Plant Species Evaluation Form

Castilleja lassenensis Eastw.

Family: Orobanchaceae (CNPS 2018) | **PLANTS Symbol:** (USDA 2018) | **Calif. Endemic:** Yes (CNPS 2018)

Synonyms/Other Names: There are no confirmed synonyms associated with this taxon. *Castilleja lassenensis* Eastw. was originally described in 1940 (Tropicos 2017). For many years, regional floras referred to *C. lassenensis* as a synonym that represented a disjunct form of *C. lemmonii*, despite the entities' morphological distinction and prior treatment as a full species. Recent field and museum work reemphasized *C. lassenensis* as an independent entity with edaphic, morphological, and geographic distinctions (Egger and Malaby 2015).

Identification Issues: The recent reaffirmation of *Castilleja lassenensis* as an entity that is distinct from *C. lemmonii* highlights the morphological overlap between these taxa. Commonly used dichotomous keys have yet to account for *C. lassenensis*. It should be noted that *C. lassenensis* has a beak and corolla tube that is entirely white or white with pale-salmon margins on the beak. Its lower corolla lip is pale green to yellow-green, with white distal teeth. *Castilleja lassenensis* has a pale green stigma. The proximal half of the calyx is pale-green, whereas the distal half is violet-purple. In contrast, *C. lemmonii* has a beak and corolla tube that is greenish on its upper surface with deep red margins on its beak. The lower lip of the corolla is greenish with violet-purple distal teeth. *Castilleja lemmonii* has a greenish to dark blue-purple stigma. Its calyx is generally pale violet-purple throughout. *Castilleja lassenensis* is largely restricted to subalpine meadows with volcanic substrates in the vicinity of Mt. Lassen, whereas *C. lemmonii* is found in granitic subalpine meadows of the Sierra Nevada (Egger and Malaby 2015).

Taxonomy:

Section of taxonomic key including *Castilleja lassenensis* adopted from Egger and Malaby (2015):

1. Calyces cleft more or less equally into four subequal lobes; all species annual except *C. arachnoidea* and *C. pilosa* ..... ***Castilleja arachnoidea, C. attenuata, C. lacera, C. pilosa, C. tenuis***

1' Calyces cleft much more deeply in the abaxial/adaxial direction than laterally; plants perennial from a woody caudex.

> 2. Leaves of plants with crisped margins; lower lip of corollas expanded, corolla beak prominently curved in the abaxial direction, the expanded margins of which are often reddish and prominent; plants of more xeric substrates ..... ***Castilleja chlorotica***
>
> 2' Leaves of plants with mostly smooth margins; lower lip of corollas not expanded, corolla beak more or less straight or only very slightly curved in the abaxial direction; plants of seasonally mesic substrates.
>
> > 3. Inflorescences almost always pink-purple to magenta, occasionally white, noticeably wider than and strongly differentiated from the leafy stem, appearing

more or less capitate; cauline leaves mostly entire, though often 3-lobed distally, below the inflorescence; segments of calyces longer, 1.5-3 mm in length; endemic to either Mt. Lassen or to the Sierra Nevada, California and adjacent Nevada.

4. Beak and tube of corollas entirely clear white or white with very pale salmon margins on the beak; lower lip pale green to yellow-green, with white distal teeth; stigmas pale green; proximal 1/2 of calyces pale green, becoming violet-purple only on the distal 1/2; plants endemic to subalpine meadows with volcanic substrates on the flanks of Mt. Lassen .... ***Castilleja lassenensis***

4’ Beak and tube of corollas greenish on the upper surface with blood red margins on the beak; lower lip greenish with violet-purple distal teeth; stigmas greenish to dark bluish-purple; calyces usually at least pale violet-purple throughout; plants widespread in subalpine meadows with primarily granitic substrates in the Sierra Nevada of California and adjacent Nevada ..... **Castilleja lemmonii**

Status:

