Serpentine Endemic Occupancy Project – 2019 Field Season Report

Rachel Kesel

David Greenberger

Andrea Williams

Michael Sturtevant

Elizabeth Neill

Introduction

Serpentine barrens are found throughout much of the One Tam area of focus. These rocky balds are the harshest of all serpentine communities. They range in size and are characterized by their island-like nature: sparse vegetation, and large amount of exposed serpentinite rock. California has the richest concentration of serpentine flora in the temperate zone and many of these species are endemic to the San Francisco Bay Area. High concentrations of rare and endemic plant species make these habitats important targets for monitoring. Population dynamics of the rare annual plants in these habitats are poorly understood.

One Tam has over 39,000 acres of protected open space, with serpentine barrens occurring on Marin Municipal Water District (MMWD), Marin County Parks (MCP) and Mount Tamalpais State Park (State Parks) lands. Vegetation mapping efforts indicate that, in aggregate, there may be over 30 acres of serpentine barren habitat across more than 85 discreet patches. Serpentine barrens have also been found in areas which were mapped to non-serpentine plant communities, indicating that vegetation maps available as of 2019 have not identified all barren habitats.

In 2016, One Tam launched a pilot project aimed at developing a monitoring design that allows staff to take a feasible sample of the barren patches each year to assess the overall health of rare plants on those habitats. The pilot began with the survey of 14 serpentine barrens in the Carson Ridge region of Mount Tamalpais on land owned by MMWD. Carson Ridge hosts abundant serpentine habitat, and proved an excellent launching point for the protocol.

Following a successful pilot season, One Tam expanded the project to remaining partner lands. In 2017, a small crew conducted 27 surveys over nine days. The next year, 28 surveys were completed over nine days. In 2019, the team conducted 27 surveys over 10 days.

Investigative Purpose

The purpose of protocol is to establish a realistic and replicable scheme for monitoring populations of serpentine endemic species found on barrens within the One Tam area of focus. The goals of the monitoring program are as follows:

1. Identify long-term trends and variability in the spatial and temporal distribution of serpentine endemic rare plant species.
2. Determine whether annual plant populations are stable despite the large fluctuation in patch abundance year to year.
3. Identify threats to serpentine endemic rare plant communities.
4. Survey all barrens within the area of focus in the first five years of this protocol.
5. Identify up to 10 “reference barrens” for annual surveys to represent the larger pool of barrens following initial surveys.

Species of Interest

Serpentine barrens provide a useful monitoring proxy inasmuch as they frequently support rare annual plant species of interest. In addition to annual plants, several rare perennial species are commonly found on or around serpentine barrens.

Scientific Name	Common Name	Life Cycle	CNPS Rank
Arctostaphylos montana ssp. *montana*	Mt. Tamalpais Manzanita	Perennial	1B.3
Calamagrostis ophitidis	Serpentine Reedgrass	Perennial	4.3
Calochortus umbellatus	Oakland Star-tulip	Perennial	4.2
Eriogonum luteolum var. *caninum*	Tiburon Buckwheat	Annual	1B.2
Leptosiphon acicularis	Bristly Leptosiphon	Annual	4.2
Lessingia micradenia ssp. *micradenia*	Tamalpais Lessingia	Annual	1B.2
Navarretia rosulata	Marin County Navarretia	Annual	1B.2
Streptanthus batrachopus	Tamalpais Jewelflower	Annual	1B.3
Streptanthus glandulosus ssp. *pulchellus*	Mt. Tamalpais Bristly Jewelflower	Annual	1B.2
Toxicoscordion fontanum	Marsh Zigadenus	Perennial	4.2

Table 1. Ten rare plant species targeted in this monitoring protocol.

Methods

Serpentine barrens are identified using GIS software in conjunction with field observations. Existing vegetation maps (MMWD and MCP), the USGS soils map, Marin geology maps, and satellite imagery are used to identify barrens, which are delineated in GIS. These polygons are taken into the field where their extents are confirmed or updated by in-situ observations.

After identifying barrens in GIS, the team visits between 20 and 30 sites each year on lands of the Marin Municipal Water District, Mount Tamalpais State Park, and Marin County Parks. No barrens are known on National Park Service lands within the One Tam area of focus. At each site, a survey is conducted to determine population characteristics including the presence or absence of the target rare species, the number of individuals present, and the presence or absence of three invasive species.

Assessment data on the rare plant species loosely follows the methods of the California Natural Diversity Database (CNDDB). GIS and tabular data from this protocol will be sent to the CNDDB for inclusion in that database every three years at minimum. These data are also entered into the Calflora Database (Calflora) for ease of sharing with One Tam partner staff.

2019 Results

In 2019, the survey team completed 27 barren surveys (Figure 1). The team was often joined by staff from One Tam, MMWD, and the Parks Conservancy. Surveys took place across 10 days spanning late May to early July. The team visited barrens ranging from Old Stage Rd. in the south to Gary Giacomini Open Space in the north – nearly 7 miles apart – with the bulk of the work centered on San Geronimo Ridge.

