

Vegetation Survey at West Avon Preserve in 2025



**WARNER COLLEGE OF
NATURAL RESOURCES**
COLORADO STATE UNIVERSITY

Vegetation Survey at West Avon Preserve in 2025

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Locations of rare plants have been redacted from this document

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Cover photo:
Harrington's beardtongue (*Penstemon harringtonii*) being visited by a metallic
wood-boring beetle (Buprestidae) at the West Avon Preserve - Photo by Robert
Monahan June 2025.

Abstract

The Colorado Natural Heritage Program (CNHP) in conjunction with Eagle Valley Land Trust has set out to better understand the vegetation present and assess the Harrington's beardtongue (*Penstemon harringtonii*) population at the West Avon Preserve. In June of 2025 CNHP botanists established four 50-meter-long vegetation monitoring transects within four study areas at the West Avon Preserve. Two transects two were established within a planned treatment area, one was established in a non-treatment (control) area, and one was established in an area that may or may not receive future treatment. Additionally, Harrington's beardtongue was surveyed for within the treatment and control areas. Thirty-eight vascular plant species and one moss were found along the transects. Thirty-six of which were native plants species and two are introduced species. The mean conservation value (C-value) of the of the plants species found was 5.25, and the Floristic Quality Index (FQI) across all the transects is 31.5. Harrington's beardtongue was found at 19 new points and a total of 40 individuals were found.

Follow-up monitoring of the transects post-treatment are required to understand the effects of treatments on the vegetation.

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Background and objectives

The West Avon Preserve lies on the north side of the I-70 corridor in the Eagle River valley. The 467-acre property is governed by the *Management Plan for West Avon Preserve* and is owned by the Town of Avon and is subject to a conservation easement which was granted to the Eagle Valley Land Trust (EVLTL) (Management Plan for West Avon Preserve, 2025). The area where the property lies is in the Southern Rockies Level III Ecoregion and Foothill Shrubland Level IV Ecoregion (Environmental Protection Agency, 2016). The property is characterized by its Intermountain Montane Sagebrush Steppe ecosystem (*Artemisia tridentata* ssp. *vaseyana* Montane Steppe Group) (NatureServe, 2025). The Preserve is underlain by the Eagle Valley geologic formation which is composed of sedimentary siltstone, sandstone, and shale, which is characterized by evaporates, namely gypsum and salt (Baca, 2000; Mallory, 1971).

This survey was undertaken to assist managers of the West Avon Preserve by providing relevant and up-to-date data the vegetation within treatment and control areas prior to woody mastication treatment (Figure 1). The survey first looked to determine the extent of Harrington's beardtongue (*Penstemon harringtonii*) within the designated areas as well as the size of the populations. Harrington's beardtongue is a globally vulnerable and state vulnerable (G3/S3) species which is endemic to central Colorado (NatureServe, 2025). Previous surveys for Harrington's Beardtongue have found the species on the preserve but due to the difficulty of differentiating Harrington's beardtongue from related species such as Osterhout's beardtongue (*Penstemon osterhoutii*), the extent of Harrington's beardtongue was unknown (Colorado Natural Heritage Program, 2025; Western Biology, 2020). Second, in the course of this survey pre-treatment vegetation data including a species list, canopy cover, and woody structure. Additionally, litter depth data was collected to understand the relative biomass of litter present at the site before and after treatments.