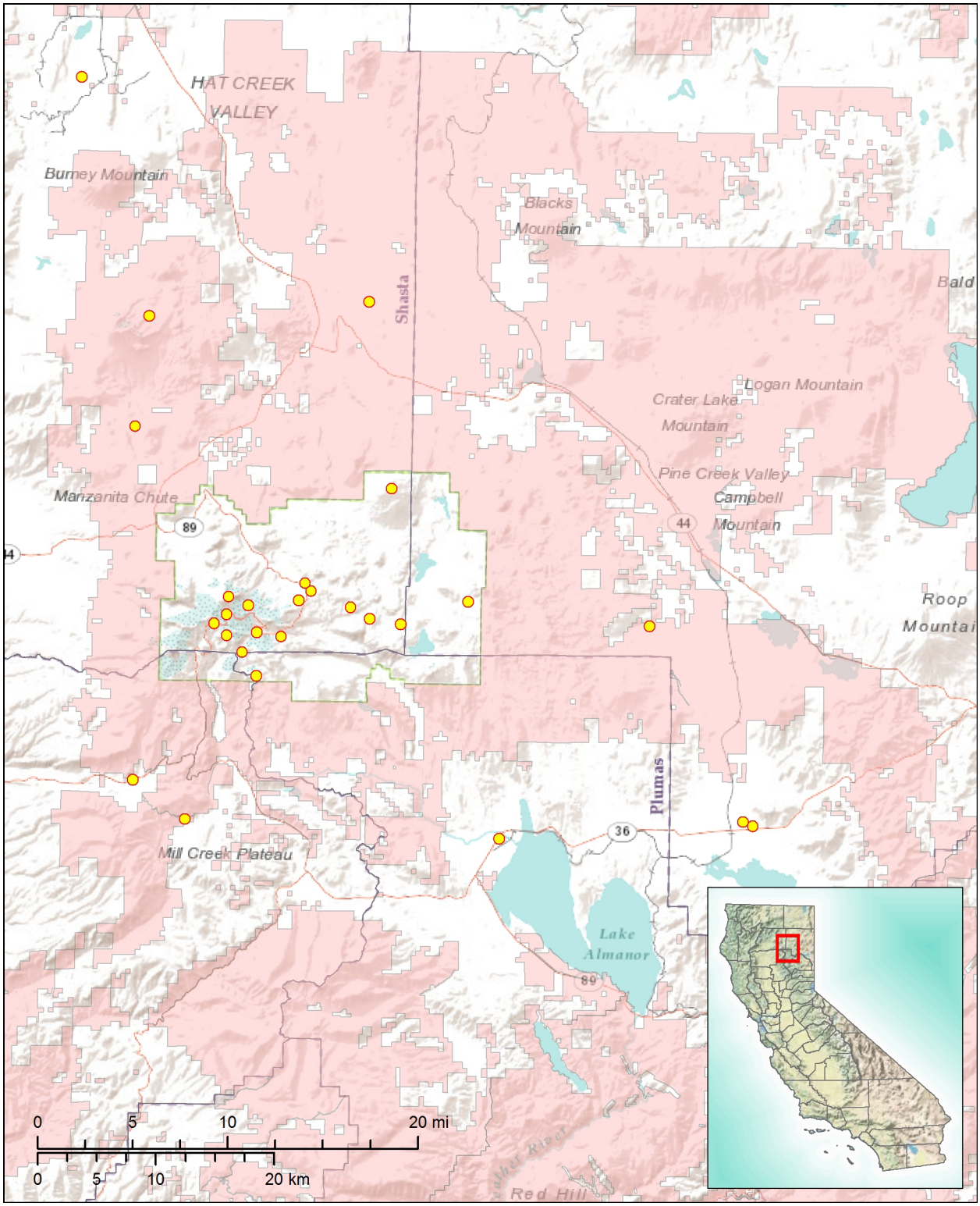
Note: Federally recognized Endangered, Threatened, Proposed, or Candidate species under the Endangered Species Act are omitted as they do not meet the definition of a Species of Conservation Concern (FSH 1909.12 § 12.52).

State Listing	G-rank	S-rank	CRPR	R5 FSS	NFP SM	CA BLM
CA: Not listed NV: Not listed OR: Not listed	G3	CA: S3 NV: Not listed OR: Not listed	1B.3	Not listed	Not listed	Not listed

SWAP:	NNHP:	NNPS:	ORBIC:	OCS:	IUCN:
Not listed	Not listed	Not listed	Not listed	Not listed	Not listed