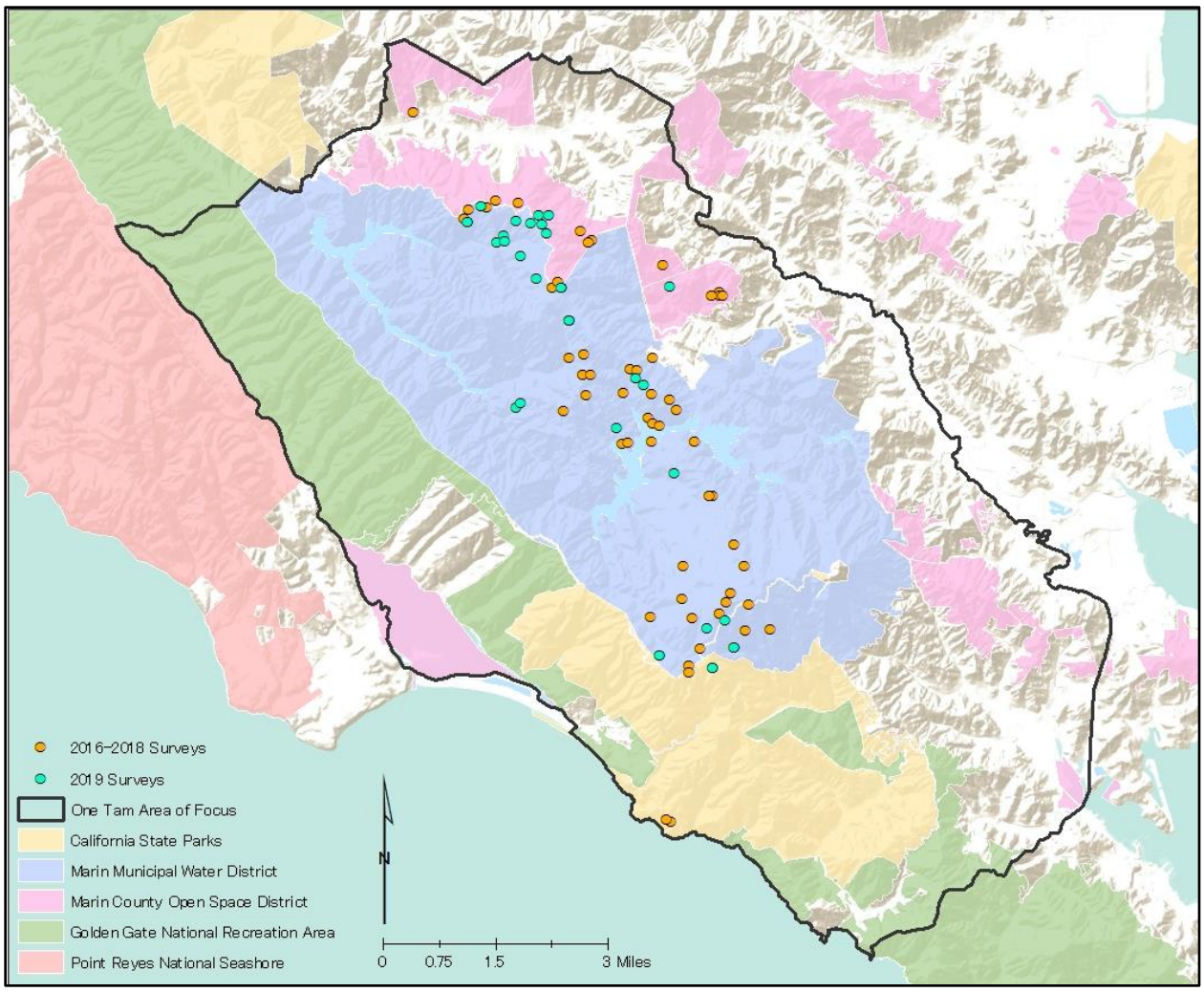
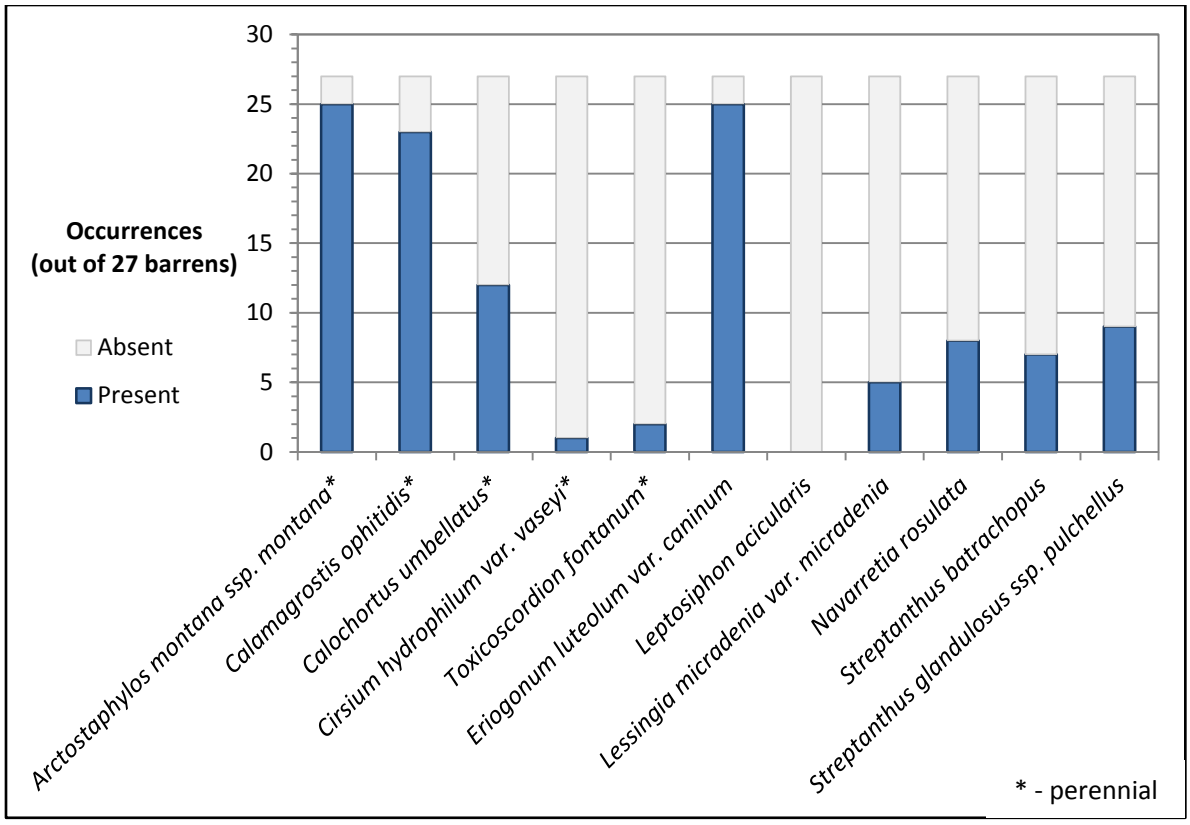


Figure 1. Project survey geography through 2019.

Occurrence Frequency

Serpentine barrens proved a good proxy for endemic rare species in 2019. Every barren hosted at least two plants from the target list. Nine of 10 target species were observed during the season (Figure 2). Absent from all barrens was Bristly Leptosiphon (*Leptosiphon acicularis*), which has not been recorded in any year of this project. It flowers earlier in the season than the other target species and has low fidelity to serpentine soil. One Tam staff censused two known patches of Bristly Leptosiphon in early May as a complement to this project.

