers (Figure 2). Locations were documented using a navigation grade GPS unit, recording a GPS point in areas of high plant abundance. The extent of surveys was determined using GPS tracks uploaded in GIS. These routes were delineated on USGS 7.5' topographic quadrangles (Appendix A and Appendix B). Sighting report forms were completed for each occurrence noting potential causes of disturbance, geology, plant community composition, presence of exotic species, and physical characteristics of the site.

Long-term Monitoring Plots

In 2015, we monitored plots that IAE had previously established (Massatti et al. 2009). We monitored the same transects and followed the established protocol. The exceptions were at ORV Hill 1 where transects were modified to have consistent length of all transects, and ORV Hill 2 where we established new transects to better capture the current *L. lepidus* var. *cusickii* population distribution (Appendix C). In future years this data will be analyzed to determine population trends and plant community changes.

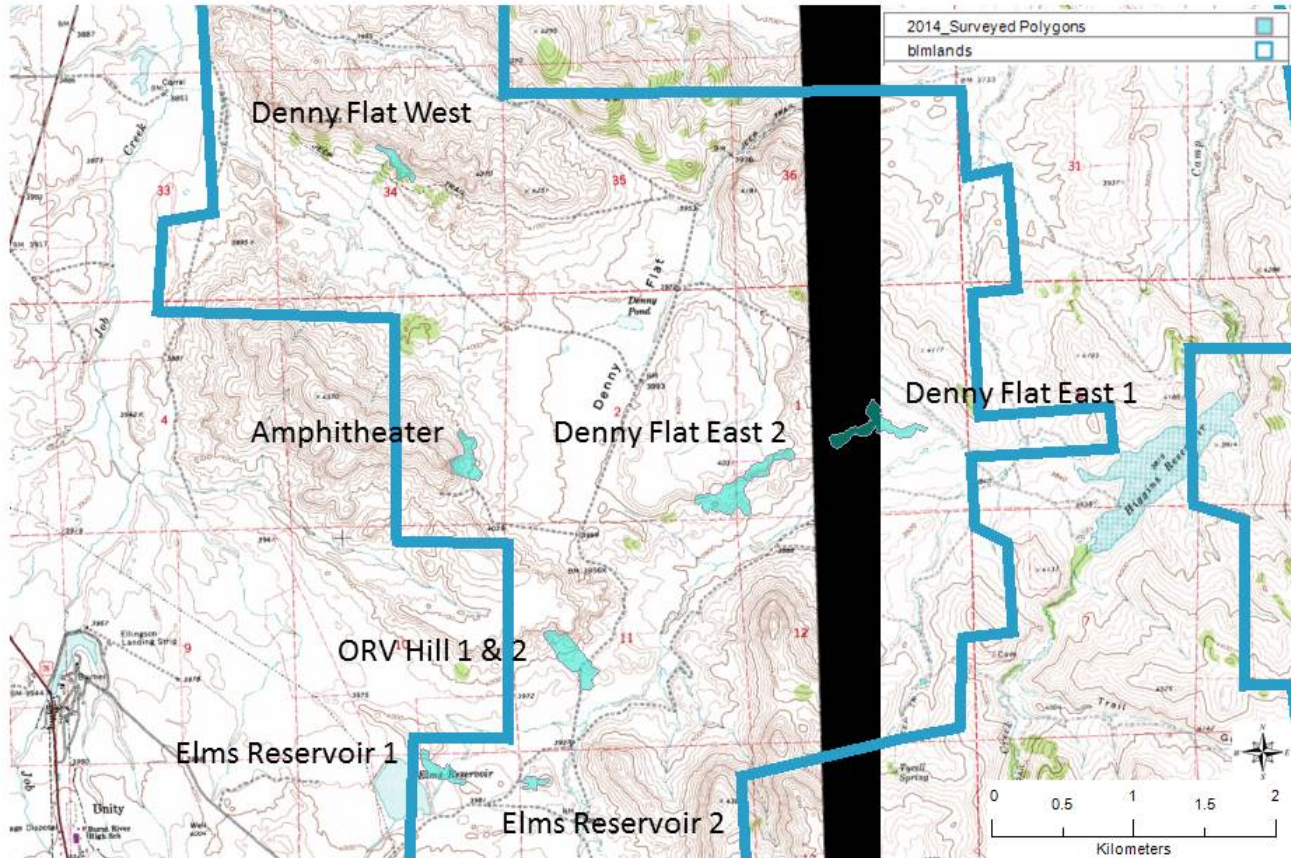


FIGURE 3. OVERVIEW OF LUPINUS LEPIDUS VAR. CUSICKII OCCURRENCES SURVEYED IN 2014 AND 2015 AT DENNY FLAT. AREAS SURVEYED ARE IN LIGHT BLUE, WITH THE BLM BOUNDARY IN DARKER BLUE.

RESULTS

Surveys of previously known occurrences

During the 2015 field season, approximately 152 acres in the Denny Flat area of Baker County were surveyed for *L. lepidus* var. *cusickii*, including the areas where permanent monitoring transects are located. Seven occurrences were observed, including extensions of previously known ones (Table 1, Appendix A). In 2015, we separated Elms Reservoir 1 and 2 and Denny Flat East 1 and 2 into two sites due to their distance from each other. Similar to in 2010, we considered Amphitheater East and West as one site, along with ORV Hill 1 and 2 due to their close proximity to each other. Surveys in 2014 and 2015 covered more area than those conducted in 2010 because they also included the area surrounding the long-term monitoring transects (Newton and Thorpe 2010, Appendix A). Therefore, direct comparisons cannot be made to the 2010 data (Table 1). Surveys were conducted in a similar fashion in all three surveys at Denny Flat West and Denny Flat East 1 and 2, so direct comparisons could be made at these sites only. At Denny Flat West we saw *L. lepidus* var. *cusickii* fluctuate from 1634 plants in 2010, 497

plants in 2014, to 1093 in 2015. At Denny Flat East 1 and 2, 1330 individuals were recorded in 2010, 1370 in 2014, and we saw a total of 6860 plants in 2015, a dramatic increase. While we recorded decreases in *L. lepidus* var. *cusickii* from 2010 to 2014 at Amphitheater (2806 and 1041, respectively) and ORV Hill 1 and 2 (1592 and 842, respectively), both sites had much higher numbers in 2015 (4429 at Amphitheater and 4908 at ORV Hill; Table 1). Elms Reservoir showed an increase from each survey (Table 1). Although the numbers from 2010 can't be directly compared, the decrease in *L. lepidus* var. *cusickii* observed over a larger survey area in 2014 followed by the increases seen in 2015, highlight the highly variable year-to-year fluctuations for this species.

Lupinus lepidus var. *cusickii* was somewhat uncommon throughout the entire area, but when encountered, formed dense patches. Although there was a noticeable amount of dead adults, this was counterbalanced by a high rate of recruitment (Figure 2). The proportion of seedlings to the rest of the population varied from 23% for Amphitheater to 35% for the Denny Flat West, Elm's Reservoir, and the ORV Hills (Table 1). Though the presence of tuffaceous soil and a lack of other vegetation were characteristics of occupied habitat, we often encountered areas that appeared appropriate but did not support *L. lepidus* var. *cusickii*. The largest sub-populations were found on steep, eroding hillsides with little vegetation (cover photo). Plants also inhabited flat areas with greater soil stability and higher shrub cover.

TABLE 1. CHARACTERISTICS OF POPULATIONS OF *L. LEPIDUS* VAR. *CUSICKII* SURVEYED IN 2014 AND 2015.

Site	Total live plants 2010	Acres Surveyed 2014/15	Seedling		Vegetative		Reproductive		TOTAL	
			2014	2015	2014	2015	2014	2015	2014	2015
			*Elm's Reservoir 1	4924	7.2	430	1289	74	1860	1735
*Elm's Reservoir 2	1831	872	69			827	1338	305	3238	2004
Denny Flat East 1	1330	14.6	414	1220	82	2153	345	1253	841	4626
Denny Flat East 2			278	519	59	1141	192	574	529	2234
Denny Flat West	1634	5.5	436	392	4	336	57	365	497	1093
*ORV Hill 1 & 2	1592	16.3	580	1764	25	2238	237	906	842	4908
*Amphitheater East & West	2806	10.1	540	1035	28	2381	473	1013	1041	4429

*2014/2015 surveys included areas not surveyed in 2010

Lupinus lepidus var. *cusickii* was most commonly associated with open spaces with very low competition on highly erodible tuffaceous soil. The plant community was dominated by desert shrubs, including the natives *Chrysothamnus viscidiflorus*, *Artemisia tridentata*, *Eriogonum sphaerocephalum*, and *Ericameria nauseosa*. Groves of *Juniperus occidentalis* dotted the landscape, along with the occasional *Pinus ponderosa*. Other natives included *Eriogonum* spp., *Elymus elymoides*, *Erigeron pumilus*, *Calochortus macrocarpa*, *Cordylanthus ramosus*, *Machaeranthera canescens*, *Poa secunda*, *Silene* sp., and *Mimulus nanus*. Invasive community members included *Bromus tectorum*, *Sisymbrium altissimum*, and *Lepidium perfoliatum*. Also present at many of our sites was a larger perennial lupine and an annual lupine, but they were easy to differentiate from *L. lepidus* var. *cusickii*.

Disturbances and potential threats were observed at each occurrence and were mainly limited to presence of invasive species in surrounding areas and human disturbance. Several areas in Denny Flat show evidence of off-road vehicle (ORV) use and illegal dumping of household appliances and car parts. While few of the populations were in immediate danger, continued use of the area by humans could easily expand into *L. lepidus* var. *cusickii* populations. Elms Reservoir 1 and 2 both had evidence of illegal dumping, with the population at Elms Reservoir 2 expanding along a well-travelled jeep track. These areas should be monitored closely in the future. Invasive species were present along roadsides and in close proximity to some populations of *L. lepidus* var. *cusickii*, however occupied habitat overall is native dominated.

Surveys of potential habitat

We surveyed Happy Camp, a site that had been identified as potential habitat to support *L. lepidus* var. *cusickii*, on July 10, 2014. This site had been identified as potential habitat in collaboration with the BLM and looking over aerial photos for evidence of tuffaceous soils. We surveyed areas of the site using the same method as the others, surveying approximately 73 acres. The site had several patches of soil that looked like they could potentially support *L. lepidus* var. *cusickii*, but upon closer inspection the soils were darker in color and rockier. We noted some areas with similar associated species, including *Eriogonum sphaerocephalum*, *Juniperus occidentalis*, *Artemisia tridentata*, *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Comandra umbellata*, *Poa secunda*, *Achnatherum hymenoides*, and *Linanthus pungens*, along with a high abundance of the annual lupine. Grazing was prevalent at this site and the general plant community did not seem to have the diversity that the other sites housed.

