OREGON DEPARTMENT OF AGRICULTURE

NATIVE PLANT CONSERVATION PROGRAM

Annual program performance report for habitat management and monitoring of *Perideridia erythrorhiza* (red root yampah) 2011

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for
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Introduction

Perideridia erythrorhiza. Commonly known as red root yampah, *P. erythrorhiza* is a highly esteemed rare plant due to its beautiful flowers, fennel-like seeds, and especially the edible tuberous roots for which it is named (Figure 1). These nutrient rich and flavorful roots were a sought-after staple for indigenous people in the Umpqua Valley (Blackburn and Anderson 1993). Unfortunately, *P. erythrorhiza* is known only from Douglas, Josephine, Jackson and Klamath counties, where it has become rare due to anthropogenic habitat degradation and loss. Currently known from only a few scattered sites, it is listed as a Species of Concern by the U.S. Fish and Wildlife Service, and as a Candidate for listing by Oregon Department of Agriculture (ODA). The loss of such a unique and culturally important plant would be dreadful—thus, it is vital to understand this plant's ecology in order to preserve it for future generations. Several populations of *Perideridia erythrorhiza* occur within Bureau of Land Management (BLM) North Bank Habitat Management Area (NBHMA; Figure 2). These administratively protected populations contribute significantly to the viability of the species, and provide a venue for conducting studies to determine the effects of selected management techniques on population size, plant growth, and reproductive output.

Figure 1. A) *Perideridia erythrorhiza* in flower and early seed. B) The fleshy tuberous roots of this species would probably survive burning. Photos by R. Woolverton and R.J. Meinke.