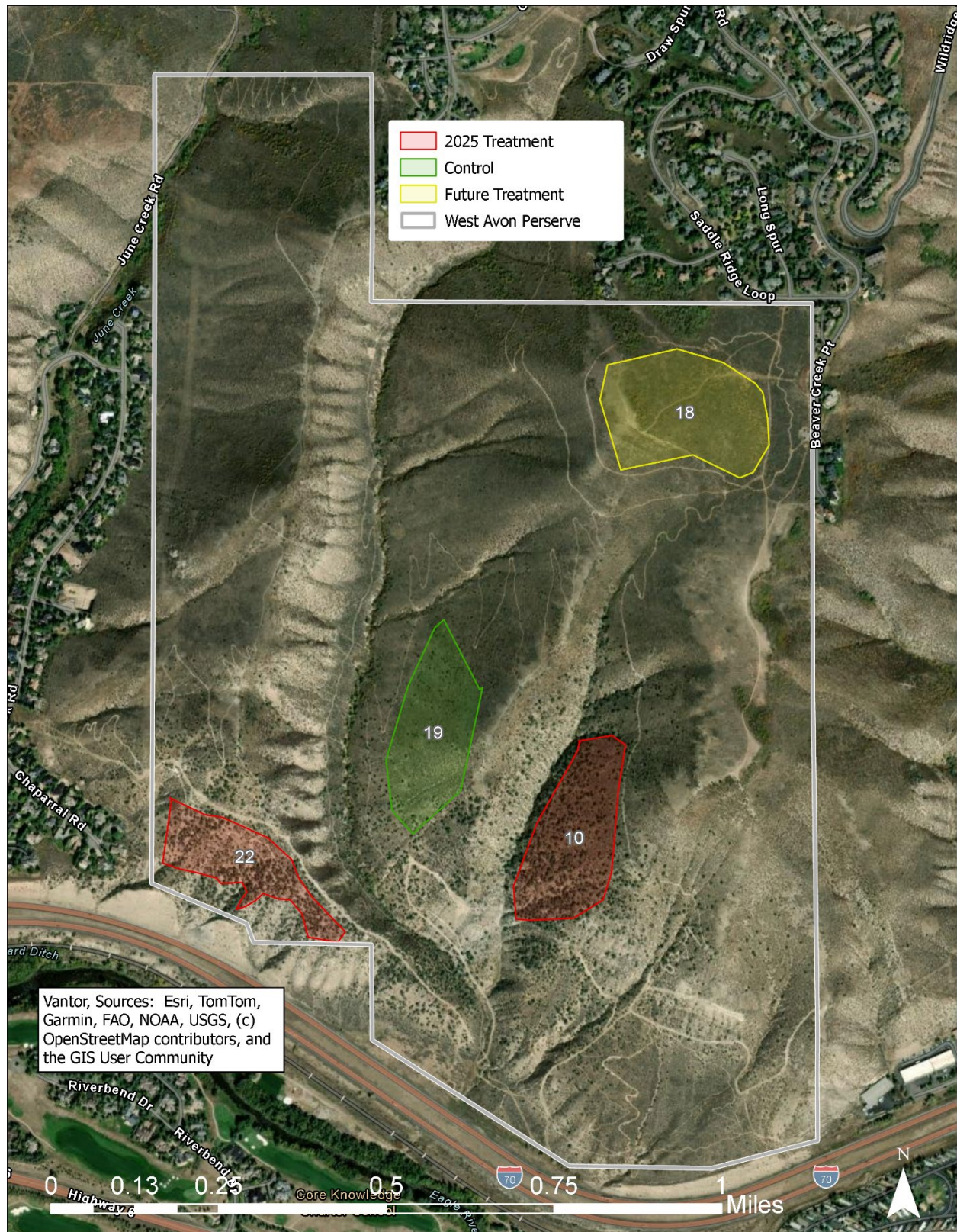


Figure 1. Map of West Avon Preserve showing the treatment and control areas and transect locations.

Locations of rare plants have been redacted from this document

Methods

In the third week of June 2025, Colorado Natural Heritage Program (CNHP) botanists Jessica P. Smith, Dee Malone, and Rob Monahan along with CNHP Conservation Science Interns Rebecca Fries, and Chris Drew traveled to Avon, Colorado to locate instances of Harrington's beardtongue (*Penstemon harringtonii*) and to establish four 50-meter vegetation transects within the West Avon Preserve. Harrington's beardtongue was surveyed for at the four treatment/control sites (polygons 10, 18, 19, and 22) and opportunistically on the way to the sites. Transects T1 and T2 were established as comparable transects in treatment areas (polygon 10) and control areas (polygon 19) respectively (Figure 1). These two transects have similar vegetation, slope, and aspect. Transect T3 was established in a treatment area (polygon 22) and transect T4 was established in an area that may receive future treatment (polygon 18) (Figure 1). All data collected in 2025 was prior to any treatments.

The GPS coordinates were taken at the origin and end point of each transect and they were permanently marked with rebar that was painted with pink chalk paint. At each 50-meter transect three data sets were collected. First, line-point intercept (LPI) data were collected at every half meter to record species composition and percent canopy cover. As a part of LPI data, litter depth and data on the tallest plant species along with its height were collected every two meters. Second, woody canopy cover data were collected by measuring the distance that each woody species intersected the transect and its height where it intersected. Third, species composition and ocular percent canopy cover data were collected within 1-meter by 1-meter subplots at five locations along each transect. This method is used to collect percent cover and species composition which can capture species that occur at low rates (less than 1% cover), but percent cover is more subjective than other methods. A detailed description of all survey protocols is provided in Appendix 1. All statistical analyses were completed using Microsoft Excel version 2401.