FUTURE ACTIVITIES

The surveys conducted in 2014 and 2015 enabled us to understand the current status and extent of *L. lepidus* var. *cusickii* and showed how much these populations can fluctuate year to year. Utilizing information gathered in surveys in 2014, we implemented long-term monitoring plots in these areas to incorporate un-sampled subpopulations to attempt to yield a more representative understanding of long-term trends across the entire population. As part of these long-term permanent monitoring plots, we will collect detailed information on *L. lepidus* var. *cusickii* individuals including seedling numbers to give us an idea of recruitment rates into the population. We will also monitor the associated plant community to provide data on long-term changes and potential interactions with invasive species.

Transect data from 2015 is reported in Appendix D. This data will be used to compare changes in plant community and *L. lepidus* var. *cusickii* population trends with future monitoring. It is recommended to continue to census the population at regular intervals, in addition to monitoring of long-term transects. The highly stochastic nature of this population is unlikely to be captured by the transects, although they will yield valuable information regarding population trends and the adjacent plant community.

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APPENDIX A. SUMMARIES FOR *LUPINUS LEPIDUS* VAR. *CUSICKII* SURVEYS

Amphitheater East and West

Survey Date: July 1, 2015

Observers: Matt Bahm, Emma MacDonald, Connor Whitaker, Sara Newman and Ceci Welch
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T13S R37E SE1/4 S3. USGS 7.5' quad: Unity. About 2.5 miles northeast of Unity, OR. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road just past 2.2 miles, then turn west onto another two-track. Follow this road approximately .6 miles. Plants were located approximately 500 ft from the road. UTM: 11T 407922E, 4923924N, Nad83.

Occurrence information: The Amphitheater area has one of the largest occurrences of *Lupinus lepidus* var. *cusickii* in the Denny Flat area (Figure 4). We found a total of 4429 live plant (1035 seedlings, 2381 vegetative, and 1013 reproductive). This population demonstrates the stochastic nature of *L. lepidus* var. *cusickii*. In 2010, we did not monitor the area surrounding the long-term transects, yet the total number of plants (2806) was higher than that seen in 2014 (2806 live plants), but had increased by 1.5x in 2015.

Survey information: This area was selected for surveying based on aerial photographs and the existence of a population in the immediate vicinity. In 2014 we surveyed approximately 10 acres of potential habitat for *L. lepidus* var. *cusickii*, which was an extension of that surveyed in 2010 (Figure 4). *L. lepidus* var. *cusickii* was found in high density on lower and middle areas of the hillside, and in the flat areas at the bottom of the hill, both within and outside of the grazing enclosure. Few individuals were found in Amphitheater East relative to Amphitheater West, and the two sections were considered one as they were located less than 100 m in distance.

Habitat Information: The Amphitheater area is so named for the large eroding hillside of tuffaceous deposits. Vegetative cover on this hillside is sparse, namely because of the steep slopes and loose soil. Species found among *L. lepidus* var. *cusickii* include *Eriogonum* spp., *Silene* sp., *Ericameria nauseosa*, *Linanthus pungens*, and *Chrysothamnus viscidiflorus*. Towards the bottom of the hill, the slope is less steep, and affords greater stability for other species, including *Bromus tectorum*, *Artemisia tridentata* ssp. *wyomingensis*, *Grayia spinosa*, *Juniperus occidentalis* ., and *Pinus ponderosa*.

Disturbance and threat information: The habitat at Ampitheater was very steep and there are little threats to the steep mid-slopes which house large numbers of *L. lepidus* var. *cusickii*. However, in the flat areas surrounding the long-term monitoring plots invasive species and cattle grazing are a threat. We noted several patches of invasive species (including *Bromus tectorum*) in the flats at the bottom of the hill, these are in close proximity to some large patches of *L. lepidus* var. *cusickii*. There was lots of evidence of cattle which could negatively impact the steep hillsides of this sensitive habitat.

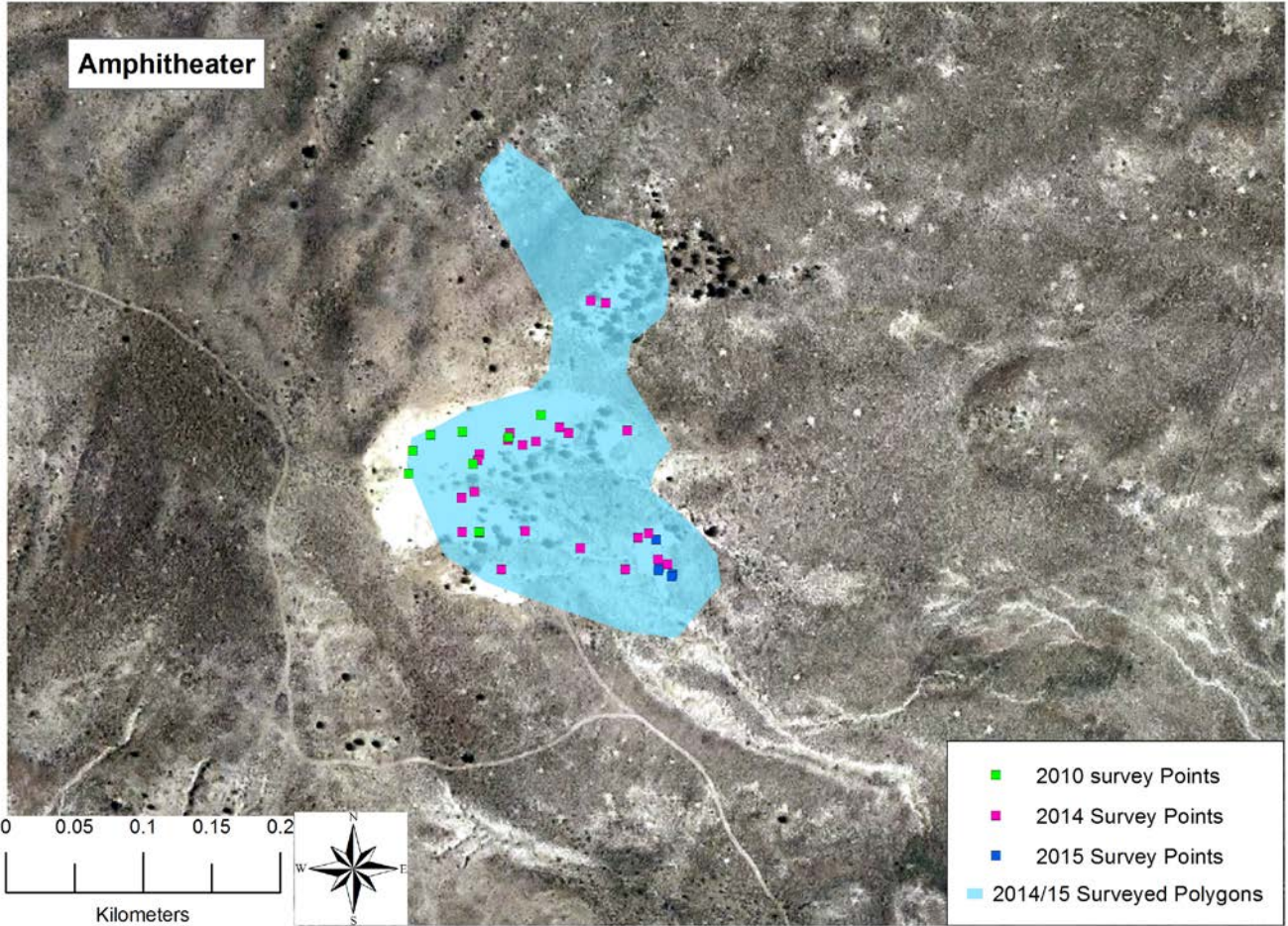


FIGURE 4. AREA SURVEYED IN 2014 AND 2015 AT AMPHITHEATER. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS, AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 5. LUPINUS LEPIDUS VAR. CUSICKII HABITAT IN THE UPPER PORTION OF AMPHITHEATER (ABOVE). POINTING OUT AREAS TO SURVEY IN THE LOWER PORTION OF AMPHITHEATER THAT HOUSES THE LONG-TERM MONITORING TRANSECTS (BELOW).

Denny Flat East 1

Survey Date: June 30, 2015

Observers: Matt Bahm, Emma MacDonald, Connor Whitaker, Sara Newman and Ceci Welch
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T13S R37E SW1/4 S1, SE1/16 SE1/4 S2. USGS 7.5' quad: Unity. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road approximately 3.2 miles, and turn right. Follow this road for another 1.3 miles. Park on the side of the road and hike across a small draw and over a hill to Denny Flat East 1. Use this site to access Denny Flat 2 overland.

Occurrence information: In 2010 Denny Flat East 1 and 2 were reported as one continuous occurrence. Given that there was more than a 100 m gap between them, we will discuss them separately in 2015. Site access is the same for both. The total area surveyed for Denny Flat East 1 was about 15 acres (Figure 6). In 2014, we found *L. lepidus* var. *cusickii* in areas where it was not noted before. In 2015, we found a substantial population of 4626 individuals (1220 seedlings, 2153 vegetative, and 1253 reproductive). Denny Flat East 1 & 2 were reported together in 2010, and the total number of plants found (1330) was much less than that found in 2015 (4626 and 2234, respectively).

Survey information: This area was selected for surveying based on aerial photographs. It is located in close proximity to Denny Flat East 2 which corresponds with ORBIC EO# PDFAB2B193.6. Although we investigated several areas with suitable habitat (presence of tuffaceous soil, low shrub cover), *Lupinus lepidus* var. *cusickii* was present in patches.

Habitat Information: At Denny Flat East 1, small patches of *L. lepidus* var. *cusickii* were found tucked away in small washes among high shrub cover including *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Artemisia tridentata*, and *Eriogonum sphaerocephalum*. Other common species included *Poa secunda*, *Mimulus nanus*, *Eriogonum microthecum*, *Hesperostipa comata*, *Linanthus pungens*, *Elymus elymoides*, *Allium* sp., *Cordylanthus ramosus*, and *Astragalus pumilus*.

Disturbance and threat information: There is little evidence of threats at this population. The area is relatively secluded; we did not see any evidence of ORV use or human impacts. While there was some evidence of cattle grazing, its effects seemed light and the plant community had all signs of being very healthy.

