# Population Viability Analysis for the clustered lady's slipper (*Cypripedium fasciculatum*)

2012

## Report to the Bureau of Land Management, Medford District

Report prepared by Erin C Gray, Thomas N Kaye, and Andrea S Thorpe

*Institute for Applied Ecology*

# PREFACE

The report the result of a cooperative project between the Institute for Applied Ecology (IAE) and the Bureau of Land Management. IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. IAE provides services to public and private agencies and individuals through development and communication of information on ecosystems, species, and effective management strategies. Restoration of habitats, with a concentration on rare and invasive species, is a primary focus. IAE conducts its work through partnerships with a diverse group of agencies, organizations and the private sector. IAE aims to link its community with native habitats through education and outreach.

Institute for Applied Ecology

Questions regarding this report or IAE should be directed to:

Thomas Kaye (Executive Director)

Institute for Applied Ecology

PO Box 2855

Corvallis, Oregon 97339-2855

phone: 541-753-3099

fax: 541-753-3098

email: tom@appliedeco.org

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**Cover photograph**: Clustered lady's slipper (*Cypripedium fasciculatum*).

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# Population Viability Analysis for the clustered lady's slipper (*Cypripedium fasciculatum*)

**REPORT TO THE BUREAU OF LAND MANAGEMENT, MEDFORD DISTRICT**

## INTRODUCTION

### Project Overview

**Figure 1.** *Cypripedium fasciculatum* (clustered lady's slipper).

Clustered lady's slipper (*Cypripedium fasciculatum* Kellogg ex S. Watson; synonym includes *Cypripedium knightiae* A. Nelson; Figure 1) is considered a candidate for listing by the Oregon Department of Agriculture, a Federal Species of Concern, and a Heritage List 2 species (threatened with extirpation in Oregon; ORBIC 2010). This orchid is rare throughout its range in the western United States. More than 800 locations for clustered lady's slipper have been identified in the Medford District BLM. Many of these populations had ten or fewer individuals at their last survey date but the current status of most of these populations is unknown. Small populations may be normal and healthy in this species or they may be at an elevated risk of extirpation. In an analysis of clustered lady's slipper and mountain lady's slipper (*Cypripedium montanum*) populations in California, we found that over the period of time follow-up observations were made (1 to 23 years), approximately 66% of populations declined in size and 30% - 45% fell to zero (Kaye and Cramer 2005). Both population size and time since previous observation were significantly correlated with extinction events. The purpose of this project was to survey populations of clustered lady's slipper in the Medford District BLM in order to expand on this earlier analysis and better model the probability of extinction [Population Viability Analysis (PVA)] for this species.

## Species Distribution and Description

Clustered lady's slipper occurs in widely disjunct locations from north central Washington south through Oregon to central California and east to the mountains of Idaho, Montana, Colorado, Wyoming, and Utah. In Oregon, this taxon occurs predominantly in the Klamath Mountains in the southwest corner of the state.

Clustered lady's slipper is small, measuring less than 18 cm from the base to the top of flowering stems. It has two opposite, elliptical leaves with a total leaf span up to 30 cm. The stem is conspicuously puberulent (Figure 1). In most cases, there is a single miniature bract between the leaves and the flowers. The flowers are tiny by lady's slipper standards, only 4.5 cm from tip to tip. Flower color ranges from brown markings on a green or golden background to predominately reddish-brown. The flowers are found in clusters of two to ten at the end of the stem, often causing the stem to droop under their weight (Figure 1). The fruits are 2 cm oblong capsules that contain thousands of small, dust-like seeds. Clustered lady's slipper has a small, shallow rhizome with fibrous roots that produces a dormant bud during the current year's growing season (Harrod 1994). This bud remains inactive through the winter, but then bolts in April to produce an aerial stem.

### Status

This species is currently considered a Sensitive Species in Regions 5 and 6 of the USDA Forest Service. National Forests covered under the Northwest Forest Plan recently treated it as a Survey and Manage Species, but this designation was converted to Sensitive Species (USDA Forest Service and USDI BLM 2001). The USDI Bureau of Land Management lists clustered lady's slipper as a Bureau Sensitive species in California and Oregon. Clustered lady's slipper is on the California Native Plant Society watch list, indicating that it is fairly endangered in California and rare outside the state. The Oregon Natural Heritage Information Center lists clustered lady's slipper as List 2 [threatened with extirpation (ORBIC 2010)]. The species' Heritage rankings are G4 (globally not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences), S3.2 in California, and S3 in Washington and Oregon (ORBIC 2010).

## Population Dynamics/Reproduction

The abundance of clustered lady's slipper stems at any one site may range from one to over 1,000. In California, the mean population size is 27 stems (Carothers 2003). Over half of the populations have fewer than 10 stems and over 90% have fewer than 100 stems. Large populations occur occasionally; one clustered lady's slipper population on the Plumas National Forest in the Sierra Nevada has over two thousand stems. This pattern of population size is similar to that observed in the Pacific Northwest. Nearly all sites in Oregon and Washington (96%) have stem counts less than 100, with most ranging between 1 and 20. Most populations on federal land were discovered during pre-disturbance surveys for proposed projects, primarily timber sales. The total number of extant sites is likely to be lower than indicated by the number of original sighting reports because some populations have declined or dropped to zero.

Clustered lady's slipper is a rhizomatous perennial that may propagate sexually and asexually. Clonal propagation from buds on rhizomes often produces tightly-grouped clumps of ramets. Genetic mapping suggests that clonal spread of clustered lady's slipper occurs only over very short distances, on the order of several centimeters. This species appears to rely primarily on sexual reproduction for expanding populations and maintaining genetic diversity (Knecht 1996). Fruit-set in the species appears to vary widely from 18% in Colorado, 29% in Idaho, to 69% in Oregon in one study (Lipow et al. 2002). The only observed pollinators of C. *fasciculatum* are female parasitoid wasps in the genus *Cinetus* (Ferguson and Donham 1999).