Tiburon buckwheat *(Eriogonum luteolum* var*. caninum)* was seen most frequently, appearing in 25 of 27 barrens. On the lower end, Tamalpais lessingia (*Lessingia micradenia* var. *micradenia*) was observed five times. Among perennials, Mt. Tamalpais manzanita (*Arctostaphylos montana* ssp. *montana*) was seen 25 times and serpentine reedgrass (*Calamagrostis ophitidis*) 23 times. Marsh zigadenus (*Toxicoscordion fontanum*) was observed only once. The distribution of this plant is limited to wetlands and does not occur on barrens proper, so it is recorded as present when observed immediately adjacent to barrens in such as a seep or wet meadow. The rare Mt. Tamalpais thistle (*Cirsium hydrophilum* var*. vaseyi*) shares this ecology, and while it is not a target species, the team collected data upon its lone adjacent occurrence.



Barren Size

Serpentine barren size in 2019 ranged from 155 square meters to 10,149 square meters. When area was compared to number of rare species, a positive correlation was found (P = .01). The overall four-year dataset also shows a statistically significant positive correlation between barren area and number of rare species (P = .01).

Weeds

In addition to looking at rare species, invasive species known to impact harsh serpentine barren environments are monitored. The protocol identifies three invasive annual grasses to target for data collection:

Scientific Name	Common Name	Cal-IPC Invasiveness Rating
Aegilops triuncialis	Barbed goatgrass	High
Brachypodium distachyon	Purple false brome	Moderate
Bromus tectorum	Cheatgrass	High

Table 2. Three invasive grass species targeted in this monitoring protocol.

Each of these three weeds was spotted at some point during 2019's surveys. *Bromus tectorum* was found in one barren and *Aegilops triuncialis* was observed in two. *Brachypodium distachyon*, by far the most widespread of the three across all years, was observed in 10 out of 28 barrens in 2019.

Overview

Barren-by-barren rare species diversity, rare species abundance, area, and weed presence is shown in Figure 4.

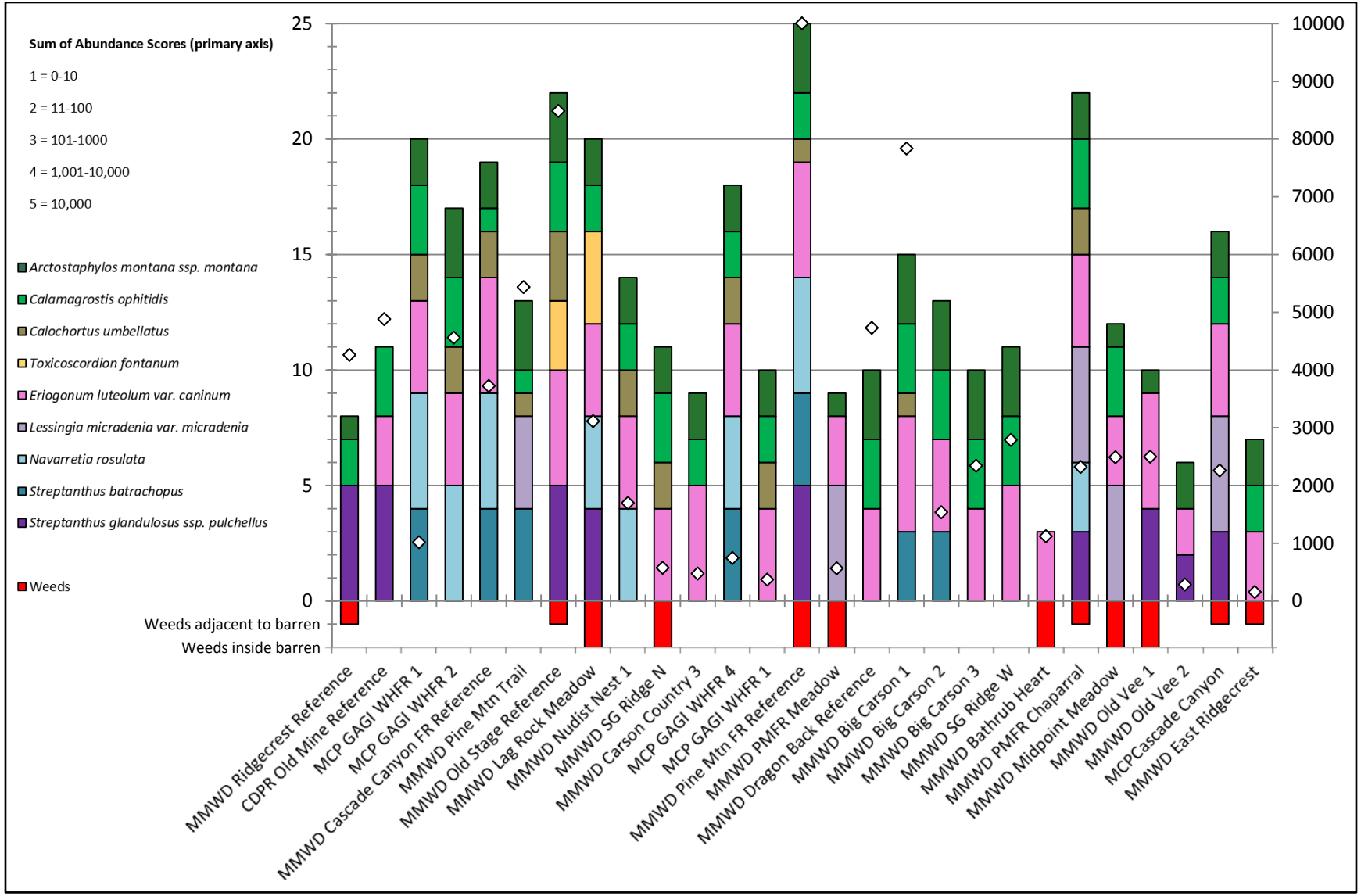


Figure 4. 2019 survey data in aggregate.

