OREGON DEPARTMENT OF AGRICULTURE

NATIVE PLANT CONSERVATION PROGRAM

Population Status Review of *Astragalus diaphanus var. diurnus*

A Challenge Cost-Share Project Report by the Native Plant Conservation Program, Oregon Dept. of Agriculture

Prepared by
Ryan Woolverton (ODA)
for the
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Table of Contents

Introduction

Astragalus diaphanus var. *diurnus* (Listed as *Threatened* under state law) is a tap-rooted annual member of the *Fabaceae* family. Like other milkvetches, it has pinnately compound leaves and the classic wing, banner, and keel flower structure (see report cover). A good description of its morphology can be found on the ODA website (*http://www.oregon.gov/ODA/PLANT/CONSERVATION/profile_asdidi.shtml*).

Astragalus diaphanus var. *diurnus* is restricted to lower- to mid-elevation (ca. 2500-3600 ft.) juniper woodland along the South Fork of the John Day River in Grant County. It is endemic to sterile volcanic soils that overlie basalt parent material and that are arid, shallow, nutrient poor, and exhibit a neutral to slightly basic pH (Wright, 1991). The sites are usually in full sun, typically have slopes between 15 and 30 degrees, and are generally south to southwest facing (Figure 1).

Figure 1. *Aerial imagery overlooking A. diaphanus var. diurnus habitat near the Johnson Creek confluence with the South Fork of the John Day River.*

Populations are potentially threatened by habitat destruction due to excavation of cinders for road maintenance; however, it is unknown how much of this type of activity occurs throughout its range. Other threats to the species may include exotic weed invasions, grazing, changes in historic fire regimes, and off-road vehicle use.

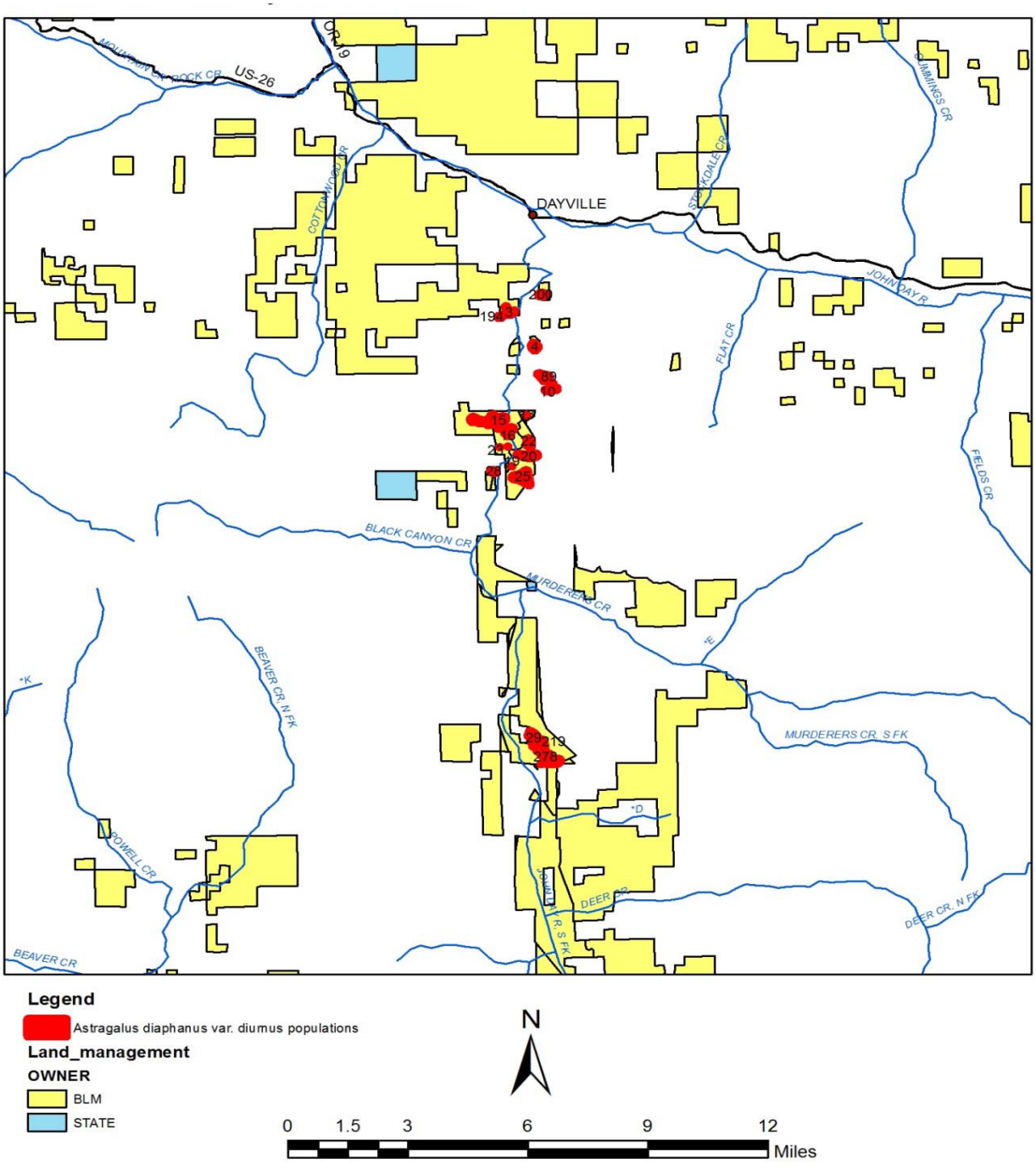

Figure 2. *Approximate locations of Astragalus diaphanus var. diurnis populations along the South Fork of the John Day River, south of Dayville, Oregon, on or near Prineville District public lands.*

Twenty two previously monitored *A. diaphanus* var. *diurnus* sites occur along South Fork Rd (see Figure 2) on BLM, State, and private land, east and west of the river between 3 and 24 miles South of Dayville. The last survey of these populations, prior to ODA's, took place in May of 2005 and 2006. Surveyors for the BLM recorded population size, phenology, population area, age class, habitat, geographic data (aspect,

slope, topographic position, elevation, light, and moisture), associated species, and threats. In addition, some of the previous year's monitoring forms had information about the changes that sites had undergone. For instance, a recommendation that two sites (4 and 5) should be combined into one was made based on the observation that patches of plants were found evenly dispersed between the two.

Even with a number of years of previous monitoring data, little formal research has been completed on this species outside the thesis by Wright (1991). Fortunately, ODA had the opportunity to work with land managers in 2011 to tackle some much needed work. We documented population size based on actual counts instead of estimating. We also conducted some new research on seed production, which broadens our understanding of *A. diaphanus* var. *diurnus* reproductive biology. In addition, we subjectively ranked the sites that we visited as poor, good, or excellent habitat based on plant density and observed threats.