## Habitat

Clustered lady's slipper can occur in a wide variety of plant community types. The majority of known clustered lady's slipper sites are in mixed conifer, Douglas-fir, and riparian forests. Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*) are the evergreen tree species most frequently associated with C. *fasciculatum*. Hardwood trees and shrubs often associated with this species include mountain dogwood (*Cornus nuttallii*), hazelnut (*Corylus cornuta* var. *californica*), canyon live oak (*Quercus chrysolepis*), and black oak (*Q. kelloggii*). Forbs frequently associated with clustered lady's slippers include trail plant (*Adenocaulon bicolor*), starflower (*Trientalis latifolia*), and false Solomon's seal (*Maianthemum racemosa*).

In southwestern Oregon, the vegetation structure around populations of clustered lady's slipper usually consists of high canopy cover of late seral species (e.g. Douglas-fir) often in association with a gap in the overstory filled by mid-level hardwood species such as madrone (*Arbutus menziesii*), black oak, canyon live oak, mountain dogwood, or tanoak [*Lithocarpus densiflorus* (Latham 2001)]. The herbaceous layer is often sparse and composed primarily of a low abundance of graminoid and forb species. Mid-successional to late-successional forest communities may be optimal habitat for clustered lady's slipper in the Cascade Range of Washington and Oregon, possibly because fungal symbionts are present in these older communities that are not in younger communities (Harrod and Knecht 1994). Knecht (1996) observed that most populations of clustered lady's slipper in that region occurred in forests with >60% canopy cover.

Most orchids have strong associations with mycorrhizal fungi, and C. *fasciculatum* is one of several *Cypripedium* species that are tightly linked to one or a few obscure families of fungi. C. *fasciculatum* is most frequently associated with mycorrhizae in the family Tulasnellaceae, and the distribution of this orchid may be limited by the distribution of fungi in this group (Shefferson et al. 2005). Because of this association, important environmental factors controlling the distribution of clustered lady's slippers may include characteristics of the upper organic layer of the soil profile and how they influence mycorrhizal fungi, rather than the nature of the parent or mineral soil. Some soil factors that may affect mycorrhizal fungi include development of the soil organic layer, soil depth, rate of decomposition of organic matter, moisture content, and pH. The bryophyte communities that cover shallow soils in which clustered lady's slippers rhizomes often grow may also be important for water retention. Coarse woody material may provide microsite moisture, shade, and protect duff and litter layers from disturbance.

# METHODS

## Data Collection

In May of 2008 – 2012, we visited 113 clustered lady's slipper populations throughout the Medford District BLM that were last surveyed between 1 and 29 years ago (Appendix A). In June 2012, we visited 10 populations that occurred in higher elevation sites [823 – 1250m (2700-4100 ft)] primarily within the Rogue River-Siskiyou National Forest. These sites were last surveyed 15-27 years ago. The information available regarding these populations varied, but generally included written physical site descriptions, general directions, habitat descriptions, and clustered lady's slipper population information. Older population descriptions included estimated latitude and longitude coordinates whereas newer sites included latitude/longitude and/or UTMs in the original site description. Newer sites were also generally flagged well and usually included "Plant Site" monument signs in the vicinity of the clustered lady's slipper populations. Five new populations found over the course of this survey work have "NEW" in their unique-ids (Appendix A), and were not included in the PVA analysis.

Sensitive Plant Sighting Forms (Medford District BLM) were completed for each population, including when the population could not be relocated. In cases where uncertainty existed about the original population's location, the entire area was intensely surveyed using the Intuitive Controlled survey method (Whiteaker et al. 1998). This was especially common for older sites where the original flagging had weathered away and no monuments marked the population. If plants were found based on the original written description, we assumed that we were part of the original population. If plants were found in an area where we had no occurrence information, we assumed they were from a new, previously undocumented population. If no plants were found, a survey form was filled out at the particular spot that best matched the original description. All clustered lady's slipper populations that were located were flagged and GPS coordinates were recorded.

## Data Analysis

Data included in the Population Viability Analysis came from four sources beyond what was collected in 2008 - 2012. The first was a selection of populations from the Sierra Nevada bioregion taken from the Carothers (2003) database (N = 78). These data were initially selected and used by Kaye and Cramer (2005) to create a Population Viability Analysis for C. *fasciculatum* and C. *montanum* in California. Data were also included from long term C. *fasciculatum* monitoring plots established in southwestern Oregon forests (land managed by Medford District BLM and Rogue-Siskiyou National Forest) and monitored by the BLM and the Institute for Applied Ecology (N = 28). These plots were established between 1996 and 1998 and monitored through 2007. Stella Copeland contributed data from her 2010 and 2011 field surveys, including two new populations (Appendix A, N= 17). These populations have been visited multiple times throughout the years, with the majority of her sites re-visited in 2010 and 2011. For the purposes of our model, we only included data for the oldest and most recent site visit. Additional information came from site revisits by USFS employees (N=2).

One set of assumptions made in the creation of the database for the Population Viability Analysis involved populations that were extinct versus those that were not relocated. While some of the information used for the analysis came from well documented monitoring projects, other data came from observations of populations without permanent markers. While we are reasonably sure that we revisited the described sites and we searched intensively in areas where populations could not be relocated, it is possible that in some cases we were not searching the exact location of the reported location. Similarly, this species is capable of dormancy and failure to relocate a population may have been the result of synchronous dormancy in a small number of plants. For the purpose of this analysis it was assumed that populations not relocated were extinct.

We also made assumptions about the actual population size of previously monitored populations. Some observers censused the entire population, while others estimated population size, potentially complicating the determination of whether a population increased or decreased over time. This problem was uncommon, but when necessary the highest integer reported for a population in a given year was used.

For example, if 50-100 plants were reported, we used 100. If the number was vague, for example 75+, >30, or ca. 50, we used the integer listed, (in the example, 75, 30, or 50, respectively). At the time of initial visit, populations used in the analysis varied in size from 1 to 1084 (Figure 2).

Extinction risk was estimated from the data using a general linear model with quasibinomial errors. The response variable was population status at the most recent visit (a binomial response, either extinct or present). The independent variables were the size of the population at the initial visitation, elevation of the population (ft), and number of years between these visitations. All analyses were performed in R 2.12 (R Core Development Team, www.cran-r.org).

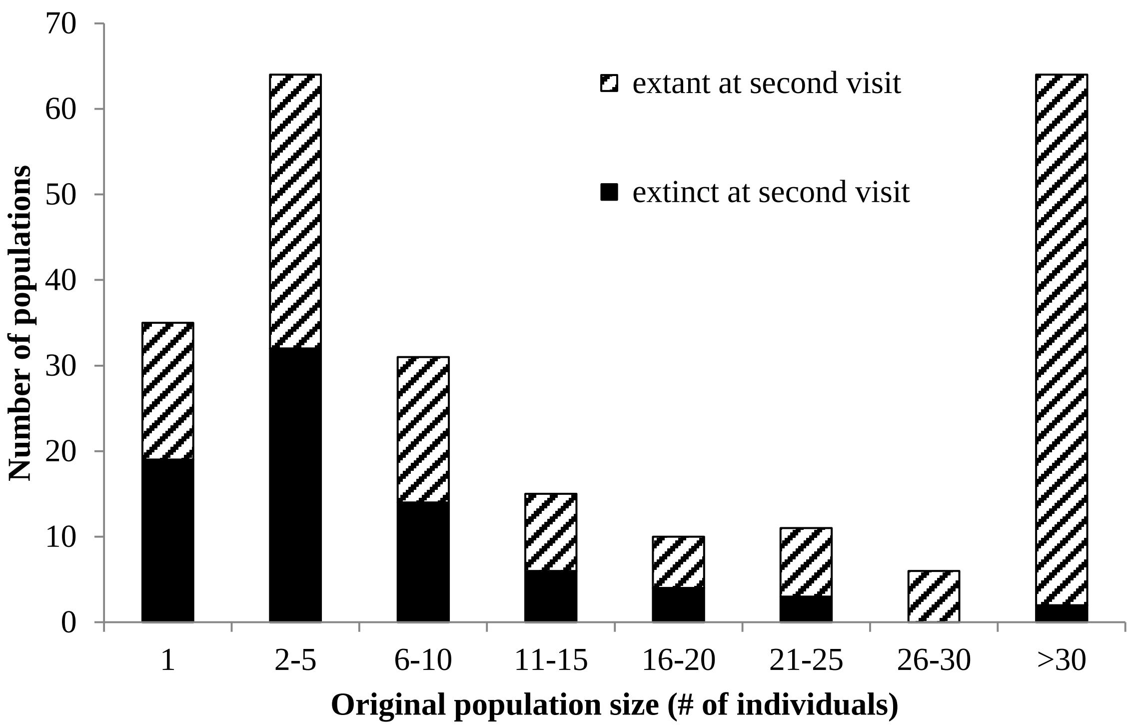


**Figure 2.** Histogram of populations used in the population viability analysis grouped by original population size and status at time of the most recent visit.

## RESULTS AND DISCUSSION

Most populations of C. *fasciculatum* have very few individuals. The data suggest an ongoing trend of population decline and local extinction. Our data set includes 236 populations of C. *fasciculatum* from Oregon and California that were revisited 1 to 29 years after the previous site visit. We found that 61% of these populations declined in size and 34% fell to zero. Small populations (<10 plants) went extinct in 50% of the cases, and mid-sized populations (10-30 plants) went extinct in 34% of the cases, while only 3% of large populations (>30 plants) declined to zero. Our analyses of all site revisits indicated that population size, time between site visits, and elevation were important factors in predicting extinction probability (Table 1). Probability of extinction was best explained by all of these factors, including an interaction between years between site visits and elevation ($p$=<0.001). The PVA indicated that small populations had a greater risk of extinction than those with large populations, and predicted extinction risk was near zero for populations >100 individuals, regardless of the length of time between samples (Figure 3). Further, extinction risk increased as the time between visits increased, most notably for smaller populations. Populations of 10 individuals had a 25% chance of going extinct after 5 years, but this risk increased to 91% after 30 years. The data provided by multiple years of surveying have not altered the overall predictions of this model compared to our previous reports, but rather increased the confidence of these predictions.

**Table 1.** Summary statistics for factors affecting extinction risk.

| | Estimate | Standard Error | t value | Pr(>\|t\|) |
|---|---|---|---|---|
| **Starting population size** | -0.09 | 0.02 | -4.36 | <0.0001 |
| **Years between site visits** | 0.38 | 0.01 | 3.81 | <0.0001 |
| **Elevation** | 0.0002 | 0.0003 | 0.713 | 0.47 |
| **Years between site visits x Elevation** | -0.00008 | 0.00003 | -2.76 | <0.001 |

Of the ten higher elevation sites visited in 2012, seven had declined to zero, and of the three that were not extinct, two were in decline. These higher elevation sites exhibited evidence of past logging/canopy thinning which may impact appropriate habitat for this species. The effect of elevation on population extinction depended on the number of years between visits (Table 1). Populations at low elevations (below 3000 feet) were significantly more likely to go extinct than high elevation populations, but only after several years (Figure 4). In other words elevation does not have an effect on extinction probability unless several years have passed. Many species have already shifted their distributions uphill in response to climate change in Europe, at a rate of 29 meters per decade (Lenoir et al. 2008). Our results suggest that negative impacts of climate change might already be apparent for C. *fasciculatum* through extinction of low elevation populations. Other anthropogenic forces such as land conversion for agricultural uses and logging could decrease appropriate habitat for the species at low elevation sites and compound the stresses created by climate change. These results suggest that numerous factors, including climate change, have the potential to negatively affect population viability for C. *fasciculatum*, especially in the lower elevation sites.

