Fritillaria gentneri
(Gentner's fritillary)
Endangered
5-Year Review: Summary and Evaluation
January 25, 2016

U.S. Fish and Wildlife Service
Oregon Field Office
Portland, Oregon

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1.0 GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, the Service will recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the presence of threats attributable to one or more of the five threat factors (i.e. present or threatened impacts of its habitat or range [Factor A]; overutilization [Factor B]; disease or predation [Factor C]; inadequacy of existing regulatory mechanisms [Factor D]; and other natural or human made factors affecting its continued existence [Factor E]) described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

General Species Information:

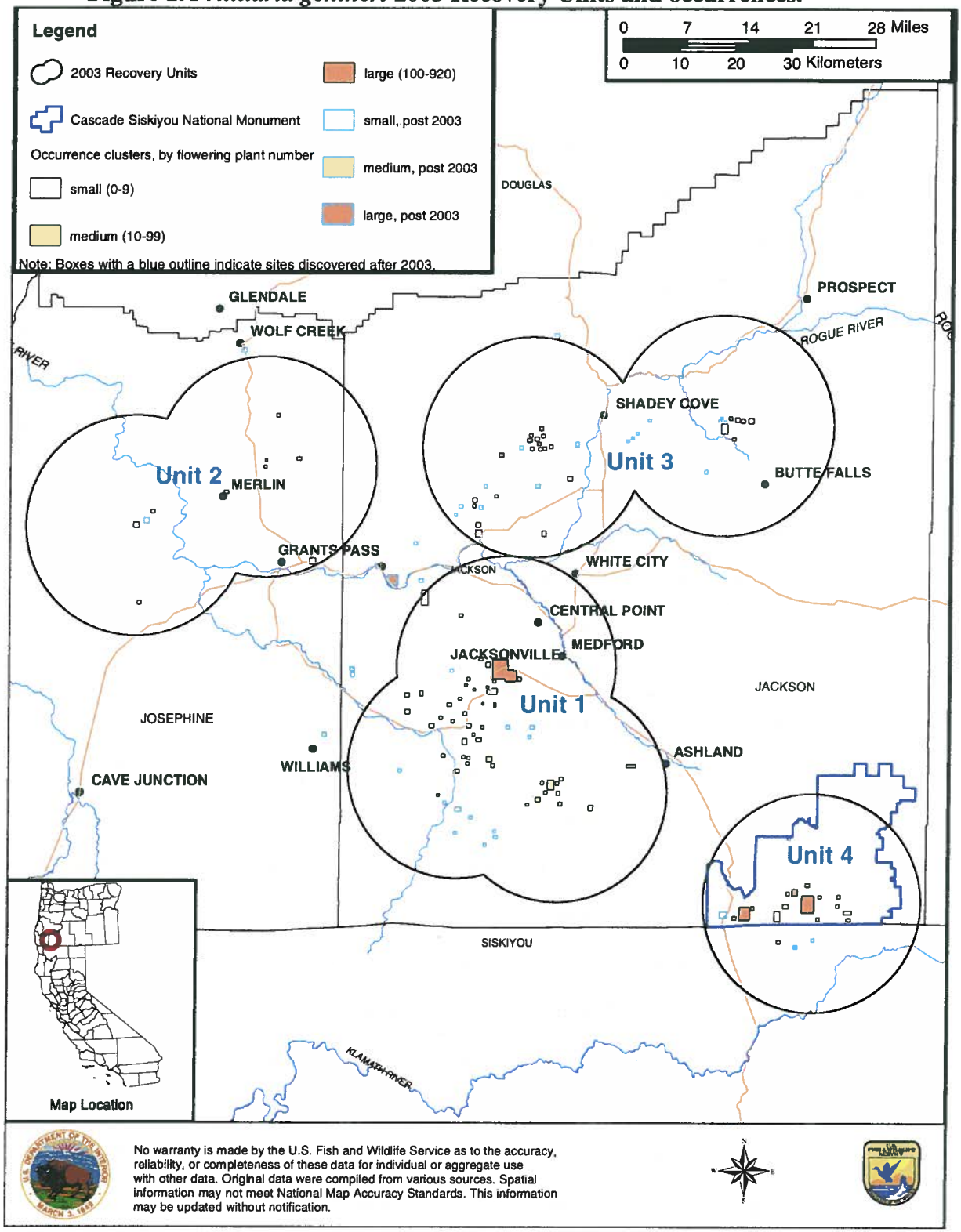
Fritillaria gentneri (Gentner's fritillary, Gentner's mission-bells) is a perennial bulb-producing herb of the Liliaceae (lily family) with showy deep red to maroon flowers with yellow checkers. Individual flowering plants can reach up to 70 cm (28 inches) in height and produce green to purplish, lanceolate to linear leaves on the flowering stalks in whorls of 3 to 5. Non-flowering plants produce one 0.6 to 72-cm (0.24 to 28-inch) long fleshy, linear to oblong leaf. Plants without flowers cannot be identified to species level because leaves are indistinguishable from other *Fritillaria* spp. Stems support from 1 to 15 flowers. The flowers are 3.5 to 4 cm (1.47 to 1.6 inches) six-petaled, hang downward, and are trumpet-shaped, often with flaring tips. Plants occasionally produce a broadly winged fruit. *Fritillaria gentneri* also produces a bulb which in turn produces a great number of tiny "rice-grain" bulblets each year. Flowering *F. gentneri* plants constitute a small percentage of an average population (Siskyou BioSurvey LLC 2013; Giles-Johnson et al. 2013). For example, during 12 years of surveys at the Pickett Creek monitoring site, only 0.26 to 3.1 percent of individuals flowered annually (Giles-Johnson et al. 2013).

This species is endemic to Jackson and Josephine counties, Oregon and Siskiyou County, California, in the Rogue and Klamath River watersheds at elevations ranging from 300 to

1,230 m (1,000 to 4,200 feet). The species occurs in a variety of upland habitat types ranging from hardwood to conifer-dominated habitat. *Fritillaria gentneri* often prefers habitat openings which allow plants to thrive with adequate sunlight during the early growing season, but plants are found in partly shaded habitats as well, occasionally occurring within a shrub canopy under dense cover (Siskiyou BioSurvey LLC 2013). Some of the more common habitat types in which *F. gentner* is found includes oak woodlands dominated by *Quercus garryana* (Oregon white oak), mixed hardwood forest dominated by *Q. kelloggii* (California black oak), *Q. garryana*, and *Arbutus menziesii* (madrone); and coniferous forests dominated by *A. menziesii* and *Pseudotsuga menziesii* (Douglas-fir) or *Pinus ponderosa* (ponderosa pine). In the furthest southern locations *Prunus subcordata* (Klamath plum) and *Q. garryana* ssp. *breweri* (Brewer's oak) are dominant species within the habitat (USFWS 2003). Although these habitat types are common in the range of *F. gentneri* from Wolf Creek and Butte Falls, Oregon to south of the Oregon-California border (Figure 1), most of the potential habitat is unoccupied (USFWS 2003).

In this review reintroduction is defined as a new outplanting of *Fritillaria gentneri* bulbs in an area within their historic range, but beyond 0.5 km (0.31 miles) from a known occurrence. An augmentation is defined as outplanting bulbs within 0.5 km of a known occurrence. A population, as used in the 5-year review, is defined as a group of individuals that occupy an area small enough to permit interbreeding regularly. An occurrence cluster, or element occurrence (EO), as utilized by Oregon Biodiversity Information Center (ORBIC) represents a grouping of patches or sub-populations, containing as least a single individual flower, that are within 0.5 km of each other and not separated by significant habitat discontinuities (Vrilakis, pers. comm. 2013). While gene flow declines over distance at different rates depending on pollinators and geographic features, the minimum default EO separation distance of 0.5 km has been accepted by ORBIC as the most suitable approximation broadly applicable to many (but not all) situations in Oregon. Though not quite applicable to *F. gentneri*, because the species rarely reproduces sexually, this system is useful to track the species' numerous patches. For example, the species is known from 133 ORBIC EOs, 2 California Natural Diversity Database (CNDDB) records, and 3 new reintroduction sites (Table 1) (CNBDDB 2004). The 138 occurrences (Appendix A) of *F. gentneri* are distributed discontinuously from Wolf Creek, Oregon, southeast to Brushy Gulch, in northern Siskiyou County, California, near the Klamath River and from Pickett Creek in Josephine County to Dog Creek and easterly to the Cascade-Siskiyou National Monument (CSNM) in Jackson County (Figure 1). The total count of all *F. gentneri* within138 occurrences including older sites is currently 2,907 flowering plants. The Recovery Plan specifies four recovery units (Figure 1). Unit 1 (Jacksonville) consists of occurrences grouped around the Jacksonville-Medford area in Jackson County, Oregon. Unit 2 (Grants Pass) consists of occurrences from Wolf Creek, Oregon to the Pickett Creek area west of Grants Pass in Josephine County, Oregon. Unit 3 (Butte Falls) covers the area northeast of Medford, and Unit 4 (CSNM) spans those occurrences located along the Oregon-California border and in northern Siskiyou County, California.

Figure 1. *Fritillaria gentneri* 2003 Recovery Units and occurrences.



Note: Boxes indicate occurrence clusters, which encompasses all occurrences within 0.5 km of one another and include subpopulations or patches within 0.5 km of each other, as defined in the 5-year review. Size classifications were determined based on natural breaks and occurrences meeting recovery level flowering plant counts (100 or greater). See Table 1 for flower plant number distribution in recovery units.

The Service's Roseburg Field Office in Roseburg, Oregon and the Yreka Fish and Wildlife Office in Yreka, California, share recovery responsibility for this species.

A.S **Reviewers**

Lead Field Office: Sam Friedman, Roseburg Field Office, Roseburg Oregon 97471; (541) 957-3478

Cooperating Field Offices: Nadine Kanim, Yreka Fish and Wildlife Office Yreka, California 96097; (530) 842-5763.

Dan Blake, Klamath Falls Fish and Wildlife Office Klamath Falls, Oregon 97601; (541) 885-8481.

1.2 Methodology used to complete the review

This 5-year review was conducted by the Roseburg Field Office (RFO) of the Oregon Fish and Wildlife Office (OFWO) following the Region 1 guidance issued in 2010. The primary sources of information used in this analysis include recent and long-term Bureau of Land Management (BLM) monitoring results, Oregon Department of Transportation (ODOT) monitoring reports, Oregon Department of Agriculture Native Plant Conservation Program (ODA) research, and the "Recovery Plan for *Fritillaria gentneri* (Gentner's fritillary)" (Recovery Plan) (USFWS 2003). Findings of this review are also informed by personal communications with species experts. This document benefitted from the reviewers mentioned above along with two other internal reviewers.