The results of our survey, along with previous years data, allow us to offer a reproducible monitoring protocol as well as suggest an effective conservation strategy. Ultimately, by monitoring and implementing a good conservation strategy, we can move closer to the goal of improving the recovery prospects for this sensitive species.

Project Background: Goals, Adjustments, and Postponement Issues

In 2010, ODA developed a Challenge Cost Share agreement with BLM's Prineville District to assess two native milkvetch species. The original study plan involved ODA evaluating 50% of the known populations for *A. diaphanus* var. *diurnus* managed by the district, and 50% of the populations for a second species, *Astragalus collinus* var. *laurentii*. BLM was to provide maps, shapefiles, and directions to the sites.

However, during initial project planning, questions were raised by ODA in an email (sent 4/13/2010—see Appendix A) regarding how many sites of *Astragalus collinus* var. *laurentii* were actually managed by BLM. (ODA's prior work with this species suggested it occurs virtually entirely on private lands.) The district was uncertain, but the number on BLM was apparently very small—an email reply indicated that only one or (possibly) three sites for the species might still exist on public lands. However, no follow-up confirmation was received. On 5/12/2010, BLM sent shapefiles for the numerous *A. diaphanus* var. *diurnus* field sites managed by Prineville, but nothing was provided for *A. collinus* var. *laurentii*. Another email was sent by ODA on 5/24/2010 (Appendix A), asking whether dropping var. *laurentii* from the

project was being considered, since (1) for whatever reason, BLM didn't appear to have much information on it, and (2) we'd just learned the budget for the project was being reduced, and eliminating the limited amount of planned work on var. *laurentii* would help balance that. Again, no reply was received, and no locational or field site information for *A. collinus* var. *laurentii* was ever sent by BLM. ODA's assumption was that *A. collinus* var. *laurentii* was not considered significant enough on the district to stress in this study, and that using the reduced project funds on var. *diaphanus* was preferable.

So ODA elected to focus on *A. diaphanus* var. *diurnus* during the study, which was clearly the more important of the two milkvetch species in terms of occurrence on public lands. Without information on either the number or locations of *A. collinus* var. *laurentii* populations on the Prineville District, this seemed to be the prudent course of action.

The project also had to be delayed by one year. Although the work was funded by FY2010 dollars, the federal agreement that obligated the funds could not be signed by BLM until August 12, 2010, evidently due to administrative issues. This was well after the field season for *A. diaphanus* var. *diurnus* had passed. Although the BLM Assistance Agreement that covers the project does not terminate until 2015, an interim report—describing ODA's work using the FY 2010 funds—was required by February 28, 2011. However, inasmuch as the agreement itself was not formalized until well after it would have been possible to initiate the project in 2010 (since the species was finished blooming and had dried up for the season by the late summer signing date), nothing relevant could be reported by February, 2011. Consequently, the project report is being submitted now, and covers the work completed during the postponed field season that was completed in 2011.

So with the above in mind, the original objectives of the project were to: 1) visit 50% of the known *A. diaphanus* var. *diurnus* sites, and either census or estimate population size; 2) estimate seed production for each population visited; 3) set up monitoring transects at five sites and collect baseline data; 4) document threats at each site; and 5) recommend management strategies to promote conservation.

Materials

Our data collection and support materials consisted of topographic maps of the monitoring area, compasses with clinometers (declination set to 17 deg. E), GPS units (One Trimble GeoXT and one Garmin GPS60), digital cameras, two- way radios, pin flags, field notebooks, and BLM/ORBIC monitoring sheets. The topographic maps were used to evaluate accessibility of the sites and to navigate the study area.

Compasses were used to record aspect and slope measurements. GPS units served to collect data regarding plant locations, subpopulation areas (polygons), elevation, and to aid navigation to the sites. We used digital cameras to document habitat, associated species, threats, and to take *in situ* pictures of *A. diaphanus var. diurnus*. Two-way radios allowed us to split up during our search for plants and then re-convene when they were found. When plants were located, we used orange pin flags to mark each plant for ease of counting. We used our field notebooks to record the relevant data and notes. BLM/ORBIC monitoring sheets from previous years monitoring work provided valuable details about population sizes, locations, threats, and habitat.

Methods

Monitoring was conducted in late May, 2011, by two ODA employees (Ryan Woolverton and Kassandra Reuss-Schmidt) along the South Fork of the John Day River corridor. We focused on obtaining population size and seed production estimates for 50% of the known sites. Data management and analyses were conducted in the office during the weeks following the field work.

Site selection

Since BLM did not specify particular sites to visit, we arbitrarily selected (in a stratified random fashion) 11 of the 22 sites for sampling (see Appendix B for selected photos of sampled sites), based on population size (from earlier BLM estimates) and their distribution east and west of the river. So although arbitrarily selected, we tried to include both small and large populations on either side of the river in order to cover as wide a range of habitat as possible. Topographic maps were used to estimate site accessibility, and to assist in targeting south to southwest facing draws. Aerial imagery was viewed in order to avoid areas with high conifer density.

Data collection

GPS units were turned on to allow time for satellite connectivity, a topographic map and compass were used to take a bearing towards the middle of the site, and general survey strategy was discussed prior to entering monitoring sites. The track feature on the GPS unit was activated so that we could review our survey route later using GIS software. In addition, we used another GPS unit (TRIMBLE GeoXT) with site locations loaded (polygon shapefiles), to monitor surveyor location and help stay within the bounds of the sites. While heading towards the middle of a site, we tried to stay within 5 to 15 m of one another. When necessary, two-way radios were used to stay in contact and allow for further spacing during

surveying. When plants were found, we re-convened and conducted a thorough search of the immediate area. Pin flags were placed six inches or less from each plant until no more plants were found. For data collection purposes, the areas where plants were found within the previously monitored sites were considered sub sites and labeled with an alphanumeric code (e.g., site 278 sub A).

After all the plants were flagged in a sub site, we collected the appropriate data. One person recorded the life stages of the plants using a tally mark system. For example, a table was drawn in the notebook with the heading categories: Flowering, Flowering/Fruiting, Vegetative, or Fruiting. Therefore, we obtained life stage information and a population census simultaneously. Concurrently, the other person quickly recorded habitat notes in their notebook on slope, aspect, soil moisture, and elevation. Once the habitat data had been recorded, flower, fruit and raceme numbers were recorded. We planned to take flower, fruit, and raceme data from at least five plants per sub site in order to estimate reproductive potential. Next, we collected fruits from multiple plants and placed them in labeled 2 ¼" X 3 ½" coin envelopes. The envelopes were labeled with the date and sub site number. When the sub sites were large, we tried to collect five fruits from five different plants for better averaging. Sometimes the sub sites were smaller and in those cases we decided to collect fewer fruits in order to have less of an effect on the milkvetch seed bank.

