Plant Species Evaluation Form

Pohlia tundrae Shaw

TUNDRA THREAD MOSS

Family: Mielichhoferiaceae (CNPS 2017) **PLANTS Symbol:** POTU5 (USDA 2017) **Calif. Endemic:** No (CNPS 2017)

Synonyms/Other Names: The original description of *Pohlia tundrae* A.J. Shaw was described in 1981 from a type locality in Pitkin County, Colorado (Tropicos 2017). Prior to formal recognition, collections were labelled as *P. annotina* var. *decipiens* in North American herbaria.

Identification Issues: *Pohlia tundrae* is known to grow alongside *P. drummondii* above the tree line in alpine habitat. Many herbarium collections of *P. tundrae* contain shoots of *P. drummondii* as well (Shaw 1981a). Both taxa occur in California and are difficult to tell apart. *Pohlia tundrae* often produces more gemmae than *P. drummondii* when occurring together. Sporophyte production and sexual reproduction is less common in *P. tundrae* when occurring alongside *P. drummondii*. The gemmae of *P. tundrae* are narrower and more elongate than the bulbiform gemmae of *P. drummondii*. Near the tree line, *P. tundrae* approaches *P. proligera* in morphology. These taxa largely differ in the length of their gemmae, which are considerably shorter in *P. proligera* (Shaw 1981b). Gemmae of *P. proligera* have peg-like leaf primordia restricted to the apex of the propagule. In contrast, *P. tundrae* has laminate leaf primordia that are not entirely restricted to the apex of the propagule (Shaw 1981b; Shaw 2014).

Taxonomy:

Taxonomic description from the *Flora of North America North of Mexico, Volume 28: Bryophyta, part 2* (Shaw 2014):

"Species ca. 85 (32 species in the flora):

Genus Description: Plants very small to large, as scattered plants or deep, sometimes extensive, turfs. Stems 0.1-10 cm, often bearing subfloral innovations below the gametangia. Leaves (with dorsal and lateral not differentiated), erect to spreading, narrowly lanceolate to ovate- lanceolate [rarely linear-lanceolate], 0.6-3.5 mm; base decurrent or not; margins plane (strongly revolute in *P. cardotii* and *P. crudoides*), finely serrate to serrulate near apex, rarely entire; apex acute (sometimes short-acuminate *in P. melanodon*); costa ending well before apex, subpercurrent, percurrent, or rarely short-excurrent; distal medial laminal cells elongate-hexagonal, rhombic, or linear-rhomboidal, sometimes narrowly vermicular; marginal cells undifferentiated or slightly narrower and longer than medial cells. Specialized asexual reproduction common, by spheric to ovoid rhizoidal tubers or axillary filiform to bulbiform gemmae. Sexual conditiondioicous, paroicous, or rarely autoicous; perigonia and perichaetia terminal (perigonia rarely lateral in *P. longibracteata*); perigonial leaf apex acute to long-acuminate; perichaetial leaves same size as vegetative leaves or sometimes strongly differentiated, lanceolate to narrowly linear-lanceolate. Seta single (multiple in *P. robertsonii*), stramineous to orange-brown, straight or bent. Capsule

inclined 0-180°, narrowly cylindric to broadly pyriform or urceolate, 1-6[-10] mm, neck sometimes 1+ times urn length; exothecial cells near mouth in 1-3+ rows, medial cell walls straight or sinuate; stomata superficial to immersed; annulus absent or present, revoluble; operculum convex, short- to long-conic, sometimes short-rostrate; peristome double [rarely absent], 4:2:4-6(-8); exostome white, pale yellow to brown, or sometimes dark reddish brown, teeth triangular to lanceolate, sometimes irregular [rarely reduced or absent], trabeculate or not, pitted basally, coarsely papillose distally (coarsely papillose throughout in *P. crudoides*); endostome basal membrane low to high, sometimes scarcely exceeding capsule rim, segments narrow to wide, strongly to weakