

Recovery Plan Revision for Gabbro Soil Plants of the Central Sierra Nevada Foothills: El Dorado bedstraw (*Galium californicum* ssp. *sierrae*) and Pine Hill flannelbush (*Fremontodendron californicum* ssp. *decumbens*)

Original Approved: [August 2002](#)

Original Prepared by: Sacramento Fish and Wildlife Office

DRAFT AMENDMENT 1

We have identified best available information that indicates the need to amend recovery criteria for this species since the Recovery Plan for Gabbro Soil Plants of the Central Sierra Nevada Foothills (recovery plan) was completed. In this recovery plan modification, we synthesize the adequacy of the existing recovery criteria, show amended recovery criteria, and describe the rationale supporting the proposed recovery plan modification. The proposed criteria amendments are shown as an appendix that supplements the recovery plan, pages III-2 through III-37 of the recovery plan that applies to El Dorado bedstraw and Pine Hill flannelbush.

**For
U.S. Fish and Wildlife Service
Pacific Southwest Region
Sacramento, California**

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Approved: [XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX](#)

Regional Director, Pacific Southwest Region, Region 8,
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Date: [XXXXXXXXXXXX](#)

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

This draft amendment was prepared by the Sacramento Fish and Wildlife Office (SFWO) of the U.S. Fish and Wildlife Service (Service) and will be peer reviewed in accordance with the OMB Peer Review Bulletin following the publication of the Notice of Availability. We used information from our files, survey information and monitoring reports spanning various localities of the species, and communication with species experts. Communication with species experts was our primary source to update the species status and threats, and was instrumental in developing amended recovery criteria.

We developed the amended recovery criteria using the concepts described in the Species Status Assessment (SSA) framework (Service 2016), and framed the criteria in terms of the current threats to each species that are attributable to the Endangered Species Act's five listing factors. While a full SSA is beyond the scope of this recovery plan revision, the Service used the SSA framework to consider what the species need to maintain viability by characterizing the status of the species in terms of its resiliency, representation, and redundancy (Schaffer and Stein 2000, Wolf *et al.* 2015).

Resiliency

Resiliency describes the ability of populations to withstand stochastic events (arising from random factors). We can measure resiliency based on metrics of population health (*e.g.* population growth, numbers of individuals, demographic factors, etc.). Highly resilient populations are better able to withstand disturbances such as random fluctuations in reproductive rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

Representation

Representation describes the ability of a species to adapt to changing environmental conditions. Representation can be measured by the breadth of genetic or environmental diversity within and among populations and gauges the probability that a species is capable of adapting to environmental changes. The more representation, or diversity, a species has, the more capable it is to adapting to changes (natural or human-caused) in its environment. In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the species' geographical range.

Redundancy

Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations across the range of the species, as well as each population's resiliency, distribution, and connectivity, redundancy gauges the probability that the species has a margin of safety to withstand or the ability to bounce back from catastrophic events (such as a rare destructive natural event or episode involving many populations).

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list." Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 96 (D.D.C. 1995)) and a Government

Accountability Audit (U.S. GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five delisting factors.

Recovery Criteria

See previous version of criteria relating to El Dorado bedstraw and Pine Hill flannelbush in the original recovery plan, pages III-2 through III-37. [[Click here to view document](#)]

Synthesis

There have been no five-year reviews of El Dorado bedstraw (bedstraw) or Pine Hill flannelbush (flannelbush) since publication of the recovery plan in 2002, and there has been no change in understanding of the species biology. Though the California Natural Diversity Database (CNDDDB) notes several additional records of the species since 2002 (CNDDDB 2006), none are outside the known spatial distribution or change our knowledge about the general abundance of the species. There has also not been an appreciable change in our understanding of new or prior threats facing these species.

El Dorado bedstraw is a small perennial herb growing to 30 cm tall in the understory of oak woodlands. Pine Hill flannelbush is a perennial shrub that reaches 1.5 m in height and is found on rocky ridges of chaparral and chaparral/woodland transition areas. Both species are fire-adapted, resprouting after fire, and occur only on gabbro-derived soils of the Pine Hill formation, in western El Dorado County. At present, the multi-owner Pine Hill Preserve system is made up of the Salmon Falls/Martel Creek, Pine Hill, Penny Lane, and Cameron Park units, and is actively growing toward recommended acreage targets described in the recovery plan.