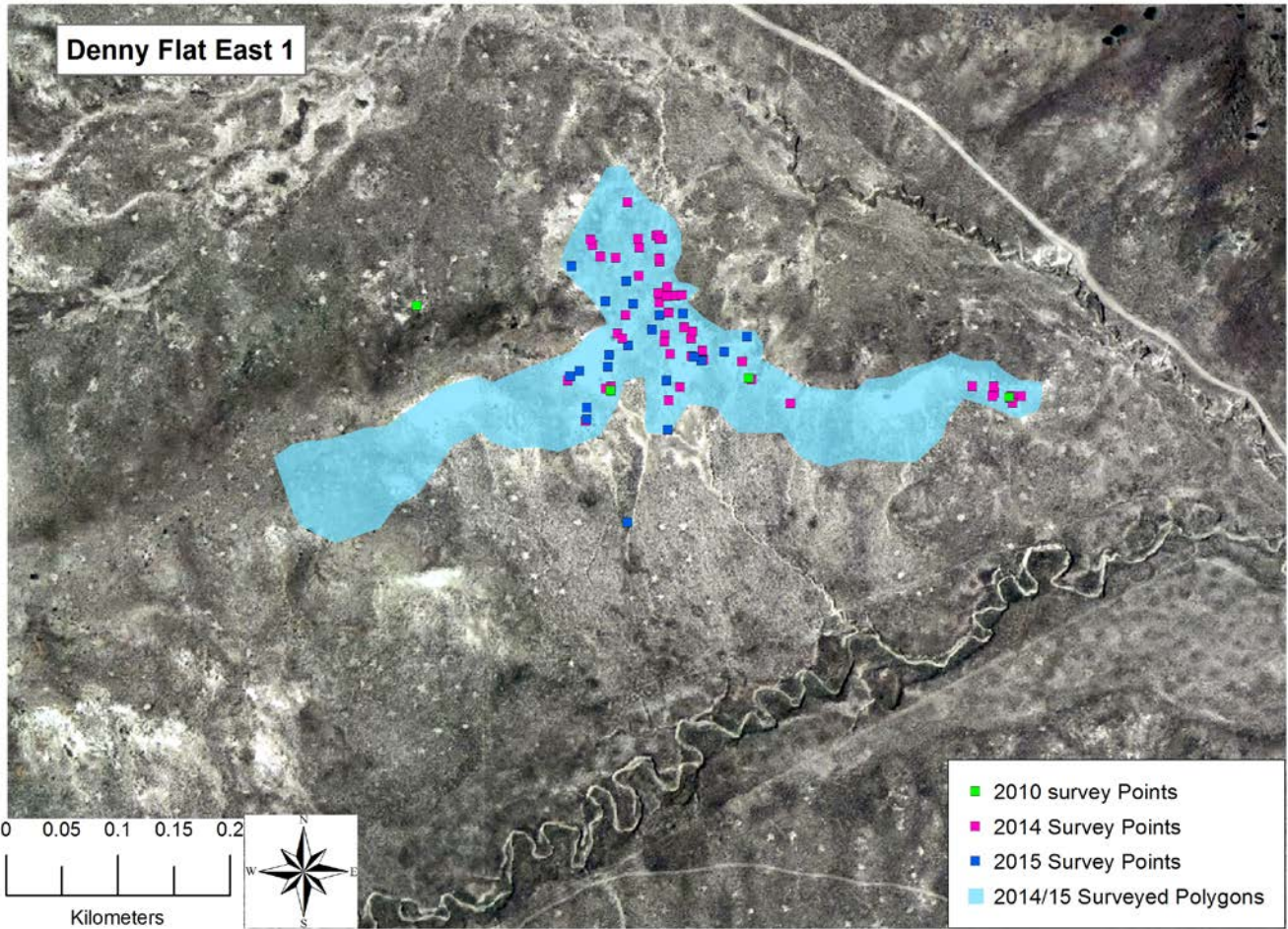


FIGURE 6. AREA SURVEYED IN 2014 AND 2015 AT DENNY FLAT EAST 1. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 7. IAE INTERN SUZANNE JOH SURVEYS FOR LUPINUS LEPIDUS VAR. CUSICKII AT DENNY FLAT EAST 1.

Denny Flat East 2

Survey Date: June 30, 2015

Observers: Matt Bahm and Connor Whitaker
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T13S R37E SW1/4 S1, SE1/16 SE1/4 S2. USGS 7.5' quad: Unity. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road approximately 3.2 miles, and turn right. Follow this road for another 1.3 miles. Park on the side of the road and hike across a small draw and over a hill to Denny Flat East 1. Use this site to access Denny Flat 2 overland.

Occurrence information: In 2010 these populations were considered one continuous occurrence, however in 2015 we observed a greater than 100 m gap between them (Figure 8). We will discuss them separately. The total area surveyed for Denny Flat East 2 was approximately 22 acres (Figure 8). In 2014 we noted individuals in areas far outside what was noted in 2010. In 2015, we found a substantial occurrence of 2234 individuals (519 seedlings, 1141 vegetative, and 574 reproductive). Denny Flat East 1 & 2 were reported together in 2010, and the total number of plants (1330) found was much less than that found in 2015 (4626 and 2234, respectively).

Survey information: This area was selected for surveying based on aerial photographs. Denny Flat East 2 corresponds with ORBIC EO# PDFAB2B193.6. Although we investigated several areas with suitable habitat (presence of tuffaceous soil, low shrub cover), *L. lepidus* var. *cusickii* was not reliably present. There was no immediately tangible reason for the presence of *L. lepidus* var. *cusickii* in some areas and absence in others.

Habitat Information: At Denny Flat East 2, small patches of *L. lepidus* var. *cusickii* were found tucked away in small washes among high shrub cover and on eroding hillsides of tuffaceous soil and low vegetative cover. Species found here include *Eriogonum sphaerocephalum*, *Artemisia tridentata*, *Erigeron pumilus*, *Poa secunda*, *Eriogonum microthecum*, *Elymus elymoides*, *Calochortus macrocarpus*, and *Cordylanthus ramosus*. *L. lepidus* var. *cusickii* was common along washes and areas of slight annual disturbance.

Disturbance and threat information: This area had few signs of disturbance. Threats from invasive species are low, and evidence of cattle grazing was light. The greatest threat appears to be erosion on some of the steep slopes.

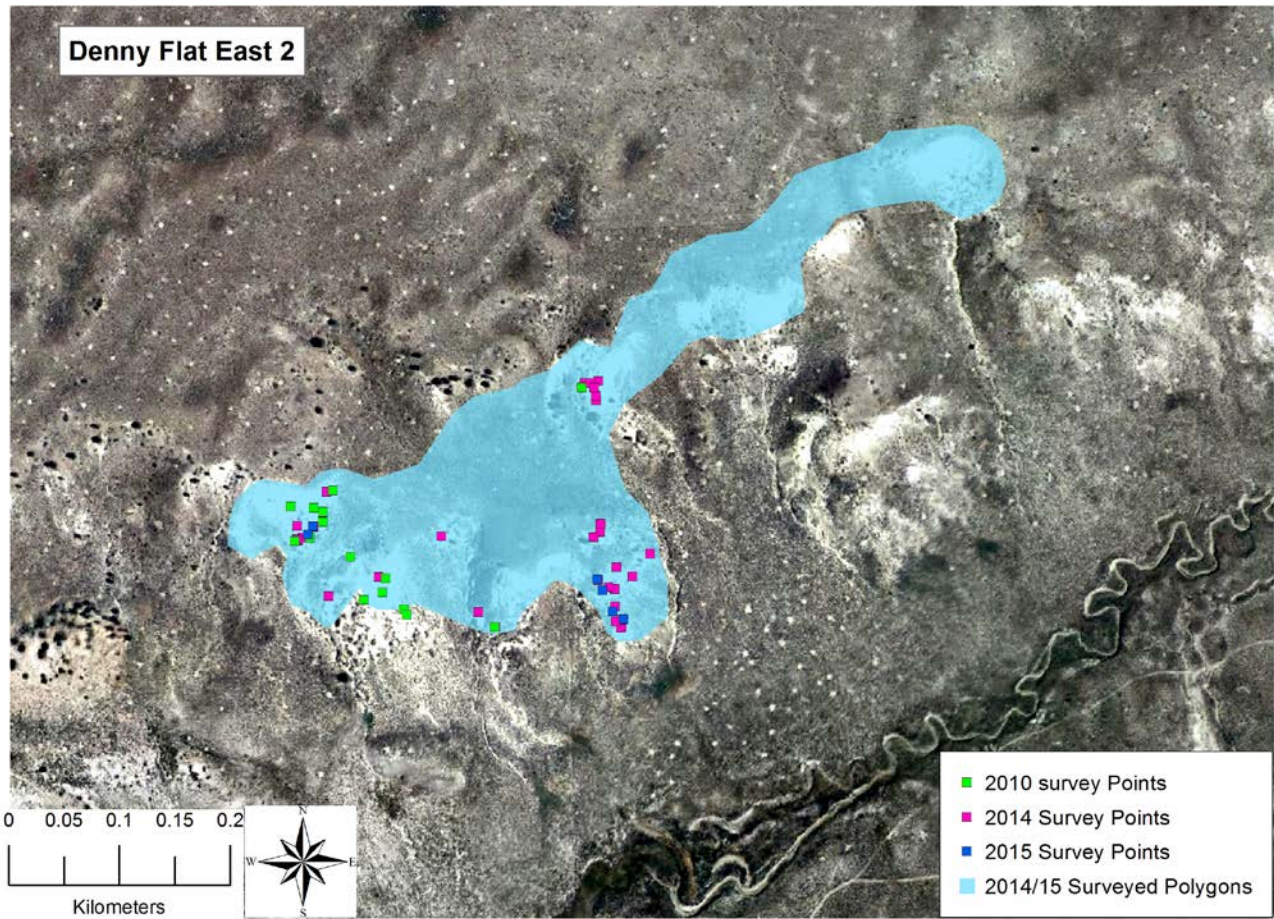


FIGURE 8. AREA SURVEYED IN 2014 AND 2015 AT DENNY FLAT EAST 2. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 9. SURVEYING FOR LUPINUS LEPIDUS VAR. CUSICKII AT DENNY FLAT EAST 2.

