OREGON DEPARTMENT OF AGRICULTURE

NATIVE PLANT CONSERVATION PROGRAM

Monitoring and habitat improvement of the federally threatened and state endangered species *Silene spaldingii* *(Year 2 of 3)*

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for
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Contents

Introduction

The high-plateau grasslands on the eastern flanks of the Wallowa mountain range in northeastern Oregon are home to the rare plant Spalding's catchfly (*Silene spaldingii* Caryophyllaceae). This region, including the area around Wallowa Lake, was once part of the bunchgrass grasslands that extended north and east into Idaho and Washington (Figure 1). Much of this native habitat has been fragmented and altered by invasive plant species, urbanization, agricultural land conversion, and grazing. These threats have resulted in the loss of vast portions of suitable habitat for the regionally endemic *S. spaldingii*, and a precipitous decline of the species throughout its range.

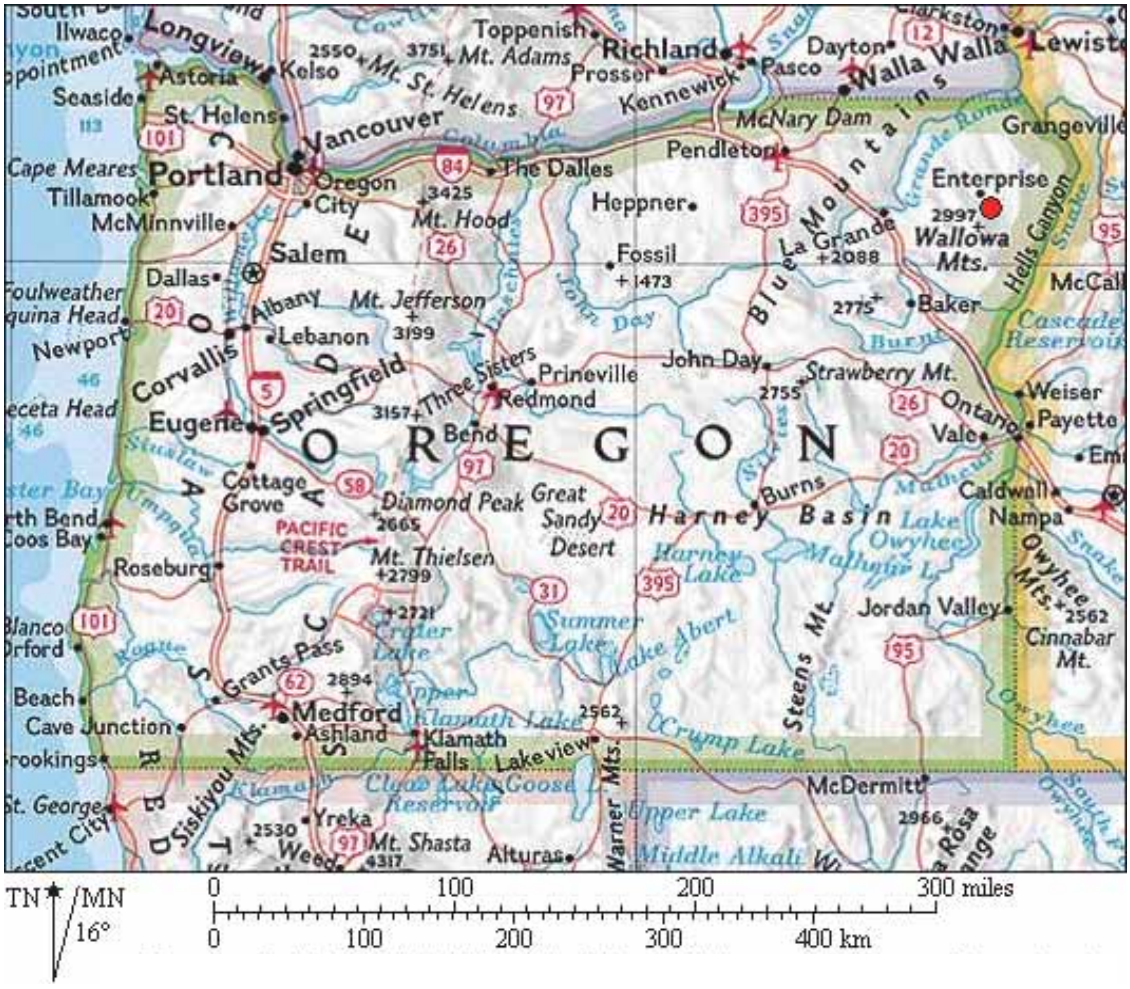

Figure 1. Location (red dot) of study site in the Blue Mountain Basins physiographic province in Wallowa County, Oregon.

Spalding's catchfly

Silene spaldingii is an herbaceous perennial, arising from a stout taproot and producing one to several shoots. The leaves are opposite and lanceolate, and the corollas of the flowers are greenish-white and clawed, with characteristically short extensions past the calyx (Figure 2). Flowering begins by the middle of July and can continue into October (Hill and Gray 2005). The plant's common name, catchfly, refers to the sticky glandular pubescence present on the leaves, stems and calyces. Due to this pubescence, the foliage of *S. spaldingii* is frequently covered with small flies and other insects that have been "caught" by the sticky hairs.

