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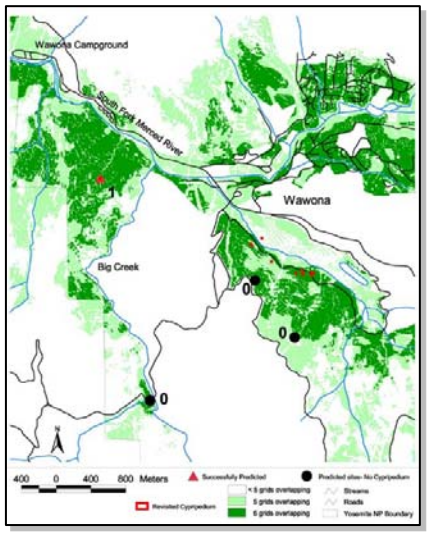
Special Status Vascular Plant Surveys and Habitat Modeling in Yosemite National Park, 2003–2004

Natural Resource Technical Report NPS/SIEN/NRTR—2010/389









ON THE COVER
USGS and NPS joint survey for Tompkins' sedge (*Carex tompkinsii*), south side Merced River, El Portal, Mariposa County, California (upper left); Yosemite onion (*Allium yosemitense*) (upper right); Yosemite lewisia (*Lewisia disepala*) (lower left); habitat model for mountain lady's slipper (*Cypripedium montanum*) in Yosemite National Park, California (lower right). Photographs by: Peggy E. Moore.

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Natural Resource Technical Report NPS/SIEN/NRTR—2010/389

Peggy E. Moore, Alison E. L. Colwell, and Charlotte L. Coulter

U.S. Geological Survey
Western Ecological Research Center
5083 Foresta Road
El Portal, California 95318

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Executive Summary

Yosemite National Park (Yosemite or 'the park') has long been the subject of botanical work aimed at describing the abundance and variety of plant life of the area. In spite of the degree to which the park's flora is understood, information on the current status of listed plant species has lagged in the past two decades. To address this need, the U.S. Geological Survey (USGS) entered into an agreement with the National Park Service (NPS) in 2003 to update information on listed species occurring in the park, to determine population status of the highest priority species, and to create predicted habitat models for a subset of those. This was one of the high-priority biological inventories identified and funded through the NPS Sierra Nevada Network Inventory & Monitoring Program's Biological Inventory Plan (NPS 2001), and the work was cost-shared between the NPS and USGS.

USGS worked with the park botanist to revise the park's special-status plant list, adding species newly documented in the park, those for which we uncovered evidence of occurrence, and new species listings. For each taxon, we provided information on listing status, distribution, habitat, elevation range, flowering period, and rationale for inclusion on the list. Following survey work in 2003 and 2004, we proposed additional candidates for the park list. These were compiled using the same procedure of evaluating evidence of occurrence, distribution, and listing information. The result is a list composed of 151 taxa that includes four state-listed species, 13 Forest Service Sensitive taxa, and 62 taxa listed by the California Native Plant Society (CNPS). The latter is a non-governmental organization widely accepted as the standard source of information on the rarity and endangerment status within the California flora. The remaining species on the park list are included for reasons of distribution and their contribution to the biological diversity of Yosemite.

Subsequent to the list revision, USGS used hand-drawn maps from the 1980s converted to digital format, available references, and herbarium specimen records, both recent and historic, as guides for surveying listed plant populations throughout the park in 2003 and 2004. We surveyed species according to a priority order established in consultation with the NPS, beginning with the four California State Rare species. We then proceeded through species listed by other federal agencies and CNPS, completing 163 surveys among 39 plant species during the two field seasons.

We collected detailed information on population size, location, and habitat at each of 127 populations. We collected specimens of plants underrepresented in the park herbarium and photographed each species along with its habitat. We documented nine species not previously known from the park and found a species of bog-orchid new to science.

Concurrently with field surveys to determine population status, USGS used mapped population perimeters and thematic data themes in a GIS environment (e.g., geology, vegetation, fire history) to map potential habitat for seven of the rare plant species we surveyed. Field verification ascertained that model accuracy ranged from 17% to 73%, depending on the species. Results served to increase the known distribution of short-leaved hulsea by 133% and mountain lady's slipper by 50%.

Acknowledgments

Dr. Dean Wm. Taylor, the foremost authority on the flora of the Yosemite region, shared his data, knowledge, and insights and brought several issues to our attention during this project. This directly resulted in locating, re-collecting, and describing a new species, the Yosemite bog-orchid (*Platanthera yosemitensis*). The National Park Service made existing survey and mapping data available to us, and the park botanist, Lisa Ordóñez, enthusiastically located and surveyed a number of populations. The Student Conservation Association provided a Conservation Associate, Angela Sanders, who was a superb botanical field assistant during the 2004 season. Yosemite Association (now Yosemite Conservancy) arranged for volunteer groups who assisted with surveys of short-leaved hulsea, slender lupine, Yosemite bulrush, and yellow daisy, each of which was significantly more effective with more searchers. The registrar at the Yosemite National Park museum, Miriam Luchans, worked cooperatively with us to accession new collections into the park herbarium. Paul Gallez, applications developer for Yosemite National Park, worked patiently and professionally with us on our database needs and developed a relational database with excellent input and output options for storage, management, and reporting of rare plant survey data.

1 - Introduction

Yosemite National Park (Yosemite or 'the park') covers over 300 square kilometers in Tuolumne, Mariposa, and Madera counties, California. It contains a diverse flora by virtue of its topographic heterogeneity, diverse ecological zones, geologic influences, and climatic and floristic history. It boasts a relatively undisturbed flora, in part resulting from protection as a national park beginning in 1890. Soon after Euro-American contact, the Yosemite region attracted the attention of botanists, many of them noted figures in American botany. It was through their efforts that the diversity of the region's flora was recognized. Their work, and that of those who followed, contributed to the recognition of the role that national parks such as Yosemite play in the preservation of North American biodiversity. Their work also remains useful today for describing the rarest components of the area's flora.

The park flora is richly, if incompletely, documented by collections residing at institutional herbaria. The botanists of the California Geological Survey were among the first to work in the Yosemite region. First William Brewer and then Henry Bolander collected many species for the first time, sending a number of what would become type specimens to Asa Gray and Sereno Watson at Harvard. Their work lives on in such names as Bolander's clover (*Trifolium bolanderi* A. Gray) and Brewer's draba (*Draba breweri* S. Watson). The likes of Willis Linn Jepson, Le Roy Abrams, Katherine Brandegee, Joseph Congdon, and Adele Grant made significant contributions in the early 1900s. H. L. Mason spent several summers with the Yosemite School of Field Natural History in the 1930s, collecting some of the park's most unusual plants. In the 1940s, John Thomas Howell and Carl Sharsmith collected widely with a keen interest in describing the region's flora. Nevertheless, until 2001, the only floristic treatment for Yosemite was Harvey Monroe Hall's and Carlotta Case Hall's (1912) *A Yosemite Flora*. Botti's (2001) *An Illustrated Flora of Yosemite National Park* is the most recent treatment. A very useful volume addressing the broader Yosemite region is in preparation (Taylor, in preparation). All of these resources serve to inform the management of Yosemite's rare plants today.

Even with access to herbarium records and plant manuals that are specific to the park, park managers have lacked information regarding current status and distribution of listed plant taxa. In most cases the most recent information on special-status plants dates from the 1980s. In a few cases (e.g., *Hulsea brevifolia*, *Piperia colemanii*, *Lupinus gracilentus*, *Orobanche californica* ssp. *grayana*), populations documented by specimens have never been surveyed. Lack of funding typically precluded botanical surveys except in connection with management actions. The National Park Service sought to address this situation by initiating biological inventories as part of the Natural Resources Inventory and Monitoring program (I&M). Their goal was to determine occurrence and status of vertebrates and vascular plants at all 270 national parks in the United States with significant natural resources.

1.1 Background

The NPS I&M program grouped national parks across the United States into 32 networks and, in 2000, initiated the inventory phase of the I&M program. The first task was to create a biological inventory plan to cover this five-year phase aimed at determining the status of vertebrates and vascular plants in U.S. national parks. Following I&M guidelines, Yosemite, Sequoia, Kings Canyon, and USGS staff produced the plan in 2001, defining goals, policy, and specific projects for implementation (NPS 2001). They followed a prescribed process to, first, determine the level

of knowledge regarding vertebrate and vascular plant occurrence in parks and then to address the status of species of special management concern. They interpreted the latter as special-status taxa and non-native plants and animals. Among the projects identified for Yosemite was determining the status of special-status vascular plant species. This report details the results of that two-year project implemented by the U.S. Geological Survey (USGS) under an inter-agency agreement with the National Park Service.

In 2003, USGS was tasked by the NPS Sierra Nevada Network I&M Program with revising the special-status vascular plant species list for Yosemite in cooperation with park staff, prioritizing species for surveys, creating a potential habitat model for high priority taxa and implementing surveys of documented populations. Working closely with the park botanist and vegetation ecologist, we revised the special-status plant list using the park's 1997 special-status plant list; a new list submitted to the park under contract in 2001; federal, state, and U.S. Forest Service (USFS) special-status plant lists; CNPS listings; specimen collections at regional herbaria; and other information. The consulting firm, Jones and Stokes Associates, Inc., provided the 2001 list to the park under a contract aimed at developing a list of special-status plant species both known to and likely to occur within each of the Sierra Nevada Network parks based on distribution and survey information, but it incorporated insufficient local occurrence information. During 2003–2004, we then surveyed populations of some of the highest priority taxa.

1.1.1 Existing Data

National Park Service Resource Management and Science staff members performed extensive surveys and mapped populations through much of Yosemite between 1980 and 1989. Today, these maps and hard copy data remain the best and most comprehensive source of information regarding Yosemite's rare plants. Park staff resurveyed a handful of species in 1999, focusing on a state-listed species at 2,000 ft, meadow species near Glacier Point Road, and alpine species near Tioga Pass. At least a portion of 1980s survey data and of 1999 survey data are available in park files.

Population location maps from the 1980s consist of hand-drawn polygons on USGS 15-minute quadrangles. These were digitized into a raster-based geographic information system (GIS) and converted from raster in the late 1990s to a vector-based format (ArcInfo [ESRI 2002]). A set of 15-minute quadrangles with hand-drawn species locations remains in resource management files for reference. They may be the original maps or hand-drawn copies. A technician with the park's Resource Management and Science staff transcribed hand-drawn locations onto 7.5-minute quadrangles, but source data for some locations appears to be lacking.

Occurrence information for some taxa was submitted to the California Natural Diversity Database (CNDDB) following surveys in the 1980s. The Database is a member of NatureServe, the nationwide network of natural heritage programs, and it stores natural history and location information on rare, threatened, endangered, and special-status species and natural communities. With the exception of a few El Portal populations, submissions to the CNDDB do not appear to have been updated since the 1980s surveys.

1.2 Study Area

Yosemite National Park is a 302,768 ha (748,156 acre) reserve located in the central Sierra Nevada of California. It ranges in elevation from 640 m (2,100 ft) in the Merced River Canyon

to nearly 4,000 m (13,114 ft) atop Mt. Lyell. The park comprises two major watersheds, the Merced River in the south and the Tuolumne River in the north, and completely encompasses the headwaters of each. During late Cenozoic uplift of the range, river gradients steepened creating deeply incised river canyons on both the western and eastern slopes. Subsequent glaciers during the Pleistocene broadened some valleys and further shaped the landscape seen today.

The park lies entirely on the gentle western slope of the Sierra Nevada, the crest of the range defining the eastern park boundary and the beginning of the steep eastern escarpment. Yosemite is famous for massive granite walls and domes, and granitic rock dominates park geology. Metamorphic rock occurs along the western boundary in the foothills and along the southeastern and eastern boundaries (Sierra Nevada crest). Metamorphics along the western boundary are largely sedimentary in origin, while the eastern belt along the crest is composed of both metasedimentary and metavolcanic rock. Erosional processes that formed the deeply incised landscape also removed 95% of metamorphics that once overlaid the intruding plutonic rock (Huber 1987). The result is a sparse, scattered distribution of metamorphics within the park. Volcanic rock is even less common with Rancheria Mountain (and smaller points north and west), Little Devil's Postpile west of Tuolumne Meadows and the south side of Merced Pass being notable locations.

Two-thirds of Yosemite lies between 2,100 m and 3,050 m (6,890 and 10,000 ft) elevation where the vegetation is predominantly mixed coniferous, montane, and subalpine forests. These forests, as well as lower-elevation pine and oak woodlands, are interrupted by sparsely vegetated bedrock slopes and domes, reflecting widespread glacial influence on the landscape.

A total of 215 different plant associations currently are recognized for the park and adjacent areas, 114 at the dominant species or alliance level of classification (Keeler-Wolf et al. 2007). These include an annual grass association in the foothills, montane chaparral types, towering forests of giant sequoia and sugar pine in the montane zone, and diminutive cushion plants in the alpine. There are more than 1,500 plant taxa documented from the park, a number of them local or regional endemics.

The El Portal Administrative Site is a 460 ha (1138 acre) area in the Merced River canyon owned and managed by the National Park Service for administrative purposes. It is contiguous with the western park boundary and ranges in elevation from 500 to 1,000 m (1,640 to 3,280 ft). We treated it as a portion of the park for the purpose of this project.

2 - Special-Status Plant Species List Revision

From fall 2002 to spring 2003, we worked with the park botanist to finalize a new special-status vascular plant species list for Yosemite. Details of the 2003 revision are in an unpublished report titled *Special Status Vascular Plant List for Yosemite National Park* and provided to NPS in spring 2003. In brief, we began with a draft list provided under contract in November 2001 and with the park's 1997 sensitive plant list. We modified entries regarding occurrence for taxa listed as not known to occur in the park but for which we found voucher records from regional herbaria (a total of 15 taxa). We modified entries for some taxa listed as occurring in the park but for which no evidence could be found and where the source of occurrence information was misquoted or were unreliable reports. We added taxa occurring in Yosemite that have listing status with the CNPS and added to the watch list several taxa expected to occur in the park but for which no evidence was yet available. For each taxon, we provided information on listing status, distribution, habitat, elevation range, flowering period and rationale for inclusion on the list. In the same database, we provided fairly detailed documentation on information sources, using standard rationales and standard sources of occurrence information.

Following survey work in 2003 and 2004, we presented additional candidates for listing to park staff. Using the same procedure of evaluating evidence of occurrence, distribution and listing information, we considered rationales for park listing and added 17 taxa to Yosemite's sensitive plant list. We deleted one taxon and added three taxa to the watch list of potentially occurring species. Our collections and historic collections formed the basis of evidence for the additions.

In addition to federal and state listing status, Yosemite has traditionally tracked the listing of park taxa by the California Native Plant Society, a non-governmental organization. The CNPS is active in compiling listing petitions for consideration by the U.S. Fish and Wildlife Service (USFWS) and the State of California. In addition, the organization develops information on the distribution, ecology, and conservation status of California's rare plants and has developed a reputation for scientific accuracy. The organization's data are widely accepted as the standard for information on the rarity and endangerment status of California plants. Among Yosemite plants, CNPS list 1B (rare, threatened, or endangered in California and elsewhere) overlaps entirely with taxa listed by the State of California, the USFWS, and/or the Forest Service. Other CNPS listings highlight rarity in California for taxa more common elsewhere (CNPS list 2), species about which more information is needed (CNPS list 3) and species of limited distribution in the state (CNPS list 4). We used listing by the CNPS, therefore, as one of the primary rationales for park listing.

Other rationales for including taxa on the Yosemite special-status plant list include listing by Region 5 (California) of the Forest Service and five categories of park 'sensitive' that relate to distribution. These additional rationales are:

1. Limited distribution in Yosemite National Park and California
2. Sierra Nevada endemism
3. Limited distribution in California but common in Yosemite
4. Wide distribution in California but limited distribution in Yosemite

5. A rationale that originated with the author of the 2001 draft list: widespread but uncommon/poorly documented in California/common in Yosemite (4 taxa)

With the 2004 additions, the Yosemite special-status vascular plant list has 90 taxa that are listed only on the park list ('park sensitive') and 61 taxa that are park sensitive and also listed by another organization or agency. The resulting lists of taxa serve as institutional memory regarding 151 species of limited distribution that occur in the park and 44 species that potentially occur and should be useful for protection, management, and planning. Information on each taxon listed is stored in Microsoft Access (Redmond, Washington) file "Special Status Plant Species List-Yosemite 2004." There are separate tables in the database for 1) the special-status plant species with evidence of occurrence in Yosemite and 2) the 'watch' list of taxa that are expected to occur in the park based on available habitat and occurrence nearby. We included metadata for the tables in the report mentioned above and also in stand-alone MS Word documents titled, "Special Status Vascular Plant Species List for YNP-2003.doc" and "Watch List-potentially occurring Spec Status Plant Spp for YNP.doc." The latter are available via links in the database.

2.1 Prioritization for Surveys

As indicated above, we categorized each of the taxa on the "Special Status Vascular Plant Species List for YNP-2003" (the version available prior to survey work described in this report) according to a list of 14 standardized rationales for inclusion on the list. The rationales indicate listing status among several governmental and nongovernmental entities as well as rationales for park-sensitive status. We took the rationales for including taxa on the park list and placed them in an order to indicate the priority level for collecting and maintaining survey data (Table 1). See the unpublished report titled *Special Status Vascular Plant List for Yosemite National Park* for details on listing status categories, NPS policy regarding plants listed by other non-federal agencies, and explanations for the various rationales for park-sensitive status.

Table 1. Rationales for including taxa on "Special Status Vascular Plant Species List for YNP-2004" in field survey priority order with number of taxa falling into each priority category. Some taxa have designated status by multiple agencies or organizations (e.g., California State Rare and CNPS List 1B). In those cases, the effective priority category is the highest one that applies to a species.

Rationale no/ Survey Priority Category	Rationale/Survey Priority Category	Taxon Count by Priority Category	Taxon Count by Effective Priority Category
1	FT or FE: Federally listed as Threatened or Endangered	0	0
2	CR or CE: California Rare or Endangered	4	4
3	FSS - Forest Service Sensitive	13	10
4	CNPS List 1B	16	4
5	CNPS List 2	13	13
6	FSC or SLC: USFWS Species of Concern or Species of Local Concern[1]	10 and 2	0
7	CNPS List 3	2	1
8	CNPS List 4	31	27
9	Limited distribution in YNP and CA	25	23
10	SN endemic	20	6
11	Limited distribution in CA/common in YNP	3	3
12	Forest Service Watch list	20	1
13	Wide distribution in CA/limited distribution in YNP	43	42
14	Widespread but uncommon/poorly documented in CA/common in YNP	4	4

[1] The Sacramento Office of the U.S. Fish and Wildlife Service no longer maintains a list of Species of Concern or Species of Local Concern.

3 - Field Surveys

3.1 Introduction and Strategy

For each taxon, we considered survey priority level, flowering season, elevation, known distribution, and access issues in planning survey strategy and timing. We planned the sequence of surveys to coincide with the flowering period of each species, whenever possible, to maximize species detection and survey accuracy.

We surveyed mainly taxa considered high priority for determining current status. These included state-listed species, species with limited distribution throughout their range (e.g., CNPS List 1B), species with limited distribution in California but more common elsewhere (CNPS List 2), and species listed by Region 5 of the Forest Service as sensitive. We surveyed some lower priority taxa because of co-occurrence with high-survey-priority taxa or for other practical reasons.

We balanced the need for starting as early as possible in the spring to take advantage of the foothill flowering period with the need for field season wrap-up in the autumn and funding limitations. Survey staff began work in April 2003 and in May 2004. Available funding covered staff through September in both years. The largest compromise was thoroughly surveying state-listed, and therefore CNPS List 1B, taxa in the Merced River Canyon in 2003 at the expense of two Forest Service sensitive species in the Hetch Hetchy area (which were also federal species of concern at the time). We wanted to provide NPS with the best information we could gather on the species in the El Portal area where further planning and development will be underway soon. The status of these four species as state-listed taxa also made them higher priority than those in the Tuolumne River Canyon. The two monkeyflowers in the Hetch Hetchy area are ephemeral annuals that could not be surveyed later in the season.

In terms of floristic authorities, we referenced the state-wide flora, The Jepson manual: Higher plants of California (Hickman 1993). Where taxonomic issues were not addressed in Hickman, we followed newer published treatments (e.g., for the new species *Piperia colemanii*). Two exceptions were our use of revisions recently published in the Flora of North American for *Scirpus subterminalis* (revised to *Schoenoplectus subterminalis*) and *Potamogeton epihydrus* ssp. *nuttallii* (revised to *Potamogeton epihydrus*) (see Appendix C).

3.1.1 Relocating Documented Populations

We reviewed California Department of Fish and Game (CDFG) Natural Diversity Database (CDFG 2003a) element occurrences (i.e., special-status plant occurrences), NPS survey data from 1980 to the present, GIS data, and herbarium specimen information from local and regional herbaria to identify known locations of target species. There were occurrences in the NPS files that we did not find in the CNDDB stand-alone database, RAREFIND (CDFG 2003a), for reasons that remain unclear (most early surveys were reported to CNDDB). We relocated previously mapped populations using GIS maps of population perimeters, USGS 7.5 minute topographic quadrangles, and 1997 aerial photographs. We relocated populations not included in the park GIS data but for which surveys had been completed and locations described and hand mapped in the 1980s. Some sites were relocated using plant specimen data from herbaria by using place names indicated on herbarium labels.

Inevitably, efforts to relocate populations based on single-plant collections produced far fewer precise locations than efforts based on mapped populations. In the case of a *Hulsea brevifolia* collection from the vicinity of Smokey Jack (historic) Campground (D. W. Taylor 10020, 30 July 1988, JEPS112701), the place name along Tioga Road was sufficient to relocate the population. In the case of a *H. brevifolia* collection from Porcupine Flat (C. W. Sharsmith 6918, 10 Aug 1962, SJSC3626), the location could be construed as within the approximately 300 m by 450 m (980 ft by 1,475 ft) "flat" at the currently labeled place name, or anywhere within the approximately 250 ha gently sloping area of upper Porcupine Creek, or even farther afield. The older the collection, the more difficult it was to have confidence in the location because of the quality of maps from the late 1800s and early 1900s and the smaller scale of the early maps. Also, many herbarium labels do not include distance and direction from place names mentioned. As a result, our lack of success finding a *H. brevifolia* population at Porcupine Flat could indicate it is no longer extant or that our search area around the stated place name was not large enough.

3.1.2 Locating New Populations

We located new populations of special-status plant species using several strategies. Following surveys of documented populations, we used global positioning system (GPS) technology to map the populations. We then used these maps to define habitat parameters from available GIS data and used a predictive habitat model to identify additional areas of potential habitat (see description of the habitat modeling exercise below, in Section 4.1). Botanists surveyed areas of potential habitat and mapped populations found. In early 2003, the modeling approach was in its earliest development. Therefore, for *Carex tompkinsii*, we first surveyed areas known to support stands. Then we applied our experience with these areas to identify areas of likely habitat for this plant in the El Portal area using USGS topographic quadrangles.

In addition, we serendipitously discovered undocumented special-status plant populations of a number of species during survey efforts. These included populations of aquatic taxa found while surveying for other aquatics, and of herbaceous and woody taxa found during other survey efforts (e.g., *Hulsea brevifolia*, *Vaccinium parvifolium*). We were able to survey many of these when we happened upon them or at a later date. One exception was the small parasitic plant, *Cuscuta suksdorfii*, collected at Soda Springs and identified by Mihai Costea of Wilfrid Laurier University in Waterloo, Ontario, contributor to the revision of *The Jepson Manual* currently under preparation. We listed additional unsurveyed taxa we found in a database detailing species, location, observers and date found in a separate database for reporting to the NPS ("PlantObs.mdb").

3.2 Species Surveyed and Justification

In consideration of the prioritization criteria that placed federally and state-listed species first and second in priority, our earliest surveys focused on the four state-listed species occurring within the park's jurisdiction: *Allium yosemitense*, *Carex tompkinsii*, *Eriophyllum congdonii*, and *Lewisia congdonii* (Table 2). No federally listed taxa are known or expected to occur in Yosemite National Park at this time, and federal species of concern, an unofficial listing produced and tracked by the USFWS Sacramento Office at the time of these surveys, followed in priority order after state-listed, Forest Service Sensitive, and some CNPSlisted taxa. We completed surveys of known locations for all four state-listed taxa and some predicted habitat locations for *Eriophyllum congdonii*.

3.2.1 Forest Service Sensitive

Taxa listed as sensitive by USFS Region 5, assumed third priority (www.fs.fed.us/r5/projects/sensitive-species). Three of those taxa were state-listed as rare and were surveyed among the highest priority taxa. Of the remaining 10 taxa, we surveyed all or most of the known locations of *Eriophyllum nubigenum*, *Hulsea brevifolia*, and *Trifolium bolanderi*. We surveyed all of the mapped locations of *Cypripedium montanum* and some of those for *Mimulus filicaulis* and *Mimulus pulchellus*. We visited the sole *Clarkia australis* location known from the park in both years. We surveyed four locations for *Lupinus gracilentus*, a species endemic to the upper Tuolumne River watershed. One survey site for *Lupinus gracilentus* was based on a mapped location, two were based on herbarium collection localities, and one was an opportune encounter. There are approximately eight localities in the park based on various sources, but some of them are vaguely described.

We had insufficient information available on population locations and habitat characteristics for two Forest Service Sensitive taxa, *Allium tribracteatum* and *Camissonia sierrae* ssp. *alticola*, to implement efficient surveys. We found five herbarium records for park collections of *A. tribracteatum* (Mason 12026, 25 July 1938, UC1199838, CNDDB occurrence #7 plus four other putative collections from the same vicinity and two other localities). The Mason collection location was at 9,300 ft on Bailey Ridge in a remote area northeast of Lake Vernon. Hickman (1993) indicates the habitat is "volcanic slopes," though no volcanic features are mapped on Bailey Ridge or the other localities within the park. Taylor (in preparation) indicates habitat is "barren, stony ridges underlain by mud flow breccia, and other open sites." We arranged for Dale McNeal to annotate the Yosemite Museum specimens, and he found them all to be *Allium obtusum* var. *obtusum*. The Mason collection from Bailey Ridge within Yosemite is apparently accurate because McNeal has seen the specimen and confirmed that it is *A. tribracteatum*, and its locality is consistent with Mason's prior and subsequent collection localities around the collection date. Once the apparent validity of the Bailey Ridge locality was ascertained in 2004, it was well past the period of flowering for *A. tribracteatum*.

We located only one herbarium record with a park location for *Camissonia sierrae* ssp. *alticola*, a 1909 W.L. Jepson collection from Merced Lake (JEPS31719), and the CNPS (Tibor 2001) indicates the collection needs verification. Dean W. Taylor (personal communications, consulting botanist, Aptos, California) indicated that Peter Raven has seen specimens from Little Yosemite Valley but that the center of distribution is Mono Hot Springs (Fresno County) where plants occur in a carbonate thermal spring system and that species identification is difficult to impossible depending on the stature of plants in a particular year. There is extensive habitat in Yosemite as described in Hickman (1993), "granite outcrops, ponderosa-pine or foothill-pine/blue-oak forests," and little information available to narrow the search.

Table 2. Taxa from the Yosemite 2003 special status vascular plant species list with the highest survey priority.

Scientific Name	Common Name	Family	Survey Priority	USFWS	USFS	Calif. State	CNPS
Allium yosemitense	Yosemite onion	Liliaceae	2		FSS	CR	1B
Carex tompkinsii	Tompkins' sedge	Cyperaceae	2		FSW	CR	4
Eriophyllum congdonii	Congdon's woolly sunflower	Asteraceae	2	FSC	FSS	CR	1B
Lewisia congdonii	Congdon's lewisia	Portulacaceae	2		FSS	CR	1B
Cypripedium montanum	mountain lady's slipper	Orchidaceae	3		FSS		4
Allium tribracteatum	three-bracted onion	Liliaceae	3	FSC	FSS		1B
Clarkia australis	Small's southern clarkia	Onagraceae	3	FSC	FSS		1B
Eriophyllum nubigenum	Yosemite woolly sunflower	Asteraceae	3	FSC	FSS		1B
Hulsea brevifolia	short-leaved hulsea	Asteraceae	3	SLC	FSS		1B
Camissonia sierrae ssp. *alticola*	Mono Hot Springs evening-primrose	Onagraceae	3	FSC	FSS		1B
Trifolium bolanderi	Bolander's clover	Fabaceae	3	FSC	FSS		1B
Mimulus pulchellus	pansy monkey-flower	Scrophulariaceae	3	FSC	FSS		1B
Mimulus filicaulis	slender-stemmed monkeyflower	Scrophulariaceae	3	FSC	FSS		1B
Lewisia disepala	Yosemite lewisia	Portulacaceae	3	FSC	FSS		1B
Lomatium congdonii	Congdon's lomatium	Apiaceae	4	FSC			1B
Lupinus gracilentus	slender lupine	Fabaceae	4		FSW, FSS		1B
Plagiobothrys torreyi var. *torreyi*	Yosemite popcorn-flower	Boraginaceae	4	SLC			1B
Agrostis humilis	mountain bent grass	Poaceae	5		FSW		2
Carex praticola	meadow sedge	Cyperaceae	5				2
Carex limosa	shore sedge	Cyperaceae	5				2
Carex scirpoidea var. *pseudoscirpoidea*	single-spiked sedge	Cyperaceae	5				2
Draba praealta	subalpine draba	Brassicaceae	5				2
Festuca minutiflora	small-flowered fescue	Poaceae	5				2
Rhynchospora alba	white beaked-rush	Cyperaceae	5				2
Viburnum ellipticum	common viburnum	Caprifoliaceae	5				2
Potamogeton epihydrus ssp. *nuttallii*	Nuttall's pondweed	Potamoget.	5		FSW		2
Claytonia megarhiza	fell-fields claytonia	Portulacaceae	5		FSW		2
Salix reticulata ssp. *nivalis*	snow willow	Salicaceae	5		FSW		2
Potamogeton robbinsii	Robbins' pondweed	Potamoget.	5				2

FSC and SLC: U.S. Fish and Wildlife Service, Sacramento Office, Species of Concern and Species of Local Concern[1]
FSS and FSW: Forest Service, Region 5, Sensitive Plant List or Forest Service Watch list on local forest
CR: Listed by the State of California as rare
CNPS List 1B: Rare, threatened, or endangered in California and elsewhere
CNPS List 2: Plants rare, threatened, or endangered in California, but more common elsewhere
CNPS List 4: Species of limited distribution (a watch list)

[1] The Sacramento Office of the U.S. Fish and Wildlife Service no longer maintains a list of Species of Concern or Species of Local Concern as of some time after 2005.

We completed no more than three *Lewisia disepala* surveys in 2004 because the flowering period begins prior to survey staff becoming available in the spring. Flowering begins immediately after localized snowmelt and lasts only a short time after granitic-dome habitats are snow free, approximately March to April. We were able to survey only until May 27, after which seed set was well progressed and all above-ground parts were senescing and blowing away. Few threats have been identified for this species, and populations occur throughout most dome habitat around Yosemite Valley.

3.2.2. California Native Plant Society (CNPS) List 1B: Rare, Threatened, or Endangered in California and Elsewhere

In addition to the 13 CNPS List 1B taxa that are state listed as rare or Forest Service Sensitive, there are only two additional CNPS List 1B species on the park list, *Lomatium congdonii* and *Plagiobothrys torreyi* var. *torreyi*. We did not attempt surveys for *Lomatium congdonii*. Botti (2001) reports *Lomatium congdonii*, an endemic of Mariposa and Tuolumne counties, as occurring in Yosemite at Miguel Meadow near Swamp Lake and in the El Portal Administrative Site. We have located no collection records to verify this, and these two locations do not contain the serpentine chaparral or woodland habitat typical for this taxon. We await further evidence of occurrence prior to attempting surveys.

Plagiobothrys torreyi var. *torreyi* is known only from the 1885 type specimen from Yosemite Valley with no more recent collections according to Taylor (in preparation). It is still extant at the type locality of Yosemite Valley at three stations according to Botti (2001). In spite of the contradictions in botanical references, both according to its occurrence and its distinctness, we surveyed a site in Yosemite Valley in 2004 and found a robust population of the putative *P. torreyi* var. *torreyi*. *P. torreyi* var. *diffusus* occurs in our area, and the appearance of herbarium specimens might suggest differences in habit over differences in genetic distinctiveness. We are trying to interest a taxonomic specialist in the issue and are referring him to our specimens as well as those at Yosemite Museum and UC/Jepson.

3.2.3. California Native Plant Society (CNPS) List 2: Rare, Threatened, or Endangered in California, but More Common Elsewhere

We undertook surveys for *Potamogeton robbinsii* at both known locations in the park, Westfall Meadows and Swamp Lake. *Potamogeton epihydrus* ssp. *nuttallii* is known in Yosemite from a single, early collection from Yosemite Valley (Bolander 6393, August 1866, UC354). Our survey resulted from a discovery of the species during a survey for *P. robbinsii*. *Rhynchospora alba* is reported from Yosemite Valley (Botti 2001, probably citing H. L. Mason, *A Flora of the Marshes of California*), but no voucher record has yet been located and we made no attempt at surveys. *Claytonia megarhiza* and *Festuca minutiflora* are both alpine species with scattered locations throughout the alpine zone and along the crest, respectively. We did not attempt surveys for either species because of the time required to access far-flung localities and the lack of threats. We surveyed all known localities of *Agrostis humilis*, *Carex limosa*, and *Draba praealta* and added a List 2 species to the park list.

Several List 2 taxa are known from fewer than five locations in the park and were not surveyed: *Carex scirpoidea* var. *pseudoscirpoidea*, *Salix reticulata* ssp. *nivalis*, and *Viburnum elipticum*. Each is known from one to two sites. *V. elipticum* is known in the park from a single collection at Wawona Golf Course on June 1, 1930 and has not been relocated. Taylor (in preparation)

indicates it is expected in our area. *C. scirpoidea* var. *pseudoscirpoidea* is reported from two locations in the Mt. Dana area, *S. reticulata* ssp. *nivalis* from just one site within the park.

We have no record of any park collections for *Carex praticola*, but Botti (2001) indicates it is reported from the H.M. Hall Research Natural Area, and Taylor (in preparation) lists two D.D. Keck collections from the summit of Mt. Conness and the White Mountain summit, both at the eastern park boundary. We did not visit those localities.

3.2.4 California Native Plant Society (CNPS) List 3: More Information Needed (Review List)

There are only two CNPS List 3 species known to occur in Yosemite: *Jensia yosemitana* (syn. *Madia y.*) and *Pseudostellaria sierrae*. The type locality for *J. yosemitana* is the base of upper Yosemite Falls, and it is also known from approximately five additional localities, mostly in the Hetch Hetchy vicinity. *P. sierrae* is a newly described species with a locality in the park. We did not have an opportunity to survey either species.

3.2.5 California Native Plant Society (CNPS) List 4: Limited Distribution (Watch List)

We surveyed one of two mapped sites for *Ivesia unguiculata* and documented five additional populations. We did not survey Westfall Meadows for *Ivesia*. We invested time in this slightly lower-priority species because of its co-occurrence with *Trifolium bolanderi*. *Sparganium natans* was known previously from three park locations north of Hetch Hetchy. We discovered a new location near Glacier Point Road during a survey for *Potamogeton robbinsii*, a CNPS List 2 species, but did not visit other localities. We did not survey the one known locality for *Stellaria obtusa* north of Beehive, but, because we had the opportunity, surveyed two sites for *Bolandra californica*, one site for *Carex buxbaumii*, one of two known localities for *Lycopus uniflorus*, and one reported locality for *Piperia colemanii*.

3.2.6 Park Sensitive

Taxa with this assigned status fell to lowest priority for surveys. Among the 90 taxa listed only on the park list, we opportunistically surveyed the only known park occurrence for *Erigeron linearis*, one of four known sites for *Scirpus clementis*, one of four for *Epipactis gigantea*, and conducted single surveys for several other taxa.

3.3 Data collection

We surveyed mapped populations, herbarium specimen localities, locations listed in available references, and other appropriate habitat. We relocated mapped populations using GIS maps, 7.5 minute topographic quadrangles, Trimble Pathfinder Pro XR global positioning system units, and 1997 aerial photographs (1:15,840 scale). We surveyed areas with previously mapped or reported populations that were entirely or partially contained within Yosemite National Park or within the El Portal Administrative Unit. We conducted surveys in a methodical way to ensure entire survey areas were checked for the presence of the species of interest. We made complete censuses of small populations. Large, extensive populations were surveyed with teams spread out across slopes of appropriate habitat. Surveyors walked belt transects within the target area that were no wider than the width over which the species could be easily detected. The width varied depending on the species stature and phenological stage. Survey belts were contiguous and spanned the length of the surveyed area. We made larger population estimates using subsample counts of homogeneous densities within 1 to 20 m^2 areas and applying those counts to mapped

areas with the same density. We surveyed predicted habitat in a similar manner, ensuring that the entire predicted area was viewed and carefully checked for species presence.

3.3.1 Survey Information

For each population found, we recorded the total estimated population size (number of plants), its absolute percent cover of the ground surface, whether or not the survey was subsequent to an earlier survey, the species distribution within the population, whether or not it represented a CNDDB occurrence, and whether or not we collected a specimen (field form available in Appendix A). Species distribution within the population was categorized as scattered individuals, scattered small clumps, large clumps, or widespread throughout. We also estimated the proportion of the population in vegetative, flowering, or fruiting stage. We adapted the methods and field survey form from the California Native Species Field Survey Form of the CNDBB (CDFG 2003b) and the Standard Field Form for Data Collection of Grossman et al. (1998).

We considered plants or groups of plants within 0.5 km (0.3 mi) of each other to be within the same population. We surveyed and mapped stands farther than 0.5 km apart as separate populations. If plants occurred in very distinct stands but within 0.5 km of each other, we sometimes mapped distinct stands but assigned them the same survey code and treated them as one population. We refer to a stand or stands when we refer to portions of populations or have insufficient evidence that a stand represents an entire population.

Mapping: Field staff used Trimble Pathfinder Pro XR Global Positioning System (GPS) units to map population perimeters. Position Dilution of Precision (PDOP, a measure of the quality of satellite geometry and a reflection of positional accuracy) was set to 6 to maximize positional accuracy. GPS data were downloaded from Trimble units to a PC desktop computer and post-processed with downloaded Trimble base station data from the Forest Service Remote Sensing Lab in Sacramento. We post-processed field GPS data to correct positions to 1–2 m (3.3–6.6 ft) accuracy using Trimble Pathfinder Office v2.9 software. We exported corrected GPS data to ArcView (ESRI 2002) shape file format and imported resulting files into a single data theme reserved for mapped populations ("Rare_plants-2004"). We labeled each polygon in the "Rare_plants-2004" theme with the species name, species code, survey code, survey date, source of data (USGS, NPS), Universal Transverse Mercator (UTM) coordinates (easting and northing) of population center (UTM Zone 11, NAD27 Datum), number of discreet polygons used to map the population, and spatial extent of the population (m^2 and ha).

We documented our survey effort, whether for known populations or for potential habitat, in terms of person hours spent searching, size of area searched, whether the search area was mapped, the percent of the mapped survey area that was searched, and a description of the area(s) surveyed. We mapped areas surveyed by collecting GPS points on survey area perimeters, by hand drawing maps on overlays of 1997 1:15,840 aerial photographs, or by doing both. The survey areas were then digitized into a GIS theme named "Area_surveyed" using ArcView v3.3 (ESRI 2002). Heads-up digitizing of the survey areas was accomplished by displaying hydrographic and topographic GIS themes, digital raster graphs showing landscape features, and Digital Ortho Quarter Quads (DOQQs) from 1993. We compared the DOQQs and other information with the 1997 photograph on which the survey perimeter had been mapped and any GPS perimeter points collected. With this information we then hand digitized the survey

perimeter. Each polygon in the "Area_surveyed" theme is labeled with the target species name, survey date, survey code, and survey area size (m^2, ha, and acres).

In addition to mapping the population location with GPS units and storing the result in a GIS theme, we recorded location information separately for permanent storage with the population and habitat data. These location data included a place name, county, landowner, USGS 7.5 minute topographic quadrangle name, and UTM coordinates of the population center. We derived UTM coordinates from either the approximate center of the GPS-mapped polygon or, in a handful of cases, from a GPS point taken from the approximate center of small populations. For each population coordinate, we recorded UTM easting, northing, UTM zone, datum, source of coordinates (GPS, 7.5 minute topographic quadrangle, ArcView Polygon Centroid), and GPS make, model, and unit number.

At each population, we took both transparency and digital (2.0 or, less often, 3.34 megapixel, jpg format) images of the special-status plant, its habitat, and, in most cases, the plot to characterize it and assist with relocation. We recorded the camera used and exposures taken to assist with labeling. We seldom photographed diagnostic features of special-status plants because of equipment limitations (lack of macro lenses, tripod). We labeled each transparency and digital image with subject, location, survey code, photographer, and date. In addition, transparencies were labeled with county and park name. This same photograph information is stored in a table named "SurveyPhotographs" (see Appendix B, Table B7).

We categorized overall site quality as excellent, good, fair, or poor and noted any current land use in the vicinity, any visible disturbances, and any apparent threats to the species or the site. We included comments and observations related to any of these.

Habitat Data: We established plots within populations and largely followed the methods of Grossman et al. (1998) to characterize rare species habitats. Plots were subjectively placed in characteristic habitat within the population. The standard size and shape of plots was 20 by 20 m^2, but plot shapes and sizes were adjusted where necessary (and recorded for each site) to scale to the population and habitat being characterized. We collected information on physical site characteristics, substrate, vegetation characteristics, and associated species.

More specifically, we characterized the topography and physiography in terms of elevation (m), slope steepness (degrees), slope aspect (degrees), topographic position, landform at three different scales, and surficial geology. We categorized sites into hydrologic regimes (Cowardin et al. 1979) where appropriate, including riverine, palustrine, and lacustrine systems, along with nontidal water regime modifiers from saturated to permanently flooded. We wrote site descriptions to have summary descriptions of sites for herbarium labels. Percent-cover values were assigned to seven categories of unvegetated ground surface to characterize the growing substrate: bedrock, large rocks, small rocks, sand, litter/duff, wood, and bare soil. To further characterize the growing medium, we placed the soil texture into one of 11 categories and soil drainage into one of six categories (Appendix A).

Surveyors noted the leaf habit (evergreen, cold deciduous, etc.), leaf type (broad-leaved, needle-leaved, etc.), physiognomic class of the site and determined the plant community to the alliance

or association using a semi-dichotomous key (Keeler-Wolf et al. 2007). They then described vegetation structure by noting dominant species in each of six vegetation strata (emergent tree, canopy tree, subcanopy tree, shrub, herbaceous, nonvascular) and assigning a cover class to each stratum (0%–1%, >1%–5%, >5%–25%, >25%–50%, >50%–75%, >75%). Associated species were compiled into a simple list with general vegetation stratum noted and cover class assigned to each species. Finally, surveyors summarized total vegetative cover with one cover class assignment and a separate overall cover class for non-native species.

Plant collections: Plant collections were a key aspect of the survey project serving to provide for accurate identification, to document and permanently voucher species on survey sites, and to add to the knowledge of species distributions in the park. Project botanists collected specimens of selected species for the purpose of accurate identification using additional time and tools available in a lab setting (for a complete list of collections, see the table "YOSE-6809-2003-4Coll'ns" in a database titled "2003-4CollForNPspecies_YM.mdb"). Specimen collections generally followed the voucher policy in the Sierra Nevada Network Biological Inventory Plan (NPS 2001:31). The policy specifies that investigators will be required to collect adequate vouchers to document species occurrence. We interpreted this to include documenting overall species composition on survey sites as well as new locations for special-status plant species. The policy also specifies, for locally rare species (i.e., park-sensitive only), that a "voucher should only be collected if at least…25 individuals of a plant species are present at a given sample site." We made collections of locally rare species well within the bounds of this policy.

Plant specimen preparation and labeling were done in accordance with NPS guidelines in the Biological Inventory Plan (NPS 2001). The NPS specified that "voucher preparation will be the responsibility of inventory [investigators]." We pressed, dried, mounted, and labeled all specimens collected that were sufficient to mount (a few specimens of associated species were too depauperate for mounting). In recognition that all vouchers taken on NPS lands are the property of the NPS, we are submitting prepared vouchers to the Yosemite National Park herbarium (YM) for permanent storage and some duplicates to University/Jepson herbaria for long-term loan.

3.3.2 Data Management

Surveyors recorded data in the field on a four page data form (Appendix A) and later transcribed them into a Microsoft Access database titled "SpecStatPlantSurveys-2003-4.mdb." We created the Access database during the first field season to meet our needs for efficiently storing survey data, plant collection details, and survey photograph information. We included the capability of producing herbarium specimen labels as well. We began working with the Yosemite National Park applications developer during the 2004 field season to create a database that more stringently met data management quality standards and to address the need for NPS managers to add survey data in the future. The title of that database is California Native Species Field Survey Report (file name "CNSFSR.mdb"), and we imported all data from the original, draft database.

4 - Potential Habitat Mapping

4.1 Introduction

The National Park Service tasked us with providing spatial distribution models of potential habitat for a few of the highest priority special-status plant species in Yosemite. Additional surveying has the proven advantage of expanding distribution information on listed species in the park (this work). In addition, rare plant species periodically are added to the park list. Whether for species known to have limited distribution in the park or for species with newly recognized status or park occurrence, potential habitat maps allow managers to use resources more efficiently by directing survey efforts to the most likely habitats.

We developed an approach using mapped population perimeters for the species of interest and available spatial data on habitat characteristics to identify areas of potential rare plant habitat. We surveyed random portions of potential habitat, collected information on populations found, and estimated accuracy of the maps based on survey results.

Climatic, edaphic, and biotic factors, among others, affect the distribution of plant species (Good 1931, 1953). Spatial data on evaporative demand and available moisture (Stephenson 1990, 1998), soil characteristics (e.g., depth, texture, pH, nutrient status), and biotic factors would be the most powerful predictors of potential plant habitat. Lacking these, we used topographic characteristics, surficial geology, and vegetation type to serve as the best available surrogates. Vegetation type, mapped to 0.5 ha resolution, was the best available integrator of habitat factors that influence plant species distributions. In addition, digital elevation models (DEMs) provided topographic factors such as elevation and aspect, and surficial geology provided some indication of substrate characteristics.

Additional factors influencing species distributions include agents of ecological change (a.k.a. disturbance) and competition. Fire history was the most comprehensive available spatial data on disturbance. We did not use flood data because they were too limited spatially and temporally; that is, they were available only for 1997 in the form of aerial photography. Related to competition, canopy closure was the best available indicator of plant density and shading. It was interpreted from aerial photography and assigned to one of six classes (<2%, 2%–10%, 11%–25%, 26%–40%, 41%–60%, >60%) for the dominant vegetation with each mapped polygon.

In preparation for developing potential habitat maps, we revisited populations mapped in the 1980s on paper 15 minute USGS topographic quadrangles that were later converted to digital raster (grid cell) and, later, vector (polygon) format. We remapped population perimeters at much finer resolution using high quality global positioning system (GPS) equipment with differential capabilities (i.e., field data were positionally corrected with base station data; Trimble ProXR hardware in combination with Pathfinder Office software (Trimble Naviation Ltd., Sunnyvale, California). Our surveys showed that most of the hand-drawn maps from the 1980s exaggerated the extent of species occurrence at a given site, probably because of the small scale of the original base maps and lack of GPS capability.

We acknowledge that the accuracy of population perimeters collected using GPS technology, however positionally accurate the line may be, will depend upon a number of factors. These include the expression of the population in the year mapped, the most appropriate phenological

stage for maximum detection, seasonal timing of the survey, detectability of the species at any stage, the thoroughness of the survey, and whether the population location can be accurately represented in polygon data. However, GPS mapping for documenting population extent and for model input still offers the best available accuracy.

4.2 Mapping Approach

We limited mapping of potential habitat to the areas within the boundaries of Yosemite National Park (3,027 km^2; 1,169 mi^2) and the El Portal Administrative Site (4.6 km^2; 1.8 mi^2) using a raster coverage of slope derived from the 10 m (33 ft) DEM coverage [slope_byd_int.grd] to define this boundary). This area was based on the most limited spatial data available at the time of the project and was selected to ensure every habitat variable would be available for each map developed.

Using this single raster base map, we converted available spatial data from its original vector format to raster format. Converted spatial data sets included elevation, slope aspect, slope steepness, surficial geology, topographic (moisture) index, fire history, and vegetation type. Though important in influencing species distributions, soil data were not available at the time of this exercise. Elevation (m), slope steepness (degrees), aspect (degrees azimuth), and moisture index were continuous variables. Surficial geology, fire history, and vegetation type were categorical. We used the original categories of surficial geology from the geologic map of the Yosemite (Huber et al. 1989), including categories of surficial deposits, plutonic rocks, and metamorphic rocks. Fire history was either the number of years since a cell last fell within a mapped fire perimeter (years since last fire) or the number of fires in the last 70 years of fire history (*Carex tompkinsii* only). There were 200 categories in the vegetation type coverage that was interpreted from 1997 aerial photography (NPS 1997), including forest, woodland, shrubland, herbaceous, and sparsely vegetated habitats.

Comparing population maps with data on each of these habitat factors, we extracted the full range of values overlapping the mapped populations of a species. We then graphed each variable to examine its distribution within the mapped species' distribution and either included the full range of values for each habitat factor, or extracted the most common values for characteristics with tailed distributions. The latter provided for identifying the most abundant or common range of values for a particular variable (between the 'tails' of the distribution, Figure 1), making use of only the predominant attributes within mapped populations and disregarding outliers. This led to more conservative map output and served to direct survey efforts to the most likely habitat. The former was more inclusive and produced a map displaying, for example, the entire elevational range in which the species occurred, every geologic substrate, and every aspect.

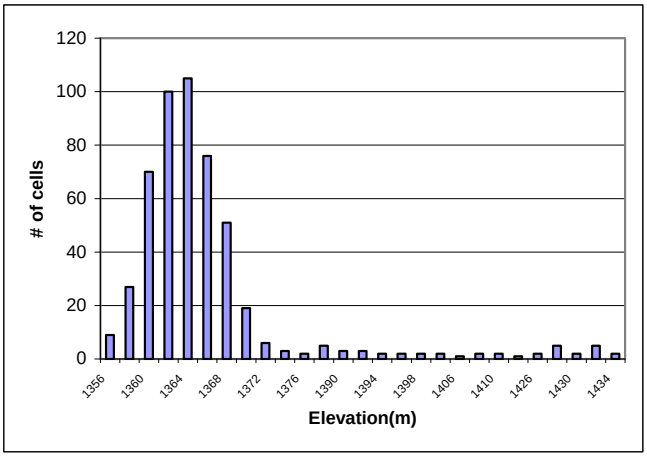


Figure 1. Distribution of elevation values (meters) among grid cells within eight populations of *Cypripedium montanum* mapped in 2003–2004, Yosemite National Park, California.

Table 3 provides an example of where we might not have included two vegetation types that overlapped with mountain lady's slipper populations by only one 100 m^2 grid cell each: giant sequoia-sugar pine/Pacific dogwood and temporarily flooded meadow. This extremely low representation may indicate mapping errors or marginal habitat.

Table 3. Mapped vegetation types occurring within mountain lady's slipper (*Cypripedium montanum*) populations, Yosemite National Park, California, 2003–2004.

Vegetative-type Code	Vegetation Type Description	100 m^2 Grid Cells (no.)
30602	Ponderosa pine-Incense Cedar Forest Alliance	3
30621	Ponderosa pine-Incense Cedar/Mountain misery Forest Association	17
30631	Ponderosa pine-Incense Cedar-California black oak Forest Association	16
40131	Douglas fir-Ponderosa pine-Incense Cedar Forest Association	446
40212	Giant sequoia-Sugar pine/Pacific dogwood Forest Association	1
40941	White fir-Sugar pine-Incense cedar Mapping Unit	53
85101	Temporarily flooded meadow	1

In summary, the steps we used to create habitat maps included the following:

1. Converting a species population map from vector to raster format.
2. Extracting the habitat characteristics overlapping a species' populations.
3. Graphing and selecting habitat characteristics based on their pattern of occurrence within populations.
4. Converting selected habitat characteristics to binary raster data.
5. Summing over all selected input variables the number of habitat characteristics co-occurring within a grid cell to represent the probability of occurrence for that species.

4.2.1 Taxa Selected for Habitat Mapping

We selected a foothill species, a montane meadow species, an upper montane forest understory species, and a species of mesic sites in lower montane forest for habitat mapping and map verification. The foothill species, Congdon's woolly sunflower (*Eriophyllum congdonii*), is a herbaceous annual endemic to the Merced River watershed. It occurs in rocky habitats adjacent to California annual grassland and *Quercus wislizeni* scrub. It is in survey priority group 2 because it is listed as rare by the State of California. This species had not been surveyed since the 1980s, and there was a good chance of expanding knowledge of its distribution in El Portal if not the park.

Bolander's clover (*Trifolium bolanderi*) is limited to wet montane meadows in Mariposa, Madera, and Fresno counties. In the park, *T. bolanderi* is found only in seasonally flooded montane meadows near Glacier Point Road. This area is a rolling upland that largely was

unglaciated during the last glacial episode (ca 10,000 BP). The meadows where *T. bolanderi* is found are nearly level and have only a few hundred feet of watershed above them; so, although they have standing water in them in early summer, the water table is below the ground surface by mid- to late-summer. *T. bolanderi* is in survey priority group 3 because it is a federal species of concern, a Forest Service sensitive species, and a CNPS List 1B species. Park staff did limited surveys in 1999 at known localities, but there was potential for increasing the number of mapped stands with further work.

Short-leaved hulsea (*Hulsea brevifolia*) is a Forest Service sensitive species and a CNPS List 1B species. It therefore falls into survey priority group 3. There were approximately 12 documented localities in Yosemite prior to 2003 based on NPS data and herbarium specimens. This species potentially responds to macro-habitat characteristics and fire regime, making it a candidate for modeling at the landscape scale.

Historic population maps and herbarium specimen data (SMASCH Database 2002) indicated 15 localities for Mountain lady's slipper (*Cypripedium montanum*) in Yosemite. This is a Forest Service sensitive species, on the watch list of CNPS (List 4) and is limited to a narrow elevational range in the park. It is a showy species that is subject to illegal collecting, and its protection would benefit from a better understanding of its distribution in the park.

In addition to the above species, we produced potential habitat maps for a handful of other species to provide tools for helping to expand their known distribution in the future. These included the new Yosemite bog-orchid (*Platanthera yosemitensis*) found during the course of this project, Tompkins sedge (*Carex tompkinsii*), and slender lupine (*Lupinus gracilentus*), a species largely limited to Yosemite.

4.2.2 Map Verification Strategy

We defined potential habitat for a given species as those areas where all or most of the selected habitat characteristics overlapped spatially. We interpreted this overlap as the highest likelihood of species occurrence among areas in the potential habitat map. For verification, we made random or stratified random selections of areas with greater degrees of overlap and surveyed as much of the predicted area as practicable, mapping areas surveyed. We calculated map accuracy as the number of sites where the species in question was detected divided by the number of predicted areas surveyed.

5 - Results

5.1 Field Survey Results and Species Status

We completed 163 surveys among 39 special-status plant taxa for the two seasons (83 surveys among 17 species in 2003 and 79 surveys among 28 species in 2004, Table 4). Species surveyed included California state-listed rare taxa (4 species), CNPS List 1B (13 species including 1 state rare species), Forest Service Sensitive (12 species), federal species of concern (12 species; this status no longer maintained by the USFWS), CNPS List 2 (6 species), CNPS List 4 (6 species), and park-sensitive. There is duplication among the categories because individual plant taxa may have multiple listing statuses among organizations (e.g., all Forest Service sensitive taxa are CNPS 1B). The number of surveys ranged from one for a species (e.g., *Sparganium natans*) to 13 for *Trifolium bolanderi* and *Carex tompkinsii*. Surveys exceeded that number for *Cypripedium montanum* if you include surveys of potential habitat (28 surveys, 15 where the species was found).

Through collections made during surveys at a variety of sites, we added nine species to the park list: *Cuscuta suksdorfii*, *Elodea canadensis*, *Lotus scoparius* var. *scoparius*, *Melica subulata*, *Platanthera yosemitensis*, *Potamogeton alpinus*, *Rumex pulcher* (non-native), *Schoenoplectus subterminalis*, and *Torilis nodosa* (non-native). We added to the known distribution in the park for several taxa: *Agrostis humilis*, *Cinna bolanderi*, *Cypripedium montanum, Eriophyllum congdonii*, *Hulsea brevifolia*, *Ivesia unguiculata*, *Lupinus gracilentus, Potamogeton epihydrus* ssp. *nuttallii*, *Sparganium natans*, and *Trifolium bolanderi* (minor additions). For example, we documented new populations for *Hulsea brevifolia* (surveys HUBR10-2 and HUBR10-7) more than 5 km from the closest known *H. brevifolia* population, a *Sparganium natans* population more than 35 km from the three previously documented populations, *Potamogeton epihydrus* more than 7 km from the only previously reported occurrence in Yosemite (not relocated in recent years), and *Schoenoplectus subterminalis* as a range extension from El Dorado County north to the Klamath Ranges. Newly discovered populations also included one of *Drosera rotundifolia*.

In the majority of cases, the previously documented populations we surveyed were extant. One exception was surveys of three mapped locations of *Cypripedium montanum* that failed to locate any plants. Other species of *Cypripedium* are known to remain dormant from one to four years after maturity (Kéry and Gregg 2004). Nevertheless, failure to detect plants that were either flowering or at vegetative stage during surveys remains a possibility (Kéry and Gregg 2004). Another exception to mapped populations found to be extant was a *Hulsea brevifolia* site adjacent to Snow Creek on a steep, open bedrock ridge where we failed to locate plants. However, the area was clearly inappropriate habitat; only a mapped location (no previous survey information) was available for the site, and the mapped location may have been in error.

Plant populations can vary in size according to many factors, including annual weather variation, competition, herbivory, management, etc. Variation may be pronounced among years, particularly for annual species, and populations should be monitored over several years before conclusions about trend are made. Despite the lack of monitoring data or even recent survey data, we will include comments by species on apparent status and changes in population size where data are available, even though their interpretability is limited.

Table 4. Surveys completed in 2003 and 2004 through an inter-agency agreement between the U.S. Geological Survey and the National Park Service documented population size and location (abundance and aerial extent) of 127 populations among 39 vascular plant taxa in Yosemite National Park.

Scientific Name	Common Name	Family	Surveys	Populations	Total Abundance
Agrostis humilis	mountain bent grass	Poaceae	4	3	115,642
Allium yosemitense	Yosemite onion	Liliaceae	4	4	2,214
Bolandra californica	Sierra bolandra	Saxifragaceae	2	2	331
Carex buxbaumii	Buxbaum's sedge	Cyperaceae	2	2	737
Carex limosa	mud sedge	Cyperaceae	1	1	528
Carex tompkinsii	Tompkins sedge	Cyperaceae	13	13	2,024
Cinna bolanderi	Bolander's woodreed	Poaceae	1	1	262
Clarkia australis	Small's southern clarkia	Onagraceae	1	0	0
Cypripedium montanum	mountain lady's slipper	Orchidaceae	28	15	1,132
Draba praealta	tall draba	Brassicaceae	2	0	0
Drosera rotundifolia	round-leaved sundew	Drosseraceae	1	1	10
Dulichium Arundinaceum	three-way sedge	Cyperaceae	1	1	88
Epipactis gigantea	stream orchid	Orchidaceae	1	1	273
Erigeron linearis	yellow daisy	Asteraceae	1	1	4,513
Eriophorum gracile	slender cotton grass	Cyperaceae	1	1	88
Eriophyllum congdonii	Congdon's woolly sunflower	Asteraceae	14	9	170,757
Eriophyllum nubigenum	Yosemite woolly sunflower	Asteraceae	8	8	9,915
Hulsea brevifolia	short-leaved hulsea	Asteraceae	22	17	8,475
Ivesia unguiculata	Yosemite ivesia	Rosaceae	6	6	40,030
Lewisia congdonii	Congdon's lewisia	Portulacaceae	3	3	7,966
Lewisia disepala	Yosemite lewisia	Portulacaceae	3	3	10,986
Lupinus gracilentus	slender lupine	Fabaceae	4	4	36,567
Lycopus uniflorus	northern bugleweed	Lamiaceae	1	1	130
Mimulus filicaulis	slender-stemmed monkeyflower	Scrophulariaceae	2	1	6,599
Mimulus pulchellus	pansy monkeyflower	Scrophulariaceae	3	2	6,805
Myrica hartwegii	Sierra sweet bay	Myricaceae	1	1	1,292
Orobanche californica ssp. *grayana*	Gray's broomrape	Orobanchaceae	1	0	0
Piperia colmanii	Coleman's piperia	Orchidaceae	1	0	0
Plagiobothrys torreyi var. *torreyi*	Yosemite popcorn-flower	Boraginaceae	1	1	7,429
Platanthera yosemitensis	Yosemite bog-orchid	Orchidaceae	8	8	844
Potamogeton epihydrus ssp. *nuttallii*	Nuttall's pondweed	Potamoget.	1	1	Unable to determine
Potamogeton robbinsii	Robbins' pondweed	Potamoget.	1	1	Unable to determine
Saxifraga mertensiana	wood saxifrage	Saxifragaceae	1	1	700
Schoenoplectus subterminalis	water bulrush	Cyperaceae	1	1	2,200
Scirpus clementis	Yosemite bulrush	Cyperaceae	2	2	82,014
Sparganium natans	small bur-reed	Typhaceae	1	1	10
Trifolium bolanderi	Bolander's clover	Fabaceae	13	8	147,444
Trillium angustipetalum	giant trillium	Liliaceae	1	1	400
Vaccinium parvifolium	red huckleberry	Ericaceae	1	1	798
Total			**163**	**127**	

For the following summary results by species, we consulted University Herbarium/Jepson Herbarium specimen data (SMASCH 2002), Jepson Online Interchange (2004), Calflora (2000), and Hickman (1993) for species distribution information. See Appendix C for information on statewide status and distribution. Species federal, state, and non-governmental status is from CNPS (2004a, 2004b). National Park Service files provided information on prior surveys. We derived information on threats from CNPS (2004a, 2004b) and direct observation.

5.1.1 Agrostis humilis

We surveyed both mapped localities at Snow Flat and Lower Cathedral Lake and a previously unmapped population adjacent toTioga Pass. Abundances in these populations varied from nearly 400 to over 113,000. The species most frequently occurred in sites dominated by *Calamagrostis breweri*. The most important associated species were *Aster alpigenus*, *Calamagrostis breweri*, *Vaccinium caespitosum*, and *Kalmia polifolia*.

Collections by A. E. L. Colwell, as determined by M. J. Harvey, contributor to the *Flora of North America* (Flora of North America Editorial Committee 1993+), added two additional localities: Lukens Lake and Lower Ottoway Lake.

Status: *Agrostis humilis* is a circumpolar species with a disjunct distribution in Alpine, Mono, Mariposa, and Tuolumne counties in California (CNPS 2004b). The CNPS (2004b) lists it as rare, threatened, or endangered in California, but more common elsewhere (List 2). It has been collected several times in the headwaters of Lee Vining Creek east of Yosemite, and the expansion of its known range in the park makes its status in the region more secure. No previous survey data are available for comparison with our results. Modification of the species' mesic turf habitat due to climate change or other factors poses the greatest threat. We noted localized impacts from trampling at the Tioga Pass population and from pack-stock grazing at Lower Ottoway Lake. Other known sites of occurrence receive frequent visitation as well, including Lukens Lake.

5.1.2 Allium yosemitense

Between May 6 and June 26, 2003, we surveyed four populations of *Allium yosemitense* (Yosemite onion), including the type locality above Bridalveil Falls. Two sites were located within the perimeter of an *Eriophyllum congdonii* population (ERCO40-4) in the Merced River Canyon near El Portal, one was along the South Fork of the Merced River, and one was along Bridalveil Creek above Bridalveil Falls. We tallied all plants, flowering or not, at ALYO10-1, -2, and -4. But, because of the lateness of the season on June 26, were forced to estimate minimum population size at ALYO10-3 by tallying plants with intact flower heads along with detached flower heads. This resulted in a minimum population size estimate of 714. The site should be resurveyed to obtain a more accurate estimate of the current population size.

We spent a total of 26.5 hours surveying all sites, producing total counts of 250, 150, 714, and 1,100 at sites ALYO10-1, -2, -3, and -4, respectively. Access was via steep canyon sides at all sites, but only the Bridalveil Creek site required climbing protection, including a rope, to ascend the Gunsight route. The largest population was one along the South Fork of the Merced River (ALYO10-4), and it covered only 1,100 m^2.

Surficial geology was metamorphic at the two El Portal populations (ALYO10-1 and -2) (Bateman and Krauskopf 1987) and a dioritic/metasedimentary contact zone within the South Fork of the Merced population (Peck 2002) but entirely granodiorite at the Bridalveil Falls population (ALYO10-3) (Peck 2002). Botti (2001) observed that *A. yosemitense* is found mostly along such contact zones west of the park. Habitat consisted of sparsely vegetated rock outcrops and scree slopes within *Quercus wislizeni*/*Arctostaphylos viscida* Woodland, *Arctostaphylos viscida* Shrubland, and *Cercocarpus betuloides* Woodland plant communities.

Status: *Allium yosemitense* a regional endemic, was first collected by Enid Michael in 1922 from the population above Bridalveil Falls, Yosemite Valley (E. Michael s.n. holotype CAS205887, isotype GH29815). She re-collected the species at the same site in 1923 and 1926. See Appendix C for additional information regarding relocation of the species in 1979. It is listed by the CNPS as rare, threatened, or endangered throughout its limited range (List 1B). California State lists it is as rare, and it is on the Forest Service Region 5 sensitive plant list.