Once the data and fruit collection were complete, we took pictures of the plants, habitat, disturbance, and associated species. The picture numbers were recorded with the sub site information in our notebooks. With the pin flags still in place, the area was mapped using a GPS unit (TRIMBLE GeoXT) to create a polygon around the extent of plants found so that we could calculate plant density (# of plants/m^2). Lastly, the pin flags were collected and a quick discussion was had to ensure that we obtained all the necessary data before moving on to the next location.

The above mentioned procedure was then repeated for all the following sites found.

Seed production estimates

Seed production estimates were based on average seed counts of fruits per site. The average numbers of seeds per fruit were calculated by taking the sum of seeds counted per fruit divided by the number of fruits collected per site. We collected large and small fruits in order to get a good representation of seed production. The average number of seeds per fruit was multiplied by the average number of flowers plus the average number of fruits per plant to yield average number of seeds produced per plant. Once the

average numbers of seeds per plant was calculated, it was multiplied by the total number of reproductive plants/site to yield a conservative estimate of seed production. The average number of seeds per plant was also multiplied by the total number of plants in a site to yield a high estimate.

(Avg. # seeds / fruit) x [(avg. # fruits + avg. # flowers)/ plant] = Est. # of seeds per plant.

Est. # of seeds/ plant x (# reproductive plants / site) = Conservative Est. # seeds per site.

The number of seeds generated by this calculation gives a conservative estimate that represents the seed production of reproductive plants only. A less conservative estimate was also calculated that included the total number of plants counted for a monitoring site.

Est. # of seeds/ plant x (total # plants/ site) = Less conservative Est. # seeds per site.

The latter calculation assumed that all plants, even those not fruiting or flowering at the time, would live to reproduce and then produce the average number of fruits, flowers and seeds.

Documentation of threats

While surveying the sites, we documented potential threats such as cattle usage, off road vehicle activity (ORV), and weeds. Pictures were taken and notes were recorded in our field notebooks for each site visited. In addition, the monitoring forms from previous years were reviewed to see how previously documented threats or disturbance compared with what we observed.

Results

Population numbers for *A. diaphanus* var. *diurnis* were generally down in 2011, possibly due to on-going disturbances, but also potentially due to lower than normal rainfall in early 2011 (see Table 3 caption). For plants that did reproduce, seed production, however, was relatively robust.

We were able to visit 10 of the 22 sites that had been assigned FL site ID #'s by BLM. The site numbers visited were: **3, 4, 13, 19, 22, 25, 28, 194, 219, and 278**. Our census of *A. diaphanus var. diurnus* sites produced varying results. For instance, we found zero, more, and less plants at sites that had previously been monitored (Table 1). Overall, we counted a total of 824 plants within the 10 sites visited, which was significantly down from populations size estimates made at many sites in previous years. The plant counts ranged from a high of 150 plants at site 278 to a low of 0 plants at sites 13 and 28.

Table 1. *Historic and newly updated population census information for A. diaphanus var. diurnus.*

Site #	*Agency*	*Monitoring Date*	*No. of plants*	*Count/Estimate*
3	BLM	?/?/1992	6	Count
3	BLM	?/?/1993	358	Count
3	ODA	5/24/2011	142	Count
4	BLM	5/15/1991	20	Est.
4	BLM	5/17/2005	200	Est.
4	ODA	5/24/2011	28	Count
13	BLM	5/26/1989	51-100	Est.
13	BLM	5/23/2001	19	Count
13	BLM	5/18/2005	28	Count
13	ODA	5/24/2011	0	Count
19	BLM	5/16/1987	0	Count
19	BLM	5/19/2005	4	Count
19	ODA	5/24/2011	32	Count
22	BLM	5/13/1991	500	Est.
22	BLM	5/19/2005	297	Count
22	ODA	5/24/2011	140	Count
25	BLM	5/22/1991	6250	Est.
25	BLM	5/26/2005	2481	Est.
25	ODA	5/24/2011	269	Count
28	BLM	5/13/1991	200	Est.
28	BLM	5/26/2005	29	Count
28	ODA	5/24/2011	0	Count
194	BLM	5/18/1992	20	Count
194	BLM	4/14/2004	13	Count
194	ODA	5/24/2011	59	Count
219	BLM	5/17/1993	2	Count
219	ODA	5/24/2011	4	Count
278	BLM	5/5/1994	1500-2000	Est.
278	BLM	6/1/2005	217	Count
278	ODA	5/24/2011	150	Count

We found that the average number of seeds per plant varied from site to site. The highest estimate for average number of seeds per plant was around 768 seeds and the lowest was around 184. Site 278 had the highest estimated seed production ranging from 104,047 to 106,170 seeds. Site 3 and site 194 also had fairly high seed production estimates (Table 2). The seed bank is clearly being re-charged.

Table 2. *Results of seed counts and production estimates (see text for more details).*

Site #	*(Avg. # flowers + Avg. # fruits) / Plant*	*Avg # seeds / fruit*	*Avg # seeds/ Plant*	*# of reproductive plants*	*Total # of plants*	*Low Seed Production Est.*	*High Seed Production Est.*
3	114.89	5.97	685.8933	84	142	57615.0372	97396.8486
4	87.15	7.4	644.91	18	28	11608.38	18057.48
19	37.1	7.8	289.38	16	32	4630.08	9260.16
22	70.9	2.6	184.34	55	140	10138.7	25807.6
25	128	6	768	117	269	89856	206592
194	76.29	6.23	475.2867	43	59	20437.3281	28041.9153
219	59	6.23	369.1275	0	4	1476.51	same
278	104.86	6.75	707.805	147	150	104047.335	106170.75

As part of our monitoring protocol, we noted any threats that we observed (see Table 3). Some had been previously mentioned in the past. Other things, such as ORV use at certain sites had not been documented before. Cheatgrass was the most observed potential threat, and herbivory was the least. We subjectively ranked the habitat in three categories: poor, good, and excellent. Poor habitat (see Figure 4) has a high abundance of threats combined with a low plant density. Good habitat has an average abundance of threats combined with average plant density. Excellent habitat (see Figure 3) was reserved for sites that have few to no threats and above average plant density (see Table 3). The average plant density for all sites was 0.081126551 plants/m^2.