As of 2007, 99 known populations of *Silene spaldingii* had been documented. Of these 99 populations, 67 were composed of 100 individuals or less (U.S. Fish and Wildlife Service [USFWS] 2007). In response to the increasing potential for extinction due to habitat loss and degradation, Oregon Department of Agriculture (ODA) listed *S. spaldingii* as endangered in 1995. In 2001, USFWS provided additional protection for this species by listing it as threatened.

Figure 2. A large healthy plant of *S. spaldingii* poses against the sky.

Plants of *Silene spaldingii* can be assigned to one of four life history stages: rosettes, vegetative (non-flowering stems), reproductive (flowering stems), and dormant individuals (Lesica and Crone 2007). Plants exhibit periods of prolonged dormancy when above-ground shoots are absent. Dormancy lasts for an average of one to two years, and sometimes as long as five years. Changes in environment and available nutrients affect

the length of these periods of dormancy (Lesica 1999, Lesica and Crone 2007, Taylor et al. 2012). Due to these periods of prolonged dormancy, long term studies of extant *S. spaldingii* populations are necessary in order to accurately document and assess demographic trends. Annual population surveying and monitoring can provide data on individuals that are dormant one year, but emergent (and countable) in a subsequent year. Data on long term population size trends also provide a more accurate picture of overall population health.

Loss of genetic fitness due to decreases in population size may affect the reproductive viability of this species (USFWS 2007). Monitoring the reproductive capacity of extant *S. spaldingii* populations helps evaluate the viability of these populations, and can identify those populations that are more likely to become extirpated due to reproductive failure.

A Recovery Plan for *Silene spaldingii* was released in 2007 (USFWS). This Plan details Recovery Actions needed to promote recovery of this species in each of five physiographic regions (including the Blue Mountains Basin region in northeastern Oregon). Actions include monitoring, surveying, invasive species control, habitat enhancement, and population creation.

Our study site at the Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite (subsequently referred to collectively as the Iwetemlaykin site; the two specific names will be used when differentiation between the sections of the site is needed) in Wallowa County falls within the Blue Mountain Basins physiographic province. Here, bunchgrass meadows characteristic of this region have been impacted and degraded by the advent of urbanization and agriculture in the Wallowa Lake area (USFWS 2007). A population of over 50 *Silene spaldingii* individuals still extends across the site. By working to document the current status of this population, provide protocols for future monitoring, and develop methods for protecting and improving habitat quality, we will contribute to the recovery of this species in Oregon.

Study objectives

Because USFWS was interested in documenting the presence and viability of *Silene spaldingii* populations throughout the greater Wallowa Lake area (rather than focusing on completing the habitat management project at Iwetemlaykin State Heritage Site that we began in 2010), our objectives for this year were modified to meet these needs.

- **Objective 1:** Monitor previously marked plants at Iwetemlaykin State Heritage Site and the Old Chief Joseph Gravesite again this year, and survey for any additional plants that were undocumented during the 2010 survey (**Recovery Action 2.4.1**)
- **Objective 2:** Survey three privately owned sites (Lewis, Schaefer, and Yanke parcels) for previously unknown populations of *Silene spaldingii* and collect baseline demographic data on plants in these new populations (**Recovery Action 1.1.2**)

Site description

Iwetemlaykin State Heritage Site and Old Chief Joseph Gravesite

The Iwetemlaykin State Heritage Site consists of rolling hills along the lower slopes of glacial moraines, which were previously dominated by native bunchgrass stands and associated indigenous herbaceous species (Figure 3). As a consequence of Euro-American settlement and years of ranching, weeds and non-native forage grasses, particularly Kentucky bluegrass (*Poa pratensis*), now cover much of the landscape. However, components of the original native plant community still exist, such as *Artemisia ludoviciana* ssp. *candicans, Koeleria cristata, Lithospermum ruderale* and *Rosa woodsii*.

The Iwetemlaykin State Heritage Site is a 62 acre parcel of land with cultural significance for several indigenous tribes, particularly the Nez Perce. The land was purchased from private ownership during the summer of 2007 by a coalition of the Oregon Parks and Recreation Department (OPRD), the Nez Perce Tribe, the Confederated Tribes of the Colville Reservation, the Confederated Tribes of the Umatilla Indian Reservation, and the Oregon State Parks Trust. The goal of the purchase was to improve protection of the site's natural and cultural resources, and to preserve and maintain the natural setting and overall appearance of the area. On October 10, 2009 this parcel of land was dedicated as the

Figure 3. Our multi-agency survey crew combed the rolling hills of the Iwetemlaykin site and the Lewis, Schaefer, and Yanke parcels with the goal of locating previously undocumented catchfly plants.

Iwetemlaykin State Heritage Site in honor of the Nez Perce who historically inhabited the area (OPRD undated).

Bordering the Iwetemlaykin State Heritage Site on the south is the Old Chief Joseph Gravesite. This site is comprised of approximately eight acres of National Park Service (NPS) property and five acres of tribal trust land (OPRD 2008).

The *Silene spaldingii* population at the Iwetemlaykin site is part of a larger population previously reported to consist of 400-550 individuals, historically extending to neighboring hillsides and moraines on the northeastern side of Wallowa Lake. The botanist William Cusick provided the first written record of *S. spaldingii* presence here in 1898 (Oregon Biodiversity Information Center [ORBIC] 2009).

