



2015 Annual Report

Spalding's Catchfly, *Silene spaldingii*, Wallowa Lake Key Conservation Area

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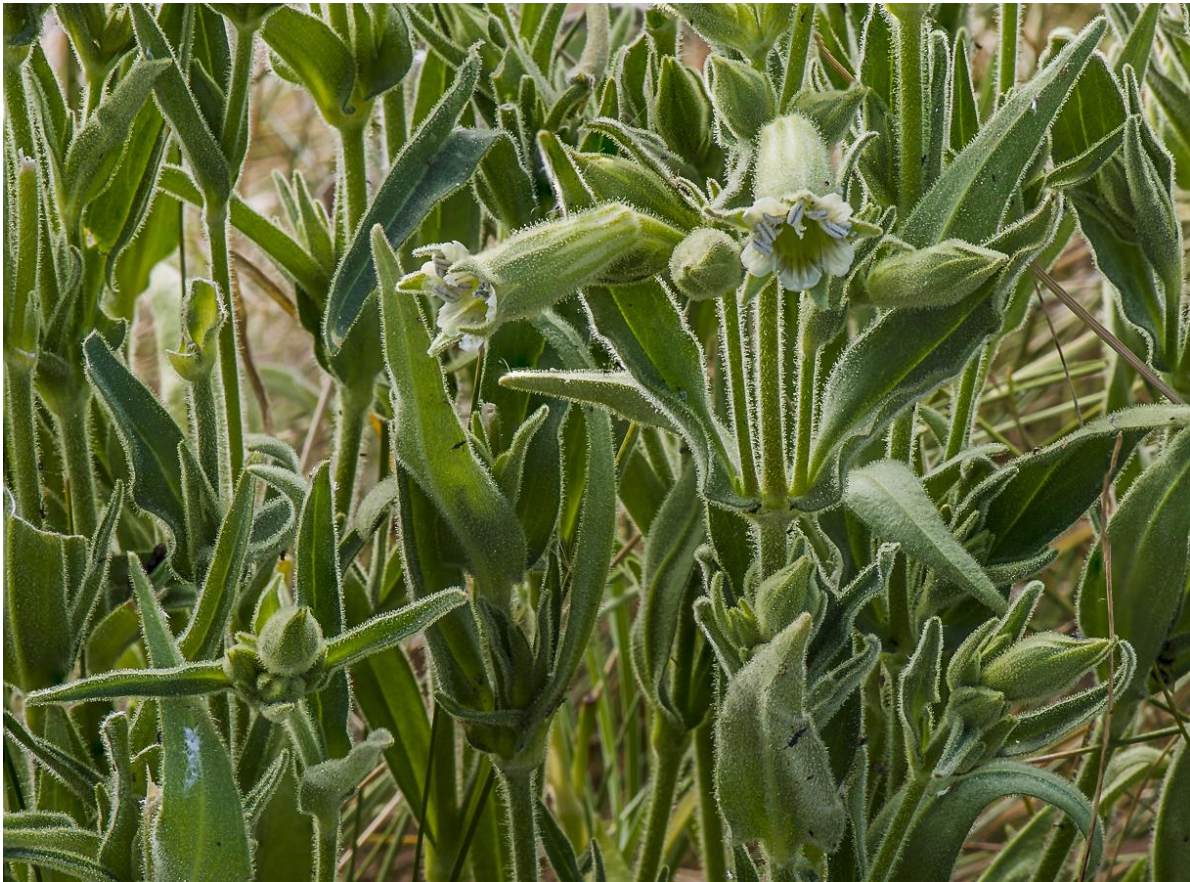


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INTRODUCTION

Spalding's Catchfly

Spalding's catchfly (*Silene spaldingii*), is an herbaceous perennial plant in the pink family (Caryophyllaceae). The plants, ranging in height from 20 to 76 centimeters (8 to 30 inches), rise from a persistent caudex atop a long taproot. Most commonly, plants are found with only one stem but often multiple stems are present. The lanceolate leaves which are 5 to 8 centimeters (2 to 3 inches) in length are opposite and attach to the stem at swollen nodes. The approximately 1.5 centimeters (0.6 inch) corollas are greenish-white with petal blades 1-2 millimeters (~0.02 inch) that extend only past the calyx. Normally 3 to 20, though sometimes more than 100, flowers are positioned horizontally near the top of the plant in a branched inflorescence (Hitchcock and Cronquist 1973). The leaves, stems and calyx of the plant are covered in sticky glandular-pubescent hairs (Figure 1). These hairs collect foreign material including insects providing the common name "catchfly."



Figure 1. Spalding's catchfly (*Silene spaldingii*) with short petal blades and dense sticky hairs.

Spalding's catchfly can be confused with similar appearing members of the *Silene* genus that occur within its range. Figure 3 shows a comparison with *Silene scouleri* (Scouler's catchfly), *S. douglasii* var. *douglasii* (Douglas' catchfly), *S. oregano* (Oregon catchfly), and *S. scaposa* var. *scaposa* (scapose silene). Scouler's catchfly is the species most likely to be confused with Spalding's catchfly within the area considered in this report (Figure 2).



Figure 2. Scouler's catchfly (*Silene scouleri*)

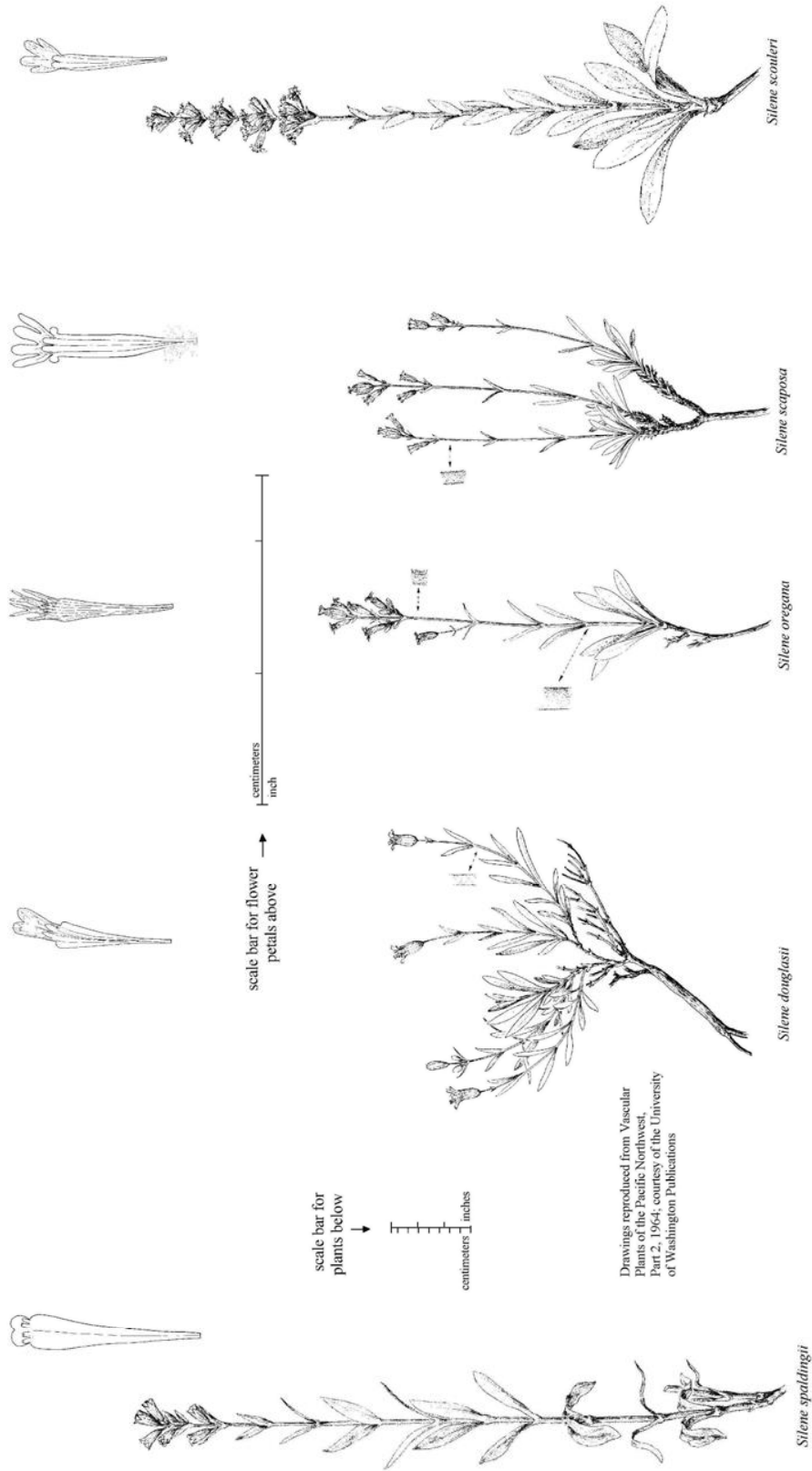


Figure 3. *Silene spaldingii* and a few of its closest look-alikes.

Spalding's catchfly plants can be undetectable in a given year during periods of dormancy when the extensive root structure does not produce above-ground shoots. Dormancy may last as long as five years and may be affected by the availability of resources and environmental variation (Lesica 1999, Lesica and Crone 2007, Taylor et al. 2012). Because of the variation in detectability of this plant, multiple year studies are necessary to determine the strength and stability of any population of Spalding's catchfly.