Information is available from previous surveys of the two populations in the park (ALYO10-3 and -4), but not for the two populations south of the El Portal Administrative Site in the Merced River Canyon. A rare plant status report dated March 1981 indicates 1,500 plants were found at the Bridalveil Falls population in 1980, reportedly including plants on the west side of Bridalveil Creek. As mentioned, we consider our estimate of 714 plants to be a minimum count based on senescing plants and flower heads. A determination of declining trend in the population cannot be made without additional work. The survey of the South Fork site (ALYO10-4) in 1981 found 550 plants compared with 1,100 found in 2003. Although there are no extant survey results from the lower (more northerly) of the two populations (ALYO10-1) on Sierra National Forest near El Portal, it was mapped in the 1980s and the perimeter included in Yosemite GIS data. We confirmed the population is still present at that site. The higher elevation Sierra National Forest site (ALYO10-2) is a new, previously undocumented location supporting 150 plants in 2003. There were no apparent direct threats to any of the populations.

5.1.3 Bolandra californica

Our work with *Bolandra californica* (Sierra bolandra) consisted of just two surveys done opportunistically on June 26 and 27, 2004. Both populations were adjacent to trails, one near Illilouette Creek and one above Ten Lakes. The former numbered approximately 80 plants and the latter 250.

Status: *Bolandra californica* is a Sierra Nevada endemic that is on the watch lists of the Forest Service and the CNPS (List 4). Its occurrence in Yosemite is infrequent, but it is broadly distributed in the park as evidenced by collections residing at University and Jepson herbaria. The CNDDB does not currently recognize any threats to the species.

5.1.4 Carex buxbaumii

We visited both known occurrences of *Carex buxbaumii* (Buxbaum's sedge) in Yosemite, namely Swamp Lake and Soda Springs. Plants occurred in perennially saturated microhabitats that are infrequent in the park. There were over 700 plants at Soda Springs, the site of a mineralized spring in Tuolumne Meadows. Two uncommon species grew there with Buxbaum's sedge, namely *Triglochin maritima* and *Trimorpha lonchophylla*. *Carex limosa*, *Drosera rotundifolia*, and *Eriophorum gracile*, all park-sensitive species, occurred at the Swamp Lake

site. There is no abundance estimate for the Swamp Lake population because a collection of *C. buxbaumii* was not identified during the field visit.

Status: *Carex buxbaumii* occurs along the northern and central coasts of California and in the central and southern Sierra Nevada. It ranges north to Alaska and east to eastern North America. It is rare throughout its range in California, only occurring in widely scattered bogs. It is on the watch list of CNPS and listed as sensitive on the park list. There may be additional undocumented occurrences in the park beyond the two mentioned above, but they have yet to be found. No previous survey data are available for comparison with our Soda Springs results. Soda Springs is a popular destination for hikers in Tuolumne Meadows, and trampling was in evidence within that population, including several trampled *C. buxbaumii*. Other potential threats include trail maintenance at Soda Springs.

5.1.5 Carex limosa

This species occurs on the south and west islands of Swamp Lake; this survey addressed only the south island where we found 528 plants predominantly around the island's perimeter. These floating islands support peaty bogs that support a number of rare species. *Lycopus uniflorus*, *Dulichium arundinaceum*, and *Eriophorum gracile* were important associates on the south island.

Status: The CNPS lists *Carex limosa* (mud sedge) as rare, threatened, or endangered in California, though it is more common elsewhere (List 2). It is on the Yosemite special-status plant list because of this listing and its limited distribution in the park. It is broadly distributed in northern North America but occurs in California only in fens in the High Sierra Nevada. There are no previous survey data for comparison with our results from Swamp Lake and no apparent threats.

5.1.6 Carex tompkinsii

Between May 15 and June 24, 2003, we targeted areas for survey that had been previously mapped or reported as supporting *Carex tompkinsii* (Tompkins sedge) within the El Portal Administrative Site. We concurrently surveyed additional likely habitat within the Administrative Site, focusing on riverbanks, seasonal flood plains, old stream terraces, and tributaries (perennial or seasonal). We surveyed several small areas inside the park within the chaparral slope southwest of Arch Rock Entrance Station in 2003 and 2004 as well. Surveyors searched partially shaded areas with particular care but fully searched all areas indicated on our survey maps (ArcView vector file "Areasurveyed").

Results confirmed the presence of *C. tompkinsii* at five locations within areas previously reported or mapped, and we documented seven stands not in existing records. We found *C. tompkinsii* plants at all areas we visited, and we tallied a total of 2,024 plants among 13 areas we surveyed. Stands varied in size from 10 to 538 plants. Most stands were within 0.5 km of other stands, and it is possible that all plants in the El Portal vicinity comprise one genetic population. Additional details are available in the *Carex tompkinsii* summary (Appendix C).

Status: Within the park, *C. tompkinsii* is known only from the Merced River Canyon in the vicinity of El Portal. The population is distributed from near the western administrative site boundary east to the Arch Rock Entrance Station. It has a broader distribution therein than

previously documented. It occurs for much of the length of the Merced River within the specified area on stream terraces as well as partially shaded slopes on both sides of the canyon. The greatest abundance appears to be in the vicinity of the main stem and tributary streams. The cumulative tally of plants among all 2003–2004 surveys was 2,024 (242 of them within the undersurveyed chaparral slope inside the park). This is quite a bit larger than tallies from surveys in 1979 and 1981 that reported "hundreds" of plants and 100–200 plants, respectively. A single subsequent survey in 1994 reported 454 plants. We suspect plants are fairly abundant on the south-facing chaparral slope southwest of Arch Rock as well. Potential threats, detailed in Appendix C, include non-native plant species, development, and fuels management.

5.1.7 Cinna bolanderi

We completed one survey on September 8, 2004, at a population found at the end of August by Dean W. Taylor and Alison E. L. Colwell. We found 262 plants in a mesic meadow that varied from moderately well-drained to poorly drained. *C. bolanderi* (Bolander's woodreed) was 1–2 m (3.3–6.6 ft) tall and occurred where there was dense herbaceous growth of *Senecio triangularis*, *Heracleum lanatum*, *Athyrium filix–femina*, and *Lupinus latifolius* var. *columbianus*. The non-native *Rumex pulcher* occurred on the site as well.

Status: *Cinna bolanderi* is a CNPS List 1B species (rare, threatened, or endangered in California and elsewhere) and has been added recently to the park's sensitive plant list. Taylor (in preparation) indicates that reports of *C. latifolia* from the central Sierra Nevada are based on *C. bolanderi*, and Brandenburg et al. (1991) indicate that the southernmost extent of *C. latifolia* is north of Yosemite. Additional work is needed to determine the status of *C. bolanderi* in Yosemite. Botanists have not been able to confirm presence of this species at the type locality since 1991 (see Appendix C).

5.1.8 Clarkia australis

We visited the single known locality in Yosemite for *Clarkia australis* (Small's southern clarkia), Bald Mountain, in both 2003 and 2004. The species is known to flower when a similar, associated species, *C. rhomboidea*, is in the fruiting stage (J. Haas, USFS, personal communication). The 2003 visit found *C. rhomboidea* still in flower and no evidence of *C. australis*. The July 1, 2004, visit was more carefully timed to coincide with fruiting stage for *C. rhomboidea*, as determined at a population outside the park on the same day, but *C. australis* was still not in evidence. Surveyors identified key characteristics for distinguishing the two species the week prior. *C. rhomboidea* has mucilage in green fruit, and this was present in plants on Bald Mountain. We were not able to confirm the presence of *C. australis* at this locality.

Status: *Clarkia australis* was a federal species of concern on the unofficial listing of the Sacramento Office of the USFWS at the time of these surveys. It is listed as sensitive by the Forest Service and on List 1B by the CNPS. It was mapped in the 1980s by park staff as occurring on Bald Mountain northwest of Aspen Valley. It has been reported to occur just inside the park boundary east of Little Nellie Falls (J. Haas, personal communication). Otherwise it is unknown from Yosemite. It is threatened by logging within its range (CNPS 2004b). Botanists were not able to confirm presence of this species in the park.

5.1.9 Cypripedium montanum

With the assistance on a few sites from NPS and the Yosemite Association, we surveyed 13 out of approximately 14 locations in the park for which we could find evidence. We were unable to verify the location of "Poison Meadow S of Miguel Meadow," the site of a 1940 collection.

We found a total of 859 plants among 14 known locations, seven of which had been mapped. We found an additional 273 plants in eight newly documented populations, out of 16 predicted areas, for a total of 1,132 plants among all surveys. Population sizes ranged from 1 (a newly documented population) to 347, with most populations supporting between 10 and 30 plants. Four previously documented locations did not have plants above ground in 2004 but may be temporarily dormant.

Historical survey data was available only for the Happy Isles population (15 plants in 1980, 25 in 1981) which was apparently obliterated during a 1996 landslide. Our surveys of the site and those of a consulting botanist have failed to relocate plants in the vicinity (D. W. Taylor, consulting botanist, personal communication).

Status: *Cypripedium montanum* (Mountain lady's slipper) is an uncommon species of moist areas and dry slopes in mixed-evergreen or coniferous forest. It has a relatively broad distribution in California, including northwestern California, the Modoc Plateau and Cascade Range, the northern and central Sierra Nevada, and the southwestern portion of the San Francisco Bay Area. Outside California, it ranges to Alaska, Montana, and Wyoming. The CNPS places *C. montanum* on List 4, species of limited distribution. It is also a Forest Service Sensitive species. According to the CNPS distribution information by county, the Tuolumne, Mariposa, and Madera county occurrences represent a disjunct distribution from the northwestern California, Modoc, and northern Sierra Nevada distribution. Within the park, *C. montanum* is patchily distributed within a narrow elevational range of 1,135 to 1,660 m (3,730 to 5,460 ft) between the Hodgdon Meadow area and the Wawona area. The 2003–2004 surveys found 8 out of 14 populations extant and newly documented eight populations through use of potential habitat mapping and surveys. The expansion of the known distribution of *C. montanum* in the park makes the species' status appear more secure. Collecting remains the major direct threat to the species within the park. CNPS cites logging as a threat. The large amount of coarse woody debris, deep shading, and depauperate populations at some sites raises the issue of what fire regime would best sustain these populations. Broad scale anthropogenic impacts may pose indirect threats.

5.1.10 Draba praealta

There is one documented locality for *Draba praealta* (tall draba) within the park. The species is also known from Dana Plateau adjacent to the eastern park boundary. We visited the mapped location on Mt. Gibbs in 2004 using location coordinates from the park's GIS and surveyed the habitat described by Botti (2001) for that site. No plants were in evidence on August 3, 2004. Surveyors noted the dry conditions at the site might have contributed to the inability to confirm the species' persistence there.

Status: This species is widely distributed in the Rocky Mountains but rare in the Sierra Nevada (Botti 2001). It is restricted to the eastern slope except for the station on Mt. Gibbs. The CNPS includes *D. praealta* on List 2: rare, threatened, or endangered in California, though more common elsewhere. A 1980 status report indicates fewer than "50 plants are known to occur in

Yosemite," but it is unclear whether the report is referring to both the Mt. Gibbs and Dana Plateau stations or just Mt. Gibbs. There are no recognized threats at this time, but the Mt. Gibbs population should be surveyed in a wetter year to verify whether it persists.

5.1.11 Drosera rotundifolia

Drosera rotundifolia (round-leaved sundew) is an infrequent species of hydric meadows in Yosemite. We completed just one portion of a survey for this species because of its low survey priority. We surveyed the south island at Swamp Lake for five species on the Yosemite special-status plant list, namely *Dulichium arundinaceum*, *Eriophorum gracile*, *Carex limosa*, *Lycopus uniflorus*, and *D. rotundifolia*. There were just 10 *D. rotundifolia* plants on the island. Although the species occurred more abundantly elsewhere around the lake, time limitations prevented additional surveying. Surveyors found an undocumented locality in a meadow along Glacier Point Road that should be mapped and surveyed. It occurred in the same meadow as a population of *Platanthera yosemitensis*. In addition, we had an undocumented locality reported to us in the vicinity of Gin Flat. We entered both locations in a plant observation database.

Status: *Drosera rotundifolia* is on the watch list of Sierra and Stanislaus national forests. It has been mapped at seven localities in the park. We reported it from an additional locality and verified its persistence at Swamp Lake. It is in survey priority group 12, and we did not do sufficient work to determine its status in Yosemite. A 1980 status report indicates that *Drosera* is "rare and extremely localized in occurrence." The report described the Swamp Lake population as the largest known in the park with approximately 100 plants. The Gin Flat population reportedly has hundreds of plants. More work is needed, but populations appear to be persisting at this time. This species is vulnerable to changes in hydrology and perhaps pH of its hydric habitat.

5.1.12 Dulichium arundinaceum

We mapped three-way sedge on the south island of Swamp Lake, the lake's margins, and at the smaller lake 600 m (1,970 ft) west-northwest. On July 13, 2004, we tallied a total of 88 plants throughout this area. Only 20% of plants were flowering, but the species is sufficiently distinctive at the vegetative stage to allow for a full accounting of the population size.

Status: *Dulichium arundinaceum* occurs in California from the Klamath and Cascade ranges south through the Sierra Nevada to the Tehachapi Mountains. It may be infrequent throughout this range judging from the few collection records. It ranges north to British Columbia and east to eastern North America. It appears to be limited to three sites in Yosemite based on herbarium records and Botti (2001): Swamp Lake, Tiltill Valley, and Lost Lake. The Lost Lake locality is based on Botti (2001), not collection records. No *D. arundinaceum* mapping had been done in the park previously, and there are no previous survey data for comparison. The Swamp Lake population is only moderate in size and could be affected by water level changes due to climatic fluctuations. This species was added to the park list in September 2004 due to limited distribution in the park. Further information on its park distribution would be useful.

5.1.13 Epipactis gigantea

One of three remaining populations of stream orchid in Yosemite Valley is located at a heavily-used site adjacent to The Ahwahnee hotel. The others are along the upper Yosemite Falls trail and up a 5.9 technical climb on Glacier Point apron. The technical climb leads to a site locally

referred to as the 'Oasis' (a vegetated seep on a steep granitic face NE of Glacier Point). The Ahwahnee stand persists, and we found 273 plants. They grow in rock fractures at the base of Royal Arch Creek where the creek reaches a ledge after flowing down a sheer granite face from the valley rim. *Salix lasiolepis*, *S. melanopsis*, *Stachys albens*, and *Potentilla glandulosa* also were abundant at the site.

Status: *Epipactis gigantea* species occurs throughout California except the Great Central Valley; however, it is limited to three sites in Yosemite Valley. It is park-sensitive but has no other listing status. We made one opportunistic survey simply to assess the status of this showy orchid at the heavily trampled Ahwahnee site. There are no previous survey data available to help determine whether the abundance has decreased at that site. There are plants along the sloping bedrock access route to the ledge, adjacent to the stream just below the ledge and away from foot traffic at the base of the cliff. Trampling is the most direct threat. Drying of the steam earlier in the season might threaten the population as well.

5.1.14 Erigeron linearis

We surveyed the only known population of *Erigeron linearis* (yellow daisy; survey priority 9) in Yosemite because a volunteer group led by the park botanist was available in the area. Surveyors found over 4,500 plants in shallow, rocky soil largely on the lee sides of rock outcrops at 3,270 m (10,730 ft). Associated species were common alpine components for the area, including *Calamagrostis purpurascens*, *Phlox diffusa*, *Arenaria kingii*, *Eriogonum ovalifolium* var. *nivale*, *Ericameria discoidea*, and *Erigeron compositus*.

Status: *Erigeron linearis* is more typical of the east slope of the northern High Sierra Nevada, the Modoc Plateau, Great Basin, and northern Rocky Mountains. It is listed as park-sensitive but has no other listing status. Botti (2001) indicates this population previously consisted of approximately 200 plants. Even if the 13 surveyors slightly overestimated the population size, it appears to be significantly larger than when last surveyed. The population is not along a common hiking route, but it is not far from a lightly used trail to historic mining cabins up the slope. Climatic variations are the most likely indirect threat.

5.1.15 Eriophorum gracile

We surveyed one of three populations reported by Botti (2001) for Yosemite, none of which had been previously mapped. At the Swamp Lake population, there were 88 plants among four stands around the perimeter of the lake. On the 'South Island,' *Eriophorum gracile* (slender cotton grass) was associated with *Menyanthes trifoliata*, *Dulichium arundinaceum*, *Carex limosa*, *Lycopus uniflorus,* and *Brasenia schreberi*.

Status: *Eriophorum gracile* is known from just three localities in Yosemite: Swamp Lake, Lost Lake, and a pond adjacent to Pothole Dome (Botti 2001). There are herbarium vouchers for the first two locations. It is a circumboreal species and is widespread in the northern hemisphere. It is relatively rare in California, however, and reaches its southern limit in Yosemite (Botti 2001). There are no previous data available. Swamp Lake is rarely visited; natural or anthropogenic modifications of the lake's hydrology are more likely impacts than any direct threats.

5.1.16 Eriophyllum congdonii

The type locality of *Eriophyllum congdonii* (Congdon's woolly sunflower) is in El Portal on the "mountains near Hennessey's." Hennessey's was located on the stream terrace at the west end of the bridge crossing Highway 140 in El Portal, the current location of a trailer village and a few private homes locally referred to as Abbieville. Scattered populations of *E. congdonii* extend from the flanks of the Merced River Canyon south to portions of the South Fork of the Merced River and Iron Mountain. We completed surveys at all sites fully within or intersecting the El Portal Administrative Site. This species was not previously recorded from the park, only from the administrative site.

Between April 25 and June 10, 2003, we surveyed five previously mapped populations and nine areas of predicted habitat. We located populations using GIS maps derived from maps hand-drawn onto 15-minute quadrangles in 1980 and 1981. These surveys remapped and produced tallies of 169,780 plants among four known populations and surveyed one newly discovered population along the South Fork of the Merced River. We found an additional 977 plants among four populations documented during potential habitat map verification, bringing the overall total number of plants to 170,757 (see map verification results below). Population sizes ranged from 30 in the South Fork of the Merced (new population) to 115,000 in one contiguous population in El Portal.

By far the most common plant communities in which *E. congdonii* occurred were California Annual Herbland Alliance and *Quercus wislizeni* Woodland Alliance. Populations were also found associated with *Lupinus albifrons* Shrubland Alliance, and *Quercus wislizeni-Arctostaphylos viscida* Woodland.

Status: The State of California listed *E. congdonii* as rare in July 1982. It is an endemic species of the Merced River Basin. The CNPS places *E. congdonii* on List 1B, rare, threatened, or endangered in California and elsewhere. It was also listed by the Sacramento Office of the USFWS Service as a Species of Concern at the time of these surveys and is listed by Region 5 of the Forest Service as Sensitive. The CNDDB (Natural Heritage System) assigns *E. congdonii* a Global rank of G2 and a state rank of S2, indicating there are only 6–20 occurrences statewide and globally. The El Portal Administrative Site is located down slope from and in the geographic center of the highest density of *E. congdonii* stands within the species' range. Planned development within El Portal is exclusively outside of *E. congdonii* habitat, and expansion onto the steep slopes of the woolly sunflower habitat appears unlikely. The new station along the South Fork of the Merced River had few individuals in 2003 (30 plants). However, additional habitat is available adjacent to the South Fork population, and an increase in size is possible.

Annual species can fluctuate tremendously between years, but past and current surveys indicate a large, relatively stable population in the El Portal vicinity. The proximity of *Centaurea solstitialis* (yellow star-thistle) to the El Portal population poses the most direct threat. *C. solstitialis* is thus far limited to annual grassland habitat, but its invasion of the thinner soils of the *E. congdonii* habitat may be only a matter of time. The National Park Service has made tremendous strides in controlling *C. solstitialis* adjacent to *E. congdonii* in recent years and has hope of maintaining that control with continued funding.

In terms of particular stands, the ridge east of Rancheria Flat was estimated at 800 plants in the early 1980s; we found approximately 8,400 plants in that stand in 2003. Park staff in the 1980s estimated the total abundance in the El Portal area as 5,000 compared with our total of 170,167.

5.1.17 Eriophyllum nubigenum

Yosemite woolly sunflower was first collected from Cloud's Rest in Yosemite in 1883 by Katherine Brandegee with an additional collection by Dodd in 1891. It was not collected again and believed extinct until rediscovered by S. Botti in 1980. Botti went on to survey and map eight populations of *Eriophyllum nubigenum* in the Little Yosemite Valley, Mt. Starr King, and Chilnualna Creek areas of Yosemite.

In 2003, we surveyed six of the eight populations mapped in the 1980s. We surveyed two additional remote sites up the Illilouette Creek drainage south of Mt. Starr King in 2004. Beyond these eight, the only other known locations for which we found evidence are the type locality reportedly somewhere on Cloud's Rest, near the confluence of Johnson Creek and the South Fork of the Merced, and outside the park at Pilot Peak and Pilot Ridge. Our surveys occurred between June 24 and July 1, 2003 and between June 21 and 23, 2004, when we relocated populations using GIS maps based on 1980s mapping efforts. We found a total of over 9,900 plants among the eight populations that ranged in size from 434 to 2,960 plants.

Populations occurred most typically on south-facing slopes on open granitic sandy benches amidst bedrock outcrops and domes. *Quercus vaccinifolia* or *Arctostaphylos patula* shrublands were common plant communities; open *Pinus jeffreyi* stands with *A. patula* or *Q. vaccinifolia* understories were common as well. Plants occurred almost exclusively in sheltered microsites adjacent to or under the perimeter of shrub canopies, beside boulders, or under overhanging boulders. Plants preferred substrates of fine granitic gravel to the exclusion of similar sites that had larger proportions of silt or organic component.

Status: *Eriophyllum nubigenum* is on the sensitive plant list of the Forest Service, Region 5, for Stanislaus NF. The CNPS includes *E. nubigenum* on list 1B, rare, threatened, or endangered in California and elsewhere. The CNDBB (Natural Heritage System) assigns *E. nubigenum* a Global rank of G2 and a state rank of S2.3, indicating there are only 6–20 occurrences statewide and globally but with no current threats known. The species is known from fewer than twenty occurrences in Mariposa, Madera, and Tuolumne counties. This central Sierra Nevada endemic is known in Yosemite from Clouds Rest south to the domes south of Mt. Starr King and the southern park boundary and west to the highlands above Wawona. Each population for which there is repeated survey information appears to have increased in size or have had years of high recruitment in 2003–2004. Population sizes of this diminutive annual likely fluctuate from year to year. It may be that in the early 1980s, the species was still recovering from the long drought in the 1970s. Table 5 lists previous survey data together with current results (a subset of all 2003–2004 surveys). Surveys in 2003–2004 enumerated over 9,900 plants among eight populations. There are no known direct threats to the species, its habitat, or its microhabitat except localized impacts of trail maintenance at Chilnualna Falls. Climate change may exert pressure on *E. nubigenum* because its preferred habitat is vernally moist gravel pans with poor soil development separated by bedrock outcrops. These sites may be vulnerable to drying early in the season. See Appendix C for more detail.

Table 5. Results of Yosemite woolly sunflower (*Eriophyllum nubigenum*) surveys for populations visited multiple times since 1980.

Location	1980–1981	1982–1983	1985	2003–2004
Top of Chinualna Falls	300			2,959
SW side Half Dome near Mt. Broderick	935	432		1,150
Dome near junction of John Muir Trail and Merced Lake Trail	741	205		2,302
East shoulder of Half Dome on S side		202		513
Johnson Creek at S Fork Merced River			150	unsurveyed

5.1.18 Hulsea brevifolia

We divided surveys for short leaved-hulsea among previously mapped populations, reported localities, and sites in the potential habitat map (see Potential Habitat Map section below for map verification results). We surveyed all seven previously mapped populations, three localities of plant collections or reports, and four populations found while traversing other areas. Three of the seven previously mapped locations had extant populations. Two were inappropriate habitat and did not support *Hulsea brevifolia* populations in the year surveyed (lower end of Snow Creek and Mt. Watkins). Rather than montane forest, these two sites were dominated by steep, open, south-facing slabs of granitic bedrock or open dome habitat. Botti, author of much of the Yosemite rare-plant mapping in the 1980s, indicated he would not expect *H. brevifolia* at the Snow Creek site and suspects the mapping or labeling at that site is in error (personal communication). The improperly mapped population near the terminous of Snow Creek may be based on the locality of a 1944 C. W. Sharsmith collection (YOSE 64296) which he listed as "Snow Creek canyon." Two previously mapped sites, Merced Grove and the Sunrise Trail, had appropriate habitat but no *H. brevifolia* detected.

We found a previously unmapped and apparently undocumented population of *H. brevifolia* in the headwaters of Meadow Brook with stands scattered along the west side of the ridge. Ten small stands of *H. brevifolia* comprised the population, in most cases occurring adjacent to large granitic rock outcroppings and among fallen, rotting logs. Loose, unstable loamy sand was a typical substrate among populations visited. Additional undocumented populations were found at the north end of Ostrander Rocks, in the vicinity of Dewey Point, and on the ridge north–northeast of Mt. Watkins.

In 2003 and again in 2004, botanists surveyed a previously mapped site of *H. brevifolia* and discovered no plants present (no record from 2003, HUBR-Predicted-8 in 2004). The site was mapped in the 1980s located along the creek coming off the south side of Cloud's Rest just upstream of Sunrise Creek. Some of the area had appropriate habitat for *H. brevifolia*, namely "dry openings in mixed conifer" forest (Botti 2001). Some of the area was much more mesic along a low-gradient creek. The only yellow-flowered asters observed were *Senecio triangularis* and *Senecio integerrimus*, and these were easily differentiated by floral and vegetative traits from *Hulsea* species.

We also visited two collection locations listed in Calflora (http://www.calflora.org), namely near Smokey Jack Campground (historic, currently closed) and at Porcupine Flat, both along Tioga Road. At the former, we surveyed and mapped a population of over 600 plants. We did not find any plants in the area searched around Porcupine Flat.

Populations ranged from the vicinity of Mt. Watkins in the north to Mariposa Grove (the type locality) in the south. They varied in size from 72 to over 1,800 individuals including mature and immature plants. They occurred most frequently in *Abies magnifica* and *Sequoiadendron giganteum* forests.

Status: *Hulsea brevifolia* is listed by the Forest Service, Region 5, as sensitive. CNPS includes it on List 1B: rare, threatened, or endangered in California and elsewhere. *H. brevifolia* is a Sierra Nevada endemic, occurring only in the central and southern Sierra Nevada from Tuolumne to Tulare County. This species occurs in Yosemite from the central portion of the park to the southern end of the park within montane coniferous forest. Outside the park, vehicles, logging, and road maintenance threaten populations. Within the park, threats include road maintenance and possibly lack of fire. No previous survey data are available for comparison, but surveys in 2003 and 2004 enumerated over 8,400 plants among 17 populations.

5.1.19 Ivesia unguiculata

Ivesia unguiculata (Yosemite ivesia) was first collected in Westfall Meadows near Glacier Point Road in 1866 by Henry N. Bolander (4964, UC954904) of the California Geological Survey. This Sierra Nevada endemic was not a particularly high priority for surveying. However, because of its co-occurrence with *Trifolium bolanderi* at several sites and its occurrence in potential *T. bolanderi* habitat, we gave it some survey attention. We completed six surveys between July 22 and August 12, 2003, adding five new locations to those documented by herbarium specimens, previous surveys, or GIS mapping data. The six surveys resulted in a total count of 40,030 plants among the six populations. Populations ranged in size from 154 to 19,825, the latter based on a subsample to estimate the total number of plants.

Ivesia unguiculata occurred almost exclusively in *Deschampsia caespitosa–Polygonum bistortoides* Herbaceous Vegetation[1] association in our surveys. Only in our fourth survey (IVUN10-4) did a population occur in *Deschampsia caespitosa* Seasonally Flooded Herbaceous Alliance that couldn't be identified to a specific association. In every case populations were in open, wet meadows surrounded by *Pinus contorta* ssp. *murrayana*. *I. unguiculata* occurred in low portions or depressions of meadows; both *Achillea millefolium* (a look-alike for *I. unguiculata* leaves) and *Horkelia fusca* (a look-alike for flowers) occur in slightly raised areas of meadows and rarely intermixed with *I. unguiculata*. In addition to *D. cespitosa* and *P. bistortoides*, other commonly associated species included *Muhlenbergia filiformis*, *Trifolium longipes*, *Pedicularis attolens*, *Mimulus primuloides*, and *Perideridia parishii* or *P. bolanderi*.

Status: *Ivesia unguiculata* is limited in distribution to meadows in the central and southern high Sierra Nevada between 1,500 and 2,500 m (4,920 and 8,200 ft) in Fresno, Mariposa, Madera,

[1] In this document, the scientific name for tufted hairgrass is spelled *Deschampsia cespitosa* when referring to the species and following the nomenclature of Hickman (1993). It is spelled *D. caespitosa* when referring to plant associations dominated by the species and following the nomenclature of Keeler-Wolf et al. (2007).

Mono, and Tuolumne counties. The CNPS currently places *I. unguiculata* on List 4, species of limited distribution (CNPS 2004a), and the Forest Service, Region 5, includes it on its list of sensitive species. The CNDBB (Natural Heritage System) assigns *I. unguiculata* a state rank of S3.2, indicating it has a moderate number of occurrences but is considered threatened. Recognized threats include grazing, trampling, and vehicles, mainly outside the park. Pack stock grazing in Yosemite is not allowed in the vicinity of *I. unguiculata* habitat but trampling is a localized threat. Pine invasion of meadows in the central and southern Sierra Nevada and its cause possibly pose a broader-scale threat to *I. unguiculata* habitat. No previous survey data are available for comparison.

5.1.20 Lewisia congdonii

We reviewed CNDDB occurrences as well as NPS survey forms and GIS data to locate populations of *Lewisia congdonii* (Congdon's lewisia). No documented populations of *L. congdonii* occur within the park or the El Portal Administrative Site. However, three populations occur within *Eriophyllum congdonii* populations that intersect the Administrative Site and, as a result, were surveyed despite the emphasis on populations within NPS jurisdiction. On May 6, 2003, we surveyed two small stands that occur on the ridge northeast of Pigeon Gulch at 825 m and 950 m (2,705 and 3,120 ft) elevation respectively (survey codes LECO10-1 and LECO10-2). The lower of the two May 6 sites (LECO10-1) was located on a set of vernally mesic rock outcrops on the northwest-facing spine of the ridge where *Allium yosemitense* was an associated species. The upper of the two May 6 sites (LECO10-2) was located on a set of vernally mesic rock outcrops southwest of the ridge crest. The third, and by far the largest, site was located between Pigeon Gulch and Cold Canyon south of the Merced River (CNDDB occurrence #3) and was surveyed on May 14, 2003.

These *L. congdonii* populations are near the northern end of the species' Mariposa County distribution that extends approximately 15 km south–southeast, approximately parallel to and west of the park boundary, to locations in the South Fork of the Merced River watershed, including Iron Mountain and Devil Peak in Sierra National Forest.

We tallied plants individually at survey sites LECO10-1 and LECO10-2, resulting in estimates of 380 and 186 plants respectively. The *Eriophyllum congdonii* survey encompassing these two sites (ERCO40-4) covered the entire southwest side of the ridge above Pigeon Gulch to 650 m (2,130 ft) above Highway 140 and the Merced River. This provides a confident assessment of occurrence on the southwest side of the ridge for a good distance above the river, but the much more forested northeast side of the ridge may contain habitat as well if bedrock outcrops are present. The ridge between Cold Canyon and Pigeon Gulch (LECO10-3) supported approximately 7,400 plants. These three surveyed stands, LECO10-1, -2, and -3, are each less than 0.5 km from another stand and should properly be considered one population.

Status: *Lewisia congdonii* has been listed by the State of California since 1982 as rare. It is known from approximately six occurrences in Fresno and Mariposa counties (Merced and Kings River canyons) between 500 and 2,800 m (1,640 and 9,190 ft). The CNDDB (Natural Heritage System) assigns *L. congdonii* a state rank of S1.3, indicating it is among the rarest of CNDDB listings but is without known threats at this time. See Appendix C for further information on listing status. LECO10-3 had an estimated 1,000 plants in 1980; 5,000 plants in 1981; and an estimated 2,700 plants in 1992. These compare with a carefully estimated 7,400 in 2003.

LECO10-1 and -2 occur up a steep ridge that is almost never visited, and there are no apparent threats to those stands. LECO10-3 has historic impacts, namely mining excavations that were worked heavily from 1930–1950. The excavations are great, open pits that have contributed loose talus to the slope, creating unstable substrates. However, *L. congdonii* prefers the more stable rock outcrops and does not appear threatened at the site. This species reaches deep into rock fractures for vernal moisture, flowers by early spring, and dies back for the summer. Perturbations that affect groundwater timing and availability, such as anthropogenically induced climate change, could affect its long-term persistence.

5.1.21 Lewisia disepala

We had to limit our surveys of *Lewisia disepala* (Yosemite lewisia) to three populations because of the very early flowering period of this species and the lack of staff to perform early spring surveys. We tallied plants individually or estimated based on subsampling within sand pans. Population sizes were 617; 3,236; and 7,133 at LEDI10-1, LEDI10-2, and LEDI10-3, respectively.

Status: *Lewisia disepala* was a federal species of concern at the time of the surveys, a Forest Service sensitive species, and a CNPS List 1B species. It is patchily distributed in Mariposa, Madera, Fresno, Tulare, and Kern counties. *L. disepala* occurs in Yosemite on the domes around Yosemite Valley and the domes around Mt. Starr King and Illilouette Ridge (Botti 2001, Yosemite GIS rare_plants theme). CNDDB assigns it a state rank of S2.2, indicating it is known from relatively few occurrences, individuals, or acres and is considered threatened. Threats include vehicles and logging (CNPS 2004b). Plants at Turtleback Dome numbered 350 in 1981 and were noted to be moderately impacted by vehicles and trampling at that time. This compares with nearly 620 found in 2004 when similar impacts were noted. No previous survey data are available for the other two populations we surveyed in 2004. In addition to the above, we noted threats at Turtleback Dome from road maintenance, utilities passing through stands, and installation of atmospheric pollution monitoring equipment and its maintenance. Two lines on the ground that feed the monitoring equipment are within 2 cm of plants. Tire tracks occurred within 3 m (9.8 ft) of plants and a heavily used campfire ring was in the center of the largest stand in the Turtleback Dome population. Plants grew within 10 cm of the fire ring, and the most obvious sleeping locations were sand pans supporting dozens of plants. Direct threats to other populations appear to be few. We noted localized herbivory, apparently by rodents. In general, perturbations that affect snow pack distribution and timing of snowmelt, such as anthropogenically induced climatic change, may affect long-term persistence *L. disepala*.

5.1.22 Lupinus gracilentus

Lupinus gracilentus (slender lupine) was first collected by Chestnut and Drew in "Tuolumne Canyon" in 1889. Botti (2001) indicates the original collection site is the same location as a 1929 collection at the bridge above Tuolumne Falls. The population at that locality is extant with approximately 270 plants occurring there in 2003. We surveyed the population (survey LUGR10-3) on August 10 and found the habitat to be a multi-aged *Pinus contorta* ssp. *murrayana* stand at the edge of the Tuolumne River. The other three sites surveyed, out of eight locations in the park based on herbarium specimens or published sources, were in mesic gaps in lodgepole pine forest as well (*Pinus contorta* ssp. *murrayana*/*Vaccinium uliginosum* Forest Association). They occurred either along permanent streams (LUGR10-2, -3, -4) or where snowmelt saturates the soil until well into the growing season (LUGR10-1). We added a new

location with a 2004 survey near Snow Flat that occurred in a similar habitat (*Pinus contorta* ssp. *murrayana*/*Ligusticum grayi* Forest). This population is extensive over an area of 11 ha and was carefully estimated at over 29,000 plants.

The NPS survey along the Forsyth Trail (leading to Sunrise Lakes) southwest of Tenaya Lake (LUGR10-1) found 3,190 *L. gracilentus* plants. This was the only population to have been mapped previously. A survey of the old Cathedral Lakes parking lot in Tuolumne Meadows (LUGR10-2) produced a count of over 3,700 plants within a 0.77 ha area. Due to time limitations, the NPS was unable to collect habitat information at that site. One of the eight locations is fairly general (e.g., upper Illilouette Creek trail) and may not be efficient to survey unless more specifics can be found on the collection location.

Status: *Lupinus gracilentus* is endemic to the upper Tuolumne River watershed according to Taylor (in preparation). Botti (2001) describes the range as extending to the Clark Range in the Merced River watershed and to the southern Sierra Nevada. Nevertheless, the species is largely restricted to Yosemite. It is on CNPS List 1B and assigned a CNDDB state rank of S2.3 indicating it is a species of limited occurrence with no current threats recognized. We noted trampling at one site and trail erosion (LUGR10-1). Trailhead redevelopment is a potential threat at the Cathedral Lakes trailhead. Populations vary tremendously in size as noted above; several are without survey data and are only reported localities. No previous survey data are available for comparison with our results.

5.1.23 Lycopus uniflorus

We implemented a single survey of northern bugleweed at Swamp Lake where we found 130 plants. They were scattered near the perimeter of one of the lake's floating islands where the growing medium consists of peat. Associates were such rare species as *Drosera rotundifolia*, *Dulichium arundinaceum*, and *Carex limosa*. The site is so unusual in structure and composition that it is not classified in the park's plant community classification.

Status: *Lycopus uniflorus* (northern bugleweed) is known from three localities in Yosemite, two based on 1930s collections and one reported by Botti (2001). It has a patchy distribution across the northern portion of the state. *Lycopus uniflorus* is on CNPS List 4, species of limited distribution. It is considered rare but broadly distributed and in sufficient numbers that extinction is unlikely (CNPS 2004b). The CNDDB state ranking is 3.3, indicating fewer than 100 occurrences or fewer than 10,000 individuals and that no current threats are recognized. Sites of occurrence in the park are infrequently visited. No previous survey data are available to compare with the Swamp Lake Survey.

5.1.24 Mimulus filicaulis

On May 31 and June 4, we surveyed two previously documented populations of *Mimulus filicaulis* (slender-stemmed monkeyflower). One population was located in the Tuolumne River Canyon upstream of Poopenaut Valley/1.5 km below O'Shaughnessy Dam (CNDDB occurrence number 2); the other was along Hetch Hetchy Road at the Poopenaut Valley trailhead (CNDDB occurrence number 4). We tallied individual plants within sparser stands and estimated according to density in denser and more abundant portions of these populations. A total of 10.4 hours were spent surveying the two populations, resulting in zero plants detected at the upper Poopenaut Valley site and an estimate of 6,600 at the Poopenaut Valley trailhead. Access to the upper

Poopenaut Valley site is somewhat rugged via glaciated and deeply incised granitic bedrock with abundant poison oak in the incisions. Access is easy and convenient at the Poopenaut Valley trailhead with plants occurring from the edge of the Hetch Hetchy Road to approximately 350 m (1,150 ft) west-northwest in mesic swales between outcrops.

Status: *Mimulus filicaulis* was a federal species of concern at the time of the surveys and included on the Forest Service, Region 5, list of sensitive plants. CNPS places it on list 1B, rare, threatened, or endangered throughout its range, and indicates it is fairly endangered (CNPS 2004b). CNDDB indicates it is known from fewer than 20 occurrences (or fewer than 3,000 individuals or 10,000 acres) and is threatened (state rank S2.2). Threats listed by CNPS (logging, reforestation with herbicides, grazing) occur largely outside the park. Few if any direct threats occur within Yosemite.

We collected insufficient information on *M. filicaulis* to accurately reflect its current status in Yosemite. The population at the Poopenaut Valley trailhead numbered 35,150 in 1988 compared with an estimated 6,599 in 2003. The failure to find *M. filicaulis* in upper Poopenaut Valley may have more to do with a discrepancy between records than a poor showing at that site in 2003. The 1988 survey listing 150 plants included clear directions, indicating plants were located 100–300 m (330–980 ft) due south from the mapped river gauging station. This was the exact location of over 3,400 *M. pulchellus* plants (MIPU10-1) in 2003. Yet other records, hand drawn onto 15 minute topographic quadrangles, indicate a location northeast of there.

5.1.25 Mimulus pulchellus

Survey dates, locations, and survey efforts for *Mimulus pulchellus* (pansy monkeyflower) were the same as for *M. filicaulis* (Section 5.1.24, above). The survey upstream of Poopenaut Valley (MIPU10-1) resulted in an estimate of 3,470 plants while the Poopenaut Valley trailhead survey (MIPU10-2) documented a 2003 population of 3,335. This species has a brightly colored corolla of red and yellow and is easily detected while flowering in the sparse herbaceous vegetation with which it grows. We censused the MIPU10-1 population by surveying contiguous belt 'transects' across the stand and then surveyed the remainder of the old stream terrace to pick up any additional plants. MIPU10-2 was surveyed by traversing the general site of interest in broad swaths of about 20 m (66 ft) width to find flats and swales that supported stands. High, rounded bedrock outcrops interrupted the flats and swales, and we checked sandy flats within the outcrops as well. The average density of plants across the population at MIPU10-2 was one plant per m^2 but densities within individual swales might have been as high as 50 plants per m^2.

Both populations were located in *Pinus ponderosa–Quercus kelloggii*/*Arctostaphylos viscida* Woodland Association. Understory associates were not similar between the two sites. For more detail, see the summary for *M. pulchellus* (Appendix C).

Status: *Mimulus pulchellus* is known only from Calaveras, Mariposa, and Tuolumne counties. It was a federal species of concern at the time of the surveys and included on the Forest Service, Region 5, list of sensitive plants. The CNPS places it on list 1B, rare, threatened, or endangered throughout its range, and indicates it is fairly endangered (CNPS 2004b). The CNDDB indicates it is known from fewer than 100 occurrences (or fewer than 10,000 individuals or 50,000 acres) and is threatened (state rank S2.2). Recognized threats include vehicles, logging, grazing, and,

potentially, development. Park populations are more likely threatened by the more indirect, broad-scale impacts of global warming and atmospheric pollutants.

We collected insufficient information on *M. pulchellus* to accurately reflect its current status in Yosemite. The population in upper Poopenaut Valley numbered 3,500 in 1988 compared with 3,470 in 2003. The population at the Poopenaut Valley trailhead numbered 4,852 in 1988 compared with an estimated 3,335 in 2003. These results should be seen as indicating stable locations rather than stable numbers because populations likely fluctuate widely among years depending on weather and fire occurrence.

5.1.26 Myrica hartwegii

We surveyed one of three mapped stands for Sierra sweet bay late in the 2004 season. *Myrica hartwegii* extends from approximately 200 m (660 ft) upstream of Wawona Campground downstream to approximately 850 m (2,790 ft) below the campground on both sides of the river. Assuming stems arising from the base of larger stems were basal sprouts and not separate plants, we estimated plants to number over 1,290. *M. hartwegii* co-occurred in the flood zone with *Alnus incana*, *Salix melanopsis*, and *Rhododendron occidentale*; *M. hartwegii* and *S. melanopsis* were most abundant. The non-natives *Cirsium vulgare* and *Holcus lanatus* occurred with it on this site as well.

Status: *Myrica hartwegii* is included on the park-sensitive plant list because it is a Sierra Nevada endemic and a species of limited distribution in California. It occurs on the west slope of the range from Yuba to Fresno counties along streams in the lower mixed-conifer zone. It is known in Yosemite only from Big Creek and the South Fork of the Merced River near Wawona. No previous survey data are available for comparison with the 2004 results. The stand mapped in the 1980s at the confluence of Big Creek and the South Fork of the Merced River is approximately 400 m (1,300 ft) upstream of the larger stand that we surveyed and should be considered part of the latter population in future surveys.The species is not generally considered threatened; however, there are localized impacts. The South Fork population at Wawona Campground is impacted by trampling and streambank erosion from campers accessing the river. The site had numerous use trails and trash.

5.1.27 Orobanche californica ssp. *grayana*

Two herbarium specimen records indicated the presence of *Orobanche californica* (Gray's broomrape) at Miguel Meadow west of Hetch Hetchy Reservoir. Botti (2001) indicates it is rare in Yosemite, known only from Miguel Meadow (herbarium specimen records) and Foresta Road just outside the park. The latter locality was checked and determined to be *O. fasciculata*. Due to this rarity, we attempted to locate the Miguel Meadow population on July 12, 2003 and July 14, 2004. We searched a series of meadows from the ranger station south, including the entire meadow where the spring is indicated on the Lake Eleanor 7.5 minute topographic quadrangle and all of Miguel Meadow. We did not find *O. californica* ssp. *grayana*, nor were there suitable habitat and suitable hosts (please see Appendix C for more discussion regarding suitable hosts and habitat for *Orobanche* spp.). Excessive thatch build up in the meadow habitats in the vicinity as well as tree encroachment has possibly degraded *Orobanche* habitat. Because the host plant was not yet in flower, we may have overlooked patches of suitable hosts.

Status: *Orobanche californica* ssp. *grayana* historically occurred in Washington, Oregon, and California. It is presumed extinct in Washington and Oregon. Within California, single occurrences are in Nevada, Placer, Plumas, Trinity, Tehama, and Sonoma counties. We were not able to confirm the species' presence in Yosemite; further work is needed. No previous information is available regarding abundance, simply occurrence. As mentioned above, grazing history, including cessation of grazing, may threaten any extant populations together with changes in fire regimes and climate.

5.1.28 Piperia colemanii

Coleman's piperia was first collected in the vicinity of Tamarack Flat in the west central portion of Yosemite in 1911. It was first described as a species after the most recent state-wide flora (Hickman 1993) was completed and so was not included in that treatment. It is known from Yosemite based on only three historic collections. We attempted to relocate the population at the type locality near Tamarack Flat in 2004 but were unable to confirm whether it persists. See Appendix C for additional details.

Status: *Piperia colemanii* has a narrow distribution extending from the Cascade Range in Siskiyou County south along the west slope of the Sierra Nevada to Fresno County (Coleman 1995) between 1,200 and 2,300 m (3,940 and 7,545 ft) elevation. It was added to the Yosemite special status vascular plant list in 2003 because it is listed by the CNPS (List 4) and is a Forest Service Watch species in Region 5. No previous survey data are available for comparison with the 2004 results. There are only three collection localities in the park where it is being sought. There are no currently recognized threats; however, Coleman (1995) indicates habitat may be threatened by logging outside of protected areas.

5.1.29 Plagiobothrys torreyi var. *torreyi*

We surveyed and failed to find *Plagiobothrys torreyi* var. *torreyi* (Yosemite popcorn-flower) at the first two locations listed in Botti (2001), namely the trail from Happy Isles to Mirror Lake and south of Sentinel Bridge, both in Yosemite Valley. We found a putative stand of *P. torreyi* var. *torreyi* at Botti's third location at Ahwahnee Meadow. We estimated this population size at over 7,400 plants.

Status: *Plagiobothrys torreyi* var. *torreyi* is known only from a few collections from Yosemite Valley. Conclusions regarding its status await further taxonomic treatment of the taxon as the distinctness of var. *torreyi* from var. *diffusus* is in question. Our preliminary impression that the erect habit and few stems with scattered leaves that distinguish *P. torreyi* var. *torreyi* from *P. torreyi* var. *diffusus* with decumbent stems may relate more to the amount of space and moisture available in a growing season than genetic distinctness. No previous survey data are available for comparison with 2004 results.

5.1.30 Platanthera yosemitensis

In the course of surveying predicted habitat for *Trifolium bolanderi*, Alison E. L. Colwell found this new, undescribed bog-orchid (Colwell et al. 2007). *Platanthera yosemitensis* (Yosemite bog-orchid) was first collected in the same vicinity in 1923 by G. H. Grinnell but remained undetermined until the 1990s. A population of six plants was reported at a Glacier Point Road meadow by Coleman (1995) and Leon Glicenstein (Hoosier Orchid Company, personal communication). Coleman made a collection (Yosemite National Park, off Glacier Point Road,

elev. 7,000 ft Lip yellowish, sepals and petals green. 6 plants, 1 site, not in other meadows. 14 Jul 1993. R. A. Coleman s.n. [NYS A12358]) during an effort to relocate the site of the G. H. Grinnell 1923 collection.

Our surveys in July to August 2003 and July to August 2004 located eight populations of *P. yosemitensis*. They ranged in abundance from two to 465 plants and in area from 0.5 m^2 to 1.2 ha. The majority of populations were in sites classified as *Polygonum bistortoides* Alliance while two were dominated by *Carex rostrata* or *Deschampsia cespitosa*. Other orchid species co-occurred with *P. yosemitensis*., namely *P. dilatata* var. *leucostachys*, and *P. sparsiflora*, as well as *Spiranthes romanzoffiana*. The most abundant associates included *Polygonum bistortoides*, *Helenium bigelovii*, and *Perideridia* spp.

The *P. yosemitensis* populations found thus far are in meadows at headwaters of creeks in steep terrain, generally with large areas of watershed above them. This implies they remain saturated throughout the summer. *P. yosemitensis* occurred in the wettest part of these wet meadows, in saturated muck with some standing water next to meanders with flowing water. See Appendix C for further information.

Status: Because only two collections existed previously (RSA and NYS) in herbaria examined thus far (CAS, GH, NYS, RSA, SJSC, UC/JEPS, US, YM), we expect *P. yosemitensis* is a species of limited distribution. The smallest populations, numbering two and three plants each, are among the closest to recreational and administrative activities. Those are the most vulnerable to disturbance. Threats include snow-grooming activity with large equipment, hazard tree felling and removal, collecting, and trampling. Further work is needed to determine the full geographic range of the species. We consider the small, unglaciated watersheds south of Yosemite Valley to be the most promising.

5.1.31 Potamogeton epihydrus ssp. *nuttallii*

Potamogeton epihydrus ssp. *nuttallii* (Nuttall's pondweed) was previously known from just one locality in the central Sierra Nevada based on an 1866 collection in Yosemite Valley by H.N. Bolander (H. N. Bolander 6393, 1 August 1866, UC354). That occurrence has not been relocated in recent years and may have been extirpated due to hydrologic changes in the Valley (Taylor, in preparation).

We located a new station for *Potamogeton epihydrus* ssp. *nuttallii* at 2,100 m (7,000 ft) south of Glacier Point Road on 17 August 2003 (AC03-44B, YOSE 117677, determination by Robert Haynes, University of Alabama). We classified the site as *Sparganium angustifolium* Herbaceous Vegetation Association. It was associated with a *Deschampsia caespitosa–Polygonum bistortoides* meadow. We were unable to estimate the size of the population because it is unclear to what extent the species produces multiple stems or how many inflorescence stems one individual may produce. Also, it was growing intermixed with other species of *Potamogeton*, the submerged leaves of which were not readily distinguishable from *P. epihydrus* leaves.

Plants occurred in slowly flowing meanders of clear, cold water within montane meadow habitat. The most important associated species included *Torreyochloa pallida* var. *pauciflora, Carex utriculata, Ranunculus flammula, Potamogeton alpinus,* and *Potamogeton pusillus* ssp. *pusillus*.

Status: *Potamogeton epihydrus* is found in still or flowing waters of lakes, ponds, rivers, and streams of the northern United States and southern Canada, extending southward in the eastern United States to Louisiana and Alabama. In California, *P. epihydrus* is rare. It is patchily distributed from the northern Coast Ranges to the Modoc Plateau and the High Sierra Nevada. It is reported from Mendocino, Shasta, El Dorado, Modoc, Plumas, and Mariposa counties. In Yosemite, it is known only from "Yosemite Valley" (H. N. Bolander 6393, 1 August 1866 UC354) and Westfall Meadows (AC03-44B). No previous survey information is available for comparison with the 25 m^2 area of plants at Westfall Meadows. Potential threats include changes in hydrology and introduced aquatic weeds from foot traffic, pack stock, and waterfowl.

5.1.32 Potamogeton robbinsii

We are aware of only four previous collections of *Potamogeton robbinsii* (Robbins' pondweed) in Yosemite, all from Swamp Lake west of Hetch Hetchy Reservoir. They date from 1937, 1938, and 1958. A 1976 hand-drawn map of species distributions in Swamp Lake by W. Evans shows a single point of *P. robbinsii* occurrence at the southeast end of the lake. The map is associated with the Yosemite School for Field Natural History Research Reserve at Swamp Lake, but the thoroughness of the 1976 survey is unknown (YSFNH 1982). Botti (2001) lists the Swamp Lake locality and Westfall Meadows. An August 2003 survey failed to locate a population of *P. robbinsii* at Westfall Meadows, finding only *P. alpinus*, *P. epihydrus*, and *P. pusillus* ssp. *pusillus*. However, we relocated the species at Swamp Lake where the population occurred strictly on the bottom of the lake. It formed a dense carpet, extending from two meters depth to the limit of visibility (≥5 m [≥16 ft]) and covering at least 0.3 ha (0.75 acre). It may be useful to note that *P. robbinsii* occurred from the inner edge of floating leaves with dense cover to deeper water. Therefore, expansion of aquatic species with floating leaves (e.g., *Brasenia shreberi*, *P. natans*), including any introduced aquatics, could impact *P. robbinsii*. We had to limit our survey to the north and west sides of the lake.

Status: In California, *P. robbinsii* has a disjunct distribution in the Klamath Ranges and the central and southern Sierra Nevada. It is listed as rare, threatened, or endangered in California by the CNPS (CNPS List 2). In addition to competition from native and non-native plant species, potential threats include siltation from runoff following fire. No previous survey data are available for comparison.

5.1.33 Saxifraga mertensiana

There are two documented locations in Yosemite for *Saxifraga mertensiana* (wood saxifrage), in the Vernal Fall vicinity and the upper portion of the (historic) Ledge Trail above Curry Village just west of Glacier Point. There are herbarium collections only from the latter. We surveyed a stand at the top of the Ledge Trail on June 5, 2004, which is undoubtedly a portion of the population mapped in the 1980s that extends farther down the Ledge Trail. A small proportion of the stand was flowering during the survey but plants were sufficiently distinct to allow an estimate of approximately 700 plants. They occurred on a mesic cliff on the west side of the north-facing gully. Associated species were common mesic cliff inhabitants such as *Holodiscus microphyllus*, *Heuchera micrantha*, *Sedum spathulifolium*, *S. stenopetalum*, and *Cystopteris fragilis*.

Status: *Saxifraga mertensiana* is a species of somewhat limited distribution in California though it is not listed by governmental or non-governmental entities beyond the listing as a sensitive

species on the park list. It occurs in California largely along the North Coast and North Coast Ranges, Klamath Ranges and northern Sierra Nevada. The Mariposa County occurrence in Yosemite forms the southern range extent. There are no known threats to the two populations, but the Ledge Trail stands presumably are more secure due to extremely low foot traffic and a much greater abundance. Botti (2001) describes the Vernal Fall population as sparse. No previous survey information is available for comparison.

5.1.34 Schoenoplectus subterminalis (*Scirpus subterminalis*)

On July 13, 2003, Alison E. L. Colwell made the first collection of *Schoenoplectus subterminalis* (water bulrush) in Yosemite. This species is known in California from the Klamath Ranges and the northern High Sierra Nevada (Hickman 1993). Its distribution extends to Alaska and eastern North America. The disjunct location at Swamp Lake may have been overlooked during the decades the area has been botanized or it may have been initiated in recent years by migrating waterfowl.

We revisited the population for a more detailed survey on July 14, 2004. *Schoenoplectus subterminalis* was rooted in 0.3 to 1 m (1 to 3 ft) of water. We noted an average of 22 emergent flowering stems per m^2 of *S. subterminalis*, leading to an estimate of over 12,000 plants total for the population. However, the species forms a vegetative "lawn" in deeper water, producing both emergent and submerged flowering stems, and it is not entirely clear how the number of emergent stems relates to total number of individual plants present.

Swamp Lake is a cold, permanent lake at 1,525 m (5,000 ft) that is protected on all sides by rocky, hilly terrain. The surrounding forest is a *Pinus lambertiana–P. jeffreyi–Abies concolor* mix (*Abies concolor–Pinus lambertiana* Alliance). We classified the site as *Potamogeton* sp. Permanently Flooded Herbaceous Alliance based on the relatively high cover of *P. natans*. Other species that occurred in deeper water with *S. subterminalis* near the edge of the lake included *Dulichium arundinaceum*, *Menyanthes trifoliata,* and *Brasenia schreberi*.

Status: *Schoenoplectus subterminalis* is listed by the CNPS as rare, threatened, or endangered in California, but more common elsewhere (List 2). The population at Swamp Lake is a new record for Tuolumne County and the park. The nearest previously known population is in El Dorado County. There are only a few known localities in the western United States, and this species is uncommon throughout its range in the eastern United States. Migrating birds may spread it, leading to this diffuse pattern of distribution, but it is unknown why it remains uncommon over this large range. Potential threats include siltation from runoff following fire.

5.1.35 Scirpus clementis

Scirpus clementis (Yosemite bulrush) is a diminutive subalpine to alpine perennial often overlooked in its native habitat. National Park Service staff together with a volunteer group completed one survey in Tuolumne Meadows in 2003. The estimated number of plants was just over 82,000 within 1.5 ha. Tuolumne Meadows is the type locality for *S. clementis*.

Status: *Scirpus clementis* is a Sierra Nevada endemic that occurs from Tuolumne County south to Tulare and Inyo counties. It was at one time listed by the CNPS on List 4 but was rejected for the 2001 edition of the CNPS *Inventory* as too common for inclusion. The park continues to list it as sensitive. Trampling by visitors accessing the meadow and river and changes in hydrology from

an established road and trail represent the most direct threats. No previous survey data for any populations are available for comparison.

5.1.36 Sparganium natans

Sparganium natans (small bur-reed) is an aquatic perennial species with floating leaves and simple, spherical flower heads. It was previously known in the park only from Swamp Lake and Tiltill Valley based on H. L. Mason 1937 and 1938 collections respectively (UC1099811, UC1056963). On August 17, 2003, we found a previously undocumented population approximately 35 km south of the known locations. The Westfall Meadows population, estimated at 10 individuals, occurs in a three-foot deep, shaded pool of a slowly flowing meander at the edge of the main meadow. *Torreyochloa pallida* var. *pauciflora* and *Carex utriculata* are important associated species, reflecting the flooded conditions.

Status: *Sparganium natans* is distributed in California from the northern and central Sierra Nevada to the high Cascade Range and Modoc Plateau. It thence ranges north to Alaska and east to northeastern North America. It is on the watch list of the CNPS (List 4) due to its limited distribution in the state. No previous survey data for any populations are available for comparison. This species has very limited distribution in Yosemite, but there are no known threats at this time.

5.1.37 Trifolium bolanderi

Trifolium bolanderi (Bolander's clover) was previously known from only 20 locations in the central Sierra Nevada (Ratliff and Denton 1993). Ten of these are in the park, including the type locality of Westfall Meadows. The National Park Service surveyed four locations in 1999. We resurveyed one of those plus the type locality, three other previously mapped locations, and two new populations between July 8 and 29, 2003. In addition, we surveyed six areas of potential habitat (see Potential Habitat Mapping results section). Surveys of the five previously documented populations and the two additional locations near Bridalveil Campground resulted in a total count of nearly 146,000 plants among seven populations. They ranged in abundance from 162 at a 33 m^2 site to an estimated 70,000 plants in the 18.5 ha meadow at the type locality.

Status: *Trifolium bolanderi* is limited to Fresno, Madera, and Mariposa counties in the central Sierra Nevada. It is listed by the CNPS as rare, threatened, or endangered in California and elsewhere (CNPS List 1B), their highest listing of extant species. The earliest available information from surveys dates from July 1978, when the population size among eight meadows including McGurk, Westfall, and Peregoy was described as in the thousands. Prior to the mapping of *T. bolanderi* in those eight meadows, it had been known only from Westfall and Peregoy meadows. The 1999 survey of Peregoy Meadow resulted in an estimated population size of "2,000 plus." Our count of 2,919 plants supports that and indicates the population may not have declined since that time. Surveyors in 1999 also visited two meadows north of Summit Meadow, estimating their populations at "1,000 plus" and "2,000 plus," and McGurk Meadow with a population estimate of over 5,000.

If we include the 1999 survey results, assuming those populations are relatively stable, *T. bolanderi* in Yosemite numbers nearly 300,000 plants and occurs in 10 meadows within an area of approximately 1,200 ha. Invasion of *T. bolanderi* habitat by *Pinus contorta* ssp. *murrayana* is the most evident threat to these populations. Maintained trails pass through

McGurk and Westfall meadows. Soil compaction and trail downcutting below the soil surface level can modify meadow hydrology. We also noted trampling, an old road bed, and patches of vegetation scraped away by animals in various sites.

5.1.38 Trillium angustipetalum

The NPS surveyed a population in Wawona south of the South Fork of the Merced River. They found 400 plants in approximately 1.4 ha. The overstory at the site was a mix of *Pinus ponderosa* and *Calocedrus decurrens*. Other important associated species were *Alnus rhombifolia*, *Rhododendron occidentale*, *Equisetum arvense*, *Pteridium aquilinum*, and *Adenocaulon bicolor*.

Status: *Trillium angustipetalum* (giant trillium) is on the Yosemite sensitive plant list due to limited distribution in the park. It is broadly distributed in California in the western Klamath Ranges, the central coast and outer South Coast Ranges, and the Sierra Nevada. However, there are only three known collections from the park of this showy species, and Botti (2001) indicates it is "restricted to a narrow elevation range within the mixed conifer" zone. There is heavy visitation and development pressure at the elevations of occurrence for *T. angustipetalum*.

5.1.39 Vaccinium parvifolium

We encountered three populations of *Vaccinium parvifolium* (red huckleberry), but found previous documentation for only one of them. The three occurrences were at North Crane Creek adjacent to the Tuolumne Grove of giant sequoias (the only occurrence in Yosemite GIS data), North Crane Creek near the confluence with Hazel Green Creek (surveyed in 2004), and at Merced Grove. We reported the unsurveyed locations to the NPS in an Access database storing opportunistic plant observations (PlantObs.mdb). We found nearly 800 plants during our survey along North Crane Creek under canopy of *Abies concolor*, *Pinus lambertiana*, and *Calocedrus decurrens*. Associated species were common understory components of this forest type.

Status: Most typically a more northern species, *V. parvifolium* occurs in California from the San Francisco Bay Area north to the North Coast, Outer North Coast Ranges and Klamath Ranges, thence east to the High Cascade Range and then down to the northern and central High Sierra Nevada. It is on the Yosemite sensitive plant list due to limited distribution in the park. A collection was made in 1935 from a North Crane Creek population (YM 64082 and UC1121149); we found no other collection records from the park. Botti (2001) cites the Tuolumne Grove locality as the only park occurrence. Increasing the number of known occurrences from one to three, makes the species status in the park appear more secure. These population locations receive almost no visitation, and there are no apparent threats at this time.

5.2 Potential Habitat Mapping

We created potential habitat maps and did map verification for *Eriophyllum congdonii*, *Trifolium bolanderi*, *Hulsea brevifolia*, and *Cypripedium montanum*. We had to limit map verification to four species because potential habitat map development was concurrent with field data collection to determine population status. We produced unverified maps for *Carex tompkinsii* and *Platanthera yosemitensis* (see unverified maps below).

5.2.1 Field Verification

Hulsea brevifolia: After evaluating spatial data on habitat characteristics associated with 11

Hulsea populations, we selected factors to use as map input and the range of values for each. We included elevations between 1,600 and 2,550 m, moisture index between 0 and 9, slope steepness between 3 and 26 degrees, no fire history, 5 surficial geology categories, and 7 vegetation types. Geologic types most commonly occurring within *Hulsea* populations were two types of granodiorite, two types of granite, and undifferentiated metasedimentary rock. Vegetation types in which *Hulsea* most commonly occurred were *Abies magnifica* mixes with *A. concolor* and/or *Pinus jeffreyi* or *A. concolor–Pinus lambertiana* types, most with greater than 40% canopy cover. We assumed aspect would not be a useful predictor because there was no pattern in *H. brevifolia* occurrence by aspect. We then constructed the map with these input values. The map highlighted specific areas in the southwest quadrant of the park (Figure 2).

We surveyed 11 sites with the greatest likelihood of being appropriate habitat and found short-leaved hulsea populations at eight of them (Figure 3). Populations ranged in size from 42 to over 1,000 plants and areas varied from 47 m^2 to 0.9 ha. The map had a 73% success rate and the surveys doubled the number of documented populations, not including the four populations we mapped during opportunistic surveys.

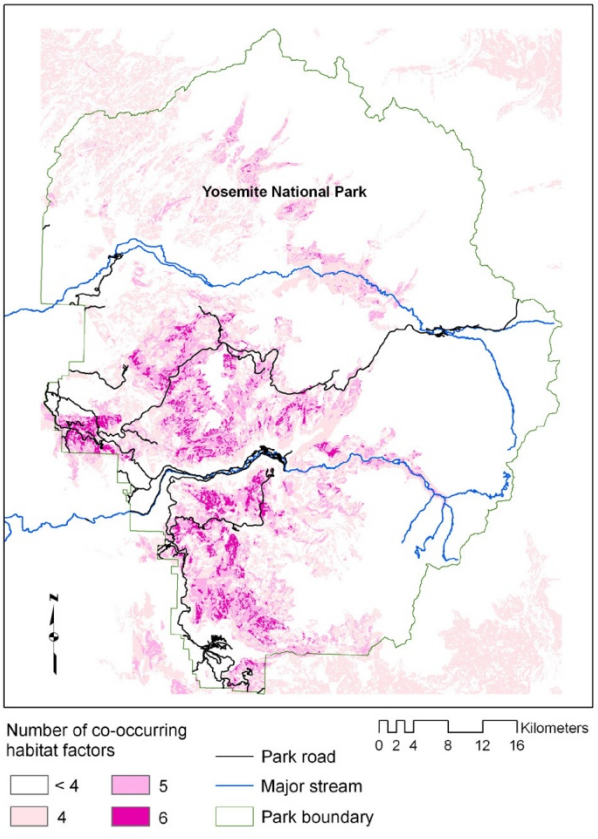


Figure 2. Potential habitat for short-leaved hulsea (*Hulsea brevifolia*) using elevation, slope steepness, moisture index, geology, and vegetation type in Yosemite National Park, California.

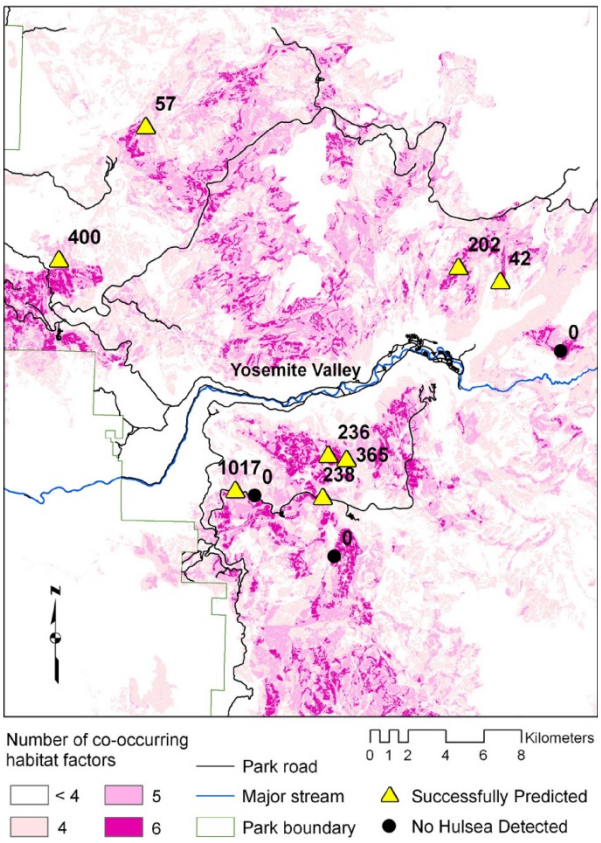


Figure 3. Verification sites for short-leaved hulsea (*Hulsea brevifolia*) potential habitat map, Yosemite National Park. Yellow triangles = sites with short-leaved hulsea; Black circles = sites with no plants detected. Numbers indicate *Hulsea* abundance.

Eriophyllum congdonii: During map verification, we documented population extensions at four potential habitat locations for Congdon's woolly-sunflower (ERCO40-Predicted-2, -3, -8, and -9) and documented one wholly new population (ERCO40-5). An additional 977 plants were found among four populations documented during habitat map verification, bringing the overall *E. congdonii* abundance among populations surveyed to approximately 170,760. The extensions of previously documented populations were on the ridge east of Pigeon Gulch (ERCO40-Predicted-8 and -9, 257 plants total), on the ridge north of the National Park Service administration/warehouse building at Railroad Flat (ERCO40-Predicted-1, 560 plants) and on the east side of Moss Creek (ERCO40-Predicted-3, 160 plants). No plants were detected at five other potential habitat locations in the El Portal Administrative Site, all of which appeared to be inappropriate habitat. These unoccupied habitats had dense tree or shrub canopy and/or no rock outcrops. Potential habitat fell in the El Portal Administrative Site only, not within the park boundary. Results indicated a success rate of 56% for the *E. congdonii* potential habitat map.

Trifolium bolanderi: We surveyed six areas of potential *T. bolanderi* habitat, finding the species only at the Horizon Ridge/Ostrander Lake Ski Trail site (TRBO10-P-6). We estimated this new population at 1,448 plants based on a subsample. Upon examination, predicted sites 1, 2, 4, and 5 did not appear to be good *T. bolanderi* habitat. Sites 1 and 2 had meadow vegetation taller than the norm for *T. bolanderi* (it was 1 m [3.3 ft] tall) and were acidic or boggy in microsites with shorter vegetation. Predicted site 4 was wetter than *T. bolanderi* sites for the time of the season, and may be located below a larger watershed than occupied habitat. Site 5 was poor habitat altogether. The only saturated soil in the meadow was at the base of a small spring on one side of the meadow with the remainder of the meadow being dominated by *Pteridium aquilinum*, *Epilobium angustifolium*, and *Symphoricarpos* spp. In contrast, site 3 appeared to contain appropriate habitat including species commonly associated with *T. bolanderi*: *Deschampsia cespitosa, Phalacroseris bolanderi, Ivesia unguiculata*, and *Perideridia bolanderi*. The habitat at site 6 (TRBO10-P-6), where we found over 1,400 plants, was typical for Bolander's clover, a montane meadow surrounded by Pinus *contorta* ssp. *murrayana* that is saturated through the growing season. We classified the occupied habitat as *Deschampsia caespitosa–Polygonum bistortoides* Herbaceous Vegetation, the plant association found in nearly every occupied habitat we visited. These results indicated a success rate of 17% for the *T. bolanderi* map.

Cypripedium montanum: We reviewed habitat data derived from eight mapped *C. montanum* populations. Mountain lady's slipper occurred mainly between 1,150 and 1,375 m (3,770 and 4,510 ft) elevation, on gentle slopes (3–15 degrees) with no history of fire and moderate soil moisture index. Three types of surficial geology predominated within mapped populations: alluvium, granodiorite of Ostrander Lake, and Granodiorite of Illilouette Creek. There were a limited number of vegetation types within these mapped populations, consisting mainly of *Pinus ponderosa–Calocedrus decurrens* mixes, an *Abies concolor–Pinus lambertiana* mix, and *Sequoiadendron giganteum–Pinus lambertiana*. We assumed aspect would not be a useful predictor because there was no pattern in *C. montanum* occurrence by aspect. We surveyed 16 sites of potential habitat and found appropriate habitat at all of them (see Figures 4 and 5 for examples), although habitat was heavily impacted at Grouse Creek. We found mountain lady's slippers at seven of the sites, resulting in a mapping success rate of 44%.

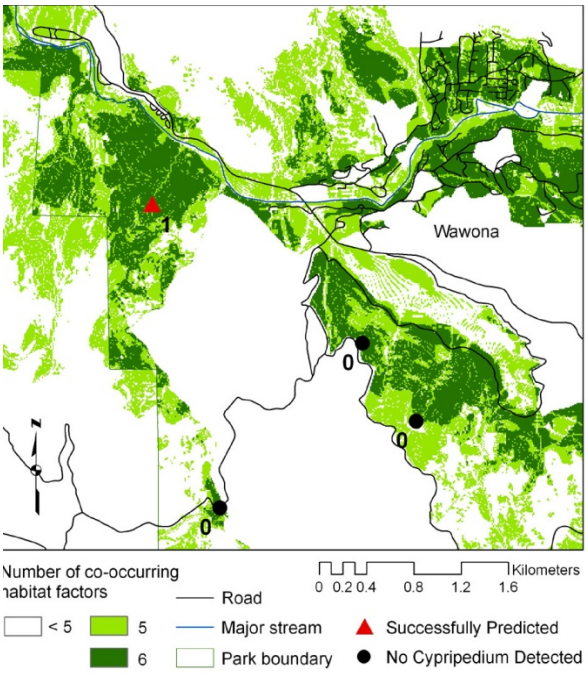


Figure 4. Model verification sites for mountain lady's slipper, Wawona area, Yosemite National Park. Red triangles=sites with mountain lady's slipper, Black circles=sites with no plants detected. Numbers indicate plant abundance.

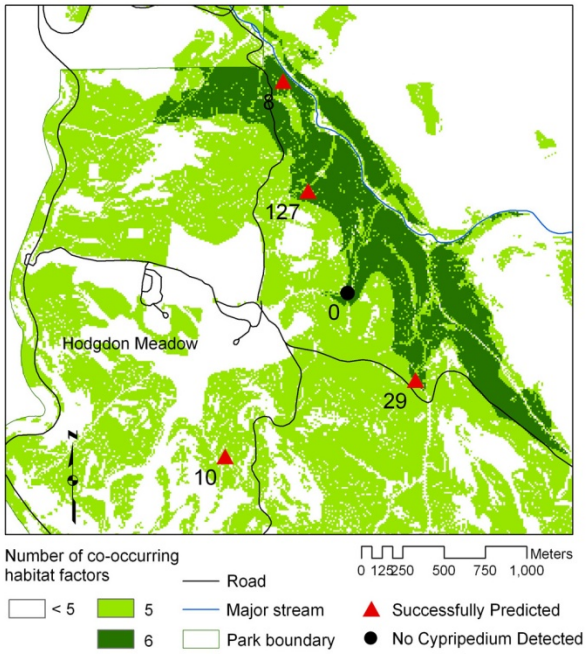


Figure 5. Potential habitat verification sites, Hodgdon Meadow area, Yosemite National Park. Red triangles = sites with mountain lady's slipper; Black circles = sites with no plants detected. Numbers indicate plant abundance.

5.2.2 Unverified Maps

Carex tompkinsii. We surveyed and mapped eight previously undocumented stands of *Carex tompkinsii* (CATO10-2, 3, 4, 6, 7, 8, 9, 11, 12), using experience with the species' habitat at survey locations rather than the potential habitat map. Map output was not available at the time of those surveys. The previously mapped extent was 133 ha comprised of two polygons: one on the north side of the Merced River north of the trailer village and east of Rancheria Flat (running as much as 180 m [590 ft] north of the river), and the other a long, narrow area from south of the Little Crane Creek confluence northeast along the north side of the river nearly to Arch Rock. During the 2003–2004 surveys, we mapped an additional 4.3 ha among eight new stands using a conservative method of limiting mapped areas to the extent of plants.

Even though we were not able to do potential habitat map verification, we produced a *C. tompkinsii* habitat map for future use. It identifies additional habitat in portions of the El Portal Administrative Site north and south of the Merced River that may support additional stands of Tompkins sedge (Figure 6).

Additional Habitat Maps: In anticipation of support for additional survey work on the new bog orchid, we produced a potential habitat map for *Platanthera yosemitensis*. We produced a potential habitat map for *Lupinus gracilentus*, a Forest Service sensitive/CNPS List 1B species, as well, but it was based on few mapped populations.

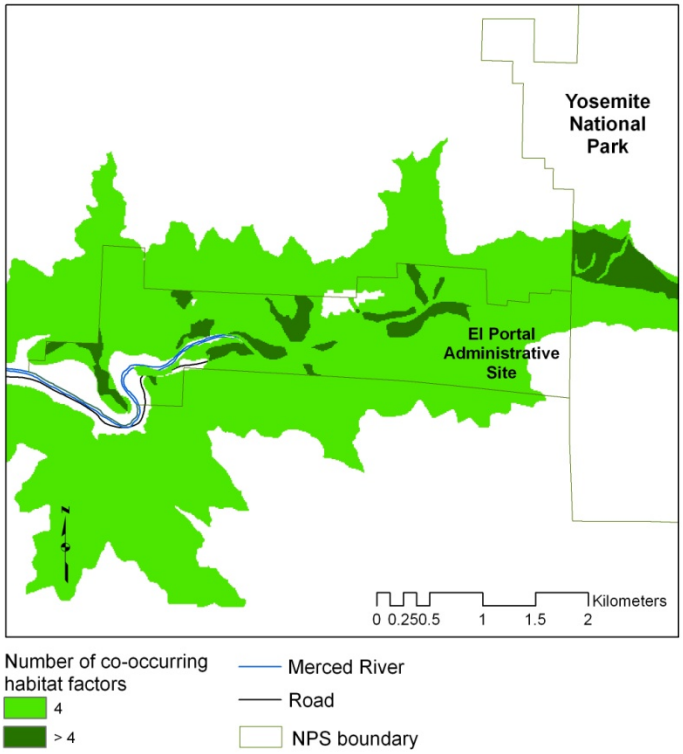


Figure 6. El Portal Administrative Site with areas of potential habitat for Tompkins sedge (*Carex tompkinsii*), Mariposa County, California.

6 - Data Management

We managed the special-status vascular plant species list and survey data according to NPS I&M specifications, namely using Microsoft Access for tabular data and ESRI Arc software for spatial data. The database storing survey results consists of 11 data tables, a separate table for each type of information collected in the field, and 22 tables to provide standardized terms during data entry. These 'pick lists' reduce data entry errors and limit the entries to the possible range of values acceptable for a given field (e.g., topographic quadrangle names, vegetation types, and associated species). As of 2005, there were 163 records in the table "SurveyTarget SpeciesInfo" each record representing a single survey. Other tables link to this table via the "SurveyCode" field. The Access database also contains a table that stores plant voucher information for each specimen collected, a table detailing plant and habitat photographs, and a query and associated report for producing formatted herbarium labels for mounted specimens. We are supplying metadata describing the format and contents of each field in Appendix B listed by table.

We worked with the NPS applications developer at Yosemite National Park on the development of a database that meets stringent data management quality standards. It was designed to address the need for NPS managers to add survey data in the future and to incorporate plant species standardized nomenclature according to the standard used by the I&M Program. The program standard is the Integrated Taxonomic Information System (ITIS) (www.itis.gov), and it incorporates synonymy, including that of Hickman (1993), the nomenclatural standard for this project.

We specified our spatial data management procedures in the methods section above, including GPS settings and equipment, post processing of field GPS data, vector file creation, and how vector files were attributed. The resulting "rare_plants-2004" vector file contains population perimeter data for 126 populations. The "areasurveyed" shape file contains survey perimeter data for 156 surveys.

We inventoried, mounted, and labeled plant specimens to prepare them for accession to the Yosemite National Park herbarium (YM). There are nearly 500 specimens, including a number of mosses. We will be supplying some duplicates to the University Herbarium and will note the repository in the database. There is an entry for each specimen sheet in a table titled "YOSE-6809-2003-4Coll'ns" in a database titled "2003-4CollForNPspecies_YM.mdb." We imported all of the data on accessioned plant specimens to the National Park Service biodiversity database, originally an application entitled "NPSpecies" but in transition to become part of a NPS application called the Natural Resources Information Portal (NRInfo Portal). We documented transparency photographs in the "tblSurveyPhotographicRecords" table of the database, including subject, location, date, photographer, and survey code.

7 - Additional Work Needed

When this project was initiated, it was clear to both NPS and USGS that only a small handful of taxa on the Yosemite special-status vascular plant species list could be surveyed given available funding. We accomplished far more than expected in terms of species surveyed and number of surveys completed. This was largely due to the dedication of USGS field botanists and the support provided by USGS to complete data documentation tasks identified in the inter-agency agreement (i.e., final reporting, database, metadata, etc.). Also, we received assistance with several surveys from NPS staff, particularly in spring 2003.

In spite of the volume of surveys completed and our best effort to gather information to support management, there is additional work to be done to fully and accurately assess the status of listed taxa. In some cases, we did not get to every known population for a species we surveyed because of access issues or length of flowering period (e.g., *Mimulus filicaulis*, *M. pulchellus*, *Lewisia disepala*). In others, insufficient information was available at the time of the surveys to efficiently direct our work (e.g., status of *Plagiobothrys torreyi* var. *torreyi* as a unique taxon, accuracy of *Allium tribracteatum* determinations for herbarium holdings). Some of the work needed will entail visits to documented localities; some will involve continuing to work with specialists to revise taxonomy. We included details of additional work needed toward the end of each species summary in Appendix C. We highlight here some specific work we recommend for selected species.

Additional populations of *Platanthera yosemitensis* could be sought in hydric meadows around 2,100 m (7,000 ft) with appropriate hydrologic regime and species composition. The potential habitat mapping should be helpful in this regard.

The Bridalveil Falls population of *Allium yosemitense* could be resurveyed during its peak flowering period, typically late May, to derive a more accurate estimate of current population size. The remainder of documented *Mimulus filicaulis* and *M. pulchellus* populations could be surveyed to derive population status. The occurrence of *Lomatium congdonii* in the park or El Portal Administrative Site could be verified through specimens, if available, or surveys because its serpentine habitat is not known to be present in either area. There is evidence in the form of a single H. L. Mason specimen collected in 1938 that *Allium tribracteatum*, a CNPS List 1B species, occurs in Yosemite. A field visit would need to coincide with the presence of mature but not senescent plants at a time when snow banks are still present en route to the site (Bailey Ridge) northeast of Hetch Hetchy Reservoir.

Cinna bolanderi (CNPS List 1B) is known from only a few locations, most of which are in the park, including the type locality at Mariposa Grove. Sites of early collections, such as Wildcat Creek, need to be redocumented, in particular the area of the type locality. The localities of some early collections cannot be relocated due to imprecise location information, but there is probably additional habitat in moist meadows between 1,900 and 2,400 m (6,230 and 7,875 ft). Botti (2001) mentions localities for *C. latifolia*, that are almost certainly *C. bolanderi*.

More work is needed on aquatic species in Yosemite. If the growth forms of *Potamogeton epihydrus* and *P. robbinsii* can be verified, the population sizes could be assessed at the survey sites of Westfall Meadows for the former (new site) and Swamp Lake for the latter. A more

detailed survey of *P. robbinsii* at Swamp Lake would require underwater light, mask, and fins because it appears to form a solid stand on the bottom of the lake beyond the limit of visibility. A method to estimate their number is not obvious, but area and cover could be assessed. The new site for *P. epihydrus* at Westfall Meadows implies additional habitat occurs in the park.

In the 1980s, NPS staff mapped 25 *Lewisia disepala* populations on exposed sites above Yosemite Valley, including some areas that see heavy use. These included Turtleback Dome (surveyed in 2004), Yosemite Point, and North Dome. Because of impacts from heavy use and the species' vulnerability to trampling and to climatic change, this species could be considered a target for monitoring, with information on status collected in the short term.

Jim Shevock, NPS research coordinator for the Californian Cooperative Ecosystem Studies Unit and Sierra Nevada botanical expert, reported *Ivesia unguiculata* from Grace Meadow in the northern portion of Yosemite. This location, if relocated and confirmed with a specimen, would extend the range in the park of this species by many kilometers.

In light of a growing understanding regarding the status of *Carex tompkinsii*, the species may be demoted in survey priority level. However, consideration could be given to additional surveys for *Carex tompkinsii* within Yosemite. Specifically, surveys could be done in the Merced River Canyon east of the park boundary and below Arch Rock Entrance Station. This was one of the few areas of known distribution neglected in our surveys due to safety issues related to working up and down the slope from El Portal Road. CNPS includes *C. tompkinsii* on List 4, species of limited distribution, but the CNDBB and Sierra National Forest have removed it from special-status listing (it is still included by the Sierra National Forest on their watch list). It is still listed by the state of California as rare, but this listing has not been reviewed in light of new information on its abundance and extent in the Kings River Canyon.

Finally, there are the remaining taxa that have received little or no attention in the park since the 1980s. These include at least 5 CNPS List 2 species, one CNPS List 3 species, nearly two dozen CNPS List 4 species, and numerous park-sensitive species. In the interest of management, protection, and future monitoring needs, surveys and assessments of species status should be extended to at least the species listed by the California Native Plant Society. Surveys of park-sensitive taxa might be done systematically as well, or opportunistically, depending on funding constraints and management needs. Species listed as sensitive in the park only typically are rare enough to elude documentation in more general surveys. Among these taxa, we recommend the following be given consideration due to rarity: *Anelsonia eurycarpa*, *Dicentra pauciflora*, *Epilobium latifolium*, *Erigeron barbellulatus*, *Galium boreale* ssp. *septentrionale*, and *Scutellaria bolanderi* ssp. *bolanderi*, (one locality each); *Antirrhinum leptaleum* (two localities); *Carex albonigra* (two localities inside the park); *Carex sartwelliana*, and *Eriophorum gracile* (three localities); and *Gentianella tenella* ssp. *tenella* (four localities). *Pseudostellaria sierrae* is a newly described species, thus far known from only two localities in Yosemite, and has not yet been surveyed. Similarly, *Cuscuta suksdorfii* is being resurrected as a unique taxon from *C. salina* and *C. californica* and is unsurveyed. A number of other taxa likewise have quite limited distribution in the park (See Botti 2001; Taylor, in preparation).

8 - Literature Cited

Bateman, P. C. and K. B. Krauskopf. 1987. Geologic map of the El Portal Quadrangle, west-central Sierra Nevada, California. Miscellaneous Field Studies Map MF-1998. U.S. Department of the Interior, U.S. Geological Survey, Washington, D.C.

Botti, S. J. 2001. *An illustrated flora of Yosemite National Park*. Yosemite Association, El Portal, California.

Brandenburg, D. M., W. H. Blackwell, and J. W. Thieret. 1991. Revision of the genus *Cinna* (Poaceae). Sida 14(4):581-596.

Calflora. 2000. The CalFlora Database. Calflora, Berkeley, California. Online. (www.calflora.org/). Accessed June 2003 to Jan 2005.

California Department of Fish and Game (CDFG). 2003a. California Natural Diversity Database. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed April 2003.

California Department of Fish and Game (CDFG). 2003b. California Natural Diversity Database. California Native Species Field Survey Form. Form FG/WHDAB/1747 Version dated 10/20/2003. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (www.dfg.ca.gov/biogeodata/cnddb/pdfs/CNDDB_FieldSurveyForm.pdf). Accessed May 2003.

California Native Plant Society (CNPS). 2004a. Inventory of rare and endangered plants (online edition v6-04b). California Native Plant Society, Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed on various dates in 2004.

California Native Plant Society (CNPS). 2004b. Inventory of rare and endangered plants (online edition v6-04d1). California Native Plant Society, Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed Dec. 2004 to Jan 2005.

Coleman, R. A. 1995. The wild orchids of California. Comstock Publishing Associates, Ithaca, New York.

Colwell, A. E. L., C. J. Sheviak, and P. E. Moore. 2007. A new *Platanthera* (Orchidaceae) from Yosemite National Park, California. Madroño 54(1):86–93.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Biological Report Series FWS/OBS-79/31. U.S. Department of Interior, Fish and Wildlife Service, Biological Services Program, Washington, D.C.

Environmental System Research Institute, Inc. (ESRI). 2002. ArcView GIS 3.3. ESRI, Redlands, California.

Flora of North America Editorial Committee. 1993+. Flora of North America: North of Mexico, 14+ vols, Oxford University Press, New York and Oxford.

Good, R. E. 1931. A theory of plant geography. The New Phytologist 30:149–203.

Good, R. E. 1953. The geography of the flowering plants. Second edition. Longmans, Green and Co., New York.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. Patterson, and others. 1998. International classification of ecological communities: Terrestrial vegetation of the United States. Volume 1. The national vegetation classification system: Development, status, and applications. Nature Conservancy, Arlington, Virginia. Online. (http://www.natureserve.org/library/vol1.pdf). Accessed 15 April 2003.

Hall, H. M., and C. C. Hall. 1912. A Yosemite flora: A descriptive account of the ferns and flowering plants, including the trees, of the Yosemite National Park; with simple keys for their identification; designed to be useful throughout the Sierra Nevada mountains. Paul Elder and Co., San Francisco, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Huber, N. K. 1987. The geologic story of Yosemite National Park. U.S. Geological Survey Bulletin 1595. U.S. Geological Survey, Washington, D.C.

Huber, N. K, P. C. Bateman, and C. Wahrhaftig. 1989. Geologic map of Yosemite National Park and vicinity, California (scale 1:125,000). U.S. Geological Survey Miscellaneous Investigations Series Map I-18.

Jepson Online Interchange for California Floristics. 2004. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed July 2003 to Jan 2005.

Keeler-Wolf, T., M. Schindel, S. San, P. Moore, and D. Hickson. 2007. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono counties, California. [Unpublished final report submitted to the National Park Service.] California Department of Fish and Game, Wildlife and Habitat Data analysis Branch, Sacramento, California.

Kéry, M. and K. B. Gregg. 2004. Demographic analysis of dormancy and survival in the terrestrial orchid *Cypripedium reginae*. Journal of Ecology 92(4):686–695.

National Park Service (NPS). 1997. Yose_1997veg_final_poly. [Computer map, Arc coverage]. Vegetation map of Yosemite National Park and vicinity, California.

National Park Service. 2001. Sierra Nevada Network Working Group: biological inventory plan for Sierra Nevada Network Parks. Sierra Nevada Inventory and Monitoring Network Unpublished Report, Sequoia and Kings Canyon National Parks, Three Rivers, California.

National Park Service. 2003. Yosemite Flora-2-10-03.mdb. [Database containing 9,631 records from local and regional herbaria on Yosemite plant collections]. B. Johnson, compiler. National Park Service, Inventory and Monitoring Program, Sierra Nevada Network, Three Rivers, California.

Peck, D. L. 2002. Geologic map of the Yosemite quadrangle, central Sierra Nevada, California. Geologic Investigations Series Map I-2751. U.S. Department of the Interior. U.S. Geological Survey, Washington, D.C

Ratliff, Raymond D. and Renee G. Denton. 1993. Bolander's clover in the central Sierra Nevada: A sensitive species? Madroño 40(3):166–173.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed July 2003 to Jan 2005.

Stephenson, N. L. 1990. Climatic control of vegetation distribution: The role of the water balance. American Naturalist 135:649–670.

Stephenson, N. L. 1998. Actual evapotranspiration and deficit: Biologically meaningful correlates of vegetation distribution across spatial scales. Journal of Biogeography 25:855–870.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

Yosemite School of Field Natural History (YSFNH). 1982. The 1976 Swamp Meadow and Swamp Lake survey report. Yosemite National Park, Yosemite School of Field Natural History, California.

Appendix A. Field Survey Form and Environmental Descriptors for Rare Plant Populations in Yosemite National Park, California, 2003 and 2004

Page 1 modified from California Native Species Field Survey Form, California Natural Diversity Database; pages 2-4 after Grossman et al. 1998.

California Natural Diversity Database Department of Fish and Game 1807 13th Street, Suite 202 Sacramento, CA 95814	*For CNDDB Use Only* Source Code _____ Quad Code _____ Elm Code _____ Occ. No. _____ EO Index No._____ Map Index No._____	Resources Management Yosemite National Park P. O. Box 700 El Portal, CA 95318 Fax: (209) 379-1116

Survey Code: | **Date (yyyy-mm-dd):** _____ - _____ - _____

California Native Species Field Survey Form – NPS Surveys

Scientific Name:

Common Name (Hickman 1993):

Species Found? ☐ Yes ☐ No If not, why?

Plant Count		%Cover		Subseq Visit?	☐Y ☐N
Areal extent of pop'n / stand		☐m^2 ☐ha ☐acres			

Distrib. on site: ☐Scattered individuals ☐Scattered small clumps ☐Large clumps ☐Widespread throughout

Existing NDDB occurrence? ☐Y Occ #_____ ☐N ☐unk

Collection? _____ _____ _____
Collector Coll # Museum / Herbarium
☐Mounted & Labelled ☐Accessioned (Catalog # _____)
☐Entered in NPSpecies (I&M sp occurrence database)

UTM of collection site if different from plot:

Reporter(s):

Address:
Yosemite National Park
P. O. Box 700, El Portal CA 95318

E-mail address:
Phone:

Survey Effort:	Survey area waypoints (if applicable):		
Size of area searched	☐m^2 ☐ha ☐acres		
Survey area mapped ? ☐Y ☐N	% area searched		
Search duration (person hours)			

Search Area Description:

Plant Information Phenology:	_____ % vegetative	_____ % flowering	_____ % fruiting

Determination: (check one or more, and fill in blanks)
☐ Keyed (cite reference): _____
☐ Compared with specimen housed at: _____
☐ Compared with photo / drawing in: _____
☐ By another person (name): _____
☐Other: _____
Comments (including plant characteristics):

Photographs:	Digital Expos
Plant	
Habitat	
Diagnostic feature	
Plot (expos and dir)	
Dig Camera ID	

May NDDB obtain duplicates at their expense? ☐ Y ☐ N

LOCATION

Location Name (from quad map)					
County		**Landowner / Mgr**		**Quad Name** (7.5')	
Population Coordinates	Easting / Longitude			Northing / Latitude	
Datum (circle one)	NAD27 NAD83 WGS84	**Coordinate System:**		UTM Zone 10 UTM Zone 11	OR (Lat. & Long.)
Source of Coordinates	☐ GPS ☐ 7.5 min. topo. Map ☐ GIS Polygon Centroid			**GPS** Make/Model/Unit no.	
Horizontal Accuracy	☐m ☐ft	**PDOP**		☐Max for line/poly	**GPS File Name**

GPS File Contents (check one):
☐ Point: >> ☐Approx. center of stand/population >> **Radius to edge of stand** _____(m) ☐Other: _____
☐ Perimeter points
☐ Line: Perimeter of stand / population? ☐ yes ☐ no: _____
☐ Polygon: Perimeter of stand / population? ☐ yes ☐ no: _____
GPS Comments:

Survey Code: _____ Page__2__ of _____

SITE INFORMATION

Overall **Site Quality:** ☐Excellent ☐Good ☐ Fair ☐Poor	
Current / surrounding **land use:**	
Visible **disturbances:**	
Threats:	
Comments:	

Plot Size (m^2):	Length	Width	or Radius	**Plot Shape**	
Plot UTM coordinates	Easting	Northing	Datum	Horiz accuracy	PDOP
Coord Loc in Plot:					

Elevation ☐ft ☐m	**ElevSource** ☐GPS ☐Altim ☐7.5' map	**Slope** ☐deg ☐%	**Aspect** (deg):
Topographic Position (see cheat sheet)			
Landform (see cheat sheet)	Macro	Meso	Micro
Surficial Geology (see cheat sheet)			

Cowardin System
___Upland ___ Palustrine
___ Riverine ___Lacustrine

Nontidal
___Permanently Flooded ___Saturated ____ Unknown
___Semipermanently Flooded ___Seasonally Flooded
___Temporarily Flooded ___Intermittently Flooded

Site Description / Environmental Comments (vegetation and habitat description, microhabitat, fire history, etc.)

Unvegetated Surface (percent cover of substrate materials)
_____ Bedrock _____ Large rocks (cobbles, boulders > 10 cm) _____ Small rocks (gravel, 0.2–10 cm)
_____ Litter, duff _____ Wood (> 1 cm)
_____ Sand (0.1–2 mm) _____ Bare soil _____ Other:

Soil Texture: ___ sand ___ loamy sand ___ sandy loam
___ loam ___ silt loam ___ silt ___sandy clay loam
___ clay loam ___ silty clay ___ clay
___ peat ___ muck ___ silty clay loam

Soil Drainage
___ Rapidly drained ___ Well drained
___ Moderately well drained ___ Somewhat poorly drained
___ Poorly drained ___ Very poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)
Trees and Shrubs
_____Evergreen
_____Cold deciduous
_____Drought deciduous
_____Mixed evergreen - cold deciduous
_____Mixed evergreen – drought decid
Or Herbs
_____Annual
_____Perennial

Leaf Type (of dominant stratum)
____Broad-leaved
____Needle-leaved
____Microphyllous
____Graminoid
____Forb
____Pteridophyte

Physiognomic class
____ Forest
____ Woodland
____ Shrubland
____ Dwarf-Shrubland
____ Herbaceous
____ Nonvascular
____ Sparsely Vegetated

Survey Code_____ Page__3__ of _____

VEGETATION DESCRIPTION (Continued)

	Cover Class
Total Vegetation Cover (Class)	
Total Non-Native Cover (Class)	

Cover Class Intervals Strata and Unvegetated Surface					
1	2	3	4	5	6
0–1%	>1–5%	>5–25%	> 25–50%	> 50–75%	> 75%

Plant Community: _____ ☐Alliance ☐Association

_____

_____

	Cover Class
Emergent tree	
Canopy tree	
Subcanopy tree	
Shrub	
Herbaceous	
Nonvascular	

***NV**= Nonvascular layer, **H**= Herbaceous layer, **S**= Shrub layer,*
***ST** = Subcanopy Tree layer; **CT**= Canopy Tree layer, **ET**= Emergent Tree layer*
(Check one. Note that a sp. may be listed more than once if it is found in > one vegetation layer.)

***Dominant** (Check box if species is dominant in the stated vegetation layer)*

NV	H	S	ST	CT	ET	Associated Species (or moss, lichen, cryptogamic crust)	Dom-inant	Cover Class
☐	☐	☐	☐	☐	☐		☐	
☐	☐	☐	☐	☐	☐		☐	
☐	☐	☐	☐	☐	☐		☐	
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Survey Code_____ Page__4__ of _____

NV	H	S	ST	CT	ET	Associated Species (or moss, lichen, cryptogamic crust)	Dom-inant	Cover Class
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Survey Comments: (survey comments, similar species on site, phenology comments, year-specific comments, etc.)

Special Status Plant Surveys 2003-2004 USGS-NPS Field Form-v2.3.doc

Environmental Descriptors for Field Survey Form

Environmental descriptors and pages 2-4 of survey form adapted from Grossman et al. 1998.

Topographic Position

Topographic position of the plot. Choose one.

- Interfluve (crest, summit, ridge): Linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.
- High slope (shoulder slope, upper slope, convex creep slope): Geomorphic component that forms the uppermost inclined surface at the top of a slope. Includes the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.
- High Level (mesa): Level top of a plateau.
- Midslope (transportational midslope, middle slope): Intermediate slope position.
- Backslope (dipslope): Subset of midslopes that are steep and linear and may include cliff segments (fall faces).
- Step in Slope (ledge, terracette): Nearly level shelf interrupting a steep slope, rock wall, or cliff face.
- Lowslope (lower slope, footslope, colluvial footslope): Inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope and toeslope.
- Toeslope (alluvial toeslope): Outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.
- Low Level (terrace): Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.
- Channel Wall (bank): Sloping side of a channel.
- Channel Bed (narrow valley bottom, gully arroyo): Bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium.
- Basin Floor (depression): Nearly level to gently sloping, bottom surface of a basin.

Landform

Enter the landform that describes the modal expression of the site. Note that on the code sheet the landform choices are listed as being either macro, meso, or micro in scale. Thus, one can select one from each of these landscape scales for any site (e.g., mountain could be macro, and cirque headwall could be meso). Your choices are:

Macro-scale Types

- canyon
- escarpment
- floodplain
- glaciated uplands
- gorge
- hanging valley
- hills
- island
- mountain valley
- mountain(s)
- plateau
- ridge and valley
- rim
- valley floor

Meso-scale Types

- bench
- bottomland
- channel
- cirque floor fluvial
- cirque headwall
- cliff
- col
- dome
- draw
- earth flow
- eroding stream channel system
- erosional stream terrace
- hillslope bedrock outcrop
- knob
- knoll
- lake/pond
- lake bed
- lake plain
- lake terrace
- lateral moraine
- ledge
- meander scar
- moraine (undifferentiated)
- mud flat
- periglacial boulderfield
- pinnacle
- ravine
- ridge
- ridgetop bedrock outcrop
- riverbed
- rock fall avalanche
- saddle
- seep
- soil creep slope
- stream terrace
- streambed
- swale
- talus
- tarn

Micro-scale Types

- linear
- mounded
- concave
- convex
- hummocky
- undulating

Surficial Geology

Note the geologic substrate influencing the plant community (bedrock or surficial materials). The list below provides an example of the values that might be included.

Igneous Rocks

- Granitic (Granite, Schyolite, Syenite, Trachyte)
- Ioritic (Diorite, Dacite, Andesite)
- Gabbroic (Gabbro, Basalt, Pyroxenite, Peridotite)

Sedimentary Rocks

- Conglomerates and Breccias
- Sandstone
- Siltstone
- Shale
- Limestone and Dolomite
- Gypsum

Metamorphic Rocks

- Gneiss
- Schist
- Slate and Phyllite
- Marble
- Serpentine

Glacial Deposits

- Undifferentiated glacial deposit
- Till
- Moraine
- Bedrock and till
- Glacio-fluvial deposits (outwash plains, ice-contacted GF deposits, eskers, kames, proglacial deltas, crevasse filling, etc.)
- Deltaic deposits (alluvial cones, deltaic complexes)
- Lacustrine and fluvial deposits (glacio-fluvial, fluvio-lacustrine, freshwater sandy beaches, stony/gravelly shoreline)

Organic Deposits

- Peat (with clear fibric structure)
- Muck
- Marsh, regularly flooded by lake or river (high mineral content)

Slope and Modified Deposits

- Talus and scree slopes
- Colluvial
- Solifluction, landslide

Aeolian Deposits

- Dunes
- Aeolian sand flats
- Cover sands

Cowardin System

If the system is a wetland, check off the name of the United States Fish and Wildlife Services (USFWS) system that best describes its hydrology and landform. Indicate "upland" if the system is not a wetland.

Assess the hydrologic regime of the site using the descriptions below (adapted from Cowardin et al., 1979).

- Semipermanently Flooded: Surface water persists throughout growing season in most years except during periods of drought. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin's Intermittently Exposed and Semipermanently Flooded modifiers.
- Seasonally Flooded: Surface water is present for extended periods during the growing season but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.
- Saturated: Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. Equivalent to Cowardin's Saturated modifier.
- Temporarily Flooded: Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes floodplain wetlands. Equivalent to Cowardin's Temporary modifier.
- Intermittently Flooded: Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent on highly localized rainstorms. This modifier was developed for use in the arid west for water regimes of playa lakes, intermittent streams, and dry washes but can be used in other parts of the U.S. where appropriate. This modifier can be applied to both wetland and nonwetland situations. Equivalent to Cowardin's Intermittently Flooded modifier.
- Permanently Flooded: Water covers the land surface at all times of the year in all years. Equivalent to Cowardin's Permanently Flooded.
- Unknown: The water regime of the area is not known. The unit is simply described as a nontidal wetland.

Unvegetated Surface

Estimate the approximate percentage of the *total* surface area covered by each category. Only include categories with over 5% cover.

Soil Texture

Using the key below, assess average soil texture.
Simplified Key to Soil Texture (Brewer and McCann, 1982)

A1 Soil does not remain in a ball when squeezed ..... sand

A2 Soil remains in a ball when squeezed ..... B

B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon ..... loamy sand

B2 Soil makes a ribbon; may be very short C

C1 Ribbon extends less than 1 inch before breaking ..... D

C2 Ribbon extends 1 inch or more before breaking ..... E

D1 Add excess water to small amount of soil. Soil feels at least slightly gritty ..... loam or sandy loam

D2 Soil feels smooth ..... silt loam

E1 Soil makes a ribbon that breaks when 1–2 inches long; cracks if bent into a ring ..... F

E2 Soil makes a ribbon 2 or more inches long; does not crack when bent into a ring ..... G

F1 Add excess water to small amount of soil; soil feels at least slightly gritty ... sandy clay loam or clay loam

F2 Soil feels smooth ..... silty clay loam or silt

G1 Add excess water to a small amount of soil; soil feels at least slightly gritty ..... sandy clay or clay

G2 Soil feels smooth ..... silty clay

Soil Drainage

The soil drainage classes are defined in terms of actual moisture content (in excess of field moisture capacity) and the extent of the period during which excess water is present in the plant root zone. It is recognized that permeability, level of groundwater, and seepage are factors affecting moisture status. Because these are not easily observed or measured in the field, they cannot generally be used as criteria of moisture status. We further recognize that soil profile morphology, for example mottling, normally, but not always, reflects soil moisture status. Although soil morphology may be a valuable field indication of moisture status, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status.

- Rapidly Drained: The soil moisture content seldom exceeds field capacity in any horizon except immediately after water addition. Soils are free from any evidence of gleying throughout the profile. Rapidly drained soils are commonly coarse textured or soils on steep slopes.

- Well Drained: The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 3 feet but may be mottled below this depth. B horizons, if present, are reddish, brownish, or yellowish.
- Moderately Well Drained: The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled (chroma < 2) in the lower B and C horizons or below a depth of 2 feet. The Ae horizon, if present, may be faintly mottled in fine-textured soils and in medium-textured soils that have a slowly permeable layer below the solum. In grassland soils the B and C horizons may be only faintly mottled, and the A horizon may be relatively thick and dark.
- Somewhat Poorly Drained: The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons; the Ae horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well drained soil on similar parent material.
- Poorly Drained: The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually very strongly gleyed. Except in high-chroma parent material the B, if present, and upper C horizons usually have matrix colors of low chroma. Faint mottling may occur throughout.
- Very Poorly Drained: Free water remains at or within 12 inches of the surface most of the year. The soils are usually very strongly gleyed. Subsurface horizons usually are of low chroma and yellowish to bluish hues. Mottling may be present but at the depth in the profile. Very poorly drained soils usually have a mucky or peaty surface horizon.

Vegetation Description

Leaf Phenology

Select the value that best describes the leaf phenology of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% cover.

- Evergreen - Greater than 75% of the total woody cover is never without green foliage.
- Cold Deciduous - Greater than 75% of the total woody cover sheds its foliage in connection with an unfavorable season mainly characterized by winter frost.
- Drought Deciduous - Greater than 75% of the total woody cover sheds its foliage in connection with an unfavorable season mainly characterized by drought.
- Mixed Evergreen - Cold Deciduous - Evergreen and deciduous species generally contribute 25%–75% of the total woody cover. Evergreen and cold deciduous species admixed.
- Mixed Evergreen - Drought Deciduous - Evergreen and deciduous species generally contribute 25%–75% of the total woody cover. Evergreen and drought deciduous species admixed.
- Perennial - Herbaceous vegetation composed of more than 50% perennial species.
- Annual - Herbaceous vegetation composed of more than 50% annual species.

Leaf Type

Select one value that best describes the leaf form of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% cover.

- Broad-Leaved - Woody vegetation primarily broad-leaved (generally contributes greater than 50% of the total woody cover).
- Needle-Leaved - Woody vegetation primarily needle-leaved (generally contributes greater than 50% cover).
- Microphyllous - Woody cover primarily microphyllous.
- Graminoid - Herbaceous vegetation composed of more than 50% graminoid/stipe leaf species.
- Forb (Broad-Leaf Herbaceous) - Herbaceous vegetation composed of more than 50% broad-leaf forb species.
- Pteridophyte - Herbaceous vegetation composed of more than 50% species with frond or frond-like leaves.

Physiognomic Class

Choose one predominant physiognomic class.

- Forest: Trees with their crowns overlapping (generally forming 60%–100% cover).
- Woodland: Open stands of trees with crowns not usually touching (generally forming 25%–60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.
- Shrubland: Shrubs generally greater than 0.5 meter tall with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 25% cover). Shrub cover may be less than 25% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class.
- Dwarf-Shrubland: Low-growing shrubs usually under 0.5 meter tall. Individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees and tall shrubs generally less than 25% cover). Dwarf-shrub cover may be less than 25% where it exceeds tree, shrub, herb, and nonvascular cover, respectively.
- Herbaceous: Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 25% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.
- Nonvascular: Nonvascular cover (bryophytes, noncrustose lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively.

- Sparse Vegetation:Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25% and greater than 0%).

Strata/Life-Form, Cover, Diagnostic Species

Visually divide the plot into vegetation layers (strata). Enter the average percent cover class of each whole stratum using the Cover Scale on the form. Cover classes are also listed below.

- Emergent Tree: Tree strata that averages greater than 10% and is significantly taller than the main canopy for the stand.
- Tree Canopy: The main tree canopy for the stand over which there may be a scattering of emergent trees and beneath which there may be an understory of subcanopy trees, shrubs, and/or herbs.
- Tree Subcanopy: The small trees that may form a distinct layer beneath the main tree canopy and the emergent trees.
- Shrub: Multistemmed (from the base), woody species less than 5 m (16 ft) tall
- Herbaceous: Graminoids, forbs, and ferns (non-woody species) forming the ground cover
- Nonvascular: Nonvascular species (bryophytes, non-crustose lichens)

Enter the name of each species occurring in each stratum and its cover class within that stratum. Use the check boxes to indicate vegetation layer membership and whether the species listed is dominant in that layer. Repeat species listings for each vegetation layer in which they occur.

Trees are defined as single-stemmed woody plants, generally 5 m (16 ft) in height or greater at maturity and under optimal growing conditions. If fire or other disturbance has modified tree growth forms so that they are multi-stemmed, trees can be any woody plants 5 meters or greater in height. Tree seedlings and saplings are identified in the layer in which they occur (e.g., *Pinus ponderosa* can be a component of the herb stratum if there are seedlings present and also of the T2 and T3 layers).

Cover Scale for Vegetative Strata, Unvegetated Surface, and Associated Species

1	0 -1%
2	>1%–5%
3	>5%–25%
4	>25%–50%
5	>50%–75%
6	>75%

Appendix B. Metadata for Tabular and Spatial Data Stemming from Special-Status Vascular Plant Surveys in Yosemite National Park

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Metadata for California Native Species Field Survey Report Database (CNSFSRdata.mdb) (tabular data)

Title
CNSFSRdata.mdb (for California Native Species Field Survey Report data)

Originator
U.S. Geological Survey, Western Ecological Research Center, Yosemite Field Station

Abstract and Purpose
Following the 2003 and 2004 surveys, USGS worked with the National Park Service applications developer at Yosemite, Paul Gallez, to design and create a database to store special-status plant survey data. The database stores survey data using the methods above, including population size, areal extent, plant vouchering, location, habitat information, vegetation structure and associated species.

The majority of the data are stored in two main data tables, separated for database structure and indexing reasons, one table (tblFieldSurveyRecordsA) for the first portion of the information collected in the field, and one table (tblFieldSurveyRecordsB) for the second portion. Separate, smaller tables store surveyor names and contacts by site (tblFieldSurveyReporters, tblPersons), unvegetated surface cover estimates from the plot (tblSurveySurfaceCoverClassRecords), vegetation structure data from the plot (tblVegetationStructure), associated species data from the plot (tblFieldSurveyRecordFloristicRecords), and listings of plant and habitat photographs taken (tblSurveyPhotographicRecords). An additional 36 tables provide standardized terms and categories of information collected from plots. Queries and reports produce formatted herbarium labels for mounted plant specimens, summaries of surveys completed, and reporting forms for data sharing with the California Native Plant Society (CNPS) and the California Natural Diversity Database (CNDDB).

Data Dictionary
The following tables comprise the data dictionary for the database entitled CNSFSRdata.mdb.

Table B1. Structure for the table 'tblFieldSurveyRecordsA' in the database CNSFSRdata.mdb

Field Name	Data Type	Size	Description
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsB
strFieldSurveyCode	Text	50	Unique code for species that is subject of field survey
datFieldSurveyDate	Date/Time	8	Date of survey
tsn	Long Integer	4	Taxonomic Serial Number for species surveyed from www.itis.gov
boolTaxonFound	Yes/No	1	Whether or not species sought during survey was found
memTaxonFoundNotes	Memo	-	If species was not found, please explain why
lngPopulationCount	Long Integer	4	Plant abundance within population
lngCoverPercent	Long Integer	4	Percent cover of species surveyed within the population

Table B1. Structure for the table 'tblFieldSurveyRecordsA' in the database CNSFSRdata.mdb (continued).

Field Name	Data Type	Size	Description
boolSubsequentVisit	Yes/No	1	Has this survey site been reported previously to CNDDB or previously documented elsewhere?
lngArealExtent	Long Integer	4	Areal extent of population
lngArealExtentMeasurementUnitID	Long Integer	4	Indicates whether areal extent of stand is expressed in m sq, ha or acres
lngDistributionTypeID	Long Integer	4	Distribution of species on site: 1=Scatter individuals 2=Scattered small clumps 3=Large clumps 4=Widespread throughout
lngNDDBStatus	Long Integer	4	Does this population represent a NDDB occurrence on record? Y, N, Unknown
strNDDBID	Text	50	NDDB occurrence number
boolCollection	Yes/No	1	Was there a collection of the surveyed species at this site on this date?
lngCollectorID	Long Integer	4	Collector's name
strCollectionNumber	Text	50	Collector's collection number
lngPhenologyVegetative	Long Integer	4	Percentage of population in vegetative growth stage
lngPhenologyFlowering	Long Integer	4	Percentage of population flowering at the time of the survey
lngPhenologyFruiting	Long Integer	4	Percentage of population fruiting at the time of the survey
boolDeterminationKeyed	Yes/No	1	For identification of the surveyed species, was it keyed using a reference?
lngDeterminationKeyedReferenceID	Long Integer	4	What reference was used to key the species?
boolDeterminationSpecimenCompared	Yes/No	1	For identification of the surveyed species, was it compared with an existing specimen?
lngDeterminationComparedStorageSiteID	Long Integer	4	Storage site of the specimen used for comparison
boolPhotoDrawingCompared	Yes/No	1	For identification of the surveyed species, was it compared with a photo or drawing?
lngDeterminationPhotoDrawingReferenceID	Long Integer	4	Reference used when comparing the species with a photo or drawing
boolDeterminationByAnother	Yes/No	1	For identification of the surveyed species, was it identified by another person?
lngDeterminationByAnotherID	Long Integer	4	Person who confirmed identification of the species surveyed
memDeterminationNotes	Memo	-	Notes related to determination of special-status species surveyed
strSurveyAreaWaypoints	Text	50	Waypoint identifiers if GPS stores waypoints
dblSurveySearchArea	Double	8	Areal extent of area searched
lngSurveySearchAreaMeasurementUnitID	Long Integer	4	Units in which search area size is expressed
boolSurveyAreaMapped	Yes/No	1	Whether or not the survey area was mapped
lngSurveyAreaSearchedPercent	Long Integer	4	Percentage of the survey area searched by surveyors for the species of interest
lngSearchDuration	Long Integer	4	Amount of time (in person hours) spent seeking the surveyed species within the search area
memSearchAreaDescription	Memo	-	A text description of the area in which the special status species sought

Table B1. Structure for the table 'tblFieldSurveyRecordsA' in the database CNSFSRdata.mdb (continued).

Field Name	Data Type	Size	Description
boolPhotosPermitDuplication	Yes/No	1	May CNDDB obtain copies of photographs at their expense
lngLocationID	Long Integer	4	Place name where survey took place selected from list of place names in tblLocations based on Geographic Names Information System from USGS for the Yosemite region
memLocationNotes	Memo	-	More detailed description, including distance and direction from landmarks where population occurs
lngLocationPopulationCoordinateEasting	Long Integer	4	Universal Transverse Mercator easting coordinate (in meters)
lngLocationPopulationCoordinateNorthing	Long Integer	4	Universal Transverse Mercator northing coordinate (in meters)
lngLocationMapDatumID	Long Integer	4	Map datum for location coordinates
lngLocationMapCoordinateSystemID	Long Integer	4	UTM Zone 10, UTM Zone 11, or Geographic system (Lat./Lon.)
lngLocationSourceTypeID	Long Integer	4	Source of the map coordinate: USGS 7.5" topo quad., GPS, or centroid of GIS pop. polygon
lngLocationEquipmentID	Long Integer	4	Model of GPS unit used
dblLocationHorizontalAccuracy	Double	8	Horizontal accuracy for population coordinate calculated by GPS unit
lngLocationHorizontalAccuracyMeasurementID	Long Integer	4	Units in which horizontal accuracy is expressed (feet or meters)
dblLocationPDOP	Double	8	Position Dilution of Precision: a measure of positional accuracy based on satellite geometry and provided by some GPS units
boolMaxLinePoly	Yes/No	1	Whether or not the PDOP is the max error for all points for the population polygon
strGPSFileName	Text	50	File name on GPS storing population coordinate/perimeter data (if any)
lngGPSContentTypeID	Long Integer	4	Gype of GPS data stored: Line, Perimeter points, Point, or Polygon
memGPSNotes	Memo	-	Notes related to GPS field data
lngLocationQuadID	Long Integer	4	USGS 7.5 minute topographic quadrangle on which site occurs with coding from tblQuads for quadrangles in the 1x1 degree area around Yosemite

Table B2. Structure for the table 'tblFieldSurveyRecordsB' in CNSFSRdata.mdb

Field Name	Data Type	Size	Description
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsA
lngLocationCountyID	Long Integer	4	County within which the survey/population occurs: 1=Alpine 2=Fresno 3=Madera 4=Mariposa 5=Mono 6=Tuolumne
lngLocationLandownerID	Long Integer	4	Landowner of property on which the survey/population occurs: 1=NPS 2=USFS 3=Mariposa County
lngSiteQuality	Long Integer	4	Overall site quality: 1=Excellent 2=Good 3=Fair 4=Poor
memSiteLandUse	Memo	-	Comments on land use within the population
memSiteDisturbance	Memo	-	Comments on disturbance within the population
memSiteThreats	Memo	-	Comments on apparent threats to the population surveyed
memSiteNotes	Memo	-	General comments on conditions within the special status plant population
lngPlotLength	Long Integer	4	Length of the plot in meters
lngPlotWidth	Long Integer	4	Width of the plot in meters
lngPlotRadius	Long Integer	4	Radius of the plot if circular in meters
strPlotShape	Text	50	Plot shape, e.g., rectangle, square, circle
lngPlotSize	Long Integer	4	Plot size
lngPlotSizeMeasurementUnitID	Long Integer	4	Units of measure for the plot size
strPlotCoordinateLocation	Text	50	Location in relation to the plot where coordinate location collected (e.g., SW corner)
strPlotUTMEasting	Text	50	Universal Transverse Mercator easting coordinate for the plot location (in meters)
strPlotUTMNorthing	Text	50	Universal Transverse Mercator northing coordinate for the plot location (in meters)
lngPlotCoordinateSystemID	Long Integer	4	UTM Zone 10, UTM Zone 11, or Geographic system (Lat./Lon.)
lngPlotMapDatumID	Long Integer	4	Map datum for plot coordinates; ; 1=NAD27, 2=NAD1983 3=WGS84
lngPlotSourceTypeID	Long Integer	4	Source of the plot coordinate: 1=USGS 7.5" topo quad., 2=GPS, or 3=centroid of GIS pop. polygon
dblPlotHorizontalAccuracy	Double	8	Horizontal accuracy for plot coordinate calculated by GPS unit
lngPlotHorAccMeasurementUnitID	Long Integer	4	Units in which horizontal accuracy is expressed (feet or meters)
dblPlotPDOP	Double	8	Position Dilution of Precision: a measure of positional accuracy based on satellite geometry and provided by some GPS units

Table B2. Structure for the table 'tblFieldSurveyRecordsB' in CNSFSRdata.mdb (continued).

Field Name	Data Type	Size	Description
lngSiteElevation	Long Integer	4	Elevation of plot
lngSiteElevationMeasurementUnitID	Long Integer	4	Units in which plot elevation expressed (feet or meters)
lngSiteElevationSourceTypeID	Long Integer	4	Source of the plot elevation: 1=Altimeter, 2=GPS, 3=USGS topographic quadrangle map
lngSiteSlope	Long Integer	4	Slope steepness of the plot
lngSiteSlopeMeasurementUnitID	Long Integer	4	Units of measure for the plot slope
lngSiteAspect	Long Integer	4	Aspect of the slope within the plot
lngSiteAspectMeasurementUnitID	Long Integer	4	Units of measure for the site aspect; they should be 8=degrees azimuth.
lngTopographicPositionID	Long Integer	4	Topographic position of the plot selected from the list in Appendix A. 1=Backslope, 2=Basin floor, 3=channel bed, 4=Channel wall, 5=High level, 6=High slope, 7=Interfluve, 8=Low level, 9=Low slope, 10=Midslope, 11=Step in slope, 12=Toeslope, 13=Bottomland
lngMacroLandformID	Long Integer	4	Macro scale landform selected from the list in Appendix A. See 14 types in tblMacroLandforms
lngMesoLandformID	Long Integer	4	Meso scale landform selected from the list in Appendix A. See 40 types in tblMesoLandforms
lngMicroLandformID	Long Integer	4	Micro scale landform selected from the list in Appendix A. 1=Linear, 2=Mounded, 3=Concave, 4=Convex, 5=Hummocky, 6=Undulating
lngSurficialGeologicalTypeID	Long Integer	4	Geologic substrate selected from the categories in Appendix A. See 39 types in tblSurficialGeologicalTypes
lngCowardinSystemTypeID	Long Integer	4	Cowardin system categories applied to the plot level: 1=Palustrine, 2=Lacustrine, 3=Riverine, 4=Upland
lngNontidalTypeID	Long Integer	4	For wetlands, hydrologic regime selected from the categories in Appendix A. 1=Permanently flooded, 2=Semipermanently flooded, 3=Temporarily flooded, 4=Saturated, 5=Seasonally flooded, 6=Intermittently flooded, 7=Unknown
memSiteDescription	Memo	-	Detailed description of the site useful for understanding the habitat and for including on herbarium labels
lngSoilTextureTypeID	Long Integer	4	Soil texture within the plot using the key in Appendix A. 1=Sand, 2=Loamy sand, 3=Sandy loam, 4=loam, 5=Silt loam, 6=Silt, 7=Clay loam, 8=Silty clay, 9=Clay, 10=Peat, 11=Muck, 12=Silty clay loam, 13=Sandy clay loam

Table B2. Structure for the table ‘tblFieldSurveyRecordsB’ in CNSFSRdata.mdb (continued).

Field Name	Data Type	Size	Description
lngSoilDrainageTypeID	Long Integer	4	Soil drainage selected from the list in Appendix A: 1=Rapidly drained, 2=Well drained, 3=Moderately well drained, 4=Somewhat poorly drained, 5=Poorly drained, 6=Very poorly drained
lngLeafPhenologyTypeID	Long Integer	4	Leaf "phenology" of the dominant stratum: 1=evergreen, 2=cold deciduous, 3=drought deciduous, 4=mixed evergreen–cold deciduous, 5=mixed evergreen–drought deciduous, 6=annual herbaceous, 7=perennial herbaceous
lngLeafTypeID	Long Integer	4	Leaf type of the dominant stratum: 1=broad-leaved, 2=needle-leaved, 3=microphyllous, 4=graminoid, 5=forb, 6=pteridophyte
lngPhysiognomicClassID	Long Integer	4	Physiognomic class: 1=dwarf-shrubland, 2=forest, 3=herbaceous, 4=nonvascular, 5=shrubland, 6=sparsely vegetated, 7=woodland
lngTotalVegetationCoverClassID	Long Integer	4	Total absolute vegetative cover of all species combined using 6 classes: 1:0%–1%, 2: >1%–5%, 3: >5%–25%, 4: >25%–50%, 5: >50%–75%, 6: >75%
lngTotalNonNativeCoverClassID	Long Integer	4	Total absolute vegetative cover of all non-native species combined using 6 classes: 1:0–1%, 2: >1%–5% 3: >5%–25% 4: >25%–50% 5: >50%–75% 6: >75%
memFieldSurveyRecordNotes	Memo	-	Notes related directly to the current-year survey for the special status species documented in this record

Table B3. Structure for the table ‘tblFieldSurveyReporters’ in CNSFSRdata.mdb.

Field Name	Data Type	Size	Description
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsA
lngPersonID	Long Integer	4	Person making observations during data collection
boolPrimaryReporter	Yes/No	1	Flag for primary reporter whose name and contact will be provided if data provided to California Natural Diversity Database

Table B4. Structure for the table ‘tblSurveySurfaceCoverClassRecords’ in CNSFSRdata.mdb.

Field Name	Data Type	Size	Description
lngSurveySurfaceCoverClassRecordID	Long Integer	4	Unique sequential number identifying each surface cover class record within this table
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsA
lngCoverClassTypeID	Long Integer	4	Categories of ground surface cover with 1 to 8 representing the following: 1=Bedrock, 2=Large rocks (cobbles, boulders > 10cm diameter), 3=Small rocks (gravel, 0.2–10 cm diameter), 4=Litter, duff, 5=Wood (>1 cm diameter), 6=Sand (0.1–2mm), 7=bare soil, 8= Water
lngPercentage	Long Integer	4	Percent cover of the ground surface within the plot of the corresponding cover class type disregarding standing live and standing dead vegetation

Table B5. Structure for the table ‘tblVegetationStructure’ in CNSFSRdata.mdb.

Field Name	Data Type	Size	Description
lngFSRVegetationStructureID	Long Integer	4	Unique sequential number identifying each vegetation structure record within this table
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsA
lngVegetationLayerTypeID	Long Integer	4	Vegetation layers present coded as follows: 1:Emergent tree, 2:Canopy tree, 3:Subcanopy tree, 4:Shrub, 5:Herbaceous, 6:Nonvascular, 7:Vine-liana
lngCoverClassID	Long Integer	4	Cover class assignment to corresponding vegetation layer as follows: 1: 0–1%, 2: >1%–5%, 3: >5%–25%, 4: >25%–50%, 5: >50%–75%, 6: >75%

Table B6. Structure for the table 'tblFieldSurveyRecordFloristicRecords' in CNSFSRdata.mdb.

Field Name	Data Type	Size	Description
lngFieldSurveyRecordFloristicRecordID	Long Integer	4	Unique sequential number identifying each floristic record within this table
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsA
tsn	Long Integer	4	Taxonomic Serial Number uniquely identifying the plant taxon tblTaxa based on www.itis.gov
lngCoverClassID	Long Integer	4	Cover class within plot of related plant taxon: 1:0%–1%, 2: >1%–5%, 3: >5%–25%, 4: >25%–50%, 5: >50%–75%, 6: >75%
lngVegetationLayerTypeID	Long Integer	4	Vegetation layer in which plant taxon is important coded as follows: 1: Emergent tree, 2: Canopy tree, 3: Subcanopy tree, 4: Shrub, 5: Herbaceous, 6: Nonvascular, 7: Vine-liana
boolDominantTaxon	Yes/No	1	Indicates whether plant species is among the dominant species within the vegetation layer indicated; dominant species per vegetation layer usually limited to 3–5 species

Table B7. Structure for the table 'tblSurveyPhotographicRecords' in CNSFSRdata.mdb.

Field Name	Data Type	Size	Description
lngSurveyPhotographicRecordID	Long Integer	4	Unique sequential number identifying each Photographic record within this table
lngFieldSurveyRecordID	Long Integer	4	Unique sequential number identifying each survey record and linking to related record in tblFieldSurveyRecordsA
lngEquipmentID	Long Integer	4	Code for the particular camera used from tblEquipment
strRollID	Text	50	Film roll number if analog film
strExposureList	Text	50	Exposure numbers
strFilmType	Text	1	Film type. S: slide/transparency, P: print
boolIncludesPlant	Yes/No	1	Image displays the plant species
boolIncludesHabitat	Yes/No	1	Image displays the plant's habitat
boolIncludesFeature	Yes/No	1	Image displays the plant's diagnostic feature(s)
boolIncludesPlot	Yes/No	1	Image displays the plot

Sensitive Data Issues

The database contains specific location names and highly accurate UTM coordinates for special status plant populations. Some of the taxa are desirable to horticultural collectors. Many are desirable to botanical collectors. Data should be protected from unauthorized use. Terms of

access to sensitive data by contractors and cooperators are to be specified under confidentiality agreements.

Post Field Data Processing of Spatial Data

Populations are represented in the CNSFSRdata database by single pair of x,y coordinates representing the approximate center of stands or populations. The purpose of these coordinates is to imbed location information within field survey data. Actual population perimeters are provided separately in Arc shape file format. These coordinates stem from single sets of coordinates collected at population centers or, more frequently, ArcView 3.3 processing of GPS-collected population perimeters. GPS data were downloaded from Trimble GPS units (Pathfinder Pro XR in 2003, GeoExplorer III in 2004) to a personal desktop computer and post-processed with downloaded Trimble base station data from the Forest Service Remote Sensing Lab in Sacramento, California; Scripts Orbit and Permanent Array Center, Gull Lake, California; or SOPAC, Mammoth Lakes, California. Post-processing of field GPS data to correct positions to 1–2 m (3.3–6.6 ft) accuracy was accomplished using Trimble Pathfinder Office v2.9 software. We exported corrected GPS data to ArcView shape file format and imported resulting files into a single data theme reserved for mapped populations (<Rare_plants-2004>). To derive population center coordinates, we derived centroids for each polygon using ArcView tools in the Xtools menu.

Metadata for the 'rare_plants-2004' and 'areasurveyed-2004' Shape files (spatial data)

Title
rare_plants-2004 and areasurveyed-2004

Originator
U.S. Geological Survey, Western Ecological Research Center, Yosemite Field Station, PO Box 700/5083 Foresta Road, El Portal, California 95318

Abstract and Purpose: USGS created the ArcView shape files, 'rare_plants-2004' and 'area_surveyed,' to store spatial data detailing population perimeters mapped in the field and survey perimeters mapped in the field and in the office. They store data collected in 2003 and 2004 under Inter-Agency Agreement F8800-02-0011 between the U.S. Geological Survey and the National Park Service. These data include perimeters for approximately 163 surveys among 39 vascular plant taxa. Some populations had been previously mapped on 15 minute quadrangles; some were mapped for the first time during this work. Positional accuracy for the populations is reflected to some extent in the 'HorizAcc' and PDOP (position dilution of precision) fields in the above database, but these were field accuracy estimates prior to post-processing of Trimble data.

Data Dictionary
Rare_plants-2004: On the recommendation of the National Park Service GIS Coordinator, we incorporated data from new mapping efforts into the existing data layer used to represent special status plant populations, namely the layer 'rare_plants.' New data are distinguished from pre-existing data based on field entries. For example, Source=Botti for data from 1980s, and Source=USGS for work we completed in 2003 and 2004. Year is another field that differentiates historic and new data sets. The existing attribute table incorporated fields that originated in an earlier version of the rare_plants data layer, a raster-based system called GRASS, including Grasscod.

We used the structure of the table created in Access to simplify incorporation of our data into existing data. This includes some of the old GRASS fields (Grasscod, Grasspco), Rplantno and Rplantid for which we do not have entries.

Table B8. Structure for the table associated with the shape file 'rare_plants-2004.' This file stores population perimeter data for special status plant species surveyed in 2003 and 2004 through an inter-agency agreement between the between the National Park Service and the U.S. Geological Survey.