Wallowa Lake moraines

Three additional areas near the Iwetemlaykin site were surveyed this year for populations of *Silene spaldingii*. These three parcels are privately owned and used as pasture for livestock. They are referred to in this study by the last name of the landowners: Lewis, Schaefer, and Yanke (Figure 4). ORBIC records and aerial photographs were used to identify the habitat within these parcels that was potentially suitable for *S. spaldingii* (ORBIC 2009).

The Lewis parcel is located directly across Highway 82 from the Iwetemlaykin State Heritage Site. The northern border of the area surveyed was defined by an irrigation canal flowing eastward. Horses grazed the parcel while the survey was conducted. Like the Yanke and Schaefer parcels, the Lewis site consists of dry, rolling slopes, but with less moisture in the gullies running between the hills than was present in the other two parcels. Invasive weeds, particularly diffuse knapweed (*Centaurea diffusa*), dominate this parcel. ORBIC records document a historic population of 400-550 plants spanning the Iwetemlaykin site and the Lewis parcel, with the majority of plants present in the privately owned Lewis site.

The Yanke parcel is the largest of the three, spanning a majority of the glacial moraine on the east side of Wallowa Lake. The Schaefer parcel is also located on the eastern moraine, with the Yanke parcel bordering it on three sides. These two parcels were surveyed at the same time, as they are separated only by cattle and elk fencing. Cattle were observed grazing here during the survey. The portions of the parcels surveyed for *Silene spaldingii* consist of dry and sometimes rocky slopes, alternating with wetter gullies. A handful of ponderosa pines (*Pinus ponderosa*) dot an otherwise open landscape. Vegetation was a mixture of both native species (such as *Artemisia ludoviciana* ssp. *candicans, Festuca idahoensis* and *Poa secunda* ssp. *secunda*) and non-native species (*Bromus inermis, Poa pratensis* and *Rumex acetosella*). A population of *S. spaldingii,* consisting of two small patches, was previously documented just north of the Schaefer parcel, extending north into the area east of the Yanke parcel (ORBIC 2009). Although all apparently appropriate habitat was searched, areas within the vicinity of these previously documented populations were priorities for intense survey efforts.

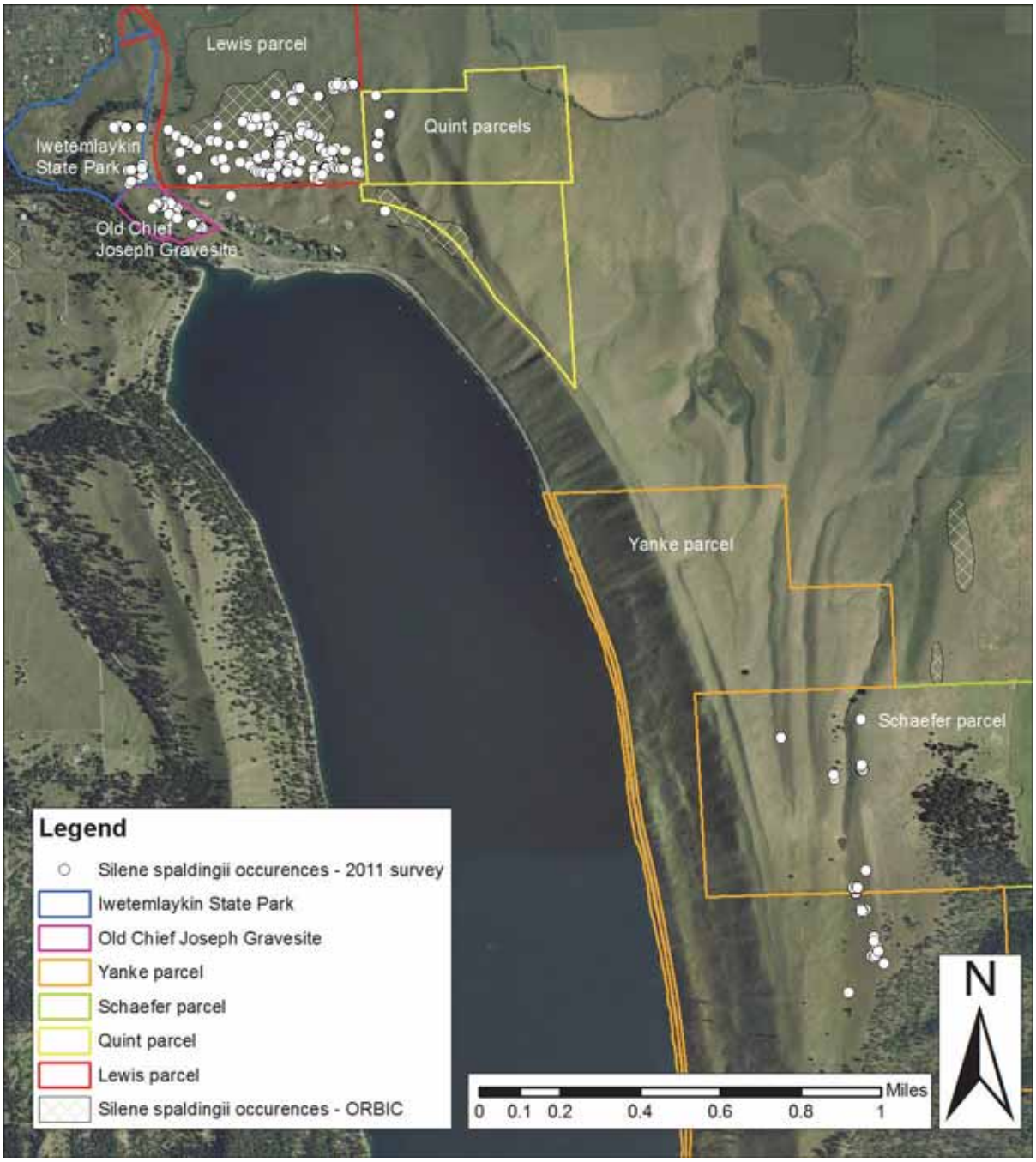

Figure 4. Location of all plants of *S. spaldingii* found during the 2011 survey. Electronic GPS location data available from ODA.