We received no information from the public in response to our Federal Notice initiating this 5-year review. This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing. We focus on current threats to the species that are attributable to the Act's five threat factors (as discussed above). The review synthesizes all this information to evaluate the listing status of the species and provides an indication of its progress towards recovery. Based on this synthesis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

1.3 Background

1.3.1 Federal Register (FR) Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 5, 2008 (73 Federal Register 11945).

1.3.2 Listing History

Original Listing

FR Notice: 64 Federal Register 69195
Date of Final Listing Rule: December 10, 1999
Entity Listed: *Fritillaria gentneri* (species)
Classification: Endangered

State Listing *Fritillaria gentneri* (Gentner's fritillary) was listed by the State of Oregon as endangered in 1995.

1.3.3 Associated rulemakings: Critical Habitat for *Fritillaria gentneri* was determined to be prudent at the time of listing. Designation of critical habitat has been deferred to concentrate resources on higher critical habitat priorities, including court-ordered designations. No other rule making has been associated with the listing of *F. gentneri.*

1.3.4 Review History: No status reviews, or other documents that contain a five-factor analysis and conclusion have been conducted since the taxon was listed. This document is the first 5-year review for *Fritillaria gentneri.*

1.3.5 Species' Recovery Priority Number at start of this 5-year review: The recovery priority number for *Fritillaria gentneri* is 2 according to the Service's 2013 Recovery Data Call for the OFWO, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the species is not a monotypic Genus, yet faces a high degree of threat, but also has a high potential for recovery.

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery Plan for *Fritillaria gentneri* (Gentner's fritillary).
Date issued: July 21, 2003
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) Policy

The Act defines "species" as including any subspecies of fish or wildlife or plant, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits the listing of DPSs to species of vertebrate fish or wildlife. Because the species under review is a plant, the DPS policy is not applicable, and the application of the DPS policy to the species' listing is not addressed further in this review.

2.2 Recovery Criteria

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? **No, we have new information on its distribution, genetics, population demographics, breeding system, and propagation.**

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? **Yes.**

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information: The following recovery criteria for downlisting *Fritillaria gentneri* are presented here and described:

Overall. Reclassification and delisting is conditional upon the establishment, management, and maintenance of a minimum of eight Fritillaria management areas, with at least two distributed within each of four recovery units (Figure 1) *as described below, where the species will be secure from all threats described in the Reasons for Listing in Part I, Section F of the recovery plan.*

Establishment of *Fritillaria* management areas (FMA) is intended to provide scheduled and active management across *Fritillaria gentneri* habitat to secure it from major threats. The primary threat this criterion addresses is habitat loss from development (Factor A) and habitat degradation due to a lack of natural resource management (causing habitat to be more fire prone or less suitable to *F. gentneri*) and fire exclusion (Factor E). The Service and BLM recently signed a conservation agreement on July 13, 2015, establishing 8 FMAs (USFWS and BLM 2015). In addition, the following management actions have occurred at several *Fritillaria* sites:

- ODOT monitors a 3-acre (1.21-hectare) roadside patch of habitat occupied

by *F. gentneri* in Josephine County, Oregon. In 2010, ODOT cleared shrubs and dead plant material from the site. Results of the clearing effort have not yet been determined.

- The ODA and local volunteers have been working with the City of Jacksonville, Oregon, to remove non-native yellow star-thistle (*Centaurea solstitialis*) and plant native vegetation within the Jacksonville Cemetery population.
- Medford BLM, the Service, and ODA have augmented *F. gentneri* at 17 occurrences and reintroduced the plant with nursery propagated bulbs on non-federal and public land in Oregon.
- Medford BLM and ODA have treated their Mariposa Botanical Area in southern Oregon for yellow starthistle.
- ODA and City of Jacksonville removed invasive Scotch broom (*Cytisus scoparius*) from the Jacksonville Woodlands site.
- Native grass seed was sown by Southern Oregon Land Conservancy (SOLC) at the Beekman Ridge Site, near Jacksonville.

This criterion has been mostly met. The Service and BLM's conservation agreement established 8 FMAs, however, only two recovery units contain at least 2 FMAs; the other recovery units have one each, and the eighth one occurs outside of mapped recovery units. An update to the recovery unit placement will enable a third recovery unit to contain 2 FMAs and agencies will pursue the establishment of additional FMAs as opportunities arise.

1. *To consider reclassification to threatened status: each recovery unit shall maintain at least 750 flowering plants. To consider delisting: each recovery unit shall maintain at least 1,000 flowering plants, whereby net demographic stability or growth is exhibited for a minimum of 15 years.*

This criterion directly addresses Factor E threats. This criterion estimates that the persistence of *Fritillaria gentneri* will be safeguarded from a lack of genetic variability when 750 flowering plants occur within each of the four recovery units and the numbers have been stable for at least 15 years. The downlisting requirement is based on a study by Yonezawa et al. (2000) which determined that 20,000 *Fritillaria camtschatcensis* (Kamchatka fritillary) individuals should be adequate to maintain sufficient adaptive genetic variability for its long-term survival. *Fritillaria camtschatcensis* is a perennial, mainly clonally reproducing plant, similar to *F. gentneri.*

A demography study by Brock and Callagan (2000) estimates 750 flowering plants would represent approximately 29,600 *F. gentneri* plants of all age-classes (i.e., juveniles, adults, and flowering adults) based on a plant demographic study in the Jacksonville Woodlands. Four recovery units each supporting 1,000 flowering plants are required for delisting *F. gentneri.* This number would represent a population of approximately 39,500 plants of all age-

classes per recovery unit. Since there is an element of uncertainty in calculating a figure for resilient *F. gentneri* recovery unit numbers, the recovery plan used conservative figures (USFWS 2003). A flowering plant census was thought to be the best tool to estimate total population size in 2003, currently, we understand that flowering plant numbers seem to be triggered by certain weather patterns and burns - and may not be the best way to estimate population size.

This criterion has not been met. Based on the 2013 annual monitoring report (Siskiyou BioSurvey LLC 2013), one of the four mapped recovery units (Unit 4/CSNM) has attained over 1,000 flowering plants in the last two years (Table 1 and Appendix B). The other three recovery units (Unit 1/Jacksonville, Unit 2/Grants Pass, and Unit 3/Butte Falls) have been below 750 flowering plants in the past 10 years (Siskiyou BioSurvey LLC 2013) (Figure 2) (Appendix B).

While the new information indicates a positive trend toward recovery in Unit 4, overall, Criterion 1 has not been met in Units 1, 2, and 3.

2. *To avoid the threat of habitat loss, the Fritillaria management areas within the recovery units should be located on public land, or private land subject to permanent conservation easement or other permanently binding agreements.*

This criterion directly addresses Factor A, Habitat loss, Factor D, Inadequacy of regulatory mechanisms, and Factor E, Other natural or manmade factors affecting continued existence. All 8 of the newly establish FMAs occur on publicly owned land. This criterion has been met.

3. *To reduce vulnerability to adverse random events inherent to small populations composed of too few and too widely scattered individuals, maximize and maintain potential genetic, ecological, and geographical variation in the species, and maintain current distributional patterns, 2 of the Fritillaria management areas within each recovery unit must consist of populations of at least 100 flowering individuals each within an 0.8-km (0.5-mile) radius of each other.*

This criterion directly addresses Factor E threats. Recovery Unit 4 (CSNM) supports some occurrences close to or exceeding 100 flowering plants (Figure 2) (Appendix B) and thus has the greatest potential to meet this criterion. The recovery plan requires that two breeding populations should be within 0.8-km of each other; however the species spreads primarily through clonal development. The recovery plan was developed for a classic sexually producing species, not one that has a strong clonal aspect. Overall, criterion 3 has not been met because only Recovery Unit 4 meets this minimum population criterion.

4. *To avoid population vulnerability arising from the inordinate*

concentration of individuals within a very small area, potentially subject to extirpation from unpredictable catastrophic events, flowering individuals should be distributed over a minimum of 50,000 m^2 (5 ha or 12.4 acres) of occupied habitat within each recovery unit.

Meeting this criterion would safeguard *Fritillaria gentneri* occurrences from Factor E threats, by providing ample space for protection and would enable greater resiliency against catastrophic events. This review assumes that $50m^2$ of cover is associated with one flowering plant individual, as consistent with the recovery plan. By this reasoning, 1,000 flowering plants are needed to reach 50,000 m^2 (12.4 acres, 5 hectares). The estimated habitat occupied within all four recovery units is 142,300 m^2, but only Recovery Unit 4 meets the 50,000 m^2 threshold for occupied habitat with approximately 96,150 m^2 cover. Criterion 4 has not been met.

Table 1. *Fritillaria gentneri* occurrence clusters per recovery units based on all available data (ORBIC 2011; Siskiyou Biosurvey LLC 2013; BLM data 2011).

Recovery Units/Other	**Occurrence clusters**				**Flowering plant count**	**Estimated flowering plant cover[1] (m^2/acres)**
	Small (0-9)	Medium (10-99)	Large (100-711)	Total		
1	53	5	1	59	571	24,050/5.9
2	8	2	0	10	106	5,500/1.4
3	33	7	0	40	173	10,2502.5
4	10	6	4	20	1,926	96,150/23.8
Outside occurrences	7	1	1	9	131	6,350/1.6
Total	111	21	6	138	2,907	142,300/35

Note: Includes some BLM and ORBIC data not in annual monitoring reports. [1]Estimating one flowering plant occupies 50 m^2 of habitat (USFWS 2003). Since the 2003 publication of the recovery plan, nine new Fritillaria gentneri occurrences have been detected outside of the 2003 Recovery unit boundaries.

5. *To maintain favorable habitat conditions, a site-specific management and monitoring plan should be developed, approved and implemented for each Fritillaria management area to prevent degradation of sites, to assess effects of management actions, and to allow for adaptive management to assure the recovery of the species. Survival of the species and removal of threats should be identified as primary objectives for these plans.*

This criterion addresses Factor A and E threats, within the *Fritillaria* management areas. Criterion 5 has been partially met by the establishment of 8 FMAs. A

general management plan is provided for each of the FMAs and the Medford BLM is developing site-specific management and monitoring plans for implementation.

6. *To protect plants from bulb collecting and herbivory by deer or livestock, each Fritillaria management area could be subject to fencing, change of grazing season or other measures if population monitoring identifies these threats.*

This criterion will address threat Factors B (Threats from collections for recreational and scientific purposes), C (Threats from herbivory and predation) within the FMAs, or any other threats that can be addressed through management. Criterion 6 has been partially met by the establishment of the FMAs. It will be fully met when site-specific management and monitoring plans for each FMA are implemented. A new threat assessment will help to guide the Service, BLM and other agencies to better address the threats the species is facing.

