Gentner's fritillary
(Fritillaria gentneri)

5-Year Status Review:
Summary and Evaluation

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

5-YEAR STATUS REVIEW
Gentner's fritillary *(Fritillaria gentneri)*

GENERAL INFORMATION

Species: Gentner's fritillary **(***Fritillaria gentneri***)**
Date listed: December 10, 1999
FR citation(s): 64 FR 69195
Classification: Endangered
Critical habitat/4(d) rule/Experimental population designation/Similarity of appearance listing: N/A

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a 5-year review is to assess each threatened species and endangered species to determine whether its status has changed, and if it should be classified differently or removed from the Lists of Endangered and Threatened Wildlife and Plants. The U.S. Fish and Wildlife Service (Service or USFWS) evaluated the threats and biological status of the Gentner's fritillary as part of a Species Status Assessment (SSA (USFWS 2022, entire)) to inform this 5-year review. The SSA report represents our evaluation of the best available scientific information, including the resource needs and the current and future condition of the species. Independent peer reviewers and partner representatives reviewed the SSA report before we used it as the scientific basis to support our 5-year review process. 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. On November 19, 2021, the Service's Oregon Fish and Wildlife Office staff and management discussed the findings of the SSA to evaluate the status of the Gentner's fritillary for its 5-year status review.

FR Notice citation announcing the species is under active review:

U.S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews for 129 Species in Oregon, Washington, Idaho, Hawaii, Montana, California, and Nevada. Federal Register 85:14240-14243. March 11, 2020.

REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) policy

DPS determinations may apply only to vertebrate taxa. The species under review is a plant. Therefore, the DPS policy is not applicable and the application of the DPS policy to the species' listing is not addressed further in this review.

Recovery Criteria

Gentner's fritillary, an herbaceous perennial plant, was listed as an endangered species on December 10, 1999 (USFWS 1999, entire). At the time of listing, the primary threats to the species were identified as loss of habitat due to development [Factor A], bulb collecting by gardeners [Factor B], herbivory and disease [Factor C], inadequacy of existing regulations pertaining to private lands [Factor D], woody species encroachment following alteration of the historical fire regime, and small population size [Factor E] (USFWS 1999, entire). Detailed assessment of the biological status of Gentner's fritillary is provided in the SSA (USFWS 2022, entire), which we incorporate by reference here.

At the time of listing, plant numbers and distribution were limited. There were 45 extant sites in Jackson and Josephine counties in southwest Oregon with an estimated total of 340 flowering plants or 23,944 individual plants. The recovery plan (USFWS 2003, entire) established four recovery units and seven recovery criteria. Only Criterion 1 differs between downlisting and delisting. The recovery criteria are:

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. For delisting purposes, these 1,000 flowering plants should occur in protected *Fritillaria* management areas and should have exhibited net demographic stability or growth for a minimum of 15 years, as determined through at least biennial demographic monitoring. For the purposes of this plan, measurements of population size and structure are based on counts of flowering individuals because non-flowering *Fritillaria* species are not easily distinguished. A population with a count of 1,000 flowering plants would be estimated to range in size from 26,008 to 52,682 individuals altogether.

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. Because populations elsewhere on public land continue to experience loss and degradation of habitat, each agency involved in land ownership or management in association with a *Fritillaria* management area should take appropriate steps to ensure the long-term conservation of this species by outlining their specific responsibilities for site protection and maintenance in general land management plans, conservation agreements, and the like.

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-kilometer (0.5-mile) radius of each other. Recovery units may include additional management areas of various sizes, as necessary, to meet the requirement of 750 flowering individuals for downlisting or 1,000 flowering individuals for delisting. If necessary, *Fritillaria* management areas may be subject to augmentation using

genetically appropriate (originating from the same recovery unit) cultivated individuals to meet the minimum size criterion (Recovery Action 2.43). *Fritillaria* management areas should contain ample habitat to provide a spatial buffer around each population and allow room for population shifts and expansion over time.

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 square meters (5 hectares or 12.4 acres) of occupied habitat within each recovery unit.

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.

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.

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.

The recovery criteria are based on sizes of the populations needed for long-term persistence. Adequate Gentner's fritillary population sizes were determined based on the research of Yonezawa et al. (2000, entire). Based on studies of the related clonal species *Fritillaria camtschatcensis* (Kamchatka fritillary), Yonezawa et al. (2000, entire) indicate that a minimum of 20,000 individuals (both flowering and non-flowering) would be needed to conserve normal levels of adaptive genetic variation under a balance of mutation and random genetic drift. Using this surrogate, we adapted these findings to Gentner's fritillary, and therefore conservation of approximately 20,000 Gentner's fritillary plants within each of these recovery units should be adequate to maintain sufficient adaptive genetic variability for the long-term survival of this species.

Updated Information and Current Species Status

The Service's last 5-year review (2016) recommended that Gentner's fritillary remain listed as endangered due to not meeting the recovery criteria. In 2022, we evaluated the current conditions of Gentner's fritillary populations through the SSA process by analyzing (1) resiliency, (2) redundancy, and (3) representation.

Currently, there are approximately 274 occupied Gentner's fritillary sites in Oregon (271) and California (3). Of the known sites, 96 sites are routinely monitored. Based on monitoring data and reported data from unmonitored sites, we conservatively estimate that 303,161 plants are

distributed across the known range of the species in 4 recovery units (Table 1) (USFWS 2022, p. 18, Figure 8). Gentner's fritillary is a rare species and we do not anticipate that it is likely to ever be as widely distributed as the closely related *F. recurva* and *F. affinis*. Federal, state, county or municipal ownership accounts for 98 percent of known Gentner's fritillary sites. In the SSA (USFWS 2022, pp. 42-51) the only available metric to evaluate condition was abundance. Therefore, resiliency, redundancy, and condition are based on abundance.

Table 1. Estimated distribution and abundance of Gentner's fritillary within recovery units. Note that the term "flowers" represents individuals flowering at the time of sampling.

Recovery Unit	Monitoring Site Estimate	Augmentation/ Reintroduction individual count	Unmonitored Site Estimate	Estimated total
1	937 Flowers / 65,986 est. individuals	6,161	136 Flowers / 9,577 est. individuals	81,722
2	130 Flowers / 9,154 est. individuals	7,858	0	17,012
3	156 Flowers / 10,986 est. individuals	4,097	19 Flowers / 1,338 est. individuals	16,421
4	2,416 Flowers / 170,141 est. individuals	5,542	174 Flowers / 12,238 est. individuals	188,006

Resiliency was assessed using the single greatest observation of flowering individuals from the previous 10 years (2011 to 2021) of site monitoring data (flowers), Bureau of Land Management (BLM) Geographic Biotic Observations of unmonitored sites (single observations), and Oregon Department of Agriculture reintroduction and augmentation monitoring data (leaves). Sites were classified as high resiliency (met or exceeded the estimated minimum viable population [MVP] with 17 or more flowers; estimated to contain 1,200 to 1,700 individuals), moderate resiliency (at least 50 percent of the MVP value with 8 to 17 flowers; estimated to contain 600 to 1,199 individuals), or low resiliency (lacking enough information, or below 50 percent of MVP with fewer than 8 flowers; estimated to contain fewer than 600 individuals). A total of 29 monitored and 4 unmonitored sites were high resiliency, 14 monitored and 2 unmonitored sites were moderate resiliency, and 53 monitored and 30 unmonitored sites were low resiliency.

Sites within 0.5 kilometer (km) (0.3 mile) of one another were considered to be a population for purposes of determining resiliency. Thus, several of the populations comprise more than one site (USFWS 2022, pp. 46-47, Table 16); the 81 sites comprise 44 populations. Population resiliency was determined by combining site monitoring data with 2017–2019 augmentation/reintroduction vegetative counts, resulting in a resiliency condition based on the estimated MVP (U.S. Fish and Wildlife Service 2022, p. 32). Of the 44 identified populations, 16 are high resiliency, 6 are moderate resiliency, and 22 are low resiliency (USFWS 2022, pp. 46-47, Table 16).

Redundancy of Gentner's fritillary appears adequate to withstand catastrophic events; 49 sites have high and moderate resiliency, with at least 5 high- or moderate-resiliency sites occurring in each recovery unit. Species distribution modeling resulted in identifying 514,485 hectares (ha)

(1,271,320 acres) of habitat in three different categories: 253,031 ha (625,254 acres) of marginal, 176,149 ha (435,274 acres) of suitable, and 85,304 ha (210,792 acres) of highly suitable habitat, throughout the potential range of Gentner's fritillary (USFWS 2022, p. 13, Figure 6). Most of the modeled habitat has not been adequately surveyed to know whether the species occurs there; when it is surveyed, additional sites are likely to be found.

Representation of Gentner's fritillary includes diversity in occupied habitats, adequate genetic diversity, and sufficient population sizes needed for long-term viability. Gentner's fritillary is found in a variety of upland habitat ranging from oak- to conifer-dominated habitat, in a range of elevations. The degree of genetic diversity within Gentner's fritillary populations is important for several reasons. First, diversity within and among populations should confer greater resistance to pathogens and parasites, and greater adaptability to environmental stochasticity (random variations such as annual rainfall and temperature patterns) and changes in climate patterns. Second, low genetic diversity within interbreeding populations leads to a higher incidence of inbreeding, and potentially to inbreeding depression.

Recent molecular analyses of 3 *Fritillaria* species representing 10 populations found evidence for substantial genetic differentiation among populations although further work is needed to quantify variation and clarify evolutionary patterns (Oregon Department of Agriculture 2022, pp. 6-8). Gentner's fritillary appears to have originated as a hybrid between the scarlet fritillary (*Fritillaria affinis*) and chocolate fritillary (*Fritillaria recurva*) (Meyers et al. 2006, entire), and expresses a range of phenotypes that may resemble the parent species. Gentner's fritillary phenotypes with characteristics closer to the scarlet fritillary occur near seasonal creeks and seasonally moist meadows that are similar to scarlet fritillary's typical habitat, whereas Gentner's fritillary phenotypes with characteristics closer to chocolate fritillary characteristics occur on dry upper slopes near the natural habitats of chocolate fritillary. Thus, genetics may differ among or within populations, with divergent phenotypes that approach either parent species or are unique to Gentner's fritillary. For example, the Hutton Creek population has at its east end (W. Fork Hutton Spring) a chocolate type Gentner's fritillary and at its west end (W. Hutton Saddle) a scarlet type. Between these, the plants grade through a "normal [Gentner's fritillary] type," thus incorporating substantial diversity in phenotype and probably in genotype (USFWS 2022, p. 34). This phenotypic diversity also indicates adequate fitness to tolerate environmental extremes and fluctuations among moister to drier/hotter conditions.

As noted above, per Yonezawa et al. (2000, entire), a population size of 20,000 individuals in each recovery unit was determined to be adequate to maintain sufficient adaptive genetic variability for the long-term survival of the species. Population estimates containing an estimated 81,722 individuals in Recovery Unit 1 and 188,006 individuals in Recovery Unit 4 greatly surpass the amount needed to conserve genetic diversity. Recovery Units 2 and 3 nearly meet the threshold with 17,012, and 16,421 estimated individuals respectively. Continued conservation in the form of augmentation and reintroduction efforts by partner agencies throughout the species' range is expected to increase the number of individuals in each recovery unit to above 20,000individuals.

The overall current condition of Gentner's fritillary indicates that a substantial number of sites have relatively high resiliency to withstand stochastic events; redundancy is adequate, with at least five high or moderately resilient sites occurring in all recovery units for the species; and

representation is also robust, with populations occurring in varied geographical and ecological settings with sufficient genetic diversity, across mostly public ownerships.