Methods

Detailed 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 populations at the Iwetemlaykin site and the private parcels did not require a population size estimation technique, as the small number of plants present in these sites could be censused individually.

In August of 2011, ODA staff monitored *S. spaldingii* plants at the Iwetemlaykin site with the help of staff from USFWS, NPS, OPRD, Wallow Land Trust, US Forest Service and the Nez Perce Tribe. Plants located and marked during surveys in 2010 (Elseth et al. 2012) were monitored again this year. Because prolonged dormancy is a part of the *S. spaldingii* life cycle, the area outside the perimeter of the previously documented population was re-surveyed in order to locate any plants in these areas that were not found due to dormancy during the 2010 surveys. As in the previous survey, the location of each newly located plant was marked with a tagged aluminum pin and recorded using a GPS. Although other species of *Silene* also occur here, *S. spaldingii* is easily distinguished from these congeners by well-defined floral characteristics, as well as the distinctly glandular foliage characteristic of the rare taxon (Hitchcock and Cronquist 1973, USFWS 2007).

Data on the number of stems per plant, the number of flowers per plant (including buds and open flowers) and the number of stems experiencing herbivory were recorded for each previously and newly observed plant. Since single plants can produce multiple flowering stems, for our study emergent stems within 20 cm of one another were considered to represent one plant. Stems with more than 10% of their biomass removed were recorded as experiencing herbivory. Because rosettes are difficult to see by the August date of our study (Idaho Natural Heritage Program undated), survey and monitoring protocols focused on reproductive and vegetative plants; we did not attempt to locate rosettes.

At the request of NPS and the Nez Perce Tribe, markers installed by ODA at plants located near the Old Chief Joseph Monument were removed this year. Compass bearings and distances from landmarks within the site were recorded in order to allow easy relocation of these plants in the future. (See Appendix A for location information.)

Our survey of the Lewis parcel was the first since 1998 (ORBIC 2009). Although some areas of the east moraine support documented populations of this species (ORBIC 2009), no records of survey results for the Schaefer and Yanke parcels are available, and it is not known when, if ever, surveys were completed for these areas. Our survey methodology was exhaustive, with up to ten people searching parallel transects throughout each site (Figure 3).

When a plant was found within one of these parcels, a GPS point was recorded. Because these sites are privately owned, no markers were left at the plant locations. At the Yanke and Schaefer parcels, the numbers of stems, flowers, stems with herbivory, and fruits were recorded for each plant. Stem number and herbivory data were also reported for all plants found at the Lewis parcel. However, due to the large size of this population, data from a sample of 35.3% of the located plants were used to estimate flower and fruit production.

Differences among sites (and between the two years at the Iwetemlaykin site) in the number of stems produced per plant, number of flowers produced per plant, number of fruits produced per plant and number of browsed stems per plant were determined using Analysis of Variance (ANOVA) in XLStat 2013. Tukey's HSD test was used to evaluate the significance of these differences at $p<0.05$.

Results

Iwetemlaykin State Heritage Site and Old Chief Joseph Gravesite (the Iwetemlaykin site)

At the Iwetemlaykin site, 19 additional *Silene spaldingii* plant locations were recorded this year, increasing the potential size of this population from 52 to 71 individuals. Because 27 of the 52 plants reported in 2010 were not evident in 2011 (due to death or dormancy), a total of 44 plants were monitored this year. Plants produced a mean of 1.41 stems and 17.7 flowers; 70.5% of plants produced at least one flower (Tables 1 and 2). The level of herbivory was lower than that observed in 2010, with stem or leaf removal by rodents, insects or other herbivores occurring on 18.2% of plants (compared to 30.8% in 2010). Cooler than average temperatures and very high levels of precipitation in June of 2010 (PRISM Climate Group 2013) resulted in slower than usual development of catchfly plants during the 2010 growing

season. Although flowers were counted at the early August monitoring date in 2010, many inflorescences were not fully developed, and additional monitoring in September was needed in order to accurately evaluate flower production. Monitoring at this later time also allowed for an evaluation of fruit production, and the collection of seeds for germination studies (Elseth at al. 2012). However, the difference in monitoring dates (September in 2010 and August in 2011) makes comparison of flower and fruit production data between the two years difficult.

Table 1. Number of stems per plant, flowers per plant, fruits per plant and browsed stems per plant at the Iwetemlaykin site in 2010 and 2011.