Conservation updates:

- In a 1997 study by Ayres and Ryan (Ayres and Ryan 1997) on *Wyethia reticulata*, a species with a similar life history, it was determined that long-lived clones like Pine Hill flannelbush maintain genetic diversity, regardless of endemism, small populations, and limited seed dispersal, likely thanks to the outcrossed breeding system, and large size and long life span of the plants. This study pre-dated the recovery plan, however it was not cited in that document. As we learn more about gabbro species ecology, it warrants consideration in light of investigation into these species' resiliency and representation.
- In 2006, Kelman *et al.* investigated the genetic relationships between Pine Hill flannelbush in El Dorado County; unidentified decumbent flannelbush in Yuba and Nevada Counties, and California flannelbush (*Fremontodendron californicum*) Fresno County (Kelman *et al.* 2006). Kelman *et al.*'s study found that taxonomic relationships of the Yuba County flannelbush population were not clearly distinguished but that their presence could represent a possible hybridization event between California flannelbush and Pine Hill flannelbush. The study recommended further research but suggested that the presence of unique alleles in the population indicates value in its conservation. Results of subsequent genetic work by a University of California, Davis researcher, to determine if Nevada and Yuba County flannelbushes are Pine Hill flannelbush, were inconclusive, therefore we continue under the assumption that these plants are not the listed entity.

- In 2007, a new bedstraw occurrence was discovered on Bureau of Land Management (BLM) lands in a new location at the Penny Lane unit of the Pine Hill Preserve. New occurrences were also documented during 2008 in Cameron Park, and in 2009 at Pine Hill (Hinshaw, pers. comm. 2018a).
- In 2007, an introduction of bedstraw was attempted at Cameron Park, with plants salvaged from a construction site, but plants did not survive. From 2012-2014, under a greenhouse setting, BLM attempted to grow out bedstraw for seed amplification and banking efforts. Although good germination rates were observed, seedlings failed to develop healthy root systems and the plants died before seed could develop and be collected (Hinshaw, pers. comm. 2018a).
- The BLM completed the Pine Hill Preserve Management Plan in 2008 which will guide management activities in support of rare plant conservation at the Pine Hill Preserve and surrounding areas.
- In 2012, BLM attempted to propagate flannelbush in a nursery setting in order to develop nursery stock with which to conduct outplantings. However, at that time, concern emerged among land managers and regulatory agencies about the dangers of acquiring and/or spreading the *Phytophthora* pathogen¹. Though rooting of flannelbush cuttings was successful, it could not be assured that soil containing future transplants was clean of pathogens so the young plants had to be sacrificed and the project was terminated (Hinshaw, pers. comm. 2018a).

Since the original recovery plan was published, there has been considerable work done toward completion of a Conservation Strategy for Gabbro Soil Species. This document, still in preparation, is being developed by a multi-party technical team comprised of representatives from the California Department of Fish and Wildlife, California Native Plant Society, El Dorado County, El Dorado Irrigation District, Science Applications International Corporation, BLM, U.S. Bureau of Reclamation, and the Service, under direction of a team comprised of management staff from the same organizations, as well as the American River Conservancy. The document is intended to provide a framework for the mitigation of impacts to the eight Gabbro soil rare plants and the planning of ongoing and future acquisition and restoration activities aimed at conservation of these species and their habitats.

Though the document has not been completed, conservation efforts have generally proceeded according to the draft strategies. In addition, County funds were used to conserve land in the Pine Hill Preserve system, though it is still short of the 5000 acre preserve size recommended in the recovery plan (**Table 1**). Additional land protections have also contributed substantially to meeting the overall acreage targets described in the recovery plan.

¹ *Phytophthora* species are introduced, soil-borne water molds, most closely related to diatoms and kelp, which can cause rapid mortality in native plants through root rot (Swiecki and Bernhardt 2003). *Phytophthora* is primarily spread to new areas through the movement of infested soil by water flow or by humans, particularly on vehicle tires, shoes, tools, and equipment that become contaminated with infested soils (Swiecki and Bernhardt 2003).

Table 1. Acreage preserved at Pine Hill formation to date, compared to that recommended in the 2002 recovery plan (Service 2002, Hinshaw pers. comm. 2018*b*).

Unit	FWS 2002 RP Recommendation (acres)	Currently protected area (acres)	Acreage needed to meet goal
Salmon Falls/Martel Creek	3,082	3,114	0
Pine Hill	975	404	571
Penny Lane	166	165	1
Cameron Park	718	540	178
<i>Galium</i> Preserve	60	-	60

As stated in the recovery plan, the central focus for recovery of these species is protection and management in perpetuity of extant bedstraw and flannelbush plants. Bedstraw and flannelbush are clonal species and spread mainly by underground stems. According to Ayres (D. Ayres, pers. comm. 2018 and Ayres and Ryan 1997), long-lived clones contain the genetic wealth of the species, genetic diversity is not maintained through regular sexual reproduction, and conservation of these species depends on preserving extant plants.

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the Act are no longer necessary and the El Dorado bedstraw and Pine Hill flannelbush may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists). Downlisting is the reclassification of a species from an endangered species to a threatened species. The term “endangered species” means any species (species, sub-species, or distinct population segment) which is in danger of extinction throughout all or a significant portion of its range. The term “threatened species” means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made “solely on the basis of the best scientific and commercial data available.” Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents.

Recovery criteria should help indicate when we would anticipate that an analysis of the species’ status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species. A decision to revise the status of or remove a species from the Federal Lists of Endangered and Threatened Wildlife and Plants, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan, which triggers rulemaking. When changing the

status of a species, we first propose the action in the *Federal Register* to seek public comment and peer review, followed by a final decision announced in the *Federal Register*.

Here we provide delisting criteria for the bedstraw and flannelbush, which will be added to the downlisting criteria described in the recovery plan, thereby making a complete set of recovery criteria.

Downlisting Recovery Criteria

All downlisting criteria are still relevant. **Table 2** shows existing downlisting criteria for bedstraw and flannelbush, all of which will remain unchanged.

Table 2. Existing Downlisting Criteria for El Dorado bedstraw and Pine Hill flannelbush from the Recovery Plan for Gabbro Soil Plants of the Central Sierra Nevada Foothills (To remain unchanged through this revision.)

Species	I. Secure and protect specified recovery areas from incompatible uses (See Table 1 for acreage of preserves)	II. Management Plans approved and implemented for recovery areas, including survival and recovery of the species as the objective	III. Monitoring in all recommended preserves shows:	IV. Other actions (See also Individual Considerations section III.B.3 in recovery plan)
El Dorado bedstraw	(k) Pine Hill preserve, Salmon Falls/Martel Creek preserve along with adjacent unoccupied habitat and 150 m (500 ft) buffer	For all populations and any occupied or unoccupied habitat identified as necessary for survival	(p) Stable or increasing with evidence of natural recruitment for a period of 60 yrs (or longer if suggested by the results of demographic monitoring)	(s) Ameliorate or eliminate threats (See Appendix H of recovery plan)
	(l) Cameron Park preserve north of Highway 50, along with adjacent unoccupied habitat and 150 m (500 ft) buffer		(q) Habitat monitoring of recommended preserves shows a mosaic of multi age class stands and habitat fragmentation has not appreciably increased (less than five percent) over current (2000) conditions.	(t) Ecological studies
	(m) Specialty <i>Galium</i> preserve and occupied habitat, along with adjacent unoccupied habitat and 150 m (500 ft) buffer		(r) Spatially and temporally, the establishment of occurrences must continue to be greater than the extirpation of occurrences.	(u) Seeds stored in at least two Center for Plant Conservation-certified facilities
				(v) Research on seed germination and propagation techniques
				(w) Effects of fire studied
				(x) Successful enhancement, repatriation, or introduction at Salmon Falls/Martel Creek
				(y) Maintain metapopulation dynamics of at least 1 large, 6 medium and 5 small occurrences at any given time throughout the range of the species. ²
Pine Hill	(i) Pine Hill preserve and	For all sites and any adjacent	(m) Stable or increasing over	(m) Ameliorate or eliminate threats

² Size of El Dorado bedstraw occurrence is related to size of parcel per the recovery plan as such: small = <10 ac, medium = 10-85 ac, large = >85 ac.

flannelbush	occupied habitat along with sufficient unoccupied habitat for fire management and a 150 m (500 ft) buffer at 8 known sites.	occupied or unoccupied habitat identified as necessary for continued survival.	60 yrs (two fire cycles or longer if suggested by results of demographic monitoring).	(See Appendix H in recovery plan)
	(j) The decumbent <i>Fremontodendron</i> within Nevada and Yuba Counties should be secured and protected unless determined not to be the listed <i>Fremontodendron</i> .		(n) Habitat monitoring of recommended preserves shows a mosaic of multi age class stands and habitat fragmentation has not appreciably increased (less than 5 percent) within any preserves over current 92000) conditions.	(n) Fire management studies
			(o) Spatially and temporally, the establishment of occurrences must continue to be greater than the extirpation of occurrences.	(o) Seeds stored in at least two Center for Plant Conservation-certified facilities
				(p) Research on seed germination and propagation techniques
				(q) Successful introduction onto Salmon Falls/Martel Creek preserve
				(r) Maintain metapopulation dynamics of at least 1 very large, 3 medium, and 4 small occurrences on the Pine Hill formation. ³

³ Size of Pine Hill flannelbush occurrence is related to size of parcel per the recovery plan as such: small = <10 ac, medium = 10-100 ac, large = 100-320 ac, very large = >320 ac.

Delisting Recovery Criteria

The criteria for delisting El Dorado bedstraw and Pine Hill flannelbush include meeting the requirements of downlisting criteria, with the following additions and/or refinements, organized by the five delisting factors.

The term *occurrence* was used in the downlisting criteria to refer to a grouping of plants in a particular location, mainly based on CNDDDB data. Hereafter, we use a single term, *population*, to refer to any grouping of plants which is separated from the next grouping by at least 0.25 mi (0.4 km) for both bedstraw and flannelbush⁴. While maximum distance for genetic exchange is not known for either species, for these relatively short dispersal distance plant species, 0.25 mi is a reasonable distance beyond which genetic exchange does not typically occur. In regards to delisting criteria, *population* shall be synonymous with occurrence, location, etc., even though future genetic work may reveal it does not genetically fit the definition of a population.

Factor A: Present or Threatened Destruction, Modification, or Curtailment of the Species Habitat or Range

Habitat destruction and fragmentation through residential and commercial development were listed as the primary threats to bedstraw and flannelbush in the listing rule. The minimum acreage goals for each preserve unit, described in the *downlisting* criteria and **Table I** above, must be reached for delisting. Increasing the minimum acreage preserve size for these species will not contribute to any greater resiliency, representation or redundancy for these species, therefore the acreage targets do not increase beyond downlisting thresholds under these delisting criteria.

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The overutilization of El Dorado bedstraw or Pine Hill flannelbush for commercial, recreational, scientific, or educational purposes is not believed to be a major threat to the species at this time. Thus, no recovery criteria have been developed for this factor.

Factor C: Disease or Predation

Bedstraw:

In the listing rule, overgrazing by horses was listed as a predation-related threat faced by bedstraw. However, if all other threats to bedstraw (Factors A and E) are reduced or ameliorated, bedstraw populations should be able to tolerate this predation.

Flannelbush:

Wilt disease was listed as a *potential* threat to flannelbush in the listing rule, however it has not been observed in wild plants.

Insect and rodent predation were listed as threats to flannelbush in the listing rule. Pre-dispersal insect predation and post-dispersal rodent predation appear to be natural parts of the system and can normally be withstood by a healthy population. However, due to flannelbush's already

⁴ Using the current CNDDDB records and seed dispersal characteristics, we determined that, for each species, populations should be considered separate if they are 0.25 mile away from each other.

reduced range and number of plants, herbivory by insects and rodents currently negatively affects flannelbush populations by preventing them from increasing in size.

- C/1** For the 8 years following achievement of populations targets for Pine Hill flannelbush (described below under Factor E), herbivory by insects and rodents must not occur in two consecutive years at levels which cause a population decline at any of the sites contributing to recovery.

Factor D: Inadequacy of Existing Regulatory Mechanisms

The inadequacy of existing regulatory mechanisms is not believed to be a major threat to El Dorado bedstraw or Pine Hill flannelbush. Thus, no recovery criteria have been developed for this factor.

Factor E: Other Natural or Manmade Factors Affecting It's Continued Existence

E/1 Number of populations with specific geographic distribution

Multiple populations of bedstraw and flannelbush at a number of occupied preserve units should provide the species the necessary *redundancy* to allow for refugia from catastrophic events and to withstand localized loss of habitat. This redundancy is sufficiently met with the number of populations required for downlisting, so we have not increased the number of populations for delisting.

However, for delisting, we have added the following specifications:

- The 12 bedstraw populations must persist in at least four different preserve units.
- The 8 flannelbush populations must persist in at least two different preserve units.
- Populations of each species must persist at the size described in E/2, for at least two full fire cycles⁵.

At some existing preserve units, suitable unoccupied habitat in which to conduct reintroductions may not be available. For both bedstraw and flannelbush, otherwise qualifying populations lying outside of identified preserves may contribute to delisting targets, as long as the habitat is protected and managed for the species in perpetuity.