Results

Thirty-eight vascular plant species and one moss were found within the transects and quadrats at the West Avon Preserve in 2025 (Table 1, Table 2). A little over half of the species found are herbaceous forbs, about a quarter are grasses, and about a quarter are woody shrubs (Table 1). Only two non-native species were found, pale madwort (*Alyssum alyssoides*) and cheatgrass (*Bromus tectorum*) (Table 1, Table 2), of which cheatgrass is the only species on the Colorado Noxious Weed List. The Floristic Quality Index (FQI) across all four transects is 31.5 (Smith et al., 2020; Rocchio, 2007). These data were collected at four transect locations that are not representative of West Avon Preserve as a whole. A more comprehensive survey of the preserve would be needed to determine statistics and indicators for the Preserve as a whole.

Table 1. Descriptive Statistics of Vascular Plant Species Across All Transects

38	Total Species Richness
8	Graminoids
21	Forbs
9	Woody Species
36	Native Species Richness
2	Introduced Species
5.25	Mean Conservation Value (C-Value)
31.5	Floristic Quality Index (FQI)

Table 2. Plants species found on transects at West Avon Preserve in 2025.

USDA Symbol	Species	Common Name	C-Value
ALAL3	<i>Alyssum alyssoides</i>	pale madwort	0
AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry	6
ARFR4	<i>Artemisia frigida</i>	prairie sagewort	4
ARTRV	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	mountain big sagebrush	5
ASCO12	<i>Astragalus convallarius</i>	lesser rushy milkvetch	6
BERE	<i>Berberis repens</i>	creeping barberry	5
BOLI6	<i>Boechera lignifera</i>	desert rockcress	8
BRTE	<i>Bromus tectorum</i>	cheatgrass	0
CAFL7	<i>Castilleja flava</i>	yellow Indian paintbrush	7
CEMO2	<i>Cercocarpus montanus</i>	alderleaf mountain mahogany	6
CHVI8	<i>Chrysothamnus viscidiflorus</i>	yellow rabbitbrush	5
COUMP	<i>Comandra umbellata</i> ssp. <i>pallida</i>	pale bastard toadflax	5
CRAC2	<i>Crepis acuminata</i>	tapertip hawksbeard	6
DENU2	<i>Delphinium nuttallianum</i>	twolobe larkspur	6
DEPIB	<i>Descurainia pinnata</i> ssp. <i>brachycarpa</i>	western tansymustard	2
ELLA3	<i>Elymus lanceolatus</i>	thickspike wheatgrass	4
EREAE	<i>Erigeron eatonii</i> var. <i>eatonii</i>	Eaton's fleabane	7
ACHY	<i>Eriocoma hymenoides</i>	Indian ricegrass	5
ERUM	<i>Eriogonum umbellatum</i>	sulphur-flower buckwheat	6
FESAS	<i>Festuca saximontana</i> var. <i>saximontana</i>	Rocky Mountain fescue	7
HECO26	<i>Hesperostipa comata</i>	needle and thread grass	6
JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	5
KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	6
LIRU4	<i>Lithospermum ruderales</i>	western stoneseed	4
OXLA3	<i>Oxytropis lambertii</i>	purple locoweed	5
PAST10	<i>Packera streptanthifolia</i>	Rocky Mountain groundsel	8
PECRC	<i>Penstemon crandallii</i> var. <i>candallii</i>	Crandall's beardtongue	6
PEHA11	<i>Penstemon harringtonii</i>	Harrington's beardtongue	6
PEOS	<i>Penstemon osterhoutii</i>	Osterhout's beardtongue	6
PHLO2	<i>Phlox longifolia</i>	longleaf phlox	6
PSSP6	<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	7
SILI5	<i>Sisymbrium linifolium</i>	flaxleaf plainsmustard	6
SYRO	<i>Symphoricarpos rotundifolius</i>	roundleaf snowberry	5
TECA2	<i>Tetradymia canescens</i>	spineless horsebrush	6
WYAR	<i>Wyethia arizonica</i>	Arizona mule-ears	3
MAGR2	<i>Xanthisma grindelioides</i> var. <i>grindelioides</i>	rayless tansyaster	4
2SHRUB	Asteraceae	unknown shrub	-
2MOSS	Bryophyta	unknown moss	-
2FORB	Magnoliopsida	unknown forb	-

Canopy Cover and Plant Heights by Transect

Transect 1



Figure 2. Transect 1, (left) photo taken from the 0-meter mark looking north, (right) photo taken from the 50-meter mark looking south towards I-70.

Transect 1 (Figure 2), found within polygon 10, is on the western facing slope of the easternmost mountain within the West Avon Preserve. Polygon 10 received treatment of woody species after this survey. The hillside where the transect is located has an estimated 20% slope and the transect runs perpendicular to the slope from south to north along an azimuth of 349°.