To assess the future viability of Gentner's fritillary, we assumed the continuation of conservation efforts at their current level. We considered an unlikely worst-than-expected scenario using a flowering rate estimate of 3.1 percent to simulate a decrease in population estimates and assess climate change impacts under a representative concentration pathway (RCP) 8.5 emission scenario where emissions rise throughout the 21st century (USFWS 2022, pp. 68–73). Applying the same methodology used for assessing current condition, most sites would decline in abundance, for a total of 7 populations with moderate resiliency, and 11 populations with high resiliency. Marginal and suitable habitat is predicted to increase by approximately 140 and 160 percent respectively, with a 70 percent decrease in highly suitable habitat. These changes result from both improvement of unsuitable habitat to marginal or suitable condition and degradation of highly suitable habitat under a projected warmer climate with higher precipitation (USFWS 2022, pp. 37-41, Figure 12). For this worse than expected scenario, 41 percent of the populations would remain in high or moderate condition and would remain distributed throughout the species' range in four recovery units. We also considered a better-than-expected scenario using a flowering rate estimate of 0.26 percent to simulate an increase in population estimates, and assess climate change impacts under a RCP 4.5 emission scenario where emissions peak around 2040, then decline (USFWS 2022, pp. 54–61). The better-than-expected future condition would likely improve with 7 populations in moderate, and 24 populations in high, resiliency conditions (USFWS 2022, Table 19; pp. 57-60). The better-than-expected scenario results in 70 percent of the populations remaining in high or moderate condition and would still be distributed throughout the species' range in all four recovery units. Marginal and suitable habitat is predicted to increase 130 percent, with a 38 percent decrease in highly suitable habitat. Thus, projected impacts of climate change are mixed and may be favorable or unfavorable depending on geographic location (USFWS 2022, pp. 37-41, Figure 12). Populations with low abundance are vulnerable to extirpation from stochastic events that may result in the loss of some smaller extant sites. However, these losses are expected to be small relative to overall abundance and distributed throughout the range of the species. Consequently, no single recovery unit or habitat will be disproportionately affected and no major changes in the species' ability to withstand stochastic or catastrophic events in the future is expected under the modeled scenarios.

The results of the SSA (USFWS 2022) indicate there has been a marked improvement in the status of the plant since listing. Collaborative conservation partnerships have monitored sites, implemented population augmentation and reintroduction projects, and protected habitat throughout the range. All of these efforts have successfully led to increased security and management of habitat, as well as increased abundance, a predicted increase in habitat, and decreased threats.

As per Criterion 1, Recovery Units 1 and 4 both surpass the abundance of 1,000 flowering plants needed for delisting. Recovery Units 2 and 3 fall short of the criterion. Although we have not met all of the abundance goals, Gentner's fritillary has increased from 45 to 274 extant sites since being listed in 1999 and increased from an estimated 24,000 to 303,161 plants. Of the 102 monitored sites, 16 sites have 600 to 1,199 plants and 33 sites have greater than 1,200 plants. At

least five high or moderately resilient sites occur in each recovery unit. Additionally, agency botanists theorize that the historical distribution was likely uneven across the range of the species. Recovery Units 2 and 3, with smaller populations and less habitat that is highly suitable, likely did not, and will not have the same number or density of populations as Recovery Units 1 and 4. Additionally, under the unlikely worse-than-expected future scenario, 40 percent of the populations would remain in high or moderate condition and would remain distributed throughout the species' range in the four recovery units (USFWS 2022, pp. 68–73).

Criteria 2, 3, 5, and 6 all focus on *Fritillaria* Management Areas (FMAs). The Service and BLM entered into a conservation agreement in 2015, establishing eight FMAs (USFWS 2022, p. 41). In 2021, the Service and U.S. Forest Service entered into a conservation agreement adding four additional FMAs (USFWS 2022, p. 41. A total of 11 FMAs have been established; 6 in Recovery Unit 1, 2 in Recovery Unit 2, 1 in Recovery Unit 3, and 2 in Recovery Unit 4. All FMAs are located on public lands (Criterion 2), include associated site-specific management plans (Criterion 5), and are subject to appropriate habitat management (Criterion 6). Recovery Units 1 and 4 meet Criterion 3, with each recovery unit including at least 2 populations of at least 100 flowering individuals within a 0.8-km (0.5-mile) radius of each other. Recovery Units 2 and 3 do not meet the Criterion 3 target because they do not include 2 populations consisting of 100 flowering plants. As previously mentioned, additional augmentation and reintroduction are planned for these areas to improve population abundance. Recovery Unit 3 also has one, rather than two, FMAs; however, the BLM has proposed additional FMAs and if they are finalized, Recovery Unit 3 will have two FMAs.