Field Name	Data Type	Description
Shape	Text	Type of feature represented in record: polygon, point
Survcode	Text	Survey code consisting of 4-letters representing 1st two letters of genus and 1st two letters of species (6 letters with some ssp) + 2 numbers (= JFlora code, e.g., ERCO40, LECO10, ALYO10) to represent the species surveyed (e.g., Eriophyllum congdonii=ERCO40) combined with sequential survey site number (e.g., ERCO40-1, ERCO40-2, ERCO40-3).
Count	Text	Number of polygons represented by record. When multiple polygons were created to represent one population survey, they were joined into a single shape.
Hectares	Text	Areal extent of mapped population in hectares
Rplantno	Text	Field carried over to rare_plant data theme from GRASS GIS system. Retained here to allow combination of 2003-4 data with existing data.
RplantID	Text	Field carried over to rare_plant data theme from GRASS GIS system. Retained here to allow combination of 2003-4 data with existing data.
Sp1plants	Text	Species code consisting of 4-letters representing 1st two letters of genus and 1st two letters of species (6 letters with some ssp) + 2 numbers (= JFlora code, e.g., ERCO40, LECO10, ALYO10)
Grasscod	Text	Field carried over to rare_plant data theme from GRASS GIS system. Retained here to allow combination of 2003-4 data with existing data.
Grasspco	Text	Code consisting of 4-letters representing 1st two letters of genus and 1st two letters of species (6 letters with some ssp)
Species1	Text	Scientific name of plant taxon with genus, specific epithet and ranks below that separated by an underscore
Sp1hcmap	Text	Indicates in the Access table whether the population perimeter is included on a hard copy map in Resources Management files: 7.5', 15', both, Engineer's maps. There are no entries in this field for rare_plants-2004.
Sp1siterep	Text	Field created in 2003 to store whether a survey site report existed for mapped population. Retained here to allow combination of 2003-4 data with existing data.
Source	Text	Author of mapping data: USGS, USGS-NPS, Botti
Year	Text	Year map data collected: 2003 or 2004. This and the preceding field set the 2003-4 data apart from 1980s data collected by NPS. Those data were undated but based on survey work in 1980s and so had 1985 assigned as standard entry.
Acres	Text	Areal extent of mapped population in acres
Sourcethm	Text	Indicates source file to differentiate different data collection efforts. In the case of the 2003-4 data, the source theme is 'rare_plants-2004.' In the case of existing data, largely collected in the 1980s, the source theme is 'rare_plants.'
Area	Text	Areal extent of mapped population in square meters
Perimeter	Text	Length of polygon perimeter in meters
X_coord	Text	Universal Transverse Mercator easting of population centroid (UTM Zone 11, NAD27 datum)
Y_coord	Text	Universal Transverse Mercator northing of population centroid (UTM Zone 11, NAD27 datum)
Species	Text	Scientific name of the special status plant species surveyed written out without published authority (e.g., Carex tompkinsii)

Sensitive Data Issues

The rare_plants-2004 spatial data theme contains locations by species that are highly accurate spatially. Species included in this spatial data set are the most sensitive taxa with the highest priority for protection. Some of the taxa are desirable to horticultural collectors. Many are desirable to botanical collectors. Data should be protected from unauthorized use. Terms of access to sensitive data by contractors and cooperators are to be specified under confidentiality agreements.

Post-field Data Processing of Spatial Data

GPS data were downloaded from Trimble GPS units (Pathfinder Pro XR in 2003, GeoExplorer III in 2004) to a personal desktop computer and post-processed with downloaded Trimble base station data from the Forest Service Remote Sensing Lab in Sacramento, California; Scripts Orbit and Permanent Array Center, Gull Lake, California; or SOPAC, Mammoth Lakes, California. Post-processing of field GPS data to correct positions to 1–2 m (3.3–6.6ft) accuracy was accomplished using Trimble Pathfinder Office v2.9 software. We exported corrected GPS data to ArcView 3.3 shapefile format and imported resulting files into a single data theme reserved for mapped populations (<Rare_plants-2004>).

Appendix C. Species Summaries

Note: listing statuses with the U.S. Fish and Wildlife Service (USFWS), California Natural Diversity Database (CNDDB), and the California Native Plant Society (CNPS) were updated within the species summaries as of June 2009.

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Agrostis humilis Vasey

Information compiled by Alison E. L. Colwell, 2005

Species Overview

Family

Poaceae

Synonyms

Podagrostis humilis (Vasey) Björkman
Agrostis thurberiana Hitchc.
Podagrostis thurberiana (Hitchc.) Hultén in part

Vernacular Name

mountain bent grass, dwarf bent grass

Status

- Federal: none
- California: none
- CNDDB: G4[1]/S1.3[2]
- CNPS: 2.3[3]
- Yosemite National Park: Sensitive



Figure C1. *Agrostis humilis* habit, Tioga Pass, Yosemite National Park, Tuolumne County, California, 30 July 2004 (photograph by Alison E. L. Colwell).

Description

See Peterson and Harvey *in preparation* for a detailed description of *A. humilis*. In Harvey (2007), *A. thurberiana* is combined with *A. humilis*; in Peterson and Harvey (*in preparation*), *A. thurberiana* and *A. humilis* are retained as separate species. We adopted the latter nomenclature.

Similar Species: *Agrostis humilis* cannot be distinguished definitively from similar grass species in vegetative condition. Small individuals of both *A. thurberiana* and *Calamagrostis breweri* appear very similar. *Muhlenbergia filiformis* is usually the same size as *A. humilis* and also occurs in similarly sized clumps, but close inspection of the leaves when these species are both present reveal that *Muhlenbergia* leaves are paler and the leaf blades are held at a greater angle to the sheath. However, *A. humilis* and *M. filiformis* often grow intermixed, with the latter usually in much greater proportion, so it is inadvisable to estimate population sizes of *A. humilis* in vegetative condition.

---

[1]CNDDB Global Rank = G4: Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern; i.e., there is some threat or somewhat narrow habitat
[2]CNDDB State Rank = S1.3: Less than 6 occurrences or less than 1,000 individuals or less than 2,000 acres: no current threats known
[3]CNPS List 2: Plants rare, threatened, or endangered in California, but more common elsewhere; Threat Code 3: not very endangered in California

Agrostis humilis is very similar in appearance to *A. variabilis*. The definitive distinction between these species is that *A. humilis* has a palea and *A. variabilis* does not. Because the palea of *A. humilis* is too small to see in the field, even with a hand lens, its presence can be inferred with the following test. If a hand lens and fresh floral material are available, and these species are in flower, one can perform a "pop test" to differentiate these species. To perform this test, pluck an inflorescence and isolate one floret between thumb and forefinger (or under forceps on a flat surface). Looking through the hand lens at the floret, squeeze it gently. If the palea/lemma pop out easily as a unit, then the plant is *A. humilis*. If the lemma merely squishes flat, then it is *A. variabilis*. Other differences are that *A. variabilis* occupies drier habitat farther from water margins and the pedicels of the florets are more variable in length. This gives a slightly more lax appearance to the inflorescence and is visible especially when the inflorescence is gripped at each end and flexed. *A. humilis* inflorescences tend to be darker purple and the pedicels shorter and of more even length.

Agrostis humilis is also similar to *A. thurberiana*, which is usually, but not always, a much larger plant. *Agrostis humilis*, however, may share habitat and intergrade with this species. Both possess a palea, so have a similar result from the pop test. See discussion of this problem below.

Uncommonly small *Calamagrostis breweri* individuals may resemble *A. humilis* at a distance, although the whole plant is noticeably more reddish-purple tinted and *C. breweri* prefers a slightly drier habitat. If the surveyor looks around, they will notice the small individuals grading into the larger, more typical *C. breweri* nearby.

Distribution

California

Agrostis humilis is known from Alpine, Madera, Mono, Mariposa, and Tuolumne counties (CNPS 2005) to British Columbia, Montana and New Mexico (Peterson and Harvey *in preparation*).

Yosemite National Park

Agrostis humilis was previously known only from the central eastern portion of Yosemite: Cathedral Lakes and Snow Flat (Botti 2001), Sheep Peak (UC641901), and the Tioga Pass vicinity. Our collections expanded the range west to Lukens Lake (AC04-245, UC1862099) and south to Lower Ottoway Lake (AC04-263, UC1862097).



Figure C2. Pink flags mark *Agrostis humilis* clumps at margin of pond in Dana Meadows, Yosemite National Park, Tuolumne County, 13 August 2004. Note that *A. humilis* plants occupy only a band of previously inundated ground within 2 m (6.6 ft) of the August water level (photograph by Alison E. L. Colwell).

Survey Methodology and Results

Survey Dates

21–22, 30 July 2004

Rationale for Survey Timing

Surveys were conducted during the time

of expected flowering and fruiting because *A. humilis* can only be definitively identified by inflorescence characters.

Personnel Conducting Surveys
Alison E. L. Colwell and Angela Sanders

Method Used to Estimate or Census the Population
Surveyors collected NPS survey data for each population and either counted directly the number of individuals present or made an estimation of population size.

In Dana Meadows (AGHU10-4) and at lower Cathedral Lake (AGHU10-3), surveyors made complete censuses of the populations. At Snow Flat (AGHU10-1), the population was too large to census, so it was estimated by the following method:



Figure C3. Angela Sanders counting *Agrostis humilis* in 1 m^2 area for estimating population size. *Agrostis humilis* occurs only in the sunken areas in the center of the meadow at Snow Flat site. Yosemite National Park, Mariposa County, California, 21 July 2004 (photograph by Alison E. L. Colwell).

1. Scanned the meadow on foot and flagged all patches of *A. humilis*.
2. Marked with a GPS point all outlying small patches of *A. humilis* and counted individual plants present in those patches.
3. Flagged perimeter of large patches and recorded perimeter GPS points to calculate area of patch (Figure C2).
4. Estimated number of individuals in large patches by extrapolating from the density found in three representative 1m^2 plots (Figure C3).

Table C1. *Agrostis humilis* Vasey survey locations and results.

Site	Location	Person Hours	Population Size
AGHU10-1	Meadow 0.75 km N of Snow Flat	6	113,162
AGHU10-2	Snow Flat	4	0
AGHU10-3	North shore of lower Cathedral Lake	3	379
AGHU10-4	Perimeter of ponds in Dana Meadows, Tioga Pass	4	2,103
Total		**17**	**115,644**

Additional Locations Not Surveyed:

- Lukens Lake, west margin and on floating logs.
- Pond perimeters at north end of Dana Meadows, outside of park boundary.
- Inlet stream on north side of Lower Ottoway Lake.

Habitat

In Yosemite National Park, *A. humilis* is found at the moist margins of subalpine lakes and ponds in subalpine meadows (Figure C4). It usually occurs in full sun or sometimes in light shade under low shrubs. It may be found on mudflats of exposed lake margins and inlet stream deltas with sparse cover, or it may be crowded among mosses and grasses on tussocks around pond margins. Clumps may occasionally be found on rotting logs at the margins of ponds or lakes. *Agrostis humilis* is relatively sparse wherever it occurs, it is usually a small component of grass and forb dominated dwarf herbaceous vegetation. A locality may often contain fewer than 20 detectable individuals.



Figure C4. Pink flags mark corners of 1 × 5 m plot, and also the perimeter of the *Agrostis humilis* occurrence at inlet stream, northeast end of lower Cathedral Lake. Social trail borders stand, Yosemite National Park, Mariposa County, 31 July 2004 (photograph by Alison E. L. Colwell).

Vegetation Communities

Calamagrostis breweri–Aster alpigenus Herbaceous Vegetation or *Vaccinium uliginosum* Dwarf Shrubland

Important Associated Plant Species

A. humilis was always found in the company of *Muhlenbergia filiformis,* often growing intermixed with this and *Calamagrostis breweri,* at water margins or in low spots in meadows, but giving way entirely to these species in slightly drier ground. *Vaccinium caespitosum* or *V. uliginosum, Aster alpigenus, Kalmia polifolia, Mimulus primuloides*, and various moss species usually were present as well. The meadows where it was found were surrounded by *Pinus contorta* ssp. *murrayana* and *Tsuga mertensiana. Salix* and *Carex* species (*C. scopulorum, C. vesicaria, C. nebrascensis*) were generally present nearby, if not immediate neighbors.

Phenological Development

In 2004, an average snowpack melted out early due to above average temperatures in March and April. The phenology for 2004 was three to four weeks ahead of schedule for the whole season. The surveys conducted on 21–22 July found *A. humilis* in full flower, as were co-occuring grasses, which allowed positive identification of this species. The survey on 30 July in Dana Meadows, however, found many individuals in fruiting stage, which made identification more difficult. This year saw low reproduction among all species in alpine meadows, including *A. humilis*, which may have had a low percentage of individuals in flower this year. This is speculation only, as individuals in vegetative condition were neither identified nor included in the survey.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator, and University Herbarium (UC), Barbara Ertter, curator

Remarks

All *A. humilis* specimens collected in 2004, including vouchers of *A. humilis* from the three survey sites and *A. thurberiana* and *A. variabilis* also found at survey sites were sent to M. J. Harvey for determination. All *A. humilis* and *A. thurberiana* were found by Harvey to be as determined. However, Harvey, in his treatment for *Flora of North America* (Harvey 2007), combined *A. thurberiana* and *A. humilis* into *Podagrostis humilis* (Vasey) Bjorkman due to widespread overlap in their habit and intergradation where they co-occur. An example of this problem was detected at a pond margin in Dana Meadows where botanists found intergrading individuals of these species. Other examples of this situation may be found in Yosemite National Park and a likely second spot is at the AGHU10-2 survey site at Snow Flat where no *A. humilis* was detected in 2004 (most likely due to the lack of flowering at this site), but *A. thurberiana* was collected in the shade of the meadow margin under *Pinus contorta*. Subsequently, Peterson and Harvey (*in preparation*) treated *A. humilis* and *A. thurberiana* as separate species.



Figure C5. Dwarf grass area at inlet stream where sparse *Agrostis humilis* occurs, northeast end of Lower Ottoway Lake, Yosemite National Park, Madera County, California.Pack animals graze the site, 12 Sept 2004 (photograph by Alison E. L. Colwell).

Discussion

Factors That May Have Affected Survey Results

Because *A. humilis* is not distinct in vegetative condition in the field, plot counts were based on the number of flowering culms. If a clump of *A. humilis* was distinct and had more than one flowering culm, it was counted as a single individual. However, when *A. humilis* culms were found embedded in the far more numerous *Muhlenbergia filiformis*, these culms were counted each as an individual, which may have led to a small overestimate if the flowering culms were in fact connected by a vegetative rhizome. However, not counting vegetative individuals has likely resulted in a significant undercount, particularly at AGHU10-2 and -4, where many of the grasses were not flowering in 2004.

Assessment of Threats or Potential Impacts

Because *A. humilis* prefers the moist margins of lakes and ponds, it is subject to trampling by hikers, swimmers, and picnickers. This threat is most apparent in the more easterly stand at Lower Cathedral Lake (AGHU10-3), where a use trail bisects the population at the inlet stream. The population at this site is only 1 × 5 m, so the trail represents a significant reduction of habitat.

The pond in Dana Meadows nearest the visitor parking just south of Tioga Pass entrance station also exhibits trampling by visitors along the pond margin where *A. humilis* grows.

At Lower Ottoway Lake, pack stock have been allowed to graze in the inlet area at the lake margin where *A. humilis* occurs (Figure C5). This is inferred by the large number of horse feces seen at the lake margin in September 2004.

One potentially overarching threat is that most meadows where *A. humilis* occurs appear to be shrinking in size due to encroachment by *Pinus contorta* along the perimeter.

Recommended Measures to Minimize Impacts

Vehicle turnouts and trailheads might be placed to minimize casual trampling of water-margin habitat. Pack animal grazing could be concentrated away from water margins.

Significance of Yosemite Populations

Agrostis humilis is known from few locations in the central Sierra Nevada. Much suitable habitat occurs in Yosemite, particularly subalpine lakesides and meadows, which may constitute much of this species' range. Because this species is easily overlooked, there are likely many more sites in Yosemite.

Additional Work Needed

USGS topographic quadrangle maps indicate additional appropriate meadow sites that have not been surveyed. In particular, not all of the pond margins in Dana Meadows have been surveyed. Park personnel could continue to make herbarium specimens of *A. humilis* and of *A. thurberiana* where they encounter them (and particularly where they appear to co-occur), because such specimens will prove valuable to future studies seeking to refine the taxonomy of this group.

Qualifications of Field Personnel at the Time of Surveys

Alison Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, MO; Lecturer on Plant Identification and Classification 2000 and 2003, University of Washington, Seattle, Washington. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Angela Sanders**:** BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition v6-05a). California Native Plant Society, Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 1 January 2005.

Harvey, M. J. 2007. *Podagrostis* (Griseb.) Scribn. & Merr. Pages 693–694 *in* Flora of North America Editorial Committee, editors. Flora of North America. Volume 24. Oxford University Press, New York.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Peterson, P. M. and M. J. Harvey. *In preparation*. *Agrostis in* Baldwin, B. G., S. Boyd, B. J. Ertter, D. J. Keil, R. W. Patterson, T. J. Rosatti, and D. Wilken, editors. The Jepson Manual, higher plants of California, Second edition. University of California Press, Berkeley, California.

Vasey, G. 1883. *Agrostis humilis*. Bulletin of the Torrey Botanical Club 10: 21.

Personal Communications

M. J. Harvey, University of British Columbia, Victoria. (Author of Flora of North America treatment for *Agrostis* and *Podagrostis* and co-author of *Agrostis* treatment in the second edition of The Jepson Manual).

Allium yosemitense Eastw.

Information compiled by Peggy E. Moore, 2003

Species Overview

Family

Liliaceae

Synonyms

None

Vernacular Name

Yosemite onion

Status

- Federal: Forest Service Sensitive (Sierra NF, Stanislaus NF)
- California: Rare
- CNDDB: G2[1]/S2.3[2]
- CNPS: 1B.3[3]
- Yosemite National Park: Sensitive



Figure C6. *Allium yosemitense* flowers, leaves, and stems, El Portal, Merced River canyon, Sierra National Forest, Mariposa County, California, 6 May 2003 (photograph by Peggy E. Moore).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Allium campanulatum S. Watson has two leaves per stem similar to *A. yosemitense* but six prominent, triangular ovary crests and perianth parts 5–8 mm (7–15 mm for *A. yosemitense*). *Allium yosemitense* bulbs are clustered and, as a result, tend to be flattened on one side. *Allium campanulatum* can have daughter bulbs on long thread-like rhizomes. *Allium tribracteatum* and *A. obtusum* have outer bulb coat sculpture clearly net-like throughout versus 0 or 2–3 rows of cells above root pad in *A. yosemitense*.

Distribution

California

Found in central Sierra Nevada in Mariposa and Tuolumne counties between 800–2,200 m (2,600–7,200 ft).

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[1]CNDDB Global Rank = G2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres throughout species range

[2]CNDDB State Rank = S2.3: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; no current threats known

[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 3: not very endangered in California

Yosemite National Park

Known in the park from one population along Bridalveil Creek at 1,450 m (4,770 ft) (type locality) (Figure C7) and one much smaller population along the South Fork of the Merced River downstream from Wawona at 1,130 m (3,700 ft).



Figure C7. *Allium yosemitense* habitat, Bridalveil Creek, Yosemite National Park, Mariposa County, California, 26 June 2003 (photograph by Charlotte Coulter).

Survey Methodology and Results

Survey Dates

6, 13 May 2003; 3, 26 June 2003

Rationale for Survey Timing

The flowering stage is preferable for *A. yosemitense* to maximize detection, and Botti (2001) indicates the flowering period is April to June. April would have been early for 2003 surveys because of the cool, moist spring. Early to mid-May was ideal for the lowest elevation populations with 60% and 50% of plants flowering at the first and second sites, respectively. The remaining plants were in vegetative condition at those sites with no indication they would be flowering that year. Surveys of other state-listed species pushed the South Fork Merced River survey back to June 3 rather than mid-May. Mid- to late-May would have been preferable at the Bridalveil Creek site; however, attempts at scheduling a joint survey with NPS staff delayed the Bridalveil Creek survey from the end of May to 26 June. As a result, all plants on that site were dispersing fruit, and the population estimate was made from dispersing flower heads.

Personnel Conducting Surveys

Peggy E. Moore, Charlotte Coulter, Alison E. L. Colwell (26 Jun 2003 only), Meghan Williams (6 and 13 May 2003).

Method Used to Estimate or Census the Population

The area of plant occurrence was small and discreet at ALYO10-1, -2, and -4, and a total stem count of individual plants was made at these sites after a thorough reconnaissance of the area. At the Bridalveil Creek site, the population occurred over a more extensive area (1.8 ha). For that site, three surveyors partitioned the entire slope between the creek and the cliff on Middle Cathedral. They then counted flower heads as they performed thorough searches of each area. Surveyors used flower heads to represent individual plants because they are the most visible portion of the plant whether they are attached or dispersed and because some plants had senesced sufficiently to be poorly visible even at close range. Fruiting heads were structurally intact. Some were still attached to stems, some were partially detached, and some had blown free from stems and were lodged under *Arctostaphylos viscida* canopies. As a result, the ALYO10-3 census is considered a minimum estimate.

Table C2. *Allium yosemitense* Eastw survey locations and results.

Site	Location	Person Hours	Population Size
ALYO10-1	Ridge northeast of Pigeon Gulch, El Portal. Rock outcrop on the nose of the ridge approximately 260 m (850 ft) above the Merced River.	19.5*	250
ALYO10-2	Ridge northeast of Pigeon Gulch, El Portal. Rock outcrops on the nose of the ridge approximately 490 m (1,600 ft) above the Merced River.		150
ALYO10-3	Southwest slope of Middle Cathedral Rock approximately 400 m upstream from Bridalveil Fall, Yosemite National Park.	4.5	714**
ALYO10-4	South Fork of the Merced River approximately 2.5 km downstream from Wawona Campground, Yosemite National Park.	2.5	1,100
Total		**26.5**	**2,214**

*Total for both areas: ALYO10-1, ALYO10-2.
**Probably a minimum estimate due to plant phenology; see above.

Habitat

Metamorphic scree slopes adjacent to rock outcrops and elevated above stream courses within *Quercus wislizeni* and *Arctostaphylos viscida* habitats. At the Bridalveil Creek and S Fork Merced River sites, plants occurred in loose, sloping scree consisting of rocks of approximately 2–15 cm in diameter. Vernally moist bedrock fractures comprised the microhabitat at the two sites in the Merced River Canyon above El Portal (ALYO10-1 and -2). Surficial geology was metamorphic at the two El Portal populations (ALYO10-1 and -2) (Bateman and Krauskopf 1987) and a dioritic/metasedimentary contact zone within the South Fork population (Peck 2002) (Figure C8) but entirely granodiorite at the Bridalveil Falls population (ALYO10-3) (Peck 2002). Botti (2001) observed that *A. yosemitense* is found mostly along such contact zones west of the park.

Vegetation Communities

Within Target Species Population: *Quercus wislizeni/Arctostaphylos viscida* Woodland, *Arctostaphylos viscida* Shrubland, *Cercocarpus betuloides* Woodland

In Survey Area Outside Documented Population(s): California Annual Grassland, *Quercus chrysolepis* Forest Alliance, *Quercus chrysolepis*/*Arctostaphylos viscida* Forest Association, *Quercus chrysolepis–Pinus sabiniana* Forest Association, *Quercus wislizeni–Q. douglasii–Pinus sabiniana*/*Bromus* spp.*–Daucus pusillus* Woodland Association, *Pinus sabiniana–Quercus wislizeni*/*Ceanothus cuneatus* Woodland Association

Important Associated Plant Species

Streptanthus tortuosus var. *tortuosus*, *Vulpia microstachys* var. *pauciflora*, *Selaginella hansenii*, *Cheilanthes gracillima*, *Eriogonum nudum*, and moss were important associates at ALYO10-1 and ALYO10-2. Site ALYO10-3 at 320 m (1,020 ft), a higher elevation than the previous sites, was dominated by *Arctostaphylos viscida* near the upper end of the manzanita's typical elevational range. Herbaceous associates included *Melica californica*, *Poa fendleriana*,

Streptanthus tortuosus var. *tortuosus*, *Cheilanthes gracillima*, *Allium campanulatum*, *Dudleya cymosa* ssp. *cymosa*, *Eriophyllum confertiflorum* var. *confertiflorum*, *Minuartia douglasii*, and *Elymus multisetus*. *Cercocarpus betuloides* dominated the vegetation at the S Fork Merced River site (ALYO10-4), a common rock outcrop dominant at low elevations. Associates in the metamorphic scree microsite included *Streptanthus tortuosus* var. *tortuosus*, *Allium campanulatum*, *Collinsia linearis*, *Chaenactis glabriuscula* var. *megacephala*, Dudleya *cymosa*, *Lupinus stiversii,* and *Minuartia douglasii*. *S. tortuosus* var. *tortuosus* and the last three species in this list are typical associates as well of *Eriophyllum congdonii*, which was found in a nearby site while surveyors were seeking another small *A. yosemitense* population.

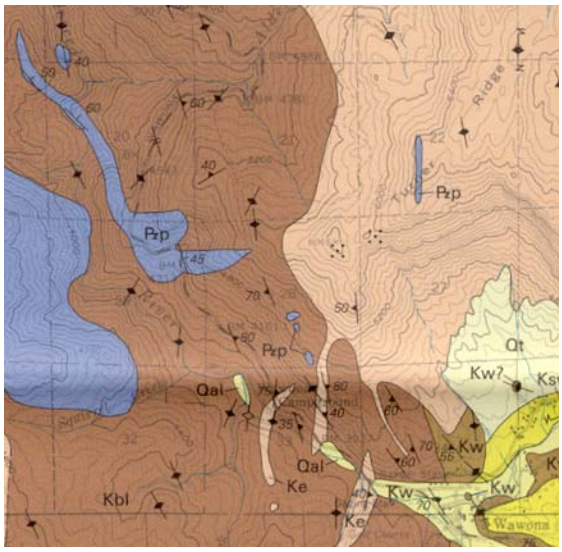


Figure C8. Quartzite of Pilot Ridge map units (in blue-purple) northwest of Wawona, Yosemite National Park, California (map by Peck 2002).

Phenological Development

As indicated above, the growth stage of *A. yosemitense* varied among the four survey sites. At sites ALYO10-1 and -2, flowering coincided with all the associated herbaceous species in the rock outcrop microsites. Flowering lagged behind the late-winter-flowering *Arctostaphylos viscida* and *Quercus wislizeni* but was similar to that of all but the earliest annual grassland species.

Most herbaceous species at ALYO10-3 were dispersing fruit or senescing as was *A. yosemitense*. That made it less evident whether flowering coincided among the species present, but it appears that the timing of flowering was similar for all species on site with the exception of *Arctostaphylos viscida*.

At ALYO10-4, *A. yosemitense* was developing fruit. Most herbaceous species were developing or dispersing fruit and beginning to dry in the well-drained soil.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Allium yosemitense was first collected by Enid Michael in 1922 from the population above Bridalveil Falls and recollected in 1923 and 1926 (our site ALYO10-3). The habitat was described as "wet cracks in the west-facing canyon wall…of Bridalveil Canyon." Alice Q. Howard of the University Herbarium at University of California, Berkeley, relocated this population on 29 May 1979 (Howard 1979). As of that date, the species was still known only from that locality. In 1980, Stephen Botti found *A. yosemitense* inhabiting both east and west-facing slopes along Bridalveil Creek above the top of Bridalveil Falls. Botti found an additional station on 22 April 1981 within the Yosemite National Park boundary located on the South Fork of the Merced River 1.5 km upstream from the confluence of Alder Creek. A survey in 1981 of

other likely habitat and of an alleged occurrence near Merced Pass failed to locate any new stations.

Discussion

Factors That May Have Affected Survey Results

U.S. Geological Survey staff performed *A. yosemitense* surveys under an inter-agency agreement with NPS. At the behest of the NPS, we restricted our efforts largely to areas under NPS jurisdiction. The first two *A. yosemitense* surveys were conducted in the Sierra National Forest but within a population of *Eriophyllum congdonii* that adjoins the NPS El Portal Administrative Site. An area likely to contain additional *A. yosemitense* habitat is the north side of the ridge on which ALYO10-1 and -2 occurred (ridge on the northeast side of Pigeon Gulch). Surveys 1 and 2, performed at peak flowering, detected no signs of disturbance and are expected to be an accurate assessment of the population as it expressed itself in 2003, a year of slightly above average rainfall (965 mm [38 in] with a 30-year mean of 762 mm [30 in], California Data Exchange Center 2004).

The third survey, ALYO10-3, was late in the period of plant growth for *A. yosemitense* and is likely to be an underestimate because as much as 30%–40% of flower heads had blown free from stems. Most detached flower heads appeared to be lodged in rocks and manzanita canopies nearby to plants; however, some could have disappeared from the site entirely, reducing the accuracy of the count. Inexperience with the approach to the site via the Gunsight, a fourth class route (rope protection required in two sections) between Lower and Middle Cathedral Rocks, as well as having only one experienced climber for three botanists slowed access to the site. We were able to spend only an hour and a half in the survey site, increasing the likelihood that plants were missed.

Assessment of Threats or Potential Impacts

There has been some concern on the part of resource protection rangers at Yosemite that climbing routes in the Cathedral Rocks area might be attracting visitation in or near the Bridalveil Creek population (type locality) and contributing to social trails or other impacts in the area. People may also pass through the site to access swimming holes in Bridalveil Creek, but this is probably limited to experienced climbers who can make quick work of the fourth class sections in the Gunsight. We saw no signs of trampling, trail formation, damage to or removal of vegetation within the population. Rock fall and slipping talus, the result of natural weathering, could threaten individual plants, but the species is presumably adapted to these conditions. The population appears fairly protected from direct threats by difficult access via a fourth-class route from below and difficult access from Glacier Point Road above.

The surveyed populations in the Merced River Canyon, main stem and south fork, are on steep slopes that see very little visitation. Alien plant species acknowledged as the most aggressive in the Merced River Canyon (*Centaurea solstitialis, C. melitensis, Rubus discolor*) are not in the vicinity of the two *A. yosemitense* populations surveyed. Alien plant species in the annual grassland surrounding sites ALYO10-1 and -2 did not occur within the *A. yosemitense* rock outcrop microhabitat. The only alien species detected in the Bridalveil Creek population (ALYO10-3) was *Vulpia myuros* var. *hirsuta*, which the California Invasive Plant Council (Cal-IPC 1999) does not consider a highly aggressive alien species, and it appears to integrate itself into native ecosystems with relatively low impact. We did not detect any alien plant species

at the South Fork site (ALYO10-4). There are no evident threats at this time to the four populations surveyed beyond the broad-scale ones of atmospheric pollutants and climatic change.

Recommended Measures to Minimize Impacts

Despite the lack of apparent trampling or trail formation in the Bridalveil Creek population, the area should be monitored periodically for signs of trampling damage or other impacts. Information about the location of climbing routes in the vicinity of this population and routes of access and egress would inform this monitoring. As part of a monitoring plan, park managers should identify how and when monitoring results trigger mitigation measures. For example, measurable criteria could be set for length and location of social trails that would trigger mitigation. Should trampling or social trail formation be found and exceed specific limits, the park could mitigate with informational signage at the climbing trailhead(s), restoration of trails being formed and, eventually, seasonal route closures.

Significance of Yosemite Populations

Allium yosemitense is endemic to Tuolumne and Mariposa counties. It is known from fewer than 20 occurrences statewide (CNPS 2003) and from only two occurrences in Yosemite National Park (Botti 2001). The type locality for *A. yosemitense* is Mariposa County, approximately 300 m upstream from the top of Bridalveil Falls (Enid Michael s.n. June 1922). The holotype is at California Academy of Sciences (CAS 205887); an isotype is at Gray Herbarium, Harvard University (GH 29815). We confirmed the continued presence of *A. yosemitense* at this site during a survey on 26 June 2003 (site number ALYO10-3).

Additional Work Needed

The remainder of the area northwest of Wawona Campground mapped as "Quartzite of Pilot Ridge (early Paleozoic)" (symbol Pzp in Figure C8) and described as including metaquartzite, quartz mica schist, phyllite, and argillite could be surveyed for *Eriophyllum congdonii*, *A. yosemitense*, *Collinsia linearis*, and other special-status plant species. Surveys might include the contact zone with adjacent granitic rock. This outcrop crosses Wawona Road and runs northwest across the South Fork of the Merced River (Peck 2002). The additional areas of Quartzite of Pilot Ridge on Turner Ridge and west of the South Fork of the Merced River could be surveyed as well.

Qualifications of Field Personnel at the Time of Surveys

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Peggy E. Moore: MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevadas: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; plant surveys in Yosemite, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Meghan Williams: BS Biology 2001, California Polytechnic State University, San Luis Obispo.

Literature

Bateman, P. C. and K. B. Krauskopf. 1987. Geologic map of the El Portal Quadrangle, west-central Sierra Nevada, California. Miscellaneous Field Studies Map MF-1998. U.S. Department of the Interior, U.S. Geological Survey, Washington, D.C.

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Department of Water Resources, Division of Flood Management. 2004. California Data Exchange Center web site. Online. (http://cdec.water.ca.gov/). Accessed 8 March 2004.

California Invasive Plant Council (Cal-IPC). 1999. Exotic pest plants of greatest ecological concern in California. California Native Plant Society, Sacramento, California. Online. (http://www.cal-ipc.org/ip/inventory/pdf/Inventory1999.pdf).

California Native Plant Society (CNPS). 2004. Inventory of rare and endangered plants (online edition v6.2). California Native Plant Society, Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 8 March 2004.

Eastwood, A. 1934. *Allium yosemitense*. Leaflets of Western Botany 1:132.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Howard, A. Q. 1979. Searching for the Yosemite onion. Fremontia 7:15–18.

Mortola, W. R., and D. W. McNeal. 1985. Taxonomy of the *Allium tribracteatum*. Aliso 11(1):27–35.

Peck, D. L. 2002. Geologic map of the Yosemite quadrangle, central Sierra Nevada, California. Geologic Investigations Series Map I-2751. U.S. Department of the Interior, U.S. Geological Survey, Washington, D.C

Bolandra californica A. Gray

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Saxifragaceae

Synonyms

None

Vernacular Name

Sierra bolandra, Sierra false coolwort

Status

- Federal: Forest Service Watch List (Sierra NF, Stanislaus NF)
- California: none
- CNDDB: G3[1]/S3.3[2]
- CNPS: 4.3[3]
- Yosemite National Park: Sensitive



Figure C9. *Bolandra californica* flowers and leaves, Ten Lakes Pass, Yosemite National Park, Tuolumne County, California (photograph by Alison E. L. Colwell).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Heuchera rubescens also prefers rock fractures, has leaves with 3–9 lobes, but the lobes are always sharp-toothed and the leaves, at 10–25 cm wide, are larger than those of *Bolandra californica*. *Lithophragma bolanderi* completely overlaps the elevation range of *B. californica* and has similar leaves with 3–5 lobes, the lobes with rounded teeth. However, *L. bolanderi* flowers have 10 stamens rather than 5 and the hypanthium is partly fused to the ovary. *Mitella* spp. petals are always green and pinnately divided into thread-like segments whereas *B. californica* petals are entire and typically purplish-edged or tipped.

Distribution

California

Northern and central High Sierra Nevada, >2,000 m (>6,500 ft) (Hickman 1993)

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[1]CNDDB Global Rank = G3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres throughout species range

[2]CNDDB State Rank = S3.3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; no current threats known

[3]CNPS List 4: Limited distribution (watch list); Threat Code 3: Not very endangered in California

Yosemite National Park
Mixed conifer, montane and subalpine zones, 1,000–2,600 m (3,300 and 8,500 ft) (Botti 2001)

Survey Methodology and Results
Survey Dates
26–27 June 2004

Rationale for Survey Timing
In 2004, there was an early onset of spring due to record high temperatures in March and warm weather in April and May. As a result, plant phenology was advanced up to a month in places. Because the leaves of *B. californica* are similar in morphology to other members of Saxifragaceae, it is most accurate to survey the species at flowering time. In spite of the wet cliff and slope habitat that *B. californica* occupies, snow melt had occurred and plants were flowering by late June even at 2,850 m (9,300 ft).



Figure C10. *Bolandra californica* habitat along a spring-fed seep near Illilouette Creek, Yosemite National Park, Mariposa County, California (photograph by Peggy E. Moore).

Personnel Conducting Surveys
Peggy E. Moore, Charlotte Coulter, Alison E. L. Colwell (+Jeff Compton on BOCA10-2)

Table C3. *Bolandra californica* A. Gray survey locations and results.

Site	Location	Person Hours	Population Size
BOCA10-1	Illilouette Fall, 30 m S of W end foot bridge, Mariposa County	1.5	81
BOCA10-2	Drainage E of Ten Lakes Pass, Tuolumne County	1	250
Total		**2.5**	**331**

Method Used to Estimate or Census the Population
Botanists made opportunistic surveys when this species was encountered. There were complete censuses at each site, with plants counted individually whether they occurred in groups or singly. At both sites, most plants were clustered in small groups. There were a few flowering plants, a few plants of mature size, and a majority occurring as small seedlings with leaves 1 cm or smaller in diameter. The latter were tightly clustered and may have resulted in an underestimate. Surveyors scanned areas they traversed in a grid pattern, most thoroughly checking the most mesic portions of the habitat.

Habitat
Snow- or spring-fed sites in rocky areas, wet cliffs, rock crevices; also, though perhaps less often, damp sites in shaded forests; 1,000 to 2,600 m (Botti 2001) (Figure C10). *Bolandra californica* may prefer north aspects because these areas retain vernal moisture longer.

Vegetation Communities

- Within target species population: Information not recorded.
- In survey area outside documented population(s): Information not recorded.

Important Associated Plant Species

Information recorded at BOCA10-2 only: *Salix* sp., *Delphinium* sp., *Erysimum capitatum* ssp. *perenne*, *Achillea millefolium*, *Mertensia ciliata*, *Phacelia quickii*, *Cystopteris fragilis*

Phenological Development

Bolandra californica plants varied in phenological stage at both sites surveyed. Some mature-sized plants were flowering, some were not, and a larger number were smaller-leaved, smaller-statured plants that appeared immature.

Location of Deposited Voucher Specimens

No vouchers were collected.

Remarks

Bolandra californica is a Sierra Nevada endemic (Hickman 1993; Taylor, in preparation; Botti 2001). It occurs somewhat infrequently, but, perhaps because of its charming flowers, is well represented in the UC and Jepson herbaria. Taylor (in preparation) lists 21 specimens from those herbaria alone.

Discussion

Factors That May Have Affected Survey Results

Surveys were done opportunistically during the course of other work and may not have been exhaustive. We did not search broad areas around the populations, only the general area. We tallied immature plants along with flowering plants, so the counts do not represent only the reproductive portion of the populations.

Assessment of Threats or Potential Impacts

The plants lowest on the slope at the Illilouette Creek population were adjacent to a popular use area along the creek and could be subject to trampling. The remainder of the population appeared unlikely to be visited. The Ten Lakes Pass population is on a cutbank of the trail to Ten lakes; bank erosion is the most evident threat.

Recommended Measures to Minimize Impacts

Practices should be implemented to minimize or avoid adverse impacts. Trail maintenance at either location should avoid direct or indirect impacts to populations such as rerouting trail through populations or increasing site erosion.

Significance of Yosemite Populations

The type locality of *B. californica* is the "Mariposa Trail," Yosemite Valley. It was collected by H. N. Bolander (4898), 1 July 1866 (Holotype at Gray Herbarium [GH42625]; isotypes at New York Botanical Garden [NY 185967], Smithsonian Institution [US 320676], University of California, Berkeley [UC11300, UC11301]).

Additional Work Needed

Populations that were mapped in the 1980s but were not surveyed in 2003–2004 include five

localities (NPS 1985):

- Poopenaut Valley
- Top of ledge on Ledge Trail
- Upper portion of Ledge Trail
- Happy Isles area west of the fen; this didn't appear to be appropriate habitat in 2004
- Artist Creek southeast of Discovery View

The author has observed additional populations of this species at the Gunsight, a seep northeast of Lake Vernon, and other areas. Plot data collected from 362 sites between 1989 and 1993 recorded occurrences of *B. californica* at two sites, 0.75 km northeast of Harden Lake and approximately 650 m north of the South Entrance. Plot data collected from 260 sites between 1998 and 1999 recorded no occurrences of *B. californica*.

The predicted habitat model could be run for *B. californica*, but additional surveys of known locations should be surveyed to derive habitat characteristics first. It is likely that the species responds to microhabitat conditions more than habitat characteristics currently available in GIS themes.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore**:** MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; plant surveys in Yosemite, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Literature

Gray, A. 1868. Proceedings of the American Academy of Arts and Sciences 7:341.

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, Yosemite National Park, California.

California Department of Fish and Game (CDFW). 2003. California Natural Diversity Database, version 3.0.3. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed 5 January 2004.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

National Park Service (NPS). Circa 1985. Rare_plants [Computer map, ESRI shape file format] Yosemite National Park, California.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley, California.

Carex buxbaumii Wahlenb.

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Cyperaceae

Synonyms

None

Vernacular Name

Buxbaum's sedge, Buxbaum sedge, brown bog sedge

Status

- Federal: none
- California: none
- CNDDB: G5[1]/S3.2[2]
- CNPS: 4.2[3]
- Yosemite National Park: Sensitive



Figure C11. *Carex buxbaumii*, Soda Springs, Yosemite National Park, Tuolumne County, California, 28 July 2004 (photograph by Alison E. L. Colwell).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions. Also see Hitchcock et al. (1969) for more detail.

Similar Species

Carex buxbaumii is in Section Atratae (>1 spikelet/culm, perigynia glabrous, achenes 3-sided, stigmas 3, style deciduous, etc.). It has a 3-sided achene, with the female flowers above the male flowers on the same terminal spikelet (Figure C12). Five other sedges occurring in our area are in Section Atratae. *Carex spectabilis* and *C. raynoldsii* are lacking the prominent awn on the scales and the uppermost spikelet is either male or male flowers above female. Basal leaves are not reduced to nearly bladeless sheaths in *C. albonigra*, *C. helleri*, and *C. heteroneura*.



Figure C12. *Carex buxbaumii* in fruit, Soda Springs, Yosemite National Park, Tuolumne County, California, 28 July 2004 (photograph by Alison E. L. Colwell).

[1]CNDDB Global Rank = G5: Population or stand demonstrably secure to ineradicable due to being commonly found in the world.
[2]CNDDB State Rank = S3.2: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; Threatened
[3]CNPS List 4: Limited distribution (watch list); Threat Code 2: Fairly endangered in California

Distribution

California

Northern Coast, North Coast Ranges, Central Coast, central and southern High Sierra Nevada, <3,300 m (<10,800 ft) (Hickman 1993)

Yosemite National Park

Mixed conifer, montane, and subalpine zones, 1,350–2,600 m (4,430–8,500 ft) (Botti 2001)

Survey Methodology and Results

Survey Dates

13, 28 July 2004

Rationale for Survey Timing

Sedges typically are identifiable only when perigynia are fully ripe. We timed the Swamp Lake survey to coincide with flowering of the majority of species of interest at that site. Although *C. buxbaumii* fruits were ripe enough, we did not identify specimens until we returned to the lab. As a result, we did not determine plant abundance at the Swamp Lake west island or the shallow lake west of Swamp Lake. We timed the Soda Springs survey to ensure fruit maturity. Plants were identifiable and we censused them at that site.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C4. *Carex buxbaumii* Wahlenb. survey locations and results.

Site	Location	Person Hours	Population Size
CABU10-1	West island of Swamp Lake	48	Not quantified
CABU 10-2	Soda Springs, Tuolumne Meadows	4	737
Total		**52**	**NA**

Method Used to Estimate or Census the Population

We attempted surveys of two areas with previously reported populations in Yosemite National Park. We did not survey the Swamp Lake west island and the lake west of Swamp Lake because reliable identification was not available in the field. We made a complete census at the Soda Springs site, counting plants individually and surveying all appropriate habitat at the spring plus the meadow down to the Tuolumne River.

Habitat

Bogs and fens, meadows and seeps, marshes (Tibor 2001); 1,350 to 2,600 m (4,430 to 8,530 ft) (Botti 2001) (Figure C13). Microhabitats in Yosemite are fens on floating mats with Sphagnum and a mineralized spring and associated wet meadow (Taylor, in preparation).

Vegetation Communities

Within Target Species Population: *Deschampsia caespitosa* Seasonally Flooded Herbaceous Alliance, Saturated temperate forb vegetation formation at Swamp Lake site

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest at Swamp Lake

Important Associated Plant Species

Swamp Lake West Island: *Carex limosa*, *C. cusickii*, *Menyanthes trifoliata, Kalmia polifolia, Eriophorum gracile*.

Soda Springs: *Triglochin maritima, Deschampsia cespitosa, Muhlenbergia filiformis, Penstemon rydbergii, Elymus trachycaulis*.



Figure C13. *Carex buxbaumii* habitat at Soda Springs, Tuolumne Meadows, Yosemite National Park, Tuolumne County, California, 28 July 2004 (photograph by Alison E. L. Colwell).

Phenological Development

All plants in the unsurveyed population at Swamp Lake on the west island were flowering on 13 July 13 2004. On 28 July 28 2004, 1,100 m (3,600 ft) higher at Tuolumne Meadows, the majority of plants were vegetative while 25% were flowering. Field botanists were more familiar with the morphology of the species by the 28 July survey and had more confidence identifying vegetative *C. buxbaumii* plants adjacent to flowering plants.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator (Swamp Lake, A. Colwell AC04-96, YOSE 118032; and AC04-97, YOSE 118015; Soda Springs, A. Colwell AC04-192, YOSE 117849)

Remarks

Carex buxbaumii is a wetland obligate species; it almost always occurs in wetlands under natural conditions (USFWS 1996). It therefore requires a moist environment, including being rooted in saturated soil during the growing season. It is broadly distributed from central California to Alaska, across to eastern North America and south as far as Georgia (USDA 2004).

Discussion

Factors That May Have Affected Survey Results

We did not assess the population at Swamp Lake and the marshy lake west of Swamp Lake because we did not complete identification of *C. buxbaumii* in the field. In addition, a portion of the population resides on a natural log raft on the west side of the lake that requires a swim to reach. We were surveying a number of other taxa at the Swamp Lake site with insufficient time remaining for *C. buxbaumii*. The site at Soda Springs, Tuolumne Meadows, was thoroughly surveyed by two botanists for two hours and the population size estimate should be fairly accurate.

Assessment of Threats or Potential Impacts

Soda Springs in Tuolumne Meadows is a popular visitor destination. Rustic attractions include Parsons Lodge, the McCauley cabin, and the soda spring itself. The trail from the Glen Aulin trailhead passes by just up the slope from the soda spring before arriving at Parsons Lodge and the McCauley cabin. A four-walled structure surrounds the most active of the spring emergence

holes and attracts visitors to the spring from the immediate vicinity. Several hundred people per day visit the vicinity and interpretive walks use it as a destination in the summer (V. Burley, National Park Service, personal communication). The National Park Service trail crew worked on what had become a multi-tread trail above the spring in 2003, installing stable rocks for foot traffic to pass through. The dirt road and the trail passing upslope of the spring are unlikely to impact the spring's water source as it is presumably deeper than surface or immediately subsurface water. Trampling is the most likely source of impacts at the Soda Springs site. We noted trampling of several *C. buxbaumii* plants at the time of the survey. Trampling has likely occurred to some extent for many years because Parsons Lodge has been used as a gathering place since 1901, and the Sierra Club owned the land and ran a campground adjacent to the site until June 1973 (M. Eissler, National Park Service, personal communication).

Recommended Measures to Minimize Impacts

Swamp Lake receives extremely low visitation. Botanists visit periodically to observe, survey, or recollect unusual, historic collections. Paleoecology work has been done at the lake (lake-bottom coring) and perhaps other research. It is possible that, in the future, visits could be planned to make remeasurements based on data collected in the 1930s by the Yosemite School of Field Natural History (aka, Research Reserve data). In all cases, visitors should be sensitive to a number of unique occurrences and other park-sensitive species. They occur in the meadow around and on the shore of Swamp Lake, on the floating islands within the lake, and at the marsh west of and downstream from Swamp Lake. Care should be taken to avoid undue collection, trampling, etc.

Carex buxbaumii is a non-showy species and doesn't attract direct attention at Soda Springs. It was our observation that the spring is sufficiently wet that it receives minimal direct trampling except right in the trail during most of the growing season. The population on the bank of the mineralized depression at the spring should be monitored to detect impacts.

Significance of Yosemite Populations

H. N. Bolander collected *Carex buxbaumii* in 1866 (UC685) at Soda Springs, Tuolumne Meadows, the earliest collection in Yosemite. Also, H. L. Mason made repeated collections at Swamp Lake (UC1100426, UC599133, UC599137, UC599141, UC599114, UC1056295, UC1102954, UC1102955) between 1937 and 1958, but there are no other reported locations in Yosemite. The species is "very rare and widely scatter in bogs elsewhere in California" (Taylor, in preparation). At the same time, it ranges across most of North America.

Additional Work Needed

Surveys should be completed for the floating islands at Swamp Lake and the lake/marsh west of Swamp Lake. We did not find *Carex buxbaumii* on the Swamp Lake south island, but that site should be checked again as there is a historic collection from there.

Additional alkaline seeps in Yosemite might be surveyed for the presence of *C. buxbaumii*. Spring locations include Alkali Creek northwest of Tuolumne Meadows, Lyell Canyon, west of Chain Lakes, and perhaps other locations.

The predicted habitat model could be run for *C. buxbaumii*, but it is likely that the species responds to microhabitat conditions more than habitat characteristics currently available in GIS

themes. The best hope of predicting additional habitat is to obtain or derive spatial data representing mineralized wet meadows.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Department of Fish and Game (CDFG). 2003. California Natural Diversity Database, version 3.0.3, November 3, 2003. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed 5 January 2004.

Carex buxbaumii Wahlenb. 1803. Kongl. Vetenskaps Academiens nya Handlingar 24: 163.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson. 1969. Vascular Plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. University of Washington Press, Seattle, Washington. 914 pp.

National Park Service (NPS). Circa 1985. Rare_plants [Computer map, ESRI shape file format] Yosemite National Park, California.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley, California.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

U.S. Fish and Wildlife Service (USFWS). 1996. National list of vascular plant species that occur in wetlands: 1996 national summary. National Wetlands Inventory, Division of Habitat and Resources Conservation, Arlington, Virgina, USA. Online. (http://www.nwi.fws.gov/bha/download/1996/national.pdf). Accessed 15 September 2004. [Current location: www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list96.pdf]

Carex limosa L.

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Cyperaceae

Synonyms

None

Vernacular Name

Shore sedge, mud sedge

Status

- Federal: none
- California: none
- CNDDB: G5[1]/S3?[2]
- CNPS: 2.2[3]
- Yosemite National Park: Sensitive



Figure C14. *Carex limosa*, Swamp Lake, Yosemite National Park, Tuolumne County, California, 13 July 2004 (photograph by Alison E. L. Colwell).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Carex limosa is in Section Limosae (>1 spikelet/culm, perigynia glabrous, stigmas 3, achenes 3-sided, perigynia glabrous, style deciduous, inflorescence bract sheathing <4 mm, leaf blades <1 cm wide and glabrous, pistillate spikelets drooping [Botti 2001]). The terminal spikelet is male; lateral female spikelets are long-peduncled, drooping, somewhat separated and number 2 to 4. Roots are covered with yellow felt. No other sedges in Limosae occur in our area. Somewhat similar taxa in section Atratae (*C. buxbaumii*, *C. spectabilis*, and *C. raynoldsii*, *C. albonigra*, *C. helleri*, and *C. heteroneura*) have erect spikelets on short stalks and lack yellow felt on the roots.

Distribution

California

High Sierra Nevada, 1,200–2,700 m (4,000–8,800 ft) (Hickman 1993)

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[1]CNDDB Global Rank = G5: Population or stand demonstrably secure to ineradicable due to being commonly found in the world.
[2]CNDDB State Rank = S3?: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres
[3]CNPS List 2: Rare, threatened, or endangered in California, but more common elsewhere; Threat Code 2: Fairly endangered in California

Yosemite National Park
Floating islands in Swamp Lake, mixed conifer zone, 1,550 m (5,000 ft) (Botti 2001)

Survey Methodology and Results
Survey Dates
13 July 2004

Rationale for Survey Timing
Sedges typically are identifiable only when perigynia are fully ripe. We planned the timing of the Swamp Lake survey o coincide with flowering of the majority of species of interest at that site.

Personnel Conducting Surveys
Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C5. *Carex limosa* L. survey locations and results.

Site	Location	Person Hours	Population Size
CALI10-1	South island of Swamp Lake	48	528

Method Used to Estimate or Census the Population
We made a complete census on Swamp Lake's south island, counting plants individually, and surveyed all appropriate habitats at the lake (lake margin and islands), plus at the two small lakes to the west.

Habitat
Sphagnum bogs, fens, meadows and seeps, 1,200 to 2,700 m (Tibor 2001). Habitat in Yosemite is limited to fens on floating mats with *Sphagnum* (Taylor, in preparation; Botti 2001) (Figure C15).

Vegetation Communities
Within Target Species Population: Not represented in the park's vegetation classification at the alliance level. At the formation level, it can be categorized as saturated temperate forb vegetation.

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest

Important Associated Plant Species
Menyanthes trifoliata, *Dulichium arundinaceum*, *Lycopus uniflorus*, *Brasenia schreberi*



Figure C15. *Carex limosa*, *Dulichium arundinaceum*, and *Eriophorum gracile* habitat, Swamp Lake, Yosemite National Park, Tuolumne County, California, 28 July 2004 (photograph by Alison E. L. Colwell).

Phenological Development
Only about 5% of plants were flowering at the time of the survey, but they were sufficiently distinctive to identify at the vegetative stage. Other species on the island were at a variety of growth stages. About half of the round-leaved sundew plants and about 20% of *Dulichium* plants were flowering, but all of the cottongrass was at the fruiting stage. Other sedges were immature.

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks
Carex limosa is a wetland obligate species; it almost always occurs in wetlands under natural conditions (USFWS 1996). It therefore requires a moist environment, including being rooted in saturated soil during the growing season. It is broadly distributed from California to Alaska and east to northeastern North America (USDA 2004). However, it is listed as endangered in Connecticut, Indiana, New Jersey, Ohio, and Pennsylvania and as extirpated in Rhode Island.

Discussion
Factors That May Have Affected Survey Results
We were surveying a number of other taxa at the Swamp Lake site with insufficient time remaining to estimate abundance for *C. limosa* on the west island. Islands appear to have been stable over the last 70 years; their floating state ensures saturated conditions and continues to support unusual species originally collected in the 1930s.

Assessment of Threats or Potential Impacts
There are no apparent direct threats at this time.

Recommended Measures to Minimize Impacts
Swamp Lake receives extremely low visitation. Botanists visit periodically to observe, survey, or recollect unusual, historic collections. Paleoecology work has been done at the lake (lake-bottom coring) and perhaps other research. It is possible that, in the future, visits could be planned to make remeasurements based on data collected in the 1930s by the Yosemite School of Field Natural History (i.e., Research Reserve data). In all cases, visitors should be sensitive to a number of unique occurrences and other park-sensitive species. They occur in the meadow around and on the shore of Swamp Lake, on the floating islands within the lake, and at the marsh west of and downstream from Swamp Lake. Care should be taken to avoid undue collection, trampling, etc.

Significance of Yosemite Populations
The earliest collection of *Carex limosa* in Yosemite was that of Reinecke and Mason (UC1100504) at Swamp Lake, and that remains the only known locality in the park.

Additional Work Needed
A survey should be completed for the west island at Swamp Lake. *C. limosa* was not found in all the other areas searched in the vicinity, including the lake shore and the lakes to the west.

Qualifications of Field Personnel at the Time of Surveys
Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant

identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Department of Fish and Game (CDFG), California Natural Diversity Database. 2003. RareFind version 3.0.5. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed 3 July 2004.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 14 January 2005.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

National Park Service (NPS). Circa 1985. Rare_plants [Computer map, ESRI shape file format]. Yosemite National Park, California.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Herbarium, University of California, Berkeley, California.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

U.S. Fish and Wildlife Service (USFWS). 1996. National list of vascular plant species that occur in wetlands: 1996 national summary. National Wetlands Inventory, Division of Habitat and Resources Conservation, Arlington, Virgina. Online. (http://www.nwi.fws.gov/bha/download/1996/national.pdf). Accessed 15 September 2004. [Current location: www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list96.pdf]

Carex tompkinsii J. T. Howell

Information compiled by Peggy E. Moore, 2004

Species Overview

Family
Cyperaceae

Synonyms
None

Vernacular Name
Tompkins' sedge

Status
- Federal: Forest Service Watch List (Stanislaus NF)
- California: Rare (11/1979)
- CNDDB: G3[1]/S3.3[2]
- CNPS: 4.3[3]
- Yosemite National Park: Sensitive



Figure C16. *Carex tompkinsii* growth habit, El Portal, Merced River Canyon, Mariposa County, California (photograph by Peggy E. Moore).

Description
See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species
Carex tompkinsii may be confused with the widespread *C. multicaulis* L. H. Bailey of dry, open coniferous forests. However, *C. multicaulis* has leaves shorter than flowering stems; stems are generally cylindrical (or upper angles blunt) and smooth in contrast to the sharply angled upper stem of *C. tompkinsii*; and *C. multicaulis* spikelets are solitary and terminal in contrast to spikelets numbering 1–3 in *C. tompkinsii* (Figure C17). Leaf blades are 1-1.5 mm wide in *C. multicaulis* and 1.5-3 mm wide in *C. tompkinsii*.



Figure C17. *Carex tompkinsii* fruiting inflorescense, El Portal, Merced River Canyon, Mariposa County, California (photograph by Peggy E. Moore).

[1]CNDDB Global Rank = G3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres throughout species range
[2]CNDDB State Rank = S3.3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; no current threats known
[3]CNPS List 4: Limited distribution (watch list); Threat Code 3: Not very endangered in California

Distribution

California

Central Sierra Nevada Foothills (near El Portal, Mariposa County), southern High Sierra Nevada (near Kings Canyon, Fresno County), 1,200–1,800 m (3,900–5,900 ft)

Yosemite National Park

The Merced River Canyon between El Portal and Arch Rock at elevations between 550 and 900 m (1,800 and 3,000 ft)

Survey Methodology and Results

Survey Dates

19, 21 May 2003; 5, 11, 17, 18, 24 June 2003

Rationale for Survey Timing

Carex tompkinsii is one of the relatively few perennial graminoids occurring below 900 m (3,000 ft) in the Merced River Canyon. It remains green through June in contrast to the Mediterranean annual grasses and native annuals that dominate the herbaceous component of its habitat. This and the plant at fruiting stage maximize its detectability during surveys.

Personnel Conducting Surveys

Peggy E. Moore, Charlotte Coulter, Meghan Williams, Alison E. L. Colwell, Lisa Ordóñez (+Karen Vaughn on CATO10-3, -5, -10; Victor Goldman on CATO10-10)

Table C6. *Carex tompkinsii* J. T. Howell survey locations and results.

Site	Location	Person Hours	Population Size
CATO10-1	N side Hwy. 140, across from Yosemite View Lodge, El Portal	2	10
CATO10-2	Old stream terrace (currently a trailer park, historically Hennessey's) on Hwy 140, El Portal	4	30
CATO10-3	Hwy 140 bridge over Merced River (currently east edge trailer village), El Portal	8	299
CATO10-4	NE side of drainage located NE and across the Merced River from the Trailer Village (historic site of Hennessy's Ranch)	3.75	538
CATO10-5	North of El Portal Road between YNP boundary and Arch Rock Entrance Station, Yosemite National Park	7.5	53
CATO10-6	0.5 km west of El Portal Road/Hwy 140 junction, El Portal	3	147
CATO10-7	Stream terrace south of El Portal Road/Hwy 140 junction, El Portal	1.5	24
CATO10-8	West of chapel in El Portal	2	174
CATO10-9	Drainage W of the chapel, El Portal	4	260
CATO10-10	Stream terrace on S side of Merced River at Crane Creek confluence (Johnny Wilson historic homestead site), El Portal	15	94
CATO10-11	Crane Creek, 270 m N of confluence w/Merced River, El Portal	4	120
CATO10-12	NE of Rancheria Flat, El Portal	8	86
CATO10-13	N side of El Portal Road, about 2.4 km downstream of Arch Rock	4	189
Total		**66.75**	**2,024**

Method Used to Estimate or Census the Population

We surveyed areas with previously mapped or reported populations that were entirely or partially contained within Yosemite National Park or within the El Portal Administrative Site. We surveyed as much appropriate habitat within the Administrative Site as time allowed. This included all old stream terraces (sites CATO10-2, -3, portions of -6, -7, -10) and permanent and ephemeral drainages on the north side of the canyon (sites CATO10-4, -9, -11, -12). We made complete censuses at each site, individually counting plants whether they occurred in groups or singly. Most plants occurred singly or in patches with scattered plants, almost never densely clustered. Surveyors scanned areas they traversed in a grid pattern, most thoroughly checking shaded and partially shaded areas and those dominated by *Toxicodendron diversilobum*. We tallied plants by numbered survey site.



Figure C18. *Carex tompkinsii* habitat, El Portal, Merced River Canyon, Mariposa County, California, 17 June 2003 (photograph by Peggy E. Moore).

Habitat

Steep, dry, rocky canyon bottoms and sides on the west slope of the central and southern Sierra Nevada between 580–900 m (1,900–3,000 ft) in the north and 900–1,800 m (3,000–5,900 ft) in the south. Loose sandy or rocky soil in partial to full shade (Figure C18). Soil can be granitic or metamorphic in origin. *Carex tompkinsii* also has invaded road cuts across much of its known distribution in the Merced River Canyon from El Portal to the Arch Rock Entrance Station to Yosemite.

Vegetation Communities

Within Target Species Population: *Quercus chrysolepis–Umbellularia californica* Forest Association, *Quercus wislizeni–Quercus chrysolepis* Woodland Association, *Quercus wislizeni–Arctostaphylos viscida* Woodland Association, *Pinus sabiniana–Quercus wislizeni*/*Arctostaphylos viscida* Woodland Association, *Pinus sabiniana–Quercus wislizeni*/*Ceanothus cuneatus* Woodland Association, *Quercus chrysolepis–Pinus sabiniana* Forest Association

In Survey Area outside Documented Population(s): Same as within populations

Important Associated Plant Species

Quercus chrysolepis and *Q. wislizeni* were the most common overstory components. *Pinus sabiniana* formed a sparse emergent vegetation layer in nearly half the sites surveyed. *Umbellularia californica*, *Cercis occidentalis*, and *Aesculus californica* occurred somewhat commonly in the subcanopy. *Toxicodendron diversilobum* was important or dominant in the shrub layer at every site surveyed. Also commonly occurring in the shrub layer were *Rhamnus ilicifolia*, *Philadelphus lewisii*, *Keckiella breviflora* var. *breviflora*, *Lonicera interrupta*, and *Rhus trilobata*. Herbaceous cover was generally less than 25% and was composed of a variety of

native and alien annual species. *Bromus diandrus* occurred at 12 of 13 sites and was important at five of them. *Torilis nodosa* and *Clarkia unguiculata* were also abundant and common among sites. The native perennial grass *Melica imperfecta* occurred on two thirds of sites visited and was abundant on a third of them. It was the only graminoid that remained green along with *C. tompkinsii* on the majority of sites.

Phenological Development

Carex tompkinsii was flowering on 41% of the sites surveyed. Plants were largely fruiting on 25% of sites, and on one third of the sites plants were equally divided between fruiting stage and vegetative condition. This progression closely followed the progress of the 12 surveys from 19 May to 24 June 2003, with the exception of sites CATO10-8, -9, -11, which had high proportions (50%) of vegetative plants late in the season. In contrast to the green, flowering to fruiting condition of *C. tompkinsii*, the vast majority of associated herbaceous species were dispersing fruit or fully senesced. This maximized detection of *C. tompkinsii* because its green foliage contrasted sharply with senescent annuals. Only the latest spring annuals (e.g., *Clarkia unguiculata*) were still flowering on any sites during the surveys.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Carex tompkinsii is a Sierra Nevada endemic once thought to be limited to three stations in the Kings River drainage and one locality in the Merced River drainage. The CNDDB listed 19 occurrences during the time they included *C. tompkinsii* occurrences in the database, two of which were in the Merced River Canyon in the vicinity of El Portal:

1. Occurrence 11: north side of the Merced River, from just above Rancheria Flat, east for approx 0.5 mile, El Portal Administrative Site, Mariposa County
2. Occurrence 12: north side of the Merced River, from about 1 mile east of El Portal to vicinity of Arch Rock, Yosemite National Park, Mariposa County

With additional occurrence reports from the southern Sierra Nevada, the California Native Plant Society (CNPS) downgraded the species listing (between 1994 and 1996) from List 1B (rare, threatened, or endangered in California and elsewhere) to List 4 (species of limited distribution, a watch list). In presenting the justification for the listing downgrade, CNDDB quotes the Forest Service justification for removing *C. tompkinsii* from the Region 5 1998 sensitive plant species list:

> "In the past few years, botanists Dana York and Jim Shevock have noted many hundreds to thousands more plants than are currently documented in the CNDDB, covering thousands of acres in the Kings River drainage. Four occurrences are in the Sierra National Forest, 7 are in the Sequoia National Forest, and at least 3...are in Kings Canyon National Park. In the Merced River drainage ([partially] in Yosemite National Park), populations were found in 1997 to be more extensive and numerous than previously known."

CNDDB (2004) no longer lists occurrences for *C. tompkinsii* because of its downgrade to CNPS List 4 and the recognition that the California State Rare listing may need to be revisited.

Both J. T. Howell (1977) and Botti (1980) reported in rare plant status reports to CNPS and NPS, respectively, that plants vary from abundant and conspicuous in some years to inconspicuous in others, perhaps depending on weather conditions.

Discussion

Factors That May Have Affected Survey Results

Historic disturbances may have modified *Carex tompkinsii* habitat in several areas, thereby reducing plant abundance and/or distribution. The old stream terrace on the south side of the Merced River at the Crane Creek confluence (Johnny Wilson's historic homestead site, CATO10-10) and the current site of the trailer village/Abbie Road area (CATO10-2, -3) have rock wall installations that were related to gardens and orchards from the late 1800s.

At the end of December 1996, a heavy, warm winter rainstorm rapidly melted high-elevations snows and sent large volumes of water down Sierra Nevada watersheds, stripping riverbanks of vegetation and recontouring the banks. The volume and rapidity of the flood scoured and recontoured the banks of the Merced River for the length of the known *C. tompkinsii* distribution in the canyon, both in the park and in the Administrative Site. Previous surveys (NDDB CaliforniaNative Species Field Survey Form dated 3 June 1994 by Peggy E. Moore that included sites CATO10-1, -2, -3, -12) reported that plants were "largely confined to …the bank of the main stem of the Merced River" at those sites. The majority of the 454 plants found during that survey were at the edge of the trailer village/Abbie Road area adjacent to the Merced River. Distribution maps and survey comments from the early to mid-1980s (National Park Service 1985, Botti and Sydoriak 1981) also indicate proximity to the river, specifically "within 200 m of the river" as well as along the highway. Our survey of the trailer village/Abbie Road area documented 329 plants, but we did not detect any in the area with the greatest abundance of plants in 1994, at the top of the river bank on the west half of the terrace. In addition to mapped survey areas, we made quick checks of banks east of Rancheria Flat and portions of the area between Crane Creek and the park boundary. In light of the degree of bank recontouring from the January 1, 1997 flood (P. Moore, personal observation) and the distribution map from the 1980s, it appears habitat and plants were lost along the Merced River bank in El Portal.