Transect 1 is dominated by shrub cover with between 37% and 50.2% of all cover being from shrubs depending on the methods used (Table 3). This transect has a moderate species richness relative to the other transects measured at the Preserve with a total of 21 species present (Table 13). Mountain big sagebrush, roundleaf snowberry, and bluebunch wheatgrass are the dominant species at Transect 1 (Table 13).

Table 3. Transect 1 canopy cover by vegetation type using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

Cover Type	5 Quadrats Average Absolute % Cover	Top Vegetation Layer LPI % Cover	Woody % Cover
Tree Cover	0.00%	0%	0.0%
Shrub Cover	49.58%	37%	50.2%
Herbaceous Cover	12.94%	26%	-
No Vegetation	37.48%	37%	-
Total	100.00%	100%	50.2%

Within transect 1 (polygon 10), the tallest species is alderleaf mountain mahogany (Table 4).

Table 4. Species heights along transect 1 (T1). Woody species are highlighted in orange.

Species	Frequency of being the tallest species	Average Height (cm) Tallest species taken every 2 meters	Average Height (cm) Woody species
alderleaf mountain mahogany	5%	77	85
bluebunch wheatgrass	27%	49	
Indian ricegrass	2%	37	
mountain big sagebrush	43%	67	39
Rocky Mountain fescue	2%	38	
roundleaf snowberry	5%	32	30
Saskatoon serviceberry			20
western stoneseed	2%	42	
yellow rabbitbrush	7%	44	32
none	7%		
Total	100%	54	41

Transect 2



Figure 3. Transect 2, (left) photo taken from the 0-meter mark looking south towards I-70, (right) photo taken from the 50-meter mark looking north.

Transect 2 (Figure 3), found within polygon 19, is on the western facing slope of the centrally located mountain within the West Avon Preserve. Polygon 19 will not receive any treatment and will be a control site for future surveys. The hillside where the transect is located has an estimated 15% slope and the transect runs perpendicular to the slope from north to south along an azimuth of 180°.

Transect 2 is dominated by shrub cover with between 47% and 62.16% of all cover being from shrubs depending on the methods used (Table 5

Table 5). This transect has a moderate species richness relative to the other transects measured at the Preserve with a total of 20 species present (Table 14, Table 13). Mountain big sagebrush and bluebunch wheatgrass are the dominant species at Transect 2 (Table 14).

Table 5. Transect 2 canopy cover by vegetation type using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

Cover Type	5 Quadrats Average Absolute % Cover	Top Vegetation Layer LPI % Cover	Woody Cover % Cover
Tree Cover	0.00%	0%	0.7%
Shrub Cover	62.16%	47%	60.4%
Herbaceous Cover	16.48%	28%	-
No Vegetation	21.36%	25%	-
Total	100.00%	100%	61.1%

Table 6. Species heights along transect 2 (T2). Shrub species are highlighted in orange and tree species are highlighted in green.

Species	Frequency of being the tallest species	Average Height (cm) Tallest species taken every 2 meters	Average Height (cm) Woody species
alderleaf mountain mahogany			104
bluebunch wheatgrass	24%	51	
mountain big sagebrush	60%	57	50
needle and thread grass	4%	55	
Rocky Mountain juniper			75
roundleaf snowberry			32
Saskatoon serviceberry	12%	61	53
yellow rabbitbrush			36
Total	100%	56	58

Transect 3



Figure 4. Transect 3, (left) photo taken from the 0-meter mark looking east, (right) photo taken from the 50-meter mark looking west.

Transect 3 (Figure 4), found within polygon 22, is on the south facing slope of the westernmost mountain within the Preserve. Polygon 22 received woody treatment after this survey was completed. The hillside where the transect is located has an estimated 15% slope and the transect runs perpendicular to the slope from west to east along an azimuth of 111°. Transect 3 is more the 50% unvegetated (Table 7) and has the lowest species richness with just 12 plant species present on the transect (Table 15). Rocky Mountain juniper, mountain big sagebrush, and bluebunch wheatgrass are the dominant species at Transect 3 (Table 15).

Table 7. Transect 3 canopy cover by vegetation type using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

Cover Type	5 Quadrats Average Absolute % Cover	Top Vegetation Layer % Cover	Woody Cover % Cover
Tree Cover	*27.98%	15%	13.7%
Shrub Cover	32.78%	15%	23.5%
Herbaceous Cover	9.45%	18%	-
No Vegetation	57.77%	52%	-
Total	100.00%	100%	37.2%

*** Tree cover not included in the total for 1m-by-1m quadrats due to the high percent cover in some quadrats.**

Table 8. Species heights along transect 3 (T3). Woody species are highlighted in orange and tree species are highlighted in green.

