

**OREGON DEPARTMENT OF AGRICULTURE
NATIVE PLANT CONSERVATION PROGRAM**

**Annual program performance
report for *Fritillaria gentneri*
cultivation and outplanting in 2013**



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for
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Recovery-based bulblet collection, bulb cultivation, outplanting, and monitoring of created populations were completed in cooperation with United States Fish and Wildlife Service, Portland, Oregon.

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Introduction

Fritillaria gentneri Gilkey (Gentner's fritillary, Gentner's redbells) is one of Oregon's most beautiful and best-loved native wildflowers (Figure 1). Discovered by the Gentner family of Jacksonville, Oregon in a friend's flower arrangement in the late 1940's (Gilkey 1951), this spectacular member of the lily family is found in only a few sites in Jackson and Josephine Counties. Declining due to habitat loss associated with rapid development in southern Oregon, and competition from exotic weeds, *F. gentneri* is listed as endangered by the Oregon Department of Agriculture (ODA 2007) and the U.S. Fish and Wildlife Service (USFWS 1999). A



Figure 1. A flowering plant of *F. gentneri*.

Recovery Plan, including recommendations for the augmentation of existing populations and the creation of new ones, was issued by USFWS in 2003. To meet recovery goals, 1000 flowering plants must occur in each of four Recovery Units. As most units currently support fewer and smaller populations than needed, achieving these goals will require the use of genetically suitable transplants to augment existing populations and create new ones (USFWS 2003).

Due to reproductive barriers, producing large amounts of “pure” *F. gentneri* seed in the field is difficult (Amsberry and Meinke 2002). The labor-intensive pollination and seed collection processes, combined with low yield, make this method impractical for creating propagules for recovery projects. Fortunately, *F. gentneri*'s propensity for vegetative reproduction

largely negates the need for seed production. Mature bulbs of *F. gentneri*, whether they develop above-ground leaves or reproductive stalks, produce many loosely attached rice grain sized bulblets on the surface of the outer bulb scales. These asexually produced bulblets are genetically identical to the parent plant, and have been postulated to be the typical means of reproduction for this species. As these bulblets mature, they themselves produce more bulblets, allowing populations of this species to persist in the absence of sexual reproduction, potentially increase in size, and spread into new habitats.

As well as contributing to the persistence of naturally occurring populations, bulblet production is a frequently used method of propagating fritillaries for medicinal and horticultural use (Paek and Murthy 2002). Bulblets that are handled with care and “sown like seed in pots with a rather deeper layer of grit” can be expected to mature more quickly than plants raised from seed, and to reach reproductive maturity in three to five years of cultivation (Pratt and Jefferson Brown 1997). Earlier flowering can also be induced by manipulating cultivation conditions, at least in some species (van Leeuwen and Dop 1990).

As well being a faster and more consistent process than producing transplants from seed, bulblet cultivation has the potential to produce more robust transplants. Asexual propagation of an ecotype adapted to a specific site produces transplants likely to be successful when planted into that site (Reinartz 1995), and cultivation of bulblets that are viable and growing when collected reduces the possibility of attempting to produce transplants from propagules (such as seeds) that are genetically incapable of developing.

In pursuit of the population creation and augmentation goals as defined in the Recovery Plan, ODA and Bureau of Land Management - Medford District (BLM) began a cooperative project in 2002 to develop protocols for cultivating and transplanting asexually produced propagules of *F. gentneri*. Over 3,000 bulblets were harvested from 90 mother bulbs in three sites, with some bulblets transplanted immediately into field sites, and others returned to Oregon State University (OSU) for cultivation studies. Cultivation protocols were developed, and successful production of large quantities of bulbs in the OSU greenhouse yard began. (See Gisler and Meinke 2002 and Amsberry and Meinke 2004 for details of these early studies).