Spalding's catchfly plants will be found in one of four stages throughout the year: rosettes (basal leaves), vegetative (non-flowering stems), reproductive (flowering/fruitletting), or dormant (Lesica and Crone 2007). The methods described in this report are intended to track changes in individuals and the population through annual and multiple year study.

The Oregon Department of Agriculture listed Spalding's catchfly as endangered in the State of Oregon in 1995, in response to the increasing potential for extinction due to habitat loss and degradation. The plant was federally listed as threatened under the Endangered Species Act on October 10, 2001 (U.S. Fish and Wildlife Service 2001).

Spalding's catchfly is a perennial wildflower found in bunchgrass grasslands, sagebrush-steppe, and occasionally in open pine communities in eastern Washington, northeastern Oregon, west-central Idaho, western Montana, and a very small portion of British Columbia, Canada.

The current study is a continuation of efforts conducted in 2010, 2011, 2012, 2013 and 2014 (Elseth et al. 2012, Jocius 2013, Moholt 2013, 2014). For consistency and comparability of data, methods that were used in this study follow, as closely as possible, those used by Elseth et al. 2012, Jocius 2013, and Moholt 2013, 2014.

Site Description

The current project was conducted as part of an ongoing effort to locate and monitor Spalding's catchfly plants within the area designated as the Wallowa Lake Key Conservation Area (see Figure 4) which covers 3,375 acres. This area is located in Wallowa County, Oregon at the head of the Wallowa Valley in the glacial till soils on the terminal and east lateral moraine of Wallowa Lake. In 1898, William Cusick was the first to document *S. spaldingii* in the Wallowa Lake area (Oregon Biodiversity Information Center 2009). The Wallowa Valley is within the physiographic region designated as the Blue Mountain Basins (U.S. Fish and Wildlife Service 2007). The majority of the Wallowa Lake Key Conservation Area is located on privately owned land. Within the conservation area, the long-term monitoring efforts, discussed here, have been focused on 13 acres held in trust by the Department of the Interior for the Nez Perce and Umatilla Tribes, but managed by the National Park Service (Old Chief Joseph Gravesite and Cemetery) and on 62 acres purchased by a coalition of the Oregon Parks and Recreation Department, the Nez Perce Tribe, the Confederated Tribes of the Umatilla Reservation, Confederated Tribes of the Colville Reservation and the Oregon State Parks Trust (Iwetemlaykin State Heritage Site).

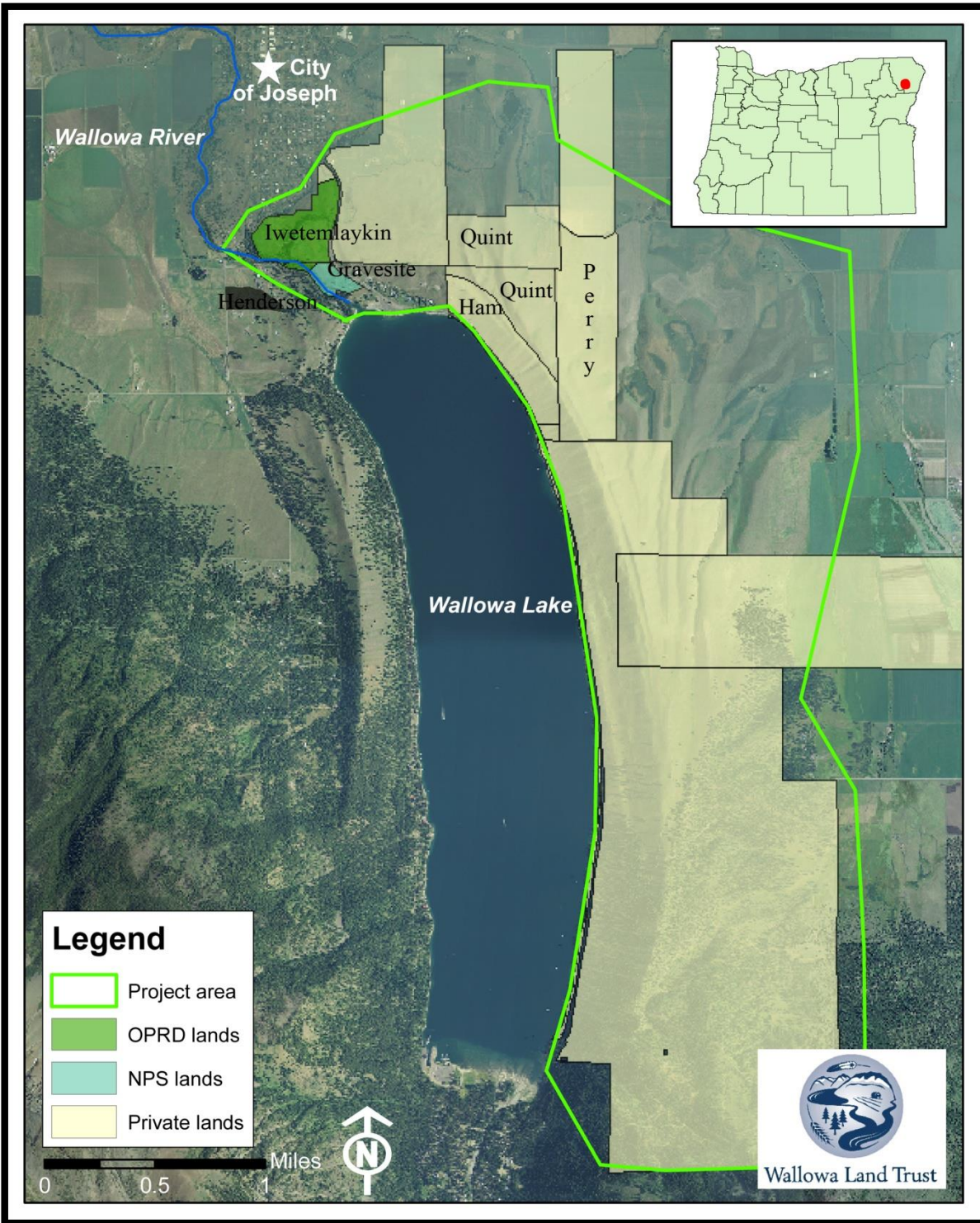


Figure 4. The Spalding's Catchfly Wallowa Lake Key Conservation Area.

STUDY OBJECTIVES

The goal of ongoing monitoring and survey efforts within the Wallowa Lake Key Conservation Area is to obtain information that will aid management and restoration decisions critical to ensuring that the Spalding's catchfly population in the Wallowa Lake Area is protected, reproductively active and self-sustaining.

The primary objectives of the 2015 Wallowa Lake Spalding's catchfly investigation were to:

- Monitor Spalding's catchfly occurrences at Iwetemlaykin State Heritage Site & the Old Chief Joseph Gravesite and to collect reproductive output data in continuation of the ongoing monitoring program started in 2010.
- Continue the collection of baseline information needed to develop a draft management plan that can be implemented for Spalding's catchfly in the Wallowa Lake Key Conservation Area.

METHODS

2015 Plant Occurrences at Iwetemlaykin State Heritage Site & Old Chief Joseph Gravesite

As stated by Elseth et al. 2012:

"Detailed monitoring protocols for accurately estimating the size of populations of *Silene spaldingii* in a variety of habitats have been developed (Lichthardt and Gray 2003, Hill and Gray 2005, Lesica and Crone 2007, Taylor et al. 2009). However, monitoring the population at the Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite and Cemetery site did not require a population size estimation technique, as the small number of plants present here could be censused individually."

Phase 1:

A Bio-Resources, Inc. botanist coordinated with the Wallowa Land Trust who provided experienced partner agency personnel and volunteers to assist with an inventory of Iwetemlaykin State Heritage Site and Old Chief Joseph Gravesite. On August 5, 2015 inventory participants were spaced in teams approximately five meters apart on the 13-acre Old Chief Joseph Gravesite property. The five meter-spaced transects were walked approximately parallel to the highway from southeast to northwest. Upon completing transects, the inventory teams moved west along the northern boundary fence and reestablished a new series of transects approximately five meters from the western most transect on the previous run. This sweep was conducted from the northern fence to the southern fence also spaced five meters apart. This allowed the teams to cover the entire site, as the western most inventory transect on the second sweep abuts the western boundary of the property (see Figure 5).

Using the same techniques, a survey was conducted on the Iwetemlaykin State Heritage Site property. Crews walked transects from south to north in the same pattern as described above, marking Spalding's catchfly sites accordingly. When Spalding's catchfly plants were encountered, if no permanent tag was present, plants were marked with pin flags. Whenever a plant was observed at least two other observers, including one botanist, verified that the plant was, in fact, Spalding's catchfly (*Silene spaldingii*) and not another *Silene* species.