7. *To ensure the continuing recovery of the species and adequacy of management actions undertaken, a post-delisting monitoring plan must be developed and ready for implementation at the time of delisting.*

A post-delisting monitoring plan including adaptive management provisions, will ensure that the species has fully recovered and is largely free of threats. Criterion 7 has not been met.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat:

2.3.1.1 New information on the species' biology and life history:

Much new information has been collected on the biology and life history of *Fritillaria gentneri* subsequent to the publication of the 2003 recovery plan. Cost share funding by Medford BLM, IAE, ODA, and the Service have enabled ODA and IAE to continue long term monitoring on this species (Table 2 and sections below).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Population Trends
For the last 10 years, the BLM has monitored *Fritillaria gentneri* flowers and leaves on 58 sites across all four recovery units and within 43 occurrence clusters (Appendix A). Beginning in 1998, 13 *F. gentneri* sites

were monitored; nine in Unit 1, none in Unit 2, three in Unit 3 and one in Unit 4. By 2008, 18 sites had been added to Unit 1, two sites added to Unit 2, 15 sites to Unit 3, and 16 sites were added to Unit 4, bringing the total to 58 (Appendix A). Flowering individuals are the most efficient to monitor because flowers are easily detected, when not browsed by deer, while leaves are less noticeable and cannot be positively identified to species. However, available science has not established that a low number of flowering plants indicate a declining population. Population size evaluation is perhaps not best measured by flowering plants alone. Future molecular research may prove that juvenile bulbs contribute significantly to population size when browsing or weather conditions impair monitoring.

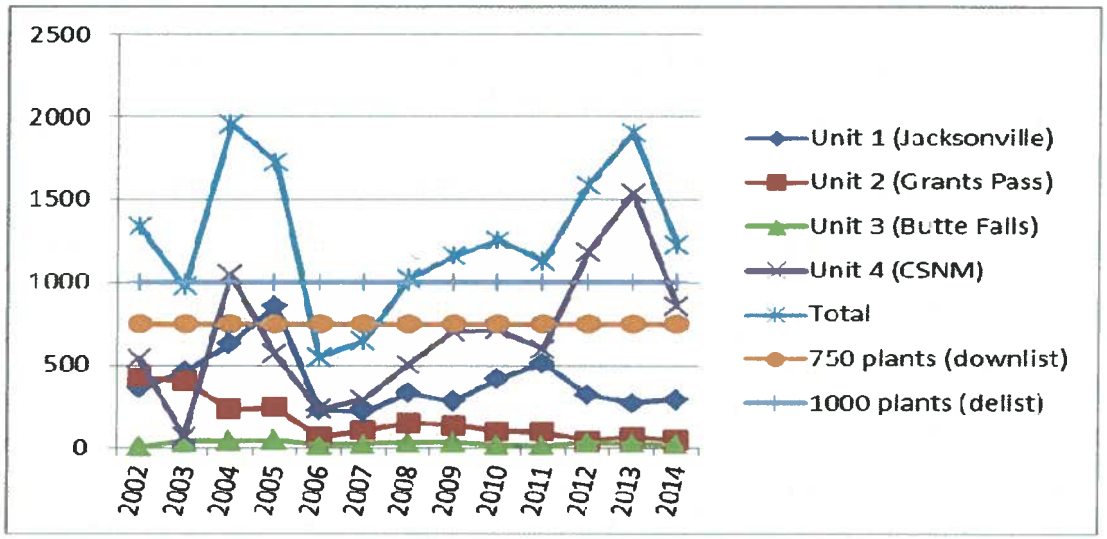
Results indicate that the number of *F. gentneri* flowering plants at most sites fluctuate annually. The overall flowering plant total indicates a seven-year increasing trend, aside from 2011 and 2014. However; although Unit 4 has been increasing, in five of the last seven years, with a net increase of 900 and 300 flowering plants in the last two years respectively, the other three recovery units (Units 1-3) are increasing or decreasing albeit at slower rates (Figure 2) (Siskiyou BioSurvey LLC 2014, Giles-Johnson et al. 2014).

Table 2. Overview of monitoring, propagation and biological, genetic, and demographic research on *Fritillaria gentneri* (1991-2014).

Name	Date	Author(s)
On the Taxonomy of *Fritillaria gentneri*	1991	L. Knight
An electrophoretic investigation into the status of *Fritillaria gentneri* (Liliaceae): Is it a 'good' species or not? Unpublished Report to the Plant Conservation Biology Program,	1991	E. Guerrant, Jr.
1998-2011 *Fritillaria gentneri* population monitoring on BLM lands annual reports.	1998-2010	Siskiyou BioSurvey LLC and Pacific Crest Consulting
Reproductive ecology of Gentner's fritillary.	2002	K. Amsberry and R. Meinke. Native Plant Conservation Program, ODA
Vegetative reproduction, propagation, and population augmentation for the endangered Gentner's fritillary (*Fritillaria gentneri*). First-year progress report December 2002.	2002	S. Gisler and R. Meinke. Native Plant Conservation Program, ODA
Testing the hypothesis that the Southern Oregon endemic *Fritillaria gentneri* (Liliaceae) derives from hybridization between *F. affinis* and *F. recurva.* Unpublished report prepared by Department of Biology and Southern Oregon University Herbarium for the Medford District BLM.	2004	G. Carey and S. L. Jessup
Watershed restoration and *Fritillaria*	2005	T. Maddux, S. Meyers, and R.

gentneri habitat enhancement at Jacksonville Cemetery.		Meknei. Native Plant Conservation Program, ODA.
Developing biogeographically based population introduction protocols for at-risk plant species of the interior valleys of southwestern Oregon: *Fritillaria gentneri* (Gentner's fritillary).	2005	R. Currin, K. Amsberry, and R. Meinke Native Plant Conservation Program, ODA
Developing cultivation methods and a local facility for the propagation establishment and augmentation of *Fritillaria gentneri* in southwest Oregon.	2005	K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Fritillaria gentneri Population Monitoring at Pickett Creek, Josephine County, Oregon: Progress Report.	2005	T. N. Kaye, K. Rohland, and S. Gisler:
Fritillaria gentneri population monitoring at Pickett Creek, Josephine County, Oregon: 2006 Progress Report, October 2006.	2006	A. S. Thorpe, K. Rohland, and T. N. Kaye Institute for Applied Ecology
Continuing investigations of hybridization and fertility of *Fritillaria gentneri* through cytological evaluations and pollen viability analysis.	2007	K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Developing cultivation methods, population establishment and augmentation of *Fritillaria gentneri* in southwest Oregon – Phase 2. Progress report for Year 1.	2008	K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Integrating California populations of *Fritillaria gentneri* into the 2003 Federal Recovery Plan 2007 Interim Report (August 31, 2007).	2008	K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Population establishment and augmentation of *Fritillaria gentneri* in southwest Oregon; Completion of Phase 2 and Initiation of Phase 3.	2009	K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Integrating California populations of *Fritillaria gentneri* into the 2003 Federal Recovery Plan 2008 Interim Report (January 9, 2009).	2009	K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Annual program performance report for *Fritillaria gentneri* cultivation and outplanting in 2010.	2010	J. Brown, K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA
Annual Review of *Fritillaria gentneri* on BLM lands 2011 Report.	2011	Siskiyou BioSurvey LLC
Fritillaria gentneri population monitoring at Pickett Creek, Josephine County, Oregon, 2011 Report.	2011	E. C. Gray, A. S. Thorpe, and T. N. Kaye
Fritillaria gentneri population monitoring at Pickett Creek, Josephine County, Oregon, Report to the Bureau of Land Management, Medford District.	2012, 2013	D. E. L. Giles-Johnson, E. C. Gray, and T. N. Kaye
Annual program performance report for *Fritillaria gentneri* cultivation and outplanting in 2011.	2012	J. Brown, K. Amsberry and R. Meinke: Native Plant Conservation Program, ODA

Figure 2. Flowering plant trends across 43 to 58 BLM monitoring sites within the four recovery units from 2002 to 2014 (Siskiyou BioSurvey LLC 2014). *Note: In 2002, 43 sites were monitored. The monitoring sites are indicated in Appendix A as the bold text.*



The cause of year-to-year fluctuations in the flowering plant counts is not well understood and could be dependent of varying factors. For example: a lack of a natural fire regimen keeping natural succession in check, a slight shift in climate patterns, such as the drought in 2014, shifts in non-native invasive plant spread could all result in decreased plant flowering. Other seasonal factors such as herbivory or disease might result in decreased flower counts. The upward trend in Recovery Unit 4 in 2012 and 2013 was likely attributable to an expansion in the study area boundaries due to new plant detections and not necessarily an increase in the population (Siskyou BioSurvey LLC 2013).

Demographic features

The 2003 recovery plan indicates that flowering plants account for a mean of 2.5 percent of the total population (USFWS 2003). However, 12 years of data from the Pickett Creek *F. gentneri* study site indicate that flowering plants accounted for an average of 1.42 percent of the total population (Giles-Johnson et al. 2013), which is 40 percent less than the 2003 recovery plan estimate. Using the Pickett Creek study, a recovery unit supporting 100 flowering plants would likely support 7,040 plants of all age-classes, and a recovery unit meeting the goal of 750 flowering plants would have an estimated 52,800 plants. The 2003 recovery plan estimate of the ratio of flowering to non-flowering plants is based on data

from only one site, and therefore may be of limited applicability. It should be noted that Picket Creek population have remained relatively stable in the last 12 years, while there has been a steady increase in the proportion of vegetative to flowering plants. This could suggest that while flowers are essential to correctly identify *Fritillaria* sp., they may not truly represent the population's health.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Breeding System Studies

Limited genetic analysis has been conducted on *Fritillaria gentneri*. Fertility studies conducted by ODA have found that *F. gentneri* is not sterile, and may produce viable seed when fertilized with pollen from another population (Amsberry and Meinke 2007). This suggests that individuals within populations are self-incompatible, which is not surprising given that most populations or patches are clonal. Intra-population fruit-set in a controlled setting for *F. gentneri* x *F. gentneri* crosses was 2.3 percent, with poor seed viability; while inter-population fruit-set of *F. gentneri* x *F. gentneri* crosses was 48.9 percent, with good seed viability (Amsberry and Meinke 2007).

Pollen Studies

Fritillaria gentneri pollen was determined to have lower viability than two closely related species, *F. recurva* and *F. affinis*. Chromosomal abnormalities associated with *Fritillaria* spp. hybridization are probably the reason for low pollen viability in *F. gentneri* from naturally occurring populations and in other pollination experiments (Amsberry and Meinke 2007).

Cytology Studies

Chromosome counts for 17 individuals of *Fritillaria gentneri*, along with four individuals of *F. affinis* and six of *F. recurva* indicate that all *Fritillaria* spp. had some degree of polyploidy, but almost all individuals of *Fritillaria gentneri* were triploid (2n=36) (Amsberry and Meinke 2007). *F. gentneri* also showed evidence of meiotic irregularities. Half of the *F. affinis* samples exhibited triploid chromosome counts, while five *F. recurva* were diploid (2n=24) and one was triploid. The results are consistent with traits of hybrid plants, but they do not prove hybridity in the species.