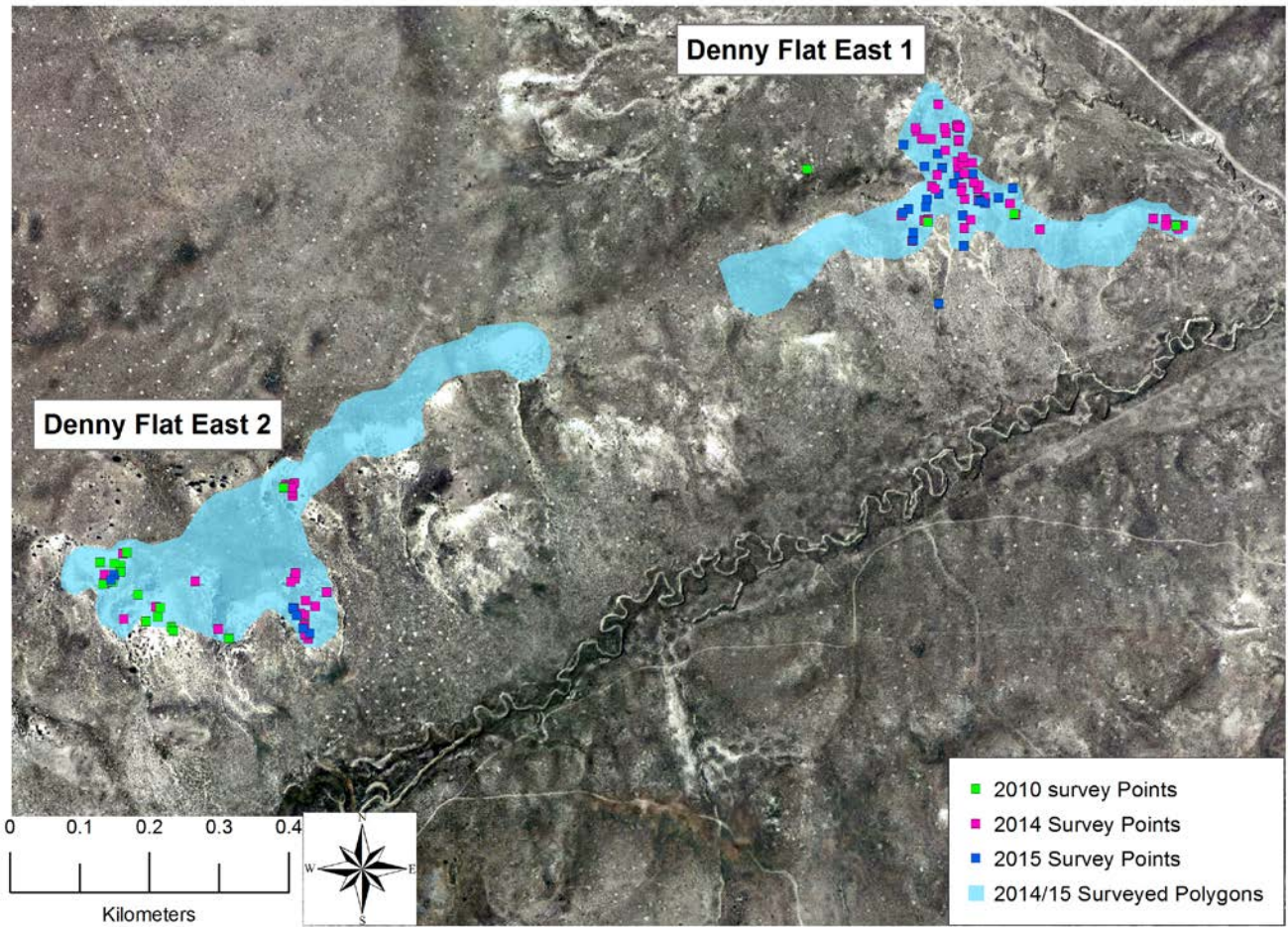


FIGURE 10. DENNY FLAT EAST 1 AND 2 OCCURRENCES SURVEYED IN 2014 AND 2015. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.

Denny Flat West

Survey Date: July 1, 2015

Observers: Matt Bahm and Ceci Welch
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T12S R37E 1/64SW 1/16SW 1/4NW S34. USGS 7.5' quad: Unity. About 3.2 miles north-northeast of Unity, OR. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road about 3.6 miles, then turn left (west). Continue on this road approximately 1.1 miles. Park and hike south-west up and over the ridge then continue west along the ridgeline until you reach the occurrence (see Appendix B) UTM: 11T 407634E, 4926024N, Nad83.

Occurrence information: The occurrence we surveyed covered an area approximately 6 acres in size (Figure 11). In 2015 the population contained a total of 1093 plants (392 seedlings, 336 vegetative, and 365 reproductive). This was a decline from the 1634 individuals (779 seedling, 628 vegetative, and 227 reproductive) seen in 2010, but higher than the 497 recorded in 2014.

Survey information: This area was chosen for surveying based on aerial photographs and recommendations from botanists familiar with the area. We investigated several hilly areas with light-colored, presumably tuffaceous soil. Most areas had high cover of trees and bunchgrasses, suggesting a soil stability that is contraindicative for *Lupinus lepidus* var. *cusickii*.

Habitat Information: The greater area of Denny Flat West supports several tree species (*Pinus ponderosa* and *Juniperus occidentalis*) and native bunchgrasses including *Achnatherum hymenoides*, *Poa secunda*, *Elymus elymoides*. Other members of the plant community include *Eriogonum* sp., *Erigeron pumilus*, *Linanthus pungens*, *Grayia spinosa*, *Machaeranthera canescens*, and *Bromus tectorum*. The soil has relatively high rock content, and pine litter is abundant. We saw many seedlings growing in the pine litter, which was unique when compared to other sites (Figure 12). *Lupinus lepidus* var. *cusickii* at this site was very patchy, and often inhabits locally barren areas of eroding soil, and was noticeably absent from more stable soil patches.

Disturbance and threat information: This area had few signs of disturbance, and invasive species, though present, pose little threat. There is evidence of a jeep trail nearby, but not impacting the area occupied by *L. lepidus* var. *cusickii*. This population's isolation from other *L. lepidus* var. *cusickii* populations at Denny Flat may play a larger role in its persistence.

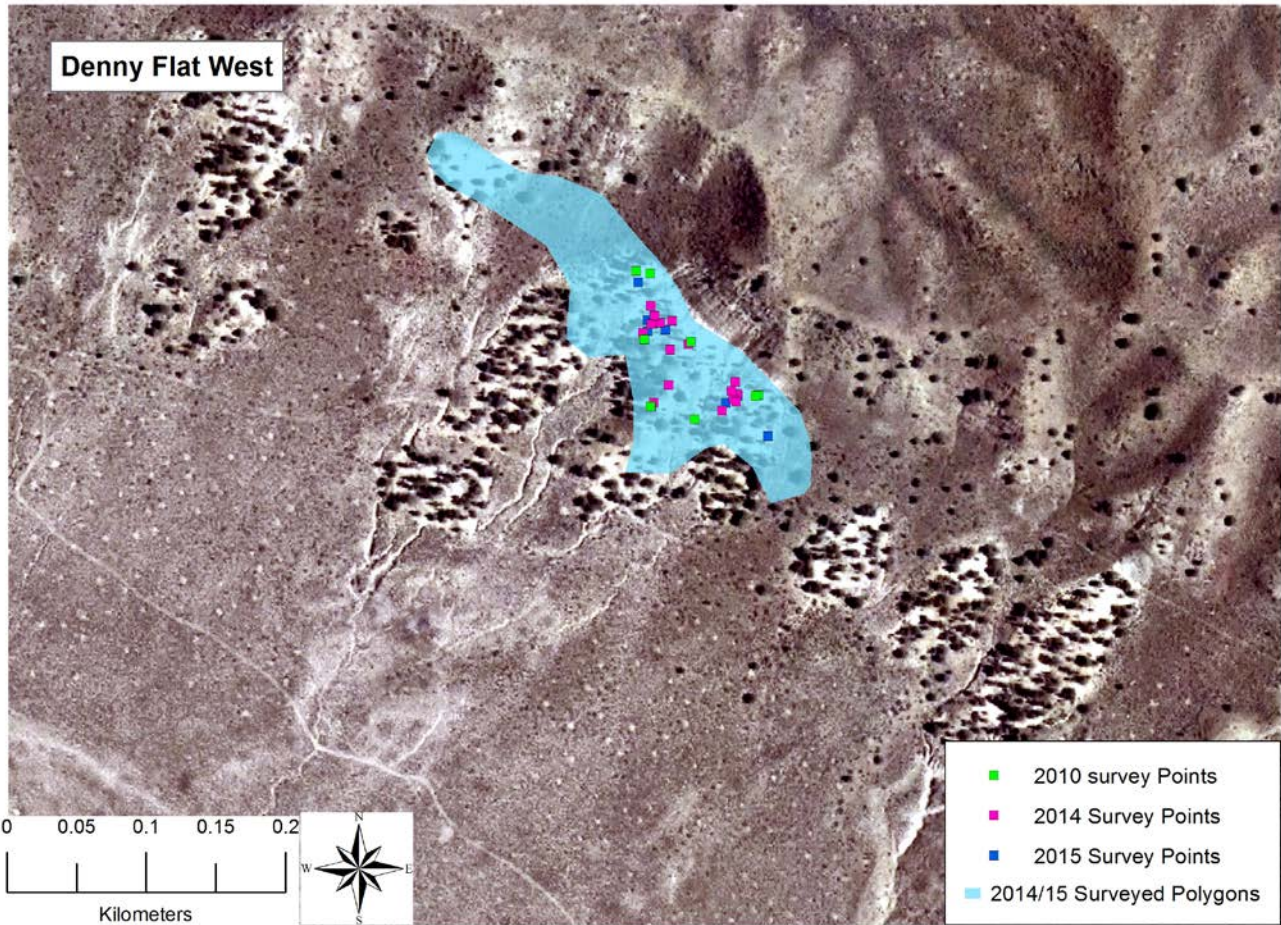


FIGURE 11. AREA SURVEYED IN 2014 AND 2015 AT DENNY FLAT WEST. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 12. LUPINUS LEPIDUS VAR. CUSICKII SEEDLINGS GROWING IN PINE LITTER (LEFT). SURVEYING FOR L. LEPIDUS VAR. CUSICKII AT DENNY FLAT WEST IN 2014, NOTE THE DARKER SUBSTRATE AND PINE LITTER PRESENT (RIGHT).

ORV Hill 1 and 2

Survey Date: June 30, 2015

Observers: Matt Bahm, Emma MacDonald, Connor Whitaker, Sara Newman and Ceci Welch
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T13S R37E SW1/4 S11. USGS 7.5' quad: Unity. About 2.3 miles northeast of Unity, OR. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road north about 1.5 miles. The ORV Hill 2 population is on the east side of the road. Follow the main road another .15 mile to find the ORV Hill 1 population about 400 feet off the road to the west. UTM: 11T 408641E, 4922533N, Nad83.

Occurrence information: In 2015 we found a total of 4908 live plants (1764 seedlings, 2238 vegetative, and 906 reproductive). While we cannot compare numbers from surveys in 2010 directly, there were more plants found in 2015, with monitoring being more extensive. In 2015 we noted plants in or near areas documented in 2014. In 2010 1592 plants were found not including the areas surrounding long-term monitoring plots. The total area surveyed encompasses approximately 16 acres (Figure 13).

Survey information: This area was selected for surveying based on aerial photographs and the information collected in previous years. These populations extend down the hillside across the main two-track road, presumably washed there by rain. They also extend onto the eastern side of the road over a small bluff that houses the long-term monitoring plots

Habitat Information: This *Lupinus lepidus* var. *cusickii* population occupies south- to southwest-facing slopes with highly erodible tuffaceous soil (Figure 14). Vegetative cover is locally sparse, and consists of *Mimulus nanus*, *Eriogonum* spp., *Silene* sp., and *Ericameria nauseosa*. Also present were *Juniperus occidentalis*, *Chrysothamnus viscidiflorus*, *Poa secunda*, *Eriogonum sphaerocephalum*. The population extends across the road to an area with high grass cover (*Pseudoroegneria spicata*, *Elymus elymoides*, *Bromus tectorum*, and *Bromus hordeaceus*). This area is lower than the road and may receive extra moisture due to drainage from the road. The east side of the road had high shrub and grass cover in lowlands and *L. lepidus* var. *cusickii* is mostly present on the open hillside with exposed soil.

Disturbance and threat information: Invasive species are present at the site and are located in close proximity to the road. There is evidence of grazing at the site, particularly in areas with *Juniperus occidentalis*. The site has lots of ORV tracks that could impact the population and create erosion in this sensitive habitat.

