SPALDING'S CATCHFLY MONITORING ON CLEAR LAKE RIDGE PRESERVE 2009-2017

UPDATED METHODS AND RESULTS

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INTRODUCTION

The Nature Conservancy staff and volunteers have been mapping and monitoring Spalding's catchfly (*Silene Spaldingii*) on Clear Lake Ridge Preserve since 2007 (Schmalz and Taylor 2011). After monitoring yearly from 2007-2011, resource constraints and a shift in monitoring approach led to a gap in monitoring between 2012-2014. Starting in 2015, the intended schedule was three consecutive years of monitoring, over which the data would be pooled and treated as one sample, followed by three years of no monitoring. The decision to pool three years' worth of data is based on the knowledge gained from demography studies that individual Spalding's catchfly plants can be dormant in any given year but re-emerge within three years (Taylor, Dingeldein, and Schmalz 2012; Lesica and Crone 2007; Hill et al. 2014). Yearly fluctuations in above-ground structures are expected, so pooling the data is more likely to capture an average condition. With this schedule, it would take 30 years to acquire five samples.

The Clear Lake Ridge population is modest (<2,000 plants) and distributed across approximately 149 ha (37 ac). We use a systematic grid-based sampling method to cover this area and spatial analyses are based on occupancy of 50 x 50m grid cells. Though this method is labor-intensive, it has allowed us to iteratively map the area that Spalding's catchfly is known to occupy—which has increased over time as search area increased—and it enables the generation of population estimates, which is something we could not obtain with a small number of permanent plots as suggested by the range-wide monitoring protocol developed by the Spalding's Catchfly Technical Team (U.S. Fish and Wildlife Service 2012).

This report summarizes the abundance data and population estimates obtained in two survey periods: 2009-2011 and 2015-2017. These results provide the initial basis for eventual trend analysis as called for at Key Conservation Areas in the Spalding's Catchfly Recovery Plan (U.S. Fish and Wildlife Service 2007). This report also provides an update to the area Spalding's catchfly is known to occupy obtained from the 2015-2017 survey period.

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SITE SELECTION METHODS

2009-2011 PERIOD

In this period, we were iteratively expanding the survey area each year using results from previous years' surveys. For example, in 2009 we started with a known area of occurrence (Ao) that was based on previous years' survey efforts. Ao was defined as any 50 x 50-m grid cell which contained a Spalding's catchfly plant observed in any manner (incidental waypoint or positive survey site results). The Ao received one survey site per grid cell, with an initial random offset from the lower left corner of the grid cell, systematically replicated in each cell. In addition, grid cells directly adjacent to the Ao received inventory points. When new occurrences were found near the inventory points, those grid cells would become part of the Ao for the following year. For this reason, the survey areas for the three-year period were different each year.

2015-2017 PERIOD

In the 2015-2017 period, we had decided to survey an identical Ao for three years in a row. The selection of Ao was based on all occurrences of Spalding's catchfly from previous surveys, and stayed the same for three years. Thus, the overlap of survey areas for these three years was 100%. As with earlier surveys, the Ao was buffered by 1 grid cell to search for new occurrences. New occurrences located in this period will become part of the Ao for the next survey period (see green dots in Figure 1).

FIELD METHODS

Methods for field data collection were slightly different in the two periods of monitoring. In the 2009-2011 period, both frequency and density data were collected at the same survey sites, which were all circles with a radius of 5m (area = 78.54 m^2). In 2015-2017, frequency data continued to be collected in circular plots, but the density quadrat size changed to 4 x 50m (area = 200 m^2). Other than the change in density quadrat size, methods were identical between the two periods.

See Appendix for detailed description of methods used in the 2015-2017 period.

ANALYSIS METHODS

FREQUENCY AND DENSITY

The intent of this analysis was to compare frequency and density of Spalding's catchfly across the two, three-year periods, treating the three consecutive years within each period as one sample (i.e. pooling the data across the three years). Although the area we surveyed expanded over time as we continued to find more Spalding's catchfly, it seemed necessary to restrict the origin of quantitative data to that subset of grid cells which were surveyed in *all* years (2009, 2010, 2011, 2015, 2016, 2017) to make valid comparisons across the periods. Furthermore, the data used for analysis came from grid cells that were occupied in *any* of the survey years. This area (surveyed in *all* years, occupied in *any* year) is the combined survey-occurrence area (Asox)

used for this comparison. Survey sites that fell within this area (Ssox) provided the subset of quantitative data used for frequency and density analyses. Table 1 shows the sample sizes for frequency and density in the two periods.