	Stems 2010	*Stems 2011*	*Flowers[1] 2010*	*Flowers 2011*	*Fruits[2] 2010*	*Browsed 2010*	*Browsed 2011*
Mean	**1.92**	**1.41**	**14.77**	**17.73**	**6.82**	**0.73**	**0.27**
Median	1	1	10	10	3.5	0	0
Std. error	0.293	0.119	2.420	3.020	1.512	0.284	0.110
Minimum	1	1	0	0	0	0	0
Maximum	15	4	77	86	64	14	4

[1]data from the September visit; [2]plants not yet in fruit during our August visit in 2011

Table 2. Percent of plants in three life history stages (and one browsed category) at all sites in 2011 and at the Iwetemlaykin site in 2010.

Site	*% with > 1 stem*	*% flowering*	*% fruiting*	*% browsed*
Iwetemlaykin 2010	38.5	84.6[1]	63.5[1]	30.8
Iwetemlaykin 2011	25.0	70.5	0.0	18.2
Lewis 2011	51.2	93.0	0.0	7.5
Schaefer 2011	27.8	83.3	0.0	16.7
Yanke 2011	18.2	78.8	3.0	6.1

[1]data from the September visit; all other data were collected in August

Wallowa Lake moraines

A total of 260 plants were documented during our survey of the three private parcels. On the Lewis parcel, 51.2% of the 201 *Silene spaldingii* plants located produced more than one stem (Table 2). Thirty five percent of these newly discovered plants (of which 93.0% were in flower) were monitored for flower and fruit production. Herbivory was uncommon here, with only 7.5% of plants experiencing browsing. No fruits were observed during our visit.

The Schaefer parcel survey yielded 36 plants, 83.3% of which produced flowers, and 27.8% of which produced more than one stem (Table 2). Only 16.7% were browsed and no fruits had yet developed on any of the plants at this site at the date of our monitoring.

Thirty three plants of *Silene spaldingii* were documented on the Yanke parcel, with 78.8% of these producing flowers (Table 2). Only 18.2% of plants at this site produced more than one stem. Herbivory was uncommon here, with only 6.1% of plants experiencing browsing. Despite the early monitoring date, one fruit was observed.

Comparison among sites

The mean number of stems produced per plant differed among sites in 2011 (Figure 5), but only the difference between plants in the Lewis and Yanke parcels was significant (at $p<0.05$), with Lewis parcel plants producing 1.84 stems and Yanke plants producing 1.21.

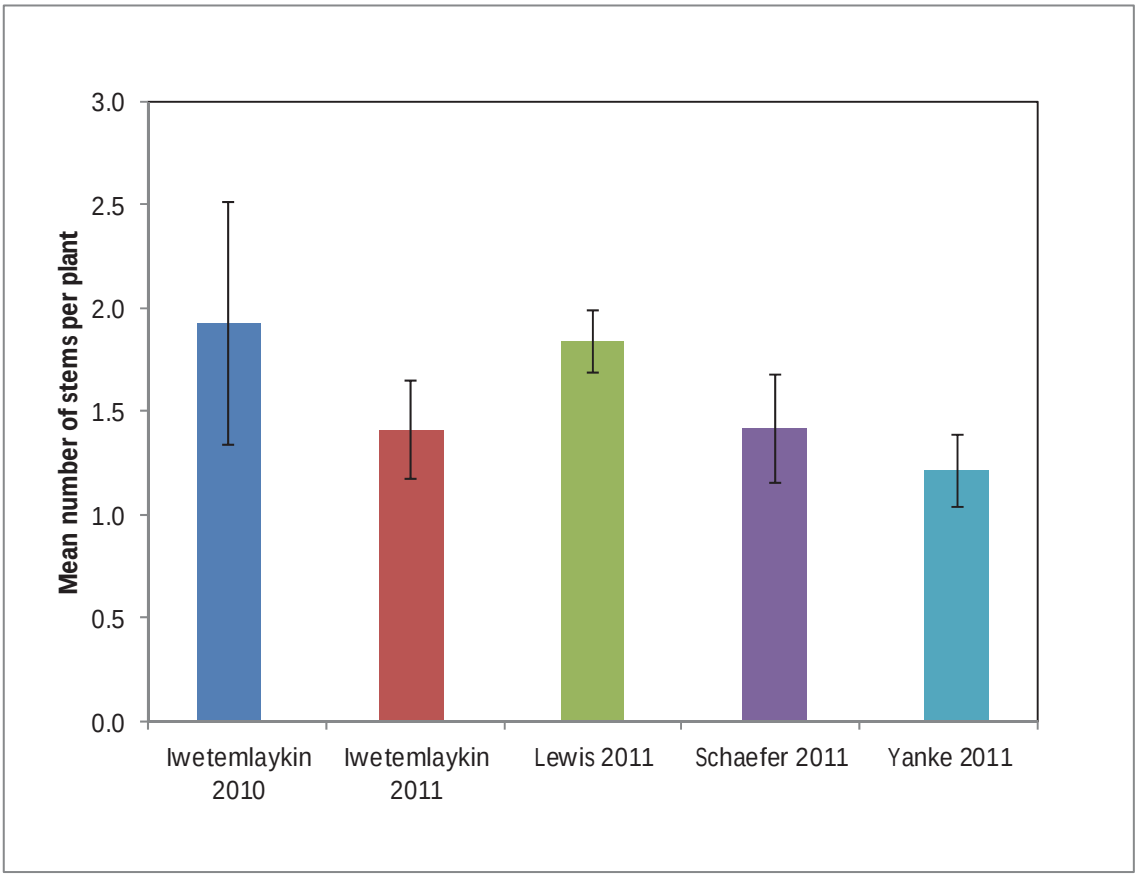

Figure 5. Mean number of stems per plant in all sites. n=52 for Iwetemlaykin 2010, n=44 for Iwetemlaykin 2011, n=201 for Lewis, n=36 for Schaefer and n=33 for Yanke. Error bars represent 95% confidence intervals above and below means.