A large fire in 1990 (A-Rock fire) burned through the Administrative Site north of Highway 140 and developed areas. The fire probably modified habitat for *C. tompkinsii*, at least in the short term. Much of the burned area had been dense *Quercus wislizeni* (interior live oak) and *Q. chrysolepis* (canyon live oak) with some emergent pines. A small proportion was *Adenostema fasciculatum* (chamise) chaparral or *Ceanothus cuneatus* (buckbrush). The fire reduced shade from live oaks, pines, and shrubs, but could have improved habitat in other ways (e.g., modifying nutrient availability). It is unclear to what extent previous surveys examined areas higher on the canyon slopes within the Administrative Site where no *C. tompkinsii* was previously mapped, but our 2003 surveys documented the species on all five of the partially shaded upland slopes we examined. This may or may not be an increase following the 1990 fire. Botti (2001) acknowledges that the "population continues for a considerable distance up the talus- and chaparral-covered slope on the north side of the canyon," but that could be based on more recent observations than is reflected in survey or collection records.

Assessment of Threats or Potential Impacts

Anticipated developments in the El Portal Administrative Site during implementation of the Yosemite National Park General Management Plan could remove or impact portions of *C. tompkinsii* habitat. Construction of housing, parking, use areas and new or improved access routes has the potential to occur in occupied habitat in the trailer village/Abbie Road area (CATO10-2, -3), in the vicinity of CATO10-4, -8, -9, west of the chapel in El Portal and other areas. Removal of vegetation for fire protection of existing or new developments could impact habitat by reducing shading with which *C. tompkinsii* is so closely associated. Trampling of upland areas used by an increased resident population and trampling of stream banks during recreational uses has the potential to damage plants directly and to degrade habitat. Road maintenance or widening could impact plants that have invaded road cuts both within the Administrative Site and within the park.

We noted the presence of an aggressive alien plant species at the Crane Creek site (CATO10-11), namely *Hedera helix* (English ivy). Its rapid, smothering growth poses a threat to the *C. tompkinsii* stand at that site. Other alien plant species found during surveys that could degrade habitat include *Lathyrus latifolius* (perennial sweet pea), *Vicia benghalensis* (purple vetch), and possibly *Bromus diandrus* (ripgut brome), and *Cynosurus echinatus* (hedgehog dogtail). Additional alien plant species established in the Administrative Site could invade *C. tompkinsii* habitat, including *Vinca major* (greater periwinkle), and additional introductions could occur with construction, import of materials, etc.

Recommended Measures to Minimize Impacts

Practices should be implemented to minimize or avoid adverse impacts to plants and habitat during site preparation, construction, maintenance, and operation of new facilities, including soil erosion, surface water runoff, and accidental point or nonpoint source chemical or petroleum spills.

Periodic monitoring of the population as a whole and monitoring during management and construction activities should include an assessment of cumulative impacts. Any assessment of cumulative impacts should include impacts on non-NPS lands (e.g., private property in the El Portal area) as well as past and foreseeable future activities.

Plants could be removed prior to road or driveway construction or widening and replaced on site or in adjacent appropriate habitat following completion of projects. Impacts during road maintenance could be minimized through mapping, monitoring and education of NPS, other agency and contractor employees.

Alien plant invasion of relatively intact habitat could be stemmed with carefully timed and appropriately designed alien plant control or removal. Mediterranean annual grasses are not typically considered good candidates for control.

Significance of Yosemite Populations

The type locality of *C. tompkinsii* is along the Copper Creek trail in Kings Canyon National Park at 1,675 m (5,500 ft) in Fresno County. It was collected by John T. Howell (collection no. 35333) 6 June 1960 (Holotype at California Academy of Sciences [CAS428953]; isotypes at California Academy of Sciences [CAS 429306], Rancho Santa Ana Botanic Garden

[RSA201476 and RSA234572], New York Botanical Garden [NY11379], U.S. National Herbarium [US02853449], Missouri Botanical Garden [MO2486746 and MO1970838]). Other than the Kings River drainage, the only other documented stations are in the Merced River Canyon between El Portal and the Arch Rock Entrance Station to Yosemite (J. T. Howell 48696, 24 April 1972, El Portal, Mariposa County, SBBG104023; D. W. Taylor 8805, 8 June 1986, Foresta Road from El Portal to Foresta, Mariposa County, UC1529067; S. J. Botti, 7 November 1979, ½ mi west of Arch Rock Entrance Station, north side of Highway 140, Yosemite National Park, Mariposa County, YM YOSE 60259).

Additional Work Needed

Additional surveying should be done north of El Portal Road between the western park boundary at the end of State Highway 140 east past the Arch Rock Entrance Station and up to the junction of the Big Oak Flat Road and El Portal Road, a distance of approximately 10.9 km (6.8 mi).

Areas of possible habitat within the El Portal Administrative Site that have not been surveyed include:

1. The drainage approximately 700 m east of Rancheria Flat, north and across the Merced River from the trailer village/Abbie Road area. The lower end of this drainage is about 50 m west of the northwest portion of TO10-6. The survey area would extend 400 m north-northwest to the boundary of the El Portal Administrative Site.

2. The Crane Creek corridor from its confluence with the Merced River upstream to the area surveyed in 2003 and east from Crane Creek across the broad south-facing slope to the boundary of the Administrative Site.

3. The area south of Highway 140, north of the Merced River and west of Yosemite View Motels private property.

4. The area north of old El Portal and west of CATO10-11.

5. The south side of the Merced River from the old Research Center/old Barium mine superintendent's house and assay office east to the old stream terrace surveyed in 2003 that supported Johnny Wilson's homestead. This area is reported to be difficult to traverse.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore: MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; plant surveys in Yosemite, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification east of Yosemite, 1986–1989.

Lisa R. Ordóñez: BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Meghan Willams: BS Biology 2001, California Polytechnic State University, San Luis Obispo.

Literature

Botti, S. J. 1980. Rare plant status report: *Carex tompkinsii* J. T. Howell. Yosemite National Park Unpublished Report, California.

Botti, S. J., and C. Sydoriak. August 1981. Rare plant population report: *Carex tompkinsii*. Yosemite National Park, California.

California Department of Fish and Game (CDFG). 2003. California Natural Diversity Database, version 3.0.3, November 3, 2003. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed 5 January 2004.

California Native Plant Society (CNPS). 2004. Inventory of rare and endangered plants (online edition, v6.2). California Native Plant Society. Sacramento, California. (Available: http://www.cnps.org/inventory). Accessed 12 March 2004.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Howell, J. T. 1961. *Carex tompkinsii*. Leaflets of Western Botany 9(12):185–187.

Howell, J. T. 1977. Rare plant status report: *Carex tompkinsii* J. T. Howell. California Native Plant Society Unpublished Report, Sacramento, California.

National Park Service (NPS). Circa 1985. Rare_plants [Computer map, ESRI shape file format]. Yosemite National Park, California.

Cinna bolanderi Scribn.

Information compiled by Alison E. L. Colwell, 2005

Species Overview

Family

Poaceae

Synonyms

Cinna pendula var. bolanderi (Scribn.) Vasey, *Cinna latifolia* Hitchcock.

Vernacular Name

Bolander's woodrush

Status

- Federal: none
- California: none
- CNDDB: G1[1]/S1.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive



Figure C19. *Cinna bolanderi* inflorescence, Old Big Oak Flat Road, Yosemite National Park, Mariposa County, California, 8 Sept 2004 (photograph by Alison E. L. Colwell).

Description

Perennial plants 8.5–20.3-tall. Tufted, with one to several culms per clump. Leaf blades to 40 cm long, 2–19 mm wide and drooping. Ligule 3.5–7 mm long. Panicle green to golden green, 7.5–43 cm long, 3–18 cm broad, loosely to densely flowered, branches spreading to loosely ascending. Spikelets acute, 4–5.5 mm long, second glume longer than or equal to lemma, 1- or 3-nerved, 4–5.5 mm long. Lemma 5-nerved, the lateral nerves sometimes faint or obscure, 3.2–4.6 mm long. Awn 0.2–1.5 mm long or absent. Palea approximately 2-nerved. Grain 2–2.9 mm long. Stamens 2, anthers 1.2–2.6 mm long.

Similar Species

Cinna bolanderi is most similar to *C. latifolia*. These have been confused by previous collectors, since the specimens listed as *C. latifolia* at YM were determined to be *C. bolanderi.* The range of *C. latifolia* is more northerly, but reaches its southern extent just north of Yosemite National Park. *Cinna bolanderi* can be distinguished by having two stamens, whereas *C. latifolia* has but one per flower. Also, the anthers of *C. bolanderi* are double the size of those of *C. latifolia*

[1]CNDDB Global Rank = G1: Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors

[2]CNDDB State Rank = S1.2: Less than 6 Occurrences or less than 1,000 individuals or less than 2,000 acres; threatened

[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 2: Fairly endangered in California

(1.2–2.6 mm as opposed to 0.4–1.1 mm). When the specimens are in fruit, *C. bolanderi* has larger spikelets (4–5.5 mm as opposed to 2.5–4 mm), nearly sessile florets (*C. latifolia* spikelets have 0.10–0.65 mm stalk), and faintly 5-nerved lemmas (*C. latifolia* lemma is 3-nerved).

Glyceria elata is a similarly large grass frequent in this habitat. This grass may be difficult to distinguish from *C. bolanderi* in vegetative stage, but is easily distinguished at flowering by its much more open panicles, with thin, spreading branches.

Distribution

California

Central and southern High Sierra Nevada, 1,850–2,400 m (6,000–7,900 ft) (Hickman 1993) According to Brandenberg et al (1991), *C. bolanderi* is endemic to central montane California (Fresno, Mariposa and Tulare counties), with all collections being from Sequoia National Park, Kings Canyon National Park, and Yosemite National Park.

Yosemite National Park

Montane zone, approximately 1,800 m (around 6,000 ft)

Survey Methodology and Results

Survey Dates

8 September 2004.

Rationale for Survey Timing

We conducted surveys during the time of expected flowering and fruiting, late summer and autumn, because *C. bolanderi* is definitively identified by its anther number and length.

Personnel Conducting Surveys

Alison E. L. Colwell, Angela Sanders, Dena Grossenbacher

Table C7. *Cinna bolanderi* Scribn.survey locations and results.

Site	Location	Person Hours	Population Size
CIBO10-1	Meadow on a tributary of Tamarack Creek	4	262

Population Location Description

Located on south side of Old Big Oak Flat Road (now a foot trail), approximately 1.6 km east of Tamarack Flat Campground. Population is in shady north end of meadow, 60 meters southwest of where the trail crosses the creek. Elevation is 6,380 feet. UTM coordinates (NAD27 datum) 11/259691/4181478.

Method Used to Estimate or Census the Population

The *C. bolanderi* population was small, so we obtained a complete count by visual survey. Some plants had single stems while others had multiple stems per plant. We tallied each cluster of flowering stems that shared a base as one individual. *Cinna bolanderi* spreads vegetatively, so this population count may be an overestimate of the number of genetically distinct individuals.

Additional Locations with Good Habitat: Meadows surrounding Crane Flat

Habitat

Cinna bolanderi is found in shady, moist sites along small streams or in meadows at 1,900 to 2,400 meters (6,230 to 7,870 ft) (Brandenburg et al. 1991) (Figure C20). Habitat at the Old Big Oak Flat Road site is a seasonally wet meadow spanning a tributary of Tamarack Creek. The soil is waterlogged in spring to early summer and resaturates when the rains start in the fall. In late summer, when *C. bolanderi* is at reproductive stage, the soil is firm but not dry. *Cinna bolanderi* individuals were clustered in the narrow, shady end of the meadow. It is unclear whether this indicates a preference for shade, or for moist soil conditions.



Figure C20. *Cinna bolanderi* habitat, Old Big Oak Flat Road, Yosemite National Park, Mariposa County, California, 9 Sept 2004 (photograph by Alison E. L. Colwell).

Vegetation Communities

Within Target Species Population: *Glyceria elata* Temporarily Flooded Herbaceous Alliance.

In Survey Area outside Documented Population(s): *Abies magnifica* Forest

Important Associated Plant Species

Heracleum lanatum, *Athyrium filix–femina*, *Senecio triangularis*, *Pteridium aquilinum*, *Glyceria elata*, *Lupinus latifolius* var. *columbianus*, *Lotus oblongifolius.*

Phenological Development

Cinna bolanderi flowers late in the season. The survey year was particularly dry, so it may have been phenologically early. Plants were found with mature and shattering fruits and some inflorescences still flowering in September. All associated species were phenologically advanced as well. In 2005, *C. bolanderi* individuals were still identifiable by intact inflorescences in mid-November.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator, and University Herbarium, University of California, Berkeley (UC), Barbara Ertter, curator

Remarks

Three specimens at YM identified as *Cinna latifolia* were determined by Alison E. L. Colwell and Dean W. Taylor to be *C. bolanderi.* These specimens are: YOSE 66660 (“Wawona,” Enid Michael s.n., 1 August 1927, Yosemite National Park herbarium) and two specimens from the same locality: YOSE 66661 and YOSE 66662 (“In mud by spring in forest. 5500'. Near new Big Oak Flat Road east of Wildcat Creek.” Carl Sharsmith 5161, 15 August 1944, Yosemite National Park herbarium). With regard to the location of the Sharsmith collection; the current Big Oak Flat Road was built in 1940, and the old road was closed to vehicle traffic due to landslides in 1942. It is therefore almost certain that Sharsmith, in referring to the “new” road, is referring to the current road. However, the current road crosses Wildcat Creek at 1,340 meters (4,400 feet) in

elevation, so, if one assumes the elevation stated on the label is correct, then either Sharsmith was 1.2 km (0.75 mile) up the hill from the road in the Wildcat Creek drainage, or he found this plant where the road passes through the 1,675 m (5,500 ft) elevation, about 4.8 km (3 miles) NW of where it crosses Wildcat Creek. This second possibility is contradicted by the locations listed on subsequent collections Sharsmith made on that date. Sharsmith 5162 was also collected "East of Wildcat Creek," and Sharsmith numbers 5163 to 5167 were collected "1 mile west of Wildcat Creek." However, Sharsmith numbers 5168 to 5170 were collected "3 miles west of Cascade Creek," and number 5172 was collected "2 miles east of Gin Flat," so he did travel through other areas with appropriate *C. bolanderi* habitat that day. Since some of his collections were made out of numerical order that day, it is not impossible that the *C. bolanderi* collections were in fact made at another site along the road.

On 12 and 20 November 2005 Alison E. L. Colwell and Dena Grossenbacher searched the hillside where Wildcat Creek crosses the road, and although there is an extensive seepage area on that hillside, and a small wet meadow below the road, no *C. bolanderi* was observed. However, the area covered by that search was no more than 0.4 km (0.25 mile) above and below the road, and considerably lower in elevation than that stated by Sharsmith. The terrain further up the hill east of Wildcat Creek becomes drier and steeper, and is not appropriate *C. bolanderi* habitat. The A-Rock fire burned much of this area in 1990, considerably changing the habitat above the road. It is unknown how this would have affected a *C. bolanderi* population.

Discussion

Factors That May Have Affected Survey Results

We searched for *C. bolanderi* in the meadows adjacent to the CIBO10-1 population along the old Big Oak Flat Road, but a wider-ranging survey of the area was not done.

Assessment of Threats or Potential Impacts

Threatened by hydrological alterations and trampling, and possibly by logging and grazing (CNPS 2005). The meadow surveyed had no apparent threats, aside from conifer encroachment into the meadow. This may not be the case for other populations remaining to be surveyed.

Recommended Measures to Minimize Impacts

Intermittent burning may be important in long-term maintenance of *C. bolanderi* habitat by curbing loss of meadow area to encroachment by conifers. Changes in meadow hydrology may affect these apparently small, localized populations.

Significance of Yosemite Populations

Cinna bolanderi is known from only a few locations, most of which are in the park, including the type locality at Mariposa Grove near Wawona (Bolander 6090, US323939, DS59312, GH23372, MO, NY380466, NY380467, NY380468) (Scribner 1884). Dean W. Taylor saw a few individuals of this plant in the Mariposa Grove along a streamlet near a main tourist trail where the trams are loaded (in the area of the type locality) in 1991. He has visited this area several times since and not seen *C. bolanderi* evident. It is potentially extirpated at this site.

Additional Work Needed

Sites of previous collections (Wildcat Creek) need to be redocumented, in particular the area of the type locality. Additional habitat is likely to exist in meadows around Crane Flat and at similar elevation meadows elsewhere in the park. The site of a collection at UC (50594) from

"Yosemite Turnpike" on 2 October 1896 (collector unknown) cannot be relocated due to incomplete label information. It could have been either in the vicinity of the Bolander collection in Wawona or of the new CIBO10-1 locality as both these areas once had turnpikes running through them.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae and to *The Jepson Manual* for *Orobanche.* Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Dena Grossenbacher: BS Biology 1998, University of Washington, Seattle, Washington.

Angela Sanders: BS Biology 2003 with specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Brandenberg, D. M., W. H. Blackwell, and J. W. Thieret. 1991. Revision of the Genus *Cinna* (Poaceae). SIDA 14(4):581–596.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 21 January 2005.

Scribner, E .L. 1884. Observations on the genus *Cinna,* with description of a new species. Proceedings of the Academy of Natural Science Philadelphia 1884:289–291, pl. 7.

Cypripedium montanum Douglas ex Lindley

Information compiled by Peggy E. Moore, 2005



Figure C21. *Cypripedium montanum*, Yosemite National Park, Tuolumne County, California, 25 May 2004 (photograph by Peggy E. Moore).

Species Overview

Family

Orchidaceae

Synonyms

None

Vernacular Name

mountain lady's-slipper, mountain lady's slipper, mountain ladyslipper

Status

- Federal: Forest Service Sensitive (Sierra NF, Stanislaus NF)
- California: none
- CNDDB: G4[1]/S4[2]
- CNPS: 4.2[3]
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Both *Cypripedium californicum* A. Gray and *C. fasciculatum* S. Watson occur in the northern Sierra Nevada, but are not known from the central portion of the range. *Cypripedium fasciculatum* has two more or less opposite basal leaves and no cauline leaves; *C. montanum* has 4–6 alternate, cauline leaves. The lip of *C. fasciculatum* is yellow-green below and purple above in contrast to the white lip of *C. montanum*. *Cypripedium californicum* upper sepal and petals are yellowish green, petals 12–18 mm and flat whereas upper sepal and petals of *C. montanum* are generally purplish or brownish purple, petals 25–60 mm and twisted. The habitats of *C. montanum* and *C. californicum* are distinct as well. *C. montanum* is associated with moist generally forested or ecotonal habitats while *C. californicum* is associated with wetlands. The leaves of other orchid species are superficially similar to those of *C. montanum*, including *Listera convallarioides*. However, *L. convallarioides* leaves are opposite.

[1]CNDDB Global Rank = G4: Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat.
[2]CNDDB State Rank = S4: Apparently secure within California; this rank is clearly lower than S3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat
[3]CNPS List 4: Limited distribution (watch list); Threat Code 2: Fairly endangered in California

Distribution

California

Northwestern California, Cascade Range, northern and central Sierra Nevada, southwest San Francisco Bay Area, Modoc Plateau (Hickman 1993)

Yosemite National Park

Mixed conifer forest between 1,100 and 1,650 m (3,600 and 5,400 ft)

Survey Methodology and Results

Survey Dates

Cypripedium montanum surveys in 2003 took place 28 June; 8, 11 July; and 6 July (10 August data collection revisit). In 2004, a dry year, survey dates ranged from 25 May to 23 June for the regular surveys. Habitat areas predicted by the model were surveyed between 1 July and 9 September 2004.

Rationale for Survey Timing

The timing of flowering in 2003 was within the typical range of May to July with the "majority of plants [flowering] during the last two weeks of June" (Botti 2001). Flowers were fully mature and just beginning to fade at the end of June, the white lip maximizing detectability in its shaded habitats. We were able to begin surveys at the end of May in 2004 due to advanced phenology following a warm, dry spring and able to complete surveys of known populations by late June. Plants remained in flower during this period. Because *C. montanum* appeared to be a good candidate for habitat modeling, we created a model based on mapped populations and implemented model verification immediately following surveys of mapped sites. With the familiarity we gained with plant stature, flower shape and color, and habitat preferences, we felt fairly comfortable continuing verification until early September. Plants remained recognizable in leaf and flower or fruit through this period. We do not recommend surveying later than 1 August due to reduced visibility of plants.

Personnel Conducting Surveys

Charlotte Coulter, Alison E. L. Colwell, Peggy E. Moore, Lisa Ordóñez, Angela Sanders

Method Used to Estimate or Census the Population

We surveyed areas with previously mapped or reported populations within Yosemite National Park. We made complete censuses at each site, individually counting stems whether they occurred in groups or singly. Most plants occurred singly or in small groups, almost never densely clustered. This justified the tally of stems as individual plants. Surveyors scanned areas they traversed in a grid pattern, most thoroughly checking shaded and partially shaded areas.

Table C8. *Cypripedium montanum* Douglas ex Lindley survey locations and results.

Site	Person Hours	Population Size
CYMO10-1	4.5	15
CYMO10-2	3	10
CYMO10-3	95	278
CYMO10-4	13	347
CYMO10-5	10	0
CYMO10-6	9	79
CYMO10-7	8	0
CYMO10-8	2	0
CYMO10-9	1	112
CYMO10-10	4	34
CYMO10-11	6	18
CYMO10-12	3	0
CYMO10-P-4	8	127
CYMO10-P-5	5	29
CYMO10-P-8	4	34
CYMO10-P-9	3	30
CYMO10-P-12	4	8
CYMO10-P-13	4	1
CYMO10-P-16	3.5	10
Total	**190.0**	**1,132**

Note regarding Happy Isles Site: The population at the south end of Happy Isles fen may have been damaged by a rock fall in 1997. The nature trail that bordered the south end of the fen went through the population, but this area is now covered in thick rock and timber debris. Dean W. Taylor reported in 2003 (consulting botanist, personal communication) that he found a few plants of *Cypripedium montanum* two years after the rockfall. These plants were on the periphery of the population and remained in the woods bordering the rockfall area. In 2004, however, a revisit did not find any evidence of the population at that site (CYMO10-7).

Habitat

Shaded or partially shaded sites in mixed conifer forest (Figure C22). Populations are typically located within 50 m (165 ft) of a stream or meadow but not in or adjacent to wetlands. Conifer leaf and stem material ("duff") provide mulch over relatively well developed soils.

Vegetation Communities

Within Target Species Population: Associations within the *Abies concolor–Pinus lambertiana* and *Pseudotsuga menziesii* alliances comprised the most typical plant communities where *C. montanum* occurred. A population occurred within *Sequoiadendron giganteum–Pinus lambertiana*/*Cornus nuttallii* Forest Association as well.

In Survey Area outside Documented Population(s): Same

Important Associated Plant Species

Cornus nuttallii, *Adenocaulon bicolor*, *Chimaphila umbellata*, *Corylus cornuta, Clintonia uniflora, Smilacina racemosa, Goodyera oblongifolia*

Phenological Development

Plant phenology among *Cypripedium* plants varied a great deal over the course of the surveys from 100% flowering to 95% fruiting. The mountain lady's-slipper flowered during the same period as associated species.



Figure C22. *Cypripedium montanum* habitat, Yosemite National Park, Mariposa County, California, 28 June 2003 (photograph by Peggy E. Moore).

Location of Deposited Voucher Specimens

No vouchers were collected.

Remarks

Cypripedium montanum is equally likely to occur in wetlands or non-wetlands (estimated probability 34%–66%) in California according to USFWS (1996). Surveys of potential habitat in 2003 and 2004 increased the number of known populations in Yosemite by 58%.

Discussion

Factors That May Have Affected Survey Results

The rock fall above Happy Isles in Yosemite Valley in 1997 and associated felled trees may be covering or at least obscuring the Happy Isles population. It has not been relocated since 1999. Plants in the vicinity of the meadow/golf course in Wawona are well known to local residents and perhaps some park visitors. Judging by the abundance of plants along the west side of the meadow in 2003, collecting pressure does not seem to be obliterating that population. It is unclear why we were unable to relocate two mapped populations at and near the south end of the meadow, but collecting pressure remains a candidate as well as dormancy and errors in 1980s-era mapping or the conversion to spatial data. Dormancy has been reported as occurring in up to 30% of a population (Kaye 1999) with the implication that small stands may not be apparent in any single year.

Assessment of Threats or Potential Impacts

Reports vary on the response of *C. montanum* to fire and to fire suppression. Other aspects of habitat modification including soil compaction and forest thinning to reduce fuels may threaten the orchid's persistence. *Cypripedium montanum* is the largest and showiest orchid in Yosemite National Park, and is a likely target for collecting.

Recommended Measures to Minimize Impacts

The practice of tree thinning and pile burning should be avoided in the vicinity of *Cypripedium* populations at least until the effects of such activities on populations are clarified.

Significance of Yosemite Populations

Jerry Franklin (University of Washington, personal communication) described the age and structure of Yosemite's mid-elevation forests as exceptional in the Sierra Nevada following a review of late successional stands through the range. It is feasible that Yosemite contains some of the best habitat for *C. montanum* near the southern extent of the species' range.

Additional Work Needed

The populations at Happy Isles, Grouse Creek, and the south end of the meadow at Wawona should continue to be sought.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore**:** MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; plant surveys in Yosemite, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989; vascular plant diversity and productivity in a subalpine watershed, Sequoia National Park, 1985.

Lisa R. Ordóñez: BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Coleman, R. A. 1995. The wild orchids of California**.** Cornell University Press, Ithaca, New York.

Kaye, T. N. 1999. Timber harvest and *Cypripedium montanum*: Results of a long-term study on the Medford District, Bureau of Land Management, Medford, Oregon. Unpublished report

submitted by the Institute for Applied Ecology under contract with the Bureau of Land Management.

Lindley, J. 1840. *Cypripedium montanum* Dougl. ex Lindl. Genera and Species of Orchidaceous Plants 528.

Seevers, J. and F. Lang. 1998. Management Recommendations for Mountain Lady's-slipper (*Cypripedium montanum* Douglas ex Lindley), v. 2.0. *In* USDA Forest Service Region 5/6 and USDI Bureau of Land Management Oregon/Washington/California, Management Recommendations for Vascular Plants. Online. (http://www.blm.gov/or/plans/surveyandmanage/SP/VascularPlants/cypripediummontanum.htm).

U.S. Fish and Wildlife Service (USFWS). 1996. National list of vascular plant species that occur in wetlands: 1996 national summary. National Wetlands Inventory, Division of Habitat and Resources Conservation, Arlington, Virgina, USA. Online. (http://www.nwi.fws.gov/bha/download/1996/national.pdf). Accessed January 2005. [Current location: http://www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list96.pdf]

Dulichium arundinaceum (L.) Britton

Information compiled by Peggy E. Moore, 2005

Species Overview

Family

Cyperaceae

Synonyms:

None

Vernacular Name

three-way sedge

Status

- Federal: none
- California: none
- CNDDB: none
- CNPS: none
- Yosemite National Park: Sensitive



Figure C23. *Dulichium arundinaceum* (Photograph courtesy of University of Minnesota).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Dulichium arundinaceum can be distinguished from *Carex* spp. because it has perfect flowers. Spikelet scales are two-ranked rather than spirally overlapping, distinguishing it from all other Cyperaceae genera except *Cyperus*. *Dulichium arundinaceum* spikelets have bristles; *Cyperus* spp. spikelets are without bristles.

Distribution

California

Klamath Ranges, Cascade Ranges, Sierra Nevada, 1,500–2,400 m (4,900–7,900 ft), to British Columbia; also eastern North America (Hickman 1993)

Yosemite National Park

Swamp Lake, Tiltill Valley, Lost Lake, 1,370–2,000 m (4,500–6,550 ft) (Botti 2001)

Survey Methodology and Results

Survey Dates

13 July 2004

Rationale for Survey Timing

Sedges typically are identifiable only when perigynia are fully ripe. We planned the timing of the Swamp Lake survey to coincide with flowering of the majority of species of interest at that site.

It was a little early for *D. arundinaceum*, but this species is distinctive even without mature inflorescences.

Personnel Conducting Surveys
Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C9. *Dulichium arundinaceum* (L.) Britton survey locations and results.

Site	Location	Person Hours	Population Size
DUAR10-1	South island of Swamp Lake	48	88

Method Used to Estimate or Census the Population
We made a complete census on Swamp Lake's south island, counting plants individually, and surveyed all appropriate habitat at the lake (lake margin and islands) plus the two small lakes to the west.

Habitat
Shallow lake and pond margins, often in standing water (Hickman 1993, Botti 2001) (Figure C24).

Vegetation Communities
Within Target Species Population: not represented in the park's vegetation classification at the alliance level. At the formation level, the site can be categorized as saturated temperate forb vegetation

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest

Important Associated Plant Species
Menyanthes trifoliata, *Carex limosa*, *Lycopus uniflorus*, *Brasenia schreberi*, *Carex cusickii*, *Utricularia gibba*

Phenological Development
Only about 20% of plants were flowering at the time of the survey, but they were sufficiently distinctive to identify at the vegetative stage. Other species on the south island were at a variety of growth stages. About half of the round-leaved sundew plants and about 5% of *Carex limosa* plants were flowering, but 100% of *Eriophorum gracile* was at the fruiting stage. Other sedges were immature.

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks
Dulichium arundinaceum is a wetland obligate species; it almost always occurs in wetlands under natural conditions (USFWS 1996). It therefore requires a moist environment, including being rooted in saturated soil during the growing season. It is broadly distributed from California to Alaska and also in the eastern portion of North America (USDA 2004).

Discussion

Factors That May Have Affected Survey Results

We were surveying a number of other taxa at the Swamp Lake site with insufficient time remaining to survey for *Dulichium arundinaceum* on the west island. Islands appear to have been stable over the last 70 years; their floating state ensures saturated conditions and continues to support unusual species originally collected in the 1930s.



Figure C24. *Carex limosa*, *Dulichium arundinaceum*, and *Eriophorum gracile* habitat, Swamp Lake, Yosemite National Park, Tuolumne County, California, 13 July 2004 (photograph by Alison E. L. Colwell).

Assessment of Threats or Potential Impacts

There are no apparent direct threats at this time.

Recommended Measures to Minimize Impacts

Swamp Lake receives extremely low visitation. Botanists may visit periodically to observe, survey or recollect unusual, historic collections. Paleoecology work has been done at the lake (lake-bottom coring) and perhaps other research. It is possible that, in the future, visits could be planned to make remeasurements based on data collected in the 1930s by the Yosemite Field School (aka, Research Reserve data). In all cases, visitors should be sensitive to a number of unique occurrences and other park-sensitive species. They occur in the meadow around and on the shore of Swamp Lake, on the floating islands within the lake, and at the marsh west of and downstream from Swamp Lake. Care should be taken to avoid undue collection, trampling, etc.

Significance of Yosemite Populations

The earliest collection of *Dulichium arundinaceum* in Yosemite was that of Reinecke and Mason 11606, July 22, 1937 (UC1076537) at Swamp Lake. There are only two other known locations: Tiltill Valley (UC632780) and Lost Lake (Botti 2001).

Additional Work Needed

Surveys should be done to document abundance at the site above Tiltill Valley and at Lost Lake.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 14 January 2005.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

U.S. Fish and Wildlife Service (USFWS). 1996. National list of vascular plant species that occur in wetlands: 1996 national summary. National Wetlands Inventory, Division of Habitat and Resources Conservation, Arlington, Virgina, USA. Online. (http://www.nwi.fws.gov/bha/download/1996/national.pdf). Accessed January 2005. [Current location: http://www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list96.pdf]

Erigeron linearis (Hook.) Piper

Information compiled by Peggy E. Moore, 2005



Figure C25. *Erigeron linearis*, Gaylor Lakes basin, Yosemite National Park, Tuolumne County, California, 21 July 2003 (photograph by Lisa Ordóñez, NPS).

Species Overview

Family

Asteraceae

Synonyms

None

Vernacular Name

yellow daisy, desert fleabane

Status

- Federal: None
- CNDDB: None
- California: None
- CNPS: None
- Yosemite National Park: Sensitive

Description

Taprooted perennial herb; leaves linear, basal, and erect; heads radiate, ray flowers yellow; inner pappus of bristles, outer pappus of short scales. See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Erigeron vagus Payson and *E. compositus* Pursh have trilobed and pinnately dissected leaves, respectively. Other Yosemite *Erigerons* have stem leaves with the exception of *E. pygmaeus* (A. Gray) E. Greene, *E. barbellulatus* E. Greene, and *E. algidus* Jepson. The three latter have blue to purple ray florets; *E. linearis* has yellow ray florets. *Erigeron barbellulatus*, and *E. algidus* leaves are oblanceolate or narrowly spatulate.

Distribution

California

Northern High Sierra Nevada, Modoc Plateau (to British Columbia, Montana, Nevada; Hickman 1993)

Yosemite National Park

Known from a single location in the Gaylor Lakes basin (Botti 2001)

Survey Methodology and Results

Survey Dates

21 July 2003

Rationale for Survey Timing
The typical flowering period for *E. linearis* is July to August (Botti 2001). Plants at the population surveyed were flowering by late July 2003.

Personnel Conducting Surveys
Lisa Ordóñez, Sara Grove, Karen Vaughn, and Yosemite Association volunteers

Table C10. *Erigeron linearis* (Hook.) Piper survey locations and results.

Site	Location	Person Hours	Population Size
ERLI20-1	Gaylor Lakes basin	19.5	4,513

Method Used to Estimate or Census the Population
The park botanist, Lisa Ordóñez, organized volunteers to grid search the area within and beyond the extent of the mapped population in the Gaylor Lakes basin to tally all *E. linearis* plants found.

Habitat
Dry, open, rocky sites on metamorphic rock in the alpine (Figure C26).

Vegetation Communities
Within Target Species Population: *Calamagrostis purpurascens–Leptodactylon pungens* Herbaceous Vegetation

In Survey Area outside Documented Population(s): same

Important Associated Plant Species
Calamagrostis purpurascens, *Phlox diffusa*, *Arenari kingii*, *Sedum lanceolatum*, and *Eriogonum ovalifolium* var. *nivale* were the most abundant associated species. Also important were *Potentilla glandulosa* ssp. *nevadensis* and *Carex filifolia* var. *filifolia*. *Potentilla fruticosa*, *Erigeron compositus*, *Phlox condensate*, and *Arabis lemmonii* var. *depauperata* were also present.

Phenological Development
All *E. linearis* plants were flowering at the time of the survey, as were the majority of associated species.

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

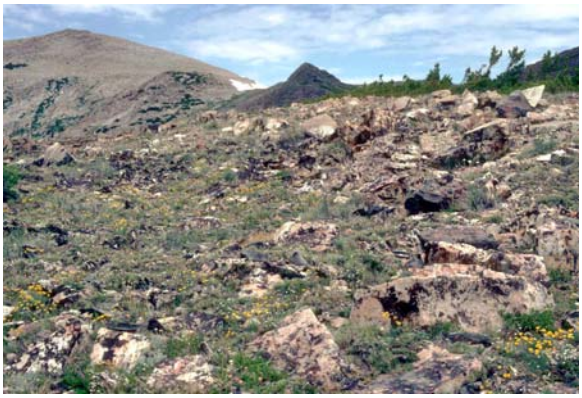


Figure C26. *Erigeron linearis* habitat, Gaylor Lakes basin, Yosemite National Park, Tuolumne County, California, 21 July 2003 (photograph by Karen Vaughn, NPS).

Discussion

Factors That May Have Affected Survey Results

There was no apparent disturbance or other factors that may have affected population status or detectability.

Assessment of Threats or Potential Impacts

No apparent impacts at the time of the survey. The Gaylor Lakes basin, at an average of approximately 3,200 m elevation, is easily accessed by hikers with a hike of less than a mile over Gaylor Ridge from Tioga Pass. Visitation has appeared to increase over the last 20 years; however, the population, as mapped in 2003, occurs on a rocky slope unlikely to receive extensive use by hikers.

Recommended Measures to Minimize Impacts

We recommend periodic monitoring of the Gaylor Lakes population to track its status and to detect any direct or indirect impacts.

Significance of Yosemite Populations

Erigeron linearis is found only in scattered locations in California, mostly along the eastern slope of the northern Sierra Nevada (Botti 2001) and the Modoc Plateau (SMASCH 2002). It is known in Yosemite and the central Sierra Nevada from a single site in the Gaylor Lakes basin (H. L. Mason 743, 9 Aug 1923, UC672253 and JEPS 21924; H.L. Mason 11372, 27 July 1936, UC712494 and UC1083138).

Additional Work Needed

Similar habitats in the northern portion of Yosemite should be surveyed to ascertain whether additional populations occur within the park boundary.

Qualifications of Field Personnel at the Time of Surveys

Sara Grove: BS Ecology 2002, Evergreen State College, Olympia, Washington. Field survey assistant for University of California Reserve System, Sedgewick Reserve, California

Lisa R. Ordóñez**:** BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Karen Vaughn**:** BS Environmental Science 2001, Barry College, Mount Berry, Georgia.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 29 April 2005.

Piper, C. V. 1906. Asteraceae *Erigeron linearis* Piper. Contributions from the United States National Herbarium 11:567.

Eriophorum gracile W. D. J. Koch



Figure C27. *Eriophorum gracile* (photograph by by Börje Wernerssen, © Naturhistoriska riksmuseet 1997).

Information compiled by Peggy E. Moore, 2005

Species Overview

Family
Cyperaceae

Synonyms
None

Vernacular Name
cotton grass

Status
- Federal: none
- California: none
- CNDDB: none
- CNPS: none
- Yosemite National Park: Sensitive

Description
See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species
Eriophorum criniger has triangular stems and barbed perianth bristles that are stiff and tawny colored. *Eriophorum gracile* has a rounded stem and bristles that are smooth, soft, and white.

Distribution

California
Northwestern California, Cascade Range, north and central High Sierra Nevada, >2,000 m (>6,500 ft); circumboreal (Hickman 1993)

Yosemite National Park
Swamp Lake, Lost Lake, pond west of Pothole Dome in Tuolumne Meadows, 1,600–2,600 m (5,250–8,500 ft) (Botti 2001)

Survey Methodology and Results

Survey Dates
13 July 2004

Rationale for Survey Timing
Sedges typically are identifiable only when perigynia are fully ripe. We planned the timing of the Swamp Lake survey to coincide with flowering of the majority of species of interest at that site. *Eriophorum gracile* flowered early at the 1,525 m (5,000 ft) Swamp Lake site, and fruit were mature during the visit.

Personnel Conducting Surveys
Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C11. *Eriophorum gracile* W. D. J. Koch survey locations and results.

Site	Location	Person Hours	Population Size
ERGR10-1	South island of Swamp Lake	48	88

Method Used to Estimate or Census the Population
We made a complete census on Swamp Lake's south island, counting plants individually, and surveyed all appropriate habitat at the lake (lake margin and islands) plus the two small lakes to the west.

Habitat
Shallow ponds and marshes; mixed conifer, montane, and subalpine zones (Botti 2001) (Figure C28)

Vegetation Communities
Within Target Species Population: Not represented in the park's vegetation classification at the alliance level. At the formation level, the site can be categorized as saturated temperate forb vegetation

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest

Important Associated Plant Species
Menyanthes trifoliata, *Carex limosa*, *Dulichium arundinaceum*, *Lycopus uniflorus*, *Carex cusickii*, *Utricularia gibba*

Phenological Development
All *Eriophorum* plants were fruiting at the time of the survey. Other species on the island were at a variety of growth stages. About half of the round-leaved sundew plants and about 5% of *Carex limosa* plants were flowering. Approximately 20% of *Dulichium arundinaceum* was flowering. Other sedges were immature.

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator (Alison E. L. Colwell AC04-104, YOSE 118047)



Figure C28. *Carex limosa*, *Dulichium arundinaceum*, and *Eriophorum gracile* habitat Swamp Lake, Yosemite National Park, Tuolumne County, California, 13 July 2004 (photograph by Alison E. L. Colwell).

Remarks

Eriophorum gracile is a wetland obligate species; it almost always occurs in wetlands under natural conditions (USFWS 1996). It therefore requires a moist environment, including being rooted in saturated soil during the growing season. It is broadly distributed across the northern tier of the United States plus California (USDA 2004) and widespread in the northern hemisphere (Botti 2001).

Discussion

Factors That May Have Affected Survey Results

We were surveying a number of other taxa at the Swamp Lake site with insufficient time remaining to survey for *E. gracile* on the west island. Islands appear to have been stable over the last 70 years; their floating state ensures saturated conditions and continues to support unusual species originally collected in the 1930s.

Assessment of Threats or Potential Impacts

There are no apparent direct threats at this time.

Recommended Measures to Minimize Impacts

Swamp Lake receives extremely low visitation. Botanists may visit periodically to observe, survey or recollect unusual, historic collections. Paleoecology work has been done at the lake (lake-bottom coring) and perhaps other research. It is possible that, in the future, visits could be planned to make remeasurements based on data collected in the 1930s by the Yosemite School of Field Natural History (aka, Research Reserve data). In all cases, visitors should be sensitive to a number of unique occurrences and other park-sensitive species. They occur in the meadow around and on the shore of Swamp Lake, on the floating islands within the lake, and at the marsh west of and downstream from Swamp Lake. Care should be taken to avoid undue collection, trampling, etc.

Significance of Yosemite Populations

The earliest collection of *Dulichium* in Yosemite was that of Mason and Reinecke 11579, 22 July 1937 (UC1100694) at Swamp Lake. Mason specified the south island of Swamp Lake for a 1938 collection (UC632750). Botti (2001) reports only two other locations: Lost Lake in Little Yosemite Valley and the pond on the west side of Pothole Dome in Tuolumne Meadows.

Additional Work Needed

Survey data should be collected to document abundance at the site above Lost Lake and Tuolumne Meadows.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

U.S. Fish and Wildlife Service (USFWS). 1996. National list of vascular plant species that occur in wetlands: 1996 national summary. National Wetlands Inventory, Division of Habitat and Resources Conservation, Arlington, Virgina, USA. Online. (http://www.nwi.fws.gov/bha/download/1996/national.pdf). Accessed January 2005. [Current location: http://www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list96.pdf]

Eriophyllum congdonii Brandegee

Information compiled by Peggy E. Moore, 2003



Figure C29. Congdon's woolly sunflower (*Eriophyllum congdonii*), a California- and CNPS-listed rare species, along Foresta Road, El Portal, Mariposa County, California (photograph by Peggy E. Moore).

Species Overview

Family

Asteraceae

Synonyms

Eriophyllum nubigenum var. *congdonii* (Brandegee) Constance

Vernacular Name

Congdon's woolly sunflower

Status

- Federal: Forest Service Sensitive (Stanislaus, Sierra)
- California: Rare (Listed July 1982)
- CNDDB: G2[1]/S2.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Eriophyllum nubigenum A. Gray, also an annual, has fewer ray flowers, typically 4–6, that are shorter (2 mm) and much less conspicuous, often barely appearing out of the woolly involucre. *Eriophyllum lanatum* (Pursh) James Forbes (vars. *integrifolium*, *croceum*, and *grandiflorum*) is a perennial with ray florets 7–20 mm long (shortest in var. *integrifolium*, the most common variety in the park) and at least slightly woody at base. *Eriophyllum confertiflorum* (DC.) A. Gray var. *confertiflorum* is a low shrub, woodier at the base than *E. lanatum*, with deeply 3–5-lobed leaves. Goldfields, *Lasthenia californica*, overlap in flowering period and may be intermixed and/or adjacent to *E. congdonii*. However, *L. californica* flowers are slightly more yellow and less golden in color with finer peduncles that are not white-woolly. *Lasthenia californica* leaves are linear, opposite and may be ciliate at base but not white-woolly throughout.

[1]CNDDB Global Rank = G2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres
[2]CNDDB State Rank = S2.2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; threatened
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 2: Fairly endangered in California

Distribution

California

Central Sierra Nevada foothills (Mariposa County), 500–1,900 m (1,650–6,200 ft)

Yosemite National Park

Mariposa County portion of Yosemite, 500–1,100 m (1,650–3,600 ft)

Survey Methodology and Results

Survey Dates

Known populations: 15, 18, 25 April 2003; 6 May 2003

New populations: 3 June 2003

Predicted habitat: 28, 29, 31 May 2003; 10 June 2003

Rationale for Survey Timing

Eriophyllum congdonii is most easily detected when flowering, April to June.

Personnel Conducting Surveys

Charlotte Coulter, Peggy E. Moore, Lisa Ordóñez, Meghan Williams

Table C12. *Eriophyllum congdonii* Brandegee survey locations and results.

Site	Location	Person Hours	Population Size
ERCO40-1	Ridge SW of Rancheria Flat, El Portal	20	115,000
ERCO40-2	Slope north of Rancheria Flat, El Portal	9	7,720
ERCO40-3	Ridge on E side of Rancheria Flat, El Portal	9	8,400
ERCO40-4	Ridge E of Pigeon Gulch, El Portal	19.5	38,630
ERCO40-5	South Fork of the Merced River, 3 km below Wawona Campground	0.5	30
ERCO40-P-1	N side of the unnamed ridge north of Railroad Flat and above Moss Creek, El Portal	2.5	560
ERCO40- P-3	East side of Moss Creek, NW of Rancheria Flat, El Portal	1.5	160
ERCO40-P-8	Ridge E of Pigeon Gulch, El Portal	3	57
ERCO40-P-9	Ridge E of Pigeon Gulch, El Portal	1.5	200
Total		**66.5**	**170,757**

Method Used to Estimate or Census the Population

We surveyed areas with previously mapped or reported populations that were entirely or partially within Yosemite National Park (none for ERCO) or the El Portal Administrative Site. We made complete censuses of small populations. Large, extensive populations were surveyed with teams spread out across slopes of appropriate habitat. Individuals scanned areas traversed and checked areas between surveyors. Population estimates were made by subsample counts within homogeneous densities and applying those counts to patches of plants with the same density.

Habitat

Eriophyllum congdonii occurred on open metamorphic scree slopes and rocky ridges adjacent to annual grassland slopes (Figure C30). Populations were sometimes located at metamorphic-

granitic contact zones. More commonly they lie on metasedimentary outcrops, mapped as quartzite of Pilot Ridge. Plants were rooted in shallow soils of slopes and benches defined by outcrops but not typically in the fractured rock of the outcrops. They decreased in abundance and quickly disappeared where nonnative annual grassland dominated. Stands sometimes extended down slope from rocky ridges into foothill woodland communities, such as interior live oak woodland.

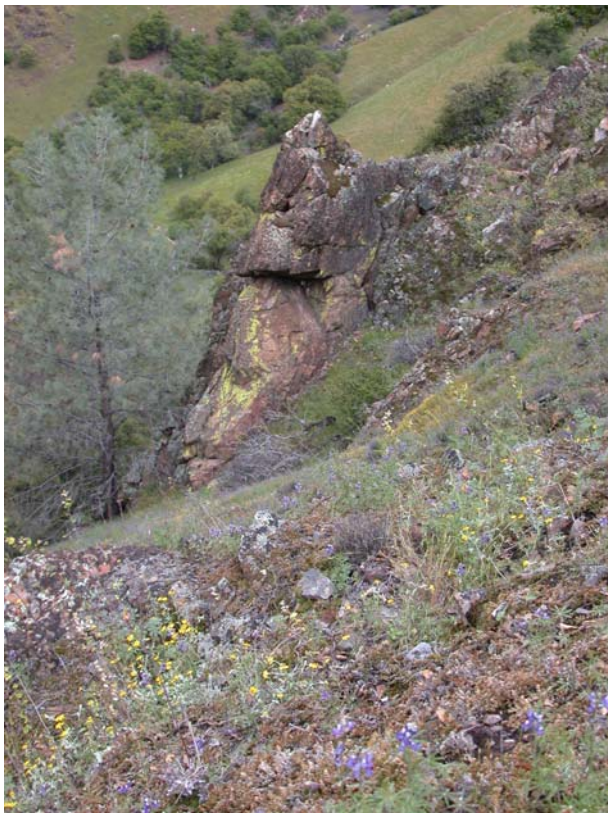


Figure C30. *Eriophyllum congdonii* habitat south of the Merced River, vicinity of El Portal, Mariposa County, California, 6 May 2003 (photograph by Peggy E. Moore).

Vegetation Communities

Within Target Species Population: California Annual Herbland Alliance and *Quercus wislizeni* Woodland Alliance most commonly; also *Lupinus albifrons* Shrubland Alliance, and *Quercus wislizeni–Arctostaphylos viscida* Woodland.

In Survey Area outside Documented Population(s): *Quercus wislizeni–Quercus chrysolepis* Woodland

Important Associated Plant Species

Streptanthus tortuosus var. *tortuosus*, *Selaginella hansenii*, and *Lupinus stiversii* were the most common associated species, especially in the most typical habitat of thin soils among rock outcrops. Other common associates included *Lasthenia californica, Minuartia douglasii, Mimulus torreyi, Pellaea mucronata* var. *mucronata, Cheilanthes gracillima, Lupinus bicolor*, and *Vulpia microstachys*. Populations were most typically in herb-dominated sites; when tree or shrub species occur, they usually provide low canopy cover and include *Quercus wislizeni, Pinus sabiniana* and, rarely, *Cercocarpus betuloides*.

Phenological Development

Surveys spanned eight weeks with *E. congdonii* at peak flowering at the beginning of surveys. Spring 2003 was unseasonably cool and rainy, providing for an extended flowering period among all the annuals in the Merced Canyon. *Eriophyllum congdonii* flower maturity was delayed and seed development was protracted, causing the flowers to remain bright and detectable for at least six weeks. Associated species remained green and flowering as well, and the bolting of grasses occurred later than usual. By the end of six weeks plants began to senesce. There was a two-week gap in survey effort; when the last two predicted habitat sites were surveyed 10 June, plants were senescent, reducing detection and resulting in low confidence of an accurate count. Despite this, 57 and 200 plants were counted in two new, unmapped sites.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Eriophyllum congdonii is a rare endemic of the Merced River basin within Mariposa County. Botti (2001) reports that it occurs only along contact zones between metamorphic and granitic rock around El Portal and Iron Mountain. Taylor (in preparation) indicates it occurs on metamorphic (particularly phyllite) scree or talus flanking the Merced River Canyon.

The population of 30 plants found on the South Fork of the Merced River, 3 km downstream from Wawona Campground, (ERCO40-5) appears to be the first documented population of *E. congdonii* within the Yosemite National Park boundary (in contrast to the El Portal Administrative Site). We discovered the stand of 30 individuals during a search for a tiny, unconfirmed population (13 individuals) of *Allium yosemitense* reported to the Park Service 21 August 1989 (well out of the species' flowering period).

A search of regional herbaria confirmed no additional *E. congdonii* collections within the park. The Twin Bridges, Moss Creek 1984 collection by Frederica Bowcutt (collection number 154, UC1552763) is in Stanislaus NF. This is the same vicinity as the 1982 Dean W. Taylor collection (collection number 7966, UC1511355) in the Moss Creek headwaters (T. 2 S., R. 19 E., center of section 25). Additional localities in CNDBB records (CDFG 2003) include Trumbull Peak, Big Grizzly Mountain, ridge between Moss Creek and Dry Gulch, and the south side of Brown Peak on Pinoche Ridge, but none within the park.

There were too few plants in the South Fork Merced River population for us to make a collection. This new park population is within 525 m stream distance of the confluence of the South Fork of the Merced River and Iron Creek, the watershed that provides connectivity with the Iron Mountain population. The Iron Mountain population on the Sierra NF is 3 km (1.9 mi) west of (and up slope from) the new population. The metamorphic outcrop, upon which this population was found (Pzp=Quartzite of Pilot Ridge [in blue-purple in Figure C8]) (Peck 2002), extends northwest and southeast from ERCO40-5. The remainder of the outcrop should be surveyed for *E. congdonii* and *A. yosemitense*.

Discussion

Factors That May Have Affected Survey Results

An unseasonably cool, moist spring allowed surveys to continue for six weeks while plants continued to flower and remain easily detectable. The NPS indicated that surveys should be limited to areas intersecting National Park Service lands, and the protracted flowering period allowed us to survey all areas of mapped populations that overlapped with the El Portal Administrative Site (until this year the species was not documented within the park boundary). We surveyed two areas of predicted habitat late in the *E. congdonii* flowering season, on 10 June 2003. Plants were senescing at that time and the dried and faded condition of the plants may have contributed to underestimates for sites ERCO40-Predicted-8 and ERCO40-Predicted-9.

We were able to traverse nearly all of the steep, loose habitat within mapped survey areas. However, there was a section (approximately 20 m wide and 30 m long) on the east side of site ERCO40-2 (ridge on the east side of Rancheria Flat) where a narrow section of cliff at the east edge of the population was not visible from above or below the cliff. This may have contributed to a slight underestimate for that site.

Assessment of Threats or Potential Impacts

The steep nature of the majority of the *E. congdonii* habitat makes it a poor candidate for development; however, residences and associated landscaping along Barium Mine Road are in close proximity to the population on the ridge to the east. Landscape maintenance, ornamental escapes, and development expansion are potential threats. Foresta Road bisects the south end of the population between Rancheria Flat and Railroad Flat to the southwest in El Portal. Road and shoulder maintenance presents a potential threat at that site and possibly others (e.g., Barium Mine Road and Pigeon Gulch vicinities). Non-native annual fescues (*Vulpia* spp.) co-occur with *E. congdonii* but are not in high densities. Most of the other non-native annual grassland species appear to do poorly on the thin-soil sites *E. congdonii* is occupying. The most aggressive of the non-native species, *Centaurea solstitialis* (yellow star-thistle), is spreading through annual grassland sites adjacent to several populations. Although yellow star-thistle favors grassland sites with moderately well-developed soils, there is no assurance it will not spread into *E. congdonii* stands. *C. solstitialis* may pose a direct threat through competition or through facilitation of other invasive species. Control measures for yellow star-thistle could have an impact on *E. congdonii* or its habitat (e.g., herbicide drift, trampling, and soil compaction associated with manual or mechanical methods).

Fences have been erected as a safety precaution around two (or more) barium mine shafts that are situated vertically in the ridge east of Rancheria Flat, El Portal. Additional fence installation or maintenance of existing fences could interfere with seed set in this annual species or could damage the seed bank.

Recommended Measures to Minimize Impacts

Any maintenance of the fences around the mineshafts adjacent to Rancheria Flat or the installation of any additional fences should be timed to avoid the period of plant growth, flowering, and seed set (approximately March through June), and methods should be chosen to ensure minimal soil disturbance. Outside of the growing season, care should be taken to avoid unnecessary substrate disturbance within appropriate habitat.

Significance of Yosemite Populations

Congdon's woolly sunflower is one of six taxa endemic to Mariposa County (Shevock 1996). It is one of four species endemic to the Merced River basin (the others being *Clarkia lingulata*, *Plagiobothrys torreyi* var. *torreyi* and *Viola adunca* var. *kirkii*) (Shevock 1996). Four out of ten collections held at UC/Jepson Herbaria are from the El Portal Administrative Site (NPS jurisdiction). The NPS has jurisdiction over approximately 3% of the *E. congdonii* acreage mapped in the park and the adjacent national forests (32 ha out of 1,022 ha total). The type locality for *E. congdonii* is in the vicinity of El Portal, but could be on NPS or USFS lands (location specified as the "mountains near Hennessy's"; Hennessy's (the stream terrace now occupied by the trailer village and "Abbieville" in El Portal) was in what is now the El Portal Administrative Site, but the collection location may have been within any of the populations within or near El Portal. Given that the type locality of this state-listed rare species is in the vicinity of El Portal and the El Portal populations lie at the geographic center of the species range, these populations are significant to the protection of *E. congdonii*. The apparently newly discovered (though rather small) population at ERCO40-5 on the South Fork of the Merced River adds to the known biological diversity of Yosemite National Park and adds a state-listed

species to the area within the park boundary (the administrative site is outside of the legislated park boundary.

Additional Work Needed

1. The remainder of the area northwest of Wawona Campground mapped as "Quartzite of Pilot Ridge (early Paleozoic)," (symbol Pzp in Figure C8) should be surveyed for *E. congdonii, Allium yosemitense* and other special status plant species. Surveys should include the contact zone with adjacent granitic rock. This outcrop crosses Wawona Road and runs northwest across the South Fork of the Merced River (Peck 2002). The additional areas of Quartzite of Pilot Ridge on Turner Ridge and west of the South Fork of the Merced River should be surveyed as well.
2. The remainder of the 1985 polygon north of Railroad Flat (NPS administrative and maintenance buildings) should be surveyed for *E. congdonii*, namely the lobe at the northwest edge of the polygon extending from the ridge top down to Moss Creek. This area is west of site ERCO40-Predicted-1, where 560 plants were found in 2003.

Qualifications of Field Personnel at the Time of Surveys

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore**:** MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; plant surveys in Yosemite, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Lisa R. Ordóñez: BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Meghan Williams: BS Biology 2001, California Polytechnic State University, San Luis Obispo.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Department of Fish and Game (CDFG). 2003. California Natural Diversity Database, version 3.0.3. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed 5 January 2004.

California Native Plant Society (CNPS). 2003. Inventory of rare and endangered plants (online edition, v6.2). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 17 November 2003.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

Mooring, J. S. 1991. A biosystematic study of *Eriophyllum congdonii* and *E. nubigenum* (Compositae, Helenieae). Madroño 38(4):213–226.

Peck, D. L. 2002. Geologic map of the Yosemite quadrangle, central Sierra Nevada, California. Geologic Investigations Series Map I-2751. U.S. Department of the Interior, U.S. Geological Survey, Washington, D.C

Shevock, J. R. 1996. Status of rare and endemic plants. Pages 691–707 *in* Sierra Nevada Ecosystem Project: Final report to Congress, Vol. II, Assessments and scientific basis for management options. Centers for Water and Wildland Resources, University of California, Davis, California. Online. (http://ceres.ca.gov/snep/pubs/web/PDF/VII_C24.PDF).

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

Eriophyllum nubigenum Greene ex Gray

Information compiled by Alison E. L. Colwell, 2003; and Peggy E. Moore, 2005

Species Overview

Family
Asteraceae

Synonyms
None

Vernacular Name
Yosemite woolly sunflower

Status
- Federal: Forest Service Sensitive (Stanislaus NF)
- California: none
- CNDDB: G2[1]/S2.3[2]
- CNPS: 1B.3[3]
- Yosemite National Park: Sensitive



Figure C31. *Eriophyllum nubigenum* habit, Chilnualna Fall Trail, Yosemite National Park, Mariposa County, California, 24 June 2003 (photograph by Peggy E. Moore).

Description
See Mooring and Johnson (1993) and Botti (2001) for detailed descriptions.

Similar Species
Eriophyllum congdonii Brandegee is a closely related species that was formerly known as *E. nubigenum* Greene ex Gray var *congdonii* (Brandeg.) Constance. *Eriophyllum congdonii* does not occur in the known localities of *E. nubigenum*, but is found at lower elevations in the region and is similar in appearance. Depauperate specimens of *E. congdonii* could be mistaken for *E. nubigenum*. The distinguishing vegetative feature of *E. congdonii* is that most leaves are irregularly and deeply lobed versus entire in *E. nubigenum*. The distinguishing floral feature of *E. congdonii* is the somewhat more conspicuous ray florets which are both more numerous (6–10) and larger (ligules 3–8 mm long) than those of *E. nubigenum*.

Phacelia quickii J. Howell is present in similar habitat to *E. nubigenum*, and, given that both are ephemeral annuals of diminutive stature, the presence of *P. quickii* in dried condition with no

[1]CNDDB Global Rank = G2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres
[2]CNDDB State Rank = S2.3: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; no current threats known
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 3: Not very endangered in California

floral parts remaining can be disconcerting when one is hunting for *E. nubigenum*. One should note that *P. quickii* dries a dark gray-brown, whereas *E. nubigenum* dries to white due to its wooly tomentum and tends to retain the reflexed phyllaries of the single floral head at the terminus of each branch. It should also be noted that *P. quickii* prefers granite outcrop microhabitat with some fine textured soil present, often below or to the side of the outcrop, whereas *E. nubigenum* is found only in pockets of decomposed granite gravel 0.1–1.0 cm in diameter, often at the top or the shoulder of an outcrop.

Gnaphalium palustre is a small-statured, white-woolly annual with spatulate leaves that are entire throughout (never with teeth or lobes near the apex). It is less woolly than *E. nubigenum* and has discoid heads (without ray florets). *Eriophyllum nubigenum* has ray florets though they are inconspicuous at 2 mm long. *Gnaphalium palustre* occurs in more mesic habitats than *Eriophyllum nubigenum*, such as Ahwahnee Meadow, Bridalveil Meadow, and Tuolumne meadows (Botti 2001); and sand bars in streams and muddy banks.

Distribution

Central Sierra Nevada highlands endemic. Known from fewer than 20 occurences in Mariposa, Madera, and Tuolumne counties only.

California

Pilot Ridge (D. Taylor 8024, UC1736652); Pilot Peak (D. Taylor 8002, UC1511354), Stanislaus National Forest

Yosemite National Park

Clouds Rest (K. Brandegee, s.n., 1883, GH6997); Little Yosemite Valley (Mrs Dodd, s.n., 1 July 1891, UC90300); Chilnualna Falls trail summit (S. Botti s.n., 2 June 1980, YM60265); Merced Peak Quad; Tenaya Lake Quad (CNPS 2005).

Survey Methodology and Results

Survey Dates

24 June, 30 June, 1 July 2003; 21, 23 June 2004

Rationale for Survey Timing

Eriophyllum nubigenum blooms May–June and is desiccated shortly thereafter. The timing of flowering varies from year to year, depending on heat and moisture, and also varies between sub-populations, depending on local moisture. It will remain intact in a desiccated condition (and identifiable) for some weeks until rain and wind decompose it. Populations sampled were either in bloom or in desiccated condition shortly after seed dispersal.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Peggy E. Moore

Table C13. *Eriophyllum nubigenum* Greene ex Gray survey locations and results.

Site	Location	Person Hours	Population Size
ERNU40-1	Top of Chilnualna Falls, Mariposa Grove Quad	6	2,959
ERNU40-2	0.7 km NE of Chilnualna Falls, Mariposa Grove Quad	3	675
ERNU40-3	NE of Mount Broderick and south of Lost Lake, Half Dome Quad	1	716
ERNU40-4	South-facing slope N of Mount Broderick, Half Dome Quad	2	434
ERNU40-5	South-facing slope NE of Half Dome and south of the trail leading to the "staircase" to Half Dome	3	513
ERNU40-6	Unnamed dome W of the junction of Sunrise Creek and "Quarter Domes" creek, Half Dome Quad	3	2,302
ERNU40-7	2 km SE of Mt Starr King	6	1,452
ERNU40-8	5.5 km S of Mount Starr King	6	864
Total		**30**	**9,915**

Method Used to Estimate or Census the Population

We made a complete census of each population. Due to the patchy population structure, we searched entire granitic outcrops out to the forest margin for *E. nubigenum*.

Habitat

Rock crevices and shallow granitic gravel especially around granitic outcrops, 1,675–2,750 m (5,500–9,020 ft) (Figure C32). *Eriophyllum nubigenum* prefers south to to southwest-facing slopes. It is often found growing in partial shade of *Arctostaphylos patula, Quercus chrysolepis*, *Quercus vaccinifolia*, or *Juniperus occidentalis*; it appears to tolerate some accumulation of undecomposed leaf material from these species. *E. nubigenum* does not occur under *Pinus* spp. or in accumulations of pine needles. It prefers granitic gravel accumulated at the tops or shoulders of granitic domes or outcrops which contain at least 75% granitic gravel and up to 25% organic material. It does not occur where significant fines or silt has accumulated, e.g. at the base or sides of granitic outcrops.

Vegetation Communities

Within Target Species Population: *Pinus jeffreyi*/*Quercus vaccinifolia* Woodland, *Pinus jeffreyi/Arctostaphylos patula* Woodland, *Quercus vaccinifolia–Arctostaphylos patula* Shrubland; *Quercus vaccinifolia* Shrubland; *Arctostaphylos patula* Shrubland

Important Associated Plant Species

Trees and Shrubs: *Juniperus occidentalis*, *Arctostaphylos patula*, *Quercus vaccinifolia*

Perennials: *Sedum obtusatum* var. *obtusatum*, *Cheilanthes gracillima*, *Melica californica*

Annuals: *Streptanthus tortuosus* var. *orbiculatus*, *Phacelia quickii*, *Mimulus layneae*, *Vulpia myuros*

Phenological Development

Eriophyllum nubigenum blooms May to June, depending on timing of snowmelt and early summer heat. Other annual species in this habitat are also in bloom at this time. Bloom duration for these species is abbreviated due to low water holding capacity of substrate. Perennial species and shrubs bloomed later.



Figure C32. *Eriophyllum nubigenum* habitat, Chilnualna Falls trail, Yosemite National Park, Mariposa County, California, 24 June 2003 (photograph by Peggy E. Moore).

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

The extremely xeric habitat preferred by *E. nubigenum* may result in significant fluctuations in population size from year to year. The locality of each population contains small patches of preferred habitat, often only one square meter. Therefore the population structure in a given locality is of several small, densely occupied patches of *E. nubigenum* of 1–100 individuals, spread out over a half hectare. In some instances a single patch may contain in excess of 1,000 individuals.

Eriophyllum nubigenum has been shown to possess relatively few pollen grains per flower, a low pollen viability of 44%, and significant self-compatibility (Mooring 1987, 1991). Self-compatibility and the reduced corolla size are typical of, and consistent with, self-pollination as a reproductive strategy. Such a strategy is not surprising in a species that is typified by small, often minute population sizes in isolated, extreme habitat. Self-compatibility enhances colonization of and reproductive survival in unstable habitat, such as the granite domes *E. nubigenum* inhabits. In self-compatible plants, the genetic and reproductive barriers to success of minute populations are less severe or absent, so small subpopulation sizes of this plant encountered by staff conducting monitoring should not necessarily be cause for alarm, especially in years of adverse weather conditions.