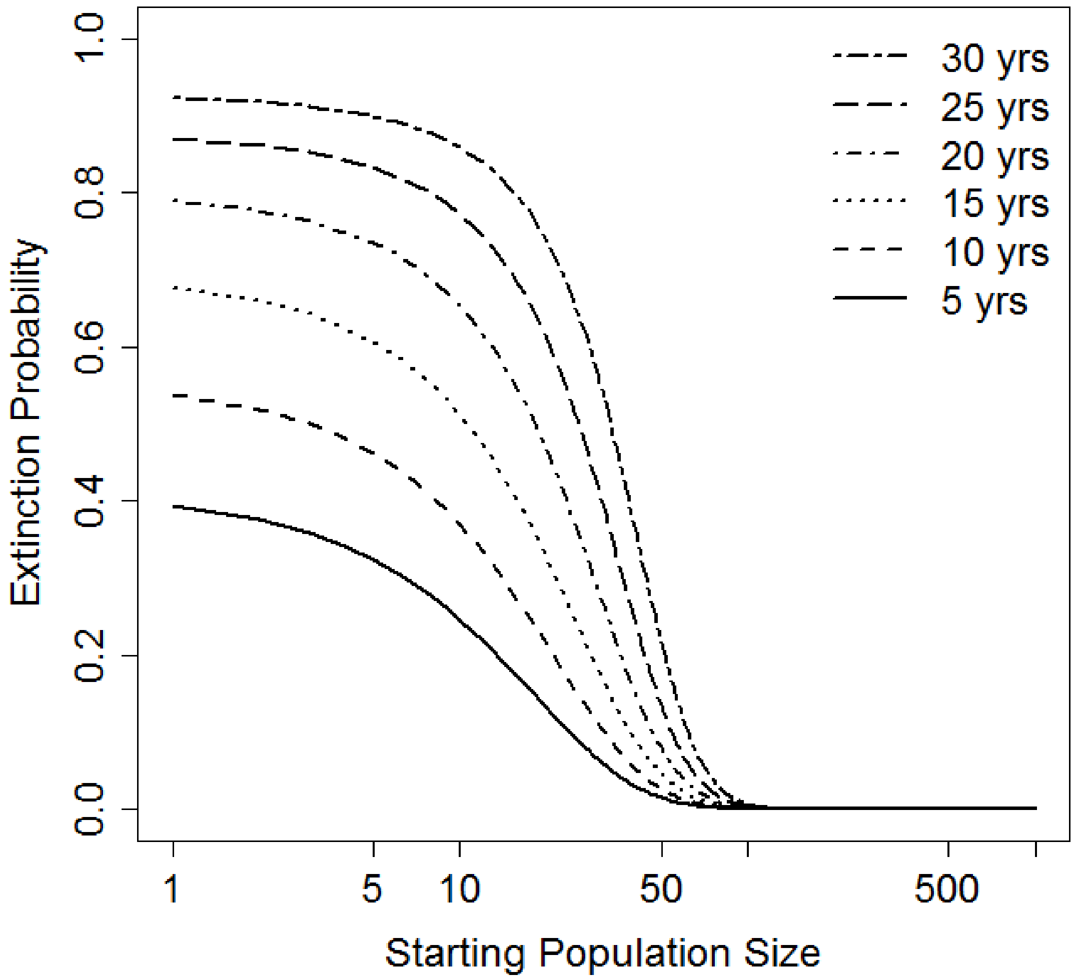


**Figure 3.** Extinction probability as a function of starting population size and years between visits (with elevation exluded from the model). Each line represents a specific time interval between population site visits. Note the logarithmic scale of the x-axis.