The larger size of plants in the Lewis site also resulted in the production of significantly more flowers per plant ($p<0.05$) than were produced in any other site, (except in the Iwetemlaykin site in 2011; the difference between the 14.8 flowers per plant produced by these plants and the 25.1 produced by plants in the Lewis site was not significant at $p<0.05$; Figure 6). In 2011, the mean number of browsed stems per plant ranged from 0.06 at the Yanke site to 0.27 at the Iwetemlaykin site, but differences among sites were not significant (Figure 7). However, the large number of browsed stems per plant in the Iwetemlaykin site in 2010 was significantly more than the low numbers of browsed stems per plant in the Yanke and Lewis sites (in 2011 – these sites were not visited in 2010).

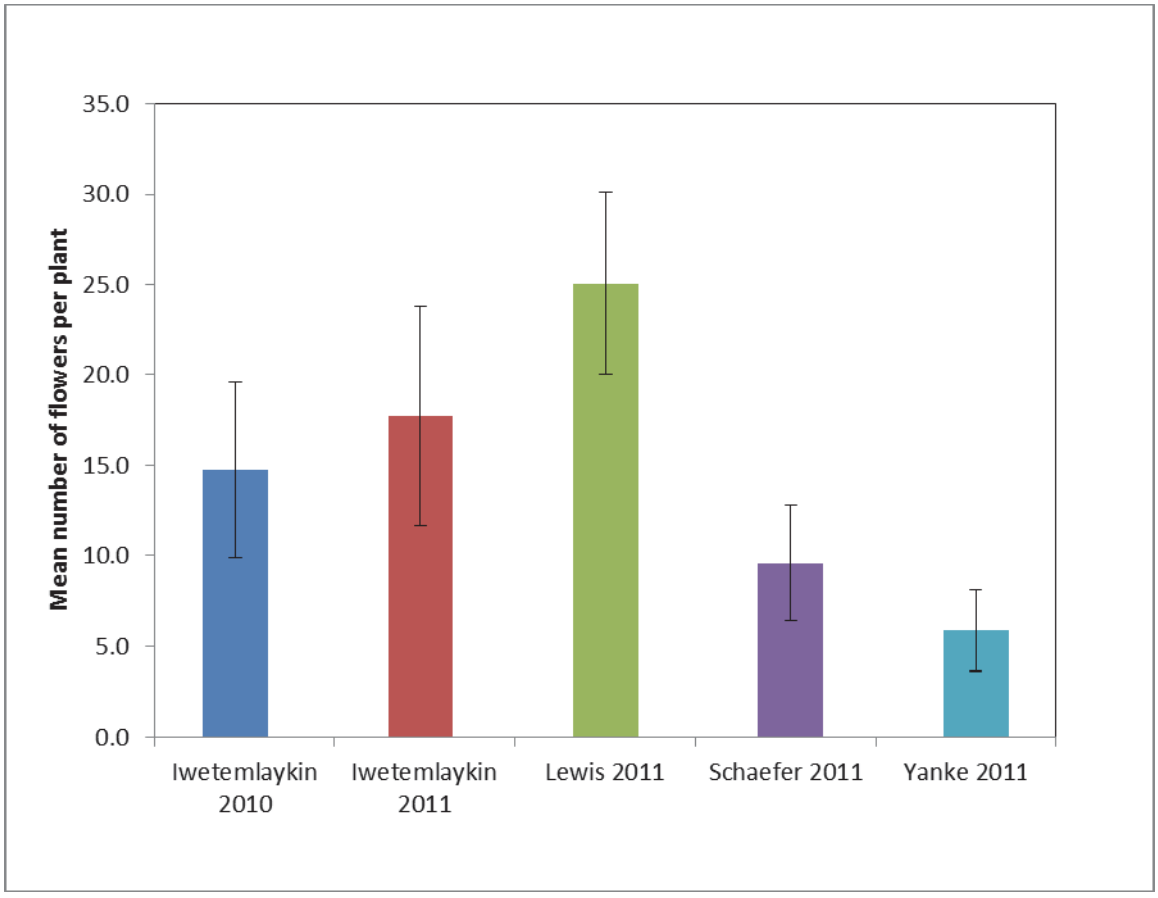

Figure 6. Mean number of flowers per plant in all sites. n=52 for Iwetemlaykin 2010, n=44 for Iwetemlaykin 2011, n=71 for Lewis, n=36 for Schaefer and n=33 for Yanke. Error bars represent 95% confidence intervals above and below means.