Table 1: Area across which data were selected for analysis and sample sizes for the two periods

Period	Asox	Number of frequency survey sites	Number of density survey sites
2009-2011	11 ha (27 ac)	208	226
2015-2017		208	113

The Asox and Ssox were determined in ArcGIS with the following steps (automated in a custom Python script) (see Figure 1):

1. Determine area surveyed (As) for each year individually (any grid cell intersected by a survey tracklog or containing a survey site)
2. Determine area occupied (Ao) for each year individually (any grid cell containing a Spalding's catchfly incidental or a positive survey site result)
3. Determine area surveyed in *all years* (an intersect of all As → Asx)
4. Determine area occupied in *any year* (a union of all Ao → Aox)
5. Determine Asox (an intersect of Asx with Aox)
6. Select survey site data falling within Asox (Ssox)

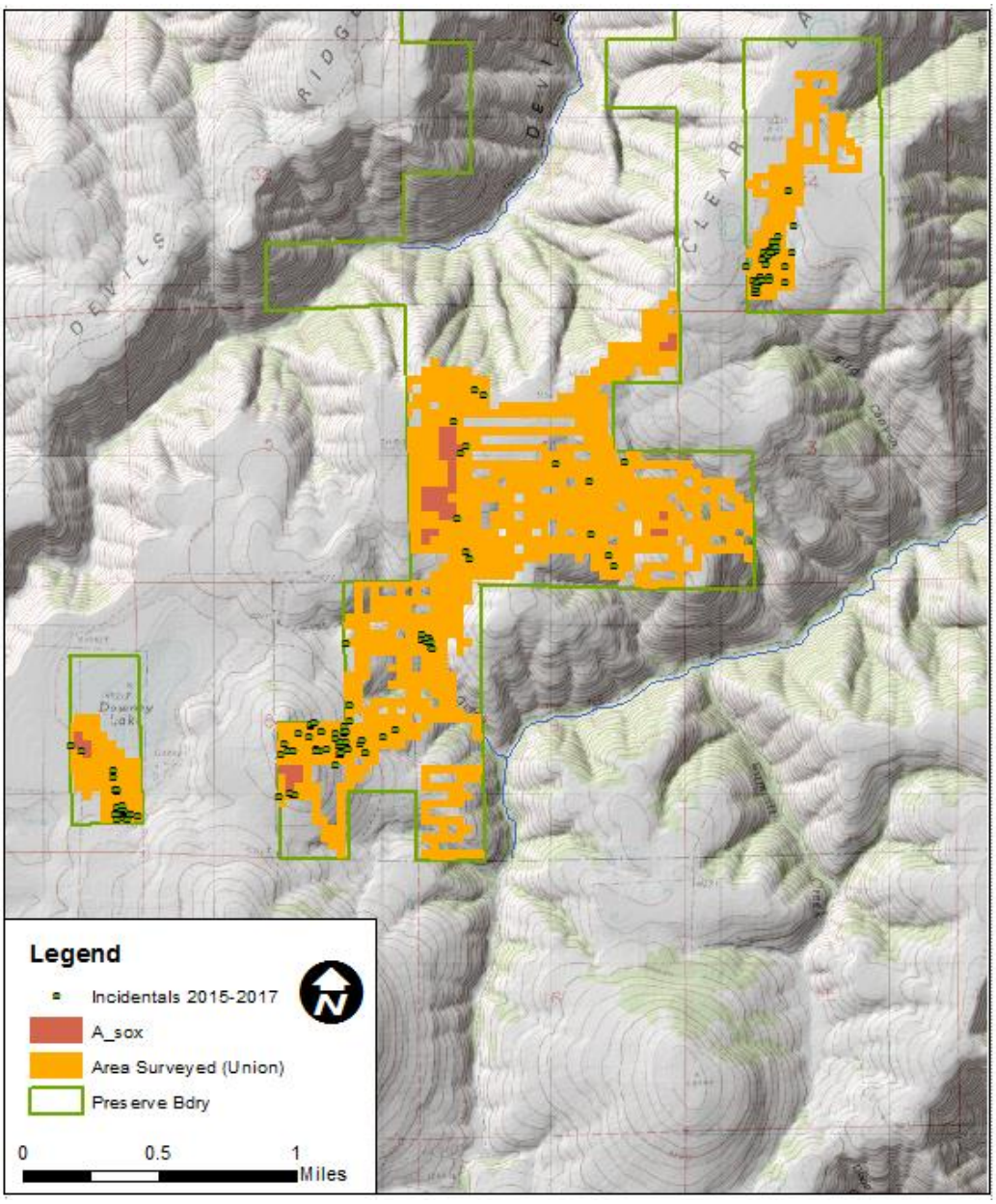

Figure 1: Entire area surveyed across both survey periods (union of all years' survey areas: 323 ha [798 ac]) and the restricted survey-occurrence area (Asox: grid cells surveyed in *all years* and occupied in *any* year; 11 ha [27 ac]). Only data from Asox were used for comparisons of Spalding's catchfly abundance across the two periods. Green dots are incidental observations of Spalding's catchfly collected in the 2015-2017 period that fell outside of Asox.

For frequency and density, a mean and 90% confidence interval were generated for each period. Frequency confidence intervals were calculated using a Wilson score method. All analyses were performed in JMP 13 (SAS Software, 2016). Statistical tests were not run on

frequency data because of the degree of overlap in confidence intervals. At the time of this writing, statistical tests on density data are on hold until expert statistical advice can be obtained for handling the extremely skewed distribution of data (high proportion of zeros).