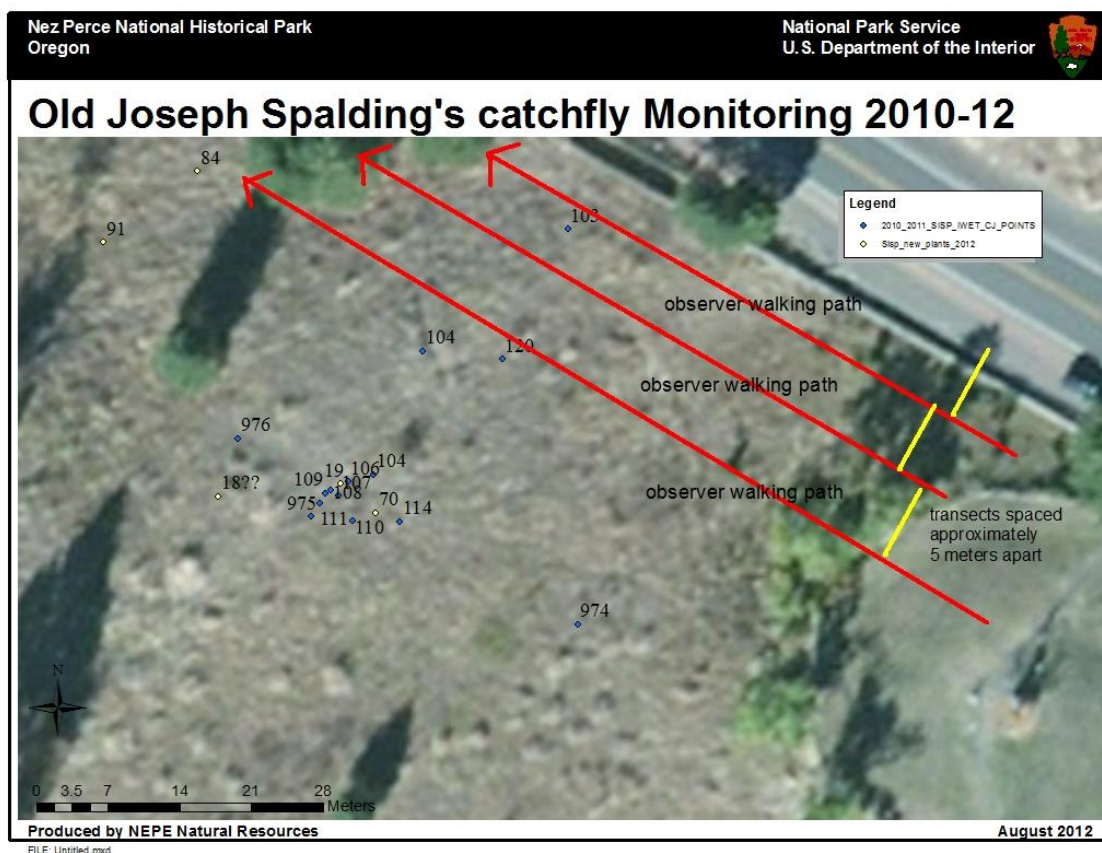


Figure 5. Data collection methodology from 2010-2014 also used in 2015 showing observer walking paths and distance from one another (from: Jocius, 2013).

Phase 2:

Individual plants encountered during the inventory that were new to the project would have been recorded with a GPS unit and marked with permanent metal stakes and numbered tags. However, no new plants were found in 2015. Previously, plants that were found very close to the Old Chief Joseph monument mound on the National Park Service site were only documented with a GPS point and not a permanent tag. However, no new plants were found in this sensitive area in 2015.

Phase 3:

The team that included the Bio-Resources, Inc. botanist visited all known Spalding's catchfly sites. Stem, browse, flower and fruit data were recorded for each plant on a data sheet (see Appendix A) and on a Trimble GPS unit. All temporary pin flags were removed.

Resurvey Late Season Plants at Iwetemlaykin and Old Chief Joseph Gravesite

On September 24, 2015, a Bio-Resources, Inc. botanist revisited Iwetemlaykin State Heritage Site and Old Chief Joseph Gravesite to collect flowering, herbivory and fruiting data on all known individuals. If new plants were located, they were to be marked, locations recorded with a GPS and added to the database with stem, browse, flower, and fruit data recorded. However, as noted previously, no new plants were found in 2015.

Macro Vegetation Plots at Iwetemlaykin State Heritage site

The following methods are those presented by Elseth et al. 2012 and are presented here with only minor modifications (e.g. dates).

Two adjacent macro plots measuring 5x20m (running east-west with a 7m buffer between them) were set up in 2010 on the Iwetemlaykin State Heritage Site, in an area where no individuals of Spalding's catchfly were found (Figure 7). Five transects were then created running west to east in each of the four subplots (Plots 1 through 4). Along these transects 20, 50x50cm quadrants were designated. The first quadrat was located in the southwest corner of the plot. Moving east incrementally 50cm and alternating between the south and north side of each transect, 20 quadrants were designated in a checkerboard fashion (Figure 7). No plants of Spalding's catchfly were known to occur in the area selected for this part of the study, but three plants are known on the boundaries of the macro plot. These were avoided during herbicide application.

One macro plot had been treated on April 30, 2014 with herbicide SelectMax™ (active ingredient Clethodim) mixed at 1.5% with 1% Modified Seed Oil (MSO) as an adjuvant. The other macro plot remained untreated. Each macro plot was divided into two smaller plots, by splitting the macro plots directly in half to create a total of four plots each measuring 5x10m. One plot was treated with herbicide then broadcast seeded with native grass seed (plot 3), one was treated with herbicide only (plot 4), one was seeded only (plot 1), and one was left

untreated as a control (plot 2).

Because quadrat size can influence frequency data (Smith et al. 1986), ODA staff (Elseth et al. 2012) designed a nested plot frame that allows efficient collection of data from a series of quadrat sizes. The technique of using this frame (nested frequency monitoring) allows flexibility in the selection of the appropriate quadrat size to include in analysis (see [http://www.webpages.uidaho.edu/veg_measure/Modules/Lessons/Module%206\(Frequency\)/Nested%20Frequency%20Techniques.htm](http://www.webpages.uidaho.edu/veg_measure/Modules/Lessons/Module%206(Frequency)/Nested%20Frequency%20Techniques.htm), Launchbaugh 2009). Frames are divided into four quadrat sizes (5x5cm, 25x25cm, 25x50cm, 50x50cm). Although data are recorded for each quadrat size, the subsequent analysis focuses on the most informative data set. (If a quadrat is too small, the target species may never be recorded, and if the quadrat is too big, target species may be in all plots.) Depending on the type and density of vegetation present, different plot sizes may be appropriate for each species or vegetation group. In the field, the smallest quadrat in which a functional group or species occurs is recorded. The appropriate quadrat size for each functional group or species is then selected based on the frequency of occurrences being between 20% and 80%.

In our study, vegetation functional groups were defined as: exotic perennial grasses (EPG; predominantly the target non-native grass *Poa pratensis*), exotic annual grasses (EAG; *Bromus tectorum* and others), exotic forbs (EF; *Cynoglossum officinale* and others), native perennial grasses (NPG; *Festuca idahoensis*, *Koeleria cristata* and others), native perennial forb (NPF; *Artemisia ludoviciana* ssp. *candicans*, *Achillea mollis*, *Lithospermum ruderale* and others) and native annual forbs (NAF; *Collinsia parviflora*, *Microsteris gracilis* and others).

Nested frequency pre-treatment monitoring data and 2015 data collected following the herbicide and native plant seeding treatment of 2014 were analyzed using a chi square statistic (Yates correction used as appropriate) to determine if the frequency of occurrence for each functional group differed before and after treatment. Pre and post treatment differences for the treated plots were compared with those for the control (no treatment).

