U.S. Fish & Wildlife Service

Draft Recovery Plan for Baker's Larkspur (*Delphinium bakeri*)

Photo credit: Kate Symonds, U.S. Fish and Wildlife Service

Draft Recovery Plan for Baker's Larkspur (*Delphinium bakeri*)

December 2014

Region 8
U.S. Fish and Wildlife Service
Sacramento, California

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Regional Director, Pacific Southwest Region, Region 8,
U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXX

Disclaimer

Recovery plans delineate such reasonable actions as may be necessary, based upon the best scientific and commercial data available, for the conservation and survival of listed species. We, the U.S. Fish and Wildlife Service (Service), publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and others. Recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in the plan formulation, other than the Service. They represent the Service's official position ***only*** after they have been signed by the Regional Director as ***approved***. Recovery plans are guidance and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

Literature Citation should read as follows:

U.S. Fish and Wildlife Service. 2014. Draft Recovery Plan for Baker's Larkspur (*Delphinium bakeri*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. vi + 40 pp.

An electronic copy of this draft recovery plan is available at the following internet locations:
http://www.fws.gov/endangered/species/recovery-plans.html

Acknowledgements

The recovery planning process has benefitted from the collaboration, advice, and assistance of several other individuals. We thank the following individuals for their assistance and apologize to anyone whose name was omitted inadvertently from this list:

Courtney Angelo — University of Hawaii, Ph.D candidate
Brian Cordone — Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service
Lisa Ellis— Pacific Southwest Region, U.S. Fish and Wildlife Service
Josh Hull — Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service
Barbara Keller — University of California Botanical Garden at Berkeley
Kirsten Tarp — Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service
Elizabeth Warne — Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service

Draft Recovery Plan Preparation and Request for Information

This *Draft Recovery Plan for Baker's Larkspur* (*Delphinium bakeri*) is intended to be both detailed and current in its presentation of scientific knowledge. However, we recognize the challenge of maintaining an up-to-date document in the face of rapidly changing science. Therefore, we welcome public review of this draft as an opportunity to gather both new information and feedback on the durability of the science presented.

Several individuals have contributed to the authorship of the *Draft Recovery Plan for Baker's Larkspur* (*Delphinium bakeri*). The individuals primarily responsible for writing this draft recovery plan are listed below.

Lead author:	Valary Bloom (Biologist, Sacramento Fish and Wildlife Office)
Contributing authors:	Kate Symonds (Biologist, Sacramento Fish and Wildlife Office) Holly Forbes (Curator, University of California Botanical Garden at Berkeley)

EXECUTIVE SUMMARY

Current Species Status

Baker's larkspur, a perennial herb of shaded woodlands in Marin and Sonoma counties, California, was determined to be an endangered species under the Endangered Species Act, as amended, (Act) throughout its entire range on January 26, 2000 (65 FR 4156), and critical habitat was designated for the species on March 18, 2003 (68 FR 12834). The species was listed by the State of California as endangered in April 2007 (California Department of Fish and Wildlife (CDFW) 2013). Baker's larkspur is currently known from one small historical occurrence along Marshall-Petaluma Road in west Marin County, California, which grows on a steep roadside embankment and is subjected to road maintenance work and stochastic events. Also, the species has been reintroduced to three locations within the historical range in Marin County, with varying establishment success.

Habitat Requirements and Threats

The remaining historical occurrence of Baker's larkspur occurs on decomposed shale in the mixed woodland plant communities of Marin County, California, at an elevation range of 295 feet (ft) (90 meter (m)) to 672 ft (205 m) in moderately moist, shaded conditions on a shallow veneer of soil along an extensive north-facing slope. These habitat requirements limit the availability of suitable reintroduction sites with appropriate habitat conditions and compatible land use.

Though habitat conversion and road maintenance was historically responsible for decreasing numbers, those threats have been curtailed. Because of the extreme range restriction of this already narrow endemic, and its small population size, the plant is highly vulnerable to extinction from random events, including, wildfire, herbivory, disease and pest outbreaks, and human disturbance.

Recovery Priority Number

The Recovery Priority Number for Baker's larkspur is 5, indicating the species faces a high degree of threat and has a low potential for recovery.

Recovery Strategy

Establishing and maintaining well-distributed populations throughout the geographic range of the species is necessary for the long-term recovery of Baker's larkspur. Our recovery strategy will focus on increasing the number of populations by reintroducing a sufficient number of populations to ensure they can withstand catastrophic events. We will also focus on ensuring each of the populations is large enough to withstand stochastic events through continued supplementation and management of reintroduced populations

Recovery Goals and Objectives

We have determined that at this time, the development of delisting criteria is not possible for Baker's larkspur given the current lack of information about the species' biology and habitat requirements, the magnitude of current threats, and the precarious environment where the single historical population of the species occurs. As a result, this recovery plan addresses an interim goal

of improving the status of Baker's larkspur to the point that it may be downlisted from endangered to threatened status. The objectives of the plan are:

1. Expand the existing populations of Baker's larkspur and establish additional self-sustaining populations of Baker's larkspur throughout its known ecological and geographical range, while preserving extant genetic diversity.
2. Ensure existing and future populations are protected from incompatible uses, such as road maintenance.
3. Reduce herbivory by slugs, snails and gophers to the point that it does not affect the species at a population level.

Recovery Criteria

Downlisting criteria comprise a combination of numerical demographic targets and measures that must be met to ameliorate or eliminate threats to species:

A.1 Each reintroduced site will be managed for the species and in conservation ownership (owned in fee title), protected by a conservation easement, or protected by a formal Memorandum of Understanding with the landowner. Lands containing each population must be protected with a buffer of compatible land use.

A.2 Outreach and education to the Marin County road maintenance crews and fire crews will ensure that the Marshall-Petaluma Road Historical Occurrence will no longer be affected by road or fire maintenance activities.

C.1 For the 8 years following achievement of population targets (described below under Factor E), herbivory by slugs, snails and gophers must not occur in 2 consecutive years at levels which cause a population decline at any of the sites that count toward recovery.

E.1 For 5 consecutive years, a total of 12 self-sustaining populations of Baker's larkspur must be distributed across its historical range.

E.2 A minimum of 1,000 flowering individuals must be present at each of the 12 populations annually, for 5 consecutive years, and must include at least 2 lower-than-average water years.

E. 3 Each site must produce at least four seedling cohorts within 10 consecutive years that contribute enough surviving individuals to cause a net population increase at the site.

Actions Needed

The actions needed to be able to downlist Baker's larkspur fall into these general categories:

1. Continue monitoring of populations and threats at each site.
2. Reintroduce Baker's larkspur to additional sites in appropriate habitat within its historical range and conduct seed collection/banking and plant propagation.
3. Manage threats to species survival at each site.
4. Conduct research into Baker's larkspur genetics, population viability, and planting techniques.
5. Continue outreach to potential landowner partners and education in regards to protection of the Baker's larkspur population.

Estimated Date and Cost of Downlisting

Date: 2044

Priority 1 actions: $1,102,850 Priority 2 actions: $123,790 Priority 3 actions: $87,000

Total Cost: $1,313,640, plus additional costs which could not be estimated at this time

Table of Contents

Disclaimer i
Acknowledgements ii
EXECUTIVE SUMMARY iii
List of Tables vi
List of Figures vi
I. BACKGROUND I-1
A. Brief Overview I-1
B. Species Description and Taxonomy I-1
C. Distribution and Habitat I-1
D. Critical Habitat I-4
E. Life History I-4
F. Abundance and Trends I-4
G. Reasons for Listing and Current Threats I-8
Factor A*: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range* I-8
Factor B*: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes* I-9
Factor C*: Disease or Predation* I-9
Factor D*: Inadequacy of Existing Regulatory Mechanisms* I-10
Factor E*: Other Natural or Manmade Factors Affecting Its Continued Existence* I-11
H. Conservation Efforts I-13
II. RECOVERY PROGRAM II-1
A. Recovery Strategy II-1
B. Recovery Goal II-1
C. Recovery Objectives II-1
D. Recovery Criteria II-2
Downlisting Criteria II-2
Delisting Criteria II-4
III. RECOVERY ACTION NARRATIVE AND IMPLEMENTATION SCHEDULE III-1
A. Recovery Action Narrative III-1
B. Implementation Schedule III-7
IV. LITERATURE CITED IV-1

List of Tables

Table 1. Survey Data for the Marshall-Petaluma Road Historical Population of Baker's Larkspur (last remaining historical occurrence).....I-5

List of Figures

Figure 1. Photo of steep terrain at Marshall-Petaluma Road Historical occurrence of Baker's larkspur.....I-2

Figure 2. Historical and Current Distribution of Baker's larkspur (Note: Size of circle is not indicative of size of population of Baker's larkspur.).....I-3

Figure 3. Transplants Ready for Reintroduction at the Marshall-Petaluma Road Private Ranch.....I-6

Figure 4. Reintroduction at the Marshall-Petaluma Road Private Ranch.....I-6

Figure 5. Baker's larkspur in cultivation at U.C. Botanical Garden, Berkeley. I-15

Figure 6. Baker's Larkspur Seed Collection at U.C. Botanical Garden, Berkeley.....I-15

I. BACKGROUND

A. Brief Overview

Baker's larkspur (*Delphinium bakeri*) is a perennial herb of Marin and Sonoma County woodlands, and is currently known from only one small historical occurrence along Marshall-Petaluma Road and three reintroduced[1] populations at seven microsites in west Marin County, California. Baker's larkspur was determined to be an endangered species under the Endangered Species Act as amended (Act) throughout its entire range on January 26, 2000 (65 FR 4156) and added to the Federal List of Endangered and Threatened Plants (50 CFR § 17.12). The species was listed by the State of California as endangered in April 2007 (California Department of Fish and Wildlife (CDFW) 2013, p. 7) and critical habitat was designated for the species on March 18, 2003 (68 FR 12834).

B. Species Description and Taxonomy

Baker's larkspur is a perennial dry season-dormant herb in the buttercup family (Ranunculaceae). It grows from a thickened, tuber-like, fleshy cluster of roots, to a height of 26 inches (in) (65 centimeters (cm)). The leaves are five-lobed, occur primarily along the upper third of the stem, and are green at the time of flowering. Another distinctive feature of the leaves is that they have a whitish area in the center. The flowers are irregularly shaped. The five sepals (outermost whorl or set of floral parts) are conspicuous, bright dark blue or purplish, with the rear sepal elongated into a spur. The inconspicuous petals occur in two pairs. The lower pair is blue-purple; the upper pair is white. Seeds are produced in several dry, many-seeded fruits, called follicles, which split open at maturity on one side. Baker's larkspur can be differentiated from other members of the genus by leaf margins that are notched or scalloped so as to form rounded teeth. The leaves do not wither at time of flowering and the flowers are loosely arranged. The species is also noted in taxonomic keys for the ease in which the main stem separates from its roots. Baker's larkspur is recognized as a valid species in several floras including *The Flora of North America North of Mexico* (Flora 1993); *An Illustrated Flora of the Pacific Northwest* (Abrams 1944); *A California Flora* (Munz and Keck 1973); *Marin Flora* (Howell *et. al.* 2007); *The Jepson Manual* (Baldwin 2012); and *A Flora of Sonoma County* (Best *et. al.* 1996).