POPULATION

To generate a population estimate for each period, I simply multiplied the mean density per period by the overall Asox. Therefore, this is a population estimate limited to the Asox used for this comparison. The survey results from the 2015-2017 period clearly show an increase in the area occupied by Spalding's catchfly—not necessarily because the population is expanding, but because as we continue expanding our search area, we are continuing to map its occurrence.

RESULTS

Frequency appeared to be relatively stable across the two sampling periods, while density and population appeared to decline[2]. Results are summarized below in Table 2 and in Figures 1 and 2.

Figures 4 and 5 illustrate the differences in overlapping survey areas (intersected areas) and areas occupied by Spalding's catchfly between the two survey periods. The most recent survey period indicates that 149 ha (37 ac) are occupied by Spalding's catchfly, compared to 77 ha (19 ac) in the 2009-2011 survey period.

Table 2: Mean frequency and density of Spalding's catchfly for the two survey periods

Period		Freq	Density *(plants/ha)*	Population
2009-2011	*Mean*	22%	134	1475
	90% CI	18 - 27%	95 - 174	1041 - 1909
2015-2017	*Mean*	21%	82	910
	90% CI	16 - 26%	59 - 106	648 - 1173

[2] Pending further investigation into statistical robustness, no firm conclusions can be made regarding density and population. The large number of zeros in the count data and resulting skewed distribution violates assumptions of normality that are required for unbiased estimates. Although large sample sizes can ameliorate this situation, it is unknown whether sample sizes for Clear Lake Ridge are large enough.

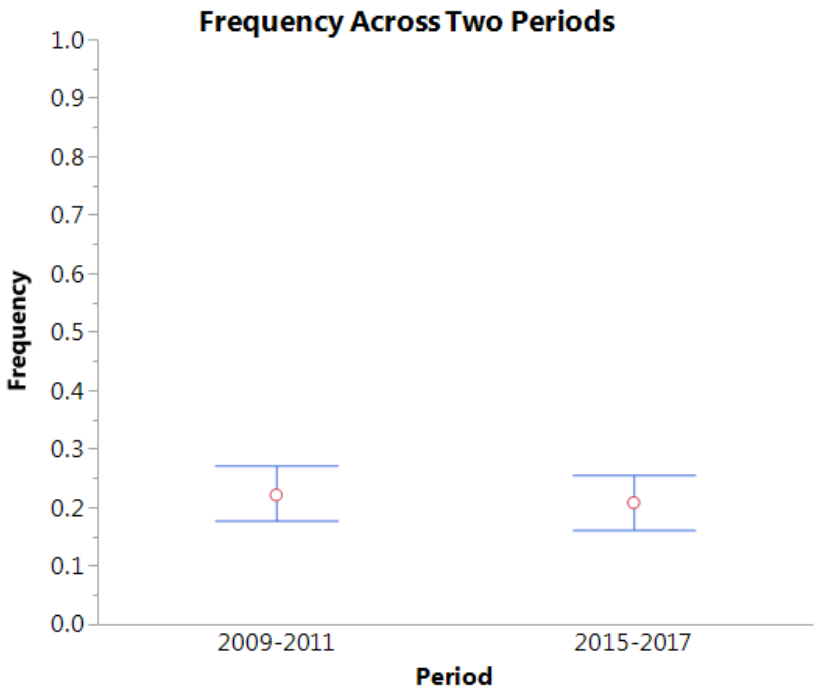

Figure 2: Frequency of Spalding's catchfly across the two survey periods. Error bars are 90% confidence intervals.