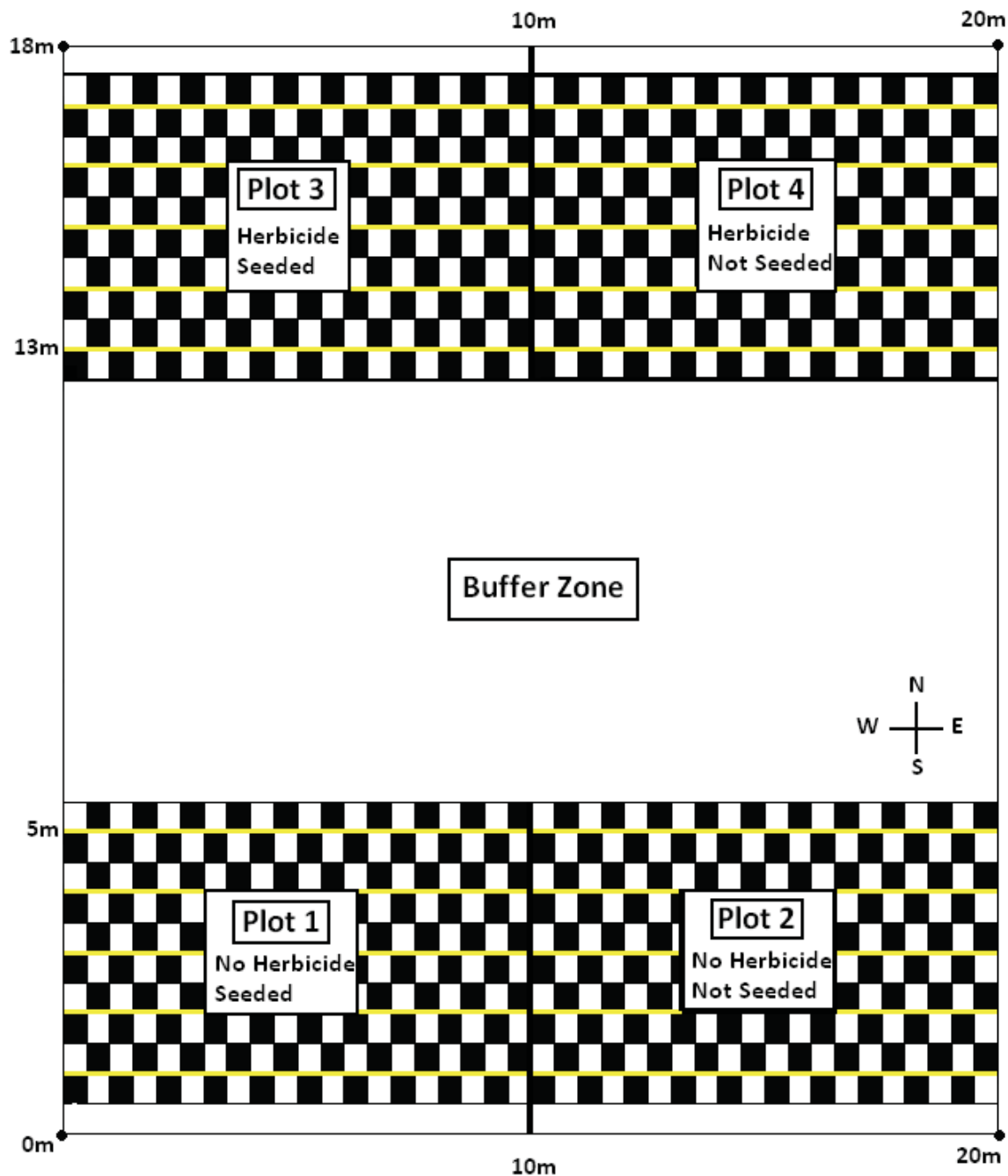


Figure 7. Habitat improvement plot layout. Plots were surveyed in a checkerboard fashion (black squares = surveyed quadrants; white squares = un-surveyed quadrants) using five transects (yellow) in each plot. The corners of the total habitat improvement area are marked with rebar stakes (black dots). Plots 1 and 2 were treated with herbicide but plots 3 and 4 will. In addition, plots 1 and 3 will be seeded with native grass, while the others will remain unseeded (from Elseth et al. 2012).

RESULTS

2015 Plant Occurrences at Iwetemlaykin State Heritage Site & Old Chief Joseph Gravesite

As noted above, the monitoring effort at the Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite and Cemetery site is an attempt to track all individual plants and is not based on a population estimate technique. Therefore, the data presented here are a representation of the potential reproductive output of the entire subpopulation found at the Iwetemlaykin Site and Old Chief Joseph Gravesite (Table 2).

During the August 5, 2015 survey of the Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite and Cemetery site, 36 plants were located. The plants had a mean of 1.25 stems per plant (see Table 2). At this relatively early date in the plants' breeding phenology, a majority of the plants (92%) were in flower while about half of the plants (53%) had fruits. It should be noted that even at this early stage in the reproductive season for Spalding's catchfly, about one quarter of the stems (24%) showed signs of large mammal herbivory where at least 10% of a stem's biomass was estimated to have been removed (see Figure 8). In the absence of herbivory, the number of plants in flower may have been higher. The 36 plants located in 2015 during the monitoring of the Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite are known individuals located previously during this ongoing study.

Appendix B presents reproductive output data from six years of monitoring. Caution should be used when comparing these data among years, because plants may not have been observed during identical points in the subpopulations breeding phenology (see Discussion).

Table 2. Summary of August 5, 2015 Monitoring Data at Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite (number of individual plants, n=36).

	<i>No. of stems</i>	<i>Browsed stem</i>	<i>No. of flowers</i>	<i>Fruits</i>
Total	45	11	723	43
Mean	1.25	0.31	20.08	1.19
Median	1	0	11	0
Standard Deviation	0.65	0.58	32.53	1.97
Standard Error	0.11	0.10	5.42	0.33
Minimum	1	0	0	0
Maximum	4	2	169	7



Figure 8. A Spalding's catchfly plant showing signs of heavy browsing, likely from deer.

Photo- © Kendrick Moholt 2014

Resurvey Late Season Plants at Iwetemlaykin and Old Chief Joseph Gravesite

A revisit to the Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite on September 24, 2015 located 35 detectable plants. One plant previously located on August 5, 2015 was no longer present. The plants had a mean 1.26 stems per plant (see Table 3). The August survey found plants primarily in flower. This mid-September survey found plants significantly advanced in their phenology with the majority of the plants, 89%, in fruit and only 9% with flower. The number of stems showing signs of herbivory showed a slight increase later in the year (36% of stems in September versus 25% of stems in August).

Table 3. Summary of September 24, 2015 Monitoring Data at Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite (n=35).

	<i>No. of stems</i>	<i>Browsed stem</i>	<i>No. of flowers</i>	<i>Fruits</i>
Total	44	16	23	289
Mean	1.26	0.46	0.66	8.26
Median	1	0	0	4
Standard Deviation	0.70	0.92	1.94	14.07
Standard Error	0.12	0.16	0.33	2.38
Minimum	1	0	0	0
Maximum	4	3	10	81

Table 4. September 24, 2015 End of Season Resurvey of Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite (- = no data, no plant)

Tag number	Total number of stems	Number of browsed stems	Number of flowers (per plant)	Number of fruits (per plant)
1	0	-	-	-
7	0	-	-	-
9	0	-	-	-
18	Tag not located	-	-	-
19	1	1	0	8
24	Tag not located	-	-	-
28	Tag not located	-	-	-
29	1	0	0	4
38	1	0	0	0
43	0	-	-	-
48	1	1	8	19
54	0	-	-	-
55	0	-	-	-
56	0	-	-	-
57	0	-	-	-
58	0	-	-	-
59	0	-	-	-
60	0	-	-	-
61	1	0	0	81
62	0	-	-	-
63	0	-	-	-
64	0	-	-	-
65	Tag not located	-	-	-
66	Tag not located	-	-	-
67	0	-	-	-
68	1	0	0	4
70	Tag not located	-	-	-
72	1	0	0	2
75	0	-	-	-
76	3	3	8	13
77	0	-	-	-
81	0	-	-	-
(45)83	1	0	0	9
84	1	0	1	7
85	0	-	-	-
87	0	-	-	-
90	1	0	0	22

91	0	-	-	-
92	0	-	-	-
95	0	-	-	-
96	0	-	-	-
98	0	-	-	-
99	1	0	0	9
100	3	3	0	4
101	0	-	-	-
103	1	0	0	1
102	0	-	-	-
104	1	0	0	4
105	0	-	-	-
106	1	0	0	6
107	0	-	-	-
108	0	-	-	-
109	1	0	0	1
110	0	-	-	-
111	0	-	-	-
112	1	1	0	0
113	1	1	0	0
114	0	-	-	-
115	1	0	0	7
116	1	0	0	7
117	0	-	-	-
118	1	0	0	13
119	1	0	0	12
120	0	-	-	-
121	1	0	0	0
122	0	-	-	-
123	0	-	-	-
124	0	-	-	-
125	0	-	-	-
126	0	-	-	-
127	Tag not located	-	-	-
128	0	-	-	-
129	0	-	-	-
130	0	-	-	-
131	0	-	-	-
132	0	-	-	-
133	0	-	-	-
134	0	-	-	-
135	0	-	-	-
136	0	-	-	-
137	0	-	-	-

138	Tag not located	-	-	-
139	0	-	-	-
240	1	0	0	13
264	0	-	-	-
265	1	0	0	0
289	2	0	0	20
293	1	0	0	0
968	1	0	0	6
969	1	0	3	8
970	0	-	-	-
971	Tag not located	-	-	-
972	Tag not located	-	-	-
973	Tag not located	-	-	-
974	1	1	0	0
975	0	-	-	-
976	1	0	0	0
977	0	-	-	-
978	1	0	0	0
979	0	-	-	-
979	0	-	-	-
980	0	-	-	-
981	4	3	2	9
982	Tag not located	-	-	-
983	0	-	-	-
984	2	2	1	0
985	Tag not located	-	-	-
986	0	-	-	-
987	0	-	-	-

Macro Vegetation Plots at Iwetemlaykin State Heritage site

Changes in frequency of functional groups pre and post treatment (2014-2015) was monitored at Iwetemlaykin plots using nested frequency vegetation monitoring. Pre-treatment (prior to herbicide and native seed treatment) data from 2014 and post-treatment data collected in 2015 use the same, appropriate quadrat size for each functional group (Tables 9 and 10, respectively). Post-treatment data collection, the quadrat size was chosen to select the frequency of occurrences, as close as possible, within a range between 20 percent and 80 percent (Smith et al. 1986). Quadrat size 1 (5x5cm) was selected for exotic perennial grasses (EPG). All other functional groups used quadrat size 2 (25x25cm). The data presented show the number of times the species in the functional group are present in the designated quadrat. Each treatment plot was sampled 100 times. Plots 1 and 2 are more similar to each other than they are to plots 3 and 4, especially for the exotic perennial grass (EPG) target group. This was noted by Elseth et al. (2012) in their report describing the design for this investigation. However, this study compares changes in frequency of groups between pre- and post- treatment years (rather than between plots). Therefore, it is assumed that initial differences do not affect analysis results.