Molecular Studies

There are marked morphological, genetic and physiological similarities in traits among *Fritillaria gentneri, F. affinis,* and *F. recurva* (Guerrant 1991, Knight 1991, Cary and Jessup 2004). Because their ranges are overlapping it is widely accepted that *F. gentneri* is a stabilized hybrid between *F. recurva* and *F. affinis*. Although not complete, ODA has

conducted an initial molecular analysis of *F. gentneri, F. affinis*, and *F. recurva* to determine if *F. gentneri* is a hybrid. Nucleotide material of the three species was examined using Superimposed Additivity Pattern analysis. Results indicated that *F. gentneri* is a hybrid resulting from multiple but separate hybridization events resulting in very low variation within local populations (Amsberry and Meinke 2007).

2.3.1.4 Taxonomic classification or changes in nomenclature: None

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historical range (e.g. corrections to the historical range, change in distribution of the species' within its historical range, etc.):

The ongoing Medford BLM monitoring along with related project monitoring for section 7 consultations has resulted in new *Fritillaria gentneri* detections which have increased the species' known range. Annual changes in spatial distribution of individual *F. gentneri* are thought to be caused by climate pattern driven factors (Giles-Johnson et al. 2013) rather than human-driven habitat management (Siskiyou BioSurvey LLC 2013).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Throughout the range of *Fritillaria gentneri*, habitat varies from relatively undeveloped to weedy and disturbed. It is assumed that fire is important for retaining suitable habitat conditions for the species by maintaining open canopies and contributing nutrients to the soil (Siskiyou BioSurvey LLC 2013). Medford BLM has documented habitat changes at several *F. gentneri* sites due to fire or no management. Although not closely studied, *F. gentneri* appears to respond positively in the short term to prescribed fire and thinning and responds negatively to vegetation succession (Siskiyou BioSurvey LLC 2013).

2.3.1.7 Other:

Collected bulblets
More than 21,000 *Fritillaria gentneri* bulblets, from across the species' range, have been collected by ODA and others for cultivation since the species was listed (Table 3). As of the winter of 2012, ODA has approximately 20,000 bulblets in cultivation at Oregon State University in Corvallis, Oregon.

Monitoring
About 60 percent of the populations, on average, will flower annually, depending on the number of individuals (Siskiyou BioSurvey LLC 2013).

This information suggests that two years of pre-project surveys are recommended for projects that may impact the species so as to account for the annual variation and to have a high likelihood of detecting the species (Appendix C).

Propagation, Reintroduction, and Augmentation
ODA has been actively involved in propagation of *Fritillaria gentneri* since 1997 (Gisler and Meinke 2002) and developed propagation protocols while documenting the success of reintroduction and augmentation efforts in southwestern Oregon (Currin et al. 2005; Amsberry and Meinke 2005; and Amberry and Meinke 2008).

To date, ODA has planted 31,060 bulbs at 22 sites in southwestern Oregon over the last 10 years (Table 4). At each site, several plots, consisting of four m^2 microplots, are established. Bulbs are planted in two to three of the four microplots, while the remainders are left as controls. For the microplots that are receiving materials, bulbs are evenly distributed into four rows (Amsberry and Meinke 2007). In 2012, all plots were monitored for emergence, leaf length and number of reproductive plants. Over 7,000 emergent leaves and 8 flowering plants were documented within the microplots at these sites. In previous long-term reintroduction efforts, transplants of a series of species survived at rates ranging from a mean of 25 (eight species - Drayton and Primack 2010) to 39 percent (seven species - Guerrant and Kaye 2007), similar to ODA's results in that, after 7 years of transplanting, *Fritillaria gentneri* leaves emerged from 23 percent of large bulbs. Although augmentation and reintroduction projects appear initially successful, continued monitoring is necessary to determine long-term success. For example, at the Jacksonville Cemetery site only one flowering plant remained in 2013, after 4,480 bulbs (of which 4,000 were small bulbs) were planted in 2004. Despite this questionable long-term success at one local site, results from other augmentation and reintroduction efforts to date indicate that these techniques can contribute to recovery.

While *Fritillaria gentneri* propagation overall has been successful, there have been challenges. For example, nursery plants can be susceptible to *Botrytis* sp., a common greenhouse and nursery fungus, which causes larger flowering plants to wilt and die prior to reproductive maturity. In 2011, approximately 40 percent of all large stock plants were infected. ODA worked with the Oregon State Extension Plant Clinic and determined the cause of the symptoms. The clinic diagnosed the problem and ODA is successfully treating the infection to eliminate the problem.

Table 3. *Fritillaria gentneri* bulblets harvested from all sites from 2004-2012 (Brown et al. 2012, Amsberry and Meinke 2009, Amsberry, pers. comm. 2013).

Site	2004	2007	2008	2009	2010	2011	2012	Total	Recovery Unit
Antioch Road	0	86	180	0	0	0	0	266	3
Bald Mountain	0	0	0	280	513	700	0	1493	1
Beekman Woods	0	0	0	0	0	200	0	200	1
Brushy Creek*	0	0	560	0	0	0	0	560	4
Cobbleigh Road	250	0	0	0	0	0	0	250	3
Dog Creek	842	0	0	0	0	0	0	842	3
Dutch Oven Creek	0	0	0	0	1450	700	0	2150	4
Grants Pass	0	0	900	0	300	1,400	2,250	4850	2
Hilltop	0	0	0	1,000	0	0	0	1000	3
Jacksonville Cemetery	1,000	0	1,000	0	0	0	0	2,000	1
Jacksonville Landfill	0	0	0	0	0	135	81	216	1
Muddy Gulch	416	780	720	315	694	1,250	0	4175	1
Pelton Lane	0	166	0	18	0	0	0	184	3
Pilot Rock (Hutton Creek)	0	544	650	0	550	500	0	2244	4
Squires Peak	0	114	230	0	0	0	0	344	1
Tooee	0	0	0	300	0	0	0	300	3
Total	2,508	1,690	4,240	1,913	3,507	4,885	2,331	21,074	

* The Brushy Creek site in located in northern California.

Table 4. Results of *Fritillaria gentneri* bulb planting per site 2004 – 2012 (Brown, pers. comm. 2013).

Site	Bulbs planted[1] (years)	Leaves Emerged[2] (year)	Flowers Emerged[3] (year)	Emergence percentage[4]	Notes[5]
Recovery Unit 1					
Beekman Ridge[J]	155 (2012)	NA	NA	NA	Augmentation
Beekman Woods[J]	600 (2009)	341 (2011)	0 (2012)	57	Augmentation
Catholic Wagon Road[J]	1,650 (2008, 2011)	702 (2012)	2 (2012)	43	Augmentation
Jacksonville Cemetery[J]	4,480 (2004) (4,000 small bulbs)	1 (2012)	1 (2012)	0.04	Augmentation
Jacksonville Woodland Park[J]	600 (2011)	378 (2012)	0 (2012)	63	Augmentation
Oregon Street (I, II, and III)[J]	1,285 (2007, 2008, 2011) (150 small bulbs)	246 (2012)	0 (2012)	19	Augmentation
Three Dog[J]	450 (2009)	170 (2011)	0 (2012)	38	Augmentation
Tunnel Ridge (I, II, III, and IV)[M]	1,082 (2009, 2010, 2011, 2012)	380 (2012)	0 (2011)	35	Reintroduction
Woods Property[J]	100 (2006)	103 (2011)	0 (2011)	100	Augmentation
Recovery Unit 2					
Dodecatheon[M]	220 (20067)	40 (2011)	0 (2011)	18	Reintroduction
Pickett Creek (I and II)[M]	5,980 (2004, 2008) (4,500 small bulbs)	1,254 (2011)	1 (2012)	21	Augmentation
Pickett Up[M]	1,898 (2011)	NA	NA	NA	Augmentation
Red Mountain[M]	1,400 (2010)	817 (2012)	0 (2012)	58	Reintroduction
Valley of the Rogue State Park[O]	274 (2009)	173 (2012)	0 (2012)	63	Augmentation
Recovery Unit 3					
Antioch Road Trespass[M]	379 (2010, 2011)	171 (2012)	0 (2011)	45	Augmentation
Cobbleigh Road[M]	250 (2009)	102 (2012)	0 (2011)	41	Augmentation
Dog Creek[M]	600 (2009)	322 (2012)	0 (2011)	52	Augmentation
Vasak[M]	614 (2012)	NA	NA	NA	Augmentation
Recovery Unit 4					
Brushy Creek[R]	164 (2011)	133 (2012)	NA	80	Reintroduction
Mariposa Botanical Area (I, II, III and bulk)[M]	4,040 (2008, 2010, 2011)	1,263 (2012)	0 (2012)	42[6]	Reintroduction
Pilot Rock[M]	4,480 (2004) (4,000 small bulbs)	282 (2012)	2 (2012)[6]	6	Augmentation
Pilot Rock Pond[M]	109 (2006)	160 (2012)	2 (2012)	147	Augmentation
Total	31,060	7,038	8	23	

NA= Data Not Available; J = City of Jacksonville lands; M = Medford BLM lands (Oregon); O = OPRD lands; R = Redding BLM lands (California); 1 = bulbs planted from nursery-grown bulbs; 2 = Indicates the number of non-flowering *Fritillaria gentneri* (1 leaf per plant) counted in outplanting plots; 3 = Indicates the number of *Fritillaria gentneri* flowers present in outplanting plots; 4 = Percentage is determined by emergence of leaves and flowering plants present divided by the number of bulbs planted; 5 = Reintroduction = bulb planting 0.5 km outside of known occurrence clusters, Augmentation = bulb planting less than 1 km from an occurrence cluster area; 6 = Bulk outplanting site was not monitored in 2012.

Climate modeling
Seasonal variation in temperature and rainfall and its potential correlation with the ratio of flowering to non-flowering plants is an information need to inform successful recovery efforts. The variables of temperature and precipitation have been examined at one of the largest *Fritillaria gentneri* populations from Pickett Creek. Using 10 years of data, a correlation was found between the number of flowering and non-flowering individuals in that a dry fall followed by a warm winter was associated with increased numbers of all age classes of *F. gentneri* and a wet spring was associated with increased number of flowering individuals (Giles-Johnson et al. 2013).

Other Conservation Efforts
Approximately 5.7 acres (2.3 hectares) supporting several *Fritillaria gentneri* plants was purchased in 2006 using funds from the Service's Recovery Land Acquisition Grant Program. A 1.25-acre (0.5 hectares) parcel of private land was donated to the City of Jacksonville as match for the federal funds used in the above purchase. The Table Rocks property, located north of White City, Oregon, with 728 acres (295 hectares) of suitable oak woodland and savanna habitat was purchased by TNC in 2008, with the help of the Service, BLM and the Oregon Watershed Enhancement Board (OWEB) and held under a Conservation Easement by OWEB. In addition, several private landowners in southern Jackson County, with land containing *F. gentneri* suitable habitat (Recovery Unit 4), have been managing their properties for this species in conjunction with the Services' Partners for Fish and Wildlife Program.