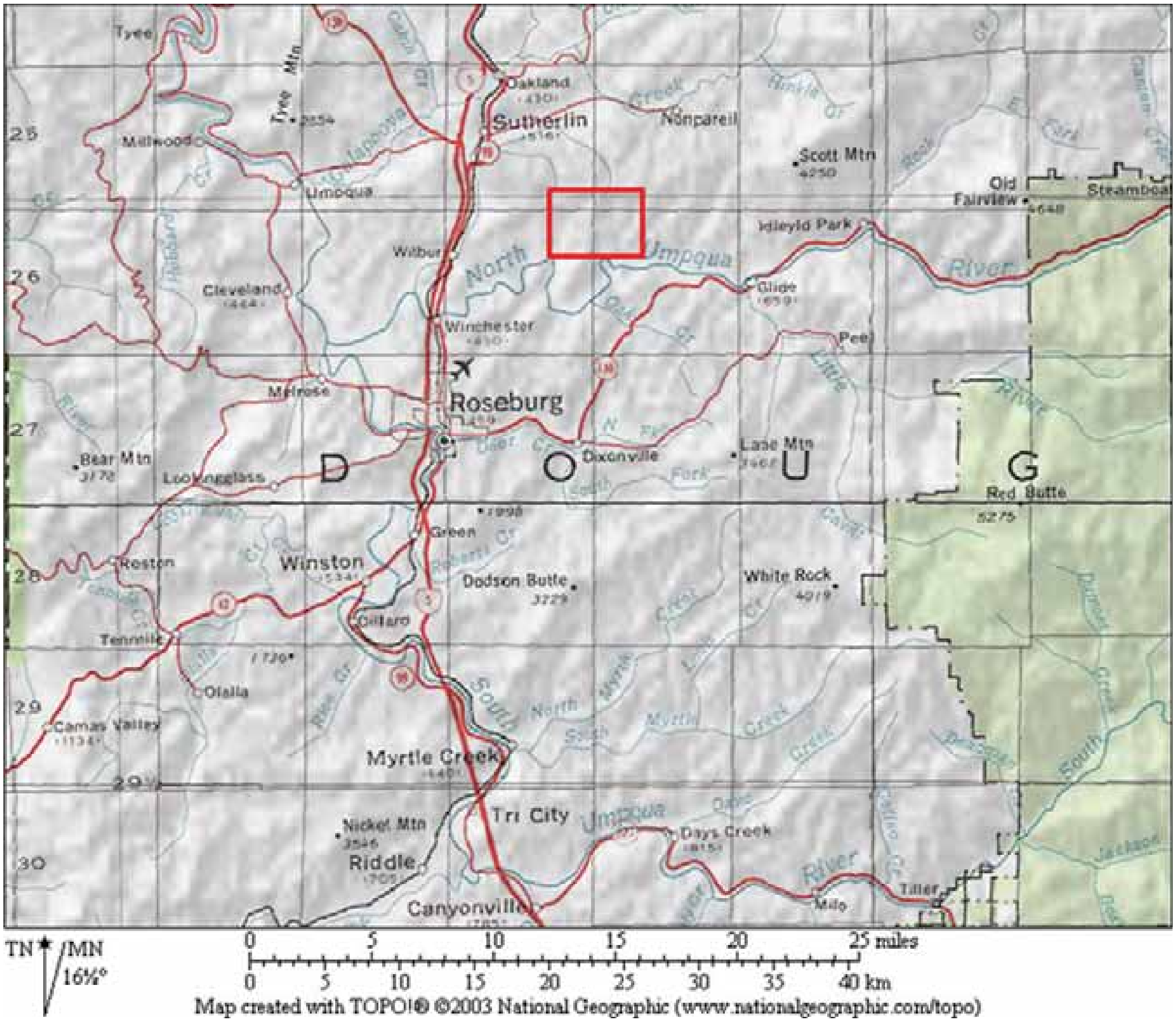

Figure 2. Location of the North Bank Habitat Management Area (shown in red) near Roseburg in Douglas County. (See appendices for specific study site locations.)

Plants of this species prefer seasonally wet areas within meadows (Figure 3), and are often associated with *Juncus* and other wetland taxa. Leaves of *P. erythrorhiza* emerge from underground tubers in spring, with leaf growth and elongation continuing until late June or July when flowering stalks begin to develop. Plants are in full flower during August, with seed maturation occurring in September (Roberts 2000).

Figure 3. Grassland, oak savannah, and seasonal wetland habitat at the North Bank Habitat Management Area.

Use of fire in NBHMA. Fire is a component of most natural ecosystems, and many vegetation communities are adapted to periodic burning. Because fire can improve hunting opportunities, increase the quality of forage for livestock, and enhance the suitability of land for crops, purposeful fires have been used by humans to manage vegetation since prehistoric times. Fires were used by Native Americans in the Willamette and Umpqua valleys for these purposes, and more recently, prescribed fire has been used to control invasive weeds and increase native plant biodiversity in managed natural areas. Good control of many invasive annual grasses has been achieved through the judicious use of prescribed burning, and a considerable number of studies have focused on documenting the specifics of effective weed treatment using this method alone, or in combination with herbicide applications (reviewed in DiTomaso et al. 2006).

As fire was likely a periodic occurrence for *P. erythrorhiza* in the pre-fire suppression era, it is possible that the species may be fire adapted or at the very least resistant. The tubers of *P. erythrorhiza* probably provide some protection from fire for this species, as most prescribed fires do not reach the high temperatures needed to damage tuberous underground structures (DiTomaso et al. 2006; Figure 1, B). However, the late-maturing phenology of this species potentially puts plants at risk during late spring or early summer fires. Plants are actively growing and beginning to produce flowering stalks in June – these structures have the potential to be damaged or destroyed by burning. Conversely, plants of another wetland species (*Plagiobothrys hirtus*) that were damaged by fire during a fall burn recovered after the fire, growing larger and producing more seed in the following summer (Amsberry and Meinke 2005). Burning may have the potential to produce these same increases in size and reproductive output for *P. erythrorhiza*.

At the NBHMA, prescribed fire is being used to control invasive weeds, especially medusahead (*Taeniatherum caput-medusae*), and improve forage for native ungulates. Late spring or early summer burns have successfully controlled medusahead in grasslands and vernal pools in California (Furbush 1953, Pollak and Kan 1996), and have promoted the growth of perennial grasses in low sagebrush habitats infested with medusahead in Oregon (Young 1992). However, none of the studies to date have specifically evaluated the effect of burning on individual native non-target species in the treatment areas. In general, information on the use of fire to manage invasive plants is focused on the immediate effects of fire on the target invasives, with little evaluation of burning treatments on other species or ecosystem components (DiTomaso et al. 2006). Additional information on the effects of fire on non-target species, especially those species of conservation concern, is needed in order to accurately evaluate the suitability of burning treatments for weed control in rare plant habitats.

Objective

The goal of this project is to evaluate effect of prescribed burning on survival, growth and reproduction of *Perideridia erythrorhiza*.

Methods

2009-2010. In August 2009, eight control and eight treatment plots were located within stands of *P. erythrorhiza* at the NBHMA (Figure 4). Locations for the eight control plots were selected in an area not scheduled for prescribed burns, and the treatment plots were located across a small stream ~200 meters away from the controls in an area scheduled to be burned for weed treatment. Plot locations were marked with rebar stakes in the area to be burned and PVC stakes in the control area. All plots were labeled with a metal tag, and GPS coordinates were recorded for each plot. Although burning of treatment plots had not yet occurred, the NBHMA was revisited for data collection in August 2010. Unfortunately, plot markers had been removed from six plots in the control area, and the locations of these disturbed plots could not be re-established. Consequently, data were collected from a total of 10 plots, two in the control area and eight in the treatment area.