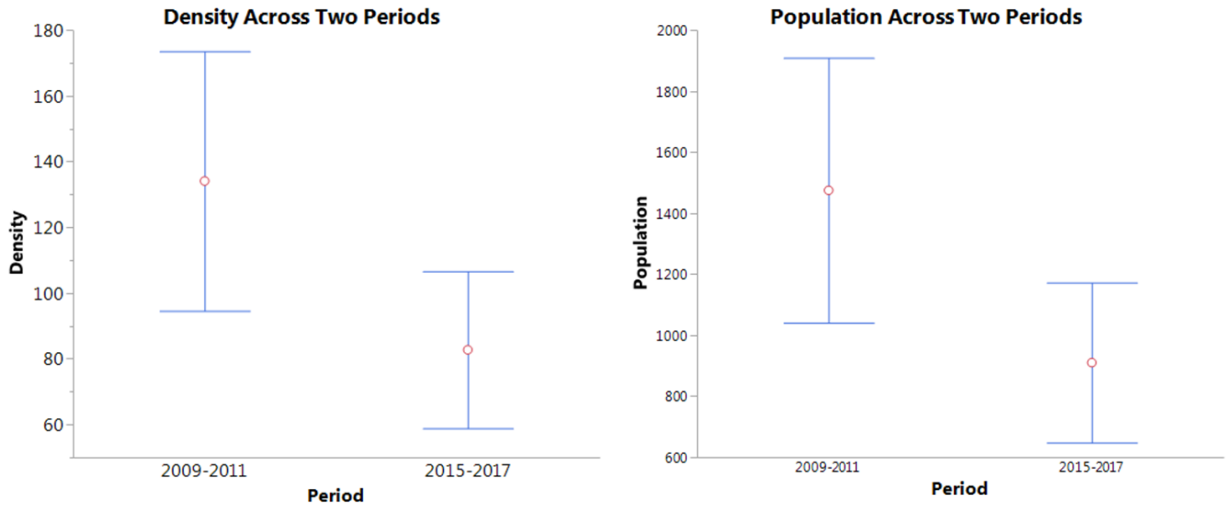

Figure 3: Density and population estimates of Spalding's catchfly across the two sampling periods. Error bars are 90% confidence intervals.