Expanded abbreviations and citations: State Listing=California Endangered Species Act Listing (CDFW 2018b), Nevada Division of Forestry Fully Protected Plant Species (NAC 527) (NDF 2012), Oregon Department of Agriculture Listed Plants (ODA 2014); G-rank=Global Conservation Status (CDFW 2018a; NatureServe 2018); S-rank=Subnational (state or province-level) Conservation Status (CDFW 2018a; NatureServe 2018; NNHP 2017; ORBIC 2016); CRPR=California Rare Plant Rank (CNPS 2018); R5 FSS=USDA Forest Service Region 5 Regional Forester Sensitive Plant Species List (USDA 2013); NFP SM=Forest Service and Bureau of Land Management Northwest Forest Plan Survey and Manage Species (USDA 2001); CA BLM=California Bureau of Land Management Designated Sensitive Species (BLM 2010); SWAP=California State Wildlife Action Plan Status (CDFW 2015); NNHP=Nevada Natural Heritage Program Status (NNHP 2017); NNPS=Nevada Native Plant Society Status (NNHP 2017); ORBIC=Oregon Biological Information Center Status (ORBIC 2016); OCS=Oregon Conservation Strategy Species (ODFW 2016); IUCN=International Union for Conservation of Nature Red List Status (IUCN 2017).

Distribution: Endemic to California and localized to a region in the vicinity of Lassen Volcanic National Park. *Castilleja lassenensis* is largely restricted to subalpine meadows near Mt. Lassen in areas with volcanic substrate (Egger and Malaby 2015). A majority of occurrences are found on National Park Service lands within five miles of Lassen NF. A total of five occurrences are found on NFS lands within Lassen NF (CCH 2017; Calflora 2017).



Map Sources: *Layers*: USDA Forest Service, Pacific Southwest National Forests: CPAD 2016. California counties: CDF 2009. *Basemaps*: California inset map: © 2013 National Geographic Society, i-cubed (Esri 2017a). Main map: Esri, DeLorme, USGS, NPS (Esri 2012) and Esri, USGS, NOAA (Esri 2017b).

Locations within California:

(Note: Record numbers indicate sites that contain an individual, population, or groups of populations located within ¼ mile of each other (per the California Natural Diversity Database (CNDDB) definition of Element Occurrences in California). Official Element Occurrence (EO) numbers for plants in California are determined solely by the CNDDB and are included within the Reference (Source) column for CNDDB data. Duplicate records from the same site are given the same record number and included in red. The Population Info column includes total number of individuals and total number and size of populations/sub-populations when provided. Elevations in meters from source were converted to feet. If not provided in original source, Land Manager information was obtained using the California Protected Areas Database (CPAD 2016) and Quad information was obtained using 24K Quads, SDE Feature Class (CDFG 2013). All other information is directly from the Reference (Source) column unless additional citation is given.)

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
1	Big Meadows	Plumas	Chester	SD7114	25-Jul-1882			Unknown	4537
2	Lassen National Park	Tehama	Mineral	CAS216887, Eastwood, Howell 1940)	Summer 1933			Lassen NF	4680
3	just E Westwood (N of Firland Rd (Hwy 36))	Lassen	Westwood East	JEPS86676	14-Jul-1990			Unknown	5155
4	NE Westwood (near golf course)	Lassen	Westwood East	JEPS79153	12-Jun-1980			Unknown	5191
5	Summit Lake. Lassen Volcanic Park	Tehama	Mineral	CAS301681	24-Jul-1940			Unknown	4913
6	Twin Meadows, S part Lassen Volcanic National Park Meadows	Shasta	Reading Peak	CCH 2017; CAS462436	15-Aug-1961			Lassen Volcanic NP	6776

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
7	Shasta County: King's Creek Meadow, Mt. Lassen National Park *Castilleja lemmonii* A. Gray; Glen Holstein; Sep 1977; |*Orthocarpus castilloides* Benth.; ; 2012-08-10; Original determination|	Shasta	Reading Peak	CCH 2017; UCD122568	30-Jul-1949			Lassen Volcanic NP	7214
8	Mt. Lassen. Bumpus Hell Trail. Holotype. *Castilleja lassenensis* M. Egger 1996-01-01	Shasta	Lassen Peak	CCH 2017, Egger, Malaby 2015, Eatwood, Howell 1940; CAS187874	7-Sep-1931			Lassen Volcanic NP	8379
9	Kings Creek Picnic Area, Lassen Volcanic National Park	Shasta	Reading Peak	Calflora (po1444)	23-Jul-2014			Lassen Volcanic NP	7386
10	Lassen National Park, Emerald lake (Shasta County, California, US)	Shasta	Lassen Peak	CalPhotos 2017	25-Jul-2008			Lassen Volcanic NP	8112