Eriophyllum nubigenum has been shown to hybridize in the laboratory with *E. congdonii*, producing identifiable intermediate types (Mooring 1987, 1991). This raises the possibility of natural hybridization between these two evidently closely related species in localities of overlapping habitat, should any exist. Natural hybridization is a serious concern for the survival of species that are rare or narrowly endemic, as their small gene pool can easily be overwhelmed by gene flow from another species. However, these two species apparently do not approach each other nearer than 11 km and the timing of their flowering does not coincide, so it is unlikely that they interbreed in nature (Mooring 1991).

Discussion

Factors That May Have Affected Survey Results

This plant is easily overlooked because of its small size and similarity in color to the granite substrate it favors and its propensity to grow in the shade of stunted shrubs and trees.

Assessment of Threats or Potential Impacts

The preferred habitat of *E. nubigenum* is the constantly eroding upper surfaces of granite balds. Local rockfall events may obliterate a population, but this is part of the natural history of this plant. On the other hand, *E. nubigenum* habitat generally offers fine views, and we found several fire rings within highly restricted *E. nubigenum* occurrences at the base of Half Dome. Repeated trampling by campers and sightseers may pose a significant threat for populations near trails.

We observed some digging by small animals within microsites of *E. nubigenum*. This may impact some populations. It is unclear if small animal populations are changing in *E. nubigenum* areas surveyed. It is possible that proximity to trails and the consequent increase in human food availability may also increase local small animal populations.

We saw evidence of recent burns due to lightning strikes in some *E. nubigenum* survey plots. Depending on the timing of the strike, it may have an impact on an *E. nubigenum* population in a given year, but the long-term effect of fire is probably beneficial in maintaining habitat. Lightning strikes and the resultant small fires may be a frequent threat to seed set of *E. nubigenum* populations in each year. However, the patchiness of the *E. nubigenum* distributions and the sparseness of vegetation in *E. nubigenum* habitat make it unlikely that wildfire would impact a whole population. Tree encroachment in *E. nubigenum* habitat was not evident.

Of the six *E. nubigenum* population surveys, five reported the presence of a single invasive non-native grass species, *Vulpia myuros*. It is unclear how long *Vulpia myuros* has been present at granitic dome sites, or whether it is increasing in cover at those sites. It represented 1% or less of cover at most sites, except ERNU40-3, where it represented 5%–25% of cover. Since it has the ability to increase in this habitat, it presents a competitive threat to *E. nubigenum*.

Recommended Measures to Minimize Impacts

Remove fire rings in *E. nubigenum* populations. It may also be useful to close areas of known habitat to camping and to alert hikers to the camping closure.

Significance of Yosemite Populations

The type locality of *E. nubigenum* is at Clouds Rest, collected in 1883 by Katherine (Curran) Brandegee (Holotype at GH6997). This species was collected again in the same general region in 1891: "*E. nubigenum*, first described from plants collected on the slope of Clouds Rest, was brought this year by Mrs. Dodd from the Little Yo Semite." (Brandegee 1891). This species was not collected again and believed extinct until rediscovered by S. J. Botti in 1980 (Botti 1982; Taylor, in preparation).

Additional Work Needed

Although there are few known locations of *E. nubigenum*, suitable habitat in Yosemite Park is far greater than the areas surveyed to date. Additional surveys of granitic domes at approximately the same elevation are likely to turn up additional populations of *E. nubigenum*.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003.

Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore**:** MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification east of Yosemite, 1986–1989.

Literature

Botti, S. J. 1982. (In Noteworthy Collections) Madroño 29(2):123.

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Brandegee, K. 1891. Flora of Yo Semite. Zoe 2:155–166

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 14 February 2005.

Mooring, J. S. 1987. Experimental hybridization between *Eriophyllum nubigenum* and *E. nubigenum* var. *congdonii* (Compositae) American Journal of Botany 74(5):746.

Mooring, J. S. 1991. A biosystematic study of *Eriophyllum congdonii* and *E. nubigenum* (Compositae, Helenieae). Madroño 38(4)213–226.

Mooring, J. S. and D. E. Johnson. 1993. *Eriophyllum*. Page 261 *in* J. C. Hickman, editor. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed July 2003 to Jan 2005.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

Hulsea brevifolia Gray



Figure C33. *Hulsea brevifolia* isotype specimen at U.S. Herbarium, H. N. Bolander 4994, 22 July 1866, Big Tree Grove, Mariposa County, California.

Information compiled by Alison E. L. Colwell, 2003; and Peggy E. Moore, 2005

Species Overview

Family

Asteraceae

Synonyms

None

Vernacular Name

short-leaved hulsea

Status

- Federal: Forest Service Sensitive (Stanislaus NF and Sierra NF)
- California: None
- CNDDB: G3[1]/S3.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Hulsea brevifolia often co-occurs with *Aster breweri* (A. Gray) Semple, the goldenaster. These two species are similar in overall appearance, but can quickly be distinguished by the following characters: *A. breweri* inflorescence heads are a pale lemon-yellow and appear discoid (e.g. lacking ray florets or "petals"), whereas *H. brevifolia* heads have obvious ray florets and are a darker orange-yellow. The *A. breweri* plants are branched above the base, often becoming bushy, whereas *H. brevifolia* plants are either single-stemmed if young, or have several stems from base if older (Figure C34). The leaves of both species are sticky, hairy, and similar in size, but differ in shape and margin. The *A. breweri* leaves are lanceolate to ovate (e.g. tapered at both tip and base) and entire (no teeth), whereas *H. brevifolia* leaves tend to be oblanceolate to spatulate (e.g. widest at tip, tapered to base) with small teeth on the distal half of the leaf margin. The definitive distinguishing character of *H. brevifolia* is the two pairs of glassy scales at the apex of the achene, one pair 1–2 mm long, the second 2–3 mm long.

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[1]CNDDB Global Rank = G3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres
[2]CNDDB State Rank = S3.2: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; threatened
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 2: Fairly endangered in California

Distribution

California

Central and southern High Sierra Nevada; 1,500–2,700 m (4,920–8,860 ft).

Yosemite National Park

Abies magnifica forest openings with exposed granite soil, often associated with rock outcrops. Central and southern portions of Yosemite National Park in the red fir zone south to Mariposa Grove.

Survey Methodology and Results

Survey Dates

17, 24, 25 July 2003; 6, 7, 14, 27 August 2003; 22, 28, 29 June 2004; plus various dates in 2004 for model verification

Rationale for Survey Timing

Hulsea brevifolia blooms June through August, the hotter, more exposed sites blooming earlier. Scouting revealed that these sites were in full bloom as of 18 July 2003, so surveys commenced for the three weeks following. *Hulsea brevifolia* can be positively identified from fruiting specimens, but is most easily detected in forest understory when in bloom.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Peggy E. Moore, Lisa Ordóñez (HUBR10-4), Karen Vaughn (HUBR10-4)

Method Used to Estimate or Census the Population

We made a complete census of plants in each population. In cases where clusters of very small seedlings were present, a separate total was kept for the seedlings. The rationale for this is that the seedlings in those cases were extremely crowded, often directly beneath amature plant, and thus not likely to survive to maturity.

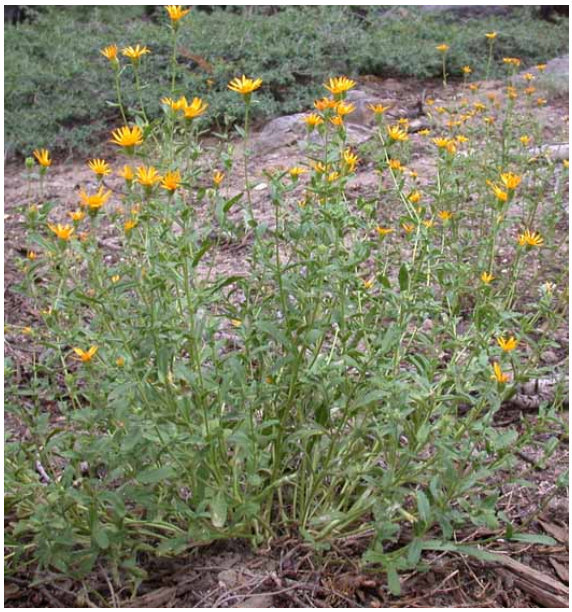


Figure C34. *Hulsea brevifolia* habit, Ostrander Rocks, Yosemite National Park, Mariposa County, California, 25 July 2003 (photograph by Peggy E. Moore).



Figure C35. *Hulsea brevifolia* habitat, Ostrander Rocks, Yosemite National Park, Mariposa County, California, 25 July 2003 (photograph by Peggy E. Moore).

Table C14. *Hulsea brevifolia* Gray survey locations and results.

Site	Location	Person Hours	Population Size
HUBR10-1	Glacier Point Road east of Ostrander Rocks	6	292
HUBR10-2	Two km north of Glacier Point Road on west side of Dewey Point Ski Trail (#14)	1	512 *+312 sdlngs*
HUBR10-3	North end of Ostrander Rocks	3.5	312 *+20 sdlngs*
HUBR10-4	Ridge north of Mt. Watkins.	8.5	890
HUBR10-5	Tioga Road, 800 m west of former Smoky Jack Campground	6	540 *+83 sdlngs*
HUBR10-7	South of Dewey Point	1	72
HUBR10-8	Upper Mariposa Grove	7	1,837
HUBR10-9	Clark Fork of Illilouette Creek	3	208
HUBR10-10	Merced Grove	8	0
HUBR10-11	Tuolumne Grove	14	860
HUBR10-P-1	2 miles NE of Aspen Valley	0.5	57
HUBR10-P-2	Glacier Point Road	1	1,017
HUBR10-P-3	Porcupine Creek Trail	3	202
HUBR10-P-5	Glacier Point Road, 1 mile E of Summit Meadow	4	238
HUBR10-P-7	Snow Creek	2	42
HUBR10-P-9	Near the junction of McGurk Meadow and Pohono Trails	3	365
HUBR10-P-10	Pohono Trail	2	236
HUBR10-P-11	Trail between Aspen Valley and the Old Tuolumne Grove Rd	0	400+
Total		**73.5**	**8,080** ***+415 sdlngs***

Survey Location Note: Other locations reported but not surveyed in 2003–2004 include Four Mile Trail in Yosemite Valley just above where a powerline crosses the trail (Margaret Willits, Mewok District Botanist, Stanislaus National Forest); Pohono Trail (Enid Michael collections, 1922 and 1927, Yosemite National Park herbarium [YM YOSE 64298 and YOSE 64297]).

Habitat

Gaps in *Abies magnifica* forest where duff is thin or nonexistent over sandy loam or gravelly soil (Figure C35). Also occurs in other upper montane forest types. Commonly occurs on steep slopes among or below rock outcrops and/or where fire has removed the duff layer and created a sparse canopy. *Hulsea brevifolia* occurs in exposures that get full sun only part of the day or dappled sun all day. It occurs frequently, but not always, on north-facing slopes. Shrub canopy of *Ceanothus cordulatus* and *Chrysolepis sempervirens* is often present but sparse on *H. brevifolia* sites, sometimes with *H. brevifolia* plants directly under the edge of these shrub canopies.

Vegetation Communities
Within Target Species Population: *Abies magnifica* forest, *Sequoiadendron giganteum–Pinus lambertiana*/*Cornus nuttallii* Forest, *Abies magnifica–Abies concolor–Pinus lambertiana* Forest, *Abies magnifica–Pinus monticola* Forest, *Abies magnifica–Abies concolor* Forest, *Abies magnifica*/*Arctostaphylos nevadensis* Forest.

In Survey Area outside Documented Population(s): *Abies magnifica–Abies concolor–Pinus lambertiana* Forest Association.

Important Associated Plant Species
Aster breweri, Senecio aronicoides, Pedicularis semibarbata, Pteridium aquilinum, Monardella odoratissima, Apocynum androsaemifolium, Symporiocarpus albus, Chrysolepis sempervirens, Ceanothus cordulatus, Viola pinetorum.

Phenological Development
Mature *H. brevifolia* plants were in bloom approximately mid-July to mid-August, although more shaded individuals were occasionally seen in bloom until late August. Smaller individuals (10 cm tall or less), interpreted as young plants, were in vegetative growth only during this time. There were small seedlings (1 cm diameter or less) clustered at base of some mature plants. Because these were often crowded and shaded by a mature plant, surveyors did not include these in the population size estimate. A separate tally was given for these plants in most cases because most are not expected to survive.

Associated species either bloomed concurrently with *H. brevifolia* at this time (*Aster breweri, Monardella odoratissima, Apocynum androsaemifolium*) or were in fruit (*Senecio aronicoides, Pedicularis semibarbata, Viola pinetorum*.).

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

Discussion
Factors That May Have Affected Survey Results
Whereas some locations of *H. brevifolia* are large, containing several hundred or more individuals over a continuous area, it appears from these surveys that the distribution of *H. brevifolia* is often in small pockets of a few individuals. These are often scattered in the *Abies magnifica* forest where a combination of open mineral soil and light canopy cover occur, generally below a rock outcrop on a steep slope. This type of microhabitat is frequent in the vicinity of the known localities of *H. brevifolia*, but *H. brevifolia* was found only in approximately 20% of these sites. Because of the dispersed nature of the population structure and the predominance of small populations, it is likely that many populations of this plant have gone unnoticed.

A second management consideration is that small populations are more likely to go extinct. An example of this may be at survey site HUBR10-6, where a population was reported on the north and west slope of Mount Watkins in the 1980s but was not relocated in 2003, despite exhaustive searching. Surveyors found appropriate habitat at the reported locality as well as many species typically associated with *H. brevifolia*. It appears that *H. brevifolia* is no longer extant at this site, although the presence of a *H. brevifolia* population on the adjacent ridge to the north leaves open

the possibility that the original report was mismapped. Furthermore, a report or data for the 1980s occurrence is missing, so it is unknown how many plants were present at the time of the previous survey. In contrast, populations at Ostrander Rocks and near the former Smoky Jack Campground have persisted since the previous survey. Perhaps it is no coincidence that these two examples are large populations.

Another factor contributing to the ephemerality of small populations of *H. brevifolia* is that these are short-lived perennials (Wilken 1975), each individual probably persisting for only a few years. Pre-flowering age classes make up a significant proportion of most populations (5%–85%), a further indication of the short-lived nature of these plants.

Hulsea brevifolia apparently has limited ability to disperse seed. The pappus consists of short scales only, giving minimal lift to the achene for wind dispersal. Individuals in a population tend to be distributed parallel to the slope, indicating that a common mode of dispersal is soil movement down slope. Often clusters of tiny (current year) seedlings, as many as 35 per 100 cm^2, were observed. This also supports the notion that *H. brevifolia* has limited dispersal. It is unknown how long seeds may persist in the soil.

Assessment of Threats or Potential Impacts

Because of the restricted nature of many short-leaved hulsea populations and their particular site requirements, road building or road maintenance may extirpate small populations in the direct path of the construction or maintenance. The presence of a road in itself is not necessarily a threat to a given population, since *H. brevifolia* appears to colonize road cut slopes adjacent to existing populations.

Although *H. brevifolia* only occurs in sites with exposed mineral soil, populations surveyed were not necessarily in areas with evidence of recent burns. However, it is possible that burns or other disturbances that expose mineral soil may allow existing *H. brevifolia* populations or seedbanks to increase. It is therefore possible, but not necessarily suggested by the current data, that *H. brevifolia* may benefit from regular burning of *Abies magnifica* forest. We did not find *H. brevifolia* in dark, closed canopy forest or in areas with deep duff or litter layers.

Deer browse the flower heads of short-leaved hulsea. Browsing damage was especially noticeable in HUBR10-8 in the Mariposa Grove. Excessive deer populations may therefore lead to a reduction in seed production.

Recommended Measures to Minimize Impacts

Trails may be rerouted to avoid small populations. Road maintenance in areas where *H. brevifolia* occurs on the road cut may need to be modified. Protection of plants from deer grazing could be considered if a population was extremely small or declining. At the type locality for the species, Mariposa Grove, a determination could be made of the extent of deer grazing on flower heads. Based on the results, management action could be considered. Fire frequency, severity and possibly timing could be studied as a possible effect on *H. brevifolia* distribution and persistence.

Significance of Yosemite Populations

The type locality for *H. brevifolia* is Mariposa County, Mariposa Big-Tree Grove (Henry N. Bolander 4994, 22 July 1866). The holotype is at Gray Herbarium, Harvard University

(GH 9255); isotypes are at DS, MO, NY, UC, US. The continued presence of *H. brevifolia* at this site was confirmed during a survey of upper Mariposa Grove (site number HUBR10-8) on 27 August 2003. A second survey in 2004 found no additional stands beyond the small one in the upper grove. Management at the grove tends to focus on fire ecology of *Sequoiadendron giganteum* and on tourism. There are likely to be compatibilities between managing this significant population of *H. brevifolia* and management strategies related to the above issues.

Additional Work Needed

It is possible that *H. brevifolia* is reasonably widespread in the *Abies magnifica* forest zone throughout Yosemite, but has heretofore been overlooked due to the dispersed distribution and small size of its populations. A systematic survey for *H. brevifolia* throughout this forest zone, while labor intensive, would produce a more comprehensive picture of *H. brevifolia* distribution and site requirements, particularly with regards to possible fire regime requirements.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore**:** MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Lisa R. Ordóñez**:** BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Gray, A. 1868. *Hulsea brevifolia* (Compositae). Proceedings of the American Academy of Arts and Sciences 7:359.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

Wilken, D. H. 1975. A systematic study of the genus *Hulsea* (Asteraceae). Brittonia 27(3):228–244.

Ivesia unguiculata A. Gray

Information compiled by Alison E. L. Colwell, 2003

Species Overview

Family
Rosaceae

Synonyms
None

Vernacular Name
Yosemite ivesia

Status
- Federal: Forest Service Watch List (Sierra NF)
- California: none
- CNDDB: G3[1]/S3.2[2]
- CNPS: 4.2[3]
- Yosemite National Park: Sensitive



Figure C36. *Ivesia unguiculata* habit, Peregoy Meadow, Yosemite National Park, Mariposa County, California, 22 July 2003 (photograph by Charlotte Coulter).

Description
See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species
Horkelia fusca Lindley and *Achillea millefolium* L. can easily be confused with *Ivesia unguiculata* because they are similar in appearance from a distance and frequently occur in adjacent habitat. All three plants have numerous narrow pinnately compound leaves from a basal rosette and have ascending cymose inflorescences approximately 20 cm tall.

These plants can be distinguished by the foliage. The leaflets of the basal leaves of *H. fusca* are wedge-shaped and only shallowly toothed or lobed. In contrast, the leaflets of the basal leaves of *Ivesia unguiculata* are deeply linearly lobed so that the leaf appears to have whorls of linear leaflets. In addition, the long hairs give the *I. unguiculata* leaves a distinctively fuzzy appearance. The overall appearance of the *I. unguiculata* leaves is a loose version of the "mousetail" presentation typical of this genus, whereas the *H. fusca* leaflets are distinct and green leafy. Although the leaves of *Achillea millefolium* are also silvery-hairy, the leaflets are

[1]CNDDB Global Rank = G3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres throughout its range
[2]CNDDB State Rank = S3.2: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; threatened
[3]CNPS List 4: Limited distribution (watch list); Threat Code 2: Fairly endangered in California

distinctly pinnately divided, so that the entire leaf is wider, with a feathery aspect rather than a whorled "mousetail" aspect.

Achillea millefolium is easy to distinguish from *I. unguiculata* and *H. fusca* when in bloom, as it has a very dense flat-topped corymb, the flowers with persistent white petals, whereas the other two species have an open corymb with several distinct headlike clusters of flowers with obovate white deciduous petals and pinkish-tinged floral parts. These latter two species can be distinguished when in flower by the shape of the anther filament. In *H. fusca*, the anther filaments are flattened and broad at the base, whereas the filaments in *I. unguiculata* are slender, uniform along their length and circular in cross-section.

Finally, a slight difference in microhabitat preference aids in distinguishing *I. unguiculata* from these other two species when they co-occur in a meadow. *Ivesia unguiculata* is found in sparsely vegetated shallow depressions in full sun areas of meadows where snow or water was standing earlier in the year. *Horkelia fusca* and *A. millefolium,* on the other hand, occur at the slightly higher (e.g., 1 dm difference) perimeter of these depressions and in meadow margins where the ground is drier and the vegetation denser.

Distribution

California

Central and southern High Sierra Nevada; Montane meadows of Mariposa, Madera, Fresno, Inyo Counties (vouchered)

Yosemite National Park

Meadows in the vicinity of Glacier Point Road, Clouds Rest Trail.

Survey Methodology and Results

Survey Dates

22, 30, 31 July; 5, 11, 12 August 2003

Rationale for Survey Timing

Ivesia unguiculata is most easily seen in meadow vegetation when in flower and also a definitive diagnosis requires the presence of anther filaments. Therefore we undertook the surveys during the flowering period of June to August.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter

Table C15. *Ivesia unguiculata* A. Gray survey locations and results.

Site	Location	Person Hours	Population Size
IVUN10-1	Peregoy Meadow	6	3,965
IVUN10-2	South end of Mono Meadow	1	154
IVUN10-3	Bridalveil Creek south-southeast of Bridalveil Campground	3.5	959
IVUN10-4	Meadow east of Ostrander Lake trail	8.5	2,545 (est.)
IVUN10-5	Meadow 1.2 km south of Glacier Point Road along Ostrander Lake trail	6	12,582 (est.)
IVUN10-6	Meadow 0.5 kilometer SSE of Ostrander Lake Trailhead	1	19,825 (est.)
Total		**13.5**	**40,030**

Method Used to Estimate or Census the Population

We counted the number of individuals present in small populations directly. For large populations, we estimated population size as follows:

1. Scanned the meadow on foot by walking back and forth at three-meter intervals to cover the area, flagging all stands of *I. unguiculata* encountered.
2. Marked with a GPS point all outlying small stands of *I. unguiculata* and censused individuals present in those patches.
3. Flagged perimeter of large stands and measured the size of the stand by taking perimeter GPS points and downloading to GIS to calculate area of stand.
4. Measured off a representative sample area of a large stand and censused all individuals in that area.
5. Estimated number of individuals in large stands based on density from sample area.

Habitat

In the areas surveyed, *I. unguiculata* is found in full sun areas of seasonally flooded montane meadows (Figure C37). The meadows are large and flat, one to several hectares in size, and located in the bottomlands of shallow watersheds at 2,010–2,130 m (6,600–7,000 feet) elevation. *Ivesia unguiculata* prefers sparsely vegetated shallow depressions in muck substrate that are drying by midsummer but where snow or water was standing earlier in the year. It has, therefore, a patchy distribution within the meadows where it is found.



Figure C37. *Ivesia unguiculata* habitat, Peregoy Meadow, Yosemite National Park, Mariposa County, California, 22 July 2003 (photograph by Charlotte Coulter).

Vegetation Communities

The meadows where *I. unguiculata* is found are surrounded by dense stands of *Pinus contorta* var. *murrayana* with intermixed *Abies concolor*.

Ivesia unguiculata is associated with *Deschampsia caespitosa* Seasonally Flooded Herbaceous Alliance and the *Deschampsia caespitosa–Polygonum bistortoides* Herbaceous Vegetation Association. *Ivesia unguiculata* is not found in the wetter part of meadows dominated by *Carex* and *Juncus*. *Ivesia unguiculata* tends to occur where the surrounding vegetation is sparse and short, mostly 1 dm or less.

Important Associated Plant Species

Ivesia unguiculata is associated on a fine scale with *Perideridia bolanderi* and *Deschampsia cespitosa* in particular. Other species frequently found in *I. unguiculata* plots are: *Polygonum bistortoides, Muhlenbergia filiformis, Eleocharis pauciflora, Trifolium longipes, Mimulus primuloides, Aster alpigenus, Spiranthes romanzoffiana, Penstemon rydbergii, Carex nebrascensis*, and *Dodecatheon alpigenum*.

Phenological Development

At the time of the surveys, larger specimens of *I. unguiculata* were either in full flower or early fruit set and smaller specimens were in a vegetative condition. This suggests that *I. unguiculata* is a perennial, requiring a minimum of a year to reach flowering stage. The average lifespan of an individual of this species is unknown, but observed size variation of individuals within a population implies that survival can be at least three years. The bunched shape of mature *I. unguiculata* and the presence of many small vegetative individuals in a population implies that *I. unguiculata* reproduces exclusively (or nearly so) from seed. No data were collected on seed viability or dispersal.

The flowering period for *I. unguiculata* is June to August, and a given individual will continue to flower over most of that time span. Although the petals are shed soon after anthesis, the anthers, which are diagnostic, are retained much longer. Consequently, the plant is readily identifiable in fruit as well as flower. June to August is also the time frame when associated species listed above are in flower.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Ivesia unguiculata is endemic to montane meadows in the central Sierra Nevada, and is documented from Mariposa, Madera, Fresno, and Inyo Counties. Grazing impacts in some of the known localities led to its listing status by the California Native Plant Society as a species of limited distribution. It appears to be both frequent and abundant in wet meadows along Glacier Point Road. Other reported localities in Yosemite National Park and elsewhere remain to be surveyed.

Discussion

Factors That May Have Affected Survey Results

In stands of several thousand individuals, it was not practicable to get an exact count of the population. We made estimates based on the density of a defined smaller areas. These estimates are sensitive to natural variations in density of these plants across a population, so the totals for estimated populations should be considered accurate to within an order of magnitude only.

Assessment of Threats or Potential Impacts

In half the meadows surveyed, foot or horse trails are present, but these are not heavily used and therefore appear to have minimal impact on *I. unguiculata*. In most of the meadows surveyed, population sizes of *I. unguiculata* are in excess of 1,000 individuals, so localized impacts on a given meadow would not be disastrous for the population. The greatest direct threat to survival of *I. unguiculata* in Yosemite National Park is that all meadows where IVUN was surveyed are shrinking in size due to encroachment by *P. contorta* at their perimeter. Changes in the timing and volume of snowmelt presumably would indirectly impact *I. unguiculata* populations.

Recommended Measures to Minimize Impacts

The inclusion of burning in the management of these areas may be important in long-term maintenance of *I. unguiculata* habitat by curbing loss of meadow area to encroachment by *P. contorta*.

Significance of Yosemite Populations

The type collection of *I. unguiculata* was made in Westfall Meadows by H.N. Bolander (4964) in 1866, (UC954904, isotype). The species was described by Asa Gray (1868) from Bolander's collection. Botti (2001) reports that this plant is "still locally common near the center of the meadow."

The populations documented in Yosemite National Park represent approximately half the documented populations for this plant that are in the SMASCH database to date (2002 version). These populations therefore enjoy the most protected status of reported localities of *I. unguiculata*.

Additional Work Needed

USGS topographical maps indicate additional potential habitat in the vicinity of known *I. unguiculata* populations that should be surveyed. There are also reports of *I. unguiculata* from Clouds Rest Trail and elsewhere in the park that have not been surveyed.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

Gray, A. 1867. Characters of new plants of California and elsewhere, principally of those collected by H. N. Bolander in the State Geological Survey: *Ivesia unguiculata*. Proceedings of the American Academy of Arts and Sciences 7:339.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed July 2003 to Jan 2005.

Personal Communications:

David Tibor, rare plant botanist, California Native Plant Society, Sacramento, California.

Lewisia congdonii (Rydb.) J. T. Howell

Information compiled by Peggy E. Moore, 2004.



Figure C38. *Lewisia congdonii* habit, El Portal, Merced River Canyon, Mariposa County, California, 14 May 2003 (photograph by Peggy E. Moore).

Species Overview

Family

Portulacaceae

Synonyms

Lewisia columbiana ssp. *congdonii* (Rydb.) Ferris

Vernacular Name

Congdon's lewisia

Status

- Federal: None
- California: Rare (July 1982)
- CNDDB: G1[1]/S1.3[2]
- CNPS: 1B.3[3]
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Lewisia disepala is a species of shallow, granitic sand located, for the most part, on or near exposed domes. It has stems shorter than the leaves with solitary, terminal flowers in contrast to *L. congdonii* few-flowered panicles. *Lewisia disepala* petals are 13–18 mm long and subtended by entire, petaloid sepals that become scarious in age.

Lewisia triphylla is a species of gravelly soil, often in proximity to granitic slabs and domes. It lacks basal leaves but has 2–5 stem leaves up to 5 cm long. Although the inflorescence can be branching, it is subumbellate rather than panicled and typically no taller than 7 cm. Sepals are entire rather than gland-toothed, and petals are 4–7 mm long, always shorter than those of *L. congdonii*.

Lewisia pygmaea is a high-elevation species that occurs in a variety of microhabitats in subalpine and alpine zones. Stems are 1–3 flowered. Leaves are up to 3.5 cm long, and stems are shorter than the leaves.

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[1]CNDDB Global Rank = G1: Less than 6 viable occurrences (Eos) or less than 1,000 individuals or less than 2,000 acres throughout species range.
[2]CNDDB State Rank = S1.3: Less than 6 occurrences or less than 1,000 individuals or less than 2,000 acres in California; no current threats known
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 3: not very endangered in California

Claytonia lanceolata differs from all *Lewisia* spp. in having a capsule that dehisces by 2–3 valves rather than a circumscissile opening. It occurs in damp to dry forest.

Distribution

California

Central Sierra Nevada (Fresno, Mariposa counties), 500–2,800 m (1,650–9,190 ft) (Hickman 1993); majority of distribution lies with Mariposa County with two additional localities in Kings Canyon (at 950 and 1,200 m [3,120 and 3,940 ft]); higher elevation sites are at Devil Peak (2,070 m [6,790 ft]) and Trumbull Peak (1,525 m [5,000 ft])

Yosemite National Park

No known locations within Yosemite National Park; type locality +/-100 m (330 ft) outside of the El Portal Administrative Site (Botti 2001); Pigeon Gulch population +/-50 m (164 ft) outside administrative site

Survey Methodology and Results

Survey Dates

6, 14 May 2003

Rationale for Survey Timing

Flowering occurs April–May (to June) each year when moss and lichen-covered rock outcrops are still moist. Plants are most visible while they are flowering due to the height added by flowering stems and the pink to white flowers.

Personnel Conducting Surveys

Charlotte Coulter, Peggy E. Moore, Meghan Williams

Table C16. *Lewisia congdonii* (Rydb.) J. T. Howell survey locations and results.

Site	Location	Person Hours	Population Size
LECO10-1	Ridge on the northeast side of Pigeon Gulch, El Portal	3	380
LECO10-2	Ridge on the northeast side of Pigeon Gulch, El Portal	13	186
LECO10-3	Ridge between Pigeon Gulch and Cold Canyon, El Portal	15	7,400
Total		**31**	**7,966**

Method Used to Estimate or Census the Population

We searched rock outcrops and areas between, radiating out from the center of each stand. We counted individual plants in survey sites LECO10-1 and -2. For LECO10-3, we censused plants within areas of a given density and applied those counts to adjacent areas of similar density, using this estimation approach throughout the sizeable stand.

Habitat

Chaparral and oak woodlands. Crevices in fractured and often moss-covered metamorphic [Quartzite of Pilot Ridge (Paleozoic?)] outcrops on steep, north-facing slopes that are wet in the early spring and dry by early summer (Botti 2001) (Figure C39). Carrot-sized roots are wedged into rock crevices of outcrops, presumably fed by groundwater filtering through rock fractures. 460–2,070 m (1,500–6,800 ft)

Vegetation Communities

Within Target Species Population:

- LECO10-1: *Quercus wislizeni*/*Arctostaphylos viscida* Woodland Association
- LECO10-2: California Annual Herbland Alliance
- LECO10-3: *Pinus sabiniana–Quercus wislizeni*/*Arctostaphylos viscida* Woodland Association

In Survey Area outside Documented Population(s):

- LECO10-1 and LECO10-2 (shared survey area): California Annual Grassland Alliance
- LECO10-3: same as within population

Important Associated Plant Species

Cheilanthes gracillima, *Dudleya cymosa* ssp. *cymosa*, *Selaginella hansenii*, *Vulpia microstachys*, and *Streptanthus tortuosus* ssp. *tortuosus* were consistent associates on mesic metamorphic outcrops within *L. congdonii* stands. Dominant overstory species forming open, interrupted canopies included *Quercus wislizeni* and *Pinus sabiniana*. *Arctostaphylos viscida* ssp. *mariposa* was the most important shrub species present. Mosses had high cover at all three sites. *Allium yosemitense* was an associate on site LECO10-1. *Lupinus bicolor* was present in two out of three stands.

Phenological Development

All *Lewisia congdonii* plants were either in vegetative (preflowering or nonflowering) condition or flowering at the time of surveys. Approximately 80%–95% of plants were flowering at sites LECO10-1 and -3 whereas 60% were vegetative at site LECO10-2. The majority of species in and around the *L. congdonii* stands were flowering, the flowering of drier-site species being prolonged by late season rains. For example, the unseasonably cool, moist spring contributed to coincident flowering of *L. congdonii* and *Eriophyllum congdonii* at all three sites. California Annual Grassland and California Annual Herbland species were flowering with few plants developing fruit as would be expected for these dates in a drier year. Within the rock outcrop microsites, *Allium yosemitense* was flowering at site LECO10-1 and most associated herbaceous species were flowering at all sites with the exception of *Dudleya cymosa* ssp. *cymosa*.



Figure C39. *Lewisia congdonii* habitat, Cold Canyon, Merced River Canyon, Yosemite National Park, Mariposa County, California, 14 May 2003 (photograph by Peggy E. Moore).

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Lewisia congdonii is known from approximately six occurrences in the canyons of the Kings and Merced

rivers (CNPS 2004). Most of the occurrences are on USFS lands (Stanislaus and Sierra forests).

In 1994, a multi-agency Memorandum of Understanding (MOU) for the conservation and protection of sensitive species in the Merced River Canyon was signed by the California Department of Fish and Game, U.S. Forest Service, Bureau of Land Management, California Department of Transportation, and Pacific Gas and Electric (CDFG 2000). The MOU specifies guidelines for highway and power line maintenance and repair, notification requirements, species monitoring, and annual reviews. The MOU emphasizes protection measures for state-listed endangered Merced clarkia (*Clarkia lingulata*) but also improves protection for Congdon's lewisia and other species.

Discussion

Factors That May Have Affected Survey Results

Historic excavations (see below), now open pits, removed portions of habitat and likely reduced abundance within the stand. The rugosity of rock outcrops where *L. congdonii* occurred could have prevented a small proportion of plants being detected during our surveys. This would have been most true at the largest site, LECO10-3, where plants occurred over a large area of rugged, relatively steep terrain. In addition, the lower (steeper and more northerly half) of LECO10-3 had abundant poison oak (*Toxicodendron diversilobum*) in leaf that slowed movements through the survey area and contributed to circuituous routes. Microsites with *L. congdonii* did not support poison oak, allowing clear views of plants on the outcrops.

Assessment of Threats or Potential Impacts

The stands at LECO10-1 and -2 are 500 m south, 350 vertical m and 1,000 m south, 405 vertical m (1,650 ft south, 1,150 vertical ft and 3,280 ft south, 1,330 vertical ft), respectively, above Highway 140 and the Merced River. They are in areas of almost zero visitation on Sierra National Forest. Bedrock substrates within these two sites, where plants are rooted in fractures, appear to be largely stable.

The northeast-facing side of the LECO10-3 site on the ridge between Cold Canyon and Pigeon Gulch is riddled with mining excavations that were worked heavily from 1930–1950 (installed some time after the 1880s) (Law 1993, Page 75). Some of the excavations are within 5 m of each other, and many have contributed loose talus to the slope, creating unstable substrates. *Lewisia congdonii* plants are on the most stable substrates throughout the stand, predominantly rock outcrops, and thus the extant population does not appear threatened by the tailings. The mining activity represents historic impacts to the population, but the remaining shafts attract only rare visits from sightseers. Although soluble barium compounds can be absorbed by plants (International Programme on Chemical Safety 1990), there is no apparent evidence that barium is toxic to terrestrial plants (Choudhury and Cary 2001).

Several occurrences of *L. congdonii*, including one in the Merced River Canyon, are along roads where alien plant control, road improvement and maintenance, and trash dumping are threats.

Recommended Measures to Minimize Impacts

Alien plant control work should be designed to prevent impacts to *L. congdonii*, including manual, chemical, and biocontrol treatments. That is, treatments should be specific to the target alien plant species and be designed in such a way as to avoid impacts to *L. congdonii* populations

or habitat. Roadwork, construction staging, and other activities should avoid impacts to the population at Pigeon Gulch that reaches the shoulder of Highway 140 (e.g., storage of any materials that could harbor alien species or damage plants should be placed distant from rare plant populations). Mining activities should be avoided within or adjacent to populations.

The National Park Service might explore what improvements to rare plant protection could be gained through signing onto the MOU established for conservation and protection of sensitive plant species in the Merced River Canyon (CDFG 2000).

Significance of Yosemite Populations

Lewisia congdonii is a Sierra Nevada endemic that was first collected on the "Hennessey Trail" in Mariposa County in 1883 by J. W. Congdon (holotype DS45334, isotype UC82850). The trail climbed steeply up the north-facing side of the Merced River Canyon from Hennessey's place (stream terrace that currently supports a trailer village and a few private houses known locally as "Abbieville;" it is located where Hwy 140 currently crosses the Merced River in El Portal) and eventually met up with the Wawona Road (USGS 1948). Botti (2001) more specifically identified the type locality as Pigeon Gulch ridge in El Portal (presumably the ridge on the northeast side of Pigeon Gulch). The majority of *L. congdonii*'s known distribution is in the Merced River main stem and South Fork though it is also known from two locations in the Kings River Canyon.

Additional Work Needed

We surveyed from Pigeon Gulch northeast to the spine of the ridge and from Highway 140 up to 1,285 m (4,200 ft) elevation, but the northeast-facing side of the ridge might be surveyed for additional stands (possibly including the type locality) (preferably by persons with low allergic reaction to poison oak). Additional populations could be sought on mesic north-facing outcrops with similar surficial geology in the canyon.

Qualifications of Field Personnel at the Time of Surveys

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore: MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification east of Yosemite, 1986–1989.

Meghan Williams: BS Biology 2001, California Polytechnic State University, San Luis Obispo.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Department of Fish and Game (CDFG). 2000. The status of rare, threatened, and endangered animals and plants of California, *Congdon's lewisia*. California Department of Fish and Game, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/plants_and_animals.asp /SPPlants.pdf). Accessed 23 February 2004.

California Native Plant Society (CNPS). 2004. Inventory of rare and endangered plants (online edition, v6-04d1). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 31 December 2004.

Choudhury, H., and R. Cary. 2001. Concise international chemical assessment. Document 33: barium and barium compounds. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals. World Health Organization, Geneva, Switzerland.

Foster, M., E. Carroll, and V. D. Hipkins. 1997. Saw-toothed lewisia: To be or not to be. Fremontia 25(1):15–19. [Genetic study of relationship to *Lewisia cantelovii* and *L. serrata*].

International Programme on Chemical Safety (IPCS). 1990. Barium. Environmental Health Criteria 107. Geneva, World Health Organization, International Programme on Chemical Safety, Geneva. Online. (http://www.inchem.org/documents/ehc/ehc/ehc107.htm).

Law, J. 1993. Memories of El Portal: A history of the gateway to Yosemite Valley. Mariposa Heritage Press, Mariposa, California.

Rydberg, P. A., and P. Wilson. 1932. Portulacaceae. Pages 279–336 i*n* N. L. Britton et al., editors. North American flora. Volume 21. New York Botanical Garden, New York. [Original description].

United States Geological Survey (USGS). 1948. Topographic map of Yosemite National Park, California. Based on geological survey maps surveyed between 1893 and 1909. 1:125,000 scale. U.S. Geological Survey, Denver, Colorado. 1 map sheet.

Lewisia disepala A. Gray

Information compiled by Peggy E. Moore, 2004



Figure C40. *Lewisia disepala*, Turtleback Dome, Yosemite National Park, Mariposa County, California, 2 April 2004 (photograph by Peggy E. Moore).

Species Overview

Family
Portulacaceae

Synonyms
None

Vernacular Name
Yosemite lewisia, Yosemite bitter root

Status
- Federal: Forest Service Sensitive (Sierra NF, Stanislaus NF)
- California: none
- CNDDB: G2[1]/S2.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive

Description
See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species
Lewisia. congdonii (Rydb.) J. Howell has few-flowered panicles much longer than the leaves in contrast to *Lewisia disepala*, which has flowering stems shorter than the leaves and solitary, terminal flowers. *Lewisia disepala* petals are obovate, 13–18 mm long and subtended by entire, petaloid sepals that become scarious in age; *L. congdonii* petals are approximately 8 mm long and lanceolate.

Lewisia triphylla (S. Watson) Robinson is a species found on gravelly soil, often in proximity to granitic slabs and domes. However, it has 2–5 stem leaves up to 5 cm long and lacks the basal rosette of leaves typical of all other Yosemite *Lewisias*, including *L. disepala*.

Lewisia pygmaea is a high-elevation species that occurs in a variety of microhabitats in subalpine and alpine zones. Leaves are flat rather than club shaped and sepals are often toothed rather than entire.

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[1]CNDDB Global Rank = G2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres
[2]CNDDB State Rank = S2.2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; threatened
[3]CNPS List 1B: Rare, threatened or endangered in California and elsewhere; Threat Code 2: fairly endangered in California

Claytonia lanceolata differs from all *Lewisia* spp. in having a capsule that dehisces by 2–3 valves rather than a circumscissile opening. It occurs in damp to dry forest.

Distribution

California

Central and southern High Sierra Nevada (Hickman 1993)

Yosemite National Park

Open domes 1500–2800 m (Botti 2001); from the west end of Yosemite Valley east to Mt. Starr King area and north to Olmsted Point



Figure C41. *Lewisia disepala* habitat, Olmsted Point vicinity, Yosemite National Park, Tuolumne County, California,18 May 2004 (photograph by Peggy E. Moore).

Survey Methodology and Results

Survey Dates

Site 1: 26 March, 2 April 2004; Site 2: 18, 20, 23 May 2004; Site 3: 24, 27 May 2004

Rationale for Survey Timing

Lewisia disepala emerges above ground with fall rains, develops flower buds and then remains dormant under blankets of winter snow (Botti 2001). During the early stages of snowmelt, plants flower while shallow, sandy substrates remain moist. Plants set seed fairly quickly, wither and die back to below-ground parts in very early spring. To maximize detection, sites must be visited during or soon after snowmelt while plants are still flowering. Plants were in the early stages of flowering at Turtleback Dome during our first visit, and setting fruit one week later when we completed our survey. Approximately 90% of plants were flowering during our survey near Olmsted Point (LEDI10-2), largely setting fruit at Mt. Watkins in late May (LEDI10-3).

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Peggy E. Moore, Lisa Ordóñez

Table C17. *Lewisia disepala* A. Gray survey locations and results.

Site	Location	Person Hours	Population Size
LEDI10-1	Turtleback Dome	8	617
LEDI10-2	Ridge East of Olmsted Point	12	3,236
LEDI10-3	Mt. Watkins	30	7,133
Total		**50**	**10,986**

Method Used to Estimate or Census the Population

We tallied individual plants in smaller stands up to approximately 50 in a stand. For larger stands, we estimated numbers by tallying the number of plants in $1m^2$ or $5m^2$ areas and applying that number to similar densities within a short distance.

Habitat

Lewisia disepala is a species of shallow, granitic sand located, for the most part, on or near exposed granitic domes (Figure C41).

Vegetation Communities

Within Target Species Population: Sparsely vegetated to non-vegetated, *Pinus monticola–Pinus contorta* ssp. *murrayana* Woodland Association

In Survey Area outside Documented Population(s): *Pinus ponderosa–Calocedrus decurrens–Quercus kelloggii* Woodland Association (Turtleback Dome population)

Important Associated Plant Species

Lewisia kelloggii, *Eriogonum incanum*, *Allium obtusum* var. *obtusum*, *Ivesia santolinoides*

Lewisia disepala is associated at the finest scale with almost no other plant cover in the gravel pans that comprise its microhabitat. At some sites, *L. kelloggii* occurs in the deeper portions of the gravel. Where gravel becomes more than two inches deep, *Calyptridium monospermum* is common.

Phenological Development

Lewisia disepala is the earliest species to flower where it occurs (see comments under rationale for survey timing). In its microhabitat of shallow gravel pans on granitic bedrock, *Lewisia kelloggii* flowers somewhat (2–3 weeks) later and *Calyptridium monospermum* somewhat later than that.

Location of Deposited Voucher Specimensd

No vouchers were collected.

Remarks

Lewisia disepala is endemic to the central and southern Sierra Nevada.

Discussion

Factors That May Have Affected Survey Results

There were three weeks of unseasonably warm weather in March 2004 and then an early spring at all elevations in the park. Plants were largely at the fruiting stage by the end of the survey at Mt. Watkins, the third and final survey for *L. disepala* on 27 May 2004. We made careful observations fairly close to the ground to maximize detection. Human use including illegal camping, utility buildings, and an air-quality monitoring station have modified habitat at Turtleback Dome.

Assessment of Threats or Potential Impacts

Trampling of the thin-soil habitat by hikers and campers poses the most direct threat. Climate change effects are likely to contribute to reductions in species abundance and/or range.

Recommended Measures to Minimize Impacts

Address issues of illegal camping at Turtleback Dome and limit the footprint and associated impacts from environmental monitoring infrastructure installed at that site.

Significance of Yosemite Populations

The type collection was made in Yosemite by Katherine Brandegee (s.n.) (location undetermined), but the holotype specimen is "not at the University and Jepson Herbaria and may be lost" or misplaced (Taylor, in preparation).

Additional Work Needed

The four specimens in the SMASCH database posted by the Jepson Herbarium (http://ucjeps.berkeley.edu/interchange.html) represent two of the populations in Yosemite National Park and one in the upper San Joaquin River drainage. The species is somewhat under collected considering the large sizes of populations and how vulnerable the species is to climate perturbations.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore: MS Range Management, University of California, Berkeley, 1992. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Lisa Ordóñez: BS Bioresource Science, University of California, Berkeley, 1998. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Literature

Botti, Stephen J. 2001. An illustrated flora of Yosemite National Park. El Portal, California.

Brandegee, K. 1894. *Lewisia rediviva* Pursh var. *yosemitana*. Proceedings of the California Academy of Science, ser. 2, 4:89.

California Native Plant Society (CNPS). 2004. Inventory of rare and endangered plants (online edition, v6-04d1). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 31 December 31 2004.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Rydberg, P. A. 1932. North American Flora 21:322. [Original description].

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

Jepson Online Interchange for California Floristics. 2004. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 31 December 2004.

Lupinus gracilentus E. Greene

Information compiled by Peggy E. Moore, 2005

Species Overview

Family

Fabaceae

Synonyms

None

Vernacular Name

slender lupine, green slender lupine

Status

- Federal: Forest Service Watch (Sierra NF, Stanislaus NF), Forest Service Sensitive (Inyo NF, Region 5)
- California: None
- CNDDB: G3[1], S3?[2]
- CNPS: 1B.3[3]
- Yosemite National Park: Sensitive



Figure C42. *Lupinus gracilentus* habit, Snow Flat vicinity, Yosemite National Park, Mariposa County, California, 21 July 2004 (photograph by Alison E. L. Colwell).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Bracts of the inflorescence are persistent and conspicuous in *Lupinus covillei* E. Greene, thread-like and deciduous in *L. gracilentus* (Figure C43).



Figure C43. *Lupinus gracilentus* flowers, Snow Flat, Yosemite National Park, Mariposa County, California (photograph by Alison E. L. Colwell).

Distribution

California

Central High Sierra Nevada (Hickman 1993)

Yosemite National Park

Cathedral and Clark ranges, 2,430–3,050 m elevation (Botti 2001)

[1]CNDDB Global Rank = G3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres
[2]CNDDB State Rank–S3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 3: not very endangered in California

Survey Methodology and Results

Survey Dates

- LUGR10-1: 22 July 2003
- LUGR10-2: 22 July 2003
- LUGR10-3: 10 August 2003
- LUGR10-4: 21 July 2004

Rationale for Survey Timing

In average to dry years, *L. gracilentus* flowers in July at its lower elevational range of around 2,500 to 2,900 m (8,200 to 9,515 ft). We limited our 2003–2004 surveys to this elevation range, and we avoided surveys after August 10 so that flower characteristics were available to distinguish *L. gracilentus* from similar species.

Personnel Conducting Surveys

Alison E. L. Colwell, Peggy E. Moore, Lisa Ordóñez, Angela Sanders

Table C18. *Lupinus gracilentus* E. Greene survey locations and results.

Site	Location	Person Hours	Population Size
LUGR10-1	Tenaya Lake	17	3,190
LUGR10-2	Budd Creek at Tioga Road	39	3,709
LUGR10-3	Footbridge above Tuolumne Falls (type locality)	1	268
LUGR10-4	Snow Creek	4	29,400
Total		**61**	**36,567**

Method Used to Estimate or Census the Population

We made a complete census of plants in each of the first three populations (LUGR10-1, -2, -3). At the Snow Creek site, we estimated abundance based on a subsample.

Habitat

Mesic to saturated, partially shaded sites in subalpine forest (e.g., *Pinus contorta* ssp. *murrayana*), 2,500–3,050 m (8,200–10,000 ft) (Figure C44). *Lupinus gracilentus* occurred in canopy gaps at some sites, along streams, and within *Pinus contorta* stands at others. Soil texture was sandy loam at each site surveyed where soil texture was identified (three out of four sites).

Vegetation Communities

Within Target Species Population: All *L. gracilentus* populations visited occurred in mesic *Pinus contorta* ssp. *murrayana* forests. Specifically, the associations were *Pinus contorta* ssp. *murrayana*/*Vaccinium uliginosum* Forest and *Pinus contorta* ssp. *murrayana*/*Ligusticum grayi* Forest.

In Survey Area outside Documented Population(s): Same

Important Associated Plant Species

Pinus contorta ssp. *murrayana* formed the tree canopy at each population surveyed. The important shrub species was *Vaccinium uliginosum* (two sites). *Luzula parviflora*, *Carex rossii*, *Perideridia parishii*, and *Calamagrostis canadensis* were the most common herbaceous species among the four sites. *Polygonum bistortoides* and *Juncus parryi* were common at two sites.



Figure C44. *Lupinus gracilentus* habitat, Snow Flat vicinity, Yosemite National Park, Tuolumne County, California, 21 July 2004 (photograph by Alison E. L. Colwell).

Phenological Development

July surveys in 2003 and 2004 found the majority of *L. gracilentus* plants flowering along with the majority of associated species. In August 2003, the population above Tuolumne Falls was mostly at the fruiting stage although not all plants were reproductive that year. The majority of other taxa were at the fruit stage as well.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Lupinus gracilentus is known in Yosemite largely from an 1889 Chesnut and Drew collection (UC150138), a 1929 C. P. Smith collection (UC659302) from above Tuolumne Falls, and a 1936 Edward Lee collection (JEPS78579) from Cathedral Lake. Botti describes the species as ranging throughout the Cathedral Range south through the Clark Range. Botti (2001) lists Long Meadow and the upper Illillouette Creek trail as population locations. There is an additional locality in Inyo County (UC511825) in the Rock Creek Lake basin.

Discussion

Factors That May Have Affected Survey Results

Annual flooding affects the site at the bridge above Tuolumne Falls (LUGR10-1); 50- and 100-year floods could be expected to affect the site to a greater degree. Such floods have occurred at least three times in the 65 years since Smith made a collection at that location. This includes the January 1997 flood when streamside vegetation was removed for great distances along streams at all park elevations. The population on Budd Creek at Tioga Road overlaps at the previous location of the Cathedral Lakes trailhead parking that was washed out in the January 1997 flood. Nevertheless, that population numbered over 3,700 in 2003.

Assessment of Threats or Potential Impacts

Redevelopment of the Cathedral Lakes trailhead parking at its previous location could impact the population on lower Budd Creek through paving, vehicle traffic, trampling, and installation of support facilities, such as bear-resistant food lockers.

Recommended Measures to Minimize Impacts

Any redevelopment of the Cathedral Lakes trailhead at Tuolumne Meadows should avoid the *L. gracilentus* population and its habitat in the vicinity. Other locations could be considered. Trails emanating from the trailhead might be routed to avoid the population, thus discouraging trampling and collecting.

Significance of Yosemite Populations

The type locality for *L. gracilentus* is Tuolumne County, Tuolumne Canyon, Chesnut and Drew s.n. July 1889. The holotype is at University of Notre Dame, Indiana (NDG). An isotype is at UC (UC150138). The continued presence of *L. gracilentus* at this general locality was confirmed during a survey of the C. P. Smith 1929 collection (coll. no. 4470, UC659302) locality at the "canyon bridge above Tuolumne Falls" (site number LUGR10-3) on 10 August 2003.

Additional Work Needed

All collections of putative *L. gracilentus* identified thus far by Theresa Sholars at College of the Redwoods, Fort Bragg campus, have been confirmed. This includes some from Rafferty Creek collected by Lisa Ordóñez, so that area should be surveyed populations mapped. *Lupinus gracilentus* appears to be more common in Yosemite than current park or herbarium records indicate. Additional collections of this rare species, which often forms extensive stands, are needed to better document its distribution.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Peggy E. Moore: MS Range Management, University of California, Berkeley, 1992. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Lisa R. Ordóñez: BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest, Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Angela Sanders**:** BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, Stephen J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05c). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 11 January 2005.

California Natural Diversity Database (CNDDB), Wildlife and Habitat Data Analysis Branch, Department of Fish and Game, January 2005.

California Department of Fish and Game (CDFG). 2003. California Natural Diversity Database, version 3.0.3, November 3, 2003. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/). Accessed 5 January 2004.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Greene, E. L. 1893. Proceedings of the Academy of Natural Sciences of Philadelphia. 1892:365. [Original description].

Lycopus uniflorus Michx.



Figure C45. *Lycopus uniflorus*, Swamp Lake, Yosemite National Park, Tuolumne County, California, 13 July 2004 (photograph by Charlotte Coulter).

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Lamiaceae

Synonyms

None

Vernacular Name

northern bugleweed

Status

- Federal: none
- California: none
- CNDDB: G5[1]/S3.3[2]
- CNPS: 4.3[3]
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

The combination of two fertile stamens and corolla with subequal lobes (corolla not two-lipped) separates *Lycopus uniflorus* from other Yosemite mints.

Distribution

California

Uncommon throughout the state; North Coast, <100 m; northern and central High Sierra Nevada (Tuolumne, Plumas counties.), 1,600–2,000 m; to British Columbia, eastern United States (Hickman 1993)

Yosemite National Park

Swamp Lake and Lost Lake, 1,525–2,000 m (5,000–6,500 ft) (Botti 2001)

Survey Methodology and Results

Survey Dates

13 July 2004

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[1]CNDDB Global Rank = G5: Secure—Common; widespread and abundant
[2]CNDDB State Rank = S3.3: 21–100 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; no current threats known
[3]CNPS List 4: Limited distribution (Watch List); Threat Code 3: not very endangered in California

Rationale for Survey Timing
We planned the timing of the Swamp Lake survey to coincide with flowering of the majority of species of interest at that site. It was a little early for *L. uniflorus*, but some plants were flowering.

Personnel Conducting Surveys
Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C19. *Lycopus uniflorus* Michx. survey locations and results.

Site	Location	Person Hours	Population Size
LYUN10-1	East shore of Swamp Lake near S Island	3	130

Method Used to Estimate or Census the Population
We made a complete census on the east shore of Swamp Lake near the south island, counting plants individually. *Lycopus uniflorus* occurred in other appropriate habitat at the west end of the lake plus the two small lakes to the west but was not censused in those locations.

Habitat
Cold bogs and floating sphagnum islands, mixed conifer zone (Botti 2001); peaty crannogs. At Swamp Lake, plants are growing in peaty soil that is level with lake's surface (Figure C46).

Vegetation Communities
Within Target Species Population: Habitat not represented in the park's vegetation classification at the alliance level. At the formation level, the site can be categorized as Saturated temperate forb vegetation .

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest

Important Associated Plant Species
Menyanthes trifoliata, *Carex limosa*, *Dulichium arundinaceum*, *Brasenia schreberi*, *Carex cusickii*, *Utricularia gibba*

Phenological Development
Only about 20% of plants were flowering at the time of the survey, but non-flowering plants were sufficiently distinctive to identify at the vegetative stage. Other species on the island were at a variety of growth stages. About half of the round-leaved sundew plants and about 5% of *Carex limosa* plants were flowering, but 100% of *Eriophorum gracile* was at the fruiting stage. Other sedges were immature. *Dulichium arundinaceum* was at the early flowering stage.

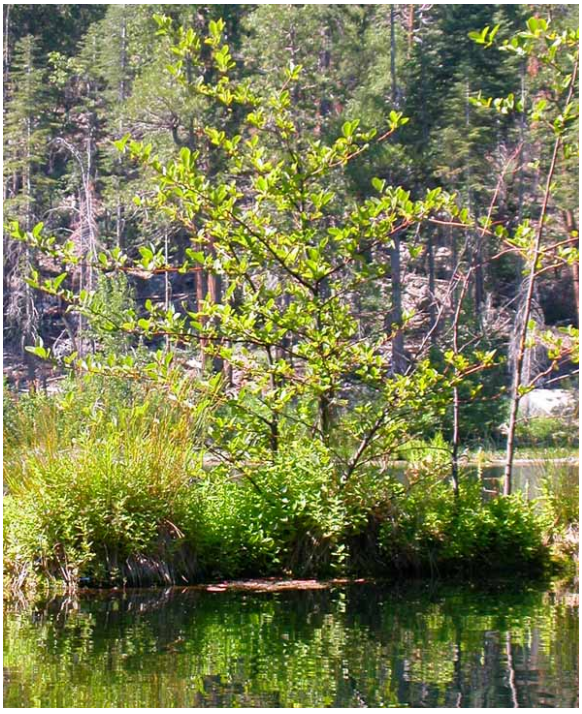


Figure C46. *Lycopus uniflorus* habitat, Swamp Lake, Yosemite National Park, Tuolumne County, California, 13 July 2004 (photograph by Charlotte Coulter).

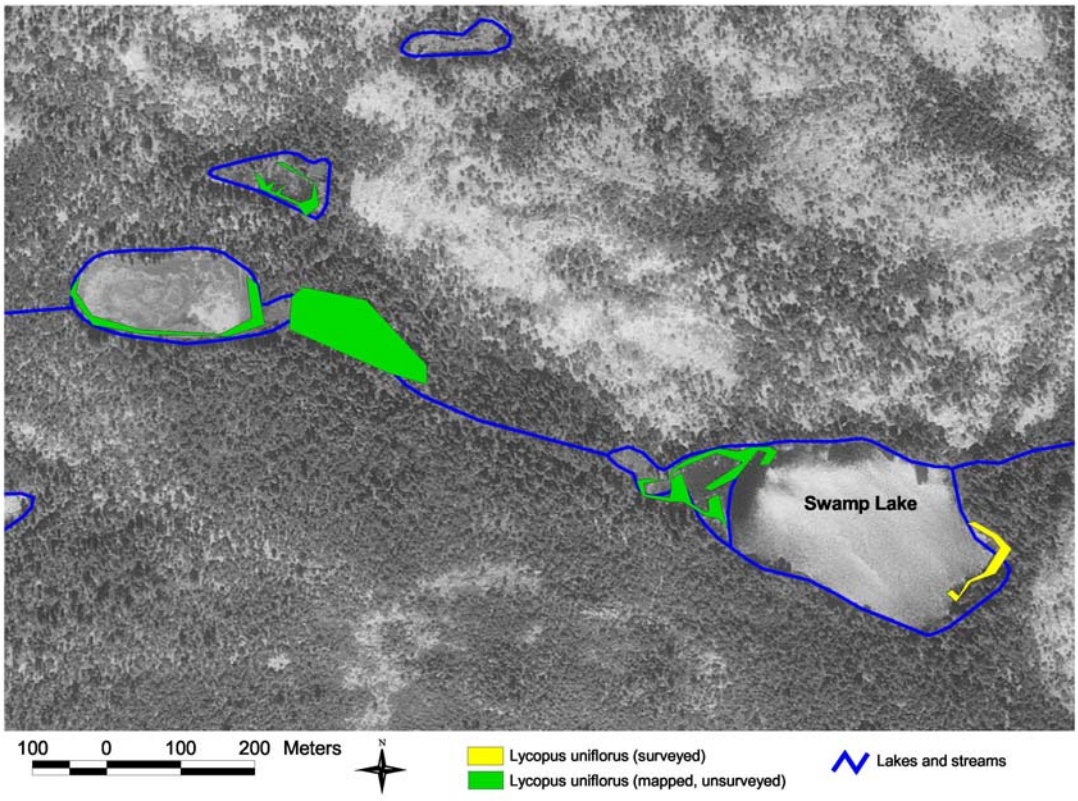


Figure C47. *Lycopus uniflorus* occurs at Swamp Lake and at meadows and lakes west of there. The 2004 survey documented *L. uniflorus* abundance at the east end of Swamp Lake, Yosemite National Park, Tuolumne County, California, and mapped all stands found.

Location of Deposited Voucher Specimens

No vouchers were collected.

Remarks

Lycopus uniflorus is a wetland obligate species; it almost always occurs in wetlands under natural conditions (USFWS 1996). It therefore requires a moist environment, including being rooted in saturated soil during the growing season. It is broadly distributed in the U.S. except for the southeast and southwest (USDA 2004).

Discussion

Factors That May Have Affected Survey Results

We were surveying a number of other taxa at the Swamp Lake site with insufficient time remaining to obtain population estimates for *L. uniflorus* at the west shore or lakes to the west in 2004 (Figure C47).

Assessment of Threats or Potential Impacts

There are no apparent direct threats at this time.

Recommended Measures to Minimize Impacts

Swamp Lake receives extremely low visitation. Botanists may visit periodically to observe, survey or recollect unusual, historic collections. Paleoecology work has been done at the lake

(lake bottom coring) and perhaps other research. It is possible that, in the future, visits could be planned to make remeasurements based on data collected in the 1930s by the Yosemite School for Field Natural History (aka, Research Reserve data). In all cases, visitors should be sensitive to a number of unique occurrences and other park-sensitive species. They occur in the meadow around and on the shore of Swamp Lake, on the floating islands within the lake, and at the marsh west of and downstream from Swamp Lake. Care should be taken to avoid undue collection, trampling, etc.

Significance of Yosemite Populations

The earliest collection of *L. uniflorus* in Yosemite was that of Mason and Reinecke (11589, 22 July 1937, UC1191819) at Swamp Lake. There is only one other reported location in Yosemite: Lost Lake in Little Yosemite Valley (Botti 2001).

Additional Work Needed

Surveys should be done to document abundance at Lost Lake and the remainder of the area around Swamp Lake.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 14 January 2005.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Rubtzoff, P. and L. R. Heckard. 1975. New distributional records for California flowering plants of aquatic and moist habitats. Wasmann Journal of Biology, 33(1-2):93. [Distributional information].

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

U.S. Fish and Wildlife Service (USFWS). 1996. National list of vascular plant species that occur in wetlands: 1996 national summary. National Wetlands Inventory, Division of Habitat and Resources Conservation, Arlington, Virgina, USA. Online. (http://www.nwi.fws.gov/bha/download/1996/national.pdf). Accessed 15 September 2004. [Location in 2010: http://www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list96.pdf]

Mimulus filicaulis S. Watson

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Scrophulariaceae

Synonyms

Mimulus biolettii Eastw. in part

Vernacular Name

slender-stemmed monkeyflower, slenderstem monkeyflower, Hetch Hetchy monkeyflower

Status

- Federal: Forest Service Sensitive (Region 5, Stanislaus NF, Sierra NF)
- California: none
- CNDDB: G2[1]/S2.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive



Figure C48. *Mimulus filicaulis*, Poopenaut Valley Trailhead, Hetch Hetchy Road, Yosemite National Park, Tuolumne County, California, 28 May 2003 (photograph by Peggy E. Moore).

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Mimulus angustatus (A. Gray) A. Gray has tufted, basal leaves only (*M. filicaulis* has cauline leaves); pedicel shorter than the calyx; and corolla 3–6 cm long. Known from Ackerson Meadow outside the western park boundary.

Mimulus breweri (E. Greene) Cov. has a corolla 0.4–1.0 cm long and glabrous anthers. *Mimulus kelloggii* (E. Greene) A. Gray has fruiting pedicels shorter than calyces; it is a foothill species just reaching the park at El Portal. *Mimulus mephiticus* E. Greene has glabrous anthers and fruiting pedicels shorter than calyces; *M. mephiticus* corollas are typically yellow in Yosemite but may be purplish. *Mimulus pulchellus* (E. Greene) A. L. Grant is commonly intermixed with stands of *M. filicaulis*. It has conspicuously bi-colored corolla lobes, the upper purple and the lower three yellow.

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[1]CNDDB Global Rank = G2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres
[2]CNDDB State Rank = S2.2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; threatened
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 2: fairly endangered in California

Distribution

California

Central High Sierra Nevada (Tuolumne, Mariposa cos.), 1,200–1,750 m (4,000–5,750 ft) (Hickman 1993).

Yosemite National Park

Endemic to Tuolumne and Mariposa counties. Main population centers are around Hetch Hetchy and the Tuolumne River Canyon west of the park, occurring in Yosemite at such locations as along the Hetch Hetchy Road near Mather, at Carlon, in Poopenaut Valley and along the Baseline Road near the park boundary, 1,050–1,750 m (Botti 2001); also known within the park from Tuolumne Grove and outside the park (but near the park boundary) from Hazel Green, Crocker Meadow and Moss Creek.



Figure C49. Mimulus filicaulis plants on an old pocket gopher mound, Poopenaut Valley Trailhead, Hetch Hetchy Road, Yosemite National Park, Tuolumne County, California, 4 June 2003 (photograph by Peggy E. Moore).