Species	Frequency of being the tallest species	Average Height (cm) Tallest species taken every 2 meters	Average Height (cm) Woody species
alderleaf mountain mahogany	8%	68	105
bluebunch wheatgrass	36%	39	
Indian ricegrass	8%	24	
mountain big sagebrush	16%	64	51
Osterhout's beardtongue	4%	5	
rayless tansyaster	4%	9	
Rocky Mountain juniper	16%	295	278
roundleaf snowberry	4%	54	15
Saskatoon serviceberry			65
yellow rabbitbrush			18
none	4%		
Total	100%	81	89

Transect 4**Figure 5. Transect 4, (left) photo taken from the 0-meter mark looking south towards I-70, (right) photo taken from the 50-meter mark looking north.**

Transect 4 (Figure 5), found within polygon 18, is at the top of the mountain in the northeast corner of the property. Polygon 18 may receive mastication treatment in the future. The hilltop where the transect is located has an estimated 15% slope and the transect runs perpendicular to the slope from north to south along an azimuth of 160°. To the east of the transect the slope decreases and the hill forms a gently sloped dome where there are fewer shrubs. This transect is roughly in an

ecotone between the hillside plant community and hilltop community which may account for the higher species diversity at this transect.

Transect 4 has notably more herbaceous cover as compared to the other transects with about 40% cover being herbaceous species (Table 9) and it has the highest species richness with 28 plant species present on the transect (Table 15, Table 16). Bluebunch wheatgrass and alderleaf mountain mahogany are the dominant species at Transect 4 with mountain big sagebrush being common but less prevalent than at other transects (Table 16).

Table 9. Transect 4 canopy cover by vegetation type using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

Cover Type	5 Quadrats Average Absolute % Cover	Top Vegetation Layer % Cover	Woody Cover % Cover
Tree Cover	0.00%	0%	0.5%
Shrub Cover	35.94%	31%	45.3%
Herbaceous Cover	17.89%	40%	-
No Vegetation	46.18%	29%	-
Total	100.00%	100%	45.8%

Table 10. Species heights along transect 4 (T4). Woody species are highlighted in orange and tree species are highlighted in green.

Species	Frequency of being the tallest species	Average Height (cm) Tallest species taken every 2 meters	Average Height (cm) Woody species
alderleaf mountain mahogany	44%	91	108
bluebunch wheatgrass	28%	38	
lesser rushy milkvetch	4%	7	
mountain big sagebrush	8%	36	44
needle and thread grass	4%	46	
Rocky Mountain juniper			35
roundleaf snowberry			53
Saskatoon serviceberry	4%	66	60
spineless horsebrush			35
thickspike wheatgrass	4%	44	
yellow rabbitbrush	4%	34	34
Total	100%	61	53

Litter

The average litter depth and percent of the transect with litter were noticeably different. Transect 1 (T1) had the highest average litter depth, 3.96 cm, which is twice the average litter depth of transect 3 (T3) at 1.42 cm. Transect 2 (T2) had litter across the largest percent of the transect at 81% for the combined woody and herbaceous litter and transect 3 (T3) had the smallest percent of litter at 57% for the combined total. (Table 11).

Table 11. Average litter depth and percent of the transect with litter.

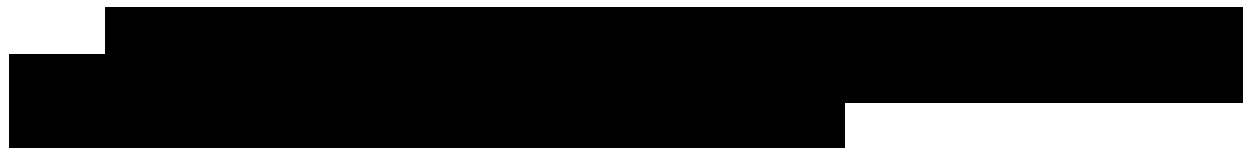
Transect	Average litter depth (cm)	Percent of transect with herbaceous litter	Percent of transect with woody litter
T1	3.96	53%	17%
T2	2.51	56%	25%
T3	1.42	45%	12%
T4	1.75	60%	9%

Harrington's beardtongue (*Penstemon harringtonii*)

Harrington's beardtongue was found at 19 new points within the West Avon Preserve and a total of 40 individuals were found. There are various other species of beardtongue growing at the West Avon Preserve including Watson's beardtongue (*Penstemon watsonii*), Crandall's beardtongue (*Penstemon crandallii*), and Osterhout's beardtongue. Osterhout's beardtongue in particular closely resembles Harrington's beardtongue but the two can be distinguished from each other by their stamens which are exserted beyond the corolla in the case of Harrington's beardtongue and are within the corolla in the case of Osterhout's beardtongue (Figure 6). These two species can be found growing together in the same habitats.