C. Distribution and Habitat

Baker's larkspur is a narrow-ranged endemic species never known to be widespread and considered rare when it was first described in the late 1930s (Ewan 1942). Historically, Baker's larkspur has only been known from three locations, one in Sonoma County and two in Marin County (CNDDB 2008), California, at an elevation range of 295 ft (90 m) to 672 ft (205 m). By the time of listing in 2000, the type locality (location at which the specimen was first found) in the Coleman Valley west of Occidental in Sonoma County had been converted to a dairy ranch (CNDDB Occurrence 4). Ewan (1942) provided information about that site as "along fence rows and in heavy low brush." Two species growing with Baker's larkspur at the type locality were *Horkelia californica* ssp. *dissita* (California honeydew) and *Ranunculus orthorynchus* (straightbeak buttercup). A second reported occurrence, in Tomales, Marin County, is known from a 1923 herbarium collection (CNDDB Occurrence 3), and by the time of listing was believed to be extirpated as well. No habitat information was reported for the now extirpated Tomales occurrence (CNDDB 2008). The third

[1] "Reintroduced" here, as opposed to "introduced", means introduced within Baker's larkspur's historical range, though not necessarily at a previously occupied location.

occurrence is along a steep roadside embankment on Marshall-Petaluma Road on the Marin County road right-of-way (CNDDB Occurrence 1) and currently represents the only known extant historical occurrence of the species. This last remaining historical occurrence is located in moderately moist, shaded conditions on a shallow veneer of soil comprised of decomposed shale along an extensive north-facing slope (Figure 1). Plant associates are listed below under the **Critical Habitat** section. To distinguish from the reintroduced populations discussed below, this occurrence will hereafter be referred to as the Marshall-Petaluma Road Historical occurrence, as opposed to a reintroduced population.

The site of the Marshall-Petaluma Road Historical occurrence burned in 2004. The fire resulted in changes in the vegetation and microclimate conditions, including destroying the *Umbellularia californica* (California bay laurel) canopy of the site. The site is now less shady with the loss of the canopy from the fire. Overall, the site has changed from being generally moist and shady to generally drier and sunnier (H. Forbes, UCBG, pers. comm., 2008). Increased sunlight has encouraged the growth of invasive vegetation such as *Conium maculatum* (poison hemlock) and *Genista monspessulana* (French broom), which are now more common on the slope. Prior to the fire, poison hemlock was only observed in the roadside ditch. Native *Rubus ursinus* (California blackberry) appears denser and has the potential to encroach into the Baker's larkspur habitat.

Figure 1. Photo of steep terrain at Marshall-Petaluma Road Historical occurrence of Baker's larkspur.
Photo credit: Harry McQuillen, former U.S. Fish and Wildlife Service

Besides this single remaining historical occurrence, the species is known from three other locations. Since March 2009, staff from the U.C. Botanical Garden at Berkeley (UCBG), in coordination with the U.S. Fish and Wildlife Service (Service), has reintroduced Baker's larkspur to three general locations within its historical range in Marin County (hereafter referred to as *reintroduced populations*): two are on private ranches, and the third is on Marin Municipal Water District (MMWD) land near Soulajule Reservoir. One of the private ranches and the Soulajule Reservoir location each include three separate locations on the property (hereafter referred to as *microsites*). All three reintroduced populations (comprised of the seven microsites) are found within 3 miles (4.8 km) of the historical remaining occurrence in Marin County (Figure 2).

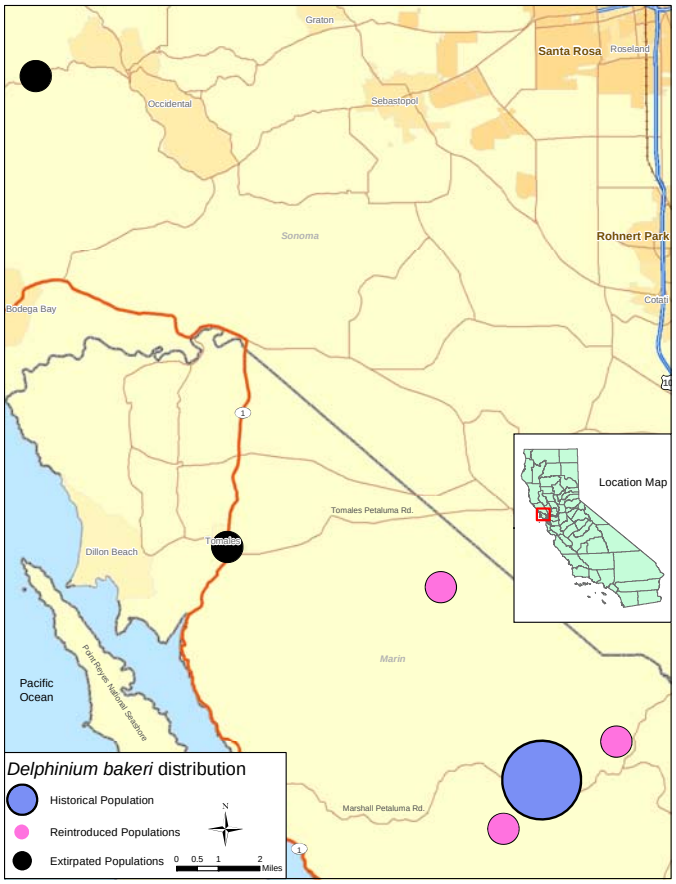

Figure 2. Historical and Current Distribution of Baker's larkspur (Note: Size of circle is not indicative of size of population of Baker's larkspur.)

All seven reintroduction microsites are located in areas very similar in habitat characteristics as the site of the Marshall-Petaluma Road Historical occurrence and include habitat consisting of steep, rocky, slopes with a thin veneer of decomposed shale (Service, *in litt*., 2008). The three reintroduction microsites at Soulajule Reservoir are on densely wooded generally north-facing slopes along the southern shore of the reservoir, approximately 1.5 air mi (2.4 km) south of the Marshall-Petaluma Road Historical occurrence. Above the slope at Soulajule Reservoir there exists a diverse native understory of ferns and other shade tolerant plants under a canopy of California bay, coast live oak, and California buckeye, which is largely free of invasive vegetation.

Lands supporting all three of the reintroduced populations are protected from development; the private ranches via a Marin Agricultural Land Trust easement that prohibits significant development, and the Soulajule Reservoir site via MMWD watershed protection. The Service entered into a Cooperative Agreement with MMWD before reintroduction of Baker's larkspur began, in which MMWD agreed not to impact populations. Also, the Service worked with MMWD to identify lands that were deemed not necessary for operations into the foreseeable future. The status of each of the reintroduced microsites is detailed below under Abundance and Trends.

D. Critical Habitat

On March 18, 2003, we published a final rule designating critical habitat for Baker's larkspur , that included two units totaling approximately 1,828 acres (ac) (740 hectares (ha)) in Marin and Sonoma Counties, California (68 FR 12843). In that document, and based on observation of the Marshall-Petaluma Road Historical occurrence, the primary constituent elements for Baker's larkspur were determined to consist of: (1) soils that are derived from decomposed shale; (2) plant communities that support associated species, including, but not limited to: *Umbellularia californica* (California bay laurel), *Aesculus californica* (California buckeye), *Quercus agrifolia* (coast live oak), *Baccharis pilularis* ssp. *consanguinea* (coyotebrush), *Symphorcarpos* cf. *rivularis* (snowberry), *Rubus ursinus* (California blackberry), *Pteridium aquilinum* (bracken fern), *Polystichum munitum* (sword fern), *Pentogramma triangularis* (goldback fern), *Dryopteris arguta* (coastal woodfern), *Adiantum jordanii* (maidenhair fern), *Polypodium glycyrrhiza* (licorice fern), *Toxicodendron diversilobum* (poison oak), *Ceanothus thyrsiflorus* (blueblossom ceanothus), *Lithophragma affine* (woodland star), and *Holodiscus discolor* (oceanspray) (though not identified during our critical habitat process, the species also co-occurs with *Heuchera micrantha* (alum root) and *Trillium chloropetalum* (wake robin)); and (3) mesic (moderate moisture) conditions on extensive north-facing slopes (68 FR 12843; March 18, 2003).

E. Life History

Baker's larkspur grows from a thickened, tuber-like, fleshy cluster of roots. All above ground vegetation dies back during the early summer such that only the fleshy cluster of roots remains present, until sufficient winter rains enable the stems to emerge again. For purposes of this plan, the first year's growth, having germinated from seed, will be referred to as a seedling. The growth arising from the prior year's germination will be referred to as a yearling. All reintroductions are done using plants that are at least 3 years old. Where not specifically referred to as seedlings or yearlings, all mention of "plants" or "adults" refers to plants at least 3 years of age.

Baker's larkspur flowers from April into May. Known pollinators that have been observed visiting flowers of the reintroduced plants on several occasions include bumblebees (Family Apidae) and hummingbirds. Baker's larkspur is self-compatible, but requires visitation by pollinators for good quality and abundant seed set (Center for Plant Conservation 2008). The approximate foraging distance from their nest of most bumblebees is approximately 1 mi (1.6 km) (Mader *et. al.* 2011),

F. Abundance and Trends

<u>Marshall-Petaluma Road Historical occurrence</u>

The Marshall-Petaluma Road Historical occurrence of Baker's larkspur has been regularly monitored by staff of the UCBG (with assistance in some years by the Marin CNPS and Service) since spring 2001, which at that time was comprised of 55 flowering individuals. The population fluctuated between 60 and 100 individual plants from 2001 to 2003 (Koontz and Forbes 2003); however, numbers steadily decreased after severe damage to the site by road maintenance crews in 2002 and 2004, and a wildfire in 2004. In spring of 2005, only nine plants appeared, and of these only two flowered, and only one set seeds. In spring of 2006, seven plants appeared. Of the two plants that flowered, all but one flower aborted (did not survive to develop viable seed) from one stem and the other stem was broken at its base before the inflorescence had fully expanded (H. Forbes, pers. comm., 2008). Plant numbers increased slightly the following year (2007); however, flowering individuals since 2007 have consistently numbered between only two and four plants (H. Forbes, pers. comm., 2008). In 2013, 11 plants were found, 4 of which flowered, but only 3 set seeds (one

flowering stem was found broken off). In summary, abundance at the Marshall-Petaluma Road Historical occurrence has been extremely low, but fairly stable over recent years (Table 1).