Time

In addition to documenting rare plant species abundance, the protocol aims to identify a model which will support analysis of the health of rare annual species over time. One element of that model is feasibility. In 2019, the One Tam staff and volunteers combined spent 143 hours surveying serpentine barrens. The travel time and data management added another approximately 90 hours. Data analysis and reporting, including preparing materials for meetings and presentations, required an additional 45 hours. Meetings, protocol revision, and preparing data for long term storage required approximately five hours in 2019. In total, approximately 280 One Tam hours were dedicated to this project.

Discussion

The protocol in place provides a framework for efficiently surveying approximately 25 - 30 barrens in a season. A long-term dataset may support such population health analysis. Repeat surveys of the reference barrens may begin to show trends within a shorter timeframe. Additionally, when all barrens within the area of focus are surveyed, trends in species distribution may be decipherable.

At present, the broad conclusions of the project include the following:

- Target invasive weeds are in or adjacent to serpentine barrens across the known distribution of serpentine barrens.
- *Brachypodium distachyon* is widespread across the serpentine barren landscape and has shown an ability to invade the interior of these endemic rare plant habitats.
- Approximately 250 hours are required per year to survey and report for this project.

2019 Tabular Dataset

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
70W Ridgecrest Reference	*Arctostaphylos montana ssp. montana*	Y	100	0	0	1-10
70W Ridgecrest Reference	*Calamagrostis ophitidis*	Y	100	0	0	11-100
70W Ridgecrest Reference	*Calochortus umbellatus*	N				
70W Ridgecrest Reference	*Toxicoscordion fontanum*	N				
70W Ridgecrest Reference	*Eriogonum luteolum var. caninum*	N				
70W Ridgecrest Reference	*Leptosiphon acicularis*	N				
70W Ridgecrest Reference	*Lessingia micradenia var. micradenia*	N				
70W Ridgecrest Reference	*Navarretia rosulata*	N				
70W Ridgecrest Reference	*Streptanthus batrachopus*	N				
70W Ridgecrest Reference	*Streptanthus glandulosus ssp. pulchellus*	Y	94	6	0	10000+
70W Ridgecrest Reference	*Aegilops triuncialis*	N				
70W Ridgecrest Reference	*Brachypodium distachyon*	ADJ				
70W Ridgecrest Reference	*Bromus tectorum*	N				
71C Old Mine Reference	*Arctostaphylos montana ssp. montana*	N				
71C Old Mine Reference	*Calamagrostis ophitidis*	Y	50	50	0	101-1000
71C Old Mine Reference	*Calochortus umbellatus*	N				
71C Old Mine Reference	*Toxicoscordion fontanum*	N				
71C Old Mine Reference	*Eriogonum luteolum var. caninum*	Y	100	0	0	101-1000
71C Old Mine Reference	*Leptosiphon acicularis*	N				
71C Old Mine Reference	*Lessingia micradenia var. micradenia*	N				
71C Old Mine Reference	*Navarretia rosulata*	N				
71C Old Mine Reference	*Streptanthus batrachopus*	N				
71C Old Mine Reference	*Streptanthus glandulosus ssp. pulchellus*	Y	30	40	30	10000+
71C Old Mine Reference	*Aegilops triuncialis*	N				
71C Old Mine Reference	*Brachypodium distachyon*	N				
71C Old Mine Reference	*Bromus tectorum*	N				
72M GAGI WHFR 1	*Arctostaphylos montana ssp. montana*	Y	95	0	5	11-100
72M GAGI WHFR 1	*Calamagrostis ophitidis*	Y	50	50	0	101-1000
72M GAGI WHFR 1	*Calochortus umbellatus*	Y	10	40	50	11-100
72M GAGI WHFR 1	*Toxicoscordion fontanum*	N				
72M GAGI WHFR 1	*Eriogonum luteolum var. caninum*	Y	45	55	0	1001-10000
72M GAGI WHFR 1	*Leptosiphon acicularis*	N				
72M GAGI WHFR 1	*Lessingia micradenia var. micradenia*	N				
72M GAGI WHFR 1	*Navarretia rosulata*	Y	70	30	0	10000+
72M GAGI WHFR 1	*Streptanthus batrachopus*	Y	10	30	60	1001-10000
72M GAGI WHFR 1	*Streptanthus glandulosus ssp. pulchellus*	N				
72M GAGI WHFR 1	*Aegilops triuncialis*	N				
72M GAGI WHFR 1	*Brachypodium distachyon*	N				
72M GAGI WHFR 1	*Bromus tectorum*	N				
73M GAGI WHFR 2	*Arctostaphylos montana ssp. montana*	Y	95	0	5	101-1000
73M GAGI WHFR 2	*Calamagrostis ophitidis*	Y	50	50	0	101-1000
73M GAGI WHFR 2	*Calochortus umbellatus*	Y	5	5	90	11-100
73M GAGI WHFR 2	*Toxicoscordion fontanum*	N				
73M GAGI WHFR 2	*Eriogonum luteolum var. caninum*	Y	60	40	0	1001-10000
73M GAGI WHFR 2	*Leptosiphon acicularis*	N				
73M GAGI WHFR 2	*Lessingia micradenia var. micradenia*	N				
73M GAGI WHFR 2	*Navarretia rosulata*	Y	70	30	0	10000+
73M GAGI WHFR 2	*Streptanthus batrachopus*	N				
73M GAGI WHFR 2	*Streptanthus glandulosus ssp. pulchellus*	N				
73M GAGI WHFR 2	*Aegilops triuncialis*	N				
73M GAGI WHFR 2	*Brachypodium distachyon*	N				
73M GAGI WHFR 2	*Bromus tectorum*	N				