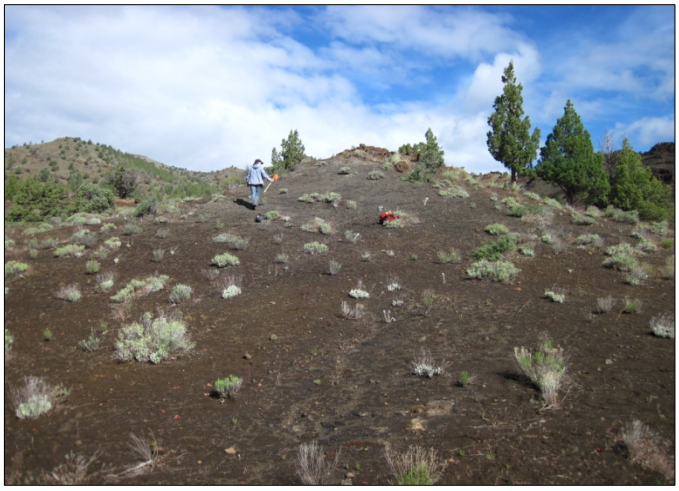

Figure 3. *Picture showing good habitat at site 3.*

Figure 4. *Picture of poor quality habitat at site 13. No ASDIDI plants were found, most likely due to high abundance of cheatgrass. Also see photo on page 19.*

Table 3. *Site characteristics for populations sampled in 2011 (selected photos, etc. in Appendix B). Reasons for the overall lower population numbers in 2011 compared to past years are not clear. This may be due to increased weeds or other disturbances, but may also be due to the fact that precipitation during the winter/spring of 2011 in the study area (especially during the critical months of Feb through May) was only 68% of normal (see http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?or2173), which may have significantly reduced the germination and survival of A. diaphanus var. diurnis plants during the year we sampled.*

Site #	Agency	Monitoring Date	# of plants	Count/Estimate	Average Plant Density (plants/m^2)	Clear Threats	Overall Habitat Quality	Reason for pop'n shift
3	BLM	?/?/1992	6	Count		None		
3	BLM	?/?/1993	358	Count		None		
3	ODA	5/24/2011	142	Count	0.11556325	Weeds, ORV, herbivory	Good, but threatened	Possible low 2011 precip
4	BLM	5/15/1991	20	Est.		None		
4	BLM	5/17/2005	200	Est.		None		
4	ODA	5/24/2011	28	Count	0.00046299	Cheatgrass	Good but patchy	Possible low 2011 precip
13	BLM	5/26/1989	51-100	Count		Erosion		
13	BLM	5/23/2001	19	Count		none		Possible low 2011 precip
13	BLM	5/18/2005	28	Count		Increasing cheatgrass		
13	ODA	5/24/2011	0	Count	0	Cheatgrass	Poor, overwhelmed with cheatgrass.	Weeds
19	BLM	5/16/1987	0	Count		None		
19	BLM	5/19/2005	4	Count		None		
19	ODA	5/24/2011	32	Count	0.00909607	None	Good	Improved census
22	BLM	5/13/1991	500	Est.		None		
22	BLM	5/19/2005	297	Count		None		
22	ODA	5/24/2011	140	Count	0.23355777	None	Excellent, low amounts of cheatgrass	Possible low 2011 precip
25	BLM	5/22/1991	6250	Est.		None		
25	BLM	5/26/2005	2481	Est.		None		
25	ODA	5/24/2011	269	Count	0.04697944	None	Good	Possible low 2011 precip
28	BLM	5/13/1991	200	Est.		None		
28	BLM	5/26/2005	29	Count		None		
28	ODA	5/24/2011	0	Count	0	Cheatgrass	Poor, lots of cheatgrass	Possible low 2011 precip Weeds
194	BLM	5/18/1992	20	Count		Cheatgrass		
194	BLM	4/14/2004	13	Count		None		
194	ODA	5/24/2011	59	Count	0.09079253	None	Good, but managed by ODFW	Improved census
219	BLM	5/17/1993	2	Count		None		
219	ODA	5/24/2011	4	Count	0.058427328	Cheatgrass	Good	No change
278	BLM	5/5/1994	1500-2000	Est.		None		
278	BLM	6/1/2005	217	Count		None		
278	ODA	5/24/2011	150	Count	0.078912749	None	Excellent, but maybe threatened by logging	Possible low 2011 precip

Discussion and Conclusions

Comments on the use of transects

Although the project specifications called for the establishment of monitoring transects, discussion with ecologists at OSU and elsewhere indicated that establishing long-term transects for demographic sampling of an annual species, such as *A. diaphanus* var. *diurnis*, could result in biased data. The nature of annual plants (i.e., which die and re-appear annually, often in quite different locations from the prior year) makes the use of permanent transects for repeated sampling of these populations a poor choice. Populations of annual plants are especially likely (when contrasted with perennials forbs, for example) to spatially shift from year to year, resulting in permanent transect data that can grossly over- or underestimate population size. Where feasible, a much better measure of population status for annuals is a simple census (as described and completed here), especially for highly patchy endemics such as this species, which can be relatively easily inventoried on site due to the well-defined and limited nature of the preferred habitat.

Survey method

Our survey method resulted in finding 824 plants in 10 populations in 2011. Our census approach resulted in an accurate survey, and indicated that population numbers were down in 2011 (Table 1). Considering the low numbers, we recommend a more extensive survey of the area be conducted in future seasons. Two weeks in late May would be an optimal amount of time for four people to completely census the sites that were not visited this year, or, to return to the same sites for updated counts. Future surveyors can use the methodology described above to navigate to previously monitored sub sites. Census information can be recorded and the remaining amount of time can be used for finding new plants, sub sites, and setting up monitoring transects.

Recommendations to future surveyors

Surveyors should each carry a GPS unit with track feature activated. Any time a plant is located during the survey, a point should be taken. The points can be used to make total counts and view the spatial distribution of the populations. They should also be overlaid onto topographic and aerial imagery layers to see how many occur within the bounds of previously surveyed sites. Land managers will be able to see the way populations move across the land simply by turning *A. diaphanus* var. *diurnus* layers on or off or by color coding them by year.

General management strategy

Land managers should conserve good habitat. If habitat cannot be conserved, efforts should be made to document the loss of rare plants such as *A. diaphanus var. diurnus*. At least by documenting the loss of habitat, future land managers can try and make decisions that will positively affect other rare plants. Even after our monitoring efforts, many unknowns still remain. For instance, how many seeds are in the seed bank? How does fire affect this species? Is herbivory significantly affecting reproduction? Will ORV usage and cattle grazing spread weeds and degrade the remaining good habitat? Are weeds, in fact, a threat to the species? Future threat-specific studies may address some or all of these issues.