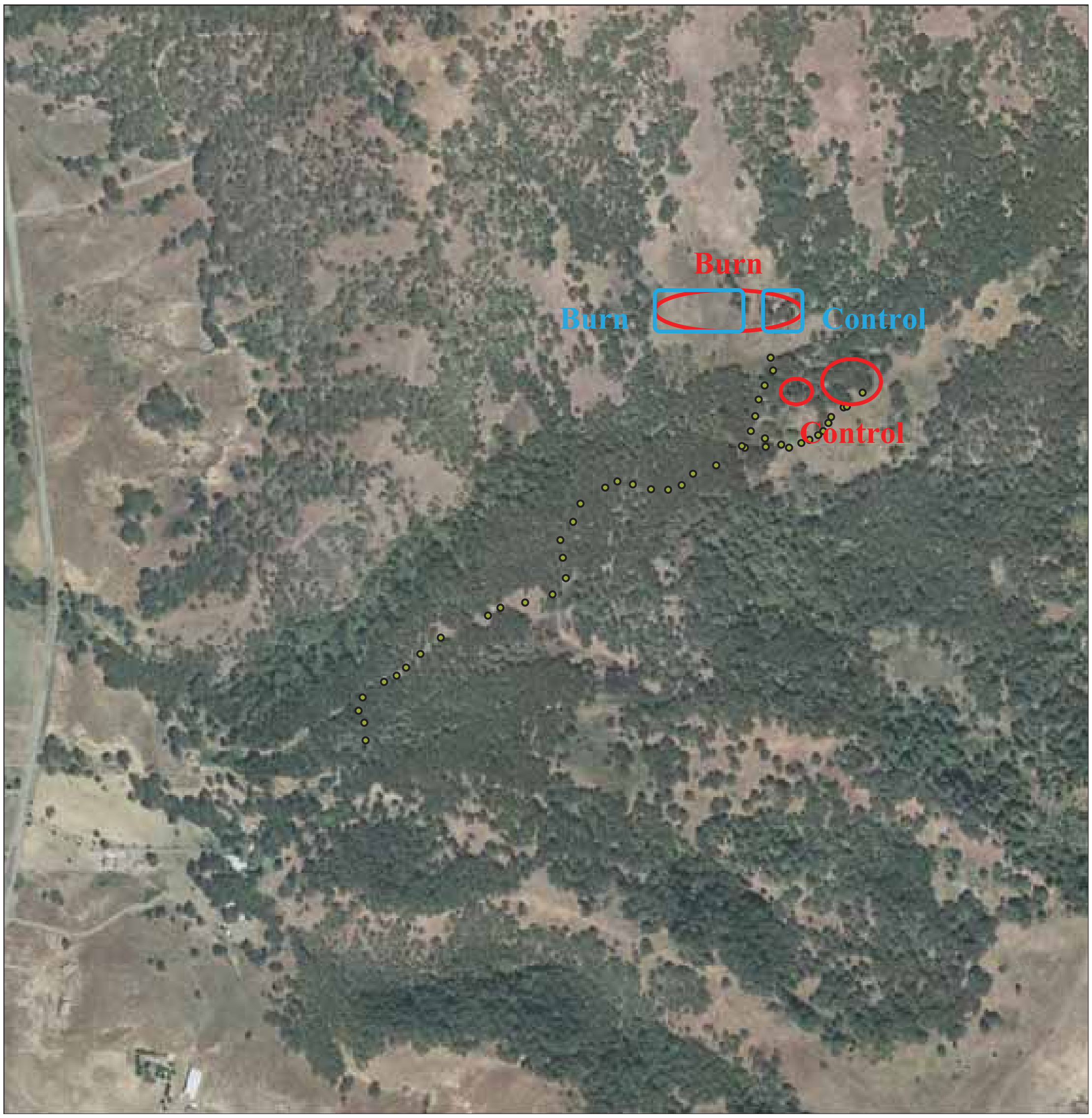

Figure 4. Original control and burn sites, outlined in red, for the *P. erythrorhiza* prescribed burn study in the NBHMA. New control and burn area outlined in blue. Yellow dots mark path to study sites.

2011. Upon visiting the control plots with BLM staff in August 2011, we discovered that the area had been mowed (Figure 5). Mowing damaged markers for the two control plots remaining (plots 701 and 702) after the previous year's vandalism destroyed plots 703-708. Locating plots was impossible due to the destruction of the locator stakes, and mowing removed biomass to the extent that data could not be collected. The effect of mowing plants during active growth is not known; re-visiting these plots in the future (if markers can be located) could provide an opportunity to evaluate the effect of this treatment on *P. erythrorhiza*.