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
74W Cascade Cyn FR Reference	*Arctostaphylos montana ssp. montana*	Y	40	0	60	11-100
74W Cascade Cyn FR Reference	*Calamagrostis ophitidis*	Y	80	20	0	1-10
74W Cascade Cyn FR Reference	*Calochortus umbellatus*	Y				
74W Cascade Cyn FR Reference	*Toxicoscordion fontanum*	N				
74W Cascade Cyn FR Reference	*Eriogonum luteolum var. caninum*	Y	0	65	35	10000+
74W Cascade Cyn FR Reference	*Leptosiphon acicularis*	N				
74W Cascade Cyn FR Reference	*Lessingia micradenia var. micradenia*	N				
74W Cascade Cyn FR Reference	*Navarretia rosulata*	Y	30	70	0	10000+
74W Cascade Cyn FR Reference	*Streptanthus batrachopus*	Y	0	65	35	1001-10000
74W Cascade Cyn FR Reference	*Streptanthus glandulosus ssp. pulchellus*	N				
74W Cascade Cyn FR Reference	*Aegilops triuncialis*	N				
74W Cascade Cyn FR Reference	*Brachypodium distachyon*	N				
74W Cascade Cyn FR Reference	*Bromus tectorum*	N				
75W Pine Mtn Trail	*Arctostaphylos montana ssp. montana*	Y	90	0	10	101-1000
75W Pine Mtn Trail	*Calamagrostis ophitidis*	Y	0	100	0	1-10
75W Pine Mtn Trail	*Calochortus umbellatus*	Y	0	100	0	1-10
75W Pine Mtn Trail	*Toxicoscordion fontanum*	N				
75W Pine Mtn Trail	*Eriogonum luteolum var. caninum*	N				
75W Pine Mtn Trail	*Leptosiphon acicularis*	N	0	0	0	
75W Pine Mtn Trail	*Lessingia micradenia var. micradenia*	Y	15	84	1	1001-10000
75W Pine Mtn Trail	*Navarretia rosulata*	N				
75W Pine Mtn Trail	*Streptanthus batrachopus*	Y	0	90	10	1001-10000
75W Pine Mtn Trail	*Streptanthus glandulosus ssp. pulchellus*	N				
75W Pine Mtn Trail	*Aegilops triuncialis*	N				
75W Pine Mtn Trail	*Brachypodium distachyon*	N				
75W Pine Mtn Trail	*Bromus tectorum*	N				
76W Old Stage Reference	*Arctostaphylos montana ssp. montana*	Y	20	0	80	101-1000
76W Old Stage Reference	*Calamagrostis ophitidis*	Y	50	50	0	101-1000
76W Old Stage Reference	*Calochortus umbellatus*	Y	0	25	75	101-1000
76W Old Stage Reference	*Toxicoscordion fontanum*	Y	90	10	0	101-1000
76W Old Stage Reference	*Eriogonum luteolum var. caninum*	IN/ADJ	30	70	0	10000+
76W Old Stage Reference	*Leptosiphon acicularis*	N				
76W Old Stage Reference	*Lessingia micradenia var. micradenia*	N				
76W Old Stage Reference	*Navarretia rosulata*	N				
76W Old Stage Reference	*Streptanthus batrachopus*	N				
76W Old Stage Reference	*Streptanthus glandulosus ssp. pulchellus*	IN/ADJ	10	50	40	10000+
76W Old Stage Reference	*Aegilops triuncialis*	N				
76W Old Stage Reference	*Brachypodium distachyon*	ADJ				
76W Old Stage Reference	*Bromus tectorum*	N				
77W Lag Rock Meadow	*Arctostaphylos montana ssp. montana*	Y	10	0	90	11-100
77W Lag Rock Meadow	*Calamagrostis ophitidis*	Y	50	50	0	11-100
77W Lag Rock Meadow	*Calochortus umbellatus*	N				
77W Lag Rock Meadow	*Toxicoscordion fontanum*	Y	50	50	0	1001-10000
77W Lag Rock Meadow	*Eriogonum luteolum var. caninum*	IN/ADJ	90	10	0	1001-10000
77W Lag Rock Meadow	*Leptosiphon acicularis*	N				
77W Lag Rock Meadow	*Lessingia micradenia var. micradenia*	N				
77W Lag Rock Meadow	*Navarretia rosulata*	IN/ADJ	50	50	0	1001-10000
77W Lag Rock Meadow	*Streptanthus batrachopus*	N				
77W Lag Rock Meadow	*Streptanthus glandulosus ssp. pulchellus*	IN/ADJ	5	10	85	1001-10000
77W Lag Rock Meadow	*Aegilops triuncialis*	N				
77W Lag Rock Meadow	*Brachypodium distachyon*	IN/ADJ				
77W Lag Rock Meadow	*Bromus tectorum*	N				