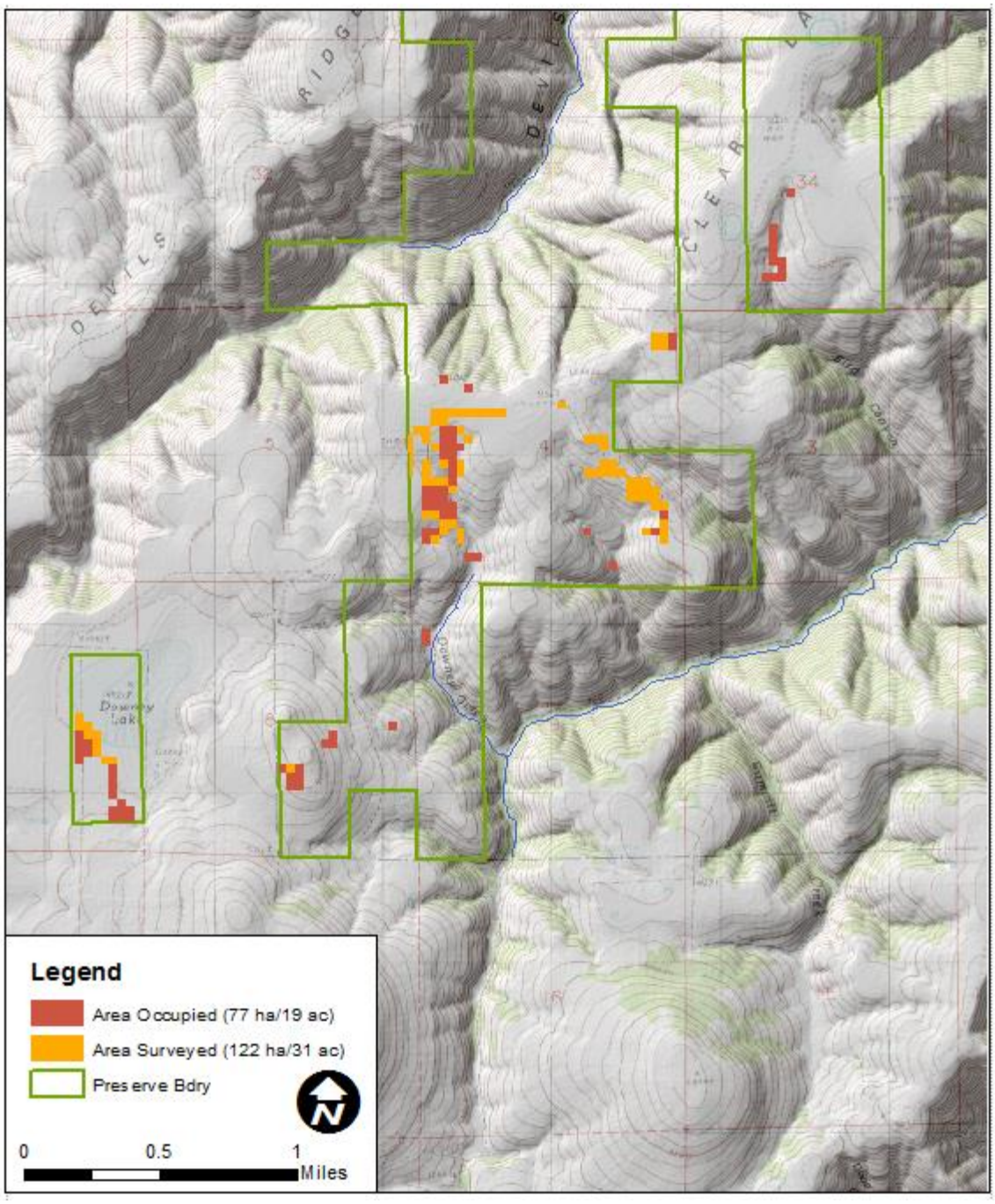

Figure 4: Area surveyed (intersect) and area occupied (union) for the survey period 2009-2011.