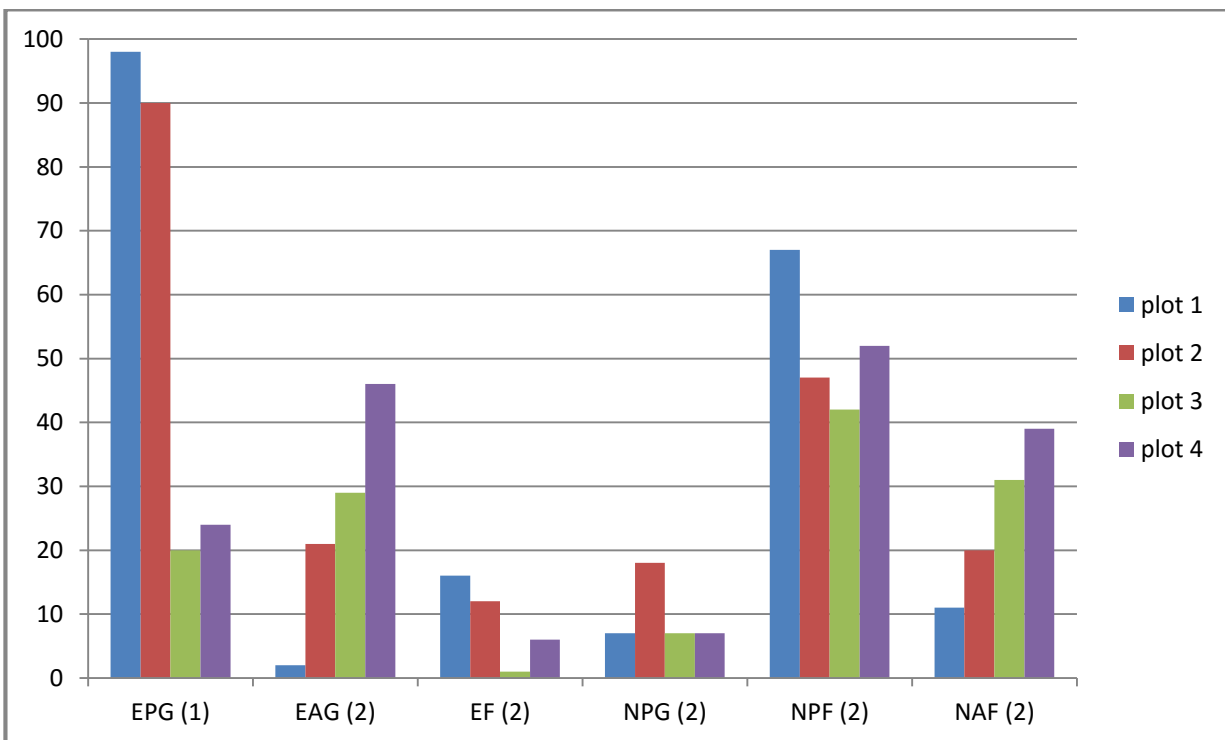


Figure 9. Pre treatment 2014. Frequencies of functional vegetative groups varied among plots sampled without treatment effect in 2014. Each plot was sampled 100 times. EPG=exotic perennial grass; EAG=exotic annual grass; EF=exotic forb; NPG= native perennial grass; NPF= native perennial forb; NAF= native annual forb. Values in parentheses represent quadrat size selected (1)=5x5cm; (2)=5x25cm; (3)=25x50cm; (4)=50x50cm.

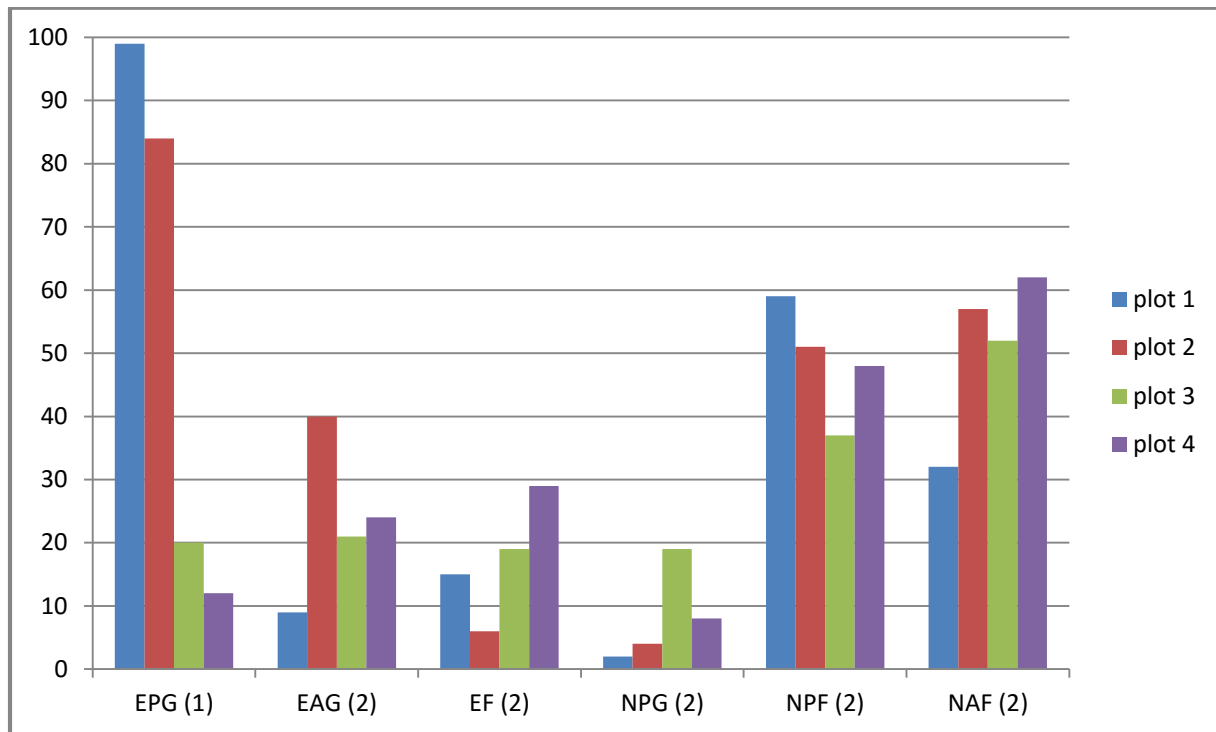


Figure 10. Post treatment 2015. Frequencies of functional vegetative groups varied among plots sampled in 2015. Each plot was sampled 100 times. EPG=exotic perennial grass; EAG=exotic annual grass; EF=exotic forb; NAF= native annual forb. Values in parentheses represent quadrat size selected (1)=5x5cm; (2)=5x25cm; (3)=25x50cm; (4)=50x50cm.

A comparison, by functional group, of pre and post treatment is seen in Figures 11 through 14. Actual X-square numbers and p-values are found in Appendix C.

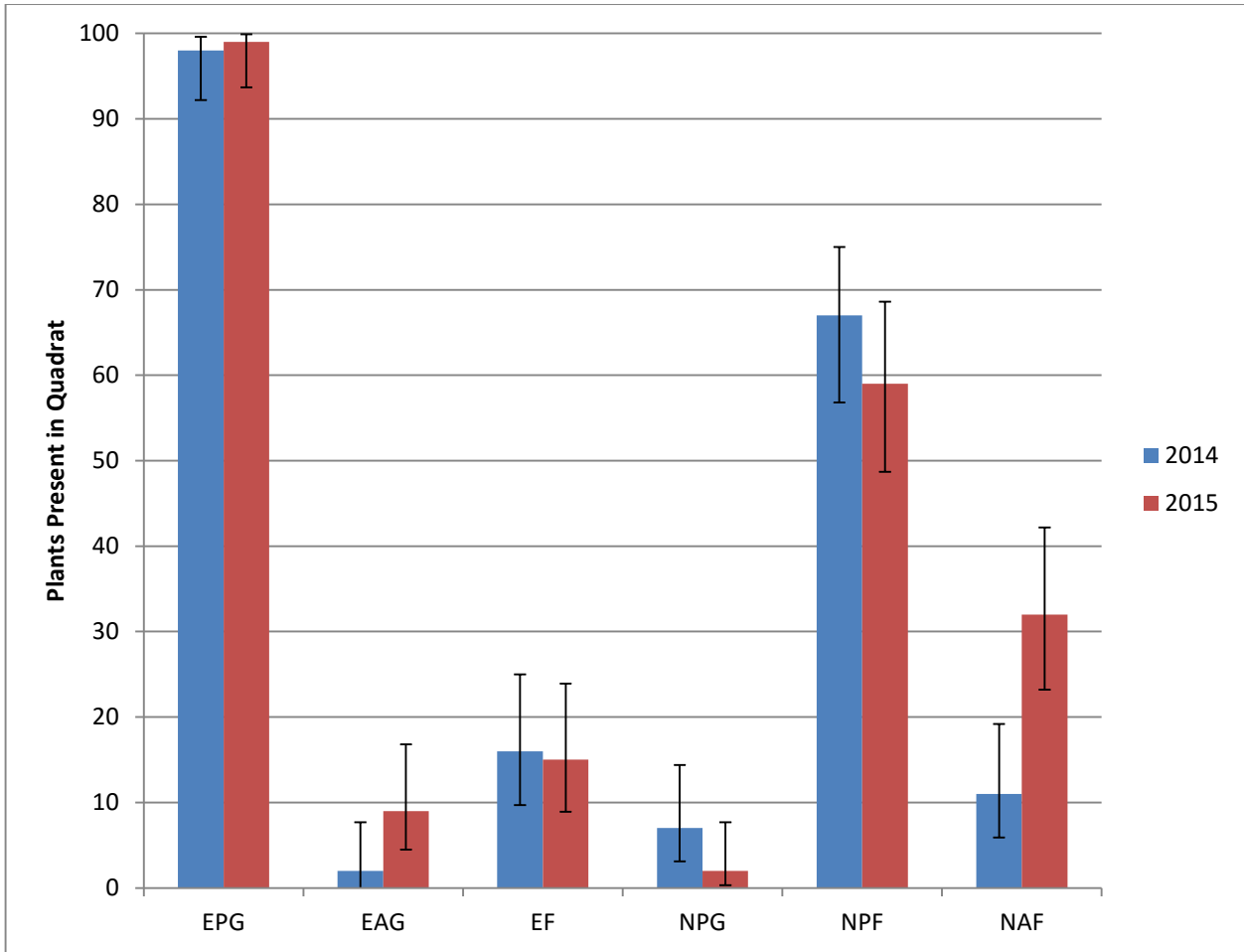


Figure 11. Macro Vegetation Plot 1. A comparison of functional groups from Plot 1, of pre-treatment (2014) and post treatment seeding with native grass seed and no application of herbicide (2015) is presented here with 0.95% confidence intervals. EPG=exotic perennial grass; EAG=exotic annual grass; EF=exotic forb; NPG= native perennial grass; NPF= native perennial forb; NAF= native annual forb. EPG functional group data collected from quadrat 1. Data from all other functional groups collected from quadrat 2.