We have ranked the sites we visited as excellent, good, and poor. The poor sites can serve as examples of what it looks like to lose good habitat. The poor sites may also be designated for habitat restoration and reintroduction. Perhaps just restoring the habitat may be enough to reinvigorate the seed bank and allow the sites to flourish once more. The sites that have been ranked good to excellent should be carefully monitored and protected from cattle grazing and ORV usage. Considering how populations numbers appear to be down in 2011, the populations within good and excellent sites should be monitored at least every other year, to see if they are growing or shrinking. A census approach is adequate, and permanent transects should be avoided for annual species such as this.

Other issues: Is var. diurnis a recognizable taxon?

Although not technically part of this project, the question has been raised over the years regarding whether *A. diaphanus* var. *diurnis* is distinct from var. *diaphanus*. In other words, are the plants of this species (described in this report) that occur along the South Fork of the John Day really unique, or are they little or no different than the many other populations of *A. diaphanus* occurring elsewhere in Oregon and Washington? The answer has management implication since, if the Prineville populations are not distinctive, the plants may no longer merit protection as sensitive or endangered.

Prineville BLM staff indicated in 2010 that the agency may be proposing to downlist *Astragalus diaphanus* var. *diurnus*, presumably because of these taxonomic questions, from sensitive to strategic. ODA looked into the history of the var. *diurnis*, to see whether or not a reduction in status is warranted based on existing information, of if additional work is required to make such a determination. The following background information and suggestions are provided:

1. The species name "*Astragalus diaphanus*" was formally described in the historical literature in 1831, based on early 19th century collections from slopes near the Columbia River.

2. Some very similar populations were later discovered in eastern Oregon, and these were named "*Astragalus diurnus*" in 1886—the original collection for this entity was believed to have come from along the South Fork of the John Day River, below Dayville. This species was also called *Phaca diurna* by Rydberg, and published in 1929 (*N. Amer. Flora 24:251-462*), but the genus *Phaca* is not used these days.

3. Both species names—*A. diaphanus* and *A. diurnus*—remain *taxonomically* valid today. And as late as 1961, the 5-volume set of Hitchcock et al. (*Vascular Plants of the Pacific Northwest*) still recognized *A. diurnus* as a distinct, separate species. The authors did say, though, that it was "very poorly understood," and may be better treated as part of *A. diaphanus*.

4. Later in 1961, Rupert Barneby (the preeminent *Astragalus* taxonomist of the 20th century) decided to reduce *A. diurnus* to a variety, changing it to *A. diaphanus* var. *diurnus* in a small manuscript that he apparently did not publish, but shared with his fried, the Oregon botanist Morton Peck. Barneby clearly felt the South Fork plants were unique, but that they were very closely related to *A. diaphanus* as a whole. The name var. *diurnis* actually first appeared in print in 1961, in Peck's well-known book , the *Manual of the Higher Plants of Oregon* (2nd ed.). Peck offered no commentary on how he felt about the distinctiveness of var. *diurnis*, apparently figuring if Barneby thought it was best treated as variety that was good enough for him. Since the name had appeared in Peck's Manual, there was no need for Barneby to then publish the name separately elsewhere—*A. diaphanus* var. *diurnus* became valid by simply appearing in print in Peck, and remains the name we use today.

5. By 1973, however, the condensed, one-volume version of Hitchcock and Cronquist had appeared (*Flora of the Pacific Northwest*), and the var. *diurnus* was no longer recognized. The name became a synonym under *A. diaphanus*. No explanation for this shift from their earlier interpretation was offered by the authors, and what the change was based on is unknown.

6. Continuing in this vein, the species *Astragalus diaphanus* is recognized by Kartesz (1999), but the var. *diurnis* is not (in *A Synonymized Checklist and Atlas with Biological Attributes for the Vascular Flora of the United States, Canada, and Greenland*). Isley (1998), in his book *Native and Naturalized Leguminosae (Fabaceae) of the United States*, follows suit. These latest opinions are not based on specific or recent research, however, and the only person who has formally studied this milkvetch, Carolyn Wright (in 1990, in her OSU Master's thesis), feels that keeping var. *diurnis* as a separate and distinct taxon is warranted.

7. Based largely on Wright's work, Dr. Stephen Meyers, the taxonomic lead for the Oregon Flora Project (OFP) at OSU, indicates that var. *diurnus* will be maintained in the current OFP checklist.

8. And Dr. Brian Knaus, who recently completed a Ph.D. degree studying *Astragalus* at OSU, is apparently going to compile the treatment of *Astragalus* for the Oregon Flora at some point. It's unlikely Dr. Knaus will change the names as they appear in the OFP checklist, since he's not personally familiar with this species. That means *A. diaphanus* var. *diurnis* is slated to appear as a recognized taxon in the new Oregon Flora—despite how the species is treated by Kartesz and Isley—unless other data come to light that support an alternate viewpoint.

9. So *Astragalus diaphanus* var. *diurnus* is a valid name *taxonomically*, but questions remain (and conceivably this is where Isely and Kartesz' doubts are rooted) as to whether it's *biologically* a "good" taxon. Perhaps this is also why BLM has wondered if the var. *diurnis* should formally remain as a Bureau sensitive taxon. Other than comments in Wright's thesis, Rupert Barneby (1964) (*Atlas of North American Astragalus*) offered the most complete discussion on the natural history of the species, and suggested the taxonomic decision could go either way, pending additional investigation.

10. So based on past and current concepts, the plants we call "*diurnus*" may represent a distinct species, a local but recognizable variety of conservation concern, or nothing more than a marginal form of *A. diaphanus* not worth special management consideration. If they are a distinct taxon, as some propose (including the Oregon Flora Project), it is a very restricted endemic and potentially endangered. If not, then *A. diaphanus* var. *diurnis* can probably come off the list. As it currently stands, it's destined to be included as a "variety" in the new Oregon Flora, barring an actual study to sort things out. Whether or not this has conservation implications for BLM is open for consideration, presumably depending on the management plans for the South Fork area, and then whether the Bureau plans to adopt a policy of recognizing all names that appear in the Oregon Flora when it is published.

11. Finally, what do we mean by a "*biologically good taxon*?" Generally, for plants this refers to whether or not a group of populations is collectively distinguishable, in terms of morphology, reproductive biology, genetics, geographic distribution, etc., from related forms. In a nutshell, a number of readily recognized, measurable traits are needed to separate out two groups of populations as different species. When it comes to varieties, one or two traits, and maybe some geographic separation (such as being isolated along the South Fork) can suffice.

12. In the case of var. *diurnis* versus the rest of *Astragalus diaphanus*, as single trait has been used to classify the South Fork plants as unique: pod form. In Peck's manual (1961), var. *diurnis* is split off simply by having papery, inflated seed pods, as well as being supposedly limited to the South Fork area below Dayville. The much more common and widespread var. *diaphanus* has, turgid, uninflated pods. Wright (1991) supported this observation in her thesis, as did Barneby (1964) in his treatment of the genus.

13. *However*, during ODA's work in 2011, populations were censused that exhibited plants with both pod types. Photos on page 28 (from site 278, Appendix B) clearly show the turgid, narrow pod type and papery, inflated type from different plants in the same patch.

14. The pod observations were mostly noted and considered after the study ended in 2011, so didn't specifically count these, and we do not have specific data to indicate the ratio of pod types in particular populations. But the anecdotal evidence suggests that relying on inflated pods as a strict indicator of the South Fork var. *diurnis* populations may not be consistent. The evaluation of this consistency, as well as an assessment of a wider range of traits, would be necessary to make an informed taxonomic decision.

15. ***Management recommendation—taxonomy.*** BLM has two options, and can draw on a range of opinion to either support recognizing var. *diurnis* as distinct taxon, or not. If the agency plans on synching their view of plant nomenclature with the forthcoming *Oregon Flora*, they might consider working out the taxonomic kinks in *A. diaphanus* through additional study now. Does var. *diurnis* warrant recognition and protection on BLM lands, or are the South Fork populations merely an unusual phase of an otherwise common species, one with little scientific or management significance? Considering its present status under Oregon law as Threatened (http://arcweb.sos.state.or.us/pages/rules/oars_600/oar_603/603_073.html), further evaluation is recommended.

Current ODA Contact Information

Kelly Amsberry
Native Plant Conservation Program, ODA
2082 Cordley Hall, Department of Botany and Plant Pathology, Oregon State University
Corvallis, Oregon 97331
(541) 737-4333 amsberrk@science.oregonstate.edu

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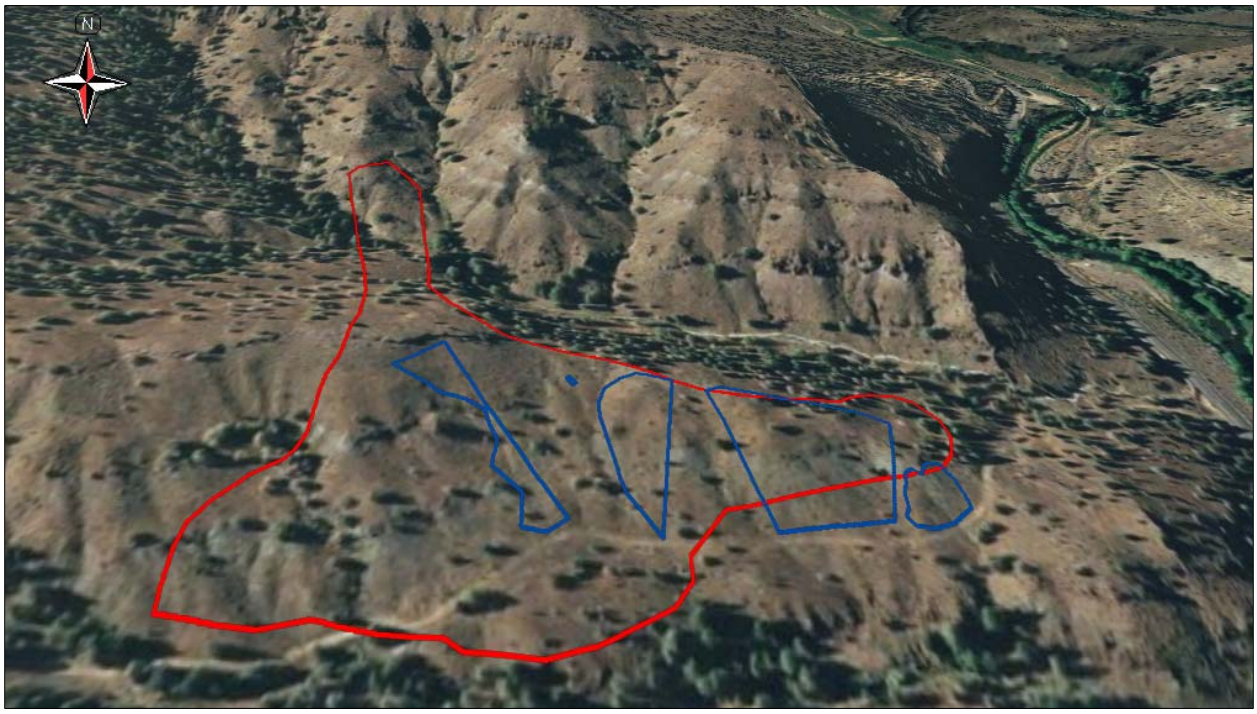
Wright, Carolyn. 1991. *A Systematic and Ecological Study of Astragalus diaphanus (Fabaceae)*. Corvallis: Oregon State University.

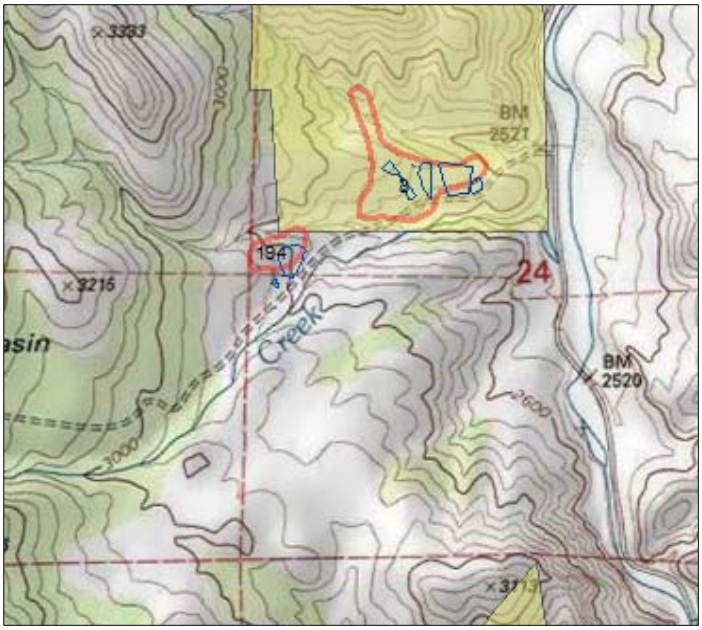
ODA Plant Division, Plant Conservation South Fork John Day Milkvetch (Astragalus Diaphanus Var. Diurnus). *Oregon.gov Home Page*. Ed. Melissa Carr. 8 July 2011. Web. 15 July 2011. <http://www.oregon.gov/ODA/PLANT/CONSERVATION/profile_asdidi.shtml>.

Appendix B. **Photos and approximate survey areas for selected sites (May, 2011).**

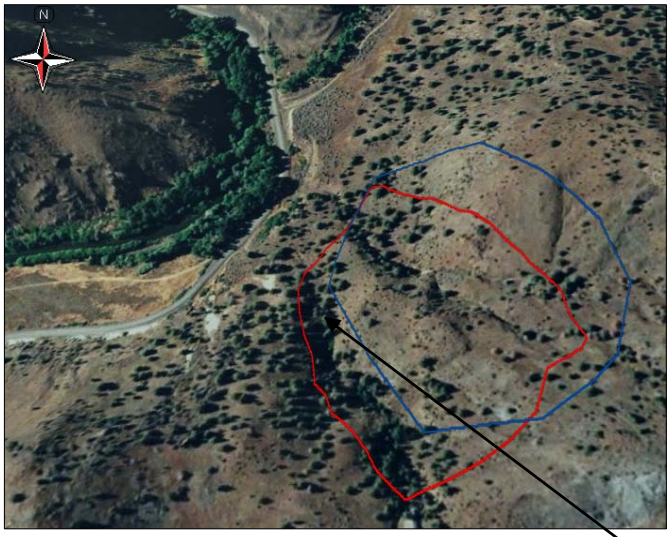
Site 3

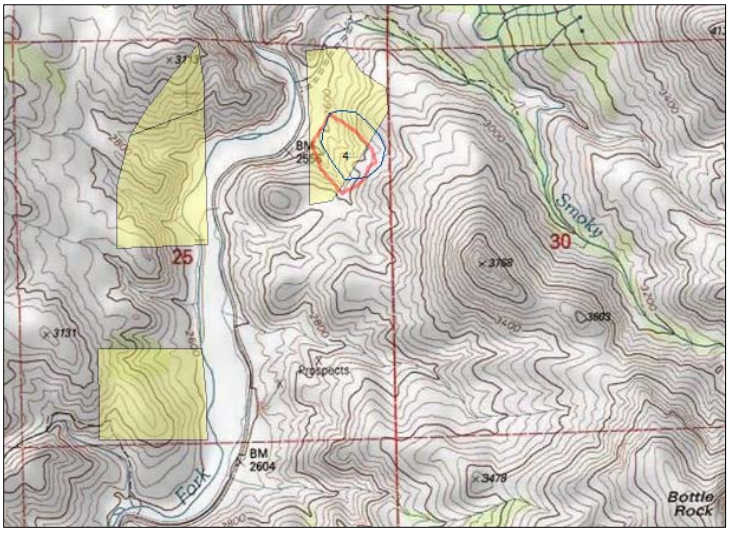


Site 194

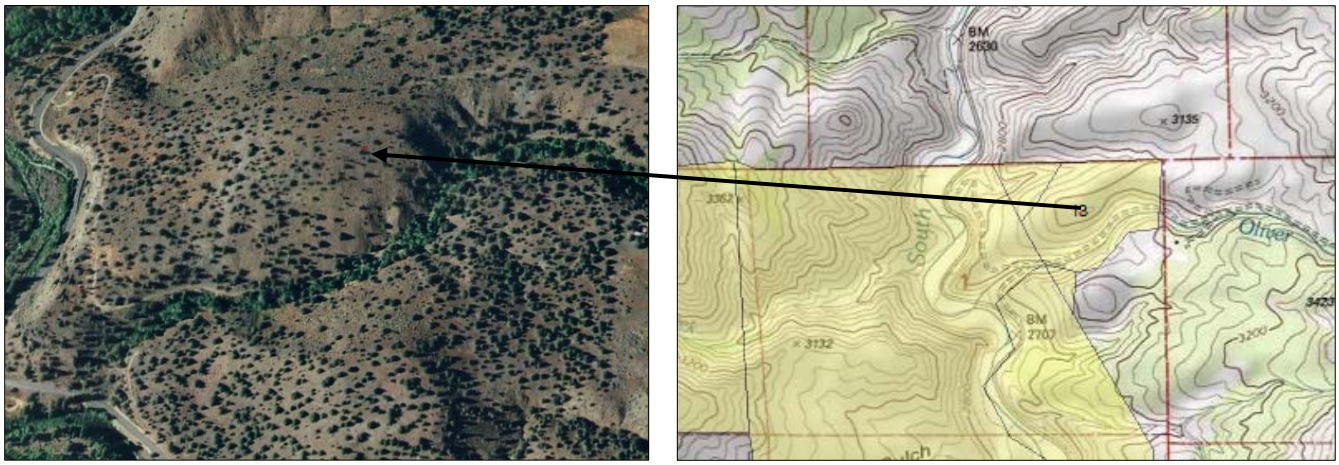


Site 4





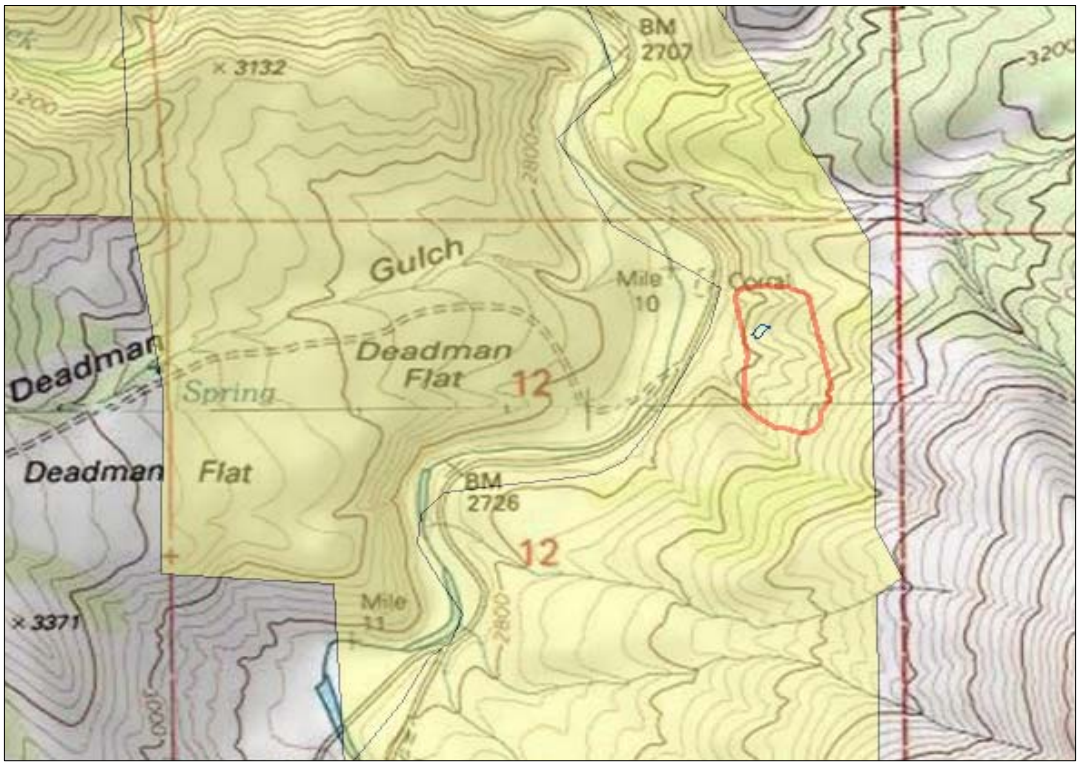