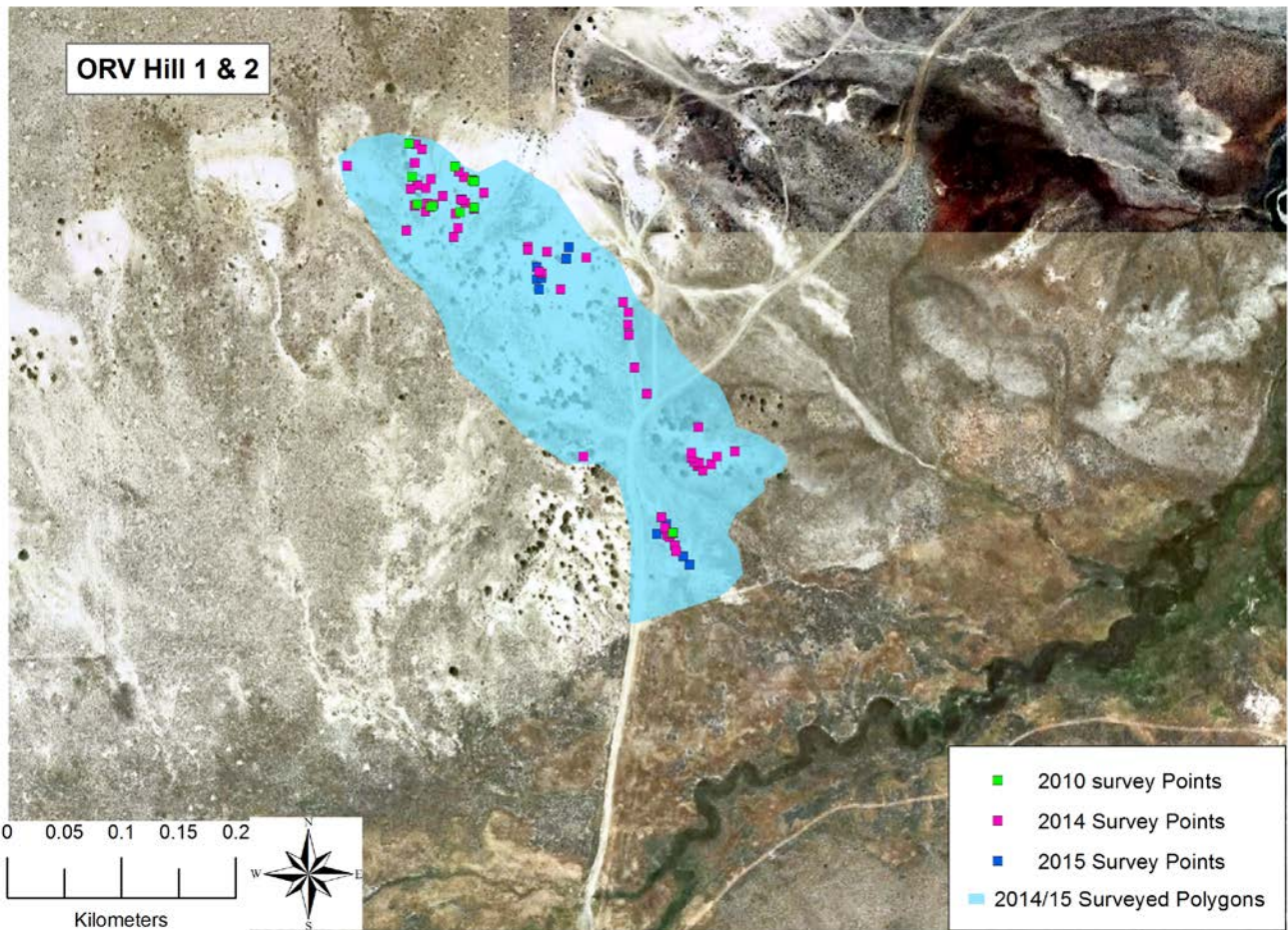


FIGURE 13. AREA SURVEYED IN 2015 AT ORV HILL 1 AND 2. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS, AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 14. LUPINUS LEPIDUS VAR. CUSICKII HABITAT AT ORV HILL 1. NOTE THE VERY STEEP SLOPES WITH EXPOSED TUFFACEOUS SOILS.

Elms Reservoir 1

Survey Date: July 1, 2015

Observers: Matt Bahm, Emma MacDonald, Connor Whitaker, Sara Newman and Ceci Welch
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T13S R37E NW1/16 NE1/4 S15, NW1/16 NW1/4 S14. USGS 7.5' quad: Unity. About 1.6 miles northeast of Unity, OR. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road approximately 0.4 miles, then turn left and follow for another 0.2 miles. Park next to the large Juniper, to the north of the reservoir. Plants are located on both sides of the road. UTM's: (Elms 1) 407656E, 4921837N; 11T Nad83.

Occurrence information: We will discuss Elms Reservoir 1 and 2 separately, given that they were separated by a distance greater than 100m. In 2015, a total of 4025 live individuals were found (1289 seedlings, 1860 vegetative, 876 reproductive). The total population area encompasses about 7.2 acres (Figure 15). In 2015, plants were found in or near areas noted in 2014.

Survey information: This area was selected for surveying based on aerial photographs and the existence of a population in the immediate vicinity. Surveys targeted the area monitored in long-term transects as well as the surrounding appropriate habitat.

Habitat Information: At Elms Reservoir 1, *Lupinus lepidus* var. *cusickii* was found on a slight hillside and a small bowl of eroding tuff. Other members of the plant community include *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Linanthus pungens*, *Poa secunda*, *Silene* sp., *Chaenactis douglasii*, and *Achillea millefolium*

Disturbance and threat information: Threats observed for this population include human impacts given the proximity to the highway. The site is impacted by human litter and illegal dumping. There is also lots of evidence of large mammal herbivory on plants. Despite these threats, this remains one of the most robust populations in the Denny Flat area.

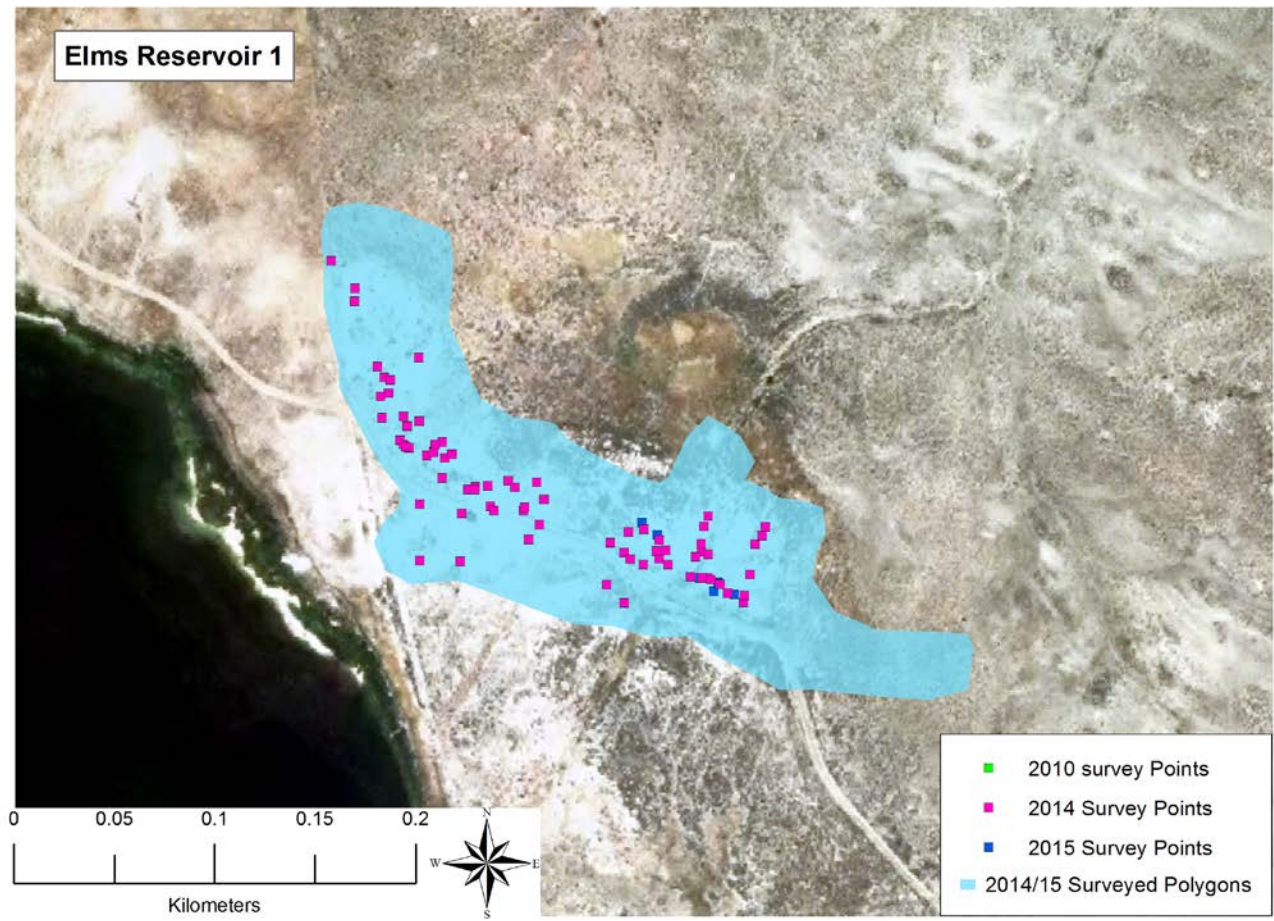


FIGURE 15. AREA SURVEYED IN 2015 AT ELMS RESERVOIR 1. BLUE DOTES INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 16. LUPINUS LEPIDUS VAR. CUSICKII HABITAT AT ELM'S RESERVOIR 1.

Elms Reservoir 2

Survey Date: July 1, 2015

Observers: Matt Bahm, Emma MacDonald, Connor Whitaker, Sara Newman and Ceci Welch
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. T13S R37E NW1/16 NE1/4 S15, NW1/16 NW1/4 S14. USGS 7.5' quad: Unity. About 1.6 miles northeast of Unity, OR. Follow US-26 east from Unity approximately 2.75 miles, and turn north onto a dirt two-track. Follow this road about 0.7 miles and park on the side of the road. Plants are located along the jeep track that continues east up the small butte. UTM's: (Elms 2) 407720E, 4921683N; 11T Nad83.

Occurrence information: We will discuss Elms Reservoir 1 and 2 separately, given that they were separated by a distance greater than 100m. A total of 2004 live individuals were found during the 2015 census (872 seedling, 827 vegetative, and 305 reproductive). The total population area encompasses about 2.9 acres (Figure 17).

Survey information: This area was selected for surveying based on aerial photographs and the existence of a population in the immediate vicinity. It was also visited in 2010 surveys.

Habitat Information: At Elms Reservoir 2, *Lupinus lepidus* var. *cusickii* was found on a flat area along a highly disturbed jeep road leading to the top of a small butte (Figure 18). Other members of the plant community include *Artemisia tridentata*, *Ericameria nauseosa*, *Erigeron pumilus*, *Eriogonum* sp., *Silene* sp., *Chrysothamnus viscidiflorus*, *Agropyron cristatum*, *Linanthus pungens*, *Poa secunda*, and *Bromus tectorum*.