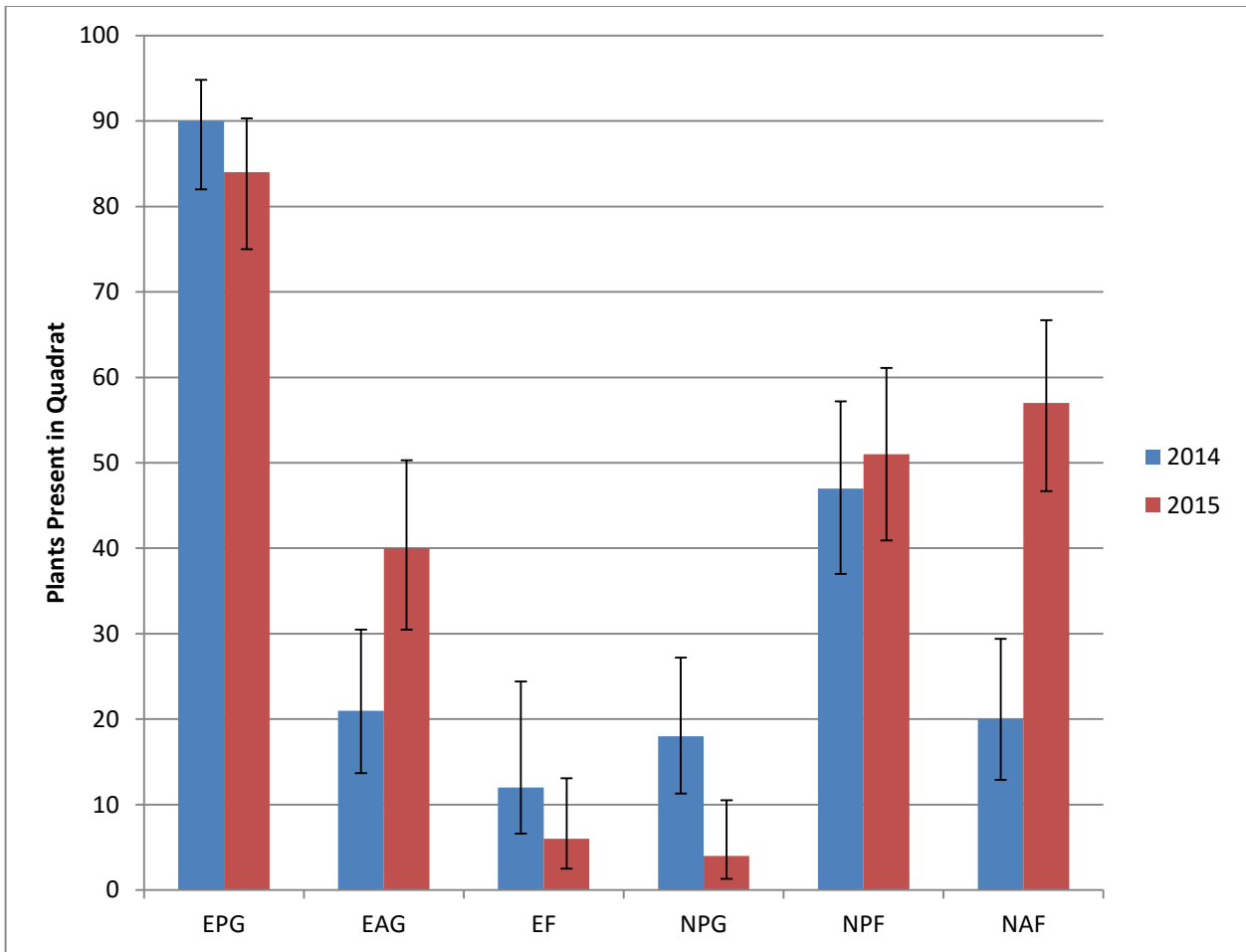


Figure 12. Macro Vegetation Plot 2. A comparison between 2014 and 2015 functional groups is shown here from Plot 2. This plot was left untreated as a control. Frequencies are presented here with 0.95% confidence intervals. EPG=exotic perennial grass; EAG=exotic annual grass; EF=exotic forb; NPG= native perennial grass; NPF= native perennial forb; NAF= native annual forb. EPG functional group data collected from quadrat 1. Data from all other functional groups collected from quadrat 2.

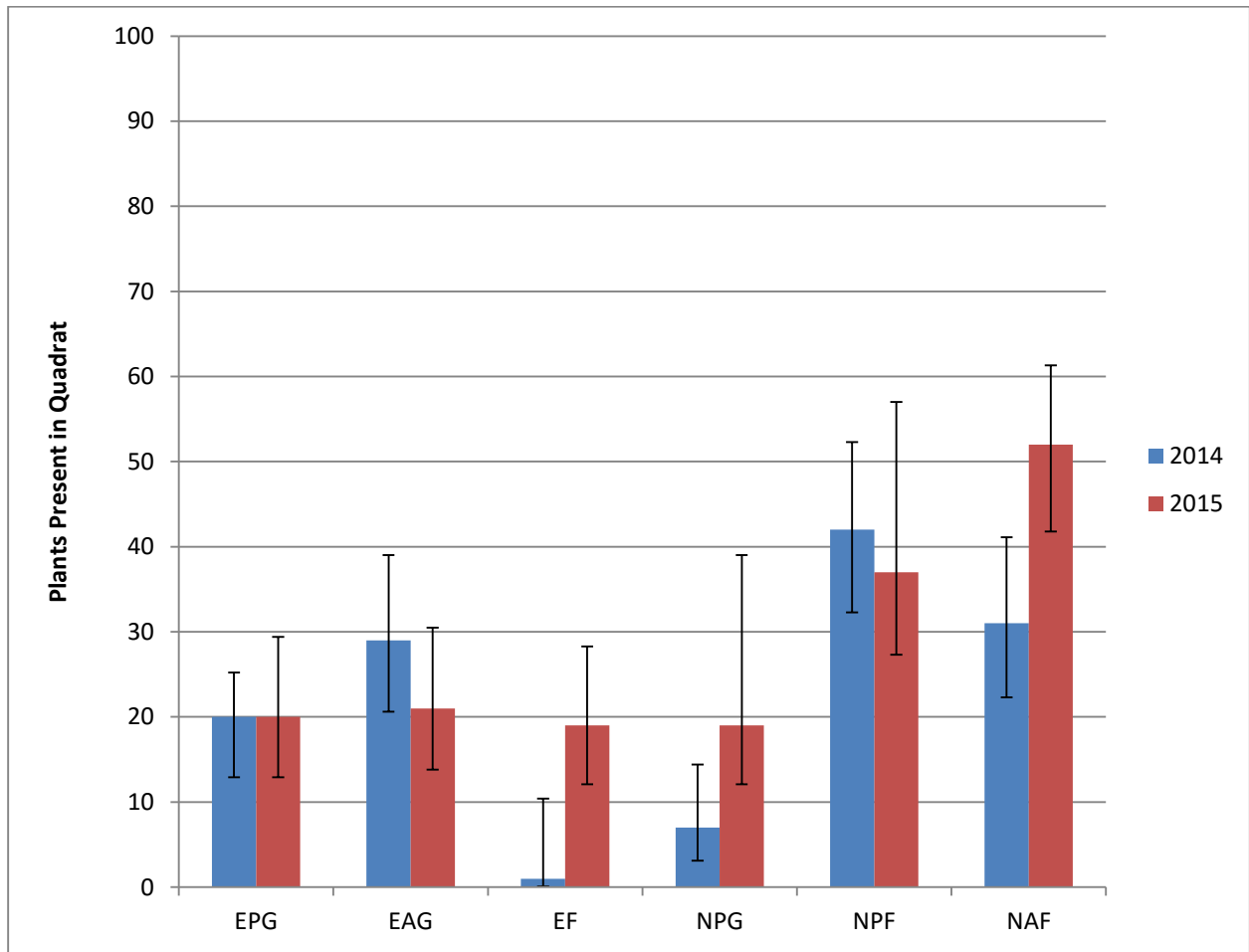


Figure 13. Macro Vegetation Plot 3. A comparison of functional groups from Plot 3, of pre-treatment (2014) and post-treatment which consisted of herbicide application and seeding with native grass seed (2015) is presented here with 0.95% confidence intervals. EPG=exotic perennial grass; EAG=exotic annual grass; EF=exotic forb; NPG=native perennial grass; NPF=native perennial forb; NAF= native annual forb. EPG functional group data collected from quadrat 1. Data from all other functional groups collected from quadrat 2.