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
78W Nudist Nest 1	*Arctostaphylos montana ssp. montana*	Y	10	0	90	11-100
78W Nudist Nest 1	*Calamagrostis ophitidis*	Y	40	60	0	11-100
78W Nudist Nest 1	*Calochortus umbellatus*	Y	0	0	100	11-100
78W Nudist Nest 1	*Toxicoscordion fontanum*	N				
78W Nudist Nest 1	*Eriogonum luteolum var. caninum*	IN/ADJ	20	80	0	1001-10000
78W Nudist Nest 1	*Leptosiphon acicularis*	N				
78W Nudist Nest 1	*Lessingia micradenia var. micradenia*	N				
78W Nudist Nest 1	*Navarretia rosulata*	IN/ADJ	50	50	0	1001-10000
78W Nudist Nest 1	*Streptanthus batrachopus*	N				
78W Nudist Nest 1	*Streptanthus glandulosus ssp. pulchellus*	N				
78W Nudist Nest 1	*Aegilops triuncialis*	N				
78W Nudist Nest 1	*Brachypodium distachyon*	N				
78W Nudist Nest 1	*Bromus tectorum*	N				
79W SG Ridge N	*Arctostaphylos montana ssp. montana*	Y	99	0	1	11-100
79W SG Ridge N	*Calamagrostis ophitidis*	Y	50	50	0	101-1000
79W SG Ridge N	*Calochortus umbellatus*	Y	0	2	98	11-100
79W SG Ridge N	*Toxicoscordion fontanum*	N				
79W SG Ridge N	*Eriogonum luteolum var. caninum*	IN/ADJ	1	98	0	1001-10000
79W SG Ridge N	*Leptosiphon acicularis*	N				
79W SG Ridge N	*Lessingia micradenia var. micradenia*	N				
79W SG Ridge N	*Navarretia rosulata*	N				
79W SG Ridge N	*Streptanthus batrachopus*	N				
79W SG Ridge N	*Streptanthus glandulosus ssp. pulchellus*	N				
79W SG Ridge N	*Aegilops triuncialis*	N				
79W SG Ridge N	*Brachypodium distachyon*	Y				
79W SG Ridge N	*Bromus tectorum*	N				
80W Carson Country 3	*Arctostaphylos montana ssp. montana*	Y	0	95	5	11-100
80W Carson Country 3	*Calamagrostis ophitidis*	Y	33	34	33	11-100
80W Carson Country 3	*Calochortus umbellatus*	N				
80W Carson Country 3	*Toxicoscordion fontanum*	N				
80W Carson Country 3	*Eriogonum luteolum var. caninum*	Y	15	85	0	10000+
80W Carson Country 3	*Leptosiphon acicularis*	N				
80W Carson Country 3	*Lessingia micradenia var. micradenia*	N				
80W Carson Country 3	*Navarretia rosulata*	N				
80W Carson Country 3	*Streptanthus batrachopus*	N				
80W Carson Country 3	*Streptanthus glandulosus ssp. pulchellus*	N				
80W Carson Country 3	*Aegilops triuncialis*	N				
80W Carson Country 3	*Brachypodium distachyon*	N				
80W Carson Country 3	*Bromus tectorum*	N				
81M GAGI WHFR 4	*Arctostaphylos montana ssp. montana*	Y	80	0	20	11-100
81M GAGI WHFR 4	*Calamagrostis ophitidis*	Y	25	50	25	11-100
81M GAGI WHFR 4	*Calochortus umbellatus*	Y	0	5	95	11-100
81M GAGI WHFR 4	*Toxicoscordion fontanum*	N				
81M GAGI WHFR 4	*Eriogonum luteolum var. caninum*	Y	1	99	0	1001-10000
81M GAGI WHFR 4	*Leptosiphon acicularis*	N				
81M GAGI WHFR 4	*Lessingia micradenia var. micradenia*	N				
81M GAGI WHFR 4	*Navarretia rosulata*	Y	5	95	0	1001-10000
81M GAGI WHFR 4	*Streptanthus batrachopus*	Y	0	10	90	1001-10000
81M GAGI WHFR 4	*Streptanthus glandulosus ssp. pulchellus*	N				
81M GAGI WHFR 4	*Aegilops triuncialis*	N				
81M GAGI WHFR 4	*Brachypodium distachyon*	N				
81M GAGI WHFR 4	*Bromus tectorum*	N				

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
82M GAGI WHFR 1	*Arctostaphylos montana ssp. montana*	Y	100	0	0	11-100
82M GAGI WHFR 1	*Calamagrostis ophitidis*	Y	50	50	0	11-100
82M GAGI WHFR 1	*Calochortus umbellatus*	Y	0	0	100	11-100
82M GAGI WHFR 1	*Toxicoscordion fontanum*	N				
82M GAGI WHFR 1	*Eriogonum luteolum var. caninum*	Y	2	98	0	1001-10000
82M GAGI WHFR 1	*Leptosiphon acicularis*	N				
82M GAGI WHFR 1	*Lessingia micradenia var. micradenia*	N				
82M GAGI WHFR 1	*Navarretia rosulata*	N				
82M GAGI WHFR 1	*Streptanthus batrachopus*	N				
82M GAGI WHFR 1	*Streptanthus glandulosus ssp. pulchellus*	N				
82M GAGI WHFR 1	*Aegilops triuncialis*	N				
82M GAGI WHFR 1	*Brachypodium distachyon*	N				
82M GAGI WHFR 1	*Bromus tectorum*	N				
83W Pine Mtn FR Reference	*Arctostaphylos montana ssp. montana*	Y	85	0	15	101-1000
83W Pine Mtn FR Reference	*Calamagrostis ophitidis*	Y	0	2	98	11-100
83W Pine Mtn FR Reference	*Calochortus umbellatus*	Y	0	2	98	11-100
83W Pine Mtn FR Reference	*Toxicoscordion fontanum*	N				
83W Pine Mtn FR Reference	*Eriogonum luteolum var. caninum*	IN/ADJ	0	99	1	10000+
83W Pine Mtn FR Reference	*Leptosiphon acicularis*	N				
83W Pine Mtn FR Reference	*Lessingia micradenia var. micradenia*	N				
83W Pine Mtn FR Reference	*Navarretia rosulata*	Y	5	90	5	10000+
83W Pine Mtn FR Reference	*Streptanthus batrachopus*	Y	0	25	75	1001-10000
83W Pine Mtn FR Reference	*Streptanthus glandulosus ssp. pulchellus*	Y	0	5	95	10000+
83W Pine Mtn FR Reference	*Aegilops triuncialis*	N				
83W Pine Mtn FR Reference	*Brachypodium distachyon*	Y				
83W Pine Mtn FR Reference	*Bromus tectorum*	N				
84W PMFR Meadow	*Arctostaphylos montana ssp. montana*	Y	100	0	0	1-10
84W PMFR Meadow	*Calamagrostis ophitidis*	N				
84W PMFR Meadow	*Calochortus umbellatus*	N				
84W PMFR Meadow	*Toxicoscordion fontanum*	N				
84W PMFR Meadow	*Eriogonum luteolum var. caninum*	IN/ADJ	0	98	2	101-1000
84W PMFR Meadow	*Leptosiphon acicularis*	N				
84W PMFR Meadow	*Lessingia micradenia var. micradenia*	IN/ADJ	25	75	0	10000+
84W PMFR Meadow	*Navarretia rosulata*	N				
84W PMFR Meadow	*Streptanthus batrachopus*	N				
84W PMFR Meadow	*Streptanthus glandulosus ssp. pulchellus*	N				
84W PMFR Meadow	*Aegilops triuncialis*	IN/ADJ				
84W PMFR Meadow	*Brachypodium distachyon*	IN/ADJ				
84W PMFR Meadow	*Bromus tectorum*	N				
85W Dragon Back Reference	*Arctostaphylos montana ssp. montana*	Y	20	0	80	101-1000
85W Dragon Back Reference	*Calamagrostis ophitidis*	Y	33	67	0	101-1000
85W Dragon Back Reference	*Calochortus umbellatus*	N				
85W Dragon Back Reference	*Toxicoscordion fontanum*	N				
85W Dragon Back Reference	*Eriogonum luteolum var. caninum*	IN/ADJ	0	99	1	1001-10000
85W Dragon Back Reference	*Leptosiphon acicularis*	N				
85W Dragon Back Reference	*Lessingia micradenia var. micradenia*	N				
85W Dragon Back Reference	*Navarretia rosulata*	N				
85W Dragon Back Reference	*Streptanthus batrachopus*	N				
85W Dragon Back Reference	*Streptanthus glandulosus ssp. pulchellus*	N				
85W Dragon Back Reference	*Aegilops triuncialis*	N				
85W Dragon Back Reference	*Brachypodium distachyon*	N				
85W Dragon Back Reference	*Bromus tectorum*	N				