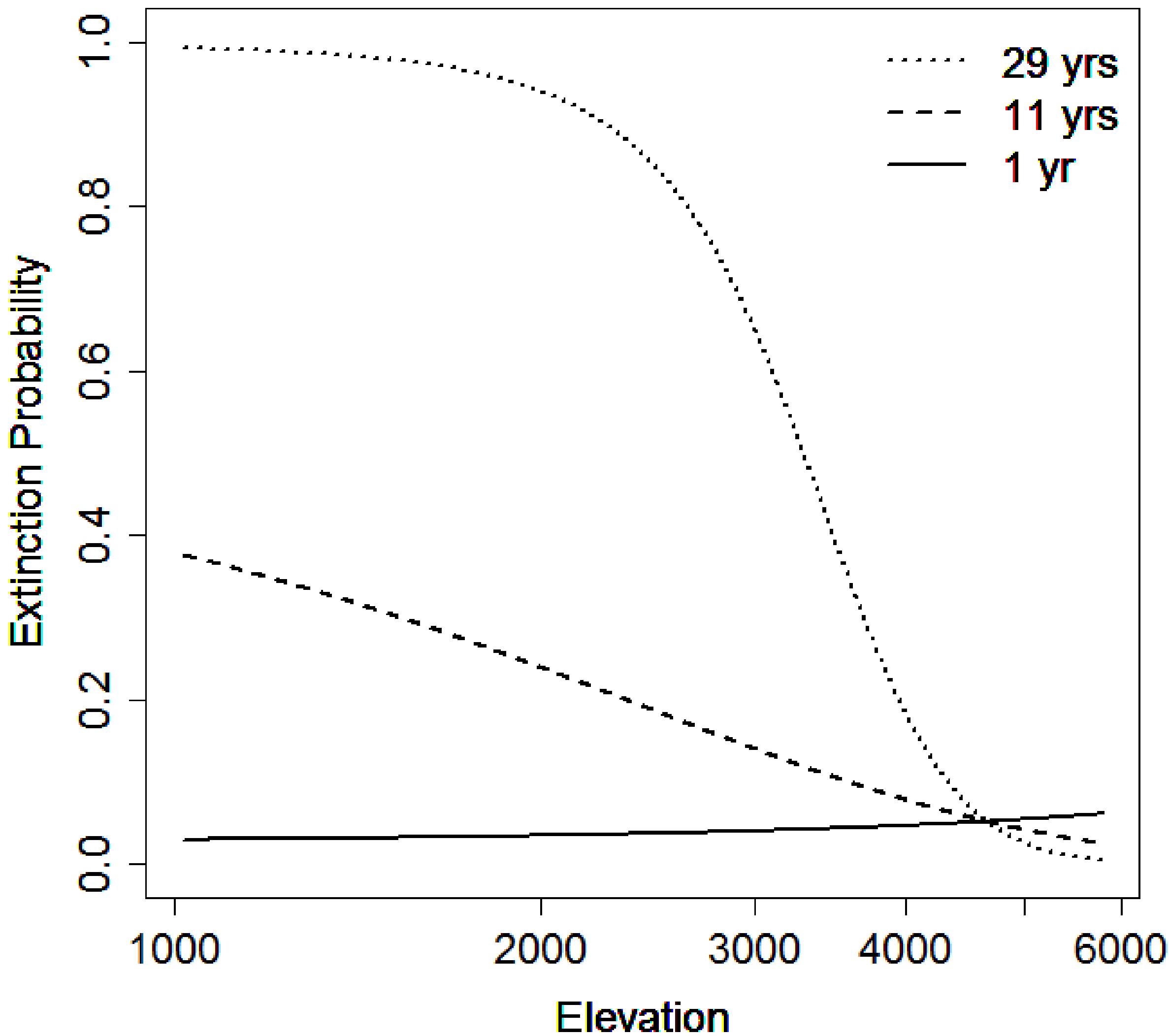


**Figure 4.** Extinction probability as a function of elevation and years between visits. Each line represents a specific time interval between population site visits. Starting population size = mean (26).

No coordinated range-wide monitoring program exists for C. *fasciculatum*. Estimates of the total number of populations of clustered lady's slipper based on historical records may highly overestimate the number of extant populations. While some of the populations that were assumed to be extinct may have been dormant, it is unlikely that all individuals in a population would be dormant, particularly because the probability of dormancy longer than one year is low (Thorpe et al. 2011). Our analysis did not estimate establishment rates but if new sites are frequently colonized, the risk of population losses documented here would be reduced. However, given the relative rarity of undisturbed habitat in the range of C.

*fasciculatum*, we believe it is unlikely that the number of new populations balances the number of extinctions. In light of the likelihood that many documented populations of clustered lady's slipper may be extinct, we recommend the maintenance of protections for this species.

We recommend the initiation of a new study of BLM and USFS populations in southern Oregon with the objective of applying the PVA to current data on populations in the Geographic Biotic Observations database (GeoBOB). Though the present PVA provides a good estimate of the likelihood of extinction of existing populations on BLM land in Oregon, it does not include information about the rate at which new populations become established, and thus may overestimate the likelihood of extinction within a given area. In future research, we recommend analyzing BLM survey data to determine which surveys were conducted in appropriate habitat and during the right time of year to detect C. *fasciculatum* populations. From these records, we can determine the probability of detecting a new population. Finally, we can revisit these populations to validate this model of population loss rates.

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# APPENDIX A. CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2008.

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8480 | 9 | Josephine | Grants Pass RA | Takilma | 40S | 7W | 9 | SW of SE | 456402 | 4660700 | Nad27 |
| 650 | 17 | Josephine | Grants Pass RA | Takilma | 40S | 7W | 9 | SW of SE | 456307 | 4660714 | Nad27 |
| 2253 | 10 | Josephine | Grants Pass RA | Sexton Mt. | 35S | 5W | 29 | SW 1/16 of NE 1/4 | 474204 | 4705244 | Nad27 |
| 7255 | 9 | Josephine | Grants Pass RA | Takilma | 40S | 7W | 17 | SW of SW | 453980 | 4659008 | Nad27 |
| 643 | 16 | Josephine | Grants Pass RA | | 39S | 8W | 17 | NW of NW | 444083 | 4670299 | Nad27 |
| 8532 | 11 | Josephine | Grants Pass RA | Holland | 39S | 7W | 5 | SW 1/16 of NW 1/4 | 453803 | 4672747 | Nad27 |
| 2266 | 10 | Josephine | Grants Pass RA | Onion Mt. | 36S | 7W | 27 | NE 1/16 of NW 1/4 | 457726 | 4695780 | Nad27 |
| 12721 | 1 | Josephine | Grants Pass RA | Wilderville | 36S | 7W | 27 | NE 1/4 | 458140 | 4695800 | Nad27 |
| 11658 | 2 | Josephine | Grants Pass RA | Onion Mt. | 37S | 7W | 3 | NW of NE | 457894 | 4692807 | Nad27 |
| 1405 | 12 | Jackson? | Grants Pass RA | Onion Mt. | 37S | 7W | 3 | NW of NW | 458034 | 4692657 | Nad27 |
| 7529 | 8 | Josephine | Grants Pass RA | Murphy | 38S | 5W | 5 | SE of NW | 473897 | 4682221 | Nad27 |
| 8968 | 3 | Jackson | Butte Falls RA | Skeleton Mt. | 33S | 3W | 20 | SE of SW | 493253 | 4725208 | Nad27 |
| !NEW-1 | NA | Jackson | Butte Falls RA | Skeleton Mt. | 33S | 3W | 20 | SE of SW | 493268 | 4725317 | Nad27 |
| !NEW-2 | NA | Jackson | Butte Falls RA | Skeleton Mt. | 33S | 3W | 20 | SE of SW | 493276 | 4725201 | Nad27 |
| 11552 | 2 | Jackson | Butte Falls RA | McConville Pk | 34S | 3W | 21 | NW of NW | 494337 | 4717015 | WGS84 |

## CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2008 (CONT.)

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9283-1 | 4 | Josephine | Glendale RA | Sexton Mt. | 34S | 5W | 17 | NE of SE | 474270 | 4717780 | WGS84 |
| 9283-2 | 4 | Josephine | Glendale RA | Sexton Mt. | 34S | 5W | 17 | NE of SE | 474573 | 4717811 | WGS84 |
| 9283-3 | 4 | Josephine | Glendale RA | Sexton Mt. | 34S | 5W | 17 | NE of SE | 474602 | 4717727 | WGS84 |
| 7554 | 8 | Josephine | Glendale RA | Golden | 33S | 5W | 28 | NW of SW | 474972 | 4724429 | Nad27 |
| 2355 | 10 | Josephine | Glendale RA | Glendale | 33S | 7W | 26 | NE 1/16 of NE 1/4 | 460088 | 4725130 | Nad27 |
| 4790 | 5 | Josephine | Glendale RA | Merlin | 34S | 6W | 15 | NE 1/16 of SE 1/4 | 468334 | 4717811 | Nad27 |
| 4789 | 5 | Josephine | Glendale RA | Merlin | 34S | 6W | 15 | SE 1/16 of NE 1/4 | 468373 | 4718155 | Nad27 |
| 9779 | 3 | Jackson | Ashland RA | Applegate | 37S | 4W | 14 | SE of SW | 488050 | 4688601 | WGS84 |

! Denotes new population found over the course of the survey work not included in the PVA analysis.