Figure 5. The area where control plots were placed in 2009 (left photos) was mowed in 2011 (right photos) requiring set-up of new control plots in an unmowed area.

In order to move forward with the study, new control and burn plots were created in stands of *P. erythrorhiza* within the area that had been previously selected as the burn area. Five new plots, (plots 392-396), were installed in the east portion of the meadow where treatment plots (scheduled to be burned) were created in 2009. This area was then designated as the new control area. Three new plots, 398-397, were then added to the west side of the previous burn so that the new burn and control area would each have nine plots in total (Appendix 1). As in the 2009 set-up, the plots were designated by two stakes, rebar for the burn plots and PVC for the control. Each plot was labeled with a numbered metal tag. The GPS coordinates were also recorded with a Trimble GPS unit to aid in locating all plots in subsequent years (Appendix 2). A twenty foot buffer was created between the new control and plots to be burned in order to allow room for fire crew operations (see Appendix 1 for current and previous plot locations). Pre-burn data were then collected from each of the 18 plots. The treatment type, number of plants per plot (abundance), number of umbels per plant (a measure of plant size), and the number of seeds per umbel for 10% of the total umbels (an estimate of reproductive capacity) were recorded (Figure 6). The data-set was then analyzed, via a student's t-test, to insure that the control and burn areas were not significantly different before being treated with the burn.

Figure 6. Data (plants/plot, umbels/plant, seed/10% of umbels) being collected in a meter squared plot in the control area.

Results/Discussion

Pre-treatment data summary/analysis. Parameters that do not differ significantly between control and treatment plots prior to treatment can be compared directly after the treatment is complete. A student's t-test was used to determine if differences in three parameters were significant between control and burn plots. P-values were greater than 0.05 for abundance of plants per plot and mean number of seeds per inflorescence (Table 1), indicating that there is no significant difference between these parameters in burned and control plots (prior to treatment). Burn and control groups can be compared directly after burning is complete. However, since the mean number of inflorescences per plant did differ significantly between burn and control groups, subsequent analysis of this parameter will need to take into account the initial difference between the two.

Table 1. Summary from data collected in 2011 showing the abundance (plants per plot), the mean number of umbels per plant (measure of plant size), and the mean number of seeds per umbel (measure of reproductive capacity). The last line contains the p-values resulting from student's t-test comparing plots within the burn and control areas.

Plot	Treatment	Plants per Plot	Mean # of inflor/pant	Mean seeds/inflor (10% of inflor)
397	Burn	39	9.00	34.86
398	Burn	11	11.64	49.50
399	Burn	8	6.75	38.80
777	Burn	10	15.30	55.27
791	Burn	3	4.33	9.00
792	Burn	1	6.00	27.00
1558	Burn	6	10.33	35.83
1559	Burn	0	0.00	0.00
1560	Burn	0	0.00	0.00
392	Control	1	13.00	34.50
393	Control	1	11.00	26.00
394	Control	13	16.38	76.06
395	Control	9	20.56	47.90
396	Control	2	4.33	0.00
788	Control	12	9.58	57.18
790	Control	5	13.20	41.29
800	Control	31	12.74	46.76
993	Control	3	27.33	56.22
p-values:		**0.983079**	**0.021082**	**0.148088**

Though the data-set from previous years is too small to analyze with a large degree of statistical significance, analysis identified some trends. An ANOVA was run on each of the three parameters to determine they varied over time (See Appendices for complete data-set and ANOVA tables). Predictably, the p-value indicates that there was a significant difference between years for all three parameters. In 2010, there was a sharp decrease in the means for all parameters; this drop was followed by a moderate resurgence in population size and vigor within the plots in 2011. The most pronounced change was observed in the abundance of plants (Figure 7). Only a slight resurgence in plant number was observed in 2011. The other two parameters recovered more appreciably; in 2011 both plant size (Figure 8) and reproductive capacity (Figure 9) achieved levels comparable to the values recorded in 2009.