Table 1. Survey Data for the Marshall-Petaluma Road Historical Population of Baker's Larkspur (last remaining historical occurrence).

Year	# Individuals	# Flowering Individuals	# seeds present (# seeds collected)
2001	64	27	9,780 (301 collected)
2002	85	23	N/A (none collected)
2003	95	38	28,860 (477 collected)
2004	51	33	7,500 (342 collected)
2005	9	2	720 (88 collected)
2006	7	2	N/A (none collected)
2007	11	2	N/A (395 collected)
2008	10	2	few (none collected)
2009	16	2	N/A (none collected)
2010	11	3	264 (all collected)
2011	10	4	1,329 (all collected)
2012	11	4	Low seed production (not quantified; no seeds collected)
2013	11	4	722 (all collected)

Data provided by Holly Forbes, UCBG

Reintroduction Sites:

Seeds from wild plants were collected and banked between 2001 and 2006. Propagation efforts were begun in 2006 by the UCBG to help reduce the risk of extinction and grow plants for reintroduction to sites within Baker's larkspur's historical range. Three general locations within the historical range in Marin County (hereafter referred to as *reintroduced populations;* Marshall-Petaluma Road Private Ranch, Chileno Valley Road Private Ranch, and Soulajule Reservoir*)* were identified for outplanting:

A. *Marshall-Petaluma Road Private Ranch site* (Figure 3 and 4):
In March 2009, 11 plants were out-planted in this single planting microsite of approximately 150 square feet on a gentle slope above a vertical road bank.

Microsite 1: This site has medium plant diversity, high density vegetation, and is very shaded. In early 2011, a large oak tree fell on the site and sawdust from its removal may have eliminated any germination and/or growth from 2010 seed. Of the five adult plants that emerged in spring 2011, three of them flowered, however seeds did not reach maturity, as the fruiting stems were destroyed, most likely from gopher (*Thomomys* spp.) activity (H. Forbes, pers. comm., 2011*a*). In 2012, only one adult plant emerged and no seedlings were observed at the site. However, in February 2012 seven additional plants were out-planted to join the sole survivor from the March 2009 planting, and though seed set was not quantified, all plants later flowered well and set seed. Also, copper sheet metal fencing was installed in 2012 around all but one plant, in an effort to control slug predation. In 2013, three adult plants emerged as well as one yearling and 42 seedlings. Of the adult plants, all three flowered and produced seeds (71 capsules, for a potential seed count of 4,260). Also, in March 2013, it was observed that copper sheet metal fencing was

encouraging accumulation of plant debris. Because large quantities of debris could smother new seedlings, the decision was made to discontinue the practice.

Figure 3. Transplants Ready for Reintroduction at the Marshall-Petaluma Road Private Ranch.
Photo credit: Valary Bloom, U.S. Fish and Wildlife Service

Figure 4. Reintroduction at the Marshall-Petaluma Road Private Ranch.
Photo credit: Valary Bloom, U.S. Fish and Wildlife Service

B. *Chileno Valley Road Private Ranch site*:
Between December 2009 and January 2011, a total of 75 plants were out-planted at three microsites on the Chileno Valley Road Private Ranch site.

Microsite 1: On this medium sloping microsite with bright shade, medium plant diversity, and medium plant density, 15 plants were out-planted in December 2009. Ten additional plants were out-planted in January 2011. As of March 2011, only 5 of the 25 plants remained with above ground growth, due to herbivory by banana slugs (*Ariolimax* spp.) and possibly other herbivores. No flowers/seeds were produced in 2011. In 2012, one seedling was observed, but no flowering plants. In 2013, 10 plants and 3 yearlings emerged. None of the adult plants flowered or produced seeds.

Microsite 2: On this gently/low sloping microsite with slightly darker shade, lower plant diversity and lower plant density than #1 above, fifteen plants were out-planted in December 2009. Ten additional plants were out-planted in January 2011. As of March 2011, only 9 of the 25 plants remained with above ground growth, due to herbivory by banana slugs and possibly other herbivores. It is likely that only three produced flowers in 2011. Similarly, in 2012, three plants flowered and set seeds. In 2013, four adult plants emerged. Of these, two flowered and produced seeds (12 capsules, with a potential seed count of 720).

Microsite 3: On this microsite across an intermittent creek from the other two microsites, the lower part has a medium slope and dark shade while the upper part has a gentle/low slope and is not as deeply shaded. The entire microsite has low plant diversity and low plant density. Fifteen plants were out-planted in December 2009 and though there was significant herbivory observed in spring 2010, 11 of the 15 plants still remained. Ten additional plants were out-planted in January 2011. As of March 2011, 21 of the 25 plants remained with above ground growth. Of these, 10 were expected to flower. In 2012, though only 1 plant flowered and set 4 capsules, 185 seedlings were observed due to the relatively heavy seed set of 2011. In 2013, 12 adult plants emerged, plus 98 yearlings and 74 seedlings. Of the adult plants, three flowered and set seeds (18 capsules, with a potential seed count of 1,080). This is by far the most successful microsite at the Chileno Valley Road Private Ranch site so far, in survivorship of adults, yearlings, and seedlings.

C. *Soulajule Reservoir site*:
At this site 110 plants total were out-planted at three microsites on public land between January 2010 and January 2011.

Microsite 1: On this gentle slope above a nearly vertical road bank, there is bright shade, high plant diversity and high plant density. In January 2010, 40 plants were out-planted to this microsite. As of March 2011, 26 remained and 730 seedlings were observed and by May 2011, one plant had four capsules. Only 2 yearlings emerged in 2012 and neither flowered, however, 56 seedlings were observed. In 2013, ten adult plants emerged as well as eleven yearlings. Of the adults, one flowered and did not produce seeds (the inflorescence was broken/chewed off in flower).

Microsite 2: On this gentle slope toward a dirt road, there is dark shade, low plant diversity and low plant density. Thirty-five plants were out-planted in January 2011. As of March 2011, 33 plants remained and by May 2011, 9 out of the 35 plants had capsules, totaling 77 capsules. No seedlings were observed because it was the initial planting year. In 2012, no plants flowered, but 62 seedlings were observed. In 2013, two adult plants emerged as well as four yearlings. Of the adults, none flowered or produced seeds.

Microsite 3: On this very steep slope above a vertical road bank, there is bright shade, medium plant diversity and high plant density. Thirty-five plants were out-planted in January 2011. As of March 2011, 34 plants remained and by May, 14 out of the 35 plants had capsules, totaling 151 capsules. No seedlings were observed because it was the initial planting year. In 2012, no plants flowered (due to herbivory), but 27 seedlings were observed. In 2013, 10 adult plants emerged as well as 33 yearlings and six seedlings. Of the adults, none flowered or produced seeds (due to herbivory).

As of Spring 2013, though none of the microsites was experiencing great success, one of the reintroductions at Chileno Valley Road Private Ranch (microsite #3) appears more suitable for long-term establishment than the other six reintroduction microsites. Invertebrate and mammalian predation limits all seven microsites in some years, as described below under Factor C threats.

G. Reasons for Listing and Current Threats

Baker's larkspur was considered rare when it was first described in the late 1930s (Ewan 1942). Of the three known historical occurrences, two were lost to habitat conversion decades ago and the remaining historical population is found on a steep road bank in Marin County which is vulnerable to disturbance (CNDDB 2008). The following five-factor analysis describes and evaluates the current and historical threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

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

The final listing rule states habitat destruction via agricultural conversion to agriculture (grainfields) as the primary reason for the decline of Baker's larkspur (Ewan 1942; 65 FR 4158, January 26, 2000).

As mentioned earlier, the Marshall-Petaluma Road Historical occurrence exists on a steep roadside embankment subjected to road maintenance work and stochastic events such as landslides, fire, and vehicle accidents. The site has sustained significant damage to the habitat since 2002. In May of 2002, as part of Marin County road maintenance, work crews scraped the slope removing the largest plants before seed set was completed despite repeated discussions between the UCBG staff, Marin CNPS, and others with the county agency responsible for roadside maintenance. In September 2004, fire-fighting crews set backfires on the slope above the Baker's larkspur in efforts to control a wildfire that started nearby. The plants are shallowly rooted, and the only individuals that survived were those that were protected by the roots of woody plants or were growing low on the slope and escaped being burned. In October 2004, county road crews, during road maintenance, removed most of the remaining individuals from the slope while clearing out the culvert located below the population, although the slope above the culvert had not eroded to block the culvert (H. Forbes, UCBG, pers. comm., 2011*c*).

The fire of 2004 resulted in changes in the vegetation and site conditions. The increased sun penetration from the fire-damaged canopy appears to have changed the microclimate at the site from generally moist and shady to generally dry and sunny which may negatively affect the ability of seedlings to become established (H. Forbes, pers. comm., 2011*c*). Increased sunlight has also encouraged the growth of invasive vegetation such as *Conium maculatum* (poison hemlock) and *Genista monspessulana* (French broom), which are now more common on the slope. Prior to the fire, *Conium maculatum* was only observed in the roadside ditch. The local (native) *Rubus ursinus* (Pacific

blackberry) appears denser and has the potential, as do the nonnative species, to displace Baker's larkspur. Establishment of non-natives has resulted in habitat loss and competition for light, soil moisture, nutrients, and space. In addition, intertwining vegetation of *R. ursinus* could break the larkspur inflorescences in windy conditions (as discussed further under Factor E).

The Service's Partners for Fish and Wildlife Program staff worked with willing landowners and the UCBG to select three general locations for reintroducing populations that were free of any current and anticipated land use conflicts, and that required minimal or no stewardship activities at the time (Service, *in litt*, 2008). Currently, the reintroduction sites at the two private ranches and Soulajule Reservoir are, due to agricultural easements and watershed protection measures, generally free from threats of habitat destruction, though may be subject to other threats described below. The two private ranches are protected from development with Marin Agricultural Land Trust agricultural easements. Soulajule Reservoir has watershed protection for water supply purposes.

In summary, after historical habitat loss, the most significant Factor A threats currently are habitat destruction, modification, or degradation from maintenance crews (*e.g.*, roadside vegetation clearing, fire control, culvert maintenance, *etc.*). Habitat alteration or loss as a result of establishment of nonnative vegetation presents a minor threat at this time.

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

Overutilization, for horticultural purposes, was historically a significant threat to this species, as stated in the listing rule (65 FR 4156; January 26, 2000). In 1992, all seed capsules were collected from the plants by vandals at the only known occurrence of Baker's larkspur along Marshall-Petaluma Road (California Department of Fish and Game, pers. comm., 1993). Because these capsules contained the plants' seeds, all sexual reproduction for 1992 was lost. Were this collection to occur regularly or in conjunction with unrelated natural events (*e.g.,* fire) the species may be lost. Whether, and the degree to which, collection of Baker's larkspur has occurred since the time of listing is unknown at this time.