## APPENDIX A. (CONT.) CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2009.

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7569 | 8 | Jackson | Ashland RA | | 39S | 3W | 29 | NW of NW | 492501 | 4666887 | WGS84 |
| 590 | 23 | Jackson | Ashland RA | | 39S | 4W | 27 | SE of NE | 487456 | 4666534 | Nad27 |
| 10277 | 4 | Jackson | Ashland RA | | 39S | 4W | 21 | NE of SE | 485901 | 4667492 | Nad27 |
| !NEW-4 | NA | Jackson | Ashland RA | | 39S | 4W | 31 | NE of SE | 482671 | 4664433 | Nad27 |
| 609 | 23 | Jackson | Ashland RA | | 39S | 4W | 31 | NE of SE | 482683 | 4664330 | Nad27 |
| 2365 | 10 | Jackson | Ashland RA | Tallowbox Mt. | 39S | 4W | 26 | SE of SW | 488157 | 4665711 | WGS84 |
| 9724-a | 3 | Jackson | Ashland RA | Applegate | 37S | 4W | 21 | NE of SW | 484988 | 4687303 | WGS84 |
| 9724-b | 3 | Jackson | Ashland RA | Applegate | 37S | 4W | 21 | NE of SW | 485029 | 4687318 | WGS84 |
| 9724-c | 3 | Jackson | Ashland RA | Applegate | 37S | 4W | 21 | NE of SW | 485005 | 4687258 | WGS84 |
| !NEW-5 | NA | Jackson | Ashland RA | Applegate | 37S | 4W | 21 | NE of SW | 485025 | 4687316 | WGS84 |
| 559 | 21 | Jackson | Ashland RA | | 37S | 4W | 27 | SW of NW | 485982 | 4686063 | WGS84 |
| Round Prairie C | 2 | Josephine | Grants Pass RA | Onion Mt. | 37S | 7W | 3 | NE of NE | 458392 | 4693114 | Nad83 |
| 11665 | 3 | Josephine | Grants Pass RA | Onion Mt. | 37S | 7W | 3 | NE of SE | 458509 | 4692192 | Nad83 |
| 1026 | 14 | Josephine | Grants Pass RA | Williams | 39S | 5W | 14 | NW of SW | 478635 | 4669123 | Nad83 |
| 1033 | 14 | Josephine | Grants Pass RA | | 40S | 7W | 12 | SW of NW | 460223 | 4661466 | Nad83 |
| 4600 | 6 | Jackson | Ashland RA | Talent | 39S | 2W | 5 | NW of NW | 502166 | 4673535 | Nad83 |
| 674 | 18 | Jackson | Ashland RA | | 39S | 4W | 31 | NW of NW | 481482 | 4665259 | Nad83 |

## CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2009 (CONT.)

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2738 | 11 | Josephine | Grants Pass RA | | 35S | 5W | 33 | SW of NW | 476395 | 4711800 | Nad83 |

! Denotes new population found over the course of the survey work not included in the PVA analysis.

# APPENDIX A. (CONT.) CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2010

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2256 | 11 | Josephine | Grants Pass RA | Grant's Pass | 35S | 5W | 33 | SW of SE | 475621 | 4702941 | Nad83 |
| 820 | 12 | Josephine | Grants Pass RA | Mt. Peavine | 34S | 8W | 34 | NE of SE | 448614 | 4713007 | Nad27 |
| 1439 | 15 | Jackson | Ashland RA | Tallowbox Mt. | 38S | 4W | 28 | SE 1/16 of SE 1/4 | 485682 | 4675359 | Nad83 |
| 2043 | 6 | Jackson | Ashland RA | Tallowbox Mt. | 39S | 4W | 23 | NW 1/16 of NW 1/4 | 487538 | 4668566 | Nad83 |
| 2311 | 12 | Jackson | Ashland RA | Ruch | 38S | 3W | 7 | SW 1/16 of SW 1/4 | 490877 | 4680193 | Nad83 |
| 2327 | 12 | Jackson | Ashland RA | Ruch | 38S | 3W | 18 | SE 1/16 of NW 1/4 | 491211 | 4679361 | Nad27 |
| 2329 | 12 | Jackson | Ashland RA | Mount Isabelle | 38S | 3W | 18 | SE of NW | 491520 | 4679118 | Nad27 |
| 2598 | 12 | Jackson | Grants Pass RA | Rogue River | 37S | 4W | 5 | SE1/16 of NW 1/4 | 483352 | 4692554 | Nad83 |
| 4781 | 7 | Josephine | Glendale RA | Golden | 34S | 5W | 9 | SE of NE | 476316 | 4719869 | Nad27 |
| 7259 | 11 | Josephine | Grants Pass RA | Takilma | 40S | 7W | 18 | SE of SW | 452514 | 4659028 | Nad83 |
| 7536 | 10 | Jackson | Butte Falls RA | Trail | 33S | 1W | 1 | SW 1/16 of SE 1/4 | 519373 | 4730273 | Nad83 |
| 7574 | 10 | Jackson | Ashland RA | Tallowbox Mt. | 39S | 4W | 32 | SE of SE | 484025 | 4664098 | Nad83 |
| 8531 | 10 | Josephine | Grants Pass RA | Holland | 39S | 7W | 3 | NW of NE | 457959 | 4673600 | Nad83 |
| 8542 | 9 | Jackson | Butte Falls RA | Trail | 33S | 1W | 10 | SE 1/16 of NW 1/4 | 515667 | 4729685 | Nad83 |
| 8778 | 11 | Josephine | Glendale RA | Sexton Mt. | 34S | 5W | 18 | NE of SE | 472791 | 4717812 | Nad27 |

# CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2010 (CONT.)

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12947 | 3 | Josephine | Glendale RA | Glendale | 33S | 6W | 29 | SW of SW | 463855 | 4723928 | Nad27 |
| 13161 | 2 | Jackson | Ashland RA | Tallowbox Mt. | 39S | 4W | 31 | NE of SE | 482548 | 4664595 | Nad27 |
| 577 | 29 | Jackson | Butte Falls RA | McConville Pk | 35S | 3W | 17 | NW of SW | 492600 | 4707985 | Nad83 |
| 609 | 2 | Jackson | Ashland RA | Tallowbox Mt. | 39S | 4W | 31 | NE of SE | 482676 | 4664422 | Nad27 |
| 3833 | 19 | Josephine | RRSNF | Takilma | 40S | 7W | 22 | SW of NE | 457655 | 4658629 | Nad83 |
| 3827 | 19 | Josephine | RRSNF | Takilma | 40S | 7W | 21 | NE of NE | 4658590 | 456720 | Nad27 |
| 3846 | 19 | Josephine | RRSNF | Takilma | 40S | 7W | 19 | NE of NE | 453449 | 4658781 | Nad83 |
| EOR 81 | 20 | Jackson | RRSNF | Talent NE | 39S | 1W | 33 | SE of NE | 515133 | 4664898 | Nad83 |
| EOR 82-1 | 13 | Jackson | RRSNF | Siskiyou Peak | 40S | 1W | 5 | SE of SE | 513531 | 4662647 | Nad83 |
| EOR 82-2 | 20 | Jackson | RRSNF | Siskiyou Peak | 40S | 1W | 5 | SE of SE | 513459 | 4662566 | Nad83 |
| EOR 830-12 | 12 | Josephine | RRSNF | Carberry Creek | 40S | 5W | 13 | NW of NW | 479524 | 4660391 | Nad83 |
| EOR 830-13 | 12 | Josephine | RRSNF | Carberry Creek | 40S | 5W | 13 | NW of NW | 479352 | 4660523 | Nad83 |
| EOR 830-14 | 12 | Josephine | RRSNF | Carberry Creek | 40S | 5W | 11 | SE of SE | 479141 | 4660672 | Nad83 |
| *22589 | 12 | Jackson | RRSNF | Squaw Lakes | 40S | 3W | 34 | SE of NW | 485881 | 4665042 | Nad83 |
| *!Alex.Gulch | NA | Jackson | Ashland RA | Tallowbox Mtn. | 39S | 4W | 26 | NW of NW | 487848 | 4667105 | Nad83 |

* Denotes populations surveyed by S. Copeland. ! Denotes new population found over the course of the survey work not included in the PVA analysis.

## APPENDIX A. (CONT.) CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2010 AND 2011 BY STELLA COPELAND.

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *575-a | NA | Josephine | Grants Pass RA | Takilma | 40S | 7W | 5 | NE of SW | 454275 | 4662769 | Nad83 |
| *French Gulch | NA | Jackson | RRSNF | Squaw Lakes | 40S | 3W | 32 | SW of NE | 493309 | 4655478 | Nad83 |
| *575 | 21 | Josephine | Grants Pass RA | Takilma | 40S | 7W | 5 | NE of SW | 454133 | 4662825 | Nad83 |
| *11943 | 3 | Jackson | Ashland RA | Siskiyou Pass | 40S | 2E | 25 | NW of SW | 538030 | 4656787 | Nad83 |
| *7003 | 7 | Jackson | Butte Falls RA | Butte Falls | 34S | 2E | 29 | NW of SE | 532106 | 4714477 | Nad83 |
| *15904 | 22 | Jackson | RRSNF | Ashland | 39S | 1E | 27 | SW of SE | 525951 | 4665843 | Nad83 |
| *3226 | 22 | Jackson | RRSNF | Ashland | 39S | 1E | 27 | NE of SE | 526294 | 4666051 | Nad83 |
| *5758/22241 | 14 | Josephine | RRSNF | Chrome Ridge | 36S | 8W | 19 | N 1/2 of SE | 443558 | 4696773 | Nad83 |
| *5745 | 15 | Jackson | RRSNF | Chrome Ridge | 36S | 8W | 18 | SE of NE | 443920 | 4698736 | Nad83 |
| *7517 | 4 | Jackson | Ashland RA | Talent | 39S | 1W | 19 | NE of NW | 510907 | 4668698 | Nad83 |
| *22589 | 12 | Jackson | RRSNF | Squaw Lakes | 40S | 3W | 34 | SE of NW | 485881 | 4665042 | Nad83 |
| *EO 802 | 11 | Jackson | RRSNF | Talent | 39S | 1W | 33 | NW of SW | 513821 | 4664566 | Nad83 |
| *7532 | 10 | Josephine | Grants Pass RA | Holland | 39S | 7W | 3 | SW of NW | 456890 | 4673190 | Nad83 |
| *1220 | 4 | Josephine | Grants Pass RA | Selma | 37S | 7W | 5 | SW of SW | 453797 | 4691675 | Nad83 |