Recovery Efforts
The BLM, the Service, ODA, and other partners have contributed to recovery efforts throughout the past 12 years. Recovery workshops attended by the three agencies and species experts were held in 2005, 2010, and 2014. At these meetings, recovery objectives were clarified and prioritized. Approximately $550,000.00 in the last 10 years were expended on *Fritillaria gentneri* recovery through long-term monitoring which includes project related presence/absence surveys, demographic and climate related studies, various research, and propagation, augmentation and reintroduction efforts (D. Kendig, pers comm. 2012). This cost is consistent within the recovery plan for ten years of effort.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms) *For each of the five listing factors outlined below, provide a brief summary and citation(s) of any relevant new information, including conservation measures, regarding the magnitude (scope and severity) and imminence of previously identified threats to the species or new threats to the species. Note if any of the factors are not relevant to the species.*

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

The effects of continued development, as documented in the original listing rule and recovery plan, have likely continued and may have caused increased habitat loss and fragmentation on private land. Examples of development described in the recovery plan include agricultural, municipal, residential, and road development. For example, the 40-acre Jacksonville Woodlands occurrence cluster is particularly threatened by development (USFWS 2003).

It is likely that some suitable habitat for *Fritillaria gentneri* could have been lost due to the development pressures in southern Oregon. The threat of habitat destruction can be reduced through land acquisition, land protection, non-native invasive plant control strategies, and compatible land use by landowners. For example, at least 5.7 acres (2.3 hectares) in the Jacksonville Woodlands occupied by *Fritillaria gentneri* were transferred from private ownership to the City of Jacksonville's Beekman Woods and received permanent protection from development. In 2008, after acquisition of 1,750 acres (708 hectares) of private land by The Nature Conservancy within and adjacent to Table Rocks in Jackson County a new 12-acre (5 hectare) *F. gentneri* population was discovered at Upper Table Rock. The land supporting this population was recently transferred to BLM and is afforded protection. At another location, a 15-acre property, supporting approximately 20 flowering plants, a conservation easement was established to ensure their long-term protection (Mergenthaler, pers. comm. 2012). While it is challenging to estimate habitat loss on private land, approximately 33 acres of *F. gentneri* habitat has been set aside for conservation.

The Federal Energy Regulatory Commission (FERC) is proposing to authorize a 234-mile liquid natural gas pipeline which will cross four counties in southwest Oregon and extend from Coos Bay in Coos County to Malin in Klamath County, Oregon. The pipeline route will cross through 777 acres of potentially suitable *Fritillaria gentneri* habitat in Jackson County. Although 591 acres were surveyed, 186 acres were not surveyed due to denial of property access by landowners (FERC 2010). Three new *F. gentneri* populations were discovered during the surveys. Given the excavation required to install pipelines, impacts to potential *F. gentneri* habitat is likely across this route.

The threat of wild fire to *Fritillaria gentneri* through the accumulation of fuels from fire suppression increases the probability of high intensity fires, which have the potential to sterilize the soil and kill *F. gentneri* bulbs (Siskiyou BioSurvey LLC 2004 and Siskiyou BioSurvey LLC 2012). In addition, the accumulation of leaf litter could, in effect, smother small bulbs and prevent them from sending up leaves. While high intensity fires

could potentially negatively impact *F. gentneri*, a periodic fire regime may be essential for maintaining an open canopy (allowing sufficient sunlight to reach the ground) and reducing the amount of leaf litter on the ground.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

The extent of use of *Fritillaria gentneri* by commercial and recreational activities is unknown; however, this native lily is quite attractive, and the genus *Fritillaria* is cultivated because of its colorful appearance. For example, flower picking and plant collection has been documented at the Jacksonville Woodlands (Pacific Crest Consulting 2010). Despite this, there is no evidence of widespread population declines due to these activities.

2.3.2.3 Disease or predation:

Evidence of herbivory of *Fritillaria gentneri* by deer (*Odocoillus* sp.), elk, rabbits, (*Sylvilagus* spp.) turkeys (*Meleagris gallopavo*), livestock, and insects is frequent and widespread (USFWS 2003; Amsberry and Meinke 2005, Siskiyou BioSurvey LLC 2014) because the plant produces highly palatable flowers. Deer can harm *F. gentneri* populations by eating leaves and flowers which can result in the death of individual plants. Fossorial mammals (e.g., gophers) and insects are also predators on *Fritillaria* sp. bulbs (Amsberry and Meinke 2005). However, loss of flowers is not anticipated to be a major threat since the species rarely produces seed and usually self-propagates through clonal bulb production. Fossorial mammal activity is also a probably and possibly important bulb dispersal vector.

The impact of livestock grazing practices on *Fritillaria gentneri* plants and habitat is not well understood. It appears that *F. gentneri* populations have persisted over the last ten years in areas with low cattle densities. Overgrazing, on the other hand, is expected to result in a complete loss of plants. It is unknown to what extent grazing can benefit the species, but possibly by reducing competing vegetation, suitable habitat can be maintained (Siskiyou BioSurvey LLC 2014). Further studies are needed to increase our knowledge of livestock grazing compatibly with *F. gentneri.*

As mentioned in the recovery plan, fungal infections were identified as a threat to the species at the time the listing rule was published, in 1999. Since them, only sporadic fungal infections have been noted and these appear to be transient and not pose an imminent threat to the species (USFWS 2003; Siskiyou BioSurvey LLC 2013).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

The State of Oregon has regulations that provide some protection for *Fritillaria gentneri*, under the Oregon Wildflower Law (Oregon Revised Statutes [ORS] 564.010-040), in that picking or digging of the species is prohibited only on state-or local non-Federal government owned or leased property and within 60.9 meters (200 feet) of any State highway. The statutes do not extend protection to listed species on private land, and although ODA classifies the species as endangered, there is no requirement for private land owners to protect rare plants or the habitat upon which they depend.

Under the Oregon's endangered species regulations (ORS 564.100), ODA is responsible for regulating commercial trafficking of the species and developing rules for its protection on all State-owned or State-leased lands, which include all non-Federal public lands. State rules for listed plants stipulate that land managers must conduct surveys prior to implementation of land actions and consult with ODA if the actions could impact listed species or land is sold or exchanged.

Outreach programs conducted by the Natural Resource Conservation Service and events such as the annual Fritillary Festival in Jacksonville has increased public awareness and informed local governmental agencies of their responsibilities under State law. Such outreach will likely reduce the potential for inadvertent disturbances involving *F. gentneri.*

Federal Lands
The BLM manages more land occupied by *Fritillaria gentneri* than any other agency or private owner within the species range. Federal management plans provide direction for management of resources, including *F. gentneri*, on BLM, National Forest, Bureau of Reclamation, and National Monument lands; however, these lands have multiple-use and right-of-way provisions which can complicate efforts to recover this species. For example, private landowners, in some situations, could obtain permission to construct a road across federal land to gain access to their inholding, even if the road crosses habitat supporting *F. gentneri.* On Federal lands, however, effects to *F. gentneri* are addressed during section 7 consultations with the Service and based on its status as an endangered species under the Act. Attempts to minimize impacts to the plants are addressed in the consultations. Also federal lands occupied by *F. gentneri* often receive annual or pre-project monitoring and periodic management, as funding and staff resources are available.

Non-Federal Lands
Fritillaria gentneri is protected on non-federal publicly owned lands (e.g., city, county or state). For example, a management plan between the City of Jacksonville and ODA has been developed to preserve and manage the

Jacksonville Cemetery grounds and reduce spread of yellow starthistle. The ability to control this invasive plant, however, is often limited by funding and volunteer involvement. To bolster the continued existence of *F. gentneri* on non-federal lands, there is a need for continued management and conservation agreements to protect *F. gentneri* sites.

Consultations
The Service has completed nine consultations under section 7 of the Act since *Fritillaria gentneri* was listed in 1999. The Service conducted two formal consultations, one with the U.S. Army Corps of Engineers for a housing development project and the second with the Medford BLM for a fuels reduction project. Seven informal consultations have been completed with Medford BLM for a variety of actions including livestock grazing, mining, timber harvesting, fire suppression, road construction, and beneficial conservation actions. Project design criteria that avoided or minimized impacts to the plants were included in the informal consultation.

2.3.2.5 Other natural or human made factors affecting its continued existence:

Fritillaria gentneri habitat is likely adapted to periodic fire to maintain an early to mid-seral mixed conifer-hardwood woodland habitat (Siskiyou BioSurvey LLC 2014). Long term fire, for example that has occurred over much of the species range, has resulted in increased shading and accumulation of litter and duff, which is thought to decrease the quantity and quality of suitable habitat. Without periodic fire, forest succession from open mixed conifer and shrub dominated vegetation to a closed conifer forest result in habitats too shady to support plants. Habitat restoration (e.g., mowing and woody shrub removal) at *F. gentneri* sites likely improves the habitat and contributes to population stability. A natural fire regime reduces competition from native plant succession and removes litter debris that threatens to stifle shoot emergence. Fire is thought to maintain habitat suitable for *F. gentneri,* because most anecdotal evidence shows a spike in the number of flowering plants two years post-fire; however, the plants then return to pre-fire flower frequencies. Studies on the long-term effects of fire on the species are needed.

An example of habitat restoration benefits to some degree, were demonstrated at the Millers Gulch site in 2006. Monitoring following fuels treatment showed an increase of nine flowering *Fritillaria gentneri* plants from the previous year but only four plants were present in 2009 and no flowers observed from 2010 – 2012, and only one plant flowered in 2013. Although *F. gentneri* responded positively to canopy opening the first year, the conditions did not remain favorable very long. The lack of flowering plants may be attributed to an excess of shade still present or

accumulation of leaf litter (Siskiyou BioSurvey LLC 2013). A fuels management treatment was also conducted at the Pearce Park site in Josephine County under ODOT management. Due to this effort, the population appears to be relatively stable (ODOT 2011; Friedman, pers. obs. 2013).

Non-native invasive plants

A major threat associated with development and roads is the spread of non-native invasive plants. At several locations *Fritillaria gentneri* is threated by encroachment from yellow star-thistle, tree-of-heaven (*Ailianthus altissima*), Scotch broom, as well as various non-native grasses (USFWS 2003; Maddox et al. 2005). The Jacksonville Woodlands occurrence cluster is facing these particular threats (USFWS 2003). In 2001, *Fritillaria gentneri* habitat and plants were inadvertently impacted at the Jacksonville Cemetery due to excavation activities. Subsequently a yellow starthistle infestation colonized a large section of the property due to the disturbance.

Litter and Thatch Accumulation

When *Fritillaria gentneri* plants are covered by a thick accumulation of duff (e.g. madrone and oak leaves, conifer needles) or thatch from accumulation of dead or living grass leaves, tillers, or racemes, individuals appear to alter their growth form by producing many small bulb leaves as opposed to adult sized leaves (Pacific Crest Consulting 2010, Siskiyou BioSurvey LLC 2013). This maybe a response to a lack of sunlight and younger plants may be unable to survive. The suppression of natural, periodic fires has likely allowed this duff or thatch layer to accumulate. The magnitude of this threat is unknown because no standardized measurement of duff or thatch accumulation or leaf mortality has been incorporated into the monitoring protocol. However, the threat it is considered to be widespread due to suppression activities across southern Oregon.