Factor C*: Disease or Predation*

The listing rule describes that most *Delphinium* species are toxic to cattle (65 FR 4159; January 26, 2000). The toxicity of Baker's larkspur has not been tested; however, Ewan (1942) noted that Baker's larkspur did not appear to be poisonous to livestock. Sheep grazing was stated in the listing rule, as threatening one of the two extirpated populations. Which of the two populations it threatened was not identified and it was not known if grazing was the primary cause of its demise (65 FR 4158; January 26, 2000). Grazing activities would have resulted in trampling of individual plants, soil compaction, consumption, and impacts which may influence presence of invasive species. Currently, sheep grazing is not known to threaten Baker's larkspur.

Since the time of listing, it has become apparent that herbivory by slugs, snails, gophers and other species can significantly damage vegetative growth of Baker's larkspur. Slugs were observed to negatively impact Baker's larkspur at all of the Soulajule Reservoir and Chileno Valley Road Private Ranch reintroduction sites and iron phosphate slug bait was found to be ineffective in reducing the number of banana slugs present (H. Forbes, pers. comm., 2011*b*).

No herbivory was noted at the Marshall-Petaluma Road Historical occurrence in 2011. At the Marshall-Petaluma Road Private Ranch, the plants observed to be flowering earlier in the year were

missing by mid-May 2011. Though signs of gophers had not been detected earlier in the year, fresh gopher activity was detected very close (2 ft (0.6 m)) to the plants during the May 2011 site visit (H. Forbes, pers. comm., 2011*a*).

Herbivory of Baker's larkspur by slugs, snails, and gophers is a significant threat to remaining individuals at small and vulnerable microsites.

Factor D*: Inadequacy of Existing Regulatory Mechanisms*

After Federal listing of Baker's larkspur in 2000, regulatory mechanisms thought to provide some degree of protection for Baker's larkspur included: (1) the *California Native Plant Protection Act*, (2) the *California Environmental Quality Act* (CEQA), (3) the *Endangered Species Act of 1973,* as amended (Act) and (4) the *National Environmental Policy Act* (NEPA) (65 FR 4159; January 26, 2000). This analysis appears to remain currently valid. However, in addition, in 2007, Baker's larkspur was listed as endangered under the California Endangered Species Act (CESA) (California Fish and Game Code, section 2080 *et seq*.).

Federal Laws and Regulations

Endangered Species Act of 1973, as amended (Act): The Act provides for civil and criminal penalties for the unlawful taking of listed species and is the primary Federal law providing protection for this species. Section 9 of the Act prohibits the taking of any federally listed endangered or threatened wildlife species; however, the take prohibition does not apply to plants. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits (1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting, digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation or in the course of any violation of a state criminal trespass law. Federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

The Service analyzes the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed animal or plant species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR 402.02).

Incidental take refers to taking of listed species that result from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.2) and such take may be exempted under section 7 or 10 of the Act. For projects without a Federal nexus that would likely result in incidental take of listed wildlife species, the Service may issue incidental take permits to non-Federal applicants pursuant to section 10(a)(1)(B). As mentioned above, federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

National Environmental Policy Act (NEPA): NEPA (42 U.S.C. 4371 *et seq*.) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural

resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

State Laws and Regulations

Native Plant Protection Act (NPPA): The NPPA was enacted in 1977, and allows the California Fish and Game Commission to designate plants as rare or endangered. The NPPA (Division 2, Chapter 10, section 1908) prohibits take of endangered or rare native plants, but includes some exceptions for certain land uses. With regard to prohibitions of unauthorized take under NPPA, landowners are exempt from this prohibition for plants to be taken in the process of habitat modification. Where landowners have been notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify the California Department of Fish and Wildlife at least 10 days in advance of changing land use in order to allow salvage of listed plants. The salvage of the plants must take place within the 10 day period. After 10 days the land owner may proceed with their land use changes.

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

California Endangered Species Act (CESA): The CESA requires State agencies to consult with CDFW on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat. Pursuant to CESA, it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities.

In summary, the Federal and California Endangered Species Acts are the primary Federal and State laws that provide protection for this species. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Federal and California Endangered Species Acts. Therefore, we continue to believe other laws and regulations have limited ability to protect the species in absence of the Endangered Species Act.

Factor E*: Other Natural or Manmade Factors Affecting Its Continued Existence*

At the time of listing, threats to Baker's larkspur under Factor E were risk of extinction due to small populations that are subject to random environmental events and genetic drift (65 FR 4159; January 26, 2000). By the time of listing, Baker's larkspur had been reduced to one site (Marshall-Petaluma Road Historical occurrence) of 35 individuals.

The combination of few sites, a small number of individuals found within each site, a naturally narrow geographic range, and restricted habitat makes this species susceptible to destruction of all or a significant part of any population from random natural events, such as erosion, landslides, pest outbreaks, fire, drought, disease, or other natural or human-made events (Schaffer 1981, Primack 1993). Quantity and viability of seed in the naturally occurring seedbank is unknown. Random events causing population fluctuations or even population extirpations are not usually a concern until the number of individuals or geographic distribution become as limited as they have for Baker's larkspur. Once a plant population becomes significantly reduced due to habitat destruction and fragmentation, the remnant population has a greater probability of extinction from random events (Matthies *et. al.* 2004).

Closely related to the threat of small populations is the specific threat of severely reduced genetic variability. Small populations are subject to increased genetic drift and inbreeding (Menges 1991; Ellstrand and Elam 1993). With the past loss of historical occurrences and few individuals remaining, the species has presumably experienced a reduction in genetic diversity in the wild. This loss of genetic diversity is exacerbated by having all the plants now in propagation arising from seed collected from fewer than 40 plants at the single remaining site. This situation leads to increased likelihood of reduced fitness and decreased ability to respond to environmental change. Table 1 illustrates the low number of seeds produced by the historical occurrence, emphasizing the need for conservation, whether in place or *ex situ*, of the capsules for retention of genetic diversity.

In addition, this species is noted in taxonomic keys for the ease with which the main stem separates from its roots. The historical occurrence's location on a road-cut makes it vulnerable to wind blasts by passing busses and trucks. Breakage of Baker's larkspur inflorescences has been observed from swinging stems of *Rubus ursinus* catching on and breaking Baker's larkspur inflorescences (H. Forbes, pers comm., 2011*c*). Due to this unique plant structure, trampling impacts (*e.g.*, by deer, livestock or small mammals) could be exacerbated; however, this is not regarded as a considerable threat to the species at this time.

There is some concern that Baker's larkspur could hybridize with other, more common *Delphinium* species, though too little is currently known about this potential to regard it as a considerable threat to the species at this time. Although eight other species of *Delphinium* occur in Marin County, only *D. nudicaule* (red larkspur) occurs in close proximity to Baker's larkspur (at one microsite at the Soulajule Reservoir reintroduction site). *Delphinium nudicaule* flowering occurs earlier than Baker's larkspur in most years, but in some years, flowering does overlap, which presents the potential for hybridization.

An additional threat to the species noted since the time of listing is the effects of global climate change. Climate is predicted to change in California during the 21st century (Field *et al.* 1999; Cayan *et al.* 2009). Even modest changes in warming could result in more runoff in winter with less runoff in spring and summer, more winter flooding, and drier summer soils (Field *et al.* 1999; Cayan *et al.* 2009). The predicted impacts on California's ecosystems projected with a high certainty include higher sea level; decreased suitable habitat for many terrestrial species as climate change intensifies human impacts; and increased competition among urban, agricultural, and natural ecosystem uses (Field *et al.* 1999).

A recent report by North Bay Climate Adaptation Initiative includes a downscaled global climate model to assess potential impacts in Napa, Sonoma and Marin counties. Although the anticipated specific effects of climate change on Baker's larkspur are unknown, according to the report, the region can expect shorter winters, longer and drier summers, more extreme weather events, and maximum summer temperature increases of approximately six to eight degrees Fahrenheit (North Bay Climate Adaptation Initiative 2013). Though it is unclear whether more or less rain will fall during the wintertime in this region, it is expected that more of it will arrive in extreme events, rather than spread out evenly over the wet season, which could negatively affect seed germination. Additionally, drought stress on soils in late summer is projected to increase approximately 10 percent (North Bay Climate Adaptation Initiative, 2013), which could affect adult survival. Though winter flooding could potentially negatively affect the species, it is more likely that unreliable winter moisture and spring drought conditions on the north-facing slopes on which Baker's larkspur resides could adversely affect this species. Also, increased occurrence of wildfires due to climate change could potentially result, as it did in 2004, in a shift of the vegetation community to one that is less shady and with an increase of non-native plants that could displace Baker's larkspur. Due to the severely reduced number of Baker's larkspur individuals and to current land use constraints in the area, it may be that the species is unable to shift to other habitat conditions in response to the effects of climate change.

In summary, the most significant Factor E threat to Baker's larkspur is extirpation of small populations which may have endured reduced genetic variability and range constriction due to random natural and human-caused events. Additionally, Baker's larkspur is likely threatened by the effects of global climate change throughout its range.

Overall, given the small population size, extreme range constriction, vulnerability to human-related disturbance, alteration of the local microclimate due to fire and subsequent invasion of non-native vegetation, herbivory at the reintroduction sites and the uncertainty of sustainability of plants at the reintroduced sites, Baker's larkspur is extremely vulnerable to extinction in the immediate future.

H. Conservation Efforts

Conservation efforts in recent years have focused on monitoring, working with Marin County public works officials to avoid future damage to the remaining historical occurrence, working with willing private landowners on reintroductions, seed collection for long-term storage, and propagation of seeds collected from the wild at the UCBG. The UCBG staff has been working closely with the Service through a grant agreement on several of these activities, as described below.

Marshall-Petaluma Road Historical Occurrence: Because of the repeated damage caused by road maintenance and fire crews at the Marshall-Petaluma Road Historical occurrence, an important component of conservation effort has been for representatives from resource agencies, the UCBG, and CNPS to work with Marin County road maintenance and fire crews to assure their future actions do not damage the Baker's larkspur or adjacent habitat. The site has been free of human-related damage since the last incidence in 2004, and there has not been impact from road crews since then.

Other onsite conservation efforts include annual monitoring of plants and collection of seed from the last remaining historical occurrence of Baker's larkspur by the UCBG since spring 2001. The UCBG has coordinated with the Service and has approval to collect seeds and voucher specimens,

as appropriate. While seed collection is usually limited to five percent of the projected seed production of listed species, circumstances at the Marshall-Petaluma Road Historical occurrence are so dire that more aggressive seed collection was deemed necessary. Most or all seed production from this occurrence would have been lost to the roadside ditch below and never germinated. Therefore, collection of a higher percentage of seed production is allowed. This enabled the use of the wild seed to propagate plants for outplanting at more sustainable reintroduction sites. The UCBG collected seeds at the historical occurrence in 2002, 2003, 2007, 2010, and 2011 and 2013. Since monitoring began by the UCBG, the occurrence has declined from 55 flowering individuals to four adult plants and a handful of seedlings in 2012. Approved members of the Marin Chapter of the CNPS also occasionally visit the site to monitor for impacts and general population trends.