Disturbance and threat information: This site is heavily disturbed. The occurrence follows a jeep road and extends onto a flat area in the immediate vicinity. Garbage dumping here is common and shotgun shells were present (Figure 18).

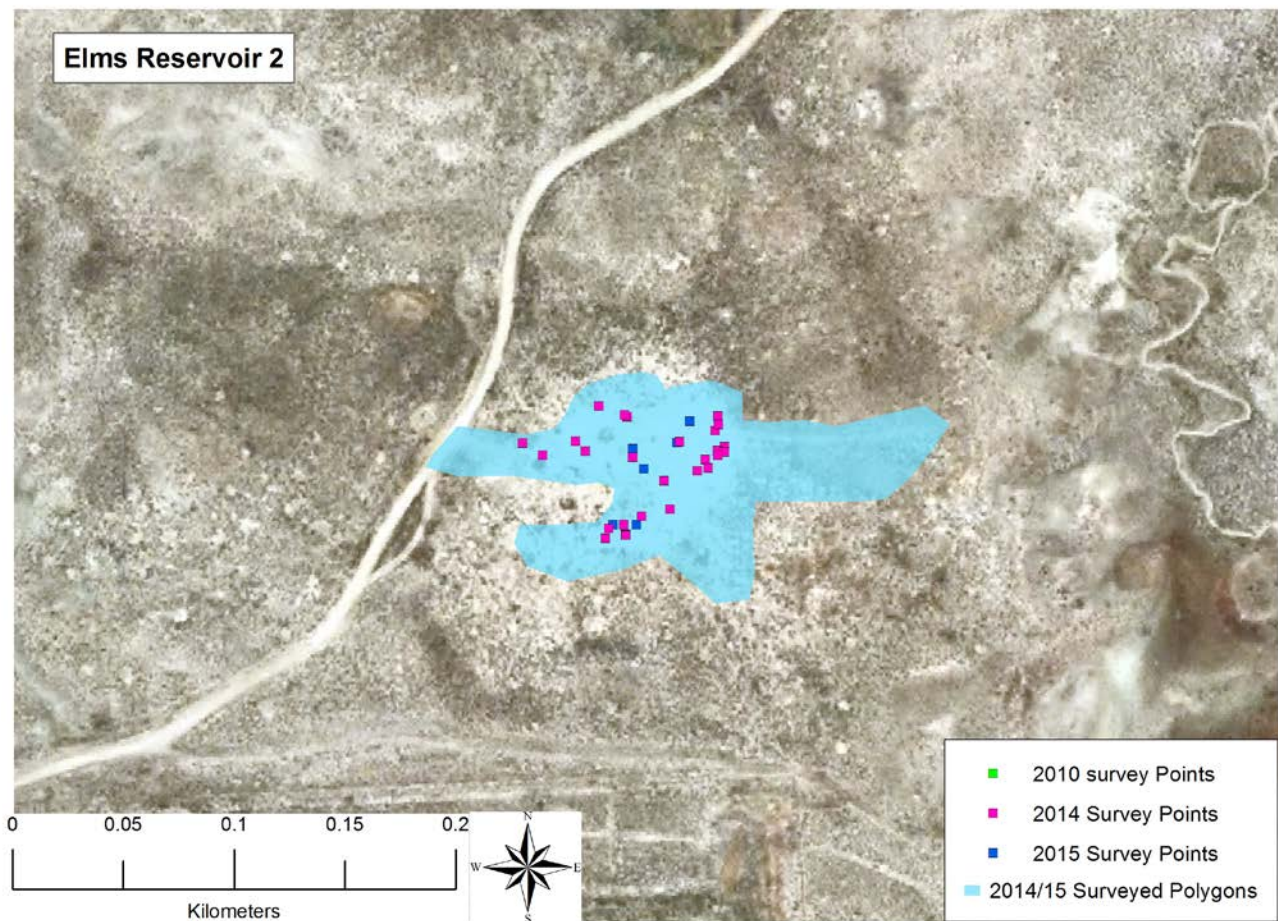


FIGURE 17. AREA SURVEYED IN 2014 AND 2015 AT ELMS RESERVOIR 2. BLUE DOTS INDICATE 2015 SURVEY POINTS, PINK DOTS INDICATE 2014 SURVEY POINTS AND GREEN DOTS INDICATE 2010 SURVEY POINTS. 2015 SURVEY POINTS INCLUDE THE PERMENANT MONITORING TRANSECTS.



FIGURE 18. LUPINUS LEPIDUS VAR. CUSICKII POPULATION GROWING ALONG A JEEP TRACK AT ELMS RESERVOIR 2 (ABOVE), AND SMALL PLANT GROWING NEXT TO GARBAGE (BELOW).

Happy Camp

Survey Date: July 9, 2014

Observers: Erin Gray, Tara Callaway, and Suzanne Joh
Institute for Applied Ecology
563 SW Jefferson Avenue
Corvallis, OR 97333

Location information: Denny Flat, Baker County. Zero out odometer at the Unity Market/Gas Station. Turn east off Highway 26 at 4.6 miles, take a left into a driveway through a gate and zero out the odometer. Follow the road past the private residence and past the barn complex (at 0.1 and 0.2 miles respectively). The road continues for a total of ~1.2 miles. At this point, the road will turn north (to the left). After traveling for approximate 0.5 miles you will be on BLM land. The road is very sandy, beware!

UTMs: 413524E, 4918821N; 11T Nad83.

Occurrence information: We found no individuals at Happy Camp.

Survey information: This area was selected for surveying based on aerial photographs and from conversations with BLM staff. The total area surveyed was 73.4 acres (Figure 19).

Habitat Information: Despite the habitat looking promising, we found no *Lupinus lepidus* var. *cusickii* at Happy Camp. The site had some areas with associated species though the soils were much more compacted. Species present included *Eriogonum sphaerocephalum*, *Juniperus occidentalis*, *Artemisia tridentata*, *Poa secunda*, *Allium* sp., *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Comandra umbellata*, *Achnatherum hymenoides*, *Linanthus pungens*, *Calochortus macrocarpa*, *Erigeron pumilus*, *Machaeranthera canescens*, *Achillea millefolium*, *Cordylanthus ramosus*, and *Astragalus pumilus*.

Disturbance and threat information: Happy Camp had extensive evidence of grazing throughout the site with cattle tracks and many bunchgrasses impacted by grazing. The soils appeared to be more compacted than other sites, with different texture.

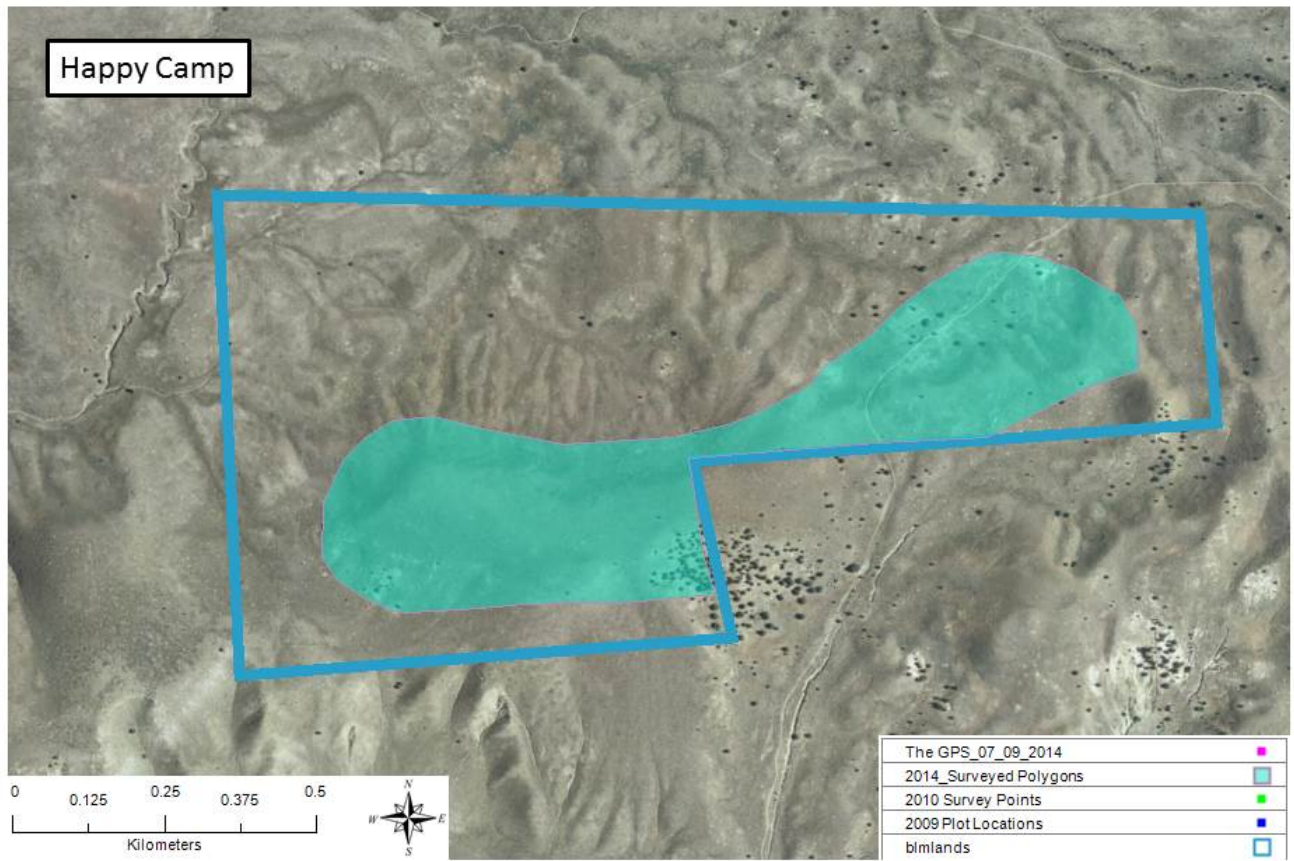


FIGURE 19. AREA SURVEYED IN 2014 AT HAPPY CAMP. NO LUPINUS LEPIDUS VAR. CUSICKII WERE PRESENT.

APPENDIX B. OVERVIEW MAPS FOR DENNY FLAT.