E/2 Number of plants⁶ per population

Populations of bedstraw and flannelbush need to be of adequate size to provide the species the necessary *resiliency* to withstand stochastic events.

⁵ Typical fire cycles in this area are 30-50 years (Ayres, pers. comm. 2018).

⁶ Both El Dorado bedstraw and Pine Hill flannelbush are clonal species, meaning they spread by virtue of underground stems, so population estimates, which count stems, could indicate genetic individuals or only parts of a clone. It is important to note that the numbers above refer to above ground plant parts, whether genetic individuals or parts of a clone. If, in the future, we determine it is important for these species to maintain a specific number of genetic individuals, recovery criteria may be revised, however at this point in time, we do not know if that is the case for these clonal species

Of the 12 populations of bedstraw and 8 populations of flannelbush required for down and delisting, small, medium, large, and very large populations must contain the number of plants described below⁷:

Bedstraw

Size of each population (per Table 2)	Minimum # of mature* plants each
Small (at least five populations)	1,750
Medium (at least six populations)	8,400
Large (at least one populations)	14,875
Total # of plants	74,025

Flannelbush

Size of each population (per Table 2)	Minimum # of mature plants each
Small (at least four populations)	15
Medium (at least three populations)	83
Very Large (at least one population)	480
Total # of plants	789

* plant that has reached reproductive maturity, as evidenced by development of flowers.

Rationale for Recovery Criteria

We have amended the recovery criteria for bedstraw and flannelbush to include delisting criteria that incorporate the biodiversity principles of representation, resiliency, and redundancy (Schaffer and Stein 2000) and threats addressed under the five factors. The amended criteria were developed based on the Service’s current understanding of the species’ needs and requirements. This understanding includes information gathered since the original recovery plan was published, such as more recent information about population status and trends, along with an updated understanding of the threats acting on the species. The criteria presented are based on the reduction of threats to the species, and they include a temporal aspect to ensure that the species are resilient to expected variation within a reasonable time frame.

Often, to describe what is necessary to delist a species, it is useful to have completed a population viability analysis (PVA). Using long term monitoring data, a PVA can predict population thresholds necessary to attain a reasonable level of certainty that the species will persist a specified time into the future (thereby not being in imminent threat of becoming endangered in the foreseeable future). Because a PVA has not been conducted for either of these species, we are left to use the best available scientific information to guide our development of recovery criteria for these species. With

⁷ The number of plants per population was calculated by first determining the density at a persistent population for each species. We used the highest density of a three year period (2007-2009) for which there was consistent monitoring conducted by BLM (BLM 2010). For bedstraw this was 175 plants/ac and for flannelbush was 1.5 plants/ac (as averaged across sites in most dense year.) Next, we multiplied this by the acreages recommended for each of the population size classes described in downlisting criteria (See footnote for Table 2; upper threshold of the acreage range for small populations, median threshold for medium populations and lower threshold for large populations of bedstraw and very large populations of flannelbush). Multiplying the density by the acreage, we arrived, for bedstraw, at (175 plants/ac)(10 ac)= 1,750 plants/small population, (175 plants/ac)(48 ac)=8,400 plants/medium population, (175 plants/ac)(85 ac)=14,875 plants/large population. For flannelbush we arrived at (1.5 plants/ac)(10 ac)= 15 plants/small population, (1.5 plants/ac)(55 ac)= 83 plants/medium population, (1.5 plants/ac)(320 ac)= 480 plants/very large population.

additional information from species experts, we have arrived at the above criteria with the below justifications.

E/1 Number of populations with specific geographic distribution

Redundancy and Representation

Bedstraw and flannelbush need to have multiple resilient populations distributed throughout their range to provide for *redundancy*. Species that are well-distributed across their historic range are less susceptible to extinction and more likely to be viable than species confined to a small portion of their range should an event like wildfire, floods, or landslides move through the species range (Redford *et al.* 2011).

Twelve populations of bedstraw distributed over at least four preserve units should provide this redundancy because it spreads the species over four geographic locations and multiple sub-watersheds within the occupied historic range. Eight populations of flannelbush distributed over at least two preserve units should provide this redundancy because it spreads the species over two geographic locations and multiple sub-watersheds within the occupied historic range. By requiring observation at multiple preserve units, we ensure the opportunity for the species' to exploit various ecological niches, increasing environmental representation.