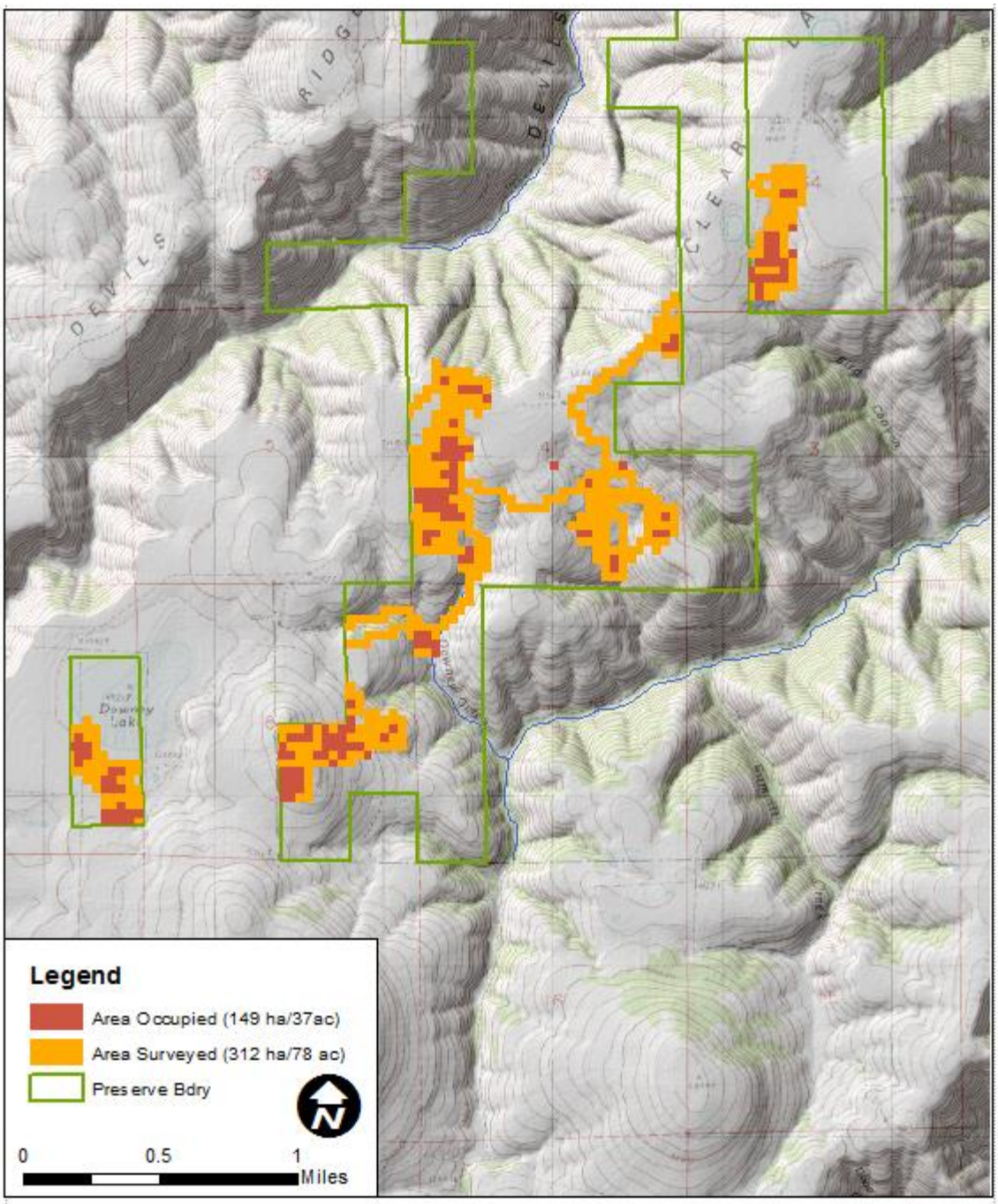

Figure 5: Area surveyed (intersect) and area occupied (union) for the survey period 2015-2017.

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Hill, Janice, Karen Gray, Juanita Lichthardt, and Kristen Pekas. 2014. "Demographic Monitoring of Spalding's Catchfly (Silene Spaldingii S . Watson) in Idaho Canyon Grasslands, Snake and Salmon Rivers (2004-2013) Final Report." *Idaho Natural Heritage Program, Idaho Department of Fish and Game*. Boise, ID. 63 pp.

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U.S. Fish and Wildlife Service. 2007. "Recovery Plan for Silene Spaldingii (Spalding's Catchfly)." U.S. Fish and Wildlife Service, Portland, Oregon. 187 pp.

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Overview

The "grid monitoring" method allows for long-term monitoring of a population of a variety of plant species of interest, including rare plants (e.g., Spalding's catchfly) and noxious weeds. It allows for long-term, statistically valid, tracking of a variety of indicators of plant abundance including area of occupancy, frequency, density, population size, and cover. Statistical inference extends to the entire known population and yet it does not require perfect knowledge of the species distribution within the study area, *a priori,* and the method can incorporate observations of the plant species of interest made outside of plots or even during other occasions. No complicated, heavy, bulky or expensive equipment is required allowing a single field observer to visit many sites in a single day on foot (i.e., large sample sizes). All plots are temporary thus no monumentation of survey sites is needed. Point location data resulting from the surveys can be used by land managers to aid in implementing interventions (e.g., livestock exclusion). In the sections below you will find all you need to know to count catchfly correctly in the field. Details on how data are stored and analyzed can be found in other documents. Counting catchfly properly requires that you can distinguish this species from other species, especially other wildflowers in the genus *Silene.* See the section *Tips for Identifying Spalding's Catchfly* at the end of this document.

Survey sites

Temporary survey sites are randomly located within the areas where Spalding's catchfly is already known to exist. A map will be provided showing the locations of survey sites to be visited. Each survey site has a unique identifier known as the Site ID. Upon arriving at the survey area, the observer's GPS unit is turned on and the tracklog cleared and started[3]. Using the map provided, the observer comes up with a general plan for visiting all of the survey sites in the area and begins by using the GPS to navigate to the first site.

Once en route, the survey effort has begun and the observer searches for Spalding's catchfly (the primary target) and any other plant species of interest (secondary targets such as noxious weeds)[4]. If any of these plants are found while en route to a survey site, their locations are recorded using the GPS as *incidental observations*. A single GPS waypoint can serve to document several plants or even a small patch[5]. Unique GPS symbols for both the primary and secondary targets are used to document which species was observed. **Observers search for plants not only at survey sites but also while travelling from one site to another**.