Site 13



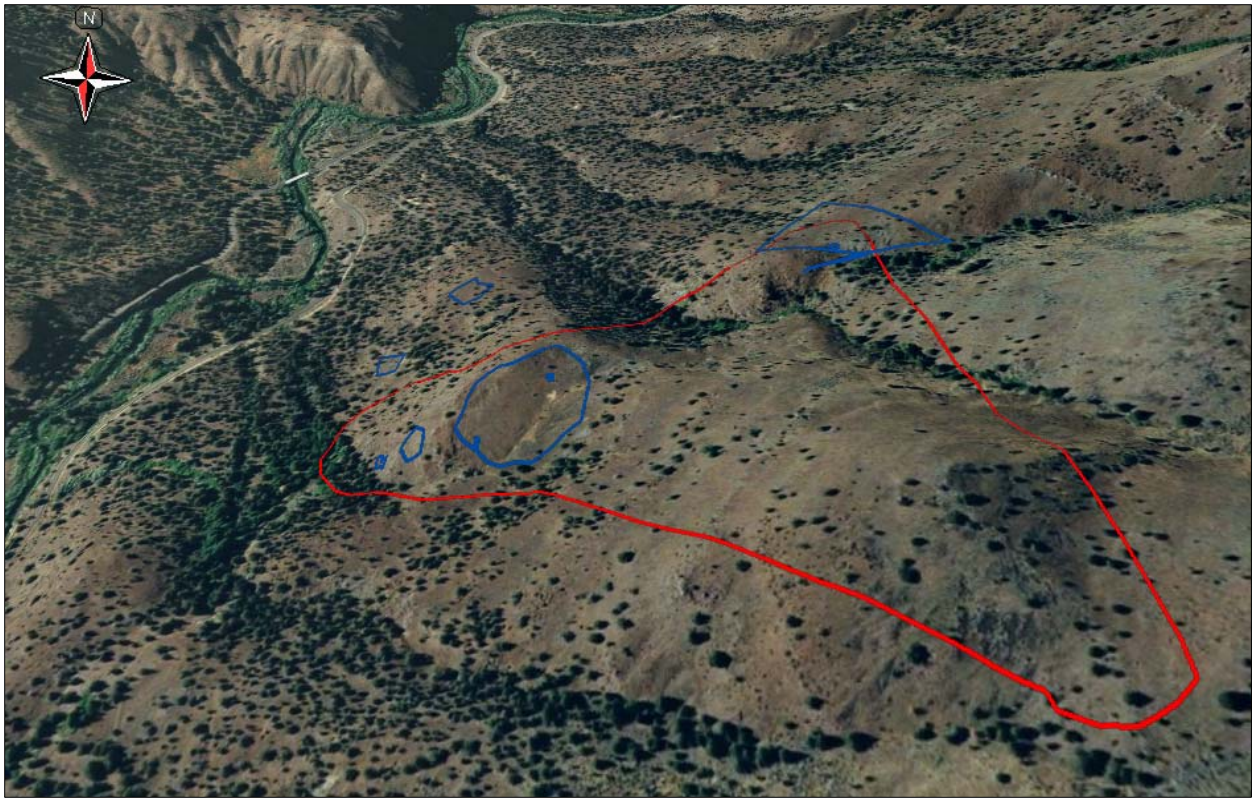
Site 19

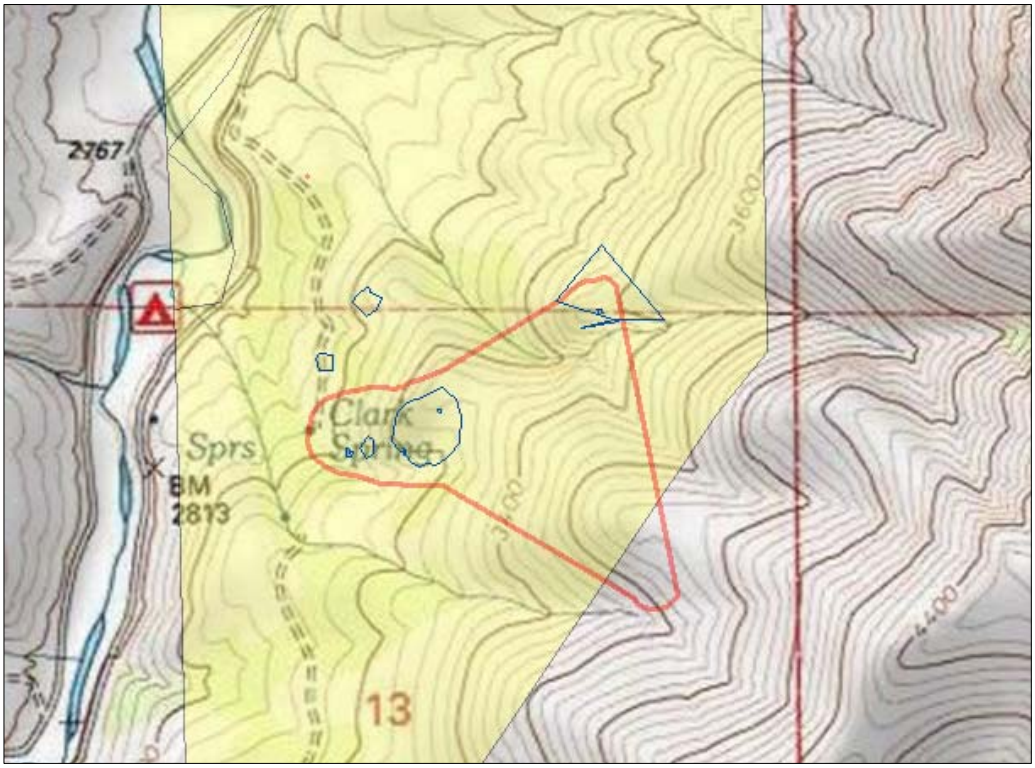
Site 22


N
22
22
22


BM
2707
3132
Gulch
Mile
10
Deadman
Spring
Deadman
Flat
12
Deadman
Flat
BM
2726
12
Mile
11
3371

Site 25





Site 28

Site 219

Site 278