Past Reintroductions: Since 2003, the UCBG, with grant support from the Service, has been propagating Baker's larkspur from seed collected from the remaining historical occurrence (Service, *in litt.*, 2008). As of fall of 2008, over 250 plants were in propagation (Figure 5) that could provide founder stock to establish several new populations of Baker's larkspur. The plants range in age from seedlings up to three or more years. After two to three years, the plants are ready for outplanting during the cool season (January to March) with a portion retained for continued seed-banking (stock-piling seeds for long-term storage; Figure 6). However, seed banking from greenhouse raised plants is not a recommended long-term strategy for rare plant conservation because it inadvertently selects for plants that thrive and set the most seed in artificial propagation, and may over time compromise the gene pool of wild-selected seeds (Allard 1988; Frankham 2008; Christie *et al.* 2011).

With numerous mature plants in propagation, beginning in 2009, the UCBG worked with the Service to actively seek and work with willing landowners (private and public) to provide suitable reintroduction sites for establishment of self-sustaining populations. As described under the **Abundance and Trends** section above, seven reintroductions at three sites have occurred to date. Suitable sites were sought out that were as "pristine" as possible so that they require a minimal amount of ongoing habitat management activities. Also, in identifying appropriate reintroduction sites, specific sites with little or no public access were preferred to reduce the risk of human-related disturbance. The reintroduction program works with landowners on an individual basis to develop mutually acceptable access agreements, under a Cooperative Agreement or easement, to allow staff and trained volunteers to monitor the site and conduct site-specific management actions, if needed.

Genetic Study: The UCBG is collaborating with Dr. Jason Koontz (Affiliate Assistant Professor of Plant Biology, University of Illinois at Urbana-Champaign) to conduct analyses of the current degree of genetic variability of Baker's larkspur. Dr. Koontz has conducted a study of microsatellites on a related *Delphinium* species and will be conducting field research on various other *Delphinium* species in the near future. This work will be in coordination with the UCBG, who will provide tissue samples for his analysis. These analyses will serve as a baseline to document any changes in variability in the future.

Figure 5. Baker's larkspur in cultivation at U.C. Botanical Garden, Berkeley.
Photo credit: Kate Symonds, U.S. Fish and Wildlife Service

Figure 6. Baker's Larkspur Seed Collection at U.C. Botanical Garden, Berkeley.
Photo credit: Valary Bloom, U.S. Fish and Wildlife Service

II. RECOVERY PROGRAM

A. Recovery Strategy

Baker's larkspur has suffered extreme range restriction and population declines resulting in low redundancy (sufficient number of populations to withstand catastrophic events) and low resiliency (populations large enough to withstand stochastic events). The species appears to prefer naturally rare habitat conditions (moderately moist, shaded conditions on slopes with a shallow veneer of soil) that is often subject to human-related disturbance, competition from non-native species, and herbivory. The one remaining historical occurrence continues to decline and to be threatened by habitat degradation from human disturbance. All but one of the three reintroduced populations requires continued intense management and supplementation. Because of the small size of the few remaining populations, herbivory by slugs, snails, and gophers, as well as genetic isolation, threaten the species. Our recovery strategy will focus on increasing redundancy by reintroducing a sufficient number of populations to ensure they can withstand catastrophic events. Finally, we will focus on resiliency by ensuring each of the populations is large enough to withstand stochastic events through continued supplementation and management of reintroduced populations. To accomplish this, the recovery strategy includes monitoring of extant and future populations, reintroduction of plants at appropriately-managed sites, research to increase our knowledge of the needs and threats to the species, as well as outreach. California Department of Fish and Wildlife should be coordinated with in relation to implementation of recovery strategies described below.

B. Recovery Goal

The ultimate goal of recovery planning is to improve the status of a species to the point where it no longer requires the protections of the Endangered Species Act. We have determined that at this time, the identification of delisting criteria is not possible for Baker's larkspur, given the current lack of information about the species' biology and habitat requirements, the extreme range restriction, the magnitude of current threats, and the precarious location and unstable environment where the species occurs. As a result, this recovery plan addresses the goal of improving the status of Baker's larkspur to the point that it may be downlisted from endangered to threatened status.

C. Recovery Objectives

To achieve this goal, the following objectives have been developed:

1.) Expand the existing populations of Baker's larkspur and establish additional self-sustaining populations of Baker's larkspur throughout its known ecological and geographical range, while preserving extant genetic diversity.

2.) Ensure existing and future populations are protected from incompatible uses, such as road maintenance.

3.) Reduce herbivory by slugs, snails and gophers to the point that it does not affect the species at a population level.

D. Recovery Criteria

An endangered species is defined in the Endangered Species Act as a species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a species warrants downlisting or delisting, we consider whether the species meets either of these definitions. A recovered species is one that no longer meets the Act's definitions of threatened or endangered. Determining whether a species should be downlisted or delisted requires consideration of the same five categories of threats (*i.e.*, the five threat factors, A-E) which were considered when the species was listed and which are specified in section 4(a)(1) of the Endangered Species Act.

Recovery criteria are conditions that, when met, are likely to indicate that a species may warrant downlisting or delisting. Thus, recovery criteria are mileposts that measure progress toward recovery. Recovery criteria are provided below for Baker's larkspur. Because the appropriateness of downlisting or delisting is assessed by evaluating the five threat factors identified in the Endangered Species Act, the recovery criteria below pertain to and are organized by these factors. These recovery criteria are our best assessment at this time of what needs to be achieved so that the species may be downlisted (*i.e.*, meeting the definition of threatened but not the definition of endangered). Because we cannot envision the exact course that recovery may take and because our understanding of the vulnerability of a species to threats is very likely to change as more is learned about the species (*e.g.*, habitat, demography, genetics) and its threats, it is possible that a status review may indicate that downlisting is warranted although not all downlisting criteria are met. Conversely, it is possible that the downlisting criteria could be met and a status review may indicate that downlisting is not warranted (*e.g.*, a new threat may emerge that is not addressed by the recovery criteria below and that causes the species to remain endangered).

Downlisting Criteria

Factor A: The present destruction, modification, or curtailment of its habitat or range. To downlist Baker's larkspur to threatened status, Factor A threats to Baker's larkspur habitat must be reduced. This will have been accomplished if the following have occurred:

A.1. Habitat protection.

Each reintroduced site will be managed for the species and in conservation ownership (owned in fee title), protected by a conservation easement, or protected by a formal Memorandum of Understanding between the Service and the landowner. Lands containing each population must be protected with a buffer of compatible land use. Due to the physical constraints of removing the threats presented by a major road, the Marshall-Petaluma Road Historical occurrence is exempted from this buffer requirement.

A.2. Outreach to reduce habitat disturbance

Outreach and education to the Marin County road maintenance crews and fire crews will ensure that the Marshall-Petaluma Road Historical Occurrence will no longer be affected by road or fire maintenance activities.

Factor B: Overutilization for commercial, scientific or educational purposes. Overutilization through collection of seeds has occurred in the past prior to Baker's larkspur being listed. Because of the species' small population size and ease of access to the last known historical population along a major roadside, overutilization through collection continues to be a threat to the species. However, since listing no documented collection has occurred other than that which has been authorized for propagation purposes. Due to the uncertainty of the extent and frequency of overutilization occurring to the species, we do not currently consider overutilization a significant threat at this time. Therefore, if the threats under Factors A, C, and E are ameliorated, then additional measures to ameliorate or reduce overutilization, beyond continuing to educate the public on the sensitive nature of the Baker's larkspur and its habitat, are not necessary.

Factor C: Disease or predation. Disease is not known to present a major threat at this time. Herbivory is a natural process which can normally be withstood by a healthy population. However, due to Baker's larkspur's already severely reduced range and number of individuals, herbivory by slugs and snails, and possibly gophers, voles, and deer, currently negatively affects Baker's larkspur populations by preventing them from increasing in size.

C.1. Herbivory

For the 8 years following achievement of population targets (described below under Factor E), herbivory by slugs, snails and gophers must not occur in 2 consecutive years at levels which cause a population decline at any of the sites that count toward recovery.

Factor D: Inadequacy of existing regulatory mechanisms. The inadequacy of existing regulatory mechanisms is not known to threaten Baker's larkspur at this time. Therefore, no recovery criteria have been developed for this factor.

Factor E: Other natural or manmade factors affecting its continued existence. To downlist Baker's larkspur to threatened status, the species must be protected from risk of extinction due to small populations that are subject to random events and genetic drift. For downlisting, the following criteria must be met:

E.1. Number of Sites/Geographic Distribution

For 5 consecutive years, a total of 12[2] self-sustaining populations of Baker's larkspur must be distributed across its historical range. This total may include the single extant historical occurrence and any newly discovered populations in addition to reintroduced populations. Microsites within the same reintroduction site may not be considered separate populations toward this total. Populations must be distributed between the Russian River to the north, Point Reyes-Petaluma Road to the south, the Pacific coast to the west and Highway 101 to the east. Marin and Sonoma counties must each support at least two populations of the

[2] Little is known about the historical abundance, size, or geographic distribution of Baker's larkspur populations, however, we know that only three historical occurrences have been described. The criterion of 12 populations throughout a wide geographic range provides for redundancy and was developed in consultation with species experts (H. Forbes, pers. comm., 2001*c*). Finally, the historical occurrences of Baker's larkspur were located in Sonoma and Marin Counties; therefore we require self-sustaining populations in both counties to restore geographic distribution.

species. For the purpose of this recovery plan, populations shall be considered separate if they are separated by at least 0.25 mi. This distance of separation allows for occasional cross-pollination by bumblebees, one of the primary known pollinators, thought to have a maximum foraging distance from their nest of one mile (Mader *et. al.* 2011).

E.2. Number of Individuals

A minimum population size of 1,000[3] flowering individuals must comprise each of the 12 populations annually for five consecutive years, and must include at least 2 lower-than-average water years[4]. This reproductive objective for the minimum reproducing adult population may be met by a combination of surviving transplants and naturally recruited plants that mature and produce abundant seed annually.

E.3. Seedling Production

Each population must produce at least four seedling cohorts within ten consecutive years that contribute enough surviving individuals to cause a net population increase at the site. Qualifying seed cohorts must not occur more than 3 years apart. The survival of subsequent generations of seedlings to reproductive maturity that produce viable seeds would demonstrate that plants at the site are completing their life-cycle without augmentation from propagation. Failure to detect surviving seedlings that mature into reproductive individuals within three years would indicate that the reintroduction is not yet achieving dynamic population objectives (Guerrant 1996).