Fritillaria Management Areas were designed to avoid the threat of habitat loss, ensure long-term conservation, reduce vulnerability to adverse random events associated with small populations, maximize and maintain potential genetic, ecological, and geographical variations in the species, and maintain current distribution patterns. The long-term conservation and protection of the species is addressed through public ownership accounting for 98 percent of all known sites. These sites are being monitored, managed for habitat quality, and the control of threats. Based on the biology and analyses conducted in the SSA, Recovery Units 1 and 4 have more than adequate resiliency, redundancy, and representation with good viability. Recovery Units 2 and 3 possess good resiliency, moderate redundancy, moderate representation, and moderate overall viability. Overall, the species' resiliency and redundancy are sufficient to withstand random adverse events; representation and distribution encompasses sufficient genetic, ecological, and geographical variations; and the known distribution and range of the species has increased from 45 sites at the time of listing to 274 sites. Therefore, the intent of FMAs in the recovery goals has been met.

Criterion 4 was intended to avoid population vulnerability arising from the inordinate concentration of individuals within a very small area. Recovery Units 1 and 4 meet the threshold for occupied habitat of 50,000 square meters (m^2), with cover of approximately 65,377 m^2 and 150,404 m^2 respectively, based on population estimates. Recovery Units 2 and 3 do not meet the 50,000 m^2 threshold for occupied habitat. However, the species distribution model indicates that there is enough habitat for populations to expand. Projected effects of climate change on habitat of this species are mixed across its range, with warmer and wetter conditions resulting both in improvement of unsuitable habitat to marginal or suitable condition and loss of highly suitable

habitat (USFWS 2022, pp. 37-41, Figure 12). As mentioned above, an estimated 303,161 plants and 274 extant sites are distributed across the known range of the species, 98 percent of which occurs on public lands, with at least 5 high or moderately resilient sites occurring in each recovery unit. Distribution of resilient populations is assessed in the SSA, which indicates adequate redundancy for the species.

Synthesis

We have reviewed the present and future viability of Gentner's fritillary in the SSA and have concluded the following for the species:

> (1) A substantial increase in Gentner's fritillary sites (from 45 at the time of listing to 274 as of 2021) and individual plants (from 24,000 to 303,161) due to newly discovered sites, plant augmentation, and increased monitoring;
> (2) A pattern of population stability or increase across the species' range;
> (3) An overall reduction in threats (habitat loss, habitat succession, herbivory, small population size, and climate change). Federal, state, county or municipal ownership accounts for 98 percent of known Gentner's fritillary sites and the establishment of *Fritillaria* management areas (FMA) provides scheduled and active management across Gentner's fritillary habitat to secure it from habitat loss and succession. Herbivory is isolated and not believed to cause mortality. The Gentner's fritillary population is much larger, with greater distribution than originally known. Climate change may increase available habitat and may improve habitat conditions.
> (4) Significant contributions to recovery efforts by our partners and their ongoing commitment to management and protection of the species across its range; and
> (5) The species meets or exceeds many targets for delisting. Specifically, the species exceeds delisting goals for plant abundance and FMA establishment targets in two recovery units, and nearly meet the targets in the remaining two recovery units. Although some individual units have not met targets, rangewide the number of estimated plants and distribution greatly exceeds the targets. We have observed substantial positive trends in population and distribution, with broad representation across southern Oregon.

We conclude that the status of Gentner's fritillary has improved to the point where we no longer consider it to meet the definition of endangered. Further, our analysis indicates that the species does not meet the definition of threatened. Therefore, it should be considered for delisting.

RECOMMENDATIONS FOR FUTURE ACTIONS

- Recommend delisting Gentner's fritillary.
- Develop a post-delisting monitoring plan.

REFERENCES:

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Yonezawa, K., E. Kinoshita, Y. Watano and H. Zentoh. 2000. Formulation and estimation of the effective size of stage-structured populations in *Fritillary camtschatcensis*, a perennial herb with a complex life history. Evolution 54:2007-2013.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Gentner's fritillary *(Fritillaria gentneri)*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

_____ Downlist to Threatened
_____ Uplist to Endangered
__X__Delist (Indicate reasons for delisting per 50 CFR 424.11):
____ Extinction
_X__ Recovery
____ Original data for classification in error
____ No change needed

CRAIG ROWLAND Digitally signed by CRAIG ROWLAND Date: 2022.07.11 15:40:28 -07'00'

Approve _____ Date _____
Acting Field Supervisor, Oregon Fish and Wildlife Office

Digitally signed by KATHERINE NORMAN Date: 2022.07.15 13:31:25 -07'00'

Approve _____ Date _____
Assistant Regional Director, Ecological Services, Pacific Regional Office