## APPENDIX A. (CONT.) CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2011

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5758 | 15 | Josephine | RRSNF | Chrome Ridge | 36S | 8W | 19 | N 1/2 of SE | 443547 | 4696777 | Nad83 |
| 9857 | 6 | Jackson | Ashland | Mount Isabelle | 37S | 3W | 8 | SW of SW | 493015 | 4689740 | Nad27 |
| 12685 | 4 | Jackson | Ashland | Applegate | 38S | 4W | 11 | NE of NE | 489235 | 4681216 | Nad83 |
| 2345 | 13 | Jackson | Ashland | Applegate | 38S | 4W | 12 | NE of NW | 489923 | 4681338 | Nad27 |
| 649 | 19 | Josephine | Butte Falls | Glendale | 33S | 6W | 23 | SW of NE | 468945 | 4726221 | Nad27 |
| 11943 | 4 | Jackson | Ashland | Siskiyou Pass | 40S | 2W | 25 | NW of SW | 538122 | 4656591 | Nad27 |
| 1187 | 16 | Jackson | Ashland | Tallowbox Mt. | 39S | 4W | 17 | NE of NW | 483507 | 4669872 | Nad27 |
| 13165 | 3 | Jackson | Ashland | Tallowbox Mt. | 39S | 4W | 29 | SW of NE | 483708 | 4666398 | Nad27 |
| 7575 | 11 | Jackson | Ashland | Tallowbox Mt. | 39S | 4W | 30 | SE of NW | 481632 | 4666533 | Nad27 |
| 9726 | 6 | Jackson | Ashland | Applegate | 37S | 4W | 22 | SW of NE | 486929 | 4687450 | Nad83 |
| 5786 | 14 | Josephine | RRSNF | Galice | 35S | 8W | 2 | SE of NE | 450344 | 4712183 | Nad83 |
| 5249 | 20 | Josephine | RRSNF | Mount Peavine | 35S | 8W | 17 | SE of SE | 445439 | 4708067 | Nad83 |
| 1384 | 19 | Josephine | RRSNF | Selma | 35S | 8W | 25 | SE of NW | 451200 | 4705673 | Nad83 |
| 5196 | 16 | Josephine | RRSNF | Chrome Ridge | 36S | 8W | 19 | NE of SW | 442782 | 4697142 | Nad83 |
| 6817 | 11 | Josephine | RRSNF | York Butte | 37S | 9W | 5 | SW of SW | 434608 | 4691583 | Nad83 |
| EO 060/5408 | 21 | Josephine | RRSNF | Pearsoll Peak | 37S | 9W | 15 | NE of NW | 438490 | 4689400 | Nad83 |
| 13130 | 7 | Josephine | RRSNF | Selma | 37S | 8W | 14 | NE of NE | 450397 | 4689640 | Nad83 |

## CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2011 (CONT.)

| Unique-id | years since obs | County | BLM Resource Area/USFS | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 96 | 3 | Josephine | RRSNF | Onion Mt. | 37S | 8W | 1 | NW of SE | 451440 | 4692030 | Nad83 |
| 108 | 2 | Josephine | RRSNF | Onion Mt. | 36S | 7W | 28 | NE 1/2 | 456568 | 4696002 | Nad83 |
| 1434/5180 | 18 | Josephine | RRSNF | Onion Mt. | 36S | 7W | 20 | SW of NE | 454776 | 4697489 | Nad83 |
| 12675 | 4 | Jackson | Ashland | Applegate | 38S | 4W | 5 | NW of SE | 483750 | 4682130 | Nad27 |
| 1425 | 16 | Jackson | Ashland | Tallowbox Mt. | 38S | 4W | 29 | SE of NW | 483383 | 4676263 | Nad83 |
| 10430 | 7 | Jackson | Ashland | Tallowbox Mt. | 39S | 4W | 16 | NE of NE | 485710 | 4669775 | Nad83 |
| 7570 | 11 | Jackson | Ashland | Ruch | 39S | 3W | 30 | SW of SE | 491865 | 4665836 | Nad83 |
| 11550 | 5 | Jackson | Butte Falls | McConville Pk | 34S | 3W | 11 | SW of SW | 497222 | 4719800 | Nad83 |
| 557 | 13 | Jackson | Ashland | Applegate | 37S | 4W | 7 | SW of SW | 481495 | 4690060 | Nad83 |
| 11657 | 5 | Josephine | Grants Pass | Onion Mt. | 37S | 7W | 3 | NW of NE | 457791 | 4692912 | Nad27 |
| 1009 | 16 | Josephine | Grants Pass | Onion Mt. | 37S | 7W | 3 | NE of NE | 458587 | 4692839 | Nad83 |
| 11582 | 5 | Josephine | Grants Pass | Selma | 37S | 7W | 15 | NW of NE | 457832 | 4689542 | Nad27 |
| 11328 | 5 | Josephine | Glendale | Sexton Mt. | 34S | 5W | 18 | NE of NW | 472097 | 4718624 | Nad27 |
| *!New Holland | NA | Josephine | Grants Pass RA | Takilma | 40S | 7W | 5 | NE of SW | 454275 | 4662769 | NAD83 |

* Denotes populations surveyed by S. Copeland. ! Denotes new population found over the course of the survey work not included in the PVA analysis.

# APPENDIX A. (CONT.) CLUSTERED LADY'S SLIPPER SITES SURVEYED IN 2012

| Unique-id | years since obs | County | USFS resource area | Quad | Township | Range | Section | 1/4 of 1/4 | UTM E (zone 10) | UTM N (zone 10) | Datum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EO-013 | 16 | Josephine | Wild Rivers | Eight Dollar Mt. | 36S | 8W | 17 | SW of SW | 444584 | 4689376 | Nad27 |
| EO-029 | 27 | Jackson | Siskiyou Mtns | Siskiyou Peak | 40S | 1W | 3 | NE of SW | 515986 | 4663104 | Nad27 |
| EO-032 | 16 | Jackson | Siskiyou Mtns | Squaw Lakes | 40S | 3W | 31 | NW of SW | 409569 | 4702178 | Nad27 |
| EO-035 | 27 | Douglas | High Cascades | Sugarpine Creek | 31S | 1E | 21 | | 524670 | 4745075 | Nad27 |
| EO-042-1 | 14 | Jackson | Siskiyou Mtns | Squaw Lakes | 40S | 3W | 23 | NE of NE | 498827 | 4658962 | Nad27 |
| EO-16-1, subpop 13 | 16 | Jackson | Siskiyou Mtns | Carberry Creek | 40S | 4W | 29 | SW of SW | 483611 | 4656172 | Nad27 |
| EO-16-1, subpop 12 | 16 | Jackson | Siskiyou Mtns | Carberry Creek | 40S | 4W | 29 | NW of SE | 483621 | 4656338 | Nad27 |
| EO-179 | 16 | Jackson | Siskiyou Mtns | Squaw Lakes | 40S | 3W | 15 | NE of NE | 497338 | 4660635 | Nad27 |
| EO-207 | 17 | Jackson | Siskiyou Mtns | Carberry Creek | 40S | 4W | 5 | SE of SW | 483192 | 4662383 | Nad27 |
| EO-836 | 15 | Jackson | Siskiyou Mns | Dutchman Peak | 41S | 2W | 16 | SW of NW | 504117 | 4650795 | Nad27 |