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
11	Lassen Volcanic National Park. S side of Horseshoe Lake	Shasta	Mt. Harkness	CHSC58518	9-Jul-1992			Lassen Volcanic NP	6602
12	Lassen Natl Forest. Barnes Flat. Swain Mtn quad. T30N R8E sec 9 SE of SE	Lassen	Swain Mountain	OBI75870	10-Aug-2011			Lassen NF	5806
13	upper Grassy Swale (Grassy Swale is a trib of Kings Creek, 150 yds above trail crossing nr center of section); Lassen Volcanic National Park	Shasta	Mt. Harkness	JEPS12511, Gillet et al. 1961	24-Aug-1955			Lassen Volcanic NP	6862
14	Near Lassen Peak parking lot, Lassen Volcanic National Park (Shasta County, California, US) notes *Castilleja lassenensis*	Shasta	Lassen Peak	CalPhotos 2017	31-Jul-2012			Lassen Volcanic NP	8468

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
15	Lassen Volcanic National Park (Lassen/Shasta County, California, US) 1. Reviewed by Mary Ann Showers Aug 3, 2001 Action: changed name from "Unknown" to "Castilleja lemmonii " Reviewer's comments: "C. lassenensis was placed in synonmy with C. lemm	Lassen/Shasta	Reading Peak	CalPhotos 2017	1-Aug-1955			Lassen Volcanic NP	6733
16	Meadows at foot of Lassens Pk. trail from Morgans Springs Meadows at foot of...Pk.	Shasta	Reading Peak	CCH 2017, Eastwood, Howell 1940; CAS28672	24-Aug-1912			Lassen Volcanic NP	8072
17	Lassen National Park	Shasta	Reading Peak	Calflora 2017 (ce340)	1-Jan-1996			Lassen Volcanic NP	6974
18	California, US	Lassen	Mt. Harkness	iNaturalist 2017 (3786794)	23-Jul-2016			Lassen Volcanic NP	7227
19	Mt. Lassen	Shasta	Lassen Peak	CAS381453	1-Aug-1953			Lassen Volcanic NP	10235

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
20	Shasta County: Summit Lake North. Lassen Volcanic National Park	Shasta	Reading Peak	UCD122571	9-Sep-1996			Lassen Volcanic NP	6701
21	NE of Summit Lake Ranger Station. Dersch Meadows. Lassen Volcanic National Park.	Shasta	Reading Peak	RSA113772, Gillet et al. 1961	20-Aug-1953			Lassen Volcanic NP	6659
22	Lassen National Park near Prospect Pk.	Shasta	Prospect Peak	CAS204750	Summer 1932			Lassen Volcanic NP	8202
23	Lassen National Forest USFS S16 in Bunchgrass Valley, approx. 4 m. W of Hwy 89. Occasional perennial in lightly shaded understory formerly wet but now dry *Pinus contorta* woods. Soil volcanic, ashy-silty. Bracts orange-yellow in color.	Shasta	Thousand Lakes Valley	CDA13529	22-Jul-1996			Lassen NF	5255

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
24	Wheel Fuelbreak Lassen National Forest; Highway 89, 44 btwn Viola & Old Station., W on S16 to Bunchgrass Vly.	Shasta	Manzanita Lake	Calflora 2017 (gr12367)	1-Jan-1996			Lassen NF	5420
25	Burney	Shasta	Burney	CAS28882	14-Jun-1923			Unknown	3134
26	Crumbaugh Lake, S side	Shasta	Reading Peak	S. Buckley pers comm. 2017; LAVO6965	20-Sep-1975			Lassen Volcanic NP	
27	McGee Peak area (present day Thousand Lakes Wilderness)	Shasta	Thousand Lakes Valley	D. Taylor (pers. comm. 2017a)	1974-1975			Lassen NF	7298

Distribution on National Forest System (NFS) Lands:

(Please see Reference column of Locations table above for references pertaining to Record Numbers indicated on NFS lands.)