Delisting Criteria

Due to the lack of necessary biological information, we are unable to develop delisting criteria at this time. We lack demographic data needed to estimate minimum viable population size at each Baker's larkspur site. Furthermore, we lack an understanding of even the basic ecology of Baker's larkspur, including natural population fluctuations and habitat requirements. Combined with its extreme range restriction, the magnitude of current threats and the precarious location and unstable environment at the only location where the species historically occurred, we are unable to develop delisting criteria for the species at this time. Therefore, this recovery plan addresses an interim goal of improving the status of Baker's larkspur to the point that it may be downlisted to threatened status. Through implementation of recovery actions we hope to learn enough about Baker's larkspur to enable us to describe the conditions necessary for delisting the species. At such time, delisting criteria should be developed and this recovery plan revised accordingly.

---

[3] The perennial Texas snowbells (*Styrax texana*) has a similarly reduced range to Baker's larkspur and a recommendation of 1,000 flowering individuals per self-sustaining population (U.S. Fish and Wildlife Service 2007). Offsetting the fact that Texas snowbells is a woody shrub and therefore likely less vulnerable to most threats, is the fact that Baker's larkspur was described as locally rare at the time it was described (Ewan 1942). Therefore, we selected 1,000 flowering individuals as the minimum for Baker's larkspur as well as it provides for population resiliency. The minimum number of flowering individuals required for downlisting was developed in consultation with species experts (H. Forbes, pers. comm., 2001*c*).

[4] Lower than average rain water year is defined as rainfall that is 35% or more below historic mean precipitation.

III. RECOVERY ACTION NARRATIVE AND IMPLEMENTATION SCHEDULE

The recovery actions identified below are those that, based on the best available science, we believe are necessary to bring about the recovery of Baker's larkspur and ensure its long-term conservation. However, these recovery actions are subject to modification as dictated by new information, changes in species status, and the completion of other recovery actions

A. Recovery Action Narrative

1. **Monitoring** of all known populations (including all microsites)

Monitoring of the historical and reintroduction sites is necessary to determine population status and trends. Monitoring data will also be useful in helping to make informed decisions about site management and to determine progress toward reaching recovery criteria and objectives.

1.1. Conduct demographic monitoring of the historical population of Baker's larkspur at Marshall-Petaluma Road Historical occurrence and the surviving reintroduced populations throughout the year to evaluate germination, flowering, and seed set (Priority 1).

Whether monitoring is conducted by the Service, UCBG, or another group, the following general guidelines should be followed. At a minimum, all populations should be surveyed annually to assess the basic population status (*i.e.*, general condition, number of adult plants and presence of any seedlings). However, a more detailed monitoring program is preferable because it more effectively indicates the true health of the population and will advance our understanding of the species' ecological needs. Several aspects to include in a monitoring plan are recommended for consideration below.

An effective population assessment will require repeated site visits, especially during the flowering period to more fully assess reproductive output. Parameters serving to further our understanding of Baker's larkspur life history or reproductive biology include the following: number of individuals within each recognizable life stage (seedling, juvenile, adult, senescent adult); leaf area index; incidence of herbivory or disease; number of adult individuals flowering; timing of flowering; number of flowers per inflorescence; number of flowering stalks per plant; number of seeds produced per flower or plant; number of individuals producing fruit; seed viability (germination rate); and persistence of individual plants between years (survival assessment), to the extent feasible.

Habitat assessment data is an important element in a monitoring program and should include the following: the composition and condition of the plant community within the reintroduction site, including presence (or absence) of invasive species, presence and identification of pollinators, soil moisture (including seasonal changes) and other soil parameters, and general site condition. This action is closely tied to Actions 1.3 and 1.4, below. Information gathered from monitoring efforts and the evaluation of the data should then be used to refine the selection of other reintroduction sites or microsites for future reintroduction efforts.

Monitoring reports provide a feedback mechanism to help assess the status of the populations(s) and will be critical in helping to improve the success of future reintroductions. Reports should include annual survey results as well as population, habitat, and threat assessment results, if conducted. Reports should be submitted at least annually to the Service and other partners, with prompt notification of any immediate site stewardship needs that would affect the ability of the restoration site to support Baker's larkspur (e.g., wildfire, *etc.*). Photomonitoring is useful for capturing qualitative information about vegetation patterns, vegetation structure, and changes at the site through time. Fixed-point, fixed-perspective photomonitoring should be established for each reintroduction site.

1.2. Conduct Action 1.1 for any newly reintroduced populations (Priority 1).

1.3. Monitor threats at the historical population at Marshall-Petaluma Road Historical occurrence and the surviving reintroduced populations (Priority 1).

Threats assessment is an important element in the management of Baker's larkspur at each population and is closely tied to Action 1.1, above. Factors assessed may include, but are not limited to, encroachment of invasive species, herbivory or trampling, excessive erosion, alteration in site hydrology, and human-related disturbance. Especially important will be a comparison of threats from year to year and monitoring of success of particular management actions. Data obtained during threat assessments will inform management strategies discussed below.

1.4. Monitor threats at any newly reintroduced populations (Priority 1).

1.5. Search for new populations within historical range (Priority 2).

2. **Reintroduction** of additional populations

Reintroductions should be conducted in accordance with the Service's *Draft Baker's larkspur (Delphinium bakeri) Reintroduction Plan, Marin and Sonoma Counties, California* (Service, *in litt.* 2008), which describes the important components of site selection methodology, transplant procedures, seeding and labeling techniques, and reporting practices and should be updated as new information is gathered.

2.1. Identify sites within the historical range of Baker's larkspur where suitable habitat conditions and compatible land use exist, for establishment of additional reintroduced populations (Priority 1).

Efforts by the UCBG[5], other groups, or the Service should continue to establish additional reintroductions on appropriate habitat within the historical range. Since little is known

[5] Whereas the existence and mission of UCBG cannot be guaranteed into the future, where UCBG is noted in the text, it should be assumed that work may be conducted by other qualified botanical institutions, as necessary. The Service is willing to work with new partners.

about habitat conditions at the historical occurrences, future site selection for reintroductions should include exploration of a wide range of habitat conditions. The number of reintroduction sites that should be planted in order to ultimately achieve a total of 12 self-sustaining populations is not known at this time. The number of reintroduction sites that can be established will be dependent on the number of willing landowners with suitable habitat, availability of Baker's larkspur for planting, labor to establish and carry out stewardship activities for long term persistence, and funding and other resources (e.g., volunteers) to support these activities.

2.2. Install plants to new reintroduction sites (Priority 1).

To the extent that available information allows, the number of individuals planted at a given reintroduction site should reflect a sufficient population size to avoid inbreeding depression and loss of desirable genetic diversity. However, because we currently lack information on gene flow and the estimated number of Baker's larkspur individuals needed to be self-sustaining, or that would achieve a minimum viable population size to maintain genetic diversity or allow long-term persistence, the number of individuals needed is not known. The species may have experienced a reduction in genetic diversity in the wild. A loss of genetic diversity would be exacerbated by having all the plants now in propagation arising from seed collected from fewer than 40 plants at the single remaining site. Because of this situation, it is critical to secure reintroduction sites throughout the entire historical range and habitat conditions for Baker's larkspur so that natural selection can operate once again on these propagules in the wild. Each subsequent greenhouse-raised generation of Baker's larkspur can inadvertently become selected for genotypes that survive and set more seed in greenhouses versus in the wild (Allard 1988; Frankham 2008; Christie *et al.* 2011).

In the absence of genetic information on Baker's larkspur, using an initial founder population size at each site of around 40 to 50 plants satisfies the default recommendation of genetic sampling of 10 to 50 individuals per source population (Guerrant 1996). Founder populations of fewer than 20 plants in an isolated population (no immigration) may increase the risk of inbreeding depression and the loss of desirable genetic diversity to allow natural selection to occur. The survival and growth of planted founder plants is essential until the next generation is established in numbers that are self-sustaining with spontaneous recruitment of seedlings. Measurement of population growth should be based on mature (flowering/seed-bearing) individuals and not seedlings, as seedlings are subject to higher rates of mortality (Harper 1977).

2.3. Augment reintroduced populations with additional individuals (Priority 2).

2.4. Collect and bank wild seed and propagate plants for use in reintroductions

In years of abundant seed set at the historical population or reintroduced sites, seed should be collected, if deemed necessary to retain genetic variation. This wild-collected seed should be used to propagate plants for use in reintroduction efforts. Preferably, only the first generation seeds of plants grown from wild seed should be used to grow plants for reintroduction. However, we recognize the potential for needing second generation seed in limited circumstances, should first generation seed supplies become exhausted.

2.4.1. Collect seeds in the wild during years of sufficient seed production (Priority 1).

2.4.2. For use in near-term reintroduction efforts, propagate to transplant size plants preferably grown from wild seed or no later than the first generation of nursery-selected seed (Priority 1).

2.4.3. Send a portion of wild-collected seed to a certified seed banking facility (Priority 2).

2.5. Collect and bank seed from nursery-raised plants

2.5.1. Collect and process seed from nursery-raised plants (Priority 2).

2.5.2. Store a portion of collected seed from nursery-raised plants onsite and send a portion to a certified seed storage facility (Priority 3).

3. **Management** of habitat at all populations.

Reintroduction sites will be managed for the species and will be in conservation ownership, protected by a conservation easement, or protected by a formal Memorandum of Understanding with the landowner. This requirement (per relevant recovery criteria) will result in involvement with landowners or managers who are willing to allow flexibility in stewardship/management and monitoring activities, if the need arises, to ensure the population persists on their land.

Reintroduction sites should be established where they are unlikely to be subject to human-related disturbance. However, if the site has a potential for vandalism, visible attractions (e.g. flags or flagging) should be removed and the reintroduced population should be disguised by surrounding the site with natural-looking accumulations of woody debris.

3.1. Adaptively manage threats (herbivory, trampling, competition with other vegetation, soil moisture, hybridization, and wildfire).

3.1.1. Control undesirable vegetation at historical and reintroduction microsites, as necessary (Priority 2).

Competition from other plant species (native and nonnative) for light, soil moisture, nutrients, and space should be reduced or eliminated.

3.1.2. Implement measures to control herbivory at historical and reintroduction microsites, as necessary (Priority 1).

The potential for herbivory and trampling should be evaluated on a site-by-site basis and exclosures or protective hardware should be installed to reduce loss of Baker's larkspur from herbivory.

3.1.3. Conduct other management measures, as necessary (Priority 2).

If there are excessive or inadequate soil moisture levels during the first few years of the transplant, supplemental water tubes should be removed/added, as necessary.

The need for modifying soil litter, and whether the problem is long-term and warrants relocating the plants, should be evaluated.