It is likely that bedstraw and flannelbush have evolved with fire and require an appropriate fire regime to germinate, successfully establish, and/or reproduce (Ayres 1977, Boyd 1985). The historical fire regime, which was favorable to the rare plants, has been altered by fire suppression and subsequent fuel buildup or, conversely, by frequent fires that do not allow for recovery of the native vegetation. Most of the rare plants at the Preserve benefit from some kind of disturbance, such as removal of shrubs that compete with the rare plants for space, sunlight, and soil nutrients. For some species, fire also plays a role in periodically promoting seed germination of rare plants.

We specified that the population levels must be maintained through two fire cycles to ensure resilience of the individual populations and to evaluate whether the species has sufficient redundancy to withstand catastrophic events. Though we don't know exactly what the natural fire return interval is for the area, we suspect it is within the range of 30-50 years (Ayres pers. comm. 2018).

E/2) Number of plants per population

Resiliency

For bedstraw and flannelbush to maintain viability, their populations or some portion of their populations must be *resilient*. A number of factors indicate resiliency, including survival, reproduction, dispersal, and abundance. To be resilient, bedstraw and flannelbush plants need to maintain a high survival rate, to resprout after disturbance such as fire, and on occasion to expand the edges of the population into adjacent suitable habitat. Flannelbush in particular may also need fire for occasional seed germination.

As described in the footnote above, we determined that if populations described under **E/1** above are present within the preserve land units described in the recovery plan at a healthy

density, then the resulting number of plants per population should indicate populations sufficiently resilient to withstand future stochastic events.

Resilient populations occupy habitats of sufficient size to sustain reproducing populations. A central component to conservation of bedstraw and flannelbush is the completion of the preserve system including full attainment of the acreage targets described in the downlisting criteria and in **Table 1** above. The preservation of extant plants and management of this habitat for these species at the acreages specified will support resilient populations at the sizes described above.

ADDITIONAL SITE SPECIFIC RECOVERY ACTIONS AND THEIR PRIORITIES

The actions identified below are those that, based on the best available science, and together with existing actions listed in the recovery plan, are necessary to bring about the recovery of bedstraw and flannelbush. However, these actions are subject to modification as might be indicated by new findings, changes in species status, and the completion of other recovery actions. Each action has been assigned a priority for implementation, according to our determination of what is most important for the recovery of these species based on the life history, ecology, and threats.

Priority numbers are defined per Service policy (Service 1983) as:

Priority 1: An action that must be taken to prevent extinction or to prevent a species from declining irreversibly.

Priority 2: An action that must be taken to prevent a significant decline of the species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species.

The following site-specific recovery actions are recommended in order to attain described delisting criteria.

- 1) Conduct controlled burns at all appropriate preserve units to maintain multiple populations of bedstraw and flannelbush within a shifting mosaic of woodland and chaparral that contains early, middle and late seral vegetation stages. **Priority 1**
- 2) Conduct outreach to private landowners residing adjacent to existing preserves and/or other private landowners within suitable habitat of these species to provide education on avoiding degradation of habitat and to encourage the voluntary sale of conservation easements by willing landowners. **Priority 1**
- 3) Conduct genetic analyses to determine extent of clonality and population structure in order to define individuals of bedstraw and flannelbush. **Priority 2**
- 4) Conduct population viability analyses for bedstraw and flannelbush. **Priority 2**
- 5) Conduct research into the regeneration ecology of bedstraw and flannelbush. **Priority 2**

- 6) Conduct research to determine effective means of mechanical and other non-fire related control of chaparral to benefit gabbro soil species. **Priority 2**
- 7) Protect habitat through acquisition of fee title or purchase of conservation easement at the Nevada and Yuba County populations of flannelbush, if they are determined through future research to be the listed flannelbush. **Priority 2**
- 8) Conduct outplantings of bedstraw and flannelbush, specifically at the Salmon Falls/Martel Creek unit where substantial suitable habitat exists. **Priority 2**
- 9) Develop a monitoring plan to span 5 years post-delisting of bedstraw and flannelbush and implement the plan at the time of delisting to measure the continuing effectiveness of management actions to conserve the species. **Priority 3**

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Personal Communications

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Hinshaw, Graciela. 2018*a*. Meeting between Graciela Hinshaw (BLM) and Valary Bloom on Jul 10, 2018 regarding acreage of habitat protected to date in each Pine Hill preserve unit

Hinshaw, Graciela. 2018*b*. Electronic mail from Graciela Hinshaw (BLM) to Valary Bloom on Aug 15, 2018 regarding acreage of habitat protected to date in each Pine Hill preserve unit.