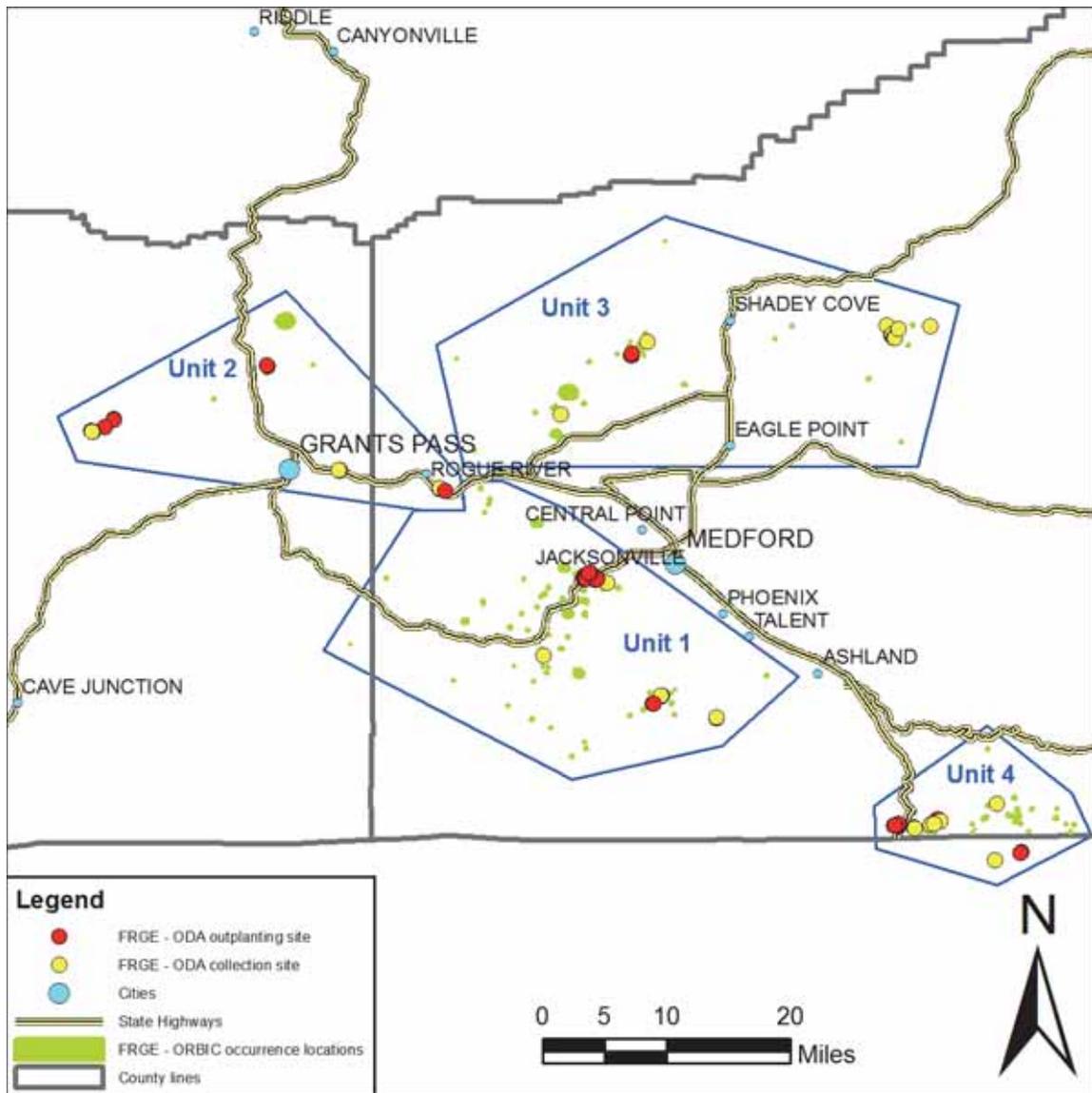


Figure 2. Location of outplanting sites (red dots) and bulblet collection sites (yellow dots) used in 2004-2013. GPS/GIS data identifying specific site locations are available from ODA. Recovery Unit boundaries (in blue) are approximate.

Summary of 2004-2012 projects

Between 2004 and 2012, ODA, BLM, USFWS, Jacksonville Woodlands Association (JWA) and City of Jacksonville continued to cooperate, outplanting 18,510 large bulbs and 12,650 small bulbs in 22 sites (Figure 2). All populations created by these efforts were monitored for emergence, leaf size and reproductive maturity each spring. Bulblet collection using protocols developed in the early studies also continued through 2012. A total of 25,735

bulblets were collected from sites managed by BLM, City of Jacksonville, Oregon Department of Transportation, and JWA. All bulblets continued to be cultivated in the OSU nursery yard. See Brown et al. 2012 for details of these projects.

Work completed in 2013

Bulblet collection

Bulblet collection protocols in 2013 were similar to those used in all of our earlier studies. Bulbs were flagged in April during flowering to ensure correct identification, and bulblets were harvested in August when plants were dormant (Figure 3). Bulblets were placed in coolers for transport to OSU, and mother bulbs were carefully replanted after bulblet harvest. A total of 2,089 bulblets were collected from four sites (Table 1).



Figure 3. This large bulb supports many bulblets. The remnant of last spring's flowering stalk is evident in the center of the bulb.

Table 1. Bulblets collected at four sites in 2013.

Site	Unit	Number of bulblets
North River Road Fire	2 or 3 ¹	1,038
Cobbleigh Road	3	450
Colestine Corral	4	295
Pilot Rock Pond	4	306
Total		2,089

¹ Recovery Unit not yet assigned.

Bulblet cultivation

Upon arrival at OSU, bulblets collected from the field sites were removed from their bags, and prepared for planting in flats (Figure 4). Flats were lined with screen to prevent soil loss, and a layer of Perlite® soil amendment was added to provide additional drainage prior to filling the flats with standard potting mix (SB-40 Grower's Mix). An array of 100 to 200 holes (each 1 cm deep) was dug in each flat, and bulblets were carefully placed in the holes and covered with soil. Each flat was labeled with the population of origin, and bulblets were watered thoroughly at the completion of planting, then placed in the nursery yard. In addition to the field-collected bulblets, bulblets were removed from large bulbs as they were prepared for outplanting. These bulblets were also planted in flats and cultivated in the nursery yard.

Watering continued sparingly as needed throughout the summer and fall. Weeds were removed as they appeared, and flats were surrounded by sawdust to prevent desiccation or freezing. In early spring, emerging leaves were fertilized with a time-release granular fertilizer (Osmocote®) and flats were treated with an iron phosphate based slug bait to prevent herbivory. Regular watering began at this time, with frequency of watering scheduled to ensure that the surface of the flats remained moist.

Our multi-year efforts to rid flats of weeds, especially *Oxalis* sp., have largely been successful. Vigilance in quickly detecting infestations, followed up by frequent hand-weeding continues to be needed. Weeds are treated with herbicide (when bulbs are dormant) only if infestations become severe.

We continued to cooperate with OSU’s Plant Clinic to identify fungal infections affecting bulbs as we observed them, and with OSU greenhouse staff to administer treatments as needed. Although some bulbs continued to be infected with *Botrytis* sp., seasonal treatment with Actinovate[®], an organic fungicide, greatly reduced these outbreaks. Actinovate[®] contains beneficial microorganisms and can be applied as a spray or drench, or mixed into soil when transplanting. More specific information on pests and diseases and on treatment application rates and times is available from ODA staff.

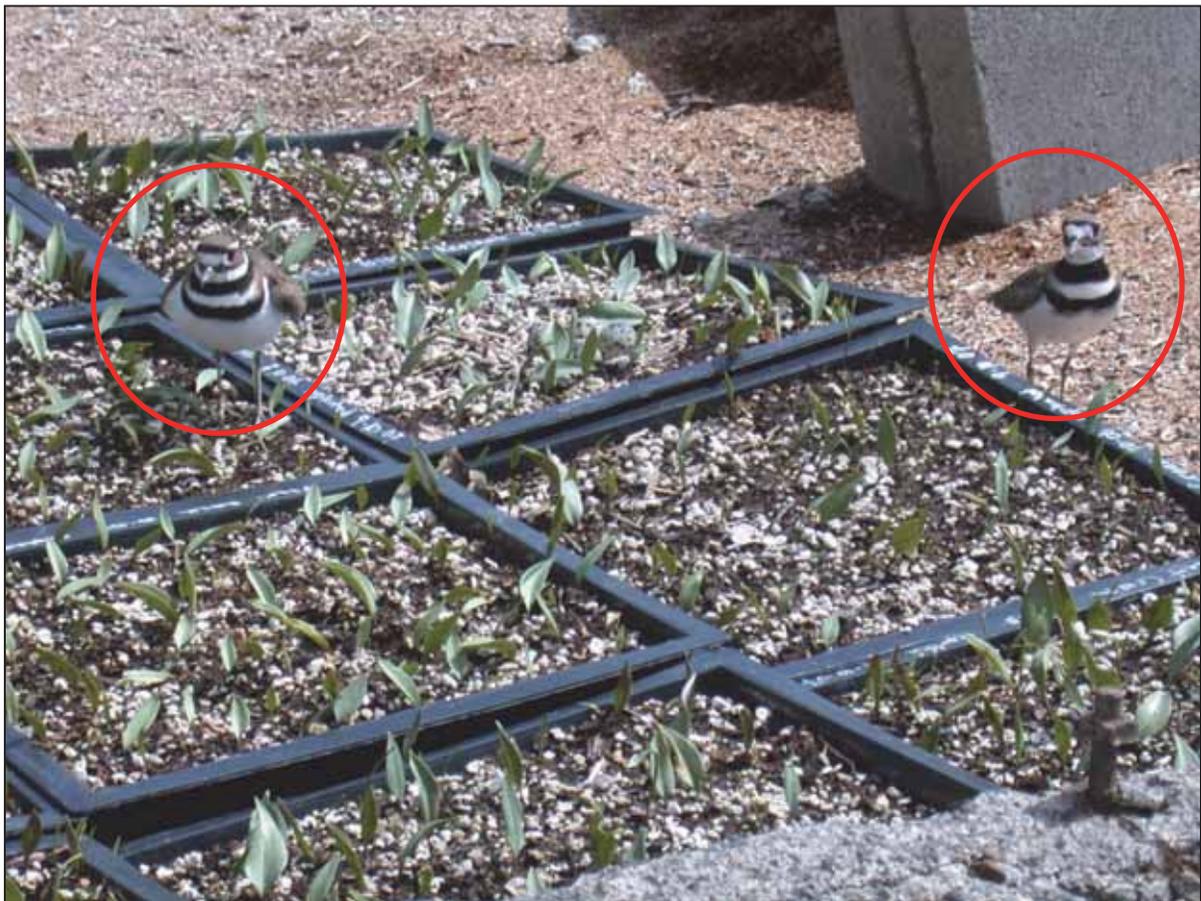


Figure 4. Each spring, flats of cultivated fritillaries in the nursery yard make a popular nesting place for a pair of killdeer.

Outplanting

Despite unexpected issues associated with the “federal shutdown”, 6,321 bulbs were outplanted at six sites in 2013 (Table 2; Figure 4).

Table 2. Summary of large and small bulbs planted at 23 sites from 2004-2013. 2013 outplantings are italicized.

Site	Unit	Planting Year	Number of Large Bulbs	Number of Small Bulbs
Beekman Ridge	1	2012	155	
		<i>2013</i>	<i>1,196</i>	
Beekman Woods	1	2009	600	
Catholic Wagon Road	1	2008	1,050	
		2011	600	
		<i>2013</i>	<i>1,200</i>	
Jacksonville Cemetery	1	2004	480	4,000
J'ville Woodland Park	1	2011	600	
		2007	85	150
Oregon Street	1	2008	450	
		2011	600	
Three Dog	1	2009	450	
		2009	250	
Tunnel Ridge	1	2010	650	
		2011	182	
		2012	250	
Woods	1	2006	100	
Dodecatheon	2	2006	220	
Pickett Creek	2	2004	480	4,000
		2008	1,000	500
Pickett Up	2	2011	1,898	
Red Mountain	2	2010	1,400	
		<i>2013</i>	<i>1,200</i>	
Antioch Trespass	3	2010	164	
		2011	215	
Cobbleigh Road	3	2009	250	
Dog Creek	3	2009	600	
Vasak	3	2012	614	
Brushy Creek	4	2011	164	
Colestine Corral	4	<i>2013</i>	<i>750</i>	
		2008	1,040	
		2010	1,050	
Mariposa B.A.	4	2011	1,950	
		<i>2013</i>	<i>1,200</i>	
Pilot Rock	4	2004	480	4,000
Pilot Rock Pond	4	2006	109	
		2011	274	
Valley of the Rogue S.P.	2 or 3 ¹	<i>2013</i>	<i>775</i>	
Total of all sites			24,731	12,650

¹ Recovery Unit not yet assigned.



Figure 4. At Beekman Ridge, planting plots were located among manzanita plants that are re-sprouting after thinning during previous fuels reduction activities.

Monitoring

In 2013, the numbers of vegetative and reproductive plants in all plots were counted (Figure 5). Because leaves can emerge from transplanted bulbs, and these bulbs can also produce bulblets with emergent leaves, greater than 100% emergence is possible.

In previous years, measurements of leaf length were used to estimate the vegetative robustness of surviving transplants - a method that worked well for leaves that were both long and wide. However, this method was not as accurate for leaves in shaded sites that grew long and thin as they reached for light. This year, in order to increase the precision of our monitoring protocol, we separated (vegetative) plants into size categories based on leaf *width*, rather than measuring leaf *length*. Leaves recorded in the large category are greater

than 4 cm wide; medium sized leaves are between 2 cm and 4 cm wide; and small leaves are less than 2 cm wide (Figure 6).



Figure 5. Monitoring plots on a steep slope at the Pickett Creek site.



Figure 6. Small (left), medium (middle) and large (right) leaves - shown here in the nursery yard.

This year, a grand total of 9,834 vegetative plants and 12 flowering plants were counted in all four recovery units (Tables 3-6). The highest number of flowering plants, as well as the most

plants in the medium and large classes, occurred in Recovery Unit 1. The highest overall number of plants resides in Unit 2 - these are mostly small vegetative plants. The lowest total number of plants occurs in Recovery Unit 3, while Unit 4 supports about the same number of total plants as Unit 1, but not as many in the large and medium size classes.

Table 3. Summary of 2013 monitoring for emergence and leaf width size class of *Fritillaria gentneri* at each out-planting site in Recovery Unit 1.

Site	Year Planted	Vegetative	Flowering	Large 4+ cm	Medium 2-4 cm	Small <2 cm
Beekman Ridge	2012	39	1	0	2	37
Beekman Woods	2009	310	0	1	10	299
Catholic Wagon Road	2008	506	6	55	124	332
	2011	140	0	0	17	123
Jacksonville Cemetery	2004	0	1	0	0	0
J'Ville Woodland Park	2011	321	0	0	30	294
	2007	74	0	0	5	69
Oregon Street	2008	160	0	6	24	130
	2011	148	0	0	18	130
Three Dog	2009	210	0	7	29	174
	2009	37	0	2	7	28
Tunnel Ridge	2010	81	0	6	25	50
	2011	71	0	0	5	66
	2012	75	0	0	3	72
Woods Property	2006	193	1	0	9	184
Unit 1 Totals		2,365	9	77	308	1,988

Table 4. Summary of 2013 monitoring for emergence and leaf width size class of *Fritillaria gentneri* at each out-planting site in Recovery Unit 2.

Site	Year Planted	Vegetative	Flowering	Large 4+ cm	Medium 2-4 cm	Small <2 cm
Dodecatheon	2006	25	0	0	4	21
Picket Creek	2004	761	0	2	42	759
	2008	370	0	1	43	326
Pickett Up	2011	1,387	2	1	68	1,318
Red Mountain	2010	1,119	0	3	44	1,072
Valley of the Rogue SP ¹	2011	87	0	26	19	42
Unit 2 Totals		3,749	2	33	220	3,538

¹Valley of the Rogue State Park is not yet officially assigned to a Recovery Unit.

Table 5. Summary of 2013 monitoring for emergence and leaf width size class of *Fritillaria gentneri* at each out-planting site in Recovery Unit 3.

Site	Year Planted	Vegetative	Flowering	Large 4+ cm	Medium 2-4 cm	Small <2 cm
Antioch Trespass	2010	136	0	4	22	110
	2011	27	0	0	0	27
Cobbleigh Rd	2009	158	0	4	15	139
Dog Creek	2009	596	0	16	56	524
Vasak	2012	388	0	0	24	364
Unit 3 Totals		1,305	0	24	117	1,164

Table 6. Summary of 2013 monitoring for emergence and leaf width size class of *Fritillaria gentneri* at each out-planting site in Recovery Unit 4.

Site	Year Planted	Vegetative	Flowering	Large 4+ cm	Medium 2-4 cm	Small <2 cm
Brushy Creek	2011	63	0	1	13	49
Mariposa Botanical Area	2008	1,103	0	1	28	1,054
	2010	400	0	5	36	359
	2011	246	0	0	5	32
Pilot Rock	2004	407	0	3	10	394
Pilot Rock Pond	2006	196	1	30	27	139
Unit 4 Totals		2,415	1	40	119	2,027

Because the number of bulbs that have been planted and the age of plantings vary among sites, visualization of the relative success of plantings can be difficult. Creating a standardized metric by calculating a weighted average of estimated leaf width, and plotting this in combination with percent bulb emergence, allows comparison of both survival and growth (two components of success) among sites (Figures 7-10). Sites with good success should be one focus of future transplanting efforts. Bulbs planted at the Pilot Rock Pond site in 2006 are probably the most successful overall, although the very large leaves at Valley of the Rogue State Park, and the high levels of emergence at the Red Mountain site, and in the plots planted in 2008 at Mariposa Botanical Area are also encouraging. Results in Unit 3 are especially promising, as plants in all sites (except one) both emerged well and produced relatively large leaves. Some sites, such as the Dodecatheon site in Unit 2, have poor potential for success – planting should be discontinued in these sites.

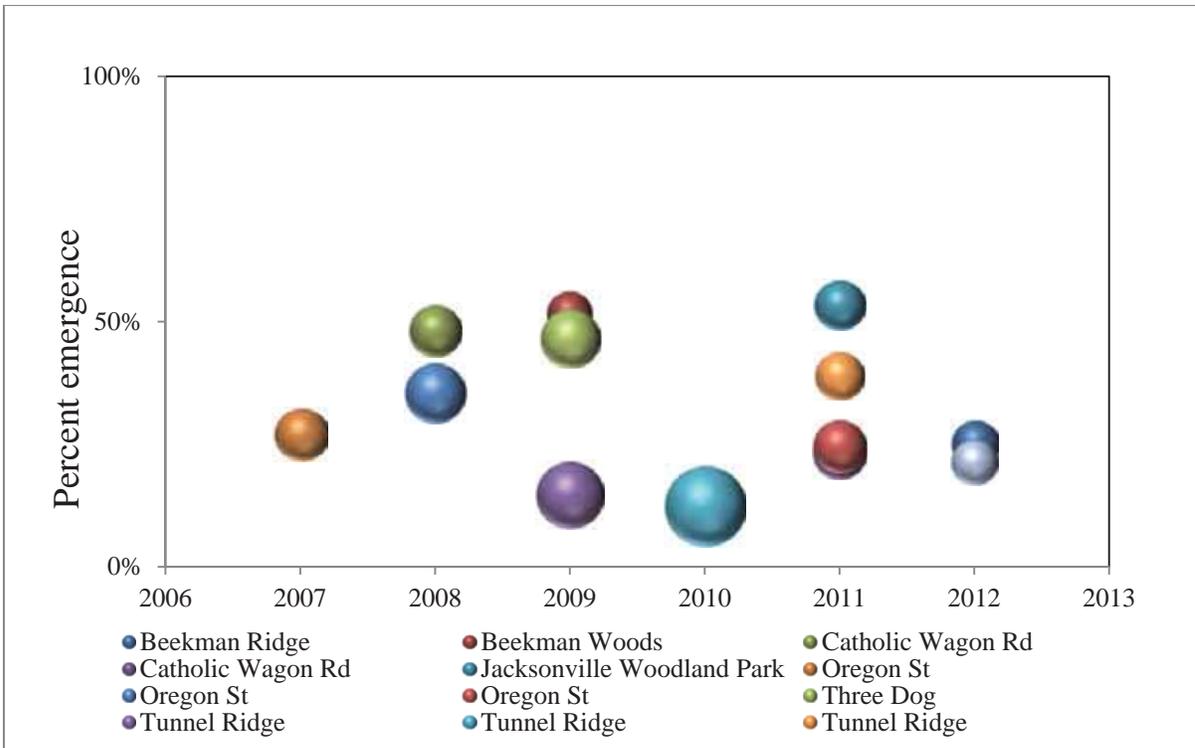


Figure 7. Emergence and estimated leaf size (bubble width) at sites in Recovery Unit 1 in 2013. Plots could not be located at the Woods Property, and Jacksonville Cemetery did not support vegetative plants in 2013; these sites are not included. Planting year is represented on the X axis.