National Forest System (NFS) lands	Record #s (from Locations table above)	CNDDB EOs	Non-CNDDB Records	Recent (seen in past 20 yrs.)	Historic (not seen in past 20 yrs.)	Most Recent Obs.	EOs/ Recs. (5 mile buffer)	Total Records on NFS lands
Angeles:	-	-	-	-	-	-	-	0
Cleveland:	-	-	-	-	-	-	-	0
Eldorado:	-	-	-	-	-	-	-	0
Inyo:	-	-	-	-	-	-	-	0
Klamath:	-	-	-	-	-	-	-	0
Lake Tahoe Basin MU:	-	-	-	-	-	-	-	0
Lassen:	2,12,23,24, 27	0	5	1	4	10-Aug-2011	22	5
Los Padres:	-	-	-	-	-	-	-	0
Mendocino:	-	-	-	-	-	-	-	0
Modoc:	-	-	-	-	-	-	-	0
Plumas:	-	-	-	-	-	-	-	0
San Bernardino:	-	-	-	-	-	-	-	0
Sequoia:	-	-	-	-	-	-	-	0
Shasta-Trinity:	-	-	-	-	-	-	-	0
Sierra:	-	-	-	-	-	-	-	0
Six Rivers:	-	-	-	-	-	-	-	0
Stanislaus:	-	-	-	-	-	-	-	0
Tahoe:	-	-	-	-	-	-	-	0
Totals:	N/A	0	5	1	4	N/A	22	5

Demographic and Population Trends: *Castilleja lassenensis* is known from an estimated 27 occurrences. Of these 27 occurrences, 22 of them are considered historical (occurrences not seen in over 20 years are considered historical by the CNDDB). Presumably due to its treatment as a synonym of *C. lemmonii* in *The Jepson Manual, 2nd Edition* (Weatherwax et al. 2012), only the type specimen of *C. lassenensis* (*Jussel s.n.* CAS187874) is included in the Consortium of California Herbaria (2017). All other records are labeled as *C. lemmonii*. A small number of specimens labeled *C. lemmonii* in the Consortium of California Herbaria have past annotation information indicating they were previously determined to be *C. lassenensis*. All records

included as *C. lassenensis* and retrieved from the Consortium of California Herbaria were done using the geographic distinction from Egger and Malaby's (2015) recognition that *C. lassenensis* only occurs on the flanks of Mt. Lassen. Thus, participants of the Consortium of California Herbaria should include all past annotations with accessions, and for these data to be available on the Consortium of California Herbaria (Green et al. 2017).

Life History: *Castilleja lassenensis* is a hemiparasitic perennial herb that blooms from June until September (CNPS 2017; Wetherwax et al. 2017). Insects and birds are the primary pollinators of *Castilleja* species (Tank et al. 2009; Tank and Olmstead 2008).

In addition to *Ribes* sp., the telial stage of *Cronartium ribicola* (white pine blister rust) is known to occur on members of the Orobanchaceae. One particular study documented *Cronartium ribicola* infections growing on *Castilleja parviflora* (sister to *C. lemmonii*), *C. applegatei, C. miniata*, and *Pedicularis racemosa* in the Cascade Ranges at multiple field locations from Mt. Rainier in Washington to Crater Lake in Oregon (Mulvey and Hansen 2011).

Haustoria are produced by holo- and hemiparastitc Orobanchaceae. Haustoria function to penetrate the roots of host plants. Holoparasitic genera (*Orobanche, Kopsiopsis, Epifagus*, etc.) form haustoria that penetrate both the xylem and phloem cells of the host plant, acquiring photosynthate, water, and mineral nutrients. Hemiparasitic genera (*Pedicularis, Castilleja, Cordylanthus, Orthocarpus, Triphysaria, Chloropyron*, etc.) have chlorophyll, generate their own photosynthate, and largely attain water and mineral nutrients from hosts. Hosts also produce a number of compounds that stimulate the production of haustoria. Xylem flow is actively encouraged by compounds – i.e. mannitol – that are highly concentrated in the parasite, maintaining an osmotic gradient between the host and the receiving plant. Annual hemiparasites increase nutrient cycling within a community, as minerals retained by host plants migrate to ephemeral parasites, which subsequently undergo decomposition and mineralization of retained nutrients. Increased nutrient cycling is thought to offset the effects of parasitism on the community. Species of Orobanchaceae may also increase diversity in scenarios where dominant species are host to hemiparasites. Reduction in growth of dominant vegetation may facilitate the occupation of less abundant species (Stevens 2001).