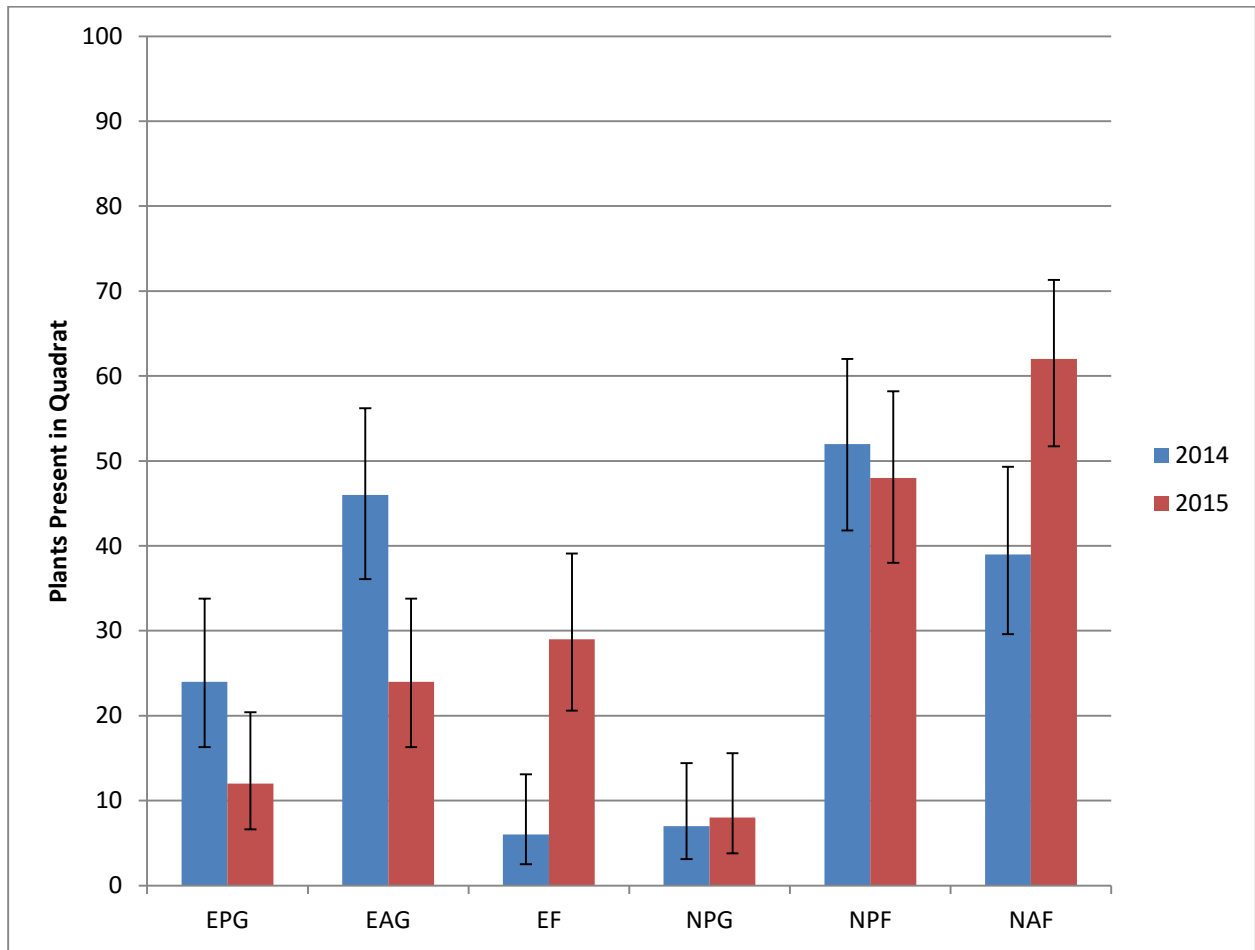


Figure 14. Macro Vegetation Plot 4. A comparison of functional groups from Plot 4, of pre-treatment (2014) and post-treatment which consisted of herbicide application only (2015) is presented here with 0.95% confidence intervals. EPG=exotic perennial grass; EAG=exotic annual grass; EF=exotic forb; NPG= native perennial grass; NPF= native perennial forb; NAF= native annual forb. EPG functional group data collected from quadrat 1. Data from all other functional groups collected from quadrat 2.

DISCUSSION

2015 Plant Occurrences and Resurvey of Late Season Plants at Iwetemlaykin State Heritage Site & Old Chief Joseph Gravesite

In 2015, Spalding's catchfly was monitored at the Wallowa Lake Key Conservation Area, within the public land portion of the population. Individual plants were monitored in this location through the reproductive season. The early August investigation found most of the individual plants in bloom with one in four stems browsed by mammalian herbivores, primarily deer. The monitoring in the later part of September found most plants in fruit with a little more than a third of stems browsed. The total number of fruits recorded increased from 43 fruits in early August to 289 fruits in September. Clearly, a late season survey is required to determine a maximum reproductive potential based on; number of fruits, seeds produced, and the viability of these seeds as proposed by Elseth et al. 2012. A late season inventory should be continued during future studies. Comparison of reproductive output among years should take into consideration plants' phenology when observations are made. Monitoring in 2015 was the sixth year of tracking the Wallowa Lake population on public land. When possible, comparison of reproductive output from year to year should take into consideration multiple observations within each year. A comparison of the maximum number of viable fruits produced in a year could be a more appropriate measure, as long as enough site visits are made to ensure observations are made during peak fruit phenology. To complicate matters further, the timing of maximum fruit production may vary from plant to plant within a given year. In addition, an estimate of actual reproductive output made too early in a given season, calculated by the number of fruits, could provide an overestimate due to early senescence, herbivory, seed predation or aborted fruit. In the future, the author recommends multiple observations of plants late in their phenology (i.e. mid-September through mid-October). . An understanding of successful seed germination in the field and survivorship to fruiting age would greatly improve the assessment of the stability of this population.

Macro Vegetation Plots at Iwetemlaykin State Heritage site

Results comparing functional groups pre and post treatment were variable and somewhat inconclusive. Of greatest concern is that the control group (plot 2) showed a significant change ($p < 0.05$) from 2014 to 2015 for half of the functional groups (see Appendix C). However, the control group did not show a significant change for the target functional group of primary interest. A pre and post treatment comparison of the functional group containing native annual forbs (NAF) showed a significant change ($p < 0.05$) in every plot (see Appendix C). It is likely that environmental factors (e.g. precipitation) may have had an effect on these ephemeral species.

The functional group of primary interest in this investigation was exotic perennial grass (EPG). Casual observation of both areas that received the graminoid targeting herbicide showed an extremely obvious reduction in annual grasses. However, an analysis of the presence/absence data recorded, using the nested frequency monitoring, show a significant difference in EPG species in only plot 4 that was treated with herbicide and not seeded (see Appendix C). Plot 3, the area that received both herbicide treatment and was seeded with native seeds did not show a significant change in the presence of EPG species. It is not believed that the addition of native seed biased observations incorrectly, because it was extremely easy to discriminate between recently germinated perennial grasses and the persistent exotic perennial grass. Because the study design used presence/absence (frequency) sampling rather than abundance or percent cover sampling, reductions in abundance that are obvious upon casual observation do not register in the results. Although substantially reduced in abundance, exotic grasses were still present in most plots in which they were present before treatment. The reduction in abundance could not be quantified with this particular form of data collection. If further work is done to examine ways to minimize competition from exotic grass species, experimental design and analysis potential would benefit from either: 1) larger areas of treatment, reducing edge effect and a sampling system with greater replication; 2) a plot design that captures abundance metrics such as percent cover, number of tillers, or dry weight; or 3) a line-point intercept approach. Any changes to the plot sampling design will require collection of another pre-treatment data set, followed by (successive) post treatment data sets. An increased application rate for herbicide may also prove useful.

Plant Occurrences on Private Land

During the 2015 field season, no surveys for previously undetected *Silene spaldingii* were conducted on private land in the Wallowa Lake Key Conservation Area. It is recommended, if permission is granted and funding is available, that surveys of private land be continued in 2016.

LITERATURE CITED

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Appendix A

Old Joseph and Iwetemlaykin *Silene spaldingii* monitoring

Date:

Data recorder:

Tag number	Total number of stems	Number of browsed stems	Number of flowers (per plant)	Number of fruits (per plant)	Comments

Valuable information for monitors:

- Emergent stems nearer together than 20cm represent one plant; stems farther apart than 20cm are counted as separate individuals.
- Stems are browsed when more than 10% of the biomass appears to be removed.
- Number of flowers value includes buds and open flowers.

Appendix B

Spalding's catchfly (*Silene spaldingii*) reproductive output data 2010-2015.

Survey data for 2013 was collected on August 8th.

Survey date for 2014 was collected on August 6th.

Survey date for 2015 was collected on August 5th.