A small potential exists for hybridization with other species of *Delphinium* if Baker's larkspur is transplanted to sites already occupied with another *Delphinium* species. It is not known how many species of *Delphinium* found within the range of Baker's larkspur may hybridize with Baker's larkspur. Avoiding sites with other *Delphinium* species would be prudent. However, if another *Delphinium* species is later found near a reintroduction site, consideration should be given to removing or transplanting nearby individuals of the non-listed *Delphinium* away from the reintroduction site. Other than the endangered *D. luteum* (yellow larkspur) (65 FR 4156; January 26, 2000) which is not known to hybridize with Baker's larkspur, none of the other *Delphinium* species within the range of Baker's larkspur are considered rare.

Other factors that may be influenced by habitat management include, but are not limited to, encouraging more pollinators, addressing excessive erosion, and addressing disease and herbivory. Such factors would be evaluated and addressed on a site-by-site basis.

3.2. Assess effectiveness of management and alter management, if necessary (Priority 2).

4. **Research**

4.1. Conduct genetic research

4.1.1. Conduct research to determine genetic variability of Baker's larkspur (Priority 1).

Genetic studies should continue in order to determine the genetic variability of this severely endangered plant which has endured a population bottleneck. This research will inform us as to whether some plants are more genetically diverse than others. This has implications for nursery propagation operations in that it may indicate that the heritage of each cohort of seeds should be tracked and that plants should be grown out for transplanting only from seed produced by plants with the highest genetic diversity. The range of genetic variation must be maintained to minimize the risk of inbreeding depression and allow for future adaptation and resilience to environmental change.

4.1.2. Use results of Action 4.1.1 in studies to determine minimum viable population size for Baker's larkspur and develop a genetics management plan (Priority 2).

We lack information on gene flow and the estimated number of Baker's larkspur individuals to reach the minimum population size to maintain genetic diversity. In association with research into genetic variability, a population viability analysis should be conducted to determine the minimum viable population size for this species and a genetics management plan should be developed. Results of these studies will inform both the development of delisting criteria (absent here) and whether a subsequent revision to downlisting criteria is appropriate.

As described under Recovery Criteria (Section II), we are unable to develop delisting criteria for the species at this time. Ecological research, including study of Baker's larkspur natural population fluctuations, life history parameters, and habitat requirements must be completed in order to estimate minimum viable population size required for recovery at each Baker's larkspur population. Through implementation of recovery actions we may learn enough about Baker's larkspur to enable us to describe the conditions necessary for delisting the species. At such time, delisting criteria should be developed and this recovery plan revised accordingly.

4.1.3. Conduct research to determine whether hybridization occurs between Baker's larkspur and other common co-occurring *Delphinium* species (Priority 3).

As described above, research is currently being conducted on hybridization potential between Baker's larkspur and other species of *Delphinium*.

4.2. Conduct experimental plantings to determine if outplanting of Baker's larkspur on steep slopes reduces predation impacts, if outplanting with associated woody species increases transplant survival, and if co-planting other compatible native species increases the presence of appropriate pollinators and results in increased seed set (Priority 3).

Research should be conducted in association with future reintroductions to determine if survival of transplants is improved if reintroductions are done in association with woody vegetation. Investigation is needed to determine if new reintroductions should be located in direct contact with or co-planted with woody vegetation. In addition, experimentation should be conducted to determine if co-planting compatible native species with Baker's larkspur at the time of reintroduction increases the presence of appropriate pollinators and results in increased seed set. Finally, research should be conducted to determine if slight increased establishment success of Baker's larkspur on steep slopes is due to reduced predation impacts, via the presumed reduced ability of herbivores to traverse the habitat.

4.3. Periodically during the implementation of recovery actions above, determine whether sufficient information exists to describe conditions necessary for the delisting of Baker's larkspur and develop delisting criteria accordingly (Priority 2).

5. **Outreach**

Due to the severe endemism and range restriction of Baker's larkspur, wide public outreach pertaining to its conservation is not a component of this recovery plan. Any outreach to a large audience that included detailed location information could endanger the species further by inadvertently drawing collectors, resulting in trampling impacts from the public, or infringing upon the privacy of participating landowners. However, recovery of the species is dependent upon willing landowners and managers who volunteer to conduct conservation activities on their lands.

5.1. Reach out to and maintain positive working relations with potentially willing private landowners in suitable habitat to educate them about Baker's larkspur recovery needs and encourage them to participate in conservation via outplanting of the species on their lands (Priority 1).

The Service will reach out through their Partners for Fish and Wildlife or Endangered Species Programs, to a targeted group of private landowners in suitable habitat for education purposes and encourage them to participate in conservation for Baker's larkspur via outplanting of the species on their lands. This outreach may take the form of a localized neighborhood meeting. A list of interested parties should be developed and individuals should be coordinated with on a private basis in regards to any ensuing conservation partnerships. The Service will then work with interested entities to develop a Memorandum of Understanding or other tools for reintroducing Baker's larkspur to their lands.

5.2. Work with interested private entities to develop a Memorandum of Understanding or other tools for reintroducing Baker's larkspur to their lands (Priority 1).

5.3. Every third year, the Service or UCBG will train the Marin County road maintenance crews and fire crews maintaining lands near the Marshall-Petaluma Road Historical occurrence in the protection of the Baker's larkspur population. Training will be conducting in winter before plants emerge for the year and will pertain to protection of Baker's larkspur near the maintenance area so that actions do not damage the plants or their immediate habitat. Trained County road and fire crew supervisors will be instructed to inform new employees during the intervening years of the rarity of this species, the importance of protecting this population and its habitat, and recommended conservation measures for Baker's larkspur and its habitat (Priority 1).

B. Implementation Schedule

The following implementation schedule outlines actions and estimated costs for this draft recovery plan. It is a guide for meeting the objectives in Chapter II. This schedule describes and prioritizes actions, provides an estimated timetable for performance of actions, indicates the responsible parties, and estimates costs of performing actions. These actions, when accomplished, should further the recovery of Baker's larkspur.

Definition of action priorities:

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 in 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.

Because situations change over time, priority numbers must be considered in the context of past and potential future actions at all sites. Therefore, the priority numbers assigned are intended to guide, not to constrain, the allocation of limited conservation resources.

Definitions of action durations:

Number- The predicted duration of the action in years.

Continual- An action that is not currently underway but will be implemented continuously throughout the recovery period once begun.

Ongoing- An action that is currently being implemented and will continue throughout the recovery period.

TBD- To be determined

Definition of responsible parties (bold party in table is the lead party for the action):

CDFW- California Department of Fish and Wildlife
CNPS- California Native Plant Society
OTHER- Other entity
OWN- Agency or Organization that administers or owns each site
PVT- Private Contractor
UCBG- University of California Botanical Garden at Berkeley
USFWS- U.S. Fish and Wildlife Service

IMPLEMENTATION SCHEDULE FOR BAKER'S LARKSPUR DRAFT RECOVERY PLAN											
Action Priority	**Action Number**	**Action Description**	**Action Duration (years)**	**Responsible Party**	**Total Cost (in $1,000 units)**	**Cost Estimate (in $1,000 units)**					**Comments**
					ANNUAL COST	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
1	1.1	Conduct demographic monitoring of the historical occurrence at Marshall-Petaluma Road and three current reintroduced microsites throughout the year to evaluate germination, flowering, and seed set.	30	**UCBG**, OWN, USFWS, CDFW, OTHER	324	10.8	10.8	10.8	10.8	10.8	Based on (4 days/yr x 4 people for Chileno Vly Rd) + (4 days/yr x 4 people for remaining sites) + (4 office days/yr) x $400/day.
1	1.2	Conduct Action 1.1 for any newly reintroduced microsites.	10	**UCBG**, OWN, PVT, USFWS, CDFW, OTHER	324	32.4	32.4	32.4	32.4	32.4	Based on 12 new reintro sites (4 more than required for downlisting). 18 days/yr x 4 people + (9 office days/yr) x $400/day.
1	1.3	Monitor threats at historical population at Marshall-Petaluma Road and three current reintroduced microsites.	Ongoing	UCBG, **USFWS**, OWN, CDFW, OTHER	0	-	-	-	-	-	This action directly associated with Actions 1.1 and 1.2. No additional costs.
1	1.4	Monitor threats at any newly reintroduced microsites.	TBD	**USFWS**, OWN, PVT, CDFW, OTHER	0	-	-	-	-	-	This action directly associated with Actions 1.1 and 1.2. No

											additional costs.
2	1.5	Search for new populations within historical range.	0.008	**USFWS**, OWN, PVT, CDFW, OTHER	2.79	2.79	-	-	-	-	3 days x $930/day
1	2.1	Identify sites within the historic range of Baker's larkspur where suitable habitat conditions and compatible land use exist, for establishment of additional reintroduced populations.	15	UCBG, **USFWS,** CDFW	139.5	9.3	9.3	9.3	9.3	9.3	10 days/yr x $930/day x 15 yrs
1	2.2	Install plants at new reintroduction microsites.	Ongoing	**UCBG**, USFWS, OWN, CDFW, OTHER	44.4	-	-	-	-	-	Based on 12 new reintro sites (4 more than required for downlisting). 3 people x 1 day/site x 12 sites x $400/day. Plus, fencing for 6 sites x $5K/site.

2	2.3	Augment reintroduced microsites with additional individuals.	Ongoing	**UCBG**, USFWS, OWN, CDFW, OTHER	TBD	TBD	TBD	TBD	TBD	TBD	As necessary.
1	2.4.1	Collect seeds in the wild during years of sufficient seed production.	30	**UCBG,** OTHER	12	0.8	-	0.8	-	0.8	Only in yrs when enough natural seed set to collect. 1 day/yr x 2 people x $400/day x 15 yrs. For calculation, assumed collection every other year for 30 yrs.
1	2.4.2	For use in short-term reintroduction efforts, propagate to transplant size plants preferably grown from no later than the first generation of nursery-selected seed.	12	**UCBG,** OTHER	72	6	6	6	6	6	Propagation expenses based on 40 plants/yr & 15 day/yr x $400/day x 12 yrs
2	2.4.3	Send a portion of wild-collected seed to a certified seed banking facility.	30	**UCBG,** OTHER	6	0.4	-	0.4	-	0.4	Only in yrs when enough natural seed set to collect. 1 day/yr x $400/day x 15 yrs.

											For calculation, assumed sending to facility every other year for 30 yrs.
2	2.5.1	Collect and process seed from nursery-raised plants.	30	**UCBG,** OTHER	60	4	-	4	-	4	10 days/yr x $400/day x 15 yrs. For calculation, assumed collection every other year for 30 yrs.
3	2.5.2	Store a portion of collected seed from nursery-raised plants onsite and send a portion to a certified seed storage facility.	Ongoing	**UCBG,** OTHER	3	3	-	-	-	-	Offsite facility, Rancho Santa Ana Seed Bank, charges flat fee of $3K.
2	3.1.1	Control undesirable vegetation at historical and reintroduction microsites, as necessary.	TBD	OWN, PVT, OTHER	0	-	-	-	-	-	This action directly associated with Actions 1.1 and 1.2. No additional costs.
1	3.1.2	Implement measures to control herbivory at historical and reintroduction microsites, as necessary.	Ongoing	**UCBG**, OWN, PVT, CDFW	TBD	TBD	TBD	TBD	TBD	TBD	As necessary.
2	3.1.3	Conduct other management measures, as necessary.	TBD	**UCBG**, USFWS, OWN, PVT, CDFW	TBD	TBD	TBD	TBD	TBD	TBD	As necessary.