Members of *Castilleja* rely largely upon their hosts for water and mineral nutrients. Uptake of host alkaloids has been shown to decrease herbivory, result in more frequent visits from pollinators, and increase overall seed production throughout the life of *Castilleja indivisa* (Adler 2000). In an additional study comparing the effects of different host species on *Castilleja indivisa*, researchers found that *C. indivisa* produced three times the number of seeds, six times the number of flowers, and attracted substantially more pollinators when parasitizing lupines in contrast to plants that parasitized grasses (Adler 2003).

Diversity: *Castilleja* is a member of the Orobanchaceae. This large and diverse parasitic family contains 99 genera that are distributed globally in both the southern and northern hemispheres (Stevens 2001). *Castilleja* is within the tribe Castillejinae along with *Triphysaria, Cordylanthus*, and *Orthocarpus*. The genus *Castilleja* contains roughly 180 species that occur in a range of habitats from coastal dunes to alpine meadows (Tank and Olmstead 2008).

Castilleja has annual and perennial clades. Hummingbird pollination is restricted to the ~150 species in the perennial clade. The remaining taxa have flowers that are largely adapted to insect pollination (Tank and Olmstead 2009; Duffield 1972). The most robust phylogenetic analysis (2 cpDNA, ITS, and ETS; ~3000 bp) on the Castillejinae demonstrates that traditional groups based on morphology are not monophyletic, warranting taxonomic revisions that were encouraged by these insights. This same phylogenetic analysis demonstrated that perennial members of *Castilleja* represent a single clade that derived from an ancestral annual lineage (Tank and Olmstead 2008). This notion is in contrast to the longstanding interpretation that perennial taxa are ancestral and that annual taxa represent a derived condition that arose as a bet-hedging strategy to extreme and fluctuating conditions (Tank and Olmstead 2008). *Castilleja lassenensis* is among the perennial clade in this group. Members of this group represent a complex taxonomic scenario. The propensity for hybridization, polyploidization, and morphological overlap among species has historically presented taxonomic and biosystematic challenges (Tank and Olmstead 2008; Tank et al. 2009; Egger and Malaby 2015).

Castilleja lassenensis was originally described in 1940 (Tropicos 2017). Until recent times, it was considered a synonym of *C. lemmonii* in local floras. Recent work reaffirmed *C. lassenensis* as a distinct taxon with edaphic, morphological, and geographic distinction (Egger and Malaby 2015). Yet published molecular phylogenies that include both *C. lemmonii* and *C. lassenensis* provide limited resolution and equivocal evidence regarding the genetic differences between these taxa. Given these insights, further genetic study with a directed focus on *C. lemmonii* is warranted (Green et al. 2017).

Habitat: *Castilleja lassenensis* occurs on volcanic substrate in meadows and seeps among subalpine coniferous forests (CNPS 2017). It was long regarded as a northerly form of *C. lemmonii*, a taxon that is known to occur in moist meadows (Wetherwax et al. 2017).

Habitat Status or Trend: The status and trend of *C. lassenensis* habitat is unknown. Field work is needed in order to obtain evidence of any ongoing trends or to determine the current status of the associated habitat.

Capacity for the Species to Disperse: Information regarding the dispersal capacity of *C. lassenensis* is non-existent in the primary literature. Despite its original description in 1940, this taxon assumed the identity of a localized form and putative synonym of *C. lemmonii*. This cryptic designation concealed the biological autonomy of *C. lassenensis* from the general research and botanical community (Egger and Malaby 2015). In one study on *Castilleja cinerea*, researchers documented that dispersal was limited to five meters (Sclafani 2006).

Threats: There are no documented threats to *C. lassenensis* (Green et al. 2017). Further study and fieldwork is needed in order to assess any threats to occurrences in the regions of Mt. Lassen.

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January 23, 2018

Reviewer(s) and Date:

David Magney, Rare Plant Program Manager, California Native Plant Society, (916) 447-2677 ext. 205, dmagney@cnps.org. January 24, 2018.

Formatting: Form is set up as 508 compliant. Please use the "styles" if further formatting is necessary.

Purpose: This is to maintain the best available science on a species that could be used by the Forest Service in a variety of functions. Specifically, there would be additional steps and evaluations to determine whether or not this species would be considered a Species of Conservation Concern under the 2012 Planning Rule or a Sensitive Species under the 1982 Planning Rule.

Additional Considerations at the Forest Level: Habitat amount and juxtaposition of both the species and habitat locations.