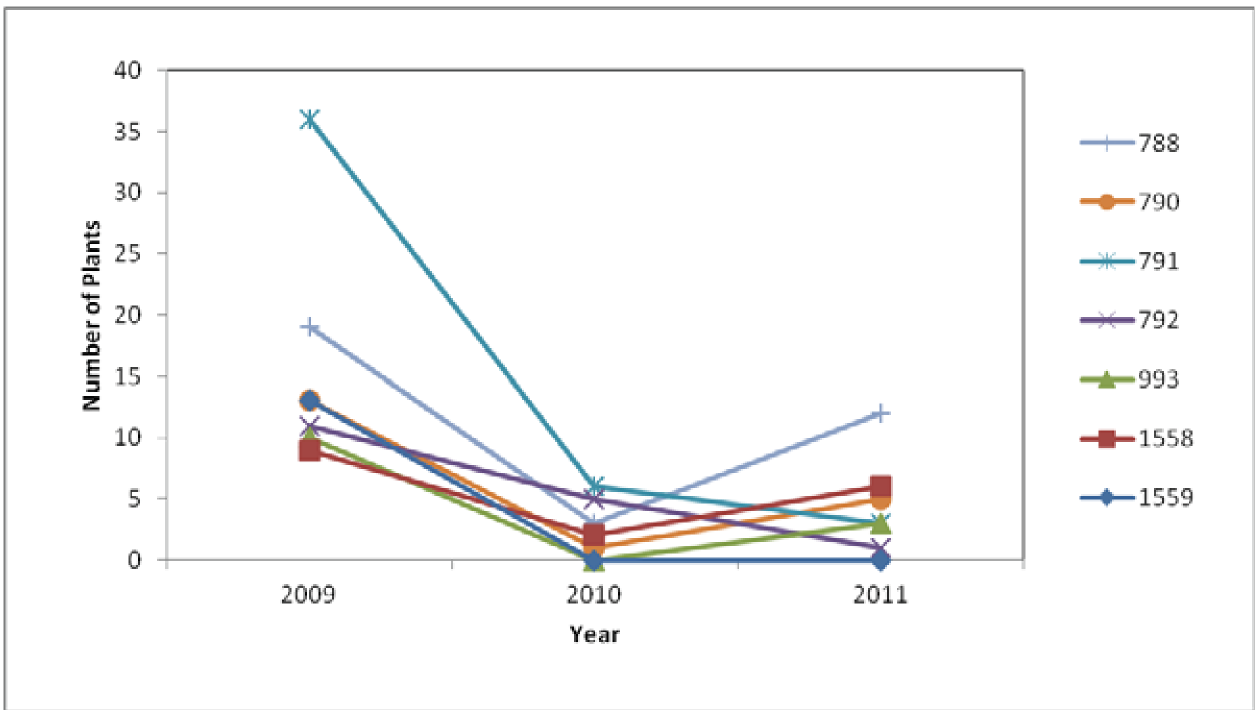

Figure 7. The number of plants per plot (abundance) decreased sharply between 2009 and 2010, with a moderate resurgence is most plots in 2011, although plant numbers continued to decline in plot 791. No plants emerged in plot 1559 in 2010 or 2011. Further monitoring of these plots will document the continuation or cessation of these trends. Individual plot numbers are listed in the key.