Figure 6. (left) *Penstemon harringtonii* with stamens which are exserted beyond the corolla. (right) *Penstemon osterhoutii* with stamens which are not exserted.



Osterhout's beardtongue is found across most the preserve and is especially prevalent on the southern end of the West Avon Preserve and in the area around polygon 22.

Acknowledgements

The help and generosity of many experts is gratefully acknowledged. Adrian Brown at Eagle Valley Land Trust played a critical role in this project. Dee Malone also was instrumental in making this effort successful. Her knowledge of Harrington's beardtongue's life history, habitat, and look-a-likes was extremely valuable.

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Appendix A. Data Collection Protocol

1. Transect Placement
 - a. Survey the designated area where a transect can be placed.
 - b. Identify the occupied habitat of *Penstemon harringtonii* within the designated area.
 - c. Place the transect start location at a random location, which is representative of the area as a whole, and when possible, within occupied *Penstemon harringtonii* habitat.
 - i. A representative transect location should have a similar vegetation, soil, and slope to the surrounding area.
 - d. The transect line can then be run out to 50 meters (or two 25 meter transects running parallel at least 10 meters apart) in the direction perpendicular to the aspect or slope of the hill, e.g. if the aspect of the slope is south facing the transect should run west to east.
2. Transect Data Collection (Figure 7)
 - a. Take photos at the start and end of the transect.
 - b. Collect point-line-intercept data every $\frac{1}{2}$ meter along the 50-meter transect, recording the species identification, litter type, and ground type. LPI will be collected starting at the 0.5-meter mark. A pin will be dropped vertically (plumb to the earth) at each half meter and each plant which touches the pin will be recorded in order of height, top level to surface. If it is windy, a judgement will be made by the observer as to if the plant would be touching the pin if there were no wind.
 - c. Collect data on the height of the tallest plant and litter depth (herbaceous or woody) every two meters starting at the 2.0-meter mark. Within a 15 cm radius of the pin drop locate the tallest plant and measure its height, and for litter do the same by finding the deepest area of litter within the radius.
 - d. Collect data in 1m subplots along the transect every 10 meters, with a random point chosen to start the 10-meter interval (for this study 3.5-meter mark was randomly chosen as the starting point). The 1-meter by 1-meter subplot should be placed on the left side of the transect tape if viewed from the origin and the numbers on the tape should be upright, e.g. the subplot spans from the 3.5-meter mark to the 4.5-meter mark with the corner of the subplot at 3.5 meters (Figure 7).
 - i. Identify every plant species in the subplot and get an ocular absolute percent canopy cover for each species (total should equal 100%). If a species has less than a 1% cover than it should

be recorded as "<1%" or "0.01" to indicate that the plant was present in the subplot even though it does not contribute to the total cover.

- ii. Take a photo of each subplot from directly above the subplot.
- e. Collect percent shrub cover along the transect line by recording the start and end point of shrubs that cross the transect. Record the maximum shrub height where it crosses the transect and species identification of each shrub.