Inbreeding Depression, Genetic Drift and Stochastic Extinction

Isolated *Fritillaria gentneri* populations continue to be threatened by natural and man-caused catastrophic events and these events have the potential to eliminate some populations (USFWS 2003). To date, there is no evidence that indicate an occurrence has been affected negatively by inbreeding depression or genetic drift because most occurrences contain identical genetics resulting from bulb division. Although, the species has 110 occurrences that have from 0 to 9 flowering plants, this does not necessarily indicate the occurrence is highly vulnerable to catastrophic stochastic events, because the non-flowering juveniles and adult plants are not monitored, and the demographic model (USFWS 2003) estimate occurrences have a far higher proportion of non-flowering individuals to flowering ones.

From what we know about the pollen viability and the species' cytology, it appears that sexual reproduction is rare, especially in small populations (Amberry and Meinke 2007). This condition is somewhat offset by the species being able to produce large numbers of clonal bulblets, having the ability to persist, and expand in range until future generations are able to achieve sexual reproduction.

Based on the most up-to-date information, *Fritillaria gentneri* relies on vegetative reproduction. However, restoration strategies should include provisions to ensure successful pollination and sexual reproduction to allow at least sporadic or occasional gene flow events. Recovery Action 3.7 recommends avenues for further research of sexual reproduction in this species.

Small population size

The number of flowering plants is our best gage to determine plant population status, because in the field, the flowers are the only distinguishable characteristic of the plant. A flowering plant count however, is at best a rough estimation of a plant population size. The majority of *Fritillaria gentneri* populations have less than two flowering plants. In the last five years, between 0 and 2 flowering plants were observed across more than half of 58 monitoring sites (Siskiyou BioSurvey LLC 2013). Patches comprised of few plants are at a much higher risk of decline or extirpation due to demographic or stochastic events compared to larger populations. Diseases, herbivory, natural disturbances, localized accumulation of duff or thatch, unfavorable weather events, successional changes, reproductive failure, and anthropogenic impacts are examples of demographic or stochastic events which can jeopardize small populations. Moreover, because of their size and the clonal nature of *F. gentneri*, these small populations may suffer from a lack of genetic diversity. Genetic uniformity may render populations more vulnerable to pests and diseases. The species also may lack the genetic flexibility to adapt to long-term environmental or climate changes.

Climate Change

The effects of climate change will likely affect ecological dynamics by altering precipitation and temperature patterns. Evidence of 30 years of warming temperatures at the end of the twentieth century show phenology of organisms, the range and distribution of species, and the composition and dynamics of communities are affected (Walther et al. 2002). Temperature records indicate that Pacific Northwest temperatures increased 0.8° C since 1920 (Littell et al. 2009). Climate change is expected to lead to increased variability in precipitation (McLaughlin et al. 2002), and increased loss of soil moisture due to evaporation and transpiration of water from plants (Field et al. 1999); this may exacerbate effects due to drought. As a consequence, *Fritillaria gentneri* habitat may

become more inhospitable given that climate models predict a temperature increase of 1 to 2° C by 2040 with another 3 to 4° C by 2080 and decreased growing season precipitation in the Pacific Northwest (Doppelt et al. 2009). Modest changes in winter warming could result in a greater percentage of flowering plants, if spring precipitation increases (Giles-Johnson et al. 2014). However; climate change is expected to lead to increased variability in precipitation, and could result in extended droughts, thus potentially impacting smaller *F. gentneri* populations. Potential methods to manage occurrences in response to shifting climate patterns can include (Steel et al. 2011):

- Manual translocation of bulbs from current sites to "new" sites to track temperature changes,
- Maintain genetic diversity (e.g. enhancing species richness in populations by crossing plants from different habitat types along an elevation profile),
- Preserve or create small-scale temperature and precipitation "refuges" (by maintaining areas with high topographical and environmental heterogeneity),
- Use seeds instead of bulbs in restoration,
- Use prescribed fires to mimic natural fire regime,
- Maintain open areas in woodlands through fire or cattle grazing ,
- Maintain habitat connectivity using landscape linkages or softening the matrix; focus on increasing connectivity for mammal dispersers may be most effective.

2.4 Synthesis

With the discovery of over 44 new occurrences since the species was listed, in 1999, the distribution of *Fritillaria gentneri* is more extensive than previously understood. Approximately 309 flowering plants have been discovered in the new occurrences, which approximate an increase of 15,450 m^2 or 3.8 acres (1.5 hectares). The most recent flowering plant total across the range of the species is 2,907 flowering plants; up from 1,696 flowering plants at the time of recovery plan publication (USFWS 2003). The estimated total coverage of *F. gentneri* is 142,150 m^2 or 36 acres (14.5 hectares).

The BLM conducts monitoring on 58 *F. gentneri* sites annually with survey representation in each of the four recovery units. Apart from unusually high flowering plant counts in 2004 (Figure 2), and periodic annual fluctuation in

flowering, the overall *F. gentneri* flowering plant counts at the monitoring sites indicate a seven year upward trends in Units 2, 3, and 4 and a level trend in Unit 1 (Figure 2). Habitat quality at several sites in Units 2 and 3 may be declining due to encroachment by woody shrubs and trees or litter accumulation. As a result, there is likely a need for active vegetation management that emulates natural disturbance patterns and creates more favorable growing conditions.

Between 2003 and 2013, 21,074 *Fritillaria gentneri* bulbs have been collected from 16 sites and propagated at an off-site nursery on the Oregon State University campus (Table 4) resulting in over 50,000 bulbs grown by propagation through 2012 (K. Amsberry, pers. comm. 2013). Since 2004, 31,060 bulbs have been planted at 22 sites within all 4 recovery units, 17 as augmentation of existing occurrences and 5 as reintroductions (J. Brown, pers. comm. 2013). The propagation efforts have yielded 7,038 non-flowering plants and 8 flowering plants, as of 2012, which is a 23 percent success rate. Although propagation and outplanting of bulbs is successful, in terms of most in-situ botanical propagation efforts, at the rate of success, it will likely take extensive bulb collection, propagation, and outplanting efforts to see recovery level populations met.

Recovery criterion 1 (Each Recovery Unit will have 750 or more flowering plants to be considered for threatened status) is not being met in three of the four recovery units. Recovery Unit 4 (CSNM) has well exceeded 750 plants in the last two years.

Recovery criterion 2 (FMAs within the recovery units should be located on public land, or private land subject to permanent conservation easement or other permanently binding agreements) has been partially met due to the establishment of eight FMAs on BLM administered land (USFWS and BLM 2015).

Recovery criterion 3 (Two *Fritillaria* management areas within each recovery unit must consist of populations of at least 100 flowering individuals each within a 0.8-km [0.5-mile] radius of each other) (Appendix A). As of 2014, this criterion is not met. Only two occurrences across the range of the species had at least 100 flowering plants. Another 11 occurrences across the species range support between 10 and 99 flowering individuals, and could potentially meet this recovery population size target in the next several years. For the remaining occurrences, that have less than 10 flowering plants, there is less likelihood that they will attain a recovery level size of 100 flowering individuals in the next 10 or 15 years due to trends in the last 10 to 15 years. We have not been able to enact management that will result in flowering plant surges.

Recovery criterion 4 (Flowering plant individuals should be distributed over a minimum of 50,000 m^2 (5 ha.) in each recovery unit) is not met, except in Recovery Unit 4. Plant cover or occupied acreage is calculated by the number of flowering plants. It is understood that this criterion will be met when criterion 1 is met.

Recovery criterion 5 (site-specific management and monitoring plan should be developed, approved and implemented for each FMA) and recovery criterion 6 (each FMA should be subject to fencing, vegetation management, or other measures if population monitoring identifies these threats) have been partially met by the establishment of FMA and their ensuing implementation.

Recovery criterion 7 (developing of a post delisting monitoring plan) has not been met.

With updated propagation techniques carried out by ODA, new long-term population demographic results, climate models, and increased understanding of the *F. gentneri* breeding system, advances have been made in understanding this species. This information has provided more insight into what may constitute a resilient and robust plant populations, how plants can be crossed to provide successful reproduction, how to propagate and establish new populations, responses to climate patters, and long-term demographic and population census trends. With these advances, it is recommended that consideration be given to update the 2003 recovery plan to reflect new distribution and demographic information and how this may inform the recovery criteria.

Based on the results of this 5-year review, we conclude that *Fritillaria gentneri* continues to meet the Endangered Species Act definition of endangered. Overall, the magnitude and immediacy of the threats to *F. gentneri* are judged to be at the same level as when the species was listed. Therefore, a change in status is not recommended at this time.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number: No change recommended

Brief Rationale: See synthesis

3.3 Listing and Reclassification Priority Number:

No change is recommended, the Listing Priority Number should remain 2

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale: Not applicable

4.0. RECOMMENDATIONS FOR FUTURE ACTIONS

Based on this review, the Service recommends conducting the following priority actions, within the next five years, to hasten the recovery of *Fritillaria gentneri*.

Priority actions:

All government entities – The Service should develop a single or multiple conservation agreements with appropriate parties to formally establish *Fritillaria* management areas at the largest population centers, to enable the best opportunity for recovery.

City of Jacksonville Cemetery Site and Jacksonville Woodlands – The Service should coordinate with the ODA and the City of Jacksonville to:

1) Revise the vegetation management plan at the Jacksonville Cemetery, to ensure that habitat restoration and non-native, invasive plants are controlled or eradicated.

2) Consider establishing additional *Fritillaria gentneri* populations or sites on city property, as feasible and appropriate.

Oregon Department of Transportation (ODOT) – The Service will continue to coordinate with ODOT to:

1) Define management activities for *Fritillaria gentneri* that will ensure the Grants Pass site to support a recovery level population (e.g., population of at least 100 plants). Determine if recent restoration efforts have been successful for this management area. Future restoration and recovery efforts will be implemented under the ODOT Routine Maintenance Habitat Conservation Plan, which is in development.

Oregon Parks and Recreation Department (OPRD) – The Service and ODA should continue coordination with OPRD to:

1) To continue reintroduction of *Fritillaria gentneri* at Rogue River State Park.

Medford District, Bureau of Land Management (BLM) and Rogue River-Siskiyou National Forest (RRNF) – The Service should coordinate with BLM and RRNF to:

1) Expand surveys on unsurveyed, suitable habitat for Fritillaria gentneri occurrences.

2) Identify sites supporting declining populations and prioritize them based on vegetation management needs.

3) Continue long-term *Fritillaria gentneri* monitoring.

4) Determine management strategies most appropriate to support large *Fritillaria gentneri* populations (e.g., manual or mechanical control, controlled burns, grazing,

developing habitat corridors) and the estimated treatment interval necessary to maintain the population at a recovery level size.