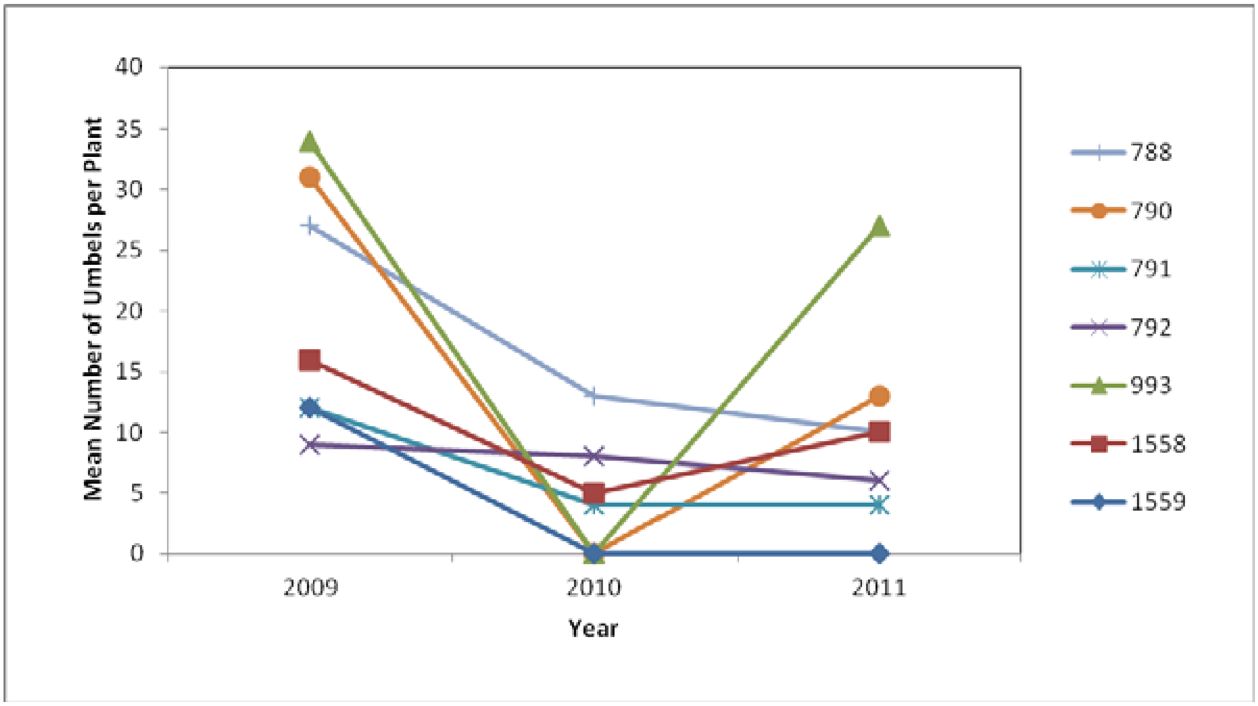

Figure 8. The mean number of umbels per plant (plant size) decreased for most plots between 2009 and 2010, but showed some recovery in 2011. Plot numbers are listed in the key.

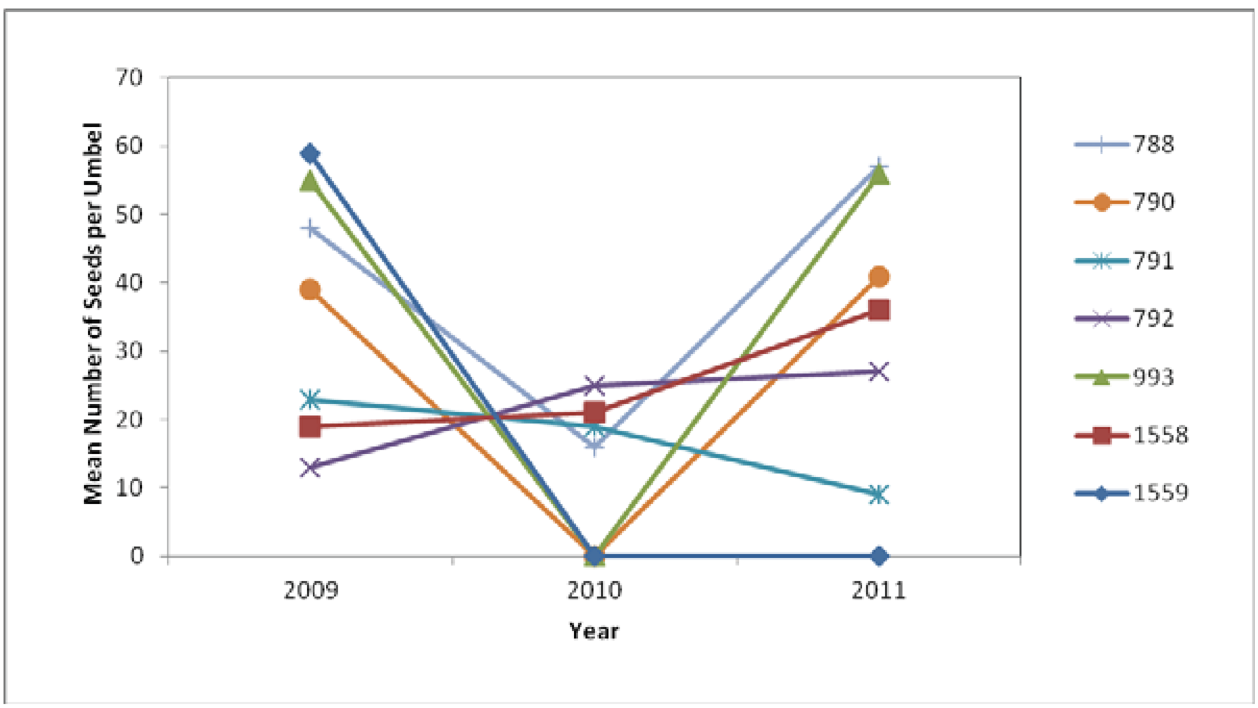

Figure 9. The number of mean number of seeds per umbel decreased sharply for four plots between 2009 and 2010. However, in 2011 the values in three of these plots increased again to previously observed levels (plot 1559 remained unoccupied). The other three plots did not exhibit extreme fluctuations. Plot numbers are listed in the key.