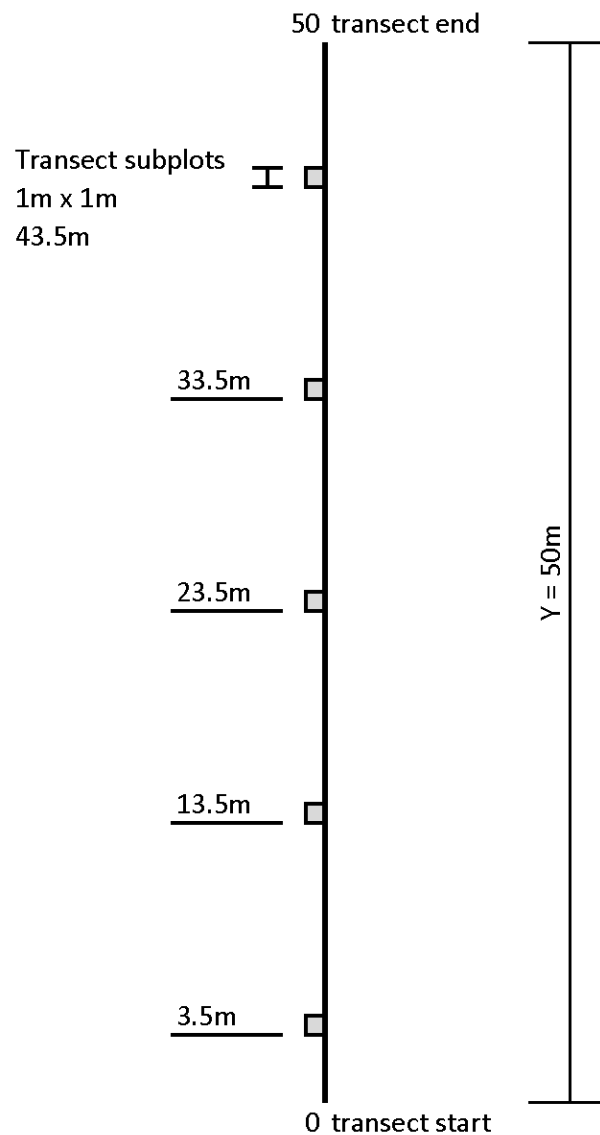


Figure 7. Transect Diagram

Appendix B. Location of Vegetation Survey Transects

Table 12. Coordinates of the start and end points of all transects. UTM coordinates are in NAD 83 Zone 13.

Transect #	Transect Treatment	Latitude	Longitude	Northing	Easting
T1	10-Treatment origin				
T1	10-Treatment end				
T2	19-Control origin				
T2	19-Control end				
T3	22-Treatment origin				
T3	22-Treatment end				
T4	18-Treatment origin				
T4	18-Treatment end				

Locations of rare plants have been redacted from this document

Appendix C. Expanded Results

Table 13. Transect 1 canopy cover by species using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

T1 Species	1m x 1m Subplot Average Absolute % Cover	Top Vegetation Layer LPI % Cover	Woody Cover % Cover
<i>Alyssum alyssoides</i>	0.67%	1%	
<i>Amelanchier alnifolia</i>	8.06%	1%	0.3%
<i>Artemisia frigida</i>	1.01%		
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	14.31%	19%	33.8%
<i>Astragalus convallarius</i>	0.02%		
<i>Berberis repens</i>	7.05%	6%	2.4%
<i>Bromus tectorum</i>	1.41%		
<i>Cercocarpus montanus</i>	4.43%	2%	
<i>Chrysothamnus viscidiflorus</i>	6.65%	4%	6.7%
<i>Comandra umbellata</i>	0.40%		
<i>Pseudoroegneria spicata</i>	5.24%	21%	
<i>Erigeron eatonii</i> var. <i>eatonii</i>	0.02%		
<i>Eriocoma hymenoides</i>	2.84%	1%	
<i>Eriogonum umbellatum</i>	0.02%		
<i>Koeleria macrantha</i>	1.03%	2%	
<i>Lithospermum ruderales</i>		1%	
<i>Phlox longifolia</i>	0.02%		
<i>Sisymbrium linifolium</i>	0.02%		
<i>Symphoricarpos rotundifolius</i>	9.07%	5%	7.0%
<i>Wyethia arizonica</i>	0.20%		
unknown herbaceous species	0.04%		
deer scat	1.01%		
herbaceous litter	10.48%		
woody litter	4.84%		
rock	5.24%		
bare ground	15.92%		
none		37%	
Total	100.00%	100%	50.2%

Table 14. Transect 2 canopy cover by species using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

T2 Species	1m x 1m Subplot Average Absolute % Cover	Top Vegetation Layer LPI % Cover	Woody Cover % Cover
<i>Amelanchier alnifolia</i>	2.13%	4%	9.9%
<i>Artemisia frigida</i>	1.16%		
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	42.22%	36%	40.2%
<i>Astragalus convallarius</i>	0.64%	1%	
<i>Boechera lignifera</i>	0.02%		
<i>Castilleja flava</i>		1%	
<i>Cercocarpus montanus</i>	6.20%	2%	2.3%
<i>Chrysothamnus viscidiflorus</i>	1.94%	3%	6.0%
<i>Crepis acuminata</i>	0.04%		
<i>Delphinium nuttallianum</i>	0.02%		
<i>Pseudoroegneria spicata</i>	3.68%	13%	
<i>Erigeron eatonii</i> var. <i>eatonii</i>	0.60%		
<i>Eriocoma hymenoides</i>		4%	
<i>Hesperostipa comata</i>	3.87%	3%	
<i>Juniperus scopulorum</i>			0.7%
<i>Koeleria macrantha</i>	2.52%	4%	
<i>Phlox longifolia</i>	0.02%		
<i>Sisymbrium linifolium</i>	0.04%		
<i>Symphoricarpos rotundifolius</i>	9.68%	2%	2.0%
<i>Wyethia arizonica</i>	3.87%	2%	
deer scat	0.58%		
herbaceous litter	7.16%		
woody litter	5.42%		
rock	0.83%		
bare ground	7.36%		
none		25%	
Total	100.00%	100%	61%

Table 15. Transect 3 canopy cover by species using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