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
86W Big Carson 1	*Arctostaphylos montana ssp. montana*	Y	20	0	80	101-1000
86W Big Carson 1	*Calamagrostis ophitidis*	Y	20	40	40	101-1000
86W Big Carson 1	*Calochortus umbellatus*	Y	0	0	100	1-10
86W Big Carson 1	*Toxicoscordion fontanum*	N				
86W Big Carson 1	*Eriogonum luteolum var. caninum*	IN/ADJ	0	75	25	10000+
86W Big Carson 1	*Leptosiphon acicularis*	N				
86W Big Carson 1	*Lessingia micradenia var. micradenia*	N				
86W Big Carson 1	*Navarretia rosulata*	N				
86W Big Carson 1	*Streptanthus batrachopus*	IN/ADJ	0	20	80	101-1000
86W Big Carson 1	*Streptanthus glandulosus ssp. pulchellus*	N				
86W Big Carson 1	*Aegilops triuncialis*	N				
86W Big Carson 1	*Brachypodium distachyon*	N				
86W Big Carson 1	*Bromus tectorum*	N				
87W Big Carson 2	*Arctostaphylos montana ssp. montana*	Y	20	0	80	101-1000
87W Big Carson 2	*Calamagrostis ophitidis*	Y	20	40	40	101-1000
87W Big Carson 2	*Calochortus umbellatus*	N				
87W Big Carson 2	*Toxicoscordion fontanum*	N				
87W Big Carson 2	*Eriogonum luteolum var. caninum*	IN/ADJ	0	85	15	1001-10000
87W Big Carson 2	*Leptosiphon acicularis*	N				
87W Big Carson 2	*Lessingia micradenia var. micradenia*	N				
87W Big Carson 2	*Navarretia rosulata*	N				
87W Big Carson 2	*Streptanthus batrachopus*	Y	0	80	20	101-1000
87W Big Carson 2	*Streptanthus glandulosus ssp. pulchellus*	N				
87W Big Carson 2	*Aegilops triuncialis*	N				
87W Big Carson 2	*Brachypodium distachyon*	N				
87W Big Carson 2	*Bromus tectorum*	N				
88W Big Carson 3	*Arctostaphylos montana ssp. montana*	Y	0	20	80	101-1000
88W Big Carson 3	*Calamagrostis ophitidis*	Y	45	45	10	101-1000
88W Big Carson 3	*Calochortus umbellatus*	N				
88W Big Carson 3	*Toxicoscordion fontanum*	N				
88W Big Carson 3	*Eriogonum luteolum var. caninum*	IN/ADJ	0	90	10	1001-10000
88W Big Carson 3	*Leptosiphon acicularis*	N				
88W Big Carson 3	*Lessingia micradenia var. micradenia*	N				
88W Big Carson 3	*Navarretia rosulata*	N				
88W Big Carson 3	*Streptanthus batrachopus*	N				
88W Big Carson 3	*Streptanthus glandulosus ssp. pulchellus*	N				
88W Big Carson 3	*Aegilops triuncialis*	N				
88W Big Carson 3	*Brachypodium distachyon*	N				
88W Big Carson 3	*Bromus tectorum*	N				
89W SG Ridge W	*Arctostaphylos montana ssp. montana*	Y	99	0	1	101-1000
89W SG Ridge W	*Calamagrostis ophitidis*	Y	40	60	0	101-1000
89W SG Ridge W	*Calochortus umbellatus*	N				
89W SG Ridge W	*Toxicoscordion fontanum*	N				
89W SG Ridge W	*Eriogonum luteolum var. caninum*	IN/ADJ	0	70	30	10000+
89W SG Ridge W	*Leptosiphon acicularis*	N				
89W SG Ridge W	*Lessingia micradenia var. micradenia*	N				
89W SG Ridge W	*Navarretia rosulata*	N				
89W SG Ridge W	*Streptanthus batrachopus*	N				
89W SG Ridge W	*Streptanthus glandulosus ssp. pulchellus*	N				
89W SG Ridge W	*Aegilops triuncialis*	N				
89W SG Ridge W	*Brachypodium distachyon*	N				
89W SG Ridge W	*Bromus tectorum*	N				