Mentha pulegium (pennyroyal) might be a factor contributing to the observed population fluctuations (Figure 10). This invasive weedy species produces allelopathic affects on another rare wetland native of Douglas County (*Plagiobothrys hirtus*) and reduces the germination rate of *P. erythrorhiza* (Amsberry and Meinke 2008). It might be beneficial to begin monitoring the prevalence of *M. pulegium* to determine if there is a correlation between pennyroyal increase and *P. erythrorhiza* decline. Additionally, documenting the effects of the burn treatment on *M. pulegium* might provide insights into the value of including burning in the management of wetlands infested with this species.

Figure 10. *Mentha pulegium* growing in conjunction with *P. erythrorhiza* inside one of our study plots. This weedy allelopathic species is very prevalent at this site and may negatively impact native plants.

The 2009-2010 decline in *P. erythrorhiza* cannot, however, be directly linked to *M. pulegium*; other factors are likely involved in the decrease in population size and vigor observed within the plots. As the thick tuberous root indicates, *P. erythrorhiza* is a perennial species. Thus, while it has been shown that *M. pulegium* has an effect on *P. erythrorhiza* seed germination (Amsberry and Meinke 2006), the presence of this species would not be expected to decrease number of established *Perideridia*. One other possibility is that the decrease in plants within the plots is not actually linked to an overall population decrease, but simply represents a difference in distribution in mature flowering plants. A study on *Perideridia americana,* a closely related species, documented variability in flowering among years, with plants flowering inconsistently in years subsequent to their first bloom (Baskin and Baskin 1992). Plots were intentionally installed in areas of high plant densities in 2009, but plants here may now be dormant, with plants outside the plots exhibiting greater emergence and reproduction. Additional monitoring data will help elucidate these possibilities.

2012 schedule

- Winter 2012 – In cooperation with BLM, review project goals and adapt study plan to account for plot disturbance; develop a plan to prevent future damage to plots
- Late June/early July 2012 – Burn plots in treatment area
- Summer 2012 (post burn) – Collect data from all plots
- Fall 2012 – Additional data collection on reproductive parameters if needed
- Fall 2012/Winter 2013 – Enter, analyze and summarize data; review literature in regard to annual variation in *Perideridia* to determine the importance and cause of the observed decline of our study plants between 2009 and 2010
- Fall 2012/Winter 2013 – Develop recommendations for the suitability of prescribed fire as a management tool in *Perideridia* populations

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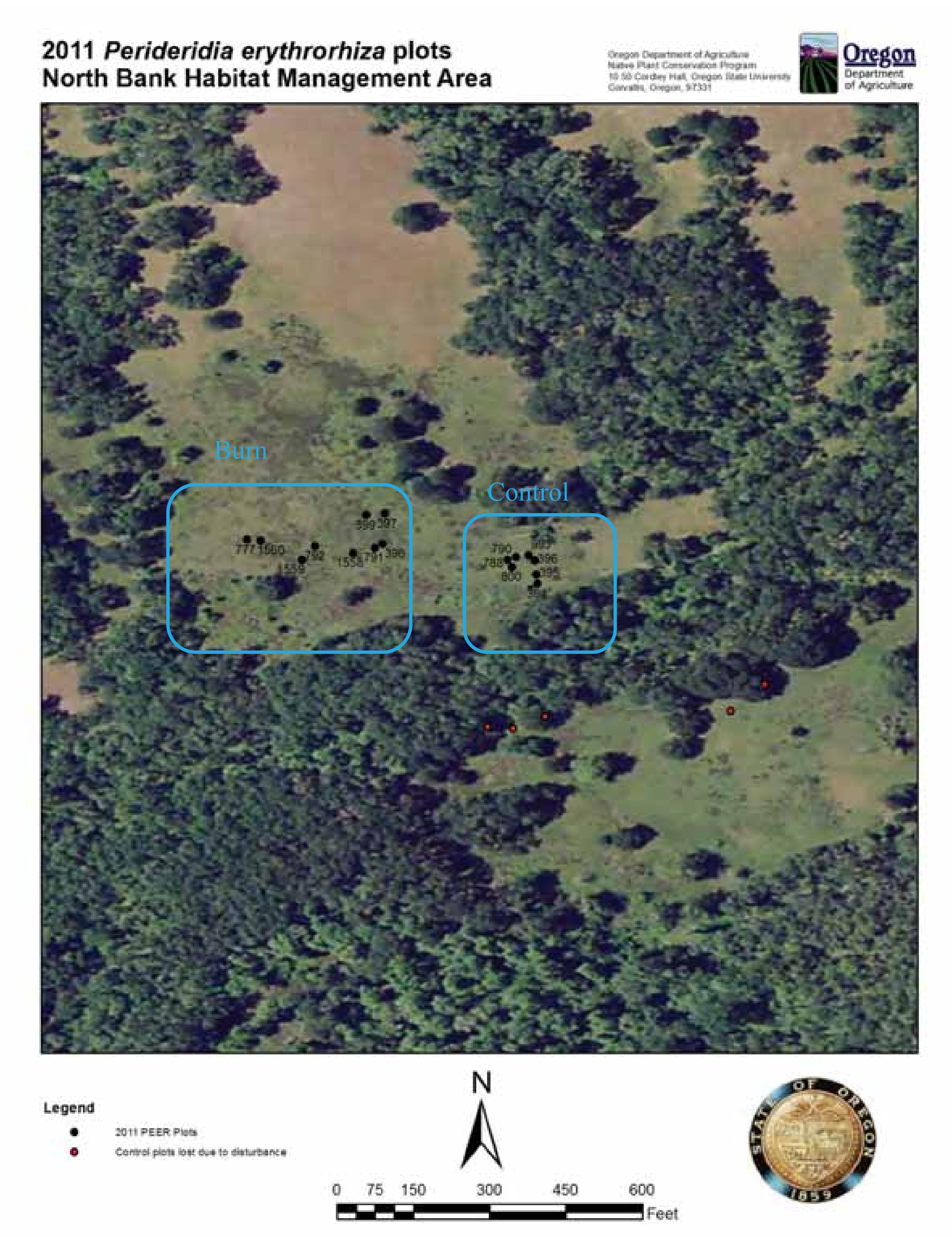
Appendices