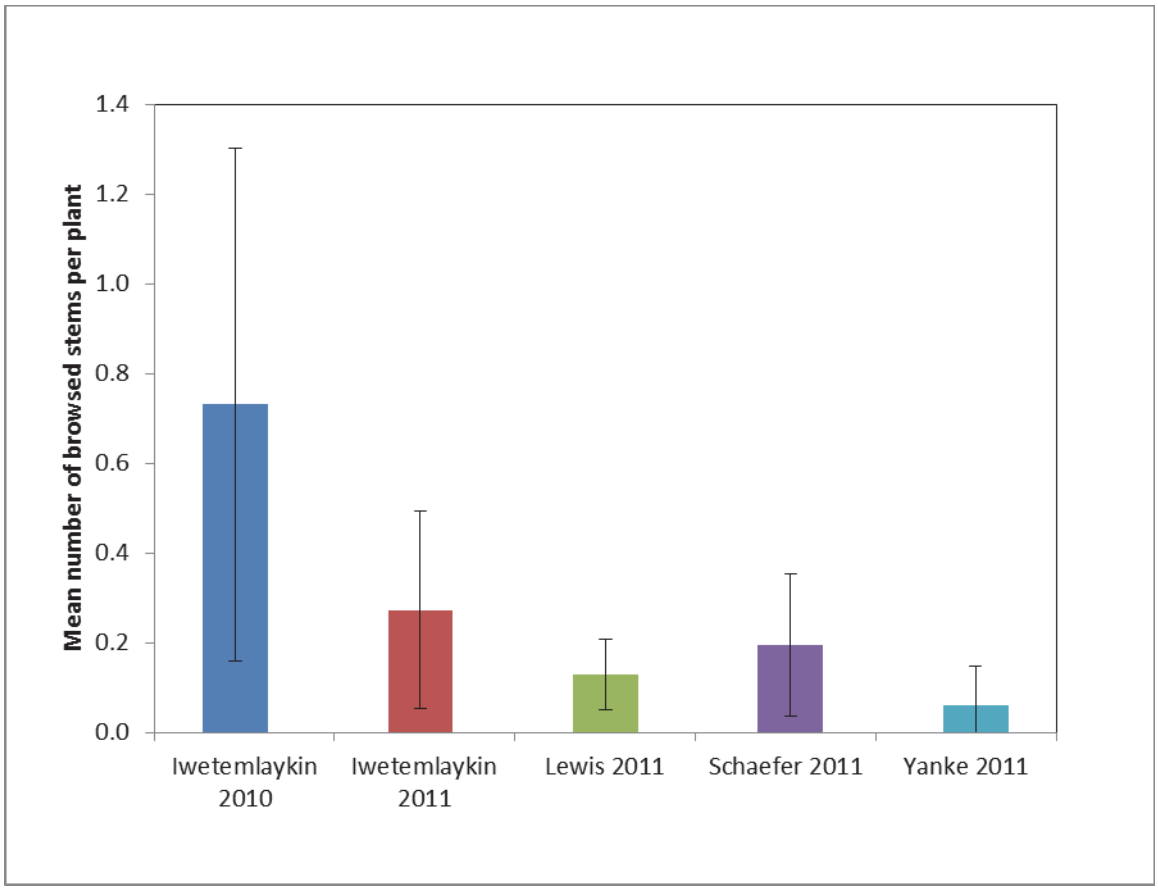

Figure 7. Mean number of browsed stems per plant in all sites. n=52 for Iwetemlaykin 2010, n=44 for Iwetemlaykin 2011, n=201 for Lewis, n=36 for Schaefer and n=33 for Yanke. Error bars represent 95% confidence intervals above and below means.

The Lewis site differed from the other sites surveyed in that catchfly plants, rather than being associated with grasses or native forbs, were scattered through a large infestation of diffuse knapweed (*Centaurea diffusa*). To help determine the extent of this infestation, a transect was set up across the site, and the presence or absence of knapweed was recorded at 49 locations. (See Appendix B for a map of this transect.) Plants of *C. diffusa* were present at 76% of these locations, and 60% of located plants were flowering (see Appendix B).

Discussion

The 2011 survey of the Iwetemlaykin site increased the documented number of plants in this population. Because prolonged dormancy is a component of *S. spaldingii* life cycles (Lesica and Crone 2007), plants seen this year for the first time may have been alive but dormant during our 2010 survey. Dormancy may also explain this year's lack of emergence at plant

markers that were occupied last year. It is also possible that markers that were recorded as unoccupied this year may mark plants that emerged as rosettes earlier this season but died back by flowering (and therefore surveying) time. In other studies, plants of *S. spaldingii* in the rosette form have been observed above ground early in the season, with dormancy of these rosettes occurring by the time other plants in the population are flowering (Idaho Natural Heritage Program undated, Hill and Gray 2005). Multiple years of surveying and monitoring are needed in order to accurately determine population size.

Browsing of plants was fairly common in the Iwetemlaykin site, and evidence of rodent activity at marked plant locations was noted during the monitoring this year. Two plant markers without emergent plants were closely associated with large, apparently recently created rodent mounds. Rodent (vole) activity was reported as a significant factor in the death of *S. spaldingii* plants in a 2008 study (Idaho Natural Heritage Program undated), and this type of disturbance could also be affecting plants at the Iwetemlaykin site. Rodents may be browsing plants to the point that they no longer have sufficient biomass to be visible (but are still alive), or may be causing mortality of the effected plants.

Browsing was less common in the other sites. The dense cover of Kentucky bluegrass at the Iwetemlaykin site may provide better cover for rodents than the sparser bunchgrass and knapweed present in the other sites. Reducing the density of this forage grass in the Iwetemlaykin site may result in a reduction in herbivore density, with a subsequent decrease in browsing. Once scheduled habitat improvements are complete, future monitoring at this site should include observations of rodent activity as well as documentation of the level of stem browsing.