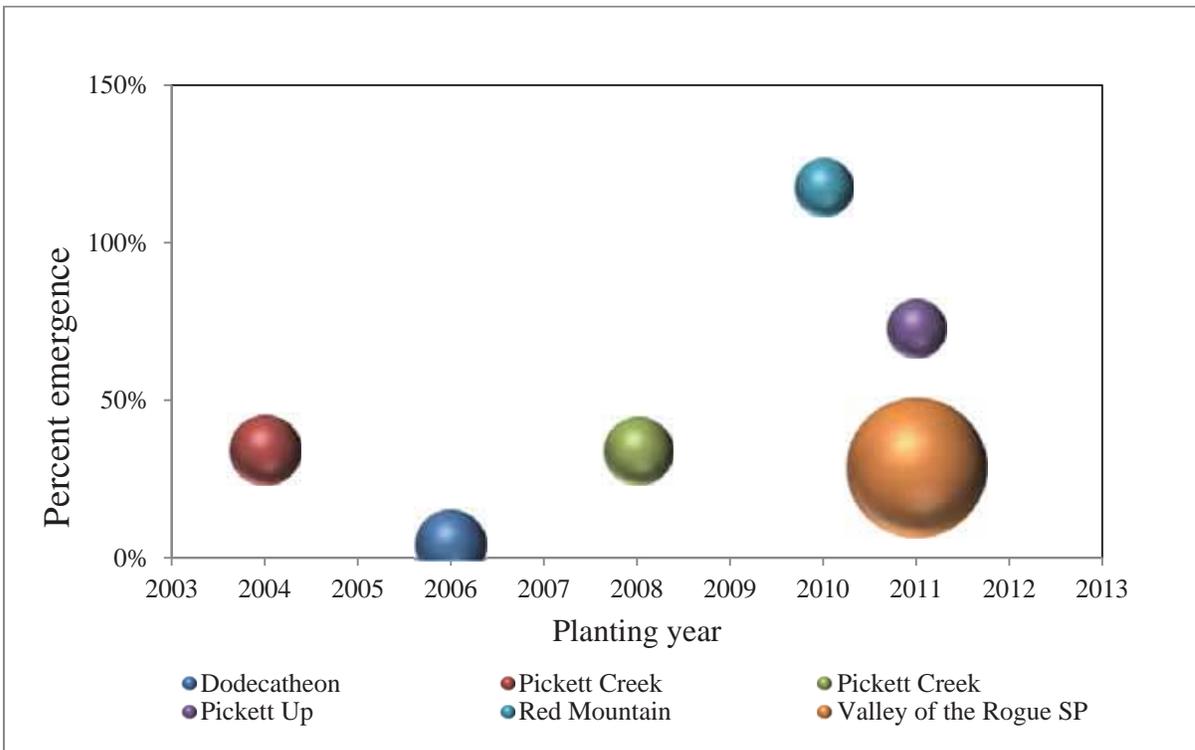


Figure 8. Emergence and estimated leaf size (bubble width) at sites in Recovery Unit 2 in 2013.

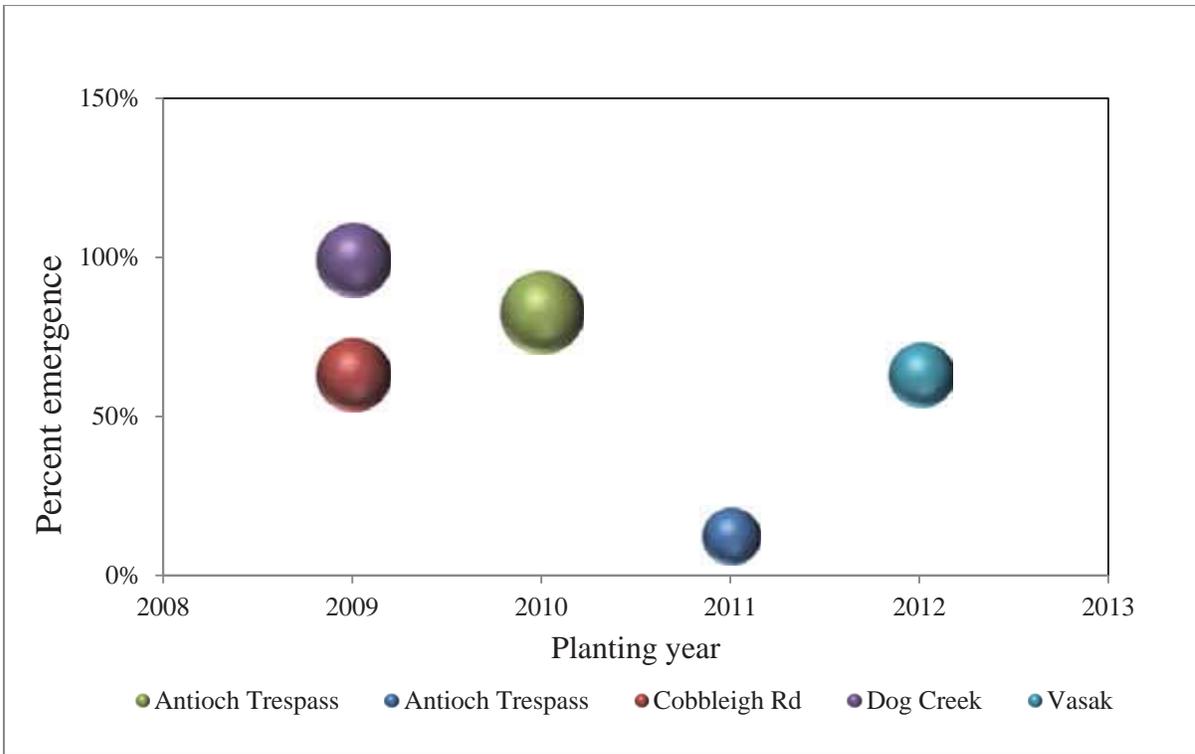


Figure 9. Emergence and estimated leaf size (bubble width) at sites in Recovery Unit 3 in 2013.