Tag ID	Stems						Stems Browsed						Flowers						Fruits						
	2010*	2011*	2012*	2013	2014	2015	2010*	2011*	2012*	2013	2014	2015	2010*	2011*	2012*	2013	2014	2015	2010*	2011*	2012*	2013	2014	2015	
1			1						0						6							4			
7				3						3						1							0		
9			1						0						51							14			
18			2						0						13							1			
19			1	2	1	1			0	2	1	0			8	6	1	25				3	0	0	2
24				3	3					0	0					15	3					0	0		
28			1		1				0		0				11		7					2		0	
29			1	1		1			1	0		0			26	45		6				15	0		0
38			1			1			0			0			7			9				3			0
43				2						0						116							0		
48				1		1				0		1				20		2					0		0
54				1		1				1		1				7		0					0		0
55	4	1	0				1	1	0				0	0	0				0			0			
56	1	1	1	1			0	0	0	0			3	5	6	4			3			0	0		
57	2		0				0		0				54		0				29			0			
58	1		0				0		0				13		0				12			0			
59	3	3	0	2			2	0	0	1			30	60	0	4			16			0	0		
60	1		0				0		0				9		0				5			0			
61	3		1	2		1	3		1	0		0	1		21	20		56	0			2	0		1
62	3		1				2		0				26		47				18			5			

63	1	1	0				0	0	0				10	10	0				7		0			
64	1		1	1			0		0	1			7		13	13			6		4	0		
65	4		0				0		0				77						64		0			
66	1		0				0		0				13						0		0			
67	1		0				0		0				0		0				0		0			
68	1	1	1	1	1	1	0	0	0	0	0	0	11	7	8	10	5	11	2		0	0	0	1
70			1	1					0	0					22	34					3	22		
72				1	1	1				0	0	0				4	3	11				0	0	0
75			2	1					0	0					47	50					18	0		
76			2	1		3			2	1		2			0	10		169			0	0		4
77				1						0						11						0		
81				1						0						9						0		
83			1	1	1	1			0	0	0	0			15	16	7	15			5	0	0	3
84			2	1	1	1			0	0	0	0			34	30	8	4			10	0	0	0
85			1						0						9						4			
87			1	2					0	0					13	23					6	0		
90			1			1			1			0			24			37			18			1
91			1	1	1				0	0	0				44	4	7				9	0	0	
92			1	1	1	1			1	0	1	0			0	20	0	19			0	0	0	0
95				1						0						16						0		
96				1	1					1	1					0	5					0	0	
98				1	1					1	1					9	0					0	0	
99		1	1		2	1		?	0		2	0		?	29		0	11			0		0	0
100			4	4	4	2			0	1	0	1			36	46	29	33			1	0	0	0
101	1	1	1	1	2		0	2	1	1	2		50	2	0	0	0		8		0	0	0	
102	1	1	0				1	0	0				13	2	0				0		0			

103	1	1	2	1		1	0	1	0	1		1	11	3	16	1		16	2		0	0		0
104	1		2	1	1	1	0		0	1	1	1	28		48	8	4	4	13		32	0	4	6
105	1		0				1		0				3		0				0		0			
106	2		2	1		1	0		1	0		0	37		46	22		6	15		35	0		0
107	1	1	1				0	0	1				10	12	12				6		0			
108	1		1				0		1				10		0				0		0			
109	2		2	1	1	1	0		0	0	0	0	24		29	16	9	11	13		26	0	0	0
110	1		1		1		0		0		0		9		0		5		4			0	0	
111	1	1	1	1	1		1	0	1	0	0		24	12	14	8	12		4		11	0	0	
112	1	1	1	2		1	0	0	1	1		1	30	13	4	42		0	7		0	0		0
113	2	1	2			2	0	1	1			0	17	0	27			26	6		5			3
114	1		1				0		0				4		18				4		13			
115	1		1	1	1	1	0		0	0	1	0	17		18	19	0	4	13		13	0	0	5
116	1	1	1		1	1	0	0	0		0	0	0	10	10		10	6	14		7		0	3
117	1		1		1		0		0		0		19		2		3		7		0		0	
118	1	1	1	1	1	2	0	0	0	0	0	0	14	7	5	6	5	6	0		0	0	0	7
119	1	1	1	1	1	1	0	0	0	0	0	0	15	15	23	35	17	13	9		11	0	0	5
120	1		0				0		0				13		0				0		0			
121	2	2	2	3			2	0	1	1			3	26	63	10			1		2	0		
122	2	1	0	2	2		1	0	0	0	0		3	5	0	25	17		2		0	0	0	
123	3		0						0				0		0				0		0			
124	3		0				0		0				1		0				1		0			
125	1		0				0		0				1		0				0		0			
126	1	2	0				0	0	0				8	52	0				2		0			
127	4	4	3	7			0	4	3	4			37	42	0	163			32		0	0		
128	1		0				1		0				0		0				0		0			

129	15		0				14		0				0		0				0		0		
130	5	3	3	2			0	0	0	0			67	36	33	35			17		7	0	
131	1		2				0		1				0		30				0		11		
132	1	1	2				1	0	0				1	64	71				0		9		
133	2		0				0		0				8		0				7		0		
134	2		0				2		0				0		0				0		0		
135	1	1	5			1	1	0	2			0	1	6	0			1	0		0		0
136	2	2	4				2	0	2				2	0	50				0		10		
137	1	2	2	1			0	0	1	0			30	46	37	40			6		11	0	
138	3	3	0				3	0	0				0	45	0				0		0		
139				1						0						69						0	
240					1	1					1	0					0	16				0	1
264					1						1						1					0	
265					2	1					2	1					1	0				0	0
289					2	2					2	2					12	20				0	0
293					1	1					0	0					4	12				0	0
968		1	1		1	1		0	1		0	0		2	0		7	25			0		0
969		1	2	1	4	1		0	2	1	3	0		11	5	0	8	6			5	0	0
970		1	1	1	1			1	4	1	0			16	0	17	36				0	0	0
971		2	0					0	0					43	0						0		
972		1	0					0	0					8	0						0		
973		1	0					0	0					2	0						0		
974		1	1	1		1		0	1	0		0		5	4	13		3			0	0	0
975		1	1					0	1					6	0						0		
976		1	1	1	1	1		0	0	1	0	0		28	61	17	28	22			36	0	0
977		1	1					0	1					6	6						0		

978		1	1	1	1	1		0	0	0	0	0		7	10	16	3	7			1	0	0	0	
979		1	1		1			0	0		1			15	13		0				3		0		
980		1	2	1				1	1	1				3	30	0					0	0			
981		3	5	3		4		1	2	0		0		12	33	36		111			2	0		1	
982		1	3	1	3			0	3	0	0			6	17	31	27				7	0	0		
983		1	0	1				0	0	0				10	0	7					0	0			
984		3	1					0	1					86	36						0				
985		1	3					0	0					19	116						21				
986		1	0	3				0	0	0				15	0	42					0	0			
987			2	1				2	2	1				0	0	9					0	0			
		Stems					Stems Browsed						Flowers						Fruits						
		2010*	2011*	2012*	2013	2014	2015	2010*	2011*	2012*	2013	2014	2015	2010*	2011*	2012*	2013	2014	2015	2010*	2011*	2012*	2013	2014	2015
Means:		1.92	1.41	1.12	1.5	1.4	1.25	0.73	0.27	0.46	0.48	0.56	0.31	14.8	17.7	15.5	22.8	7.9	20.1	6.83	No data	4.5	0.4	0.1	1.19
Totals:		100	63	102	81	51	45	38	14	42	26	20	11	764	780	1377	1230	284	723	355	-	405	22**	4***	43****
* 2010-2012 data from Jocius, 2013																									
** see data from the September 19 th survey for a more appropriate comparison																									
*** see data from the September 9 th & 10 th survey for a more appropriate comparison																									
**** see data from the September 24 survey for a more appropriate comparison																									

Appendix C

Comparison of functional groups pre and post treatment (2014-2015) at Iwetemlaykin nested frequency vegetation

Analyses were conducted using Pearson's Chi-squared test with Yates' continuity; df=1; Quadrat size 1= (5cm x 5cm); Quadrat size 2= (25cm x 25cm)

	Plot 1 no herbicide seeded with native grass	Plot 2 control- no herbicide no seed	Plot 3 treated with herbicide	Plot 4 treated with herbicide no seed
EPG (exotic perennial grass) Quadrat size 1	X-squared = 0, p-value = 1	X-squared = 1.1052, p-value = 0	X-squared = 0, p-value = 1	X-squared = 4.0989, p-value = 0.0429
EAG (exotic annual grass) Quadrat size 2	X-squared = 3.4632, p-value = 0.0627	X-squared = 3.4632, p-value = 0.0627	X-squared = 1.3067, p-value = 0.2530	X-squared = 9.6923, p-value = 0.0018
EF (exotic forb) Quadrat size 2	X-squared = 0, p-value = 1	X-squared = 1.5263, p-value = 0.2167	X-squared = 16.0560, p-value = 6.151e-05	X-squared = 16.7620, p-value = 4.238e-05
NPG (native perennial grass) Quadrat size 2	X-squared = 1.8615, p-value = 0.1724	X-squared = 8.6313, p-value = 0.0033	X-squared = 5.3492, p-value = 0.0033	X-squared = 0, p-value = 1
NPF (native perennial forb) Quadrat size 2	X-squared = 1.0511, p-value = 0.3053	X-squared = 0.1801, p-value = 0.6713	X-squared = 0.3348, p- value = 0.5629	X-squared = 0.1800, p-value = 0.6714
NAF (native annual forb) Quadrat size 2	X-squared = 11.85, p-value = 0.0006	X-squared = 27.3680, p-value = 1.682e-07	X-squared = 8.2381, p-value = 0.0041	X-squared = 9.6810, p-value = 0.0019



Figure 15. A drying late season plant with ripe fruits. Photo- © Kendrick Moholt 2014