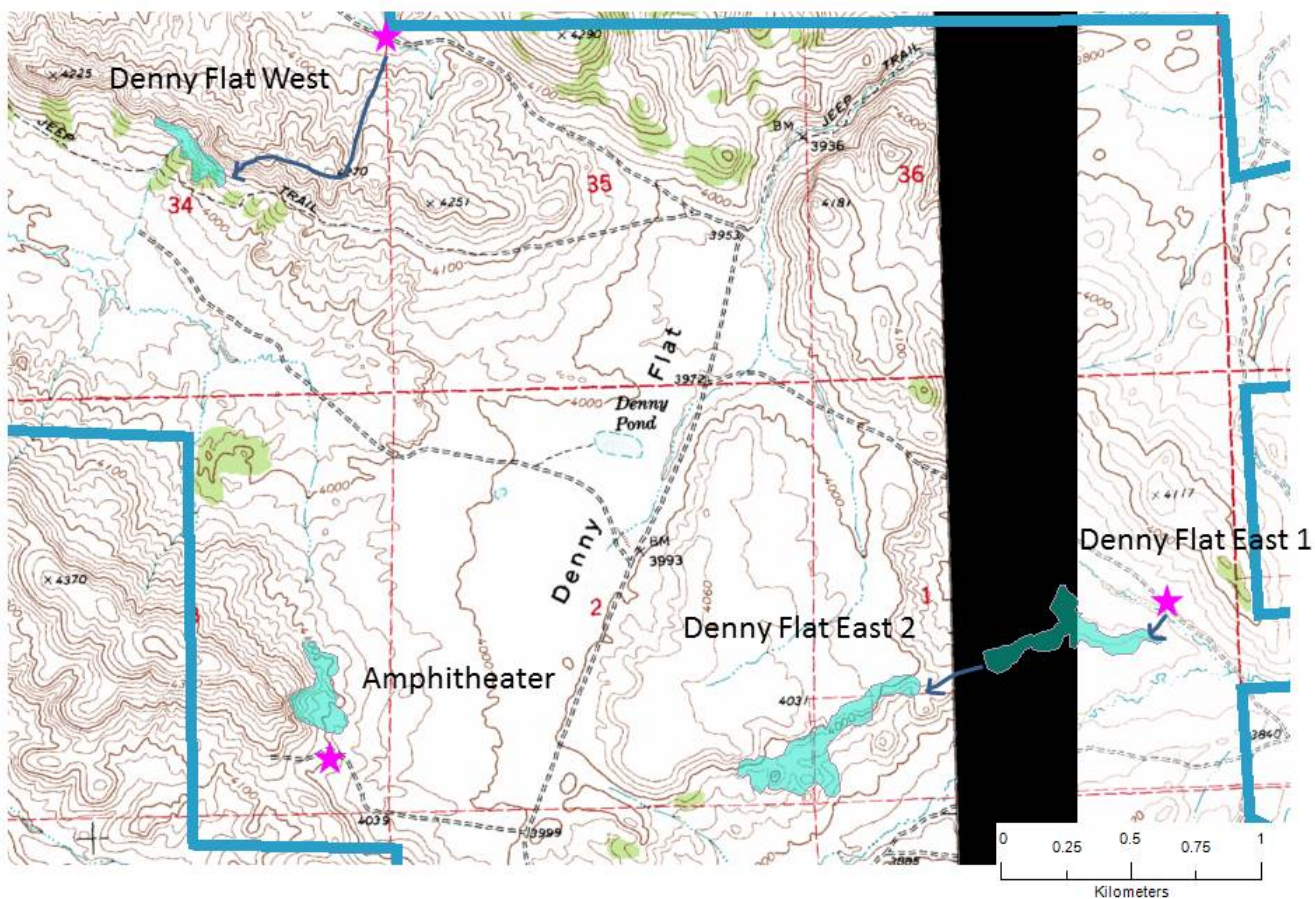


FIGURE 20. OVERVIEW OF NORTHERN SECTION OF DENNY FLAT. PINK STARS INDICATE AREAS TO PARK, AND GREY ARROWS INDICATE THE DIRECTION TO HIKE FOR SITE ACCESS.

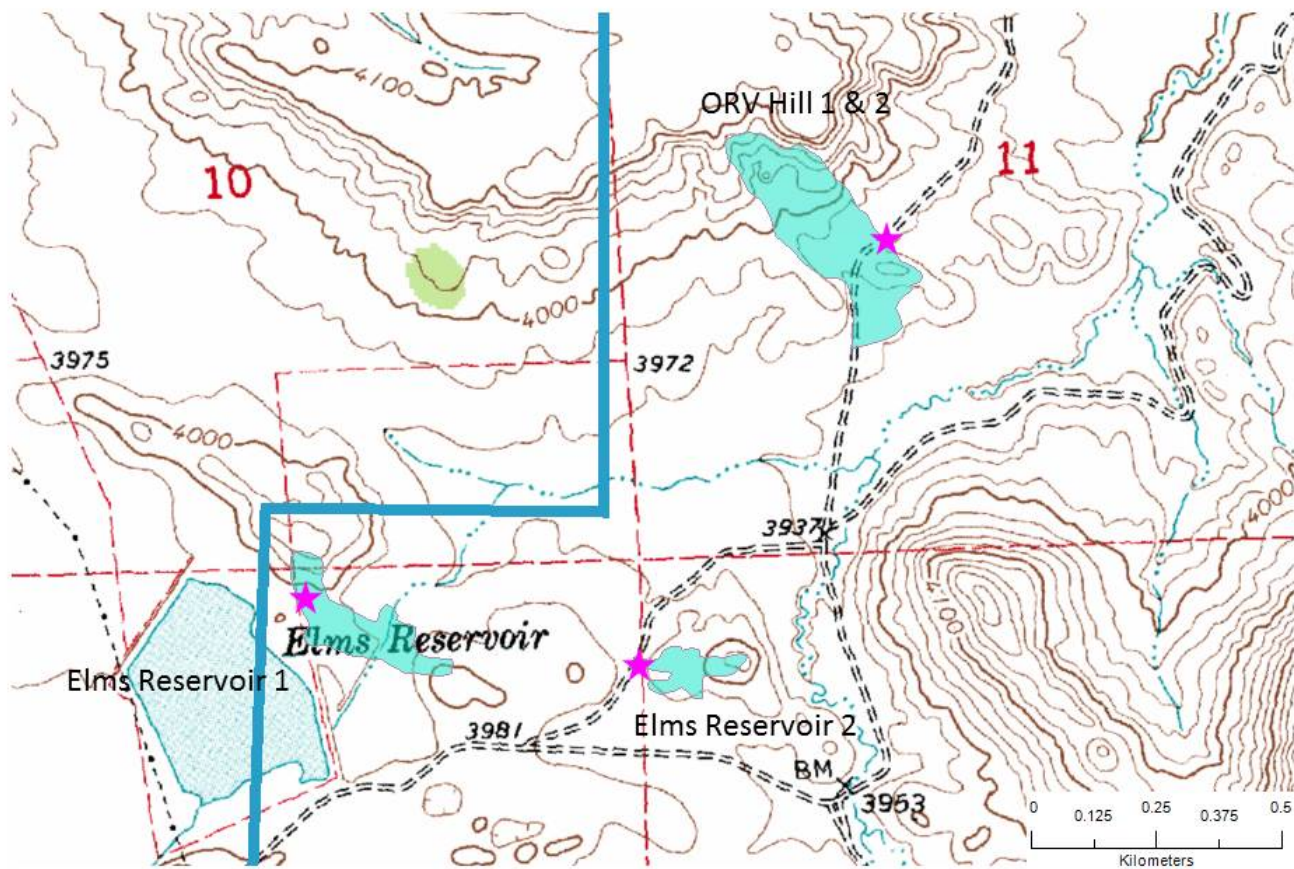


FIGURE 21. OVERVIEW OF SOUTHERN SECTION OF DENNY FLAT. PINK STARS INDICATE AREAS TO PARK FOR SITE ACCESS.

APPENDIX C. 2015 LUPINUS LEPIDUS VAR. CUSICKII TRANSECT LOCATIONS.

Sub-population	Tran- sect	Tag #		GPS Coordinates (Origin)		Bearing (origin to end)	side of tape monitored
		0m	10m				
Denny Flat East 1	1	562	563	44.46428	-118.12119	19°	NW (uphill)
Denny Flat East 1	2	516	517	44.45989	-118.13560	295°	N (right from origin)
Denny Flat East 1	3	564	565	44.46393	-118.12101	364°	E (right from origin)
Denny Flat East 2	1	566	567	44.45989	-118.13560	210°	W (right from origin)
Denny Flat East 2	2	538	539	44.45907	-118.13210	308°	N (right from origin)
Denny Flat East 2	3	536	537	44.45931	-118.13233	338°	E (right from origin)
ORV Hill 1	1	518	none	44.45091	-118.14810	167°	W (right from origin)
ORV Hill 1	2	896	none	44.45082	-118.14805	167°	W (right from origin)
ORV Hill 1	3	519	520	44.45081	-118.14810	187°	W (right from origin)
ORV Hill 2	1	534	535	44.45074	-118.14808	95°	S (right from origin)
ORV Hill 2	2	533	532	44.45106	-118.14774	130°	S (right from origin)
ORV Hill 2	3	522	523	44.45097	-118.14777	150°	SW (right from origin)
Denny Flat West	1	528	none	44.48121	-118.16118	70°	SE (right from origin)
Denny Flat West	2	529	none	44.48170	-118.16171	314°	N (right from origin)
Denny Flat West	3	531	none	44.48176	-118.16187	180°	E (right from origin)
Amphitheater	1	530	none	44.46222	-118.15585	80°	N (upslope)
Amphitheater	2	none	none	44.46204	-118.15583	126°	S (right from origin)
Amphitheater	3	none	none	44.46202	-118.15583	126°	S (right from origin)
Elm Reservoir 1	1	521	402	44.44321	-118.15937	310°	N (left from origin)
Elm Reservoir 1	2	524	none	44.44295	-118.15903	86°	N (left from origin)
Elm Reservoir 1	3	402	none	44.44301	-118.15912	100°	W (left from origin)
Elm Reservoir 2	1	525	none	44.44255	-118.15160	30°	W (left from origin)
Elm Reservoir 2	2	526	none	44.44253	-118.15185	140°	NE (left from origin)
Elm Reservoir 2	3	527	none	44.44222	-118.15197	74°	N (left from origin)

*Missing transect tags will be replaced in 2016.

APPENDIX D. 2015 PERMENANT MONITORING TRANSECTS DATA FOR LUPINUS LEPIDUS VAR. CUSICKII.

Number and size class of vegetative and reproductive *Lupinus lepidus* var. *cusickii* found in permanent monitoring transects in 2015.

Site	Transect	Vegetative				Reproductive		
		Seedling (<5cm)	Small (5-10cm)	Medium (>10-25cm)	Large (>25cm)	Small (5-10cm)	Medium (>10-25cm)	Large (>25cm)
Denny Flat East 1	1	2	2	0	0	1	2	1
Denny Flat East 1	2	37	28	1	0	6	7	3
Denny Flat East 1	3	0	1	0	0	0	1	0
Denny Flat East 2	1	47	11	0	0	4	0	0
Denny Flat East 2	2	15	7	0	0	7	1	2
Denny Flat East 2	3	21	12	0	0	1	0	0
ORV Hill 1	1	11	9	0	0	0	0	0
ORV Hill 1	2	21	6	0	0	1	0	0
ORV Hill 1	3	50	5	0	0	0	0	0
ORV Hill 2	1	19	13	0	0	2	0	0
ORV Hill 2	2	6	8	0	0	4	0	0
ORV Hill 2	3	6	7	0	0	8	0	0
Denny Flat West	1	90	36	0	0	18	5	0
Denny Flat West	2	48	27	0	0	8	11	3
Denny Flat West	3	15	14	0	0	5	4	1
Amphitheater	1	29	34	0	0	9	2	0
Amphitheater	2	11	14	0	0	0	1	0
Amphitheater	3	15	10	0	0	0	3	0
Elms Reservoir 1	1	9	8	0	0	2	0	0
Elms Reservoir 1	2	19	14	0	0	4	5	0
Elms Reservoir 1	3	81	53	0	0	20	14	2
Elms Reservoir 2	1	28	11	0	0	9	1	0
Elms Reservoir 2	2	55	10	0	0	5	0	0
Elms Reservoir 2	3	28	2	0	0	0	0	0

Plant community data for *L. lepidus* var. *cusickii* permanent monitoring transects at Denny Flat East 1 & 2 in 2015.