Appendix 1



Appendix 2

2011 GPS Coordinates for Plot Locations

Plot #	Location
394	-123.241552 43.317449 Decimal Degrees
395	-123.241955 43.318059 Decimal Degrees
396	-123.241965 43.318137 Decimal Degrees
397	-123.242772 43.318390 Decimal Degrees
398	-123.242784 43.318226 Decimal Degrees
399	-123.242873 43.318379 Decimal Degrees
777	-123.243517 43.318248 Decimal Degrees
788	-123.242112 43.318138 Decimal Degrees
790	-123.242068 43.318156 Decimal Degrees
791	-123.242829 43.318205 Decimal Degrees
792	-123.243151 43.318213 Decimal Degrees
800	-123.242087 43.318100 Decimal Degrees
993	-123.242000 43.318164 Decimal Degrees
1558	-123.242944 43.318176 Decimal Degrees
1559	-123.243219 43.318139 Decimal Degrees
1560	-123.243444 43.318245 Decimal Degrees

Appendix 3

Summary of data from 2009 through 2011 for plots with more than one year of data collection (new plots installed in 2011 are not included, and destroyed plots in the previously designated control area are also not included.) The plots installed at this site in 2009 were originally designated as burn plots. The column titled '2011 Treatment' indicates the new allocation of the plot and the column titled 'Year' indicates the year in which the data were recorded.

Plot	2011 Treatment	Year	Plants Per Plot	Mean # of umbels/plant	Mean # of seeds/umbel[1]
788	Control	2009	19	27	48
790	Control	2009	13	31	39
993	Control	2009	10	34	55
788	Control	2010	3	13	16
790	Control	2010	1	0	0
993	Control	2010	0	0	0
788	Control	2011	12	10	57
790	Control	2011	5	13	41
993	Control	2011	3	27	56
791	Burn	2009	36	12	23
792	Burn	2009	11	9	13
1558	Burn	2009	9	16	19
1559	Burn	2009	13	12	59
791	Burn	2010	6	4	19
792	Burn	2010	5	8	25
1558	Burn	2010	2	5	21
1559	Burn	2010	0	0	0
1560[2]	Burn	2010	5	4	15
777[2]	Burn	2011	10	15	55
791	Burn	2011	3	4	9
792	Burn	2011	1	6	27
1558	Burn	2011	6	10	36
1559	Burn	2011	0	0	0
1560[2]	Burn	2011	0	0	0

[1]*The method for collecting data in this column differed slightly in 2011 and may affect among year comparison.*
[2]*These plots were not measured every year and were not included in Figure 7.*

Appendix 4

ANOVA Table for Plants/Plot by Year

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	741.238	2	370.619	10.02	0.0012
Within groups	666.0	18	37.0		
Total (Corr.)	1407.24	20			

ANOVA Table for Umbels/Plant by Year

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	902.952	2	451.476	6.63	0.0070
Within groups	1226.29	18	68.127		
Total (Corr.)	2129.24	20			

ANOVA Table for Seeds/Umbel by Year

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	2502.38	2	1251.19	3.99	0.0369
Within groups	5648.86	18	313.825		
Total (Corr.)	8151.24	20			