2	3.2	Assess effectiveness of management and alter management, if necessary.	TBD	**USFWS**, OWN, CDFW	TBD	TBD	TBD	TBD	TBD	TBD	This action directly associated with Actions 1.3 and 2.4. No additional costs. Altered management would incur costs to be determined.
1	4.1.1	Conduct research to determine genetic variability of Baker's larkspur.	Ongoing	**PVT**	80	80	-	-	-	-	Lump sum estimate for average genetic study= $80,000
2	4.1.2	Use results of Action 4.1.1 in studies to determine minimum viable population size for Baker's larkspur and develop a genetics management plan.	1	UCBG, **PVT,** OTHER	55	55	-	-	-	-	Approximate lump sum estimate of developing genetics management plan
3	4.1.3	Conduct research to determine if hybridization occurs between Baker's larkspur and other common co-occurring *Delphinium* species.	0.25	**PVT**	80	80	-	-	-	-	Approximate lump sum estimate for average genetic study

3	4.2	Conduct experimental plantings to determine if outplanting of Baker's larkspur on steep slopes reduces predation impacts, if outplanting with associated woody species increases transplant survival, and if co-planting other compatible native species increases the presence of appropriate pollinators and results in increased seed set.	5	**UCBG,** OTHER	4	0.8	0.8	0.8	0.8	0.8	Conducted in association with Action 2.2. No additional cost for field time- only for data analysis. 2 day/yr x 5 yrs x $400/day
2	4.3	Periodically during the implementation of recovery actions above, determine whether sufficient information exists to describe conditions necessary for the delisting of Baker's larkspur and develop delisting criteria accordingly.	0.25	**USFWS**	TBD	TBD	TBD	TBD	TBD	TBD	
1	5.1	Reach out to and maintain positive working relations with potentially willing private landowners in suitable habitat to educate them about Baker's larkspur recovery needs and		USFWS	27.9	1.86	1.86	1.86	1.86	1.86	Conducted in association with Action 2.1. Mostly effort dovetailed, however 2 days/yr x $930/day x 15 yrs for public outreach/

		encourage them to participate in conservation via outplanting of the species on their lands.									neighborhood meeting component
1	5.2	Work with interested private entities to develop a Memorandum of Understanding or other tools for reintroducing Baker's larkspur to their lands.	15	USFWS	69.75	4.65	4.65	4.65	4.65	4.65	Conducted in association with Action 2.1. Mostly effort dovetailed, however, 5 days/yr x $930/day x 15 yrs development of agreements. Dependent on number of interested parties.
1	5.3	Every third year, the Service or UCBG will train the Marin County road maintenance crews and fire crews maintaining lands near the Marshall-Petaluma Road Historical occurrence in the protection of the Baker's larkspur population.	30	UCBG, **USFWS,** CNPS, OTHER	9.3	.93	-	-	.93	-	1 day/yr x $930/day x 10 yrs. To occur every third year.

Priority 1 actions: $1,102,850 Priority 2 actions: $123,790 Priority 3 actions: $87,000

Total Cost: $1,313,640

IV. LITERATURE CITED

Abrams, L. 1944. Illustrated flora of the Pacific States, Vol 2: Buckwheats to Kramerias. Stanford University Press, Stanford, California.

Allard, R. W. 1988. Genetic changes associated with the evolution of adaptiveness in cultivated plants and their wild progenitors. The Journal of Heredity 79(4).

Baldwin, B., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken. 2012. The Jepson Manual: Vascular Plants of California, 2nd edition. University of California Press, Berkeley, California.

Best, C., J.T. Howell, W. Knight, I. Knight, and M. Wells. 1996. A Flora of Sonoma County. California Native Plant Society Press, Sacramento, California.

California Natural Diversity Data Base (CNDDB). 2008. Occurrences of *Delphinium bakeri*. 3 pp.

Cayan, D., M. Dettinger, I. Stewart, and N. Knowles. 2005. Recent changes towards earlier springs: early signs of climate warming in western North America? U.S. Geological Survey, Scripps Institution of Oceanography, La Jolla, California.

Cayan, D., M. Tyree, M. Dettinger, H. Hildalgo, T. Das, E. Maurer, P. Brominski, N. Graham, and R. Flick. 2009. Climate change scenarios and sea level rise estimates for California 2008 Climate Change Scenarios Assessment. California Climate Change Center.

Center for Plant Conservation (CPC). 2008. CPC National Plant Collection Plant Profile, *Delphinium bakeri*. http://www.centerforplantconservation.org/ASP/CPC_ViewProfile.asp?CPCNum=1375# Site updated 3/4/2010. Date Accessed: 6/18/14

Christie, Mark R., M. L. Marine, R. A. French, M. S. Blouin. 2011. Genetic adaptation to captivity can occur in a single generation. Proceedings of the National Academy of Sciences. www.pnas.org/cgi/doi/10.1073/pnas.1111073109

Ellstrand N.C. and D.R. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology and Systematics 24: 217–242.

Ewan, J. 1942. The genus *Delphinium* in North America: series Echinatae of subsection Subscaposa, and miscellaneous noteworthy species. Bulletin of the Torrey Botanical Club 69:137–150.

Field, C.B., G.C. Daily, F.W. Davis, S. Gaines, P.A. Matson, J. Melack, and N.L. Miller. 1999. Confronting climate change in California. Ecological impacts on the Golden State. A report of the Union of Concerned Scientists, Cambridge, Massachusetts, and the Ecological Society of America, Washington, DC.

Flora of North America Editorial Committee (Flora), (eds.). 1993. Flora of North America North of Mexico. Vol 3: Magnoliidae and Hamamelidae. Oxford University Press, New York and Oxford.

Frankham, Richard. 2008. Genetic adaptation to captivity in species conservation programs. Molecular Ecology 17: 325–333.

Guerrant, Edward O. 1996. Designing populations: Demographic, genetic, and horticultural dimensions. Pages 171–207 in: D. A. Falk, C. I. Millar and M. Olwell (eds.). Restoring Diversity: Strategies for Reintroduction of Endangered Plants. Island Press, Washington, DC.

Harper, J.L. 1977. Population Biology of Plants. Academic Press, London, Elsevier Science & Technology Books.

Howell, J.T., F. Almeda, W. Follette, and C. Best. 2007. Marin flora: An illustrated manual of the flowering plants, ferns, and conifers of Marin County, California. San Francisco CA: California Academy of Sciences and California Native Plant Society (Marin Chapter).

Intergovernmental Panel on Climate Change [IPCC]. 2007. Climate change 2007: the physical science basis. Summary for policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Secretariat, World Meteorological Organization and United Nations Environment Programme, Geneva, Switzerland.

Koontz, J.A. and H. Forbes. 2003. Demography and conservation genetics of the endangered Baker's Larkspur (*Delphinium bakeri*, Ranunculaceae). Prepared for the Species Conservation and Recovery Program, Habitat Conservation Planning Branch, California Department of Fish and Game. Research Permit 01–01. 20 pp.

Mader, E., M. Shepherd, M. Vaughan, S.H. Black, and G. LeBuhn. 2011. Attracting Native Pollinators; Protecting North America's Bees and Butterflies. The Xerces Society, Storey Publishing, North Adams, MA. 339 pp. + appendices.

Matthies, D., I. Brauer, W. Maibom, and T. Tscharntke. 2004. Population size and the risk of local extinction: empirical evidence from rare plants. Oikos 105: 481–488.

Menges, E.S. 1991. The application of minimum viable population theory to plants. Pages 45–61 in: D.A. Falk and K.E. Holsinger (eds.). Genetics and Conservation of Rare Plants. Oxford University Press, New York, New York.

Munz, P.A. and D.D. Keck. 1973. A California Flora. University of California Press, Berkeley, California. 1681 pp.

North Bay Climate Adaptation Initiative. 2013. Climate Change in the North Bay for Residents of Marin, Sonoma, and Napa Counties. Climate Smart North Bay Fact Sheet Series. North Bay Climate Adaptation Initiative. Santa Rosa, CA.

NEPCoP (New England Plant Conservation Program). 1992. New England Wild Flower Society, Inc. Vol. 7, No. 1.

Pavlik, B. l996. Defining and measuring success. Pages 127–155 in: Falk, D., C. Miller, and M. Olwell, (eds.). Restoring Diversity, Strategies for Reintroduction of Endangered Plants. Island Press, Washington, D.C.

Primack, R. 1993. Essentials of Conservation Biology. Sinauer and Associates. Sunderland, MA.

Schaffer, M.L. 1981. Minimum population sizes for species conservation. Bioscience 31.2: 131–134.

U.S. Fish and Wildlife Service. 1983. Endangered and threatened species; listing and recovery priority guidelines. **Federal Register** 48:43098–43105.

U. S. Fish and Wildlife Service. 2000. Endangered and threatened wildlife and plants; determination of endangered status for two larkspurs from coastal northern California. **Federal Register** 65:4156–4162.

U. S. Fish and Wildlife Service. 2003. Endangered and threatened wildlife and plants; final designation of critical habitat for two larkspurs from coastal northern California. **Federal Register** 68:12834–12863.

U. S. Fish and Wildlife Service. 2007. Endangered and threatened wildlife and plants; Five year reviews of 24 Southwestern Species. **Federal Register** 72: 20134–20136.

In Litteris

U.S. Fish and Wildlife Service, 2008. Draft Baker's Larkspur (*Delphinium bakeri*) Reintroduction Plan, Marin and Sonoma Counties, California. Service files.

Personal Communications

California Department of Fish and Game (California Department of Fish and Wildlife). 1993. EPP Telecon report. Telephone conversation record. 2 pp.

Forbes, Holly. 2011*a*. Curator, U.C. Botanical Garden at Berkeley. Electronic mail from Holly Forbes to Valary Bloom (Service) in regards to Baker's larkspur reintroduction success monitoring. May 20, 2011.

Forbes, Holly. 2011*b*. Curator, U.C. Botanical Garden at Berkeley. Electronic mail from Holly Forbes to Valary Bloom (Service) in regards to slug deterrent measures at Baker's larkspur reintroduction sites. September 7, 2011.

Forbes, Holly. 2011*c*. Curator, U.C. Botanical Garden at Berkeley. Electronic mail from Holly Forbes to Valary Bloom (Service) in regards to success of seed set, threats to Baker's larkspur, and genetic introgression. September 23, 2011.