5) Continue to expand *Fritillaria gentneri* reintroduction and augmentation efforts.

California Department of Fish and Wildlife (CDFW) – The Service should coordinate with CDFW to:

1) Define management activities for *Fritillaria gentneri* that will allow the Brushy Gulch sites to support a recovery level population. If necessary, habitat within these management areas could be opened up by mechanical brush treatment, allowing the present population to expand.

USFWS, Roseburg Field Office – The Service will perform the following, as funding and staffing allow:

1) Review recovery criteria, as appropriate, based on new distribution, threats, population, demography, breeding system, and propagation information, and adjust recovery criteria to reflect best available information.

2) Evaluate new occurrence information and update the recovery units accordingly.

3) Fund research to better estimate *Fritillaria gentneri* population size using sampled molecular data from non-flowering juvenile plants.

4) In cooperation with our partners, fund expansion of *Fritillaria gentneri* recovery activities such as propagation, population augmentation, reintroduction, monitoring, and habitat management.

5) Continue to encourage studies that examine the effects of global climate change on this species and how it could affect species dispersal using bulb translocation.

6) Once *Fritillaria gentneri* seeds can be produced more readily, investigate the success of seeding for augmentation and reintroduction.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW

***Fritillaria gentneri* (Gentner's fritillary)**

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Review Conducted By: Sam Friedman

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve _____ Date 25 Jan 16

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Region 1

Approve _____ Date _____

APPENDIX A. Occurrence Clusters within Gentner's frillary Recovery Areas.
Bolded text indicates element occurrences (EOs) which are annually monitored; 1 = two or more monitoring sites in occurrence cluster.

Jacksonville Area, including Recovery Unit 1 (59 EOs)				
Name	**BLM No. / ORBIC No.**	**Last year monitored**	**Flowering plant count**	**BLM Monitoring site(s)**
10371	10371	2004	2	N
12549	12549	2007	2	N
12550	12550	2007	3	N
12580	12580	2007	5	N
13116	13116	2007	1	N
13125	13125	2012	5	N
13753	13753	2010	6	N
13984	13984	2011	1	N
14031	14031	2011	1	N
14235	14235	2011	1	N
14338	14338	2012	4	N
Bald Mtn. 1,2	**3596**	**2012**	**91**	**Y**
Baldy Mtn.	**9489**	**2012**	**0**	**Y**
Bear Gulch	**7712**	**2012**	**12**	**Y**
Beaver Creek	NA	2012	0	N
Bill Nye Mine	7739	2001	1	N
Bishop Creek	**2727**	**2012**	**6**	**Y**
Blacksmith Creek	**7707**	**2012**	**4**	**Y**
China Gulch East	**1808**	**2012**	**6**	**Y**
China Gulch West	**1818**	**2012**	**8**	**Y**
Cody Road	NA	1982	5	N
Culvig Gulch	8904	2005	9	N
Deep Shaft Mine Adit	13544	2012	1	N
E of Forest Creek	4676	2012	1	N
Eagle Canyon	**7721**	**2012**	**72**	**Y**
Eagle Canyon and Hulkill Mtn.	13087	2007	2	N
Forest Creek Ridge	**7704**	**2012**	**3**	**Y**
Goat Cabin Ridge 1	**7710**	**2012**	**5**	**Y**
Goat Cabin Ridge 2	**7711**	**2012**	**2**	**Y**
Hope Spring	7737	2012	2	N
Jacksonville Woodlands	**2728**	**2012**	**134**	**Y**
Lick Gulch	7705	1999	3	N
Little Applegate Rec	7706	1999	4	N
Lower Little Applegate	**7747**	**2012**	**0**	**Y**
Logtown Cemetery	NA	2003	0	N
Lomas Road	**247**	**2012**	**0**	**Y**
Lower Little Applegate 2	NA	2001	1	N
Matney Gulch	1813	2002	1	N
Millers Gulch[1]	**1789, 4081**	**2013**	**16**	**Y**
Muddy Gulch	**480**	**2012**	**85**	**Y**
N of Sailor Gulch	7719	1990	5	N
NW of Cinnebar Mtn.	8029	1999	6	N
Oregon Belle	**2469**	**2012**	**3**	**Y**
Poorman's Creek	**986**	**2012**	**7**	**Y**
Quady Winery	**3808**	**2012**	**0**	**Y**
S of Poorman Gulch	NA	1987	3	N
SE of Jacksonville	NA	1987	8	N
Spencer Gulch 1	**243**	**2012**	**1**	**Y**
Spencer Gulch 2	**342**	**2012**	**0**	**Y**
Lower Little Applegate 1	**7747**	**2012**	**0**	**Y**

Name	BLM No. / ORBIC No.	Last year monitored	Flowering plant count	BLM Monitoring site(s)
Star Gulch	NA	1998	0	N
Star Gulch 2	NA	2009	6	N
SSW of Jacksonville	NA	1988	4	N
Tunnel Ridge	NA	2013	1	N
W of Jacksonville	NA	1987	3	N
W Side of Muddy Gulch	**7713**	**2011**	**3**	**Y**
W of Poorman Creek	NA	1995	3	N
Wagon Trail Road	**350**	**2012**	**0**	**Y**
Wellington Butte	**2539**	**2012**	**2**	**Y**
Woodrat Mtn	**3700**	**2012**	**8**	**Y**
Woodrat Mtn. II	14336	2012	3	N
Total			**571**	

Grants Pass Area, including Recovery Unit 2 (9 EOs and 1 introduction site)				
Name	**BLM No. / ORBIC No.**	**Last year monitored**	**Flowering plant count**	**BLM Monitoring site(s)**
Dodecatheon[2]	NA	2012	1	N
Red Mountain	7745	2012	0	N
S of Red Mountain	13174	2000	0	N
Merlin	NA	2000	0	N
Pierce Park Road	NA	2013	32	N
Pickett Creek	**7212**	**2013**	**68**	**Y**
N of Pickett Creek	**7217**	**2012**	**0**	**Y**
Mt. Sexton	42, 351	2003	0	N
Waters Creek	NA	2012	0	N
Winona	ORBIC: 9	1982	5	N
Total			**106**	

Butte Falls Area, including Recovery Unit 3 (39 EOs)				
Name	**BLM No. / ORBIC No.**	**Last year monitored**	**Flowering plant count**	**BLM Monitoring site(s)**
11466	11466	2010	0	N
12796	12796	2008	1	N
13140, 13668	13668	2010	33	N
13667	13667	2010	3	N
13684	13684	2010	3	N
13687	13687	2010	3	N
13933	13933	2011	1	N
Antioch Road 1	**706**	**2013**	**1**	**Y**
Antioch Road 2,3	**707**	**2013**	**0**	**Y**
Antioch Road 4	**4694**	**2013**	**3**	**Y**
Antioch Road 5	**4888**	**2013**	**1**	**Y**
Antioch Road 6	**4898**	**2013**	**0**	**Y**
Antioch Road 7	**4903**	**2013**	**0**	**Y**
Antioch Road 8	**4904**	**2013**	**0**	**Y**
Antioch Road 9	14121	2013	7	N
Big Butte Creek	7722	2004	1	N
Cardwell Creek	2871,	2010	0	N
Cliff Creek	**2195**	**2013**	**0**	**Y**
Cobleigh Road[1]	**2022,4178, 7724, 13669**	**2013**	**31**	**Y**
Dog Creek Road	9385	2010	13	N
Dog Creek Middle	13670, 13671	2010	0	N
N of Dog Creek	**7723**	**2013**	**0**	**Y**
Dry Creek 1	14120	2011	5	N
Dry Creek 2	13688	2010	1	N

Holcomb Spring	705	1998	0	N
Sams Valley	7700	1998	9	Y
Indian Creek	12794	2007	1	N
Lyman Mtn.	ORBIC: 10	1982	20	N
Rocky Flat	13665	2010	1	N
Obenchain Rd	**2182**	**2013**	**2**	**Y**
PCGP Road to MP	13279	2008	4	N
Ramsey Canyon	**1473**	**2013**	**0**	**Y**
Ramsey Road	ORBIC: 8	1982	2	N
Right Fork Sardine Creek	13922	2009	1	N
S of Boswell Mtn.	11504, 11505	2006	3	N
Sams Creek[1]	**7716, 7717**	**2013**	**11**	**Y**
Snider Creek	14011, 14012, 14013	2010	11	N
Upper Table Rock	13789	2010	1	N
Wedgewood Drive	**7699**	**2013**	**0**	**Y**
Total			**173**	

Cascade Siskiyou National Monument Area, including Recovery Unit 4 (17 EOs, 2 CNDDB occurrences, and 1 introduction site)				
Name	**BLM No. / ORBIC No.**	**Last year monitored**	**Flowering plant count**	**BLM Monitoring site(s)**
Brushy Gulch 1	55707	2004	101	N
Brushy Gulch 2	55708	2004	45	N
Brushy Creek	NA	2012	0	N
Colestine Corral	7734	2011	40	N
E of Camp Creek	7735, 7736	2007	16	N
E of Salt Creek	12282	2007	5	N
Lone Pine Ridge	7730, 7742	2001	21	N
Lower Camp Creek	12264	2007	20	N
Lower Dutch Over	**7731,7732, 7733,7743, 7744,12118**	**2013**	**164**	**Y**
Mariposa	NA	2012	0	N
Pilot Rock	**7740**	**2013**	**9**	**Y**
Pilot Rock Lower	**3649, 4187, 4190, 3747, 4187, 4189**	**2013**	**1113**	**Y**
Slide Ridge	12416,1242, 12428	2007	6	N
Soda Mtn.	12253	2007	1	N
Tyler Creek	12057	2007	1	N
Upper Dutch Oven	**425, 7726, 7727**	**2013**	**343**	**Y**
Upper Camp Creek	12194	2007	1	N
W of Agate Flat	12240, 12246, 12253	2007	3	N
W of Skookum Creek	12291	2007	1	N
West Fork Dutch Oven 3	**7728**	**2013**	**36**	**Y**
Total			**1926**	

Occurrences outside Recovery Units (9 EOs)				
Name	**BLM No. /ORBIC No.**	**Last year monitored**	**Flowering plant count**	**BLM Monitoring site(s)**
12930	12930	2010	2	N
14043	14043		1	N
Colvig Gulch	8904		9	N
North River Road	13487, 13930	2013	104	N

Rogue River	ORBIC: 92	2006	1	N
Waldpole Creek	12797		0	N
Ward Creek	4148		0	N
Williams	3806		12	N
Wolf Creek	NA	2010	2	N
Total			**131**	

APPENDIX B. Annual *Fritillaria gentneri* flowering plant totals at 58 monitoring sites within the Recovery Units.

Recovery Unit No./Name	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Monitoring sites	13	27	29	35	42	38	50	50	50	50	58	58	58	58	58	58
1/Jacksonville	8	116	281	253	365	462	631	860	230	220	332	283	418	515	322	273
2/Grants Pass	NA	80	306	91	424	406	235	249	68	107	153	140	104	100	46	68
3/Butte Falls	1	6	3	10	8	41	42	52	19	25	32	35	18	15	36	29
4/CSNM	29	38	17	136	541	69	1047	565	233	296	508	703	715	597	1,182	1,537
Total	38	239	607	490	1,338	978	1,955	1,726	550	648	1,025	1,161	1,255	1,127	1,586	1,907

APPENDIX C. *Fritillaria gentneri* (Gentner's fritillary) Pre-Project Survey Protocol

The protocol is not required but is recommended and is designed for surveying areas where Federal or non-Federal activities may impact *Fritillaria gentneri* plants or occupied habitat. The Service endorses the use of this protocol for gathering information on *F. gentneri* in proposed project areas for assessing effects of the proposed actions. This protocol has been peer-reviewed by other Federal and non-Federal agencies and their comments incorporated. Note that any information on presence of *F. gentneri* within and/or adjacent to the proposed planning or activity areas is important, even if it does not meet the guidelines described below. However, if the only information available for a particular activity was acquired through less intensive surveys, the Service must conservatively assess (i.e., a worst-case analysis) the impacts of the action on *F. gentneri*. It is always useful to document reasons for not adhering to the recommended protocol.

This protocol should serve two primary purposes: (1) provide adequate coverage and assessment of the area for the presence of *Fritillaria gentneri*, and (2) ensure a high probability of locating *F. gentneri* and mapping populations that may be affected by proposed activities thereby minimizing the potential for unauthorized impacts. It is not appropriate to use this protocol for annual monitoring or for other research applications. This protocol is intended to apply to all *F. gentneri* habitat, however, changes in survey guidance may occur as new information and survey results become available.

Habitat Information. The plant occurs in a variety of habitats including oak woodlands dominated by Oregon white oak (*Quercus garryana*), mixed hardwood forest dominated by California black oak (*Q. kelloggii)*, Oregon white oak, and Pacific madrone (*Arbutus menziesii)*, and coniferous forests dominated by Pacific madrone and Douglas-fir (*Pseudotsuga menziesii*). Sixteen examples of the variety of habitats that support *Fritillaria gentneri*, as identified in the Gentner's fritillary final recovery plan (USFWS 2003), across its range in Siskiyou County, California; Jackson County, Oregon; and Josephine County, Oregon include:

- Oregon white oak and Pacific madrone woodland
- Oregon white oak – Douglas fir ecotone
- Dry Douglas fir forest
- Moist riparian Douglas fir – white fir (*Abies concolor*) forest
- Mixed hardwood / conifer with California black oak, Oregon white oak, Douglas fir, ponderosa pine (*Pinus ponderosa*), and wedgeleaf ceanothus – whiteleaf manzanita (*Arctostaphylos viscida*) in shrub layer
- Oregon white oak / birchleaf mountain mahogany (*Cercocarpus betuloides*)- wedgeleaf ceanothus ecotonal chaparral
- Ponderosa pine – Douglas fir forest
- Oregon white oak / wedge-leaved ceanothus (*Ceanothus cuneatus*) dry chaparral
- California black oak forest with silktassle (*Garrya fremontii*), poison oak (*Toxicodendron diversiloba*), birchleaf mountain mahogany; serpentine influence
- Grassland / meadow
- Moist riparian shrub community
- Moist chaparral with California black oak, silktassle, birchleaf mountain mahogany, whiteleaf manzanita; serpentine influence

- Jeffrey pine (*P. jeffreyi*) – whiteleaf manzanita serpentine site
- Ecotone between Oregon white oak/ serviceberry (*Amelanchier alnifolia*) chaparral and white fir – Douglas fir forest
- Klamath plum (*Prunus subcordata*) and Brewer's oak (*Q. garryana* ssp. *Breweri*) woodland
- Opening in white fir – Douglas fir forest

Fritillaria gentneri may also be present on the ecotones of these habitats with many other habitats, or small inclusions of these habitats within larger landscapes.

The 25 soil types that the plant has been known to occur on are Abegg, Beckman-Colestine complex, Brader-Debenger complex, Caris-offennbacher complex, Cornutt-Dubakelia complex, Dubakella-Pearsoll complex, Farva, Heppsie, Heppsie-McMullin complex, Holland, Langellain, Langellain-Brader complex, Manita, McNull-Medico complex, McMullin-Rockoutcrop complex, McNull, McNull-Medco complex, McNull-McMullin complex, Ruch, Tallowbox, Tatouche, Vannoy, Vannoy-Voorhies complex, Woodseye-rockoutcrop complex and Xerothents-Dumps complex (USFWS 2003). The soil type most commonly supporting the plant is Vannoy and one of the least common types is Holland. Only on one instance has the plant been found on the Holland soil type.

Surveyor Qualifications
Surveyors should be able to recognize *Fritillaria gentneri* suitable and potentially suitable habitat. Surveyors must be able to differentiate between *F. gentneri* and the related *F. recurva* (scarlet fritillary) and *F. affinis* (chocolate fritillary). It is understood that accurate identification of *F. gentneri* is only accomplished with flowering individuals and that vegetative Fritillaria leaves could be any of the related species.

To assist in identifying suitable habitat, the surveyor should be able to recognize commonly associated species in any growth stage, including: Oregon white oak, wedge-leaved ceanothus, poison oak, whiteleaf manzanita, and Pacific madrone. One or more of the above species will usually be present in suitable habitat. Figure 1 provides a comparison between the common *F. recurva* (scarlet fritillary) and *Fritillaria gentneri*.

Survey Timing
Fritillaria gentneri surveys should be conducted when the plants are flowering in April or May but may vary from site to site according to relative location and elevation. When the species is not known from the site or within the general area (and when the survey intensity is likely to be relatively low), surveys must be scheduled during the optimal flowering period when detection of the plant is most likely. Annual climate and blooming patterns must be evaluated every year and may result in slightly earlier and slightly later surveys. In general, *F. gentneri* at low to mid elevation areas bloom in April – May, and at higher elevation sites (e.g. the Cascade Siskiyou National Monument) bloom in May to early June.

Figure 1. Comparison between *Fritillaria gentneri* (left) and *Fritillaria recurva* (right).

Survey Frequency

A complete *Fritillaria gentneri* survey in appropriate suitable habitat for a specific area requires a two season survey protocol within one 10-year period. Areas surveyed that are not occupied by at least some vegetative fritillary leaves, do not need to be re-surveyed a second year.

Surveys need not be concurrent, but are recommended to occur within 5 years of each other. Because populations may not flower every year, and sometimes stay dormant, a two-year survey protocol increases the chances of finding small *Fritillaria gentneri* patches that were not blooming during the initial survey.

The presence of patches of vegetative fritillary plants (non-flowering) in a 1st year survey will trigger a 2nd year survey to determine if the species is *Fritillaria gentneri* or the more common fritillaries (*F. recurva* or *F. affinis*). If no fritillary leaves are present within survey area, it will be inferred that no *Fritillaria* spp. are present at site, and a 2nd year survey is not required.

Survey Intensity

The level of survey intensity varies based on whether the survey will be conducted *at*, *near*, or *well away* from an occupied fritillary site, and also whether it is the first or the second survey. For the first year survey effort all suitable habitat within or near a known *Fritillaria gentneri* site should be examined and all flowering plants and patches with vegetative leaves documented. The second year survey will be a more focused survey around juvenile leaf sites and where plants were detected during the first survey.

FIRST YEAR SURVEYS

Known Sites
Surveys at known occupied sites, where the intent is to define occupied habitat, should be conducted with more scrutiny than a presence/absence survey. The intent when surveying within occupied habitat is to ascertain suitable to detect all potential flowering plants and to map an area with all potential individual vegetative leaves. In these cases, the surveyor must either be well experienced in recognizing suitable habitat, or define suitable habitat very broadly. Occupied habitat would be determined by working slowly outward from known individuals, inspecting all ground surfaces, until the habitat is deemed unsuitable based on vegetation characteristics. The duration of the survey will vary depending on site-specific vegetation density, survey acreage, and the number of staff-hours dedicated to this task.

Suitable Habitat within Recovery Areas
The appropriate intensity for surveys of suitable or potentially suitable habitat within the species' range (see Figure 1) would be less than for known occupied habitat, but adequate enough to detect all flowering individuals, and all patches of vegetative leaves. This method involves careful scanning of vegetation for *Fritillaria gentneri* flowers and leaves. The amount of time should be enough to carefully scan above and within all of the vegetation strata, but will vary depending on site-specific vegetation density, survey acreage, and the availability of surveyors. One surveyor on average should be able to cover approximately 20 acres (8 hectares) of suitable habitat per day.

Suitable habitat outside of Recovery Areas
The appropriate intensity for surveys of suitable habitat or potentially suitable habitat OUTSIDE THE RECOVERY AREAS would be such that all new populations with flowering plants would be encountered. This method involves walking through suitable habitat, scanning the vegetation strata for fritillary flowers, and observing the vegetation undergrowth for vegetative leaves. With this intensity level, one surveyor should be able to cover approximately 50 acres (20.2 hectares) of suitable habitat per day.

SECOND SURVEY
During the second year survey, all existing *Fritillaria gentneri* sites and the immediate surrounding area will be revisited to better define population boundaries. All locations with undefined *Fritillaria* spp. leaves documented in the first survey, will be revisited in an attempt to validate the presence of *Fritillaria gentneri* by finding flowering plants.

Data Collection and Reporting
Data collected depends on the intent of the survey. In all cases, the location of all occurrences should be mapped or otherwise documented sufficiently to enable individuals to be relocated. Occurrences must be mapped on aerial photographs or topographic maps, and taking GPS coordinates is required for each occurrence. Hyper-accurate hand drawn maps showing individual locations within an occurrence with distances to visible landmarks are helpful, but not required. If the entire population is not censused, an estimate of the number of individuals should be made. On Federal lands, all data for each survey will be collected on the Bureau of Land Management or US Forest Service plant survey and sighting forms. Surveys on non-

Federal lands will use the Oregon Biodiversity Information Center rare plant survey form to document field effort and sightings. All fields will be filled out. Patches of indeterminate *Fritillaria* leaves in suitable habitat will be mapped on aerial photos or topographic maps and coordinates taking using GPS on the first years' survey and revisited in the second survey.

Where a boundary between occupied and unoccupied habitat has been determined, notes should be taken to support a determination that the habitat is unsuitable.

A final report should be provided to the Service that includes locations and numbers of flowering adult and vegetative *Fritillaria gentneri* found, occurrence habitat descriptions including maps delineating suitable, potentially suitable, and non-suitable *Fritillaria gentneri* habitat.

References

U.S. Fish and Wildlife Service (USFWS). 2003. Recovery Plan for *Fritillaria gentneri* (Gentner's fritillary). Portland, Oregon. Viii + 89 pp.

Figure 2. Adult *Fritillaria gentneri* leaf

Figure 3. Flowering *Fritillaria gentneri*