Site			DFE 1	DFE 1	DFE 1	DFE 2	DFE 2	DFE 2
Transect			1	2	3	1	2	3
Species/Ground Cover	Growth Form	Origin						
moss/lichen			0.0	0.0	0.0	0.0	0.0	0.0
bareground			94.3	88.3	88.3	91.7	90.0	86.0
litter			0.7	1.7	1.7	0.0	2.3	4.4
rock			5.0	8.3	5.3	12.7	5.7	11.0
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chrysothamnus viscidiflorus</i>	Shrub	N	0.0	0.0	17.3	0.0	0.0	0.0
<i>Ericameria nauseosa</i>	Shrub	N	0.0	0.7	0.7	0.0	0.0	0.0
<i>Eriogonum sphaerocephalum</i>	Shrub	N	0.0	0.3	8.0	0.0	0.0	0.0
<i>Grayia spinosa</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Achnatherum hymenoides</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Agropyron cristatum</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus tectorum</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus</i> sp.	Gram	I?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Elymus elymoides</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca idahoensis</i>	Gram	N	0.0	0.7	0.0	0.0	0.0	0.0
<i>Hesperostipa comata</i>	Gram	N	0.0	1.4	0.7	0.0	0.1	0.0
<i>Phleum pratense</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa secunda</i>	Gram	N	0.0	0.3	0.0	0.0	0.0	0.0
<i>Psuedoregnaria spicata</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Achillea millefolium</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Allium</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Astragalus pumilis</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chaenactis douglasii</i>	Forb	N	0.2	0.0	0.0	0.0	0.0	0.0
<i>Cordylanthus ramosus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cryptantha</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Erigeron pumilis</i>	Forb	N	0.0	0.0	0.0	0.2	0.0	0.0
<i>Eriogonum microthecium</i>	Forb	N	2.0	11.7	1.4	0.0	11.3	7.3
<i>Lepidium perfoliatum</i>	Forb	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Linanthus pungens</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lupinus lepidus</i> var. <i>cusickii</i>	Forb	N	1.0	2.0	0.0	0.1	0.5	0.1
<i>Lupinus</i> sp. (not LUCU)	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mimulus nanus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Machraeranthera canescens</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Silene</i> sp.	Forb	?	0.0	0.0	0.7	0.0	0.2	0.5
<i>Tragopogon</i> sp.	Forb	I	0.0	0.0	0.0	0.0	0.0	0.0

Plant community data for *L. lepidus* var. *cusickii* permanent monitoring transects at ORV Hills 1 & 2 in 2015.

Site			ORV 1	ORV 1	ORV 1	ORV 2	ORV 2	ORV 2
Transect			1	2	3	1	2	3
Species/Ground Cover	Growth Form	Origin						
moss/lichen			0.0	0.0	0.0	0.0	0.0	0.0
bareground			96.3	98.0	92.3	86.7	88.3	88.3
litter			2.0	0.0	0.0	2.0	0.0	5.0
rock			3.3	2.0	7.7	3.3	5.0	5.7
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	Shrub	N	0.0	0.0	0.0	2.3	3.7	0.7
<i>Chrysothamnus viscidiflorus</i>	Shrub	N	0.0	0.0	0.0	0.0	6.0	19.3
<i>Ericameria nauseosa</i>	Shrub	N	0.0	0.0	0.0	0.7	0.0	0.0
<i>Eriogonum sphaerocephalum</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Grayia spinosa</i>	Shrub	N	0.0	0.0	0.0	0.0	11.7	0.0
<i>Achnatherum hymenoides</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Agropyron cristatum</i>	Gram	I	0.0	0.0	0.0	1.7	1.7	0.0
<i>Bromus tectorum</i>	Gram	I	0.0	0.0	0.0	1.7	2.3	3.0
<i>Bromus</i> sp.	Gram	I?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Elymus elymoides</i>	Gram	N	0.0	0.0	0.0	9.0	9.7	10.0
<i>Festuca idahoensis</i>	Gram	N	0.0	0.0	0.0	4.0	0.7	0.7
<i>Hesperostipa comata</i>	Gram	N	0.0	0.0	0.2	0.0	0.0	0.0
<i>Phleum pratense</i>	Gram	I	0.0	0.0	0.0	3.3	3.7	8.3
<i>Poa secunda</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Psuedoregnaria spicata</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	1.0
<i>Achillea millefolium</i>	Forb	N	0.0	0.0	0.0	9.3	3.3	6.3
<i>Allium</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Astragalus pumilis</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chaenactis douglasii</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.3
<i>Cordylanthus ramosus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cryptantha</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Erigeron pumilis</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriogonum microthecium</i>	Forb	N	0.3	0.0	0.0	0.0	0.0	0.0
<i>Lepidium perfoliatum</i>	Forb	I	0.0	0.0	0.0	0.0	0.0	1.0
<i>Linanthus pungens</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	2.0
<i>Lupinus lepidus</i> var. <i>cusickii</i>	Forb	N	0.1	0.1	0.1	0.4	0.3	0.4
<i>Lupinus</i> sp. (not LUCU)	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mimulus nanus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Machraeranthera canescens</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Silene</i> sp.	Forb	?	0.0	0.0	2.2	0.0	0.0	0.0
<i>Tragopogon</i> sp.	Forb	I	0.0	0.0	0.0	0.0	0.0	0.0

Plant community data for *L. lepidus* var. *cusickii* permanent monitoring transects at Denny Flat West and Amphitheater in 2015.

Site			DFW	DFW	DFW	AMP	AMP	AMP
Transect			1	2	3	1	2	3
Species/Ground Cover	Growth Form	Origin						
moss/lichen			0.0	0.0	0.0	0.0	0.0	0.0
bareground			8.0	26.7	80.7	91.7	54.0	94.7
litter			7.0	5.0	13.0	0.0	0.1	0.0
rock			85.0	68.3	6.3	8.0	46.0	5.3
<i>Artemesia tridentata</i> ssp. <i>wyomingensis</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chrysothamnus viscidiflorus</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ericameria nauseosa</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriogonum sphaerocephalum</i>	Shrub	N	0.2	0.2	0.0	0.0	2.0	0.0
<i>Grayia spinosa</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Achnatherum hymenoides</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Agropyron cristatum</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus tectorum</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus</i> sp.	Gram	I?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Elymus elymoides</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Festuca idahoensis</i>	Gram	N	0.1	2.0	0.0	0.0	0.0	0.0
<i>Hesperostipa comata</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Phleum pratense</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Poa secunda</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pseudoregnaria spicata</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Achillea millefolium</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Allium</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Astragalus pumilis</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Chaenactis douglasii</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cordylanthus ramosus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cryptantha</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Erigeron pumilis</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriogonum microthecium</i>	Forb	N	0.0	0.3	0.2	0.0	0.0	1.0
<i>Lepidium perfoliatum</i>	Forb	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Linanthus pungens</i>	Forb	N	0.0	0.0	0.0	0.0	0.2	0.0
<i>Lupinus lepidus</i> var. <i>cusickii</i>	Forb	N	0.8	2.3	1.0	0.7	0.1	0.4
<i>Lupinus</i> sp. (not LUCU)	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mimulus nanus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Machraeranthera canescens</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Silene</i> sp.	Forb	?	0.0	0.0	0.0	0.0	0.0	0.3
<i>Tragopogon</i> sp.	Forb	I	0.0	0.0	0.0	0.0	0.0	0.0

Plant community data for *L. lepidus* var. *cusickii* permanent monitoring transects at Elms Reservoir 1 & 2 in 2015.

Site			ER 1	ER 1	ER 1	ER 2	ER 2	ER 2
Transect			1	2	3	1	2	3
Species/Ground Cover	Growth Form	Origin						
moss/lichen			0.0	0.7	2.0	0.0	0.0	0.0
bareground			96.7	89.3	85.7	91.7	98.0	95.3
litter			2.0	5.3	8.3	3.0	1.3	4.0
rock			1.3	0.1	0.0	5.3	0.7	0.7
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	Shrub	N	0.0	2.3	8.2	0.0	0.0	8.3
<i>Chrysothamnus viscidiflorus</i>	Shrub	N	0.7	1.4	3.0	1.7	2.0	4.3
<i>Ericameria nauseosa</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	1.7
<i>Eriogonum sphaerocephalum</i>	Shrub	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Grayia spinosa</i>	Shrub	N	0.0	2.0	0.0	0.7	0.0	5.3
<i>Achnatherum hymenoides</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Agropyron cristatum</i>	Gram	I	0.0	0.0	0.0	0.0	2.3	1.8
<i>Bromus tectorum</i>	Gram	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bromus</i> sp.	Gram	I?	0.0	0.2	0.0	0.0	0.0	0.0
<i>Elymus elymoides</i>	Gram	N	1.5	1.0	0.7	3.7	1.0	0.0
<i>Festuca idahoensis</i>	Gram	N	3.0	1.3	6.3	0.3	0.0	0.2
<i>Hesperostipa comata</i>	Gram	N	2.8	0.3	0.0	11.0	8.3	4.0
<i>Phleum pratense</i>	Gram	I	0.0	0.0	0.2	0.0	0.0	0.0
<i>Poa secunda</i>	Gram	N	0.0	1.0	2.7	0.0	0.0	0.0
<i>Pseudoregnaria spicata</i>	Gram	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Achillea millefolium</i>	Forb	N	1.2	0.5	1.5	0.0	0.0	0.0
<i>Allium</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.0	0.0
<i>Astragalus pumilis</i>	Forb	N	0.0	0.3	0.0	0.0	0.0	0.0
<i>Chaenactis douglasii</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.2
<i>Cordylanthus ramosus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cryptantha</i> sp.	Forb	N?	0.0	0.0	0.0	0.0	0.2	0.0
<i>Erigeron pumilis</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Eriogonum microthecium</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lepidium perfoliatum</i>	Forb	I	0.0	0.0	0.0	0.0	0.0	0.0
<i>Linanthus pungens</i>	Forb	N	0.0	4.0	9.3	0.0	0.0	4.3
<i>Lupinus lepidus</i> var. <i>cusickii</i>	Forb	N	0.4	1.4	5.3	0.7	0.2	0.1
<i>Lupinus</i> sp. (not LUCU)	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mimulus nanus</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Machraeranthera canescens</i>	Forb	N	0.0	0.0	0.0	0.0	0.0	0.0
<i>Silene</i> sp.	Forb	?	0.3	0.0	0.7	0.2	0.7	0.0
<i>Tragopogon</i> sp.	Forb	I	0.0	0.0	0.0	0.2	0.0	0.0