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
90W Bathtub Heart	*Arctostaphylos montana ssp. montana*	N				
90W Bathtub Heart	*Calamagrostis ophitidis*	N				
90W Bathtub Heart	*Calochortus umbellatus*	N				
90W Bathtub Heart	*Toxicoscordion fontanum*	N				
90W Bathtub Heart	*Eriogonum luteolum var. caninum*	IN/ADJ	0	100	0	101-1000
90W Bathtub Heart	*Leptosiphon acicularis*	N				
90W Bathtub Heart	*Lessingia micradenia var. micradenia*	N				
90W Bathtub Heart	*Navarretia rosulata*	N				
90W Bathtub Heart	*Streptanthus batrachopus*	N				
90W Bathtub Heart	*Streptanthus glandulosus ssp. pulchellus*	N				
90W Bathtub Heart	*Aegilops triuncialis*	N				
90W Bathtub Heart	*Brachypodium distachyon*	IN/ADJ				
90W Bathtub Heart	*Bromus tectorum*	N				
91W PMFR Chaparral	*Arctostaphylos montana ssp. montana*	Y	90	0	10	11-100
91W PMFR Chaparral	*Calamagrostis ophitidis*	Y	30	20	50	101-1000
91W PMFR Chaparral	*Calochortus umbellatus*	Y	0	0	100	11-100
91W PMFR Chaparral	*Toxicoscordion fontanum*	N				
91W PMFR Chaparral	*Eriogonum luteolum var. caninum*	IN/ADJ	0	80	20	1001-10000
91W PMFR Chaparral	*Leptosiphon acicularis*	N				
91W PMFR Chaparral	*Lessingia micradenia var. micradenia*	IN/ADJ	35	65	0	10000+
91W PMFR Chaparral	*Navarretia rosulata*	Y	10	80	10	101-1000
91W PMFR Chaparral	*Streptanthus batrachopus*	N				
91W PMFR Chaparral	*Streptanthus glandulosus ssp. pulchellus*	Y	0	10	90	101-1000
91W PMFR Chaparral	*Aegilops triuncialis*	ADJ				
91W PMFR Chaparral	*Brachypodium distachyon*	N				
91W PMFR Chaparral	*Bromus tectorum*	N				
92W Midpoint	*Arctostaphylos montana ssp. montana*	Y	80	0	20	1-10
92W Midpoint	*Calamagrostis ophitidis*	Y	30	20	50	101-1000
92W Midpoint	*Calochortus umbellatus*	N				
92W Midpoint	*Toxicoscordion fontanum*	N				
92W Midpoint	*Eriogonum luteolum var. caninum*	Y	0	99	1	101-1000
92W Midpoint	*Leptosiphon acicularis*	N				
92W Midpoint	*Lessingia micradenia var. micradenia*	IN/ADJ	75	25	0	10000+
92W Midpoint	*Navarretia rosulata*	N				
92W Midpoint	*Streptanthus batrachopus*	N				
92W Midpoint	*Streptanthus glandulosus ssp. pulchellus*	N				
92W Midpoint	*Aegilops triuncialis*	N				
92W Midpoint	*Brachypodium distachyon*	IN/ADJ				
92W Midpoint	*Bromus tectorum*	N				
93W Old Vee 1	*Arctostaphylos montana ssp. montana*	Y	100	0	0	1-10
93W Old Vee 1	*Calamagrostis ophitidis*	N				
93W Old Vee 1	*Calochortus umbellatus*	N				
93W Old Vee 1	*Toxicoscordion fontanum*	N				
93W Old Vee 1	*Eriogonum luteolum var. caninum*	Y	1	98	1	10000+
93W Old Vee 1	*Leptosiphon acicularis*	N				
93W Old Vee 1	*Lessingia micradenia var. micradenia*	N				
93W Old Vee 1	*Navarretia rosulata*	N				
93W Old Vee 1	*Streptanthus batrachopus*	N				
93W Old Vee 1	*Streptanthus glandulosus ssp. pulchellus*	Y	0	1	99	1001-10000
93W Old Vee 1	*Aegilops triuncialis*	N				
93W Old Vee 1	*Brachypodium distachyon*	IN/ADJ				
93W Old Vee 1	*Bromus tectorum*	N				

Plot_ID	Species	Pres?	Pct_Veg	Pct_Fl	Pct_Fr	Count
94W MMWD Old Vee 2	*Arctostaphylos montana ssp. montana*	Y	100	0	0	11-100
94W MMWD Old Vee 2	*Calamagrostis ophitidis*	N				
94W MMWD Old Vee 2	*Calochortus umbellatus*	N				
94W MMWD Old Vee 2	*Toxicoscordion fontanum*	N				
94W MMWD Old Vee 2	*Eriogonum luteolum var. caninum*	Y	0	98	2	11-100
94W MMWD Old Vee 2	*Leptosiphon acicularis*	N				
94W MMWD Old Vee 2	*Lessingia micradenia var. micradenia*	N				
94W MMWD Old Vee 2	*Navarretia rosulata*	N				
94W MMWD Old Vee 2	*Streptanthus batrachopus*	N				
94W MMWD Old Vee 2	*Streptanthus glandulosus ssp. pulchellus*	Y	0	20	80	11-100
94W MMWD Old Vee 2	*Aegilops triuncialis*	N				
94W MMWD Old Vee 2	*Brachypodium distachyon*	N				
94W MMWD Old Vee 2	*Bromus tectorum*	N				
95M Cascade Canyon	*Arctostaphylos montana ssp. montana*	Y	0	0	100	11-100
95M Cascade Canyon	*Calamagrostis ophitidis*	Y	40	10	50	11-100
95M Cascade Canyon	*Calochortus umbellatus*	N				
95M Cascade Canyon	*Toxicoscordion fontanum*	N				
95M Cascade Canyon	*Eriogonum luteolum var. caninum*	IN/ADJ	0	90	10	1001-10000
95M Cascade Canyon	*Leptosiphon acicularis*	N				
95M Cascade Canyon	*Lessingia micradenia var. micradenia*	IN/ADJ	85	15	0	10000+
95M Cascade Canyon	*Navarretia rosulata*	N				
95M Cascade Canyon	*Streptanthus batrachopus*	N				
95M Cascade Canyon	*Streptanthus glandulosus ssp. pulchellus*	Y	0	1	99	101-1000
95M Cascade Canyon	*Aegilops triuncialis*	N				
95M Cascade Canyon	*Brachypodium distachyon*	ADJ				
95M Cascade Canyon	*Bromus tectorum*	N				
96W East Ridgecrest	*Arctostaphylos montana ssp. montana*	Y	20	0	80	11-100
96W East Ridgecrest	*Calamagrostis ophitidis*	Y	10	70	20	11-100
96W East Ridgecrest	*Calochortus umbellatus*	N				
96W East Ridgecrest	*Toxicoscordion fontanum*	N				
96W East Ridgecrest	*Eriogonum luteolum var. caninum*	Y	0	25	75	101-1000
96W East Ridgecrest	*Leptosiphon acicularis*	N				
96W East Ridgecrest	*Lessingia micradenia var. micradenia*	N				
96W East Ridgecrest	*Navarretia rosulata*	N				
96W East Ridgecrest	*Streptanthus batrachopus*	N				
96W East Ridgecrest	*Streptanthus glandulosus ssp. pulchellus*	N				
96W East Ridgecrest	*Aegilops triuncialis*	N				
96W East Ridgecrest	*Brachypodium distachyon*	N				
96W East Ridgecrest	*Bromus tectorum*	ADJ				