Survey Methodology and Results

Survey Dates

- MIFI10-1: 31 May 2003
- MIFI10-2: 4 June 2003

Rationale for Survey Timing

Mimulus filicaulis occurs on moist shaded banks, meadow borders, and moist gravelly flats that dry early in the growing season (Figure C49). Occupied habitat is often very shallow, sandy soils over granitic bedrock that can be ephemerally moist prior to severe drying by late June. Four California state-listed species at the lowest elevations in Yosemite and the El Portal Administrative Site were designated first priority for surveys, and we initiated surveys for those taxa as soon as staff members were available. We surveyed *Mimulus filicaulis*, in the second priority group of taxa, as early in the season as time could be borrowed from first priority surveys at the end of May. The mid- to late-May period would be preferable for the start of future surveys, but our dates were ideal for the sites we surveyed (90% of plants were flowering). We discontinued *M. filicaulis* surveys once the probability of detection seriously declined due to shriveling of plants and flower parts as the plants senesced to avoid under-representing plant abundance in survey areas.

Personnel Conducting Surveys

Peggy E. Moore, Charlotte Coulter

Table C20. *Mimulus filicaulis* S. Watson survey locations and results.

Site	Location	Person Hours	Population Size
MIFI10-1	Upper Poopenaut Valley	1.1	0
MIFI10-2	Poopenaut Valley Trailhead	9.3	6,600
Total		**10.4**	**6,600**

Method Used to Estimate or Census the Population

- MIFI10-1: N/A
- MIFI10-2: We searched the entire area throughout and beyond the area mapped as *M. filicaulis* in 1988 (the last park record). We traversed the 2003 survey area with two surveyors who checked all benches between granitic outcrops, as well as sandy flats within outcrops. We made complete stem counts for sparser and/or smaller stands and, for larger stands, made stem counts within m^2 areas that we then applied to similar densities within the stand to estimate total abundance.

Population Location Description

- MIFI10-1: Upper Poopenaut Valley, 1.5 km (0.95 mi) downriver from O'Shaughnessy Dam and 0.5 km (0.3 mi) northeast of Poopenaut Valley on an old stream terrace). The mapped population is 100 m south of a stream gauging station on the Tuolumne River that is installed at the north edge of the stream terrace. The population was described as extending from 100–200 m south of the gauging station (NDDB occurrence number 2). No *M. filicaulis* plants found at this location in 2003.
- MIFI10-2: Poopenaut Valley Trailhead on the Hetch Hetchy Road 5.8 km (3.6 mi) toward Hetch Hetchy Reservoir from Mather Ranger Station. The population extends from the Hetch Hetchy Road 350 m west-northwest out the ridge with scattered stands between a small, unnamed creek southwest of the trailhead and the trail to Poopenaut Valley (NDDB occurrence number 4).

Habitat

Mimulus filicaulis occurs in vernally moist situations on shaded banks, meadow borders, and on moist gravelly flats below 1750 m (5,700 ft) (Figure C50). Sites are typically in full sun or partial shade. Within those sites, plants are most abundant on bare to semi-bare soils with low herbaceous cover such as gopher mounds or sparsely vegetated microsites in montane meadows. Plants



Figure C50. *Mimulus filicaulis* habitat, Poopenaut Valley Trailhead, Hetch Hetchy Road, Yosemite National Park, Tuolumne County, California, 4 June 2003 (photograph by Peggy E. Moore).

may also be moderately abundant in microsites where herbaceous cover is sparse due to shallow soils with very temporary vernal moisture.

Vegetation Communities
Both sites surveyed were located in areas dominated by (and would be mapped as) *Pinus ponderosa–Quercus kelloggii/Arctostaphylos viscida* Woodland Association. However, the microsites where *M. filicaulis* occurred were herbaceous-annual sites with low tree and shrub cover (see Figure C50 and associated species list).

Important Associated Plant Species
Within the plot used to characterize the MIFI10-2 population, the most abundant species were *Wyethia angustifolia*, *Madia yosemitana*, and *Madia elegans* ssp. *elegans*; however, *Wyethia* and *Madia* were not typical throughout most of the population. Other associated species within the MIFI10-2 plot included *Limnanthes alba*, *Trifolium wildenovii*, *Vulpia microstachys*, and *Lupinus nanus*; these species were more typical associates throughout the population.

Phenological Development
M. filicaulis was among the first species to flower on survey sites along with other early flowering species such as *Mimulus pulchellus*, *Vulpia microstachys*, *Limnanthes alba*, *Vulpia bromoides*, and *Aira caryophyllea*. Ephemeral annuals were still green, and soil was still moist from unseasonably late, frequent spring rains. Approximately 90% of plants were flowering; fewer than 5% had fading flowers or developing fruits.

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks
Mimulus filicaulis is endemic to Mariposa and Tuolumne counties. The largest population centers are in the vicinity of Hetch Hetchy Reservoir and in the Tuolumne River Canyon west of Yosemite (Botti 2001). Botti (2001) indicates that population numbers can vary significantly from year to year, reflecting the degree of seed-bank response to annual weather patterns.

The type collection of *M. filicaulis* was made southwest of Yosemite by J. W. Congdon s.n. 12 June 12 (GH 78747). The species was described by Sereno Watson (1891) of Gray Herbarium from Congdon's collection. The type locality is Snow Creek near Darrah in Mariposa County 17 km (10 mi) west of Wawona and 14 km west of the park boundary. Another J. W. Congdon collection (s.n., 1 June1890) from the same time period resides at Jepson Herbarium, University of California, Berkeley (JEPS74243).

Discussion
Factors That May Have Affected Survey Results
We did not find any *M. filicaulis* plants at the upper Poopenaut Valley site (MIFI10-1) despite surveying in the location recorded as "100–300 m due south of the [Tuolumne] river from river gauging station on bank" in a 1988 survey form. Yosemite Park records have the above location on the survey form but the location mapped on the Lake Eleanor 15 minute topographical quadrangle as approximately 400 m north-northwest of that location. We traversed the mapped area and did not encounter *M. filicaulis* plants or appropriate habitat in the latter vicinity. Despite the abundance of *M. pulchellus* in the survey area, with which *M. filicaulis* is closely associated

in the Hetch Hetchy vicinity, the location surveyed may not have been the same as that surveyed in 1988 due to discrepancies in the survey records.

The 6,600 plants found at the Poopenaut Valley trailhead site (MIFI10-2) during the 2003 survey is greater than the 50 plants reported by Botti in 1984 and much fewer than the 35,150 plants reported by Sydoriak in 1988. It is unclear to what extent fire activity may have played a role in the population variability, but Botti (2001) has observed that *M. filicaulis* is "a vigorous pioneer following intense fire," and survey results may reflect patterns associated with fire occurrence and exclusion. Yosemite National Park fire history records indicate only the 1996 Ackerson complex burned in or near the site within the last 75 years. It is also likely this ephemeral annual species responds dramatically to weather patterns on an annual basis.

Assessment of Threats or Potential Impacts

There are no evident direct impacts notable at this time with the exception of some minor trampling by infrequent visitors around the Poopenaut Valley trailhead. Increases in visitation to the area could have minor impacts. Regional air quality and climate change pose the most likely threats to park populations especially in light of resultant changes in fire frequency and intensity and interannual weather patterns.

Recommended Measures to Minimize Impacts

Further development of the Poopenaut Valley trailhead should be avoided, especially on the north and west sides of the road. Plants extend to within a few meters of the fill supporting the road and are, therefore, within the non-wilderness road corridor. The best avenue of reducing the effects of declining air quality and climate change is to continue interagency efforts of educating the public on ways to improve regional air quality and ways to reduce greenhouse gas emissions.

Significance of Yosemite Populations

Botti (2001) reports that the "main population centers [are] located around Hetch Hetchy and the Tuolumne River Canyon west of the park." The 39 specimens currently listed in the SMASCH (2004) database reflect a distribution that extends from the above area south to the South Fork of the Tuolumne River and vicinity. The California Native Plant Society (2003) lists logging, reforestation with herbicides, and grazing as threats to *M. filicaulis*. The lack of these activities on National Park Service lands may provide greater protection for Yosemite populations.

Additional Work Needed

CNDDB (CDFG 2003) records indicate the population sought in May 2003 above Poopenaut Valley, 1.5 km below O'Shaughnessy Dam, continues on the northwest side of the Tuolumne River where 19 plants were found in 1988 according to NPS records; 150 plants were found during the 1988 survey on the southeast side of the river according to NPS records. The location on the south side of the river was surveyed in 2003 based on Yosemite National Park records only and may or may not have been in the correct location (records are contradictory regarding location). The areas on both sides of the river should be surveyed to determine if the population is extant. Three other areas mapped in the 1980s as supporting *M. filicaulis* populations should be surveyed:

1. On the Hetch Hetchy Road at the park boundary (NDDB occurrence number 5)

2. On the Hetch Hetchy Road between benchmarks 4866 and 5027 (NDDB occurrence number 34)
3. Along Hetch Hetchy Road, about 2 air miles ENE of Mather Ranger Station, near benchmark 4749 and in the SW quarter of the SW quarter of Section 29 (NDDB occurrence number 38).

In addition, an attempt should be made to relocate a small Baseline Road population reported in 1988. Ten *M. filicaulis* plants were found 31 May 1988 on Baseline Road approximately "1.2 mi west of Baseline Camp" (end of the dirt road leaving Evergreen Road from just south of Evergreen Lodge, paralleling the Mt. Diablo Baseline for 1.9 km before ending at the Mather water tank/Baseline Camp) and approximately 100 m south of the Mt. Diablo Baseline (252100 m E × 4197328 m N, UTM Zone 11S, North American Datum 1927 at 1690 m elevation) according to the marked location on the Lake Eleanor 15 minute topographic quadrangle.

Qualifications of Field Personnel at the Time of Surveys

Peggy E. Moore: Range Management, University of California, Berkeley, 1992. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Literature

Bacigalupi, R. 1981. The identity of *Mimulus filicaulis*. Changing Seasons 1 Supplement (3):3–5. [Taxonomic discussion].

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2004. Inventory of rare and endangered plants (online edition, v6.2). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 24 March 2004.

California Department of Fish and Game (CDFG), California Natural Diversity Database. 2003. RareFind version 3.0.5. Wildlife and Habitat Data Analysis Branch, Sacramento, California. Online. (http://www.dfg.ca.gov/biogeodata/cnddb/).

Grant, A. L. 1924. A monograph of the genus *Mimulus*. Annals of the Missouri Botanical Garden. 11(2–3):99-388. [Taxonomic treatment].

Hickman, J. C. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 31 December 2004.

Watson, S. 1891. *Mimulus filicaulis*. Proceedings American Academy of Arts and Sciences 26:125. [Original description].

Mimulus pulchellus (E. Drew ex Greene) A. L. Grant

Information compiled by Peggy E. Moore, 2004



Figure C51. *Mimulus pulchellus*, Poopenaut Valley Trailhead, Hetch Hetchy Road, Yosemite National Park, Tuolumne County, California, 4 June 2003 (photograph by Peggy E. Moore).

Species Overview

Family

Scrophulariaceae

Synonyms

Eunanus pulchellus E. Drew ex Greene

Vernacular Name

pansy monkeyflower, yellowlip pansy monkeyflower

Status

- Federal: Forest Service Sensitive (Region 5, Stanislaus NF)
- California: none
- CNDDB: G3[1]/S3.2?[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species

Mimulus bicolor Benth., another bicolored annual *Mimulus* in the region, has upper lobes white, conspicuous pedicels that are longer than the calyx and deciduous corollas. It similarly has a yellow lower lip but contrasts with the 1–2 mm pedicels and persistent corolla of *M. pulchellus*. *Mimulus filicaulis* S. Watson, a diminutive annual with which *M. pulchellus* co-occurs in the area, has corolla deciduous, lobes all reddish-purple, and pedicels longer than calyces.

Distribution

California

Northern and central Sierra Nevada Foothills (Calaveras, Tuolumne, Mariposa cos.), 600–2,000 m (1,950–6,550 ft) (Hickman 1993)

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[1]CNDDB Global Rank = G2G3: Intermediate between G2 and G3 global rankings
[2]CNDDB State Rank = S2S3.2: Intermediate between 6–20 and 21–80 occurrences or between 1,000–3,000 individuals and 3,000–10,000 individuals or between 2,000–10,000 acres and 10,000–50,000 acres; threatened
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 2: fairly endangered in California

Yosemite National Park

Occurs near the western boundary of Yosemite in Poopenaut Valley, along the Hetch Hetchy Road, at Hodgdon Meadow, Big Meadow and Ackerson Meadow, 1,050–1,550 m (3,450–5,050 ft) (Botti 2001).

Survey Methodology and Results

Survey Dates

- MIPU10-1: 31 May 2003
- MIPU10-2: 4 June 2003

Rationale for Survey Timing

Mimulus pulchellus occurs in moist meadows and vernally wet, open, sandy benches and depressions below 1,550 m that dry early in the growing season. Occupied habitat can be very shallow, sandy soils over granitic bedrock that can be ephemerally moist prior to drying by late June. Four California state-listed species at the lowest elevations in Yosemite and the El Portal Administrative Site were designated first priority for 2003–2004 USGS surveys, and we initiated surveys for those taxa as soon as staff was available. We surveyed *Mimulus pulchellus*, in the second priority group of taxa, as early in the season as time could be borrowed from first priority surveys at the end of May. The mid- to late-May period would be preferable for the start of future surveys, but our dates were ideal for the sites we surveyed with 90% of plants flowering at the time of the visit. We discontinued *M. pulchellus* surveys once the probability of detection seriously declined due to shriveling of flower parts as the plants senesced to avoid under-representing plant abundance in survey areas.

Personnel Conducting Surveys

Peggy E. Moore, Charlotte Coulter

Table C21. *Mimulus pulchellus* (E. Drew ex Greene) A. L. Grant survey locations and results.

Site	Location	Person Hours	Population Size
MIPU10-1	Upper Poopenaut Valley	1.1	3,470
MIPU10-2	Poopenaut Valley Trailhead	9.3	3,335
Total		**10.4**	**6,805**

Method Used to Estimate or Census the Population

- MIPU10-1: Complete stem count for entire 2,000 m^2 derived by walking in a grid pattern through the population. Searched entire stream terrace for *M. pulchellus* plants.
- MIPU10-2: We searched the entire area through and beyond the mapped area of species occurrence (from 1988 survey). We traversed the 2003 survey area with two surveyors who checked all benches between granitic outcrops as well as sandy flats within outcrops. We made complete stem counts for sparser and/or smaller stands and, for larger stands, made stem counts within m sq areas that we then applied to similar densities within the stand to estimate total abundance.

Population Location Descriptions

- MIPU10-1: Upper Poopenaut Valley, 1.5 km (0.95 mi) downriver from O'Shaughnessy Dam and 0.5 km (0.3 mi) northeast of Poopenaut Valley on an old stream terrace (254189E × 4202209N, UTM Zone 11, NAD27 datum). The population is 100 m south of a stream gauging station on the Tuolumne River that is installed at the north edge of the stream terrace. The plants extended from 100 m south of the gauging station to 200 m south of the station in a band approximately 20 m wide.
- MIPU10-2: Poopenaut Valley Trailhead on the Hetch Hetchy Road 5.8 km (3.6 mi) toward Hetch Hetchy Reservoir from Mather Ranger Station. The population extended from the Hetch Hetchy Road 350 m west-northwest out the ridge with scattered stands between a small, unnamed creek southwest of the trailhead and the trail to Poopenaut Valley.

Habitat

Mimulus pulchellus occurs on moist gravelly flats; on vernally wet, open, sandy benches and depressions; and in vernally wet ephemeral stream channels—in short, vernally moist depressions—below 1,550 m (5,100 ft) (Figure C52). Sites are typically in full sun or sometimes with a portion in partial shade. Within those sites, plants are most abundant on bare to semi-bare soils with low herbaceous cover such as gopher mounds, deposits from silty streams or cutoff channels, or sparsely vegetated microsites in montane meadows. Plants may also be moderately abundant where herbaceous cover is sparse due to thin soils with temporary vernal moisture.

Vegetation Communities

Both populations surveyed were located in sites dominated by (and would be mapped as) *Pinus ponderosa–Quercus kelloggii*/*Arctostaphylos viscida* Woodland Association. However, the microsites where *M. pulchellus* occurred were herbaceous-annual sites with low tree and shrub cover.

Important Associated Plant Species

Surveyed populations are within areas dominated by *Pinus ponderosa*, *Quercus kelloggii*, and *Arctostaphylos viscida* ssp. *mariposa*, as well as other shrub species. The two stands surveyed differed in associated herbaceous species because MIPU10-1 was a much more mesic valley bottom site, while MIPU10-2 was an upland, bedrock-dominated site with vernally moist flats. Important associated species at the MIPU10-1 site included *Deschampsia danthonioides, Limnanthes alba, Bromus hordeaceous, Poa secunda* ssp. *secunda, Aira caryophyllea*, and *Minuartia douglasii*. Within the plot used to characterize the MIPU10-2 population, the most abundant species were *Wyethia angustifolia*, *Madia yosemitana*, and



Figure C52. *Mimulus pulchellus* habitat, Poopenaut Valley Trailhead, Hetch Hetchy Road, Yosemite National Park, Tuolumne County, California, 4 June 2003 (photograph by Peggy E. Moore).

Madia elegans ssp. *elegans*; however, *W. angustifolia* and *Madia* spp. were not typical throughout most of the population. Other associated species within the MIPU10-2 plot included *Limnanthes alba*, *Trifolium wildenovii*, *Vulpia microstachys*, and *Lupinus nanus*; these species were more typical associates throughout the population.

Phenological Development

Mimulus pulchellus was among the first species to flower on survey sites, along with other early flowering species, such as *Mimulus filicaulis*, *Vulpia microstachys*, *Limnanthes alba*, *Madia exigua*, and *Aira caryophyllea*. Ephemeral annuals were still green, and soil was still moist from unseasonably late, frequent spring rains. Approximately 90% of plants were flowering; fewer than 5% had fading flowers or developing fruits.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Mimulus pulchellus is endemic to the foothills of Calaveras, Tuolumne and Mariposa counties and occurs infrequently near the western boundary of Yosemite (Botti 2001)

Discussion

Factors That May Have Affected Survey Results

The Tuolumne River flooded portions of the river terrace at the upper Poopenaut Valley site in 2003 prior to the survey. There was some silt deposition in places. It was not apparent how this might have affected the germination of *M. pulchellus*.

Assessment of Threats or Potential Impacts

Outside Yosemite National Park, *M. pulchellus* is considered threatened by vehicles, logging, and grazing, and potentially by development (CaliforniaNative Plant Society 2003).

Recommended Measures to Minimize Impacts

Further development of the Poopenaut Valley trailhead should be avoided, especially on the north and west sides of the road. Plants extend to within a few meters of the fill supporting the road and are, therefore, within the non-wilderness road corridor.

Significance of Yosemite Populations

M. pulchellus was first described from specimens collected at Lake Eleanor (Botti 2001) in the northwest portion of Yosemite National Park (V.K. Chestnut and E. Drew, holotype, UC).

Additional Work Needed

Two other areas mapped in the 1980s as supporting *M. pulchellus* populations should be surveyed:

1. along the Hetch Hetchy Road 0.5 mi southeast of the Poopenaut Valley Trailhead
2. on the Hetch Hetchy Road between benchmarks 4866 and 5027 (USGS Lake Eleanor 15 minute quadrangle).

Habitat parameters should be derived from GIS analysis of mapped populations to model any additional potential habitat. Potential habitat should then be verified by sampling predicted areas.

Qualifications of Field Personnel at the Time of Surveys

Peggy E. Moore: MS Range Management, University of California, Berkeley, 1992. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2003. Inventory of rare and endangered plants (online edition, v6.2). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 19 March 2004.

Grant, A. L. 1924. Scrophulariaceae *Mimulus pulchellus*. Annals of the Missouri Botanical Garden 11(2–3):316–317.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Myrica hartwegii S. Watson

Information compiled by Peggy E. Moore, 2005



Figure C53. *Myrica hartwegii*, South Fork Merced River, Wawona, Yosemite National Park, Mariposa County, California, 1 September 2004 (photograph by Charlotte Coulter).

Species Overview

Family

Myricaceae

Synonyms

None

Vernacular Name

Sierra sweet bay, Sierra bayberry

Status

- Federal: None
- California: None
- CNDDB: None
- CNPS: None
- Yosemite National Park: Sensitive

Description

Deciduous shrub 1–2 m tall; leaves alternate, oblanceolate, sharply serrate, sparsely puberulent and dull green (Figure C54); dioecious, flowers in catkin-like structures with many flowers per inflorescence; fruit a drupe with one stone. See Hickman (1993) and Botti (2001) for detailed descriptions.

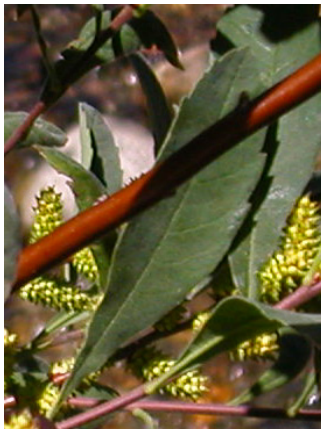


Figure C54. *Myrica hartwegii* leaves and fruits, South Fork Merced River, Yosemite National Park, Mariposa County, California, 1 Sept. 2004 (photograph by Charlotte Coulter).

Similar Species

Other non-viny shrubs with catkin-like inflorescences in Yosemite have either opposite (Garryaceae) or compound (Juglandaceae) leaves, or fruits that are capsules with multiple seeds (Salix), acorns (Fagaceae), winged nutlets in a cone-like structure (*Alnus*), or nuts (*Corylus*).

Distribution

California

Endemic to the northern and central Sierra Nevada (Hickman 1993)

Yosemite National Park

South Fork Merced River downstream from Wawona, Big Creek (Botti 2001)

Survey Methodology and Results

Survey Dates

1 September 2004

Rationale for Survey Timing
M. hartwegii remains easily identifiable after flowering. We scheduled the survey late in the growing season while both male and female plants were fruiting and after more ephemeral species were well past flowering.

Personnel Conducting Surveys
Charlotte Coulter, Angela Sanders

Table C22. *Myrica hartwegii* S. Watson survey locations and results.

Site	Location	Person Hours	Population Size
MYHA10-1	South Fork of the Merced River adjacent to the Wawona Campground	7	1,292

Method Used to Estimate or Census the Population
Myrica hartwegii plants along the South Fork had multiple stems from a single base. It appears to sprout from the base. Stems emerging from a shared base were considered individual plants and tallied as such. The abundance estimate did not include any young plants that could not be distinguished from root shoots and so may be an underestimate.

Population Location Description
South Fork of the Merced River adjacent to the Wawona Campground and 850 m (2,790 ft) downstream on both sides of the river. This location is approximately 350 m (1,150 ft) downstream of the Big Creek confluence with the South Fork.

Habitat
Rocky stream banks within the seasonal flood zone to 5 m (16 ft) upslope, 500–1,310 m (1,640–4,300 ft), adjacent to lower montane forest (Figure C55).

Vegetation Communities
Within Target Species Population: *Salix melanopsis* Seasonally Flooded Shrubland Alliance

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest Association

Important Associated Plant Species
Pinus ponderosa and *Alnus rhombifolia* were dominant in the overstory. *Salix melanopsis*, *Apocynum cannabinum*, and *Rhododendron occidentale* were the important shrub species, each in lesser abundance than *M. hartwegii* within a 200-m^2 plot. Important herbaceous species included *Equisetum hyemale* ssp. *affine*, *Lotus purshianus* var. *purshianus*, *Pteridium aquilinum*, and *Panicum acuminatum* var. *acuminatum*. Non-native herbaceous species present included *Cirsium vulgare* and *Holcus lanatus*.

Phenological Development
Nearly all associated species were at the fruiting stage. Reproductive *M. hartwegii* were fruiting; 10% of the population did not appear to be reproductive in 2004.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Myrica hartwegii was first collected by J. C. Fremont (24) along the "borders of the San Joaquin River near the foot of hills," 21 December 1845. Syntypes at New York Botanical Garden (NY8509) and Gray Herbarium, Harvard University (GH 33549, 33550, 33551).



Figure C55. *Myrica hartwegii* habitat along the South Fork of the Merced River, Yosemite National Park, Mariposa County, California, 1 September 2004 (photograph by Charlotte Coulter).

Discussion

Factors That May Have Affected Survey Results

Annual winter and spring flooding, as well as higher volume periodic flooding, affects the site along the South Fork of the Merced River. However, this species is adapted to flooding and is expected to recover fairly quickly following such events. The river and its banks are heavily used by campers from the Wawona Campground (Figure C56). There is trampling and bank erosion resulting from this use. It is unclear whether this has affected plant abundance on the site.

Assessment of Threats or Potential Impacts

Soil compaction likely results from human trampling of the river bank at the Wawona Campground. Trampling of vegetation and the introduction of aggressive non-native plant species has reduced habitat quality for much of the length of the campground. Effects include soil loss, reduced soil air volume and water holding capacity, competition from non-native species, and nutrient loss due to reduction of litter layer.

Recommended Measures to Minimize Impacts

Non-native plant species should be removed from the vicinity of the *M. hartwegii* population. Campers might be directed to hardened stretches of streamside if any are available (e.g., sand bars) for fishing, swimming, etc.

Significance of Yosemite Populations

Myrica hartwegii is endemic to the northern and central Sierra Nevada and a species of quite limited distribution in Yosemite. It is known from just three stands currently, one stretching from the Wawona Campground downstream to the park boundary and two along Big Creek.

Additional Work Needed

Two additional stands of *M. hartwegii* were mapped in the 1980s by park staff. One is at the mouth of Big Creek at the confluence with the South Fork of the Merced River. The other is on Big Creek southwest of the South Entrance Station to the park. These stands should be surveyed

to assess their status, and additional surveys completed in the vicinity (e.g., the remainder of Big Creek) to seek additional stands and ascertain the current status of the species in the park.

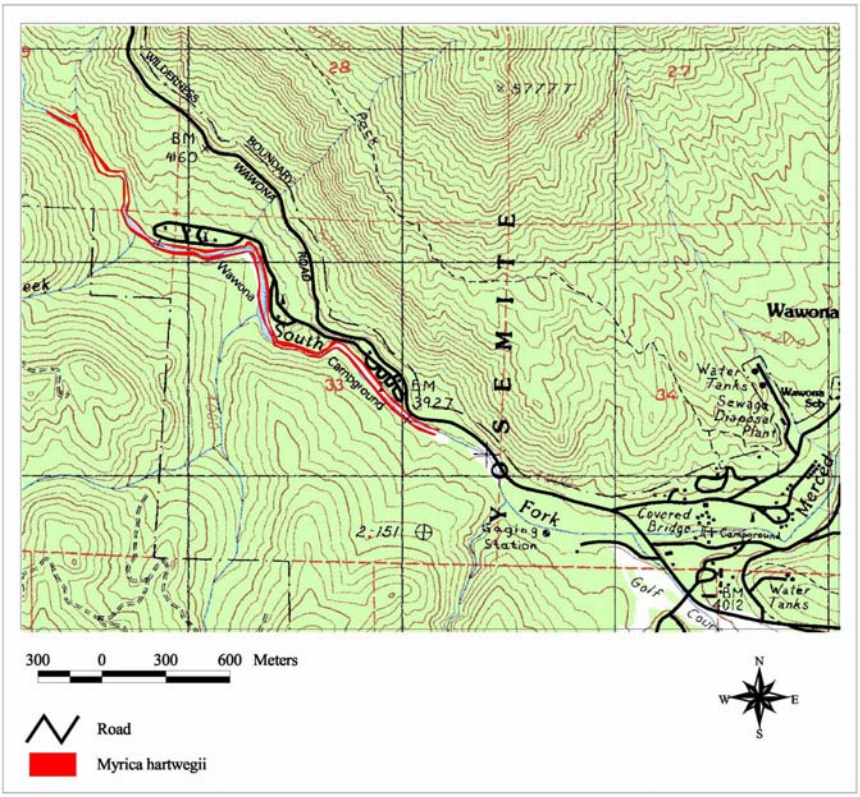


Figure C56. *Myrica hartwegii* population along the South Fork of the Merced River, Wawona Campground and downstream, Yosemite National Park, Mariposa County, California. Survey date: 1 September 2004.

Qualifications of Field Personnel at the Time of Surveys

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders**:** BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Watson, S. 1875. *Myrica hartwegii*. Proceedings of the American Academy of Arts and Sciences 10:350.

Orobanche californica Cham. and Schldl. ssp. *grayana* (G. Beck) Heckard

Information compiled by Alison E. L. Colwell, 2005



Figure C57. *Orobanche californica* ssp. *grayana* inflorescence, Meteor Meadow, Trinity County, California, 12 August 2003 (© 2003 Dean Wm. Taylor).

Species Overview

Family

Orobanchaceae

Synonyms

O. grayana G. Beck

Vernacular Name

California broomrape

Status

- Federal: none
- California: none
- CNPS: none
- Yosemite National Park: Sensitive

Description

Orobanche californica ssp *grayana*, is an annual or biennial root parasite of *Erigeron* and *Aster* species. It germinates in response to the presence of an appropriate host root and attaches via a sucker-like connection initiated by the seedling radical tip. It grows as a rootless tubercle on the host root until it reaches sufficient size to flower, which is about 1 cm in diameter. The inflorescence appears above ground between July and October. The plants are 4–10 cm in total length, including underground parts. The stem may be branched or not, the leaves reduced to colorless scales along the stem. The entire plant is buff colored to pinkish tinged. The inflorescence is a convex to flat-topped corymb, flowers 3–20. The corolla is 20–30 mm, tube gradually widening to 5–8 mm. Corolla lobes are pointed, white with pink venation on the interior, and two swollen yellow palatial folds between lower petals.

Similar Species

Orobanche californica can be distinguished by habitat and host species. However, there are two other Sierran species of *Orobanche* that are morphologically similar and can be mistaken for this species if the habitat and host are not carefully noted.

- *Orobanche corymbosa* (Rydb.) Ferris occurs in openings in sagebrush scrub, generally on *Artemisia tridentata*. It occurs from 1,200–3,500 m (3,940–11,480 ft). It can be distinguished from ORCAGR by rounded upper corolla lobes and generally a more highly colored interior of corolla lobes of yellow tones with the pink.
- *Orobanche californica* ssp *jepsonii* (Munz) Heckard occurs on dry flats, slopes and peaks below 2200 m, on *Grindelia* species. It can be distinguished from *O. californica* by its

more robust size (10–35 cm), the stem below the inflorescence being 6 cm or more long, whereas it is generally less than 3 cm long in *O. californica*. The inflorescence is racemose to paniculate, the racemes 5–20 cm long.

Distribution

California

West slopes Sierra Nevada, mid-elevation seasonally moist meadows. Documented from a single site in each of the following counties: Nevada, Placer, Plumas, Trinity, Tehama, Sonoma (although the two reports from Sonoma County may be misidentified *O. californica* ssp *jepsonii*).

Yosemite National Park

Miguel Meadow, west of Hetch Hetchy Valley, 5,200': H.L. Mason 12127 7/11/39 JEPS 20913, UC199825; Yosemite National Park, Miguel Meadows, by willows near pond beside camp, Lake Eleanor Quad: David Dunn 259 7/12/40 YM 3880; Wawona, moist meadow margin, 4200': C. W. Sharsmith 4758 7/2/44 YOSE 66557; Yosemite: Hone and Sherman 32, no date, UC1375676.

Survey Methodology and Results

Survey Dates

12 July 2003, 15 July 2004

Rationale for Survey Timing

This plant was previously collected twice in the locality surveyed, on 11 July 1939 and 12 July 1940. We expected, therefore, that it would be in flower again on approximately the same date.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C23. *Orobanche californica* Cham. and Schldl. ssp. *grayana* (G. Beck) Heckard survey locations and results.

Site	Location	Person Hours	Population Size
ORCA24-1	Miguel Meadow	10	Unknown (none found)

Method Used to Estimate or Census the Population

Orobanche species are obligate parasites, and require a large and stable host population for long-term survival. Furthermore, they prefer sandy soil with sparse vegetation cover, such that sunlight reaches bare ground. Because *Orobanche* spp. are diminutive and often similar in color to the soil, the search focuses first on finding a combination of suitably large host populations on preferred substrate. In the case of *O. californica*, the host would be any of a number of species of *Aster* or *Erigeron*, or possibly other perennial Asteraceae forbs. Known localities of *O. californica* possess large numbers (hundreds to thousands) of one or more host species, in bottomland meadows of mid-elevation which are seasonally moist due to snow pack, but which are well drained and dry by midsummer. Although *O. californica* is never found in wet or boggy habitat, populations tend to be found in areas in which the host has reliable access to water, such as the lowest point of a dry meadow, or at the base of a slope or swale. *O. californica* flowering

events may also be linked to localized summer rain showers, the inflorescences emerging from the soil 1–2 weeks after a local downpour. If there is more than one local downpour in the July–September blooming season, then it can be expected that there will be more than one cohort of inflorescences emerging accordingly.



Figure C58. *Orobanche californica* ssp. *grayana* habitat, Meteor Meadow, Trinity County, California, 12 Aug 2003 (© 2003 Dean Wm. Taylor).

Once suitable host and habitat are found, then a careful visual inspection of the ground in the vicinity of the host plants is required. In some cases *Orobanche* will emerge in the shade of their host, but in most cases will emerge in open ground within a meter to several meters away from their host. In the case of newly emerging inflorescences, cracked or mounded soil may be the first indication that *Orobanche* is emerging below. Another clue is the presence of dried inflorescences. *Orobanche* will set seed and dry brown in a few weeks after emerging, but the dried inflorescence stalks may persist up to a year. If dried inflorescences are seen, then fresh ones are often lurking nearby.

Orobanche californica is an annual or overwintering biennial, usually single stalked, so each stalk represents one individual. The population size can only be estimated from the number of flowering stalks present, although the actual number of growing individuals present below ground is much larger. It is unknown what percentage of *Orobanche* tubercles will emerge and flower in a given year. A given population will vary from none to several hundred individuals, depending on the amount of moisture in a growing season, so it is likely that the pre-flowering mortality is very high. However, *O. californica* is outcrossed so no seed set will occur in the absence of emerged inflorescences. In that respect, a count of inflorescences, while it likely only represents a fraction of living individuals in a given year, does represent the size of the gene pool for that year.

In this survey, we found no large populations of suitable host species in the vicinity of the 1939 and 1940 collections. We found no fresh or dried inflorescences of *O. californica*. It is possible that a survey conducted later in the year would have been more successful in identifying suitable host populations. It would also be useful to revisit survey areas more than once in a flowering season, since the flowering dates can be variable from year to year.

Population Location Descriptions

David Dunn's collection reports the following: "By willows near pond beside camp at Miguel Meadows." The camp appears to be in center of NW section 12, south of Eleanor Road and Miguel Creek, on the Lake Eleanor 7.5 minute USGS topographic quadrangle. This is now an occasionally occupied Ranger Station and pack camp, but was the site of the Yosemite School of Field Natural History, run by Herbert L. Mason from 1938 to 1942. Mason's collection reports: "Miguel Meadow, west of Hetch Hetchy Valley 5,200'. The pond and spring in the meadow

adjacent to the former field school camp were relocated and are still surrounded by willows. The UTM location for this site is: UTM Zone 11, 250362E 4204884N; the datum is NAD 1927.

Habitat

Seasonally moist meadows 1,200–1,800 m (3,940–5,900 ft). (e.g. meadows that have significant snow cover in winter) (Figure C58). Loose sandy substrate with sparse to dense vegetation cover.

Vegetation Communities

Within Target Species Population: *Erigeron* spp. or *Aster* spp./mid-montane meadow

In Survey Area outside Documented Population(s): *Abies concolor–Pinus lambertiana* Alliance

Important Associated Plant Species

The required host species (*Aster* spp. [e.g. *A. occidentalis*] or *Erigeron* spp. [e.g. *E. peregrinus, E. breweri*]) must be present in large and stable populations in order to support a population of *Orobanche californica* ssp. *grayana*.

Mason's 1939 collection includes a snippet of presumed host, labelled "*Aster* on sheet, possibly *eatonii*". Dean W. Taylor (consulting botanist, personal communication) suggests that the material is in fact from *Erigeron brewerii*. No *E. brewerii* was located on this survey, but small populations of *Erigeron* and *Aster* species were not yet in flower at the time of the survey, so it is possible they are still present in the area.

Phenological Development

This species is reported to flower July through September, although flowering dates will vary from year to year, depending on the timing of summer rains. As a rule of thumb, it will be in flower 1–2 weeks after a local summer downpour. In years where the preceding winter and spring were abnormally dry, it will not appear at all. The timing of flowering of *O. californica* coincides with a flush of growth of the host plant in preparation for its own flowering.

Location of Deposited Voucher Specimens

We collected no voucher specimens because we did not relocate the species.

Remarks

Although not yet officially recognized as a rare species, *O. californica* is among the most infrequently recorded species in California. There are a handful of collections from the Willamette Valley in Oregon and the Columbia River Valley in Washington from 100 years ago, but it is presumed extinct in both those states. Because of its ephemeral appearance above ground and its diminutive size, it may easily be overlooked in botanical surveys. However, its preferred habitat of seasonally moist mid-elevation meadows leaves it vulnerable to impacts from human uses.

Discussion

Factors That May Have Affected Survey Results

Because the host plant was not yet in flower, we may have overlooked patches of suitable host plant.

Assessment of Threats or Potential Impacts

This area was until the 1940s a cattle and sheep ranch, with extensive pastures. The lack of fire and discontinuation of grazing in Miguel Meadow since 1940 has resulted in encroachment of the surrounding forest on the meadow habitat and very thick thatch buildup in the meadows themselves. *Orobanche californica* requires its host species to be present and they may be crowded out in tall, dense vegetation. *O. californica* seeds may survive many years in a seed bank until suitable conditions and hosts return.

Recommended Measures to Minimize Impacts

Burn Miguel Meadow vicinity.

Significance of Yosemite Populations

Miguel Meadow is one of two reliably documented occurrences of ORCAGR in Yosemite National Park. It was reported by Steve Botti (personal communication) to occur along Foresta Road, above El Portal, but we did not find suitable habitat or host species in that area.

Additional Work Needed

Additional survey hours at Miguel Meadow and Wawona Meadow may successfully relocate this plant. Other sites in the park with suitable habitat and host species may occur.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. El Portal, California.

Heckard, L. R. 1973. A taxonomic re-interpretation of the *Orobanche californica* complex. Madroño 22(2):41–104.

Heckard, L. R. 1993. *Orobanche. In* J. C. Hickman, editor. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed July 2003 to Jan 2005.

Personal Communication

Dean W. Taylor, consulting botanist, Aptos, California (Provided Trinity County locality information).

Stephen Botti, National Park Service (retired) (Provided locality information for Yosemite National Park)

Piperia colemanii Rand. Morgan and Glicenstein

Information compiled by Peggy E. Moore, 2004



Figure C59. *Piperia colemanii*, 1 air m northwest of Beardsley dam, Tuolumne County, California, 22 June 2005 (© 2005 Dean Wm. Taylor).



Figure C60. *Piperia unalascensis* (Spreng.) Rydb., Warner Valley, Drakesbad, Lassen Volcanic National Park, Plumas County, California, 1 July 1998 (© 1998 James B. Gratiot).

Species Overview

Family

Orchidaceae

Synonyms

None

Vernacular Name

Coleman's piperia

Status

- Federal: Forest Service Watch list
- California: none
- CNDDB: G3[1]/S3.3[2]
- CNPS: 4.3[3]
- Yosemite National Park: Sensitive

Description

See Coleman (1995:11) and Morgan and Glicenstein (1993) for detailed descriptions.

Similar Species

Where the spur is shorter than the lip in *Piperia colemanii* (Figure C59), the spur of *Piperia unalascensis* is approximately twice as long and equal to or exceeding the length of the length of the lip (Coleman 1995) (Figure C60). The lip is more upcurved and triangular-lanceolate in the former as well. *P. unalascensis* leaves are broader and the flowers scented. *P. colemanii* flowers are without scent. The spur of *Piperia transversa* is at least twice as long as the lip and is oriented perpendicular to the axis of the inflorescence.

Distribution

California

A narrow strip extending from the Cascade Range in Siskiyou County south along the west slope of the Sierra Nevada to Fresno County (Coleman 1995). Documented or reported from the following counties only: Butte, Colusa, Fresno, Madera, Mariposa, Placer, Plumas, Shasta, Siskiyou, Tulare, and Tuolumne (CNPS 2004). The Colusa County location is disjunct with the remainder of the distribution.

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[1]CNDDB Global Rank = G3: 21–100 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres

[2] CNDDB State Rank = S3.3: 21–100 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres: no current threats known

[3] CNPS List 4: Plants of limited distribution - a watch list; Threat Code 3: not very endangered in California

Yosemite National Park

The species has a patchy distribution along the central to southern western portion of Yosemite (Tamarack Flat, Yosemite National Park, alt. 6390 ft, 14 July 1911, LeRoy Abrams 4698 [holotype DS51997]; Mariposa Grove, Mariposa County [W. L. Jepson 4307 30 July 1911 JEPS64475]; Pohono Trail [Robert J. Rodin 844, 5 August 1946, UC770961]).



Figure C61. *Piperia colemanii* habitat, near Merced Grove, Yosemite National Park, Mariposa County, California, 27 June 2007 (photograph by Dena Grossenbacher, USGS).

Survey Methodology and Results

Survey Dates

8 September 2004

Rationale for Survey Timing

This plant was originally collected in the Tamarack Flat vicinity at the end of July 1911. The September 2004 survey was opportunistic and done in combination with a *Cinna bolanderi* survey in the area. We expected that the plants would retain identifiable characteristics if found. Plants should be sought in July as recommended by Coleman (1995).

Personnel Conducting Surveys

Alison E. L. Colwell, Angela Sanders

Table C24. *Piperia colemanii* Rand. Morgan and Glicenstein survey locations and results.

Site	Location	Person Hours	Population Size
PICO30-1	Old Big Oak Flat Road	4	Unknown (none found)

Method Used to Estimate or Census the Population

Not applicable

Habitat

The habitat of *P. colemanii*, based on the limited number of known localities, is open coniferous forests and chaparral between 1,200 and 2,300 m (3,940 and 7,550 ft) elevation (Coleman 1995, CNPS 2005) (Figure C61). Morgan and Glicenstein (1993) reported it growing in sandy soil, and Coleman (1993) observed it growing in disturbed areas along roadsides.

Vegetation Communities

Within Target Species Population: No population found

In Survey Area outside Documented Population(s): Population not found and vegetation type in survey area not recorded.

Important Associated Plant Species
No survey data were collected, but Coleman (1995) indicates that *P. colemanii* co-occurs with *P. unalascensis*, *P. transversa*, *Corallorhiza maculata*, *C. striata*, and *Cypripedium montanum*.

Phenological Development
No populations found

Location of Deposited Voucher Specimens
No vouchers were collected.

Remarks
The type locality of *P. colemanii* is at Tamarack Flat, Yosemite National Park, alt. 6,390 ft, 14 July 1911, LeRoy Abrams 4698 (holotype DS51997 (now part of CAS)). This species was collected again along the Pohono Trail in 1946 (see distribution section).

Discussion
Factors That May Have Affected Survey Results
The 2004 survey may have been too late in the growing season to detect *P. colemanii* plants if they did not dry well in fruit following their July flowering period.

Assessment of Threats or Potential Impacts
Piperia colemanii occurs infrequently throughout its range as far as is known. However, because of its similarity in appearance to *P. unalascensis*, it may easily be overlooked in botanical surveys. Morgan and Glicenstein (1993) list only 19 known locations. Most colonies occur outside protected areas and are subject to habitat loss due to logging (Coleman 1995).

Recommended Measures to Minimize Impacts
There should be further surveys to better understand the distribution and habitat requirements of *P. colemanii* in Yosemite. There should be use of this information to avoid impacts to the species resulting from development, administrative activities, or visitor use.

Significance of Yosemite Populations
The type locality for *P. colemanii* is Mariposa County, Tamarack Flat, LeRoy Abrams 4698 14 July 1911. The holotype is at California Academy of Sciences (DS51997). We were unable to confirm the presence of *P. colemanii* at this site in 2004. Management in the area is focused on visitor use and protection in the campground and visitor use along the historic old Big Oak Flat Road (now a trail that leads to Yosemite Valley). There is little active management along the trail and no vehicle use.

Additional Work Needed
P. colemanii should be sought again near Tamarack Flat Campground where Morgan and Glicenstein (1993) reported 70 individuals.

Qualifications of Field Personnel at the Time of Surveys
Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North

Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Angela Sanders: BS Biology 2003 with specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed on 11 January 2005.

Coleman, R. A. 1995. The wild orchids of California. Cornell University Press. Ithaca, New York.

Morgan, R., and L. Glicenstein. 1993. *Piperia colemanii*. Lindleyana 8:89.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 15 November 2004.

Personal Communication

Dean W. Taylor, consulting botanist, Aptos, California (Provided information for additional collection localities).

Plagiobothrys torreyi var. *torreyi* (Gray) Gray

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Boraginaceae

Synonyms

None

Vernacular Names

Yosemite popcorn-flower, Torrey's popcornflower

Status

- Federal: none
- California: none
- CNDDB: G4T2Q[1]/S2.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive



Figure C62. *Plagiobothrys torreyi* var. *torreyi* habit, Ahwahnee Meadow, Yosemite Valley, Yosemite National Park, Mariposa County, California, 9 June 2004 (photograph by Charlotte Coulter).

Description

See Hickman (1993:390) and Botti (2001:104) for detailed descriptions.

Similar Species

Plagiobothrys torreyi var. *diffusa* has few to many stems that are decumbent to ascending in contrast to few erect stems in *P. torreyi* var. *torreyi*.

Distribution

California

Known only from Yosemite Valley, Mariposa County

Yosemite National Park

Plagiobothrys torreyi var. *torreyi* is known only from Yosemite Valley.

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[1]CNDDB Global Rank = G4T2Q: G4 = Apparently secure at the species level; this rank is clearly lower than G3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat.T2 = 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres. Q = Questionable taxonomy; Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower conservation priority. Note: Subspecific taxa receive a T-rank attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies.

[2]CNDDB State Rank = S2.2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; threatened

[3]CNPS List 1B: Rare, threatened or endangered in California and elsewhere; Threat Code 2: fairly endangered in California

Survey Methodology and Results

Survey Dates

9 June 2004

Rationale for Survey Timing

The survey year 2004 was advanced in terms of snow-melt timing and plant growth due to a warm, dry spring. Small annual species were flowering mid-May to mid-June, and surveying any later would have encountered specimens well past flowering. As it was, portions of the population had senescent plants.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C25. *Plagiobothrys torreyi* var. *torreyi* (Gray) Gray survey locations and results.

Site	Location	Person Hours	Population Size
PLTO11-1	Ahwahnee Meadow	6	7,429

Method Used to Estimate or Census the Population

Most plants were distinct individuals, and a complete count of plants was possible. In some portions of the population there were small patches of very dense single-stemmed plants that were difficult to distinguish. We estimated the number of plants for these areas. We used vegetative characteristics (hispid hairs on the helicoid inflorescense) to distinguish immature plants to avoid underestimation.

Habitat

Moist meadows, flats and forest edges at approximately 1,200 m (3,940 ft) elevation (Hickman 1993).

Vegetation Communities

Within Target Species Population: Disturbed forest-meadow edge

In Survey Area outside Documented Population(s): *Quercus kelloggii* Forest Alliance

Important Associated Plant Species

Elymus trachycaulus ssp. *subsecundus*, *Rumex acetosella*, *Lessingia* sp., *Achillea millefolium* var. *lanulosa*, *Bromus japonicus*, *Chamomilla suaveolens*

Phenological Development

Seventy-five percent of plants were flowering at the time of the survey. Only 5% were pre-flowering and had distinctive characteristics.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator, and Jepson Herbarium, Bruce Baldwin, curator

Remarks

The type locality of *P. torreyi* var. *torreyi* is Yosemite Valley, Yosemite National Park, Mariposa County, alt. 1,200 m (3,937 ft), 1865, John Torrey 338 (holotype GH97031). This species was collected again in Yosemite Valley in 1911 (H. M. Hall 8858, UC164532; LeRoy Abrams 4505, UC204912, UC882396, UC882496).



Figure C63. *Plagiobothrys torreyi* var. *torreyi* habitat, Ahwahnee Meadow, Yosemite Valley, Yosemite National Park, Mariposa County, California, 9 June 2004 (photograph by Charlotte Coulter).

Discussion

Factors That May Have Affected Survey Results

We made cursory surveys and failed to find populations at the first two locations listed in Botti (2001), namely the trail from Happy Isles to Mirror Lake and south of Sentinel Bridge. At the third location, we found an abundant population at the east edge of Ahwahnee Meadow in an old roadbed (Figure C63). In sparsely vegetated areas within the population, *P. torreyi* var. *torreyi* plants were several branched with the branches decumbent. If *P. torreyi* var. *torreyi* is a valid taxon distinguished by erect stems and if *P. torreyi* var. *diffusus* plants were growing intermixed with *P. torreyi* var. *torreyi* plants, then there might have been an overcount.

Assessment of Threats or Potential Impacts

The old road bed through Ahwahnee Meadow is used as a trail currently. Trampling may occur at the site. Restoration of the old road to meadow conditions may be under consideration now or in the future.

Recommended Measures to Minimize Impacts

There should be further surveys to better understand the distribution and habitat requirements of *P. torreyi* var. *torreyi* in Yosemite. The resulting information should be used to avoid impacts to the species resulting from development, administrative activities, visitor use, and site restoration.

Significance of Yosemite Populations

The type locality for *P. torreyi* var. *torreyi* is Yosemite Valley, Mariposa County, John Torrey 338, 1885 (Taylor, in preparation). We await final determination of collected specimens before we can confirm the species' presence at this site. The subspecies is known only from Yosemite Valley and has not been recollected in many years.

Additional Work Needed

Specialists should clarify the taxonomic distinctness of *P. torreyi* var. *torreyi*. Should its distinctness be confirmed, additional surveys are needed in appropriate habitat in Yosemite Valley and elsewhere in the area.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (www.cnps.org/inventory). Accessed 11 January 2005.

Gray, A. 1874. Contributions to the botany of North America (continued); A synopsis of the North American thistles; Notes on Boraginaceae; Synopsis of North American species of Physalis; Characters of various new species. Proceedings of the American Academy of Arts and Sciences 10:58. [Original description].

Gray, A. 1885. Contributions to the botany of North America. Proceedings of the American Academy of Arts and Sciences. 20:284. [Revised nomenclature of the species (not ssp.)].

Hickman, J. C. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html).

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

Personal Communication

Dean W. Taylor, consulting botanist, Aptos, California.

Platanthera yosemitensis Colwell, Sheviak, and P. Moore

Information compiled by Alison E. L. Colwell, 2003–2007



Species Overview

Family

Orchidaceae

Synonyms

Habenaria borealis Chamisso var. *viridiflora Chamisso, H. saccata* Greene, *Limnorchis stricta* (Lindley) Rydberg, *Platanthera gracilis* Lindley, *P. hyperborea* (Linnaeus) Lindley var. *viridiflora* (Chamisso) Kitamura; *P. hyperborea* var. *viridiflora* (Chamisso) Luer, *P. saccata* (Greene) Hulten, *Platanthera purpurascens* (Rydberg) Sheviak and W. F. Jennings.

Vernacular Name

Yosemite bog-orchid

Status

- Federal: none
- California: none
- CNDDB: G2[1]/S2.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive

Description

Platanthera yosemitensis is a perennial with a rosette of gladiate leaves in vegetative condition. It generally produces a single inflorescence each year, the shoot for the subsequent year forming at the side of the current year's stalk. The inflorescence spike is 20–80 cm, with 1–2 cauline leaves on lower two-thirds of the stem, and 3 basal leaves. There are 30–50 flowers sparsely arranged in an irregular spiral on the upper half of the stem, each with a small subtending bract. The flower size gradually diminishes towards the upper end of the inflorescence and the uppermost flowers generally do not develop mature fruit. Flowers are resupinate, the lip with spur ending up lowermost. The three petals are 4-mm long, thick, waxy yellow-green, entire-margined, tapered with rounded tips



Figure C64. *Platanthera yosemitensis* plant near Glacier Pt. Road, Yosemite National Park, Mariposa County, California, 12 August 2003 (photographs by Alison E. L. Colwell).

[1]CNDDB Global Rank = G2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres.
[2]CNDDB State Rank = S2.2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres, threatened.
[3]CNPS List 1B: Plants rare, threatened, or endangered in California and elsewhere; Threat Code 2: fairly endangered in California.

and held erect, curved towards each other so that their tips almost touch. In a few flowers, this lip is extended, but is never descending. The lower petal is elaborated at its base into a saccate or scrotiform spur 2.8 mm in length. The three sepals are 4 mm long, and are a similar green color to the stem. The upper sepal is ovate, held erect; the two lateral sepals are oblong, reflexed downwards along the side of the ovary. The fruit is a stout cylindrical capsule, from 1 cm long in lowest flowers (largest), and diminishing in size progressively up the inflorescence. The flowers are strongly scented, the scent permeating the meadow. The odor is sweet-spicy-musky, reminiscent of chutney to some; foot odor, asafetida, or horse manure to others. The short nectary spur, the strong odor, and the short distance between the viscidia (0.3 mm) is indicative of a fly or mosquito pollination syndrome. (See Colwell et al. 2007 for additional details.)

Similar Species

Platanthera dilatata var. *leucostachys* and *Platanthera sparsiflora* both co-occur with *P. yosemitensis* at both the habitat and microsite level. All three orchids possess a rosette of gladiate leaves and a leafy flowering stalk, so in the absence of flowers they cannot be distinguished. However, all three can be easily distinguished at a distance by flower color. *Platanthera dilatata* var. *leucostachys* flowers are bright white, *P. sparsiflora* flowers are the same shade of green as the flowering stalk, and *P. yosemitensis* flowers are a paler greenish-yellow. In addition, *P. yosemitensis* flowers are also smaller than those of the other two species; its inflorescences are therefore notably narrower, and taper more noticeably towards the tip, with the apical flowers generally not maturing fully. The definitive distinguishing feature of *P. yosemitensis* is the saccate spur below each flower. No other *Platanthera* sp. in this region possesses a saccate spur. *Platanthera dilatata var. leucostachys* and *P. sparsiflora* each have linear spurs longer than the petals. *Platanthera yosemitensis* flowers are strongly sweet-spicy-musk scented during the daytime, whereas the other species are either unscented or scented in the evening, although this trait is restricted to flowering stage only. During fruiting stage, *P. yosemitensis* can be distinguished by its sparse inflorescence and smaller capsule size, with capsules diminishing in size upwards, the terminal half dozen or so flowers having no fruit at all. Often the dried floral parts remain on the developing ovary and the saccate spur can be distinguished in a dried condition. Finally, *P. yosemitensis* is found in wetter sections of meadows than the other two species, in or beside small flowing drainages or in particularly saturated springs and seeps. The other two *Platanthera* species may approach the margins of these areas. The three *Platanthera* species which occur in Yosemite may hybridize, so there may be occasional individuals in a meadow which possess intermediate traits.

Distribution

Central Sierra Nevada

California

Mariposa County

Yosemite National Park

Nine known sites in the vicinity of Glacier Point Road within 3.5 km radius of Summit Meadow.

Survey Methodology and Results

Survey Dates

30 July 2003; 12, 20 August 2003; 11, 27 July 2004; 10–11 August 2004; 26 September 2004

Rationale for Survey Timing

Platanthera yosemitensis blooms from approximately mid-July to early August. Before blooming, *P. yosemitensis* is indistinguishable from related species. By mid-August most individuals are in fruiting stage and are therefore more difficult to detect, although still distinguishable from related species.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Peggy E. Moore, Angela Sanders

Table C26. *Platanthera yosemitensis* Colwell, Sheviak and P. Moore survey locations and results.

Site	Person Hours	Population Size
PLYO10-1	4	465
PLYO10-2	1	193
PLYO10-3	2	2
PLYO10-4	2	22
PLYO10-5	10	3
PLYO10-6	4	45
PLYO10-7	6	36
PLYO10-8	3	78
PLYO10-9	10	2

Method Used to Estimate or Census the Population

We traversed the entire meadow area with two people, counting each flowering stalk of *P. yosemitensis* This method may have underestimated populations in three ways:

1. We did not count individuals in a vegetative stage because they are not distinguishable from the co-occurring *Platanthera sparsiflora* and *Platanthera dilatata* var. *leucostachys*. Athough we observed few *Platanthera* spp. vegetative rosettes, we do not know what proportion of the total population size is represented by non-flowering individuals.
2. Animal damage is a significant factor. Bears are frequent visitors to the meadows where *P. yosemitensis* occurs and can flatten the vegetation by their passage. Sections of flattened vegetation may contain uncounted *P. yosemitensis* stalks. Deer graze on *Platanthera* inflorescences. If browsing removes all of the flowers from a stalk, it cannot be positively identified as *P. yosemitensis* and was therefore not counted.
3. The flowering date of *P. yosemitensis* individuals in a given meadow is affected by the amount of sun and water at the microsite where they occur. We did our censuses on one date only for each population, so we may have undercounted individuals that were in a pre- or post-flowering stage, and therefore difficult to detect visually.

Habitat

Platanthera yosemitensis occurs in wet meadows between 2,100 and 2,225 m (6,900 and 7,300 ft) elevation (Figure C65). These meadows are at headwaters of creeks in steep terrain, generally with large areas of watershed above them, which means that they remain saturated throughout the summer. *Platanthera yosemitensis* occurs in the wettest parts of these wet

meadows, in saturated muck with some standing water next to meanders with flowing water, or in meadow-seeps. *Platanthera yosemitensis* is found in both full sun in the center of the meadows and also in part shade near the perimeter. *Platanthera yosemitensis* inhabits sites which are densely vegetated but in which the vegetation is less than 1 m (3.3 ft) tall.



Figure C65. *Platanthera yosemitensis* habitat, Yosemite National Park, Mariposa County, California, 10 August 2004 (photograph by Alison E. L. Colwell).

Vegetation Communities

Platanthera yosemitensis meadows are surrounded by mature *Abies magnifica–Pinus contorta* forest. They contain large stands of *Vaccinium uliginosum* ssp *occidentale*, *Cornus sericea*, *Salix lemmonii*, and *Salix jepsonii*.

Within Target Species Population: *Polygonum bistortoides* Alliance, *Deschampsia caespitosa* Alliance, *Carex* (*rostrata*, *utriculata*) Seasonally Flooded Herbaceous Alliance.

In Survey Area outside Documented Population(s): *Senecio triangularis* Temporarily Flooded Herbaceous Alliance on drier periphery of plots.

Important Associated Plant Species

Platanthera dilatata var. *leucostachys, P. sparsiflora, Spiranthes romanzoffiana, Lotus oblongifolius, Polygonum bistortoides, Perideridia bolanderi, Dodecatheon alpinum, Oxypolis occidentalis, Pedicularis attolens*, and *Senecio clarkianus* were present in most plots. Also a few individuals of the following families may be present: Cyperaceae, Juncaceae, including *Carex lemmoni, C. nebrascensis, C. utriculata, Eleocharis pauciflora,* and *Luzula subcongesta*.

Phenological Development

Platanthera yosemitensis blooms mid-July to early August, although a few individuals in each population may bloom earlier or later than that. During early August to September the plants set fruit, the inflorescence stalks turning brown as the capsules mature. It is unknown how long lived an individual *P. yosemitensis* is, but the three flowering individuals dug up for specimens each had a segment of rhizome terminating in the remains of the previous year's inflorescence, with the current year's inflorescence terminating an offshoot of that. In addition, there was a small offshoot at the base of the current year's inflorescence that appeared to be the initiation of the subsequent year's inflorescence. This suggests that *P. yosemitensis* lives at least three years, probably longer. It is also possible that an individual may set two offshoots from the current year's growth, thus allowing some increase via vegetative propagation, although the spacing of *P. yosemitensis* individuals in a locality suggests seed as the dominant dispersal mechanism.

Location of Deposited Voucher Specimens

Three flowering stage specimens were collected from PLYO10-2 (AC03-33). Of these, one was sent for determination to Charles Sheviak, New York State Museum, Albany, New York; one

will be deposited at University Herbarium (UC1861834), Barbara Ertter, curator; and one will be deposited at Yosemite National Park herbarium (YM) (YOSE 117815), Barbara Beroza, curator. In addition, one dried flower from each of 10 plants, and two inflorescence tips in fixative for chromosome counting, were also collected from PLYO10-2 (AC04-150). Two specimens in fruiting stage were collected from PLYO10-1, both for YM (AC03-46, YOSE 117804, and AC03-22, YOSE 117810), and one from PLYO10-6 for scientific illustration (AC04-238, subsequently deposited at Missouri Botanical Garden, James Solomon, curator [MO04479050]). One dried flower from each of 10 plants was provided to Charles Sheviak (NYS, AC04-229), and a specimen from PLYO10-8 (AC-4-306) was collected for deposit at YM (YOSE 118101). At PLYO10-1, flowering stage specimens of *Spiranthes romanzoffiana*, *Platanthera sparsiflora*, and *P. dilatata* var. *leucostachys* were also collected for deposit at YM.

Remarks

Until recently *P. yosemitensis* was known from only two specimens collected by George Henry Grinnell on July 14, 1923. These specimens are now at Rancho Santa Ana Botanic Garden (RSA; accession numbers 382340 and 382332) and describe the locality as "Yosemite near Glacier Point" and "Meadow above Chinquapin." These vague locality descriptions were typical in Grinnell's era and determination of his exact locality is further complicated by the fact that Glacier Point Road was rerouted in 1930 such that meadows accessible from the old road are different from those accessible from the current road. It is therefore impossible to determine the meadow whence Grinnell's collections came. However, the old Glacier Point Road still exists as a bridal/hiking trail and we explored meadows along that trail in 2004 documenting two additional populations of *P. yosemitensis*.

A single population of 10 individuals was discovered in 1993 "in a meadow frequented by tourists" (Coleman 1995) which was confirmed by Leon Glicenstein (Hoosier Orchid Company, personal communication) to be in the vicinity of Glacier Point Road. Initially in 1993, a single inflorescence was removed and sent to Charles Sheviak with photographs for determination (NYS Accession A12358) (Jepson Online Interchange 2004). Twenty-two individuals were confirmed to be present at this site in 2004. This and the seven additional survey plots described above represent the sum total of known localities for this species as of 2005.

Material from PLYO10-2 was sent to Charles Sheviak for examination, and his initial analysis was that the flowers of this plant are similar to those of *P. purpurascens*, but the foliage was so significantly different that it cannot be from the same species. Material that C. Sheviak examined from the 1993 collection near Glacier Point Road when he made the assignment of *P. purpurascens* did not include the critical leaf material.

The taxonomy of *Platanthera* spp. is complicated by numerous local races and the frequency of successful natural hybrids between species. However, *P. yosemitensis* possesses numerous distinctive characteristics which set it apart from the co-occurring species and also distinguish it from previously described species in North America: small saccate spur, lower lip held erect, strong musky diurnal scent, yellow floral coloration, thickened petals, and small distance between viscidia. It is most similar to *P. purpurascens* and *P. stricta*, which also possess greenish-yellow flowers with saccate spurs, but these species differ in leaf shape and are geographically disjunct from the central Sierra Nevada. For these reasons, we considered this

plant an undescribed species and published a formal species description in *Madroño*, the journal of the California Botanical Society (Colwell et al. 2007).

Most populations surveyed harbor all three *Platanthera* species mentioned above and *Spiranthes romanzoffiana*. A few individuals of *P. sparsiflora* and of *P. dilatata* var. *leucostachys* possess variable morphology suggestive of some degree of hybridization between these two species in PLYO10-1 and -2. One individual at PLYO10-4 appeared to be a hybrid between *P. yosemitensis* and *P. dilatata* var. *leucostachys*. Vouchers of all four orchid species were made for YM from the PLYO10-1 site and leaf material of one plant of all three *Platanthera* species was harvested for DNA analysis and sent to C. Sheviak. Chromosome counts are being made of material from PLYO10-2 collected by C. Sheviak to determine whether this species is allopolyploid in origin.

Discussion

Factors That May Have Affected Survey Results

We censused sites PLYO10-1 and -7 in August, when plants were in fruit rather than flower. This species can be distinguished definitively at this stage, but is difficult to see at a distance. This and the fact that deer grazing and bear trampling had impacted a significant amount of the meadows means that the populations are somewhat larger than the flowering stalks counted.

Assessment of Threats or Potential Impacts

The following surveyed sites are in meadows in excellent condition rarely visited by people: PLYO10-1, -2, -3, and -7. There is little development in the watersheds above these meadows. The main natural threats are to reproduction in that bears knock over inflorescences and deer graze them. This may present a significant threat mainly to the small populations at PLYO10-3 and -5.

In contrast, PLYO10-4 bears significant human traffic and the population there may be impacted by human trampling or flower collecting. In addition, PLYO10-6 has been impacted by activities related to the ski resort in which it resides. Vehicle ruts have affected water flow in this spring area, and may have diminished the size of the population by drying of soil or pooling of water. PLYO10-5 is also in a meadow groomed for cross-country ski traffic, but there are no visible impacts in the site of the population.

Another consideration is that two known populations appear to have so few individuals as to be prone to elimination due to small natural events. One of these, PLYO10-3 was surveyed in 2003 and 2004 and two individuals were found each time, in apparently the same location. The plants in these populations also appear to set few fruits, implying that problems with fertilization may put these populations at risk.

Recommended Measures to Minimize Impacts

Exact locations of *P. yosemitensis* populations should be made available to the public on a need-to-know basis only.

The population at Badger Pass ski area should be protected from vehicular intrusion and other uses that would affect the soil and hydrology.

Significance of Yosemite Populations

Meadows in the area of Glacier Point Road appear to be shrinking due to encroachment by *Pinus contorta* ssp. *murrayana*, affecting to some extent the perimeters of the *P. yosemitensis* sites. In the absence of future fires and/or under the influence of climatic change, tree encroachment may have general effects on the watershed hydrology and thus also indirectly affect the *P. yosemitensis* meadows.

Additional Work Needed

There has not been an exhaustive survey of all potential wet meadow habitats in this area. There are additional meadows in the area that fit the habitat requirements of this plant. Because two of the currently known sites possess few individuals, monitoring and resurveying of these meadows may contribute to the conservation of this species.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore: MS Range Management 1992, University of California, Berkeley. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Angela Sanders: BS Biology with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Coleman, R. A. 1995. The wild orchids of California. Comstock Publishing Associates, Ithaca, New York.