T3 Species	1m x 1m Subplot Average Absolute % Cover	Top Vegetation Layer % Cover	Woody Cover % Cover
<i>Amelanchier alnifolia</i>	0.80%	2%	2.2%
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	8.99%	10%	15.8%
<i>Astragalus convallarius</i>	0.02%		
<i>Cercocarpus montanus</i>	17.99%	3%	4.6%
<i>Chrysothamnus viscidiflorus</i>	4.00%		0.6%
<i>Descurainia pinnata</i> ssp. <i>brachycarpa</i>	0.02%		
<i>Pseudoroegneria spicata</i>	7.40%	14%	
<i>Eriocoma hymenoides</i>	1.60%	4%	
<i>Juniperus scopulorum</i>	* 27.98%	15%	13.7%
<i>Penstemon crandallii</i> var. <i>candallii</i>	0.02%		
<i>Penstemon osterhoutii</i>	0.40%		
<i>Symphoricarpos rotundifolius</i>	1.00%		0.3%
deer scat	0.60%		
herbaceous litter	19.99%		
woody litter	6.20%		
rock	8.59%		
bare ground	22.39%		
none		52%	
Total	100.00%	100%	37.2%

* Canopy cover of *Juniperus scopulorum* not included in the total

Table 16. Transect 4 canopy cover by species using three methods ocular estimates in 1m-by-1m quadrats, line-point intercept for the top layer of vegetation, and woody canopy cover.

T4 Species	1m x 1m Subplot Average Absolute % Cover	Top Vegetation Layer % Cover	Woody Cover % Cover
<i>Alyssum alyssoides</i>	0.02%		
<i>Amelanchier alnifolia</i>	1.61%	3%	7.0%
<i>Artemisia frigida</i>		2%	
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	1.61%	7%	7.3%
<i>Astragalus convallarius</i>	0.40%		
<i>Boechera lignifera</i>	0.24%		
<i>Castilleja flava</i>	0.02%		
<i>Cercocarpus montanus</i>	24.09%	17%	22.5%
<i>Chrysothamnus viscidiflorus</i>	1.61%	1%	2.2%
<i>Comandra umbellata</i>	0.02%		
<i>Crepis acuminata</i>	0.22%	1%	
<i>Descurainia pinnata</i> ssp. <i>brachycarpa</i>	0.04%		
<i>Pseudoroegneria spicata</i>	8.43%	23%	
<i>Elymus lanceolatus</i>	0.42%	1%	
<i>Erigeron eatonii</i> var. <i>eatonii</i>	0.20%		
<i>Eriocoma hymenoides</i>	3.61%	2%	
<i>Hesperostipa comata</i>	2.01%	4%	
<i>Juniperus scopulorum</i>			0.5%
<i>Koeleria macrantha</i>	0.60%	5%	
<i>Lithospermum ruderales</i>	0.60%		
<i>Oxytropis lambertii</i>	1.00%		
<i>Packera streptanthifolia</i>	0.02%		
<i>Penstemon harringtonii</i>	0.02%		
<i>Sisymbrium linifolium</i>		1%	
<i>Symphoricarpos rotundifolius</i>	7.03%	3%	4.8%
<i>Tetradymia canescens</i>			1.5%
unknown Asteraceae shrub		0%	
unknown Bryophyta		1%	
deer scat	2.41%		
herbaceous litter	15.66%		
woody litter	11.24%		
rock	2.41%		
bare ground	14.45%		
none		29%	
Total	100.00%	100.00%	45.80%

Subplot photos

Transect 1



Figure 8. Transect 1 (polygon 10) subplot photos for meter mark 3.5 (left) and 13.5 (right).



Figure 9. Transect 1 subplot photos for meter mark 23.5 (left) and 33.5 (right).



Figure 10. Transect 1 subplot photos for meter mark 43.5.

Transect 2



Figure 11. Transect 2 (polygon 19) subplot photos for meter mark 3.5 (left) and 13.5 (right).



Figure 12. Transect 2 subplot photos for meter mark 23.5 (left) and 33.5 (right).



Figure 13. Transect 2 subplot photos for meter mark 43.5.

Transect 3



Figure 14. Transect 3 (polygon 22) subplot photos for meter mark 3.5 (left) and 13.5 (right).



Figure 15. Transect 3 subplot photos for meter mark 23.5 (left) and 33.5 (right).



Figure 16. Transect 3 subplot photos for meter mark 43.5

Transect 4



Figure 17. Transect 4 (polygon 18) subplot photos for meter mark 3.5 (left) and 13.5 (right).



Figure 18. Transect 4 subplot photos for meter mark 23.5 (left) and 33.5 (right).



Figure 19. Transect 4 subplot photos for meter mark 43.5.