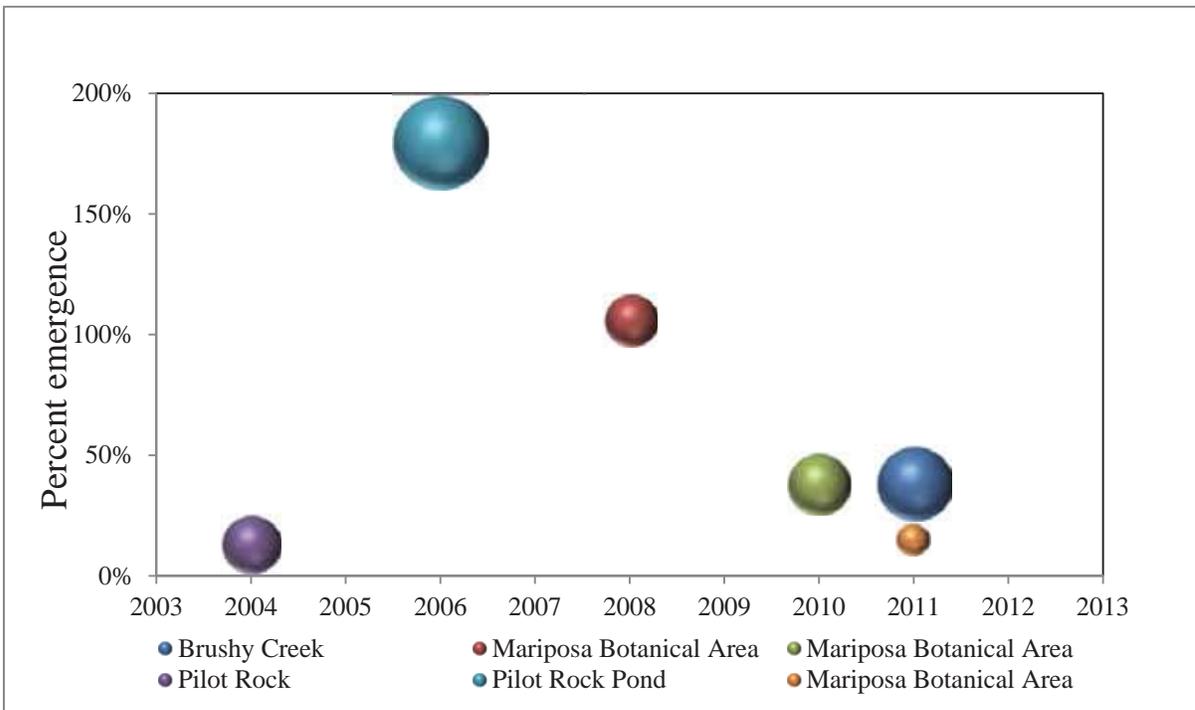


Figure 10. Emergence and estimated leaf size (bubble width) at sites in Recovery Unit 4 in 2013. Planting year is represented on the X axis.

In addition to continuing to transplant into sites demonstrating success, our efforts should also focus on sites in those recovery Units needing the largest increases in number of flowering plants in order to meet downlisting goals. The Recovery Plan, as currently written, requires 750 flowering plants in each Recovery Unit in order to reclassify *F. gentneri* as Threatened (USFWS 2003). Unit 3 supports fewer flowering plants than the other three Units (USFWS 2003), far fewer than the 750 required. Based on both need and potential for success, future outplanting efforts should be concentrated in Unit 3.

Summary

- Outplanting efforts have contributed to recovery; 12 additional flowering plants and 174 large plants (which will presumably flower soon) have been added to the total number of plants. Medium and small plants continue to develop and will begin to flower as they mature.
- Success of plantings varies by site and planting year. Evaluation of both survival (emergence) and growth (leaf width) must be considered in order to determine outplanting success.
- The modifications in our monitoring methodology initiated this year will improve monitoring accuracy and reduce variation among sites, making it easier to evaluate planting success.
- Outplantings in Unit 3 have been relatively successful, and this Unit is the most in need of an increase in plant numbers in order to meet downlisting criteria.
- Future collection, cultivation and outplanting projects should focus on Unit 3.

Schedule for 2014

- Continue to cultivate plants in the nursery yard. Continue to work with OSU greenhouse staff, OSU Plant Clinic, and OSU student greenhouse manager to prevent and treat weed infestations and fungal infections.
- Select sites in Unit 3 for outplanting this fall.
- Outplant ~1,230 bulbs into selected sites.

- Prepare data sheets for modified monitoring protocol and provide these sheets to BLM.
- Cooperate with BLM and USFWS to schedule a meeting of the *Fritillaria gentneri* Working Group, and assist with the Group's efforts to evaluate the progress of recovery and prioritize steps needed to meet downlisting criteria.

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