Colwell, A. E. L., C. J. Sheviak, and P. E. Moore. 2007. A new *Platanthera* (Orchidaceae) from Yosemite National Park, California. Madroño 54(1):86–93.

Jepson Online Interchange for California Floristics. 2004. Jepson Flora Project. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed September 2004.

Lindley, J. 1835. The genera and species of Orchidaceous plants. London.

Sheviak, C. J. 2002. *Platanthera*. *In* Flora of North America Editorial Committee, editors. Flora of North America. Volume 26. Oxford University Press, New York.

Sheviak, C. J., and W. F. Jennings. 1997. *Platanthera purpurascens*. North American Native Orchid Journal 3(4):445.

Personal Communication

Charles Sheviak, New York State Museum, Albany, New York. (Determined specimen from PLYO10-2; coauthored species description).

Leon Glicenstein, Hoosier Orchid Company, Indiana. (Provided locality information for 1993 locality).

Randall Morgan, Santa Cruz, California. (Provided contact information for Leon Glicenstein for locality information on 1993 sighting).

Potamogeton epihydrus Rafinesque

Information compiled by Alison E. L. Colwell, 2003

Species Overview

Family

Potamogetonaceae

Synonyms

Potamogeton epihydrus subsp. *nuttallii* (Chamisso and Schlectendal) Calder and Roy L. Taylor; *P. epihydrus* var. *ramosus* (Peck) House

Vernacular Name

ribbonleaf pondweed



Figure C66. *Potamogeton epihydrus* (© 2005 Gary Fewless).

Status

- Federal: Forest Service Watch List
- California: none
- CNDDB: G5T5[1]/S2.2[2]
- CNPS: 2.2[3]
- Yosemite National Park: Sensitive

Description

Potamogeton epihydrus is a submerged aquatic perennial. Its cauline stems are flattened, without spots, 10–90 cm, glands and turions absent. Leaves are both submersed and floating or floating absent in immature specimens. Submersed leaves sessile, lax, stipules persistent, inconspicuous, convolute, free from blade, red-brown, not ligulate, 1–3 cm, not fibrous, not shredding at tip, apex obtuse; blade red-brown to light green, linear, not arcuate, 5–22 cm × 1–10 mm, base not clasping, without basal lobes, margins entire, not crispate, apex not hoodlike, blunt to acute, lacunae present, broad band each side of midvein; veins 3–13. Floating leaves petiolate; petioles continuous in color to apex, 2.0–12.5 cm. Blade adaxially light green, narrowly oblong-oblanceolate to elliptic, 2–8 cm × 4–20 mm, base acute, apex rounded or bluntly cuspidate; veins 11–41. Inflorescences unbranched, emersed; peduncles not dimorphic, axillary, erect, cylindric

[1]CNDDB Global Rank = G5T5: G5 = Population or stand demonstrably secure to ineradicable due to being commonly found in the world. T5 = Subspecific taxon demonstrably secure to ineradicable due to being commonly found in the world. Note: Subspecific taxa receive a T-rank attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies; where n = 1, 2,3,4,5 as described under G-rank. Note: Recent treatment eliminated the subspecies.

[2]CNDDB State Rank for ssp. *nuttallii*= S2.2: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres; threatened.

[3]CNPS List 2 for ssp. *nuttallii*: Rare, threatened, or endangered in California, but more common elsewhere; Threat Code 2: Fairly threatened in California

1.5–5.0(–16.0) cm; spikes not dimorphic, cylindric 0.8–4 cm. Fruits are sessile, greenish brown, round-obovoid, flattened, abaxially and laterally keeled, 2.5–4.5 × 2–3.6 mm, lateral keels without sharp points; beak erect, 0.5 mm; sides without basal tubercles; embryo with less than 1 full spiral. This description adapted from Haynes and Hellquist (2000).



Figure C67. *Potamogeton natans* (© M. Hassler).

Similar Species

Potamogeton epihydrus is superficially similar to *P. natans* L. (Figure C67), since both possess elliptic shaped floating leaves. However, the floating leaves of *P. epihydrus* are generally smaller, having a blade of 2–8 cm × 0.4–3.5 cm versus the 6–11 cm × 2–6 cm of *P. natans*. The definitive distinction between these species is that submerged leaves of *P. epihydrus* have a band of lacunae (air sacs) on each side of the midrib. Haynes and Hellquist (2000) write: "*Potamogeton epihydrus* is one of our more easily recognized species: it has floating leaves, linear submersed leaves and fruits with an embryo with one full spiral or less. The only other North American pondweed with a similar set of characteristics is *P. tennesseensis*, which differs from *P. epihydrus* by the former having long tapering apices in the submersed leaves whereas the latter has blunt to acute apices."

Distribution

Still or flowing waters of lakes, ponds, rivers and streams of northern United States and southern Canada, extending southward in the eastern United States to Louisiana and Alabama. Elevation 10–1,900 m (33–6,230 ft).

California

Rare in California: Northern Outer Coast Ranges, High Sierra Nevada, Modoc Plateau, reported from the following counties: Mendocino, Shasta, El Dorado, Modoc, Plumas, and Mariposa.

Yosemite National Park

Yosemite Valley (H. N. Bolander 6393, 1 August 1866, UC354), Westfall Meadows (this survey)

Survey Methodology and Results

Survey Dates

17 August 2003

Rationale for Survey Timing

Potamogeton species flower in late August through September. It is essential to have reproductive structures present, especially mature fruits, to positively identify species and to be certain that mature stage leaves are present. It is not useful to collect sterile material of these species.

Personnel Conducting Surveys
Alison E. L. Colwell

Table C27. *Potamogeton epihydrus* Rafinesque survey locations and results.

Site	Location	Person Hours	Population Size
POEP10-1	Westfall Meadows	2	unknown

Method Used to Estimate or Census the Population
Visual count of clusters of stems.

Population Location Descriptions
Westfall Meadows: 2 km south of Glacier Point Road and Bridalveil Campground on trail. *Potamogeton epihydrus* occurs in meanders through center of Westfall Meadows.

Habitat
Potamogeton epihydrus is found in slowly flowing meanders that have full sun exposure and which are bordered by sedges, grasses and occasional clumps of willow (Figure C68). Water is cold and clear and consists of pools 2–3 feet deep and 4–6 feet wide interspersed with vegetation-clogged necks that often have riffles. Bottom of tanks is of fluffy organic material and small cobble, silt. *Potamogeton epihydrus* is in clumps of plants 1–2 meters diameter, sometimes intermixed with other *Potamogeton* species.

Vegetation Communities
Within Target Species Population: *Sparganium angustifolium* Permanently Flooded Herbaceous Alliance/*Sparganium angustifolium* Herbaceous Vegetation Association.

In Survey Area outside Documented Population(s): *Deschampsia caespitosa–Polygonum bistortoides* Herbaceous Vegetation Association

Important Associated Plant Species
Torreyochloa pallida var. *pauciflora, Carex utriculata, Sparganium angustifolium, Callitriche verna, Ranunculus flammula, Potamogeton alpinus, Potamogeton pusillus* ssp *pusillus*.

Phenological Development
Potamogeton epihydrus was in flower or early fruit at the time of the survey. Whereas terrestrial forbs and grasses were in fruit at the time of the survey in Westfall Meadows, the aquatic forbs and grasses were either in flower/early fruit or still in vegetative stage.



Figure C68. *Potamogeton epihydrus* habitat, Westfall Meadows, Yosemite National Park, Mariposa County, California, 17 August 2003 (photograph by Alison E. L. Colwell).

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks
It is imperative that fruits be present to distinguish *Potamogeton* species, as they are extremely plastic in their vegetative morphology. Furthermore, *P. epihydrus* is distinguished by features not present in dried material, so it is important either to identify this species in the field using a hand lens, or to retrieve material in water back to the laboratory for examination under a microscope.

Discussion
Factors That May Have Affected Survey Results
It is unknown to what extent this plant ramifies vegetatively or how many inflorescence stems one individual may present. Furthermore, *P. epihydrus* was growing intermixed with other species of *Potamogeton*, the submerged leaves of which were not readily distinguishable from *P. epihydrus* leaves. For these reasons we did not report an estimate of the number of *P. epihydrus* individuals present at this site.

Assessment of Threats or Potential Impacts
There were no known invasive weeds present, although there was dense aquatic vegetation and also dense *Salix* sp. along the borders of the meander, which might eventually choke off the open flowing tanks of the meander and thus cause loss of habitat for *P. epihydrus*. Although there is a hiking trail across this meander in the vicinity of *P. epihydrus*, the impact is minimal and not a significant threat.

Recommended Measures to Minimize Impacts
Ensure that the hiking/bridal trail users cross the meander only in the designated spot.

Significance of Yosemite Populations
This is the third collection of this species for Mariposa County and for Yosemite National Park. The first collection was made in Yosemite Valley by Henry Bolander on 1 August 1866. The second collection was by LeRoy Abrams of Stanford University. This species may well inhabit other waters in Yosemite, but as is typical for aquatic plants, it is rarely collected. The genus *Potamogeton* in particular is poorly collected, in part due to the requirement for mature fruits (only available in late summer/early fall) and that material is only readily identifiable when fresh. This is especially true for *P. epihydrus* which is distinguished by lacunae along the midrib, which are not discernable in dried pressed specimens. This species is widespread and common in lakes and streams of the north United States and southern Canada; it is likely spread occasionally into California by migrating waterfowl.

Additional Work Needed
Verification of the growth pattern of this species is needed so it can be accurately counted in surveys.

Qualifications of Field Personnel at the Time of Surveys
Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North

Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Literature

Haynes, R., and C. B. Hellquist. 2000. Potamogetonaceae. *In* Flora of North America Editorial Committee, editors. Flora of North America. Volume 22. Oxford University Press, New York.

Rafinesque, C. S. 1808. Medical Repository, series 2, 5:354.

Rafinesque, C. S. 1811. Medical Repository, series 3, 2:409.

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html).

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

Tibor, D., convening editor. 2001. Inventory of rare and endangered plants of California, Special publication 1. Sixth edition. California Native Plant Society, Sacramento, California.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

Personal Communication

Robert Haynes, Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama. (Provided confirmation of specimen identifications).

Potamogeton robbinsii Oakes

Information compiled by Alison E. L. Colwell and Peggy E. Moore, 2005

Species Overview

Family

Potamogetonaceae

Synonyms

None

Vernacular Name

Robbins' pondweed

Status

- Federal: none
- California: none
- CNDDB: G5[1]/S2.3[2]
- CNPS: 2.3[3]
- Yosemite National Park: Sensitive



Figure C69. *Potamogeton robbinsii* from Swamp Lake, Yosemite National Park, Tuolumne County, California, 14 July 2004 (Alison E. L. Colwell collection no. AC04-136, Yosemite National Park herbarium YOSE 118035).

Description

For detailed descriptions, see Hickman (1993:390), Botti (2001:104), and Haynes and Hellquist (2000:53).

Similar Species

Among Yosemite pondweeds, *Potamogeton robbinsii* is superficially similar to *P. foliosus* Raf. var. *foliosus* and *P. pusillus* L. var. *pusillus*. All three have linear leaves that are all submersed. However, *P. robbinsii* has stipules fused to leaf bases for at least 1 cm with the tip projecting as a ligule while *P. pusillus* and *P. foliosus* have stipular sheaths predominantly free from base of leaf blade. Haynes and Hellquist (2000) write: "*Potamogeton robbinsii* is one of our most easily recognized species when it is fertile. It is the only species with branched inflorescences." They go on to indicate that "…plants flower only rarely." They add, "It also is the only species with truly auriculate leaves, the blades forming small lobes projecting past the stem on each side of the stem. Leaf blades of other *Potamogeton* species may have slightly rounded bases, but no others have lobes that actually protrude past the stem."

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[1]CNDDB Global Rank = G5: G5 = Population or stand demonstrably secure to ineradicable due to being commonly found in the world

[2]CNDDB State Rank = S2.3: 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres: no current threats known.

[3]CNPS List 2: Rare, threatened, or endangered in California, but more common elsewhere; Threat Code 3: not very endangered in California

Distribution

Shallow to deep water of ponds, lakes and slow-moving rivers of northeastern United States, southeastern Canada, Alaska to Washington, Idaho, Oregon and California. Elevation 0–3,000 m (0–9,840 ft).

California

Klamath Ranges, central and southern High Sierra Nevada. Reported from the following counties: Inyo, Madera, Mono, Siskiyou, Tuolumne

Yosemite National Park

Swamp Lake (L. Reinecke and H.L. Mason 11602, 22 July 1937, UC1100092; H. L. Mason 11857, 6 July 1938, YM 66538 and UC1056564; H. L. Mason 14847, 9August 1958, UC1111026), Westfall Meadows (Botti 2001)

Survey Methodology and Results

Survey Dates

14 July 2004

Rationale for Survey Timing

Potamogeton spp. flower in late August through September. It is essential to have reproductive structures present, especially mature fruits, to positively identify species and to be certain that mature stage leaves are present. It is not useful to collect sterile material of these species.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C28. *Potamogeton robbinsii* Oakes survey locations and results.

Site	Location	Person Hours	Population Size
PORO10-1	Swamp Lake, west of Hetch Hetchy Reservoir	0.5	unknown

Method Used to Estimate or Census the Population

Species forms a dense carpet on the bottom of the lake making abundance difficult to estimate.

Population Location Descriptions

Swamp Lake, west of Hetch Hetchy Reservoir, Yosemite National Park, Tuolumne County, California.

Habitat

Haynes and Hellquist (2000) confirm our observations that *P. robbinsii* "occurs in fairly deep water, forming large colonies that essentially cover the substrate." Botti (2001) specifies habitat as deep ponds, lake margins and slow-moving streams in the mixed conifer, montane and subalpine zones between 1,600 and 2,800 m (5,250 and 9,190 ft) (Figure C70).

Vegetation Communities

Within Target Species Population: *Potamogeton* (*diversifolius, filiformis*) Permanently Flooded Herbaceous Alliance.

In Survey Area outside Documented Population(s): *Calocedrus decurrens–Alnus rhombifolia* Forest, *Abies concolor–Pinus lambertiana* Forest Alliance

Important Associated Plant Species

Brasenia shreberi, Nuphar lutea ssp. *polysepalum Potamogeton natans*

Phenological Development

Potamogeton robbinsii was predominantly in vegetative stage at the time of the survey. A sufficient number of plants (5%) were flowering to allow for collection of complete specimens and reliable determination. Vegetative characteristics were sufficient to identify the remainder of the stand as *P. robbinsii*.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

It is important that fruits be present to distinguish *Potamogeton* species, as they can be extremely plastic in their vegetative morphology. *Potamogeton robbinsii* can be keyed using vegetative characteristics, however.

Discussion

Factors That May Have Affected Survey Results

It is unknown to what extent this plant ramifies vegetatively, or how many inflorescence stems one individual may present. For this reason we did not report an estimate of the number of *P. robbinsii* individuals present at this site.

Assessment of Threats or Potential Impacts

There were no known invasive weeds present, although there was dense aquatic vegetation along the outermost portion of the lake. A pronounced expansion of these native aquatics with floating leaves could impact *P. robbinsii* because it did not occur under dense floating mats. Other potential threats include introduced aquatic plants, lake turbulence and siltation from runoff after a fire.

Recommended Measures to Minimize Impacts

Any footwear, pack animals and equipment brought to the lake for research or other purposes should be free of plant propagules. Mitigation to prevent lake siltation following wildfire should be considered but only implemented with the greatest care.



Figure C70. *Potamogeton robbinsii* and *Schoenoplectus subterminalis* habitat at Swamp Lake, Yosemite National Park, Tuolumne County, California, 14 July 2004 (photograph by Alison E. L. Colwell).

Significance of Yosemite Populations

This is a re-collection at the only confirmed location in Yosemite for this species of limited distribution in California. The Westfall Meadows locality is not supported with a herbarium collection. This species may well inhabit other waters in Yosemite, but as is typical for aquatic plants, it is rarely collected. The genus *Potamogeton* in particular is poorly collected, in part due to the requirement for mature fruits (only available in late summer/early fall) and that material is only readily identifiable when fresh.

Additional Work Needed

Verification of the growth pattern of this species so abundance can be accurately reported in surveys.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; Lecturer on Plant Identification and Classification 2000 and 2003, University of Washington, Seattle, Washington. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology, 2003, with specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

California Native Plant Society (CNPS). 2005. Inventory of rare and endangered plants (online edition, v6-05a). California Native Plant Society. Sacramento, California. Online. (http://www.cnps.org/inventory). Accessed 14 January 2005.

Haynes, R. and C. B. Hellquist. 2000. Potamogetonaceae. Page 47–74 *in* Flora of North America Editorial Committee, editors. Flora of North America. Volume 22. Oxford University Press, New York.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Nieuwland, J. A. 1913. Notes on our local plants. American Midlland Naturalist 3:14–22. [Description of Potamogetonaceae *Spirillus robbinsii* Nieuwl., p. 19].

Oakes, W. 1841. Notice of some rare plants of New England, with some descriptions of new species. Magazine of Horticulture, Botany and All Useful Discoveries and Improvements in Rural Affairs 7:180. [Description of Najadaceae *Potamogeton robbinsii* Oakes].

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 12 January 2005.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service. 2004. The PLANTS Database, Version 3.5. National Plant Data Center, s Rouge, Louisiana, USA. Online. (http://plants.usda.gov).

Personal Communication

Robert Haynes, Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama.

Saxifraga mertensiana Bong.

Information compiled by Peggy E. Moore, 2004

Species Overview

Family

Saxifragaceae

Synonyms

None

Vernacular Name

wood saxifrage

Status

- Federal: none
- California: none
- CNDDB: none
- CNPS: none
- Yosemite National Park: Sensitive



Figure C71. *Saxifraga mertensiana*, Skaggs Springs Road, Mendocino County, California, 6 March 2004 (© 2004 Norman Jensen).

Description

See Botti (2001) and Hickman (1993) for detailed descriptions.



Figure C72. *Saxifraga mertensiana* flower, top of the historic Ledge Trail, Yosemite Valley, Mariposa County, California, 5 June 2004 (photograph by Peggy E. Moore).

Similar Species

Saxifraga odontoloma has leaves simply and evenly toothed with glands at the tips of the teeth. *Saxifraga mertensiana* has leaves that are doubly or irregularly toothed and the teeth glandless (Botti 2001; Taylor, in preparation). *Saxifraga odontoloma* petals are early deciduous and two spotted at the base while *S. mertensiana* petals are not readily deciduous and are without spots.

Distribution

California

North Coast, Klamath Ranges, outer North Coast Ranges, uncommon in northern and central Sierra Nevada; to Alaska, Montana; below 2,500 m (<8,200 ft) (Hickman 1993)

Yosemite National Park

Known only from the steep gully south of Curry Village traversed by the historic Ledge Trail and reported from the vicinity of the Mist Trail near Vernal Fall (Botti 2001), 1,375–2,000 m (4,500–6,560 ft)

Survey Methodology and Results

Survey Dates

5 June 2004

Rationale for Survey Timing

Record high temperatures in March and additional warm weather during the spring advanced plant phenology by approximately a month in 2004. Because the leaves of *Saxifraga* spp. are similar in morphology to other members of Saxifragaceae, it is most accurate to survey the species at the flowering stage. In spite of the wet cliff and slope habitat that *S. mertensiana* occupies, snow melt had occurred and plants were flowering by early June even at 2,000 m (6,550 ft).

Personnel Conducting Surveys

Peggy E. Moore, Charlotte Coulter, Alison E. L. Colwell

Table C29. *Saxifraga mertensiana* Bong. survey locations and results.

Site	Location	Person Hours	Population Size
SAME10-1	Mariposa County, Yosemite Valley, top of the historic Ledge Trail	3	700

Method Used to Estimate or Census the Population

We scanned the entire cliff supporting the stand, individually counting plants at the base of the cliff and estimating abundance for clusters of plants higher on the cliff. There were few flowering plants, but the leaves are distinctive and differentiate *S. mertensiana* from *S. odontoloma*. We surveyed only the uppermost portion of the Ledge Trail and did not account for stands farther down the gully.

Habitat

Moist shaded cliffs and mossy rock outcrops in the montane zone (Botti 2001, Hickman 1993) (Figure C73). May prefer north aspects because they retain vernal moisture longer.

Vegetation Communities

Within Target Species Population: *Pinus jeffreyi–Abies concolor* Woodland

In Survey Area outside Documented Population(s): *Abies magnifica* Forest

Important Associated Plant Species

Holodiscus microphyllus, *Acer glabrum*, *Ribes nevadense*, *Cystopteris fragilis*, *Heuchera micrantha*, *Aquilegia formosa*

Phenological Development

A small minority of plants were flowering while 95% were at the vegetative stage. The majority of associated species were reaching the flowering stage.

Location of Deposited Voucher Specimens

No vouchers were collected.

Remarks

Saxifraga mertensiana is more common in the northern Sierra Nevada and the northwestern portion of California (CalFlora 2005). It was first collected in Yosemite from the Ledge Trail in 1912 (H. P. Chandler and E. B. Babcock 1028, 6 June 1912, Ledge Trail, Yosemite Valley, 4300 ft UC169311).



Figure C73. *Saxifraga mertensiana* habitat in a north-facing gully near Glacier Point, Yosemite National Park, Mariposa County, California, 5 June 2004 (photograph by Peggy E. Moore).

Discussion

Factors That May Have Affected Survey Results

We made our single survey opportunistically during the course of other work, and it was not exhaustive according to the reported extent of the population along the length of the Ledge Trail. Yosemite GIS data indicate a stand midway along the portion of the trail that follows the creek, and the 1912 collection was from near the base of the Ledge Trail judging by the 4,300 ft (1,310 m) elevation noted on the specimen.

Assessment of Threats or Potential Impacts

There are no apparent direct threats to the Ledge Trail population. The trail is now closed and rarely traveled. The steep sides of the gully through which the trail passes discourage foot traffic from those who access the area. Less is known about the lower stands in the Ledge Trail population but there is little evidence of direct impacts. The unsurveyed population along the Mist Trail near Vernal Fall is located above and below the most heavily visited trail in the Yosemite according to 1980s mapping of the population. It could be subject to trampling but the steep cliffs on which it occurs largely prevent access. Changes in snow pack and warming temperatures related to climate change may pose the greatest threat to this more northerly species.

Recommended Measures to Minimize Impacts

Trail maintenance along the Mist Trail should be planned to avoid direct or indirect impacts to plants and their habitat such as trampling by trail workers and increasing site erosion.

Significance of Yosemite Populations

The two populations in Yosemite represent the southern extent of the species' range.

Additional Work Needed

Ledge Trail population should receive a more complete survey. The population mapped in the 1980s but not surveyed in 2003–2004 is easily accessible along the Mist Trail near Vernal Fall. It should be surveyed, and there should be a collection made from there to permanently document its occurrence.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore: MS Range Management, University of California, Berkeley, 1992. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Calflora. 2005. The CalFlora Database. Calflora, Berkeley, California. Online. (www.calflora.org/). Accessed: 17 January 2005.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

National Park Service (NPS). Circa 1985. Rare_plants [Computer map, ESRI shape file format] Yosemite National Park, California.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley, California.

von Bongard, A. H. G. 1835. Saxifragaceae: *Saxifraga mertensiana* Bongard. Mémoires de l'Academie Imperiale des Sciences de St.-Petersbourg, Series 6, Sciences Mathematiques, Physiques et Naturelles, 2:141.

Schoenoplectus subterminalis (Torrey) Soják.

Information compiled by Alison E. L. Colwell, 2003; and Peggy E. Moore, 2004

Species Overview

Family

Cyperaceae

Synonyms

Scirpus subterminalis Torrey.

Vernacular Name

Swaying Bulrush, Water Bulrush, Water Club-Rush,

Status

- Federal: none
- California: none
- CNDDB: G4G5[1]/S2S3[2]
- CNPS: 2.3[3]
- Yosemite National Park: Sensitive



Figure C74. *Schoenoplectus subterminalis*, Swamp Lake, Yosemite National Park, Tuolumne County, California, 14 July 2004 (photograph by Alison E. L. Colwell).

Description

Schoenoplectus subterminalis, is an aquatic perennial forming submerged vegetative mats. The leaves are sheathing at base, filiform, flaccid, to 1 meter long, less than 1 mm wide, submerged or tips floating. Inflorescence is a solitary, erect spikelet 1.0–1.5 cm, borne on a 1 mm diameter emergent culm. Subtending bract is stiff, erect, 2–3 cm, appearing as an extension of the culm. Inflorescence scales are straw-colored, with a green midline, ovate-lanceolate, 4.0 × 2.5 mm, with mucronate tip. Margins are smooth but lacerate adjacent to mucro. Perianth consists of six spinulose beige bristles. Fruit an achene. Style trifid. See Smith (2002).

Similar Species

None in this area

Distribution

Lakes, ponds, marshes 750–2,250 m (2,460–7380 ft)

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[1]CNDDB Global Rank: G4G5 = Either Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors or Secure—Common; widespread and abundant. Note: A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community.
[2]CNDDB State Rank: S2S3 = Intermediate between 6–20 occurrences or 1,000–3,000 individuals or 2,000–10,000 acres AND 21–100 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres.
[3]CNPS List 2: Rare, threatened, or endangered in California, but more common elsewhere; Threat Code 3: not very endangered in California

California
Klamath Ranges, northern Sierra Nevada.

Yosemite National Park
Swamp Lake.

Survey Methodology and Results
Survey Dates
14 July 2004

Rationale for Survey Timing
In bloom in June, in fruit June–July. However, the delicate nature of the culms may mean that they are emergent for only a short time.

Personnel Conducting Surveys
Alison E. L. Colwell, Charlotte Coulter, Angela Sanders

Table C30. *Schoenoplectus subterminalis* (Torrey) Soják survey locations and results.

Site	Location	Person Hours	Population Size
SCSU10-1	north and west margins of Swamp Lake in 0.3–1.0 m of water	24	2,200

Method Used to Estimate or Census the Population
Individual plants were difficult to identify because they spread rhizomatously. Plants are flowering in water 0.3–1.0 m (1–3.3 ft) deep. They form a lawn in deeper water. There was no evidence of flowering in deeper water at the time of the survey. Abundance estimate is based on flowering culms.

Population Location Descriptions
Along north and west margins of Swamp Lake in 0.3–1.0 m (1–3.3 ft) of water.

Habitat
In shallow water of protected lake, attached to organic sediments of bottom (Figure C75). In full sun.

Vegetation Communities
Within Target Species Population: *Potamogeton* Permanently Flooded Herbaceous Alliance

In Survey Area outside Documented Population(s): *Abies concolor–Pinus Lambertiana* Alliance

Important Associated Plant Species
Brasenia schreberi, *Dulichium arundinaceum*, *Menyanthes trifoliata*, *Utricularia vulgaris*

Phenological Development
In flower in June, in fruit June–July. Although there was no evidence of flowering in water deeper than 1 m (3.3 ft), the lake level appeared to have been 25 cm higher shortly before the survey. Plants may flower as the lake level allows their emergence.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator (A. E. L. Colwell AC03-15, YOSE 117665; and AC04-138, YOSE 118041) and Jepson Herbarium (JEPS), University of California, Berkeley, Bruce Baldwin, curator (AC04-138, UC1862084)



Figure C75. *Potamogeton robbinsii* and *Schoenoplectus subterminalis* habitat at Swamp Lake, Yosemite National Park, Tuolumne County, California, 14 July 2004 (photograph by Alison E. L. Colwell).

Remarks

This species is listed as sensitive in Idaho, and as endangered in Oregon. It is widespread in the eastern United States, but uncommon throughout its range. Disjunct populations such as the one at Swamp Lake are probably initiated by migrating waterfowl.

The emergent inflorescences are distinctive and very helpful to positively identify this otherwise submerged aquatic plant. Sampling was done from a flotation device. Access to Swamp Lake from the old road (now a trail) between Lake Eleanor and Miguel Meadow is without benefit of trail, over difficult terrain. Therefore any equipment for additional surveying would need to be packed in to Miguel Meadow and carried from there to Swamp Lake.

Discussion

Factors That May Have Affected Survey Results

If it was early in the phenology, additional flowering culms may have appeared later, meaning we may have underestimated the size of this population. We do not know whether a single individual produces more than one flowering culm or what percentage of individuals in a population will be in flower at a given time, both of which may affect the accuracy of the count. Determination of how many culms represent an individual of this species would require a wetsuit and snorkel or similar apparatus and also cause significant disturbance to the lake sediments.

Assessment of Threats or Potential Impacts

There is no current surrounding human use of this lake or watershed. There is no apparent threat to this population at this time.

Recommended Measures to Minimize Impacts

Fire effects monitoring may be useful in tracking major changes in surrounding forest vegetation. Related changes in the hydrologic processes supporting this lake could have consequences for the aquatic flora.

Significance of Yosemite Populations

The population at Swamp Lake is a new record for Tuolumne County and Yosemite National Park. The nearest previously known population is in El Dorado County. There are only a few known localities in the western United States, and this species is uncommon throughout its range in the eastern United States. Migrating birds may distribute propagules between waterbodies, leading to this diffuse pattern of distribution, but it is unknown why it remains uncommon over its broad range.

Additional Work Needed

Swamp Lake is a unique body of water harboring many unusual species. Its flora is well studied owing to past utilization of a summer field botany school. The physical features particular to Swamp Lake may be useful in identifying other bodies of water that may harbor this and other unusual species.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Bacigalupi, R. 1966. A species of *Scirpus* new to California. Leaflets of Western Botany 10(1):16. [First reported occurrence in California].

Smith, S. G. 2002. *Schoenoplectus*. *In* Flora of North America Editorial Committee, editors. Flora of North America. Volume 23. Oxford University Press, New York.

Smith, S. Galen, A. E. Schuyler, William J. Crins. 1993. *Scirpus*. *In* J. C. Hickman, editor. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Soják. 1972. Časopis Národního Musea, Oddíl Přírodovědný. 140:127. [Systematic revision.].

Torrey, J. 1824. A flora of the northern and middle Sections of the United States. 1:47. New York. (Original description.)

Personal Communication

Dean W. Taylor, Aptos, California. (Verified identification of specimen).

Scirpus clementis M. E. Jones

Information compiled by Peggy E. Moore, 2005

Species Overview

Family

Cyperaceae

Synonyms

New treatment as *Trichophorum clementis* (M. E. Jones) S. G. Smith (Smith 1995)

Vernacular Name

Yosemite bulrush

Status

- Federal: none
- California: none
- CNDDB: none
- CNPS: none
- Yosemite National Park: Sensitive



Figure C76. *Scirpus clementis*, Virginia Canyon, Yosemite National Park, Tuolumne County, California, 26 July 2005 (photograph by Peggy E. Moore).



Figure C77. *Scirpus clementis* stand (yellowing plants) with *Vaccinium caespitosum*, Gaylor Lakes basin, Yosemite National Park, Tuolumne County, California, 9 September 2004 (photograph by Peggy E. Moore).

Description

See Botti (2001) and Hickman (1993) for detailed descriptions.

Similar Species

All other species of *Scirpus* in Yosemite have inflorescences subtended by leaf-like bracts. The single *S. clementis* spike is subtended by the long-awned, lowermost spikelet scale (Botti 2001). In contrast with other locally occurring *Scirpus*, it has a solitary head and is the only dwarf subalpine to alpine *Scirpus* spp. documented from the central Sierra Nevada.

Distribution

California

Central and southern High Sierra Nevada; 2,400 to 3,600 m (7,900 to 11,800 ft) (Hickman 1993)

Yosemite National Park

Once thought to be rare in Yosemite, Yosemite bulrush has been collected from at least three localities (SMASCH 2002) and reported from at least seven other sites (Botti 2001), 2,440–3,650 m (8,000–12,000 ft).

Survey Methodology and Results

Survey Dates

25 July 2003

Rationale for Survey Timing

Late July is the height of the flowering period. Surveys can be done following flowering when the plant takes on a gold color and is easily distinguishable from associated species by color, stature and its dense, stiff culms (Figure C77).

Personnel Conducting Surveys

Lisa Ordóñez

Table C31. *Scirpus clementis* M. E. Jones survey locations and results.

Site	Location	Person Hours	Population Size
SCCL10-1	Tuolumne Meadows, Yosemite National Park, Tuolumne County	48	82,014

Method Used to Estimate or Census the Population

Surveyors made a grid search with each of the 12 persons in the group closely checking a swath of ground in the area between Tioga Road and Pothole Dome in Tuolumne Meadows. Results were summed among all surveyors.

Habitat

Dry to wet subalpine and alpine meadows and streambanks (Botti 2001, Hickman 1993) (Figure C78).

Vegetation Communities

Within Target Species Population: *Oreostemma alpigenum* var. *andersonii* (syn. *Aster alpigenus* var. *andersonii*) Herbaceous Alliance

In Survey Area outside Documented Population(s): *Ptilagrostis kingii* Herbaceous Vegetation

Important Associated Plant Species

Aster alpigenus, *Deschampsia cespitosa*, *Carex* sp., *Polygonum bistortoides*, *Vaccinium caespitosum*, *Dodecatheon alpinum*

Phenological Development

The flowering period for *S. clementis* is from July to August, the height of the growing season for the habitats in which it occurs. Approximately 90% of plants were flowering at the time of the survey in late July 2003. *Scirpus clementis* plants have a golden yellow color and tightly clustered stiffly erect culms that distinguish them from associated species.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Scirpus clementis is a Sierra Nevada endemic that occurs from Tuolumne County south (Botti 2001). *Flora of North America* (FNA 2002) treats *S. clementis* M. E. Jones as *Trichophorum clementis* (M. E. Jones) S. G. Smith (Smith 1995).



Figure C78. *Scirpus clementis* habitat, Tuolumne Meadows, Yosemite National Park, Tuolumne County, California, 2,600 m, 15 Aug 1996 (photograph by M. P. McClaran).

Discussion

Factors That May Have Affected Survey Results

The survey of the area between Tioga Road and Pothole Dome in Tuolumne Meadows was very thorough and probably accounted for plants of nearly all size classes. Surveys using fewer people would be hard pressed to be as thorough, and future surveys of the site should endeavor to derive comparable data. However, we did not survey the remainder of the western portion of Tuolumne Meadows, which is a portion of the type locality and the locality of a 1944 Sharsmith collection (Sharsmith 4996, 25 July 1944, SJSU12925).

Assessment of Threats or Potential Impacts

The surveyed stand of *S. clementis* is bordered on the south side by the Tioga Road and on the west and north side by a trail. Although a fence and signage currently discourage foot traffic from the Pothole Dome parking area, there may have been trampling of the area in the past as evidenced by the installation of a fence. The road and trails may modify groundwater flow, and trampling causes soil compaction.

Recommended Measures to Minimize Impacts

Avoid trail construction through meadows to prevent impacts to wetland hydrology. Retain the fencing and signs directing people away from the middle of the meadow at the Pothole Dome parking area.

Significance of Yosemite Populations

Tuolumne Meadows is the type locality of *S. clementis*. There is an isotype at Dudley Herbarium (DS, now incorporated into CAS), but we did not locate original collection information.

Additional Work Needed

Tuolumne Meadows should receive a more complete survey in anticipation of upcoming redevelopment of the area. During work on other projects *S. clementis* was observed in the central portion of Tuolumne Meadows, around middle Gaylor Lake, at Townsley and Dorothy lakes, and along the Mono Pass Trail, in addition to other undocumented locations.

Qualifications of Field Personnel at the Time of Surveys

Lisa R. Ordóñez: BS Bioresource Science 1998, University of California, Berkeley. Eight years experience with vascular plant survey, collection and identification, threat assessment and impacts mitigation for sensitive plant species, and invasive plant management for public land management agencies. Yosemite National Park Botanist, 2001–2004; Malheur National Forest,

Burns Ranger District Botanist, 1999–2001; Malheur National Forest Botanist Trainee, seasonal 1995–1998.

Literature

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Calflora. 2005. The CalFlora Database. Calflora, Berkeley, California. Online. (www.calflora.org/). Accessed 17 January 2005.

Dhooge, S. and P. Goetghebeur. 2002. Cyperaceae *Oreobolopsis clementis* (M. E. Jones) Dhooge and Goetgh. Novon 12(3):341.

Flora of North America Editorial Committee, 2002. Flora of North America: North of Mexico. Volume 23: Magnoliophyta: Commelinidae (In Part): Cyperaceae. Oxford University Press, New York.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Jones, M. E. 1912. Cyperaceae *Scirpus clementis*. Contributions to Western Botany 14: 21.

National Park Service (NPS). Circa 1985. Rare_plants [Computer map, ESRI shape file format] Yosemite National Park, California.

SMASCH Database: Specimen MAnagement System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 17 January 2005.

Smith, S. G. 1995. New combinations in North American *Schoenoplectus*, *Bulboschoenus*, *Isolepis*, and *Trichophorum*. Novon 5:97–102.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley, California.

Sparganium natans L.

Information compiled by Alison E. L. Colwell, 2003



Figure C79. *Sparganium natans*, Chain Lakes, Yosemite National Park, Tuolumne County, California, 9 Sept. 2004 (© 2004 Dean Wm. Taylor).

Species Overview

Family

Sparganiaceae

Synonyms

Sparganium minimum (Hartman) Fries

Vernacular Name

small bur-reed

Status

- Federal: none
- California: none
- CNDDB: G5[1]/S3.3[2]
- CNPS: 4.3[3]
- Yosemite National Park: Sensitive

Description

Sparganium natans is a submerged aquatic perennial. The description, according to Kaul (2000), is as follows: Plants are slender, grasslike, limp, to 0.6 m. Leaves and inflorescences floating or, when stranded, more or less erect. Leaves limp in water unkeeled, flat, 0.04–0.6 m long, 2–6(10) mm wide; leaves of stranded plants shorter, firmer. Inflorescences: rachis unbranched, flexuous; bracts ascending, basally inflated; pistillate heads 1–3, axillary, not contiguous, sessile or most proximal short-peduncled, 0.5–1.2 cm diameter in fruit; staminate head 1 or apparently so, terminal, not contiguous with distalmost pistillate head. Flowers: tepals without subapical dark spot, erose; stigmas 1; lance-ovate. Fruits dark greenish or brownish, subsessile, body ellipsoid to obovoid, not faceted, barely or not constricted at equator, 2–4 × 1.0–1.5 mm, tapering to beak; beak curved, 0.5–1.5 mm, tepals attached at base, reaching about to equator. Seeds 1.

Similar Species

Sparganium angustifolium Michaux. may co-occur with *S. natans*. It is extremely similar in appearance to *S. natans*, but is slightly more robust. It can be distinguished from *S. natans* when in flower because it always has at least two staminate heads per inflorescence, although these are

[1]CNDDB Global Rank = G5: Population or stand demonstrably secure to ineradicable due to being commonly found in the world

[2]CNDDB State Rank = S3.3: 21–100 Element occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; no current threats known

[3]CNPS List 4: Limited distribution (Watch List); Threat Code 3: not very endangered in California

generally contiguous so that they appear as one long head in anthesis. *S. natans* has one or only rarely two staminate heads which are well separated.

Distribution

California

2,040–2,740 m (6,700–9,000 ft) on both slopes of the Sierra Nevada (Taylor, in preparation) in the following counties (SMASCH 2002): El Dorado, Madera, Modoc, Placer, Plumas, Shasta, Sierra, Trinity, Tuolumne.

Yosemite National Park

Westfall Meadows (A. E. L. Colwell AC03-45, 8/17/2003, YOSE 117670), Hog Ranch (W .L. Jepson 3487, 7/30/09, JEPS 32225); Swamp Lake near Miguel Meadow (H. L. Mason 11603, 7/22/1937, UC1099811; H. L. Mason 14858, 8/9/1958, UC1102973); Tiltill Valley (H .L. Mason 12066, 8/1/1938, UC1056963)

Survey Methodology and Results

Survey Dates

17 August 2003

Rationale for Survey Timing

Sparganium natans blooms from June to September throughout its range, with bloom times tending toward the latter end of that time period in cooler montane waters. Because floral characters are required for its identification, searches should be attempted in August and September in the Yosemite region.

Personnel Conducting Surveys

Alison E. L. Colwell

Table C32. *Sparganium natans* L. survey locations and results.

Site	Location	Person Hours	Population Size
SPNA10-1	Westfall Meadows, south of Glacier Point Road	2	10

Method Used to Estimate or Census the Population

Count of inflorescences.

Population Location Descriptions

Westfall Meadows, south of Glacier Point Road. Population is located in a single deep tank (i.e., pool) at the bottom of the meadow below where the meanders of both arms of the meadow flow together. The tank is just at the edge of where the joined meander flows into the forest. Elevation 2,170 m (7,127 ft).

Habitat

Lakes, ponds, 2,000–2,500 m (6,560–8,200 ft). Westfall Meadows population is in a shaded pool of a slowly flowing meander at edge of meadow (Figure C80). Pool is approximately three feet deep, three feet wide by eight feet long, bracketed by vegetation-clogged riffles and bordered on all sides by low-growing aquatic vegetation.

Vegetation Communities

Within Target Species Population: *Sparganium angustifolium* permanently flooded herbaceous alliance/*Sparganium angustifolium* herbaceous vegetation.

In Survey Area outside Documented Population(s): *Deschampsia caespitosa–Polygonum bistortoides* Herbaceous Vegetation Association

Important Associated Plant Species

Torreyochloa pallida var. *pauciflora, Carex utriculata, Salix* sp., *Ranunculus flammula*.



Figure C80. *Sparganium natans* habitat, Westfall Meadows, Yosemite National Park, Mariposa County, California, 17 August 2003 (photograph by Alison E. L. Colwell).

Phenological Development

Sparganium natans was in flower at time of survey. A single survey was made only, so it is unclear whether all individuals in the population were in flower or whether some may have flowered after the survey. Although terrestrial forbs and grasses in Westfall Meadows were at the time largely in fruiting stage, aquatic forbs and grasses were either in flower or still in vegetative growth.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks

Sparganium angustifolium is also present in the meanders of Westfall Meadows, and is considerably more numerous there. We noted it in both south and west meanders of the meadow above their confluence. *Sparganium angustifolium* is noticeably more robust than *S. natans*, but it is helpful to have specimens of both present for this difference to be obvious. It is possible that *S. natans* was present in other areas of the meadow, but was overlooked because of the presence of *S. angustifolium* there. It is also possible that *S. natans* has been mistaken for *S. angustifolium* in other areas of the park as well.

Discussion

Factors That May Have Affected Survey Results

We do not know what percentage of a population of these plants will flower in a given year or how many inflorescences per individual is typical. For this study, we assumed one inflorescence per individual. This doubtless leads to an underestimation of the population in the case of vegetative individuals being present, and an overestimation in the case of more than one inflorescence per individual. We made no attempt to distinguish individuals by their distribution on the tank bottom.

Assessment of Threats or Potential Impacts

The *S. natans* in Westfall Meadows is very restricted. Further encroachment of *Pinus contorta* surrounding Westfall Meadows may shade out the species, as the occurrence is at the forest

margin. Encroachment of other aquatic vegetation (*Torreyochloa pallida* var. *pauciflora* and *Ranunculus flammula*) may also crowd out the *S. natans*. The Westfall Meadows *S. natans* population is located well away from trails or human use.

Recommended Measures to Minimize Impacts

Methods to forestall encroachment by *Pinus contorta* into Westfall Meadows would be helpful in preventing loss of this localized population.

Significance of Yosemite Populations

Although this is the only reported occurrence in the southern part of Yosemite National Park, it is not an unexpected one, as *S. natans* is a circumboreal species. It is distributed across the northern U.S. and Canada, and reported occasionally from the Sierra Nevada as far south as Sierra National Forest in Madera County. As an aquatic species, *S. natans* is likely spread by migrating waterfowl, which are present in the meanders of Westfall Meadows in late summer. The infrequency of reports of this species in California are most likely due to the infrequency of cold, slowly flowing water and possibly also because it is mistaken for *S. angustifolium*, which is more common both in Yosemite and elsewhere in California.

Additional Work Needed

It is difficult to distinguish *S. natans* from a depauperate specimen of *S. angustifolium*. It should be verified that this population of *S. natans* is not in fact *S. angustifolium* which is depauperate due to the additional water depth and partial shade of its location.

We do not know to what extent *S. natans* ramifies vegetatively or how many inflorescences are produced per individual. It would be useful to use snorkel gear to inspect the distribution of *S. natans* individuals in a population.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Literature

Cook, C. D. K., and M. S. Nicholls. 1987. A monographic study of the genus *Sparganium* (Sparganiaceae). Part. 2. Subgenus *Sparganium*. Botanica Helvetica 97:1–44. [Comprehensive taxonomic treatment].

Kaul, Robert. B. 2000. Sparganiaceae. Page 277 *in* Flora of North America Editorial Committee, editors. Flora of North America. Volume 22. Oxford Press, New York.

Linnaeus, Carolus. 1753. Species *plantarum*. 2:971. [Original description].

SMASCH Database: Specimen Management System for California Herbaria. [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University

Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 19 January 2005.

Taylor, D. W. In preparation. Flora of the Yosemite Sierra. Unpublished draft, 1997. Jepson Herbarium, University of California, Berkeley.

Trifolium bolanderi A. Gray

Information compiled by Alison E. L. Colwell, 2003

Species Overview

Family
Fabaceae

Synonyms
None

Vernacular Name
Bolander's clover

Status
- Federal: Forest Service Sensitive
- California: none
- CNDDB: G[1]/S3.2[2]
- CNPS: 1B.2[3]
- Yosemite National Park: Sensitive



Figure C81. *Trifolium bolanderi*, Westfall Meadows, Yosemite National Park, Mariposa County, California, 10 July 2003 (photograph by Peggy E. Moore).

Description
See Hickman (1993) and Botti (2001) for detailed descriptions.

Similar Species
Trifolium bolanderi frequently co-occurs with *Trifolium longipes* Nutt. var. *nevadense* Jepson, which can be confusing when these two species are both present in vegetative or fruiting stage. They can be distinguished by the following traits:



Figure C82. *Trifolium bolanderi* flower and leaves, Westfall Meadows, Yosemite National Park, Mariposa County, California, 10 July 2003 (photograph by Peggy E. Moore).

Flowers/Fruits: *T. bolanderi* flowers are white with purple calyces and are drooping (Figure C82), whereas *T. longipes* flowers are pink to white and held upright. *Trifolium bolanderi* flowers dry to a dark brown whereas *T. longipes* flowers dry to a rust brown, so for a few weeks post-flowering, these two species can be distinguished by the shade of brown of the retained floral parts, as well as whether the dried flowers are drooping or upright. The retained dried floral parts contain the seed, which is dispersed when the flowers break off of the peduncle. At that point, *T. bolanderi* would

[1]CNDDB Global Rank = G3: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres
[2]CNDDB State Rank = S3.2: 21–80 occurrences or 3,000–10,000 individuals or 10,000–50,000 acres; threatened
[3]CNPS List 1B: Rare, threatened, or endangered in California and elsewhere; Threat Code 2: Fairly endangered in California

become much more difficult to detect in meadow vegetation as the fresh or dried flower heads are the best visual cue.

Leaves/Habit: *T. bolanderi* basal leaves are a bluish green and rounded in outline, with a rounded or even notched leaf apex and short petiole. The few cauline leaves may be oval in outline. The leaves are smooth margined and venation pattern is not evident on upper surface of leaf. *Trifolium bolanderi* has a very dense growth habit of short stature, although the flowering stalks may be 2–3 dm tall in very dense vegetation. Vegetative plants can be distinguished by their dense bluish patches of foliage. Leaves are held erect at midday. A single flowering plant can have as few as three leaves or form a dense leafy patch 3 dm or more across.

In contrast, *Trifolium longipes* leaves are bluish green to green and ovate to elongate in outline with a mucronate tip, and often have tiny bristles at the ends of the many lateral leaf veins. Sometimes *T. longipes* leaves have reddish margins. The many tiny parallel lateral veins on the upper surface of *T. longipes* leaves are marked by white streaks. *T. longipes* habit is not as dense or short as that of *T. bolanderi* and this species tends to inhabit the drier parts of meadows, although there is considerable overlap in the microhabitat preferences of these two species.

Distribution

California

Trifolium bolanderi occurs in moist montane meadows between 2,100 and 2,300 m (6,890 and 7,550 ft) in Mariposa, Madera and Fresno counties (Hickman 1993).

Yosemite National Park

There are nine known localities within Yosemite National Park, along Glacier Point Road south of Yosemite Valley. Outside of Yosemite, there are collections from Jackass Meadow, Graveyard Meadow, and Clover Meadow in Madera County, and an early collection by H. M. Hall and H. P. Chandler in the North Fork of the Kings River, Fresno County, in July 1900 (UC64631).

Survey Methodology and Results

Survey Dates

8, 10, 14, 24, 29, 30 July 2003; 11, 12 August 2003

Rationale for Survey Timing

We conducted surveys during the time of expected flowering and fruiting because *T. bolanderi* is most easily seen when it is flowering or when fruiting heads are present.

Personnel Conducting Surveys

Alison E. L. Colwell, Charlotte Coulter, Peggy E. Moore (+Sylvia Haultain, Cheryl Bartlett, Juliet Lao on 10 July 2003)

Table C33. *Trifolium bolanderi* A. Gray survey locations and results.

Site	Location	Person Hours	Population Size
TRBO10-1	Meadow 450 m SSE of Ostrander Lake Trailhead[1]	15	7,200
TRBO10-2	Westfall Meadows (type locality)[1]	26	70,000
TRBO10-3	Meadow 450 m S of Ostrander lake Trailhead on Glacier Point Road[1]	3	8,400
TRBO10-4	Southwest of Bridalveil Campground	2	783
TRBO10-5	NW of Bridalveil Campground[2]	2	1,470
TRBO10-6	North Peregoy Meadow[2]	3	2,919
TRBO10-7	W side of Bridalveil Campground[2]	3	162
TRBO10-P-6	Ostrander Lake Trail[2]	4	1,448
Total		**58**	**92,382**

[1]Surveyed in 2003; no extant prior survey data available.
[2]Surveyed in 2003; some data collected for *T. bolanderi* at these populations during 1999 survey.

Method Used to Estimate or Census the Population

We collected data for each population surveyed and either counted the number of individuals present or made an estimation of population size (see method below).

In the meadow 450 m south-southeast of Ostrander Lake trailhead, we counted the entire meadow by tallying individual plants. In subsequent meadows surveyed, our method was as follows:

1. Scanned the meadow on foot and flagged all patches of *T. bolanderi*.
2. Marked with a GPS point all outlying small patches of *T. bolanderi* and counted individuals present in those patches.
3. Flagged perimeter of large stands (e.g., more than 1,000 individuals) and either measured stand size directly with a tape or mapped perimeter with GPS to calculate area of patch.
4. Censused plants in a measured subset of the stand for extrapolation to entire stand.
5. Estimated number of individuals in larger stands based on plants per unit area. (Estimation based on a dense *T. bolanderi* plot of 50 × 35 m where individuals tallied in Westfall Meadows. Plot contained 3,670 *T. bolanderi* individuals.)

Additional Population Locations Not Surveyed in 2003

1. Unnamed meadow 800 meters due north of Summit Meadow picnic area (surveyed in 1999)
2. Unnamed meadow 1000 meters down drainage from Summit Meadow picnic area (surveyed in 1999)
3. McGurk Meadow (surveyed in 1999)

Additional Locations with Good Habitat

Southern end of Mono Meadow, meadow at headwaters of Meadow Brook

Habitat

In Yosemite National Park, *T. bolanderi* is known only from seasonally flooded montane meadows along Glacier Point Road (Figure C83). This area is a level upland that was not glaciated during the last glacial episode (ca 10,000 BP). The meadows where *T. bolanderi* are found have little or no slope and have only a few hundred feet of watershed above them, so, although they have standing water in them in early summer, the surfaces are completely dry by mid to late summer.



Figure C83. Alison E. L. Colwell in *Trifolium bolanderi* habitat, meadow near Ostrander Lake trailhead, Yosemite National Park, Mariposa County, California, 8 July 2003 (photograph by Peggy E. Moore).

Trifolium bolanderi is found in full sun in the center of large meadows, under canopy of *Pinus contorta* at the perimeter of large meadows, and in the partial shade of small forest openings. It is most frequent in microsites in which the soil is fully saturated at blooming time, although it is also found blooming in microsites with a few inches of standing water and found in a vegetative or fruiting state in microsites that have recently dried out. It is most dense where the standing vegetation is on average 1 dm or shorter and is not found at all in vegetation taller than 3 dm.

Vegetation Communities

Deschampsia caespitosa–Polygonum bistortoides Herbaceous Vegetation Association

Important Associated Plant Species

T. bolanderi was found in the parts of meadows dominated by the following species: *Deschampsia cespitosa, Polygonum bistortoides, Perideridia parishii, Carex nebrascensis, Juncus balticus,* and *Juncus orthophilus*. Associated species that are not dominant components of the *T. bolanderi* community are: *Trifolium longipes, Mimulus primuloides, Muhlenbergia filiformis, Phalacroseris bolanderi, Hypericum anagalloides, Eleocharis pauciflora, Dodecatheon alpinum, Oreostemma alpigenum* var. *andersonii,* and *Pedicularis attolens.*

Phenological Development

The 2002–2003 winter snow pack was average, with cold temperatures and snowfall persisting through May. June 2003 was unusually hot, so phenology was at normal times for July blooming plants. At the time of surveys (8 July–5 Aug 2003), *T. bolanderi* populations were 80% in fruiting stage (dried brown flower heads persisting on peduncles, containing mature seeds). Ten percent were still in flower in the wetter, more densely vegetated areas of the meadows and in wet, shaded perimeters. Another 10% were in a non-flowering vegetative stage that year, primarily those in sparsely vegetated areas that had apparently been scraped bare of vegetation by foraging animals in the previous year. We estimated that peak flowering probably occurred 22–28 June 2003 in the large meadows in sunny locations. In partly shaded locations and small meadows, peak flowering occurred in mid-July.

Location of Deposited Voucher Specimens

Yosemite National Park herbarium (YM), Barbara Beroza, curator



Figure C84. Isotype specimen, *Trifolium bolanderi*, H. N. Bolander 4967, "Westfall's Meadows [*sic*]," 1866 (Catalog #US321245).

Remarks

Each flowering head on average produced 2–3 mature seed in 2003. The seeds mature three weeks after flowering.

Discussion

Factors That May Have Affected Survey Results

There are some factors unique to *T. bolanderi* habit and microsite that contribute to error in our population size estimation. First, *T. bolanderi* can form dense patches in its preferred microhabitats. It is difficult to count the number of individuals constituting these patches, so we estimated the number of individuals present. We based our estimation on the fact that *T. bolanderi* does not root at the nodes, but flops outward from a central taproot. Therefore we gathered inflorescence stalks in a patch together in one hand and judged from how many point sources they were emanating. This method recovers most flowering individuals present in a mat, but may result in an underestimate of vegetative individuals interspersed among them. It does not account for multiple flowering individuals with adjacent taproots.

Second, in taller (e.g. >1 dm), dense vegetation, the only part of *T. bolanderi* that is easily seen is the inflorescence, since basal leaves remain low and are few in dense vegetation. Vegetative individuals are therefore undercounted in densely vegetated segments of meadows.

Both these factors will have contributed to minor underestimates of population size in 2003 surveys.

Assessment of Threats or Potential Impacts

In half the meadows surveyed, foot or horse trails lead through the population of *T. bolanderi*, but these are not heavily used and light usage does not appear to harm the plants. In most of the meadows surveyed, population sizes of *T. bolanderi* are in excess of 1,000 individuals and are distributed throughout the moister areas of the meadows, so trails affect a small percentage of individuals.

A second threat is surface scraping by animals (probably deer) foraging for shoots or roots. In all meadows, multiple patches of vegetation several square meters in size had been scraped off in the preferred *T. bolanderi* habitat, which has a negative impact on *T. bolanderi* flowering and seed set. *T. bolanderi* appears to densely colonize the patches of ground that were stripped of vegetation in the previous year, so the net effect may be either positive or negative.

The greatest threat is that most meadows appear to be shrinking in size with associated perimeter encroachment by *Pinus contorta* var. *murrayana*.

Recommended Measures to Minimize Impacts

Intermittent burning may be important in long-term maintenance of *T. bolanderi* habitat by curbing loss of meadow area to encroachment by *Pinus contorta*.

Significance of Yosemite Populations

Trifolium bolanderi is known only from 20 locations in the central Sierra Nevada, according to Ratliff and Denton, 1993. Ten of these are in Yosemite National Park, including the type locality of Westfall Meadows (H.N. Bolander 4967, 1866, holotype GH63485, isotype US321245) (Figure C84). All Yosemite localities are in meadows along Glacier Point Road south of Yosemite Valley.

Additional Work Needed

USGS topographical maps indicate additional appropriate wet meadow sites within a couple miles of known *T. bolanderi* populations (e.g., upper tributaries of Illilouette Creek east of Horizon Ridge) that have not been surveyed.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Charlotte Coulter**:** BA Biology 1987, University of California, Santa Cruz, California; MA Geography 2002, San Diego State University, San Diego, California; plant collection and identification, 2001, 2002; plant ecological survey, Browns Valley, California, 1994,1995.

Peggy E. Moore: MS Range Management, University of California, Berkeley, 1992. Nineteen years of experience with vascular plant survey, identification and ecology in the central and southern Sierra Nevada: distribution, abundance and ecology of introduced plants in the Sierra Nevada national parks, 1998–1999; species diversity, abundance and productivity in three subalpine meadow types, 1994–2000; park wide plant survey, 1990–1994; special status plant surveys in the El Portal Administrative Site, 1992; alpine plant survey and community classification along the east edge of Yosemite, 1986–1989; vascular plant diversity and productivity in a subalpine watershed, Sequoia National Park, 1985.

Literature

Botti, Stephen J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Gray, A. 1868. Leguminosae *Trifolium bolanderi*. Proceedings of the American Academy of Arts and Sciences 7: 335.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley.

Ratliff, R. D. and R. G. Denton. 1993. Bolander's clover in the central Sierra Nevada: A sensitive species? Madroño 40(3):166–173.

Vaccinium parvifolium Sm.

Information compiled by Peggy E. Moore, 2005



Figure C85. *Vaccinium parvifolium* leaves and fruit, North Crane Creek, Yosemite National Park, Tuolumne County, California, 30 August 2004 (photograph by Alison E. L. Colwell).

Species Overview

Family

Ericaceae

Synonyms

None

Vernacular Name

red huckleberry

Status

- Federal: None
- CNDDB: None
- California: None
- CNPS: None
- Yosemite National Park: Sensitive

Description

See Hickman (1993) and Botti (2001) for detailed descriptions. Among California Ericaceae, *Vaccinium* is distinguished by its woody growth habit and inferior ovary.

Similar Species

Vaccinium caespitosum Michaux has finely toothed leaves and prostrate stems less than 10 cm high. *Vaccinium parvifolium* leaves are entire and plants are 1 to 4 m high. *Vaccinium uliginosum* L. ssp. *occidentale* (A. Gray) Hultén is 30 to 70 cm tall. Its stems are round and the calyx lobes exceed the tube; whereas, the stems of *V. parvifolium* are angled and the calyx lobes are absent or minute (Botti 2001).

Distribution

California

North Coast, Klamath Ranges, Outer North Coast Ranges, High Cascade Range, northern and central High Sierra Nevada, San Francisco Bay Area (to southeast Alaska; Hickman 1993)

Yosemite National Park

Previously known from a single location near the Tuolumne Grove along North Crane Creek at 1,740 m elevation (Botti 2001). This work adds two additional localities.

Survey Methodology and Results

Survey Dates

30 August 2004

Rationale for Survey Timing
The typical flowering period for *V. parvifolium* is May to June (Botti 2001). Plants at the population surveyed were flowering by 25 May 2004.

Personnel Conducting Surveys
Alison E. L. Colwell, Angela Sanders

Table C34. *Vaccinium parvifolium* Sm. survey locations and results.

Site	Location	Person Hours	Population Size
VAPA10-1	North Crane Creek	4	798

Method Used to Estimate or Census the Population
We carefully distinguished individual plants with matted, litter-covered stem bases from adjacent individuals and tallied the result to obtain a total count within the well-defined stand. Some plants were difficult to distinguish from neighbors.

Habitat
Deeply shaded forests near streams in the mixed conifer zone (Botti 2001) (Figure C86).

Vegetation Communities
Within Target Species Population: *Abies concolor–Pinus lambertiana–Calocedrus decurrens*/*Cornus nuttallii*/*Corylus cornuta* Forest Association

In Survey Area outside Documented Population(s): Same

Important Associated Plant Species
Rhododendron occidentale, *Cornus nuttallii*, *Abies concolor*, *Chimaphila umbellata*, and *Corylus cornuta* were the most abundant associated species. Also important were *Calocedrus decurrens*, *Alnus rhombifolia*, *Clintonia uniflora*, and *Adenocaulon bicolor*. *Rosa bridgesii*, *Goodyera oblongifolia*, and *Equisetum hyemale* were among the species also present.

Phenological Development
We found the population surveyed on 25 May 2004 during the typical flowering period, but few plants in the population flowered in 2004.

Location of Deposited Voucher Specimens
Yosemite National Park herbarium (YM), Barbara Beroza, curator

Remarks
This is a common species from coastal Washington and Oregon east to the lower



Figure C86. *Vaccinium parvifolium* habitat, North Crane Creek, Yosemite National Park, Tuolumne County, California, 30 August 2004 (photograph by Alison E. L. Colwell).

elevations of the Cascade Range (Abrams 1951: 329), *V. parvifolium* is locally rare in the central Sierra Nevada which represents the southern extent of the species' range (Jepson Online Interchange 2005). The Yosemite plants differ in several respects from typical *V. parvifolium*: the fruits mature purple in color, in contrast to the red mature fruits seen over most of the species' range. The fruits also exhibit a ridge around the distal perimeter of the fruit, whereas *V. parvifolium* fruits are typically spherical. Finally, the plants are less upright in habit than is typical elsewhere, often becoming matted under forest litter on the steep slopes on which they occur. Whether these differences are indicative of a distinct taxonomic status for the Yosemite plants is not settled.

Discussion

Factors That May Have Affected Survey Results

There was no apparent disturbance or other factors that may have affected population status or detectability.

Assessment of Threats or Potential Impacts

There are no apparent impacts currently. Lower North Crane Creek receives little visitation.

Recommended Measures to Minimize Impacts

We recommend periodic monitoring of the North Crane Creek population to track its status and to detect any direct or indirect impacts.

Significance of Yosemite Populations

The lower North Crane Creek site, along with an observation we made of a population on Moss Creek below Merced Grove (unsurveyed, UTM NAD 27 Zone 11 250726E, 4180467N, 5,300 feet elevation, ca 20 individuals), brings to three the total number of *V. parvifolium* populations known in Yosemite.

Additional Work Needed

Additional surveys along North Crane Creek, South Fork of the Tuolumne River and other riparian areas in the west central portion of Yosemite should be completed to provide a better understanding of the *V. parvifolium* distribution in Yosemite.

Qualifications of Field Personnel at the Time of Surveys

Alison E. L. Colwell: BA Botany 1985, Cornell University, Ithaca, New York; PhD Evolution and Population Biology 1994, Washington University, Saint Louis, Missouri; lecturer on plant identification and classification, University of Washington, Seattle, Washington, 2000 and 2003. Contributing author to *Flora of North America* for Orobanchaceae. Vascular plant survey North Cascades National Park, Washington, 2002. Collecting forays for University of Washington Herbarium, 1997, 1998, 1999, 2001, 2002.

Angela Sanders: BS Biology 2003 with a specialization in ecology and a minor in Geography, Appalachian State University, Boone, North Carolina.

Literature

Abrams, L. 1951. Illustrated flora of the Pacific States. Volume III, Geraniaceae to Scrophulariaceae. Stanford University Press, Stanford, California.

Botti, S. J. 2001. An illustrated flora of Yosemite National Park. Yosemite Association, El Portal, California.

Hickman, J. C., editor. 1993. The Jepson manual: Higher plants of California. University of California Press, Berkeley, California.

Jepson Online Interchange for California Floristics. 2004. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 15 September 2005.

Smith, J. E. 1817. Ericaceae *Vaccinium parvifolium* Sm. *In* A. Rees, The Cyclopaedia 36(2):Vaccinium no. 3. [Original description].

SMASCH Database: Specimen Management System for California Herbaria [Web application for label data from 350,000 California specimens of vascular plants]. 2002. University Herbarium and Jepson Herbarium, University of California, Berkeley. Online. (http://ucjeps.berkeley.edu/interchange.html). Accessed 14 September 2005.

Appendix D. Taxa Added to the Park Plant List during the Course of Special Status Vascular Plant Surveys in Yosemite National Park 2003–2004.

Species	Collector	Collection No.	Det. By[1]	Rep.[2]
Cuscuta suksdorfii Yuncker	A. E. L. Colwell , Angela Sanders	AC04-159	Joel McNeil	YM
Elodea canadensis Michx.	A. E. L. Colwell	s.n.	A. E. L. Colwell	YM
Lotus scoparius (Nutt.) Ottley var. *scoparius*	Charlotte Coulter	s.n.	A. E. L. Colwell	YM
Melica subulata (Gris) Scribner	A. E. L. Colwell, Charlotte Coulter	AC04-06	A. E. L. Colwell	YM
Platanthera yosemitensis Colwell, Sheviak and P. Moore	A. E. L. Colwell	AC03-22, AC03-45, AC03-46, AC03-33(YM), AC04-150(NYS), AC04-238 (MO), AC04-306(YM)	Charles Sheviak	YM, NYS, MO
Potamogeton alpinus Balbis	A. E. L. Colwell	AC03-43	Robert Haynes	YM
Rumex pulcher L.	A. E. L. Colwell , Angela Sanders	AC04-258	Fred Hrusa	YM
Schoenoplectus subterminalis (Torr.) Sojak	A. E. L. Colwell	AC03-15 , AC04-138	Dean W. Taylor	YM
Torilis nodosa (L.) Gaertn.	Charlotte Coulter	s.n.	Charlotte Coulter	YM

[1]Det. by = Determined by
[2]Rep. = Repository (i.e., museum code from Index Herbariorum)

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1201 Oakridge Drive, Suite 150
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www.nature.nps.gov

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