Our discovery of plants of *S. spaldingii* outside of previously reported populations suggests that more undocumented sites near Wallowa Lake support this species. Additional surveys of suitable habitat will probably locate more plants. Documentation and active conservation of the populations documented by our 2011 survey, as well as additional plants found in the future, will increase population numbers range-wide and move this species toward recovery and de-listing.

The meta-population occupying the Iwetemlaykin site and Lewis parcel appears to be declining. In 1989, 400-550 plants were documented, with 500 again reported "mostly east of the road" after visits in 1997 and 1998 (ORBIC 2009). Our thorough survey in 2011 located 201 plants in the Lewis property and 57 in the Iwetemlaykin site (for a total of 258) - considerably less than the totals previously observed. Because visual estimates of population size, such as those reported by ORBIC, tend to underestimate the numbers of plants present (Currin and Meinke 2013), more plants than were reported probably existed at the time of the early surveys. By contrast, our survey was completed systematically, with up to ten people thoroughly searching each site. Because our accurate survey located *fewer*, rather than *more* plants than previously reported, the decline of the Iwetemlaykin/Lewis population is likely of greater magnitude than is represented by a comparison of the reported numbers. ORBIC reports state that only four plants occurred "in the monument" in 1998, while our survey located 21 plants in the vicinity of Chief Joseph's Gravesite in 2011, corroborating our assumption that previous estimates were probably low.

Although there were fewer plants present than in past years, individuals in the Lewis site were larger than those in other sites and produced more flowers. Although seed production was not documented during our study, an estimation using previously collected data indicates that approximately 24,675 seeds were dispersed into this site in 2011 (Elseth et al. 2010, R.V. Taylor, 2012 personal communication). The large size of existing plants, in combination with high levels of seed production, suggests that seeds are not germinating, or small plants are not surviving, resulting in a demographic that is skewed toward larger, older plants (i.e. "an aging population").

ORBIC's 1997 and 1998 reports also state that the Lewis site "now has a serious outbreak of [diffuse] knapweed." Our survey documented the extent of this infestation, with knapweed plants present at 76% of points in a transect across the area occupied by *S. spaldingii*. Diffuse knapweed (*Centaurea diffusa*) inhibits seed germination and seedling growth of forage grasses (Muir and Majak 1983), and the closely related spotted knapweed (*C. maculosa*) releases chemicals that inhibit the growth of native plants and prevent germination of their seeds (Bais et al. 2002, Bais et al. 2003, Perry et al. 2005). In an Oregon study,

allelopathic chemicals released by a non-native weed (*Mentha puligeum*) reduced the germination and growth of two rare native plants, despite vigorous competition by one exceptionally robust native (Amsberry and Meinke 2008). The knapweed infestation at the Lewis site may be preventing germination of seeds and the recruitment of seedlings, while allowing older plants to persist. As older plants die and are no new ones are recruited, population numbers dwindle, resulting in the decline we observed.

Infestations of non-native weeds are "one, if not the largest, of the threats facing [*S. spaldingii*]" (USFWS 2007). Our results suggest that weed infestations are negatively impacting populations in both the Iwetemlaykin and Lewis sites. Developing and implementing plans to treat the diffuse knapweed infestation at the Lewis property, and reduce the proliferation of Kentucky bluegrass in the Iwetemlaykin site should be priority actions for the near future.

Recommendations for promoting recovery

- Continue to monitor populations of *Silene spaldingii* at Iwetemlaykin State Heritage Site and Old Chief Joseph Gravesite for number of stems, number of flowers and number of browsed stems (**Recovery Action 2.4.1**).
- Complete the habitat enhancement study begun in 2010, and develop a plan for treatment of Kentucky bluegrass (*Poa pratensis*) infestations in the Iwetemlaykin State Heritage site (**Recovery Action 2.5.3**).
- Using recommendations from the habitat enhancement study, treat Kentucky bluegrass infestation and monitor for treatment efficacy (**Recovery Action 2.3.1.2**).
- Map the diffuse knapweed infestation at the Lewis site and develop a treatment plan (**Recovery Actions 2.3.1.5, 2.3.1.6**).
- Treat knapweed infestation at the Lewis site and monitor for treatment efficacy (**Recovery Action 2.3.1.2**).
- Evaluate the potential for using biocontrol agents to treat diffuse knapweed infestations at the Lewis site (**Recovery Action 2.5.3**).
- Work to ensure conservation of the Lewis, Yanke and Schaefer populations through easements, Conservation Agreements, land acquisition or other methods (**Recovery Actions 1.1.3, 2.3.3, 2.6.4, 2.7.2, 2.7.3**).
- Continue to survey areas near Wallowa Lake that are likely to support undocumented populations of *Silene spaldingii* (**Recovery Action 1.1.2**).

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Appendices

Appendix A.

Location of plants with markers removed in 2011 at Chief Joseph Gravesite

Plant identified as **971**
35.5 m at 211˚ from wall

Plant identified as **972**
39.6 m at 227˚ from wall

Plant identified as **101**
25.3 m at 232˚ from wall

Plant identified as **102**
38.4 m at 231˚ from wall

COMPASS SET TO 17˚ E. Declination

Rock wall at Old Chief Joseph Gravesite, looking east from Monument. Take measurements from the raised portion at the end of the wall (white arrow).

Appendix B.

Location of diffuse knapweed transect on Lewis parcel