Monitoring vs Inventory Sites

There are three kinds of survey sites: *frequency monitoring sites, density monitoring sites* and *inventory sites* and these are distinguished from each other using unique symbols on your map and GPS. Both types of monitoring sites must be visited[6], plots established and plants counted. In contrast, **inventory sites** must simply be visited and inspected for the presence of any primary or secondary targets, but no plants are counted. Any primary or secondary targets found at or near inventory points are recorded as incidental observations.

[3] See the *Sniffer's guide to setting up your Garmin GPS 76Cx/CsX* for more information.

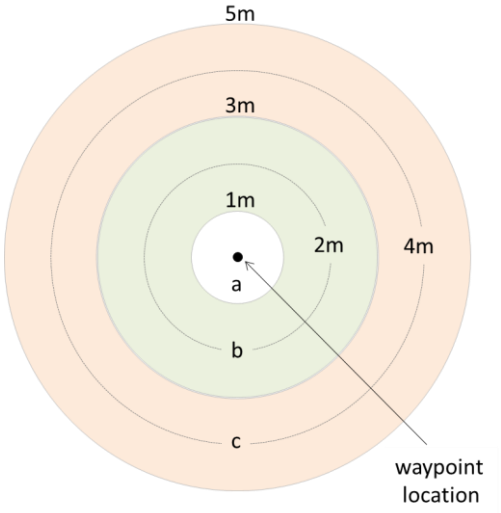
[4] You should know which plants are secondary targets before starting the survey. If you are unsure, ask your crew leader.

[5] You need not record a waypoint for every single plant encountered. A general rule is to record a new point for additional incidental observations only once you are 10-20 m from the last observation.

[6] Observers navigate to within 2m of the waypoint. As soon as the GPS indicates that the observer is within 2m of the waypoint, sh/e stops and establishes the point at that location.

At **frequency monitoring** sites the field observer establishes a 5m radius circular plot (78.54 m^2) centered at the place arrived at via GPS navigation by placing a survey stake between the feet thus establishing and marking the plot center. The observer then inspects the plot in three steps to acertain presence/absence of the target species. If no plants are immediately evident, the plot is searched in three steps (Box 1). and the observer marks indicates the plant's presence on the data sheet (PRESENT = YES). If the plant is not observed then PRESENCE = NO. Each visit to a frequency monitoring site results in a single entry on the data sheet.

Box 1. How to search the frequency monitoring plot.



First, the area within 1m of plot center (a) is inspected; if the target is not found the observer marks a point 2 m from plot center and walks a circular transect 2 m wide searching for the plant (b). If it's still not found the same is done 4 m from the plot center. As soon as the primary target is encountered within the plot the search ends and the target is considered *present*.

At **density monitoring** sites the observer counts all Spalding's catchfly plants within a 50m x 4 m *belt* (Box 2). Counts are made separately for *flowering*, *non-flowering* and *predated* plants as defined below

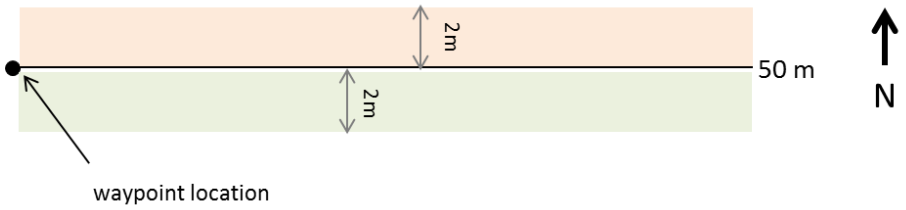
- A ***plant*** is a collection of one or more stems all within 20 cm of one another and greater than 20 cm distant from any other stem.
- A ***flowering plant (FL***) is a plant with *at least* one flowering stem. A flowering stem is a stem that has flower buds, flowers, or fruits or other evidence that it has produced flowers in the past or will in the future.
- A ***non-flowering plant (NFL***) is a plant with erect stems but having no reproductive structures.
- A ***predated (Pr)*** stem is a stem that has been browsed from the top down (usually by a cow, elk, or deer), thus severing its stems and often its inflorescences[7]. A *predated plant is one which has more than half its stems predated* (regardless of whether the remaining stems are flowering or non-flowering)

Note that it is not usually necessary to collect waypoints for catchfly plants within the 5 m circular or the 50 x 4 m monitoring plots. If no plants occur within the plot but do occur just outside the plot, be sure to collect an incidental waypoint. If you see plants on either end of the 50 m transect you should collect a waypoint for those as well, even if they are inside the plot.

[7] If a plant was browsed but has re-grown an inflorescence from an axillary bud, code this plant as FL.

Also, if there are secondary targets (e.g., noxious weeds) present you should collect incidental observations for those.

Box 2. How to count plants within the 50m belt transect.



One end of the transect is established at the location of survey site waypoint. A 50m tape is then stretched 50 m to the east (azimuth = 90°) or west (270°) (see data sheet!). The observer walks 1 m from the right side of tape counting all Spalding's catchfly plants rooted within a two meters of the tape (orange shaded area). Upon reaching the end of the tape the observer turns around and counts all plants on the opposite side of the tape (green shaded area)

At the end of the survey

- Save your tracklog and clear the memory.
- Ensure that all data sheets are complete
- Deliver data sheets to the crew leader.

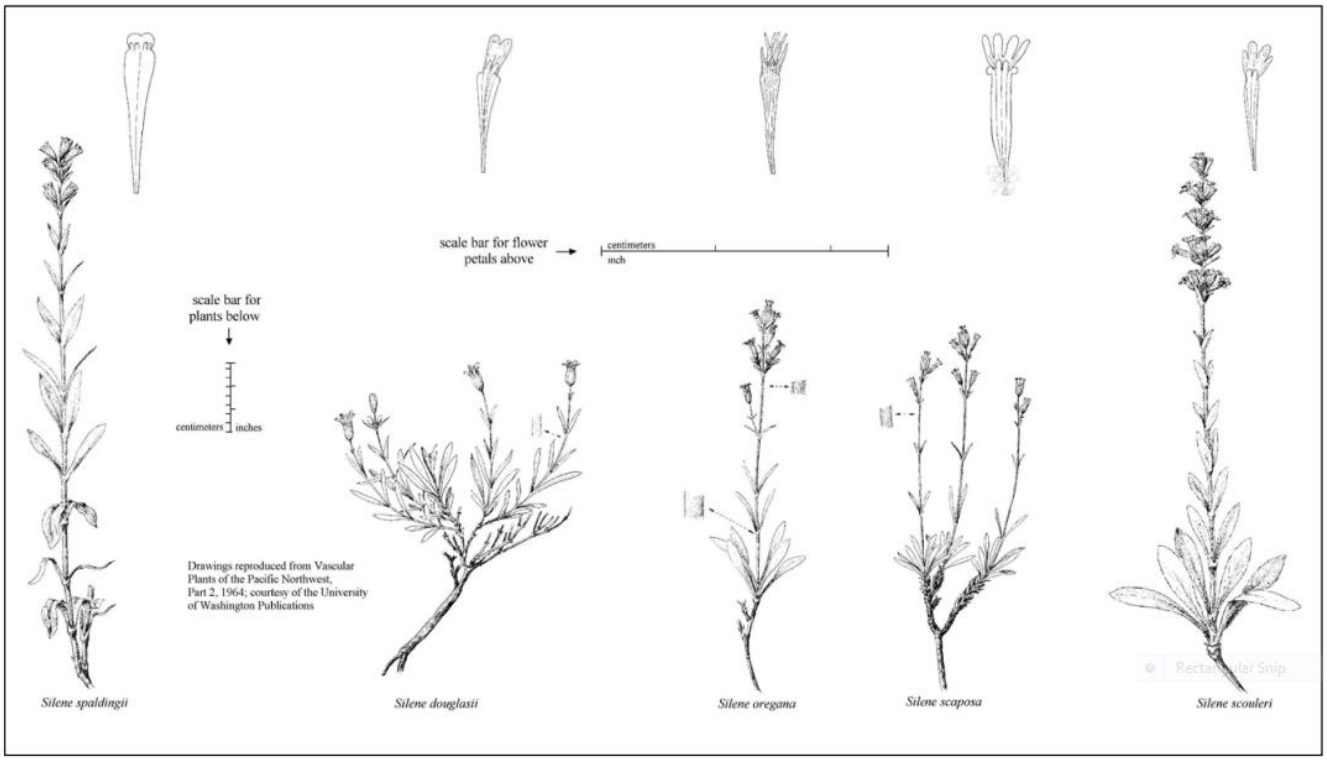
Equipment List

- Protocol (this document)
- Plant ID materials
- GPS, plus at least 4 AA batteries
  Compass (with declination adjusted)
- Datasheets and clipboard
- Pencils
- Candy canes (survey stakes)
- 50m tape

Tips for Identifying Spalding's Catchfly

A single flowering, muliti-stemmed plant

Detail of a flower and flower buds



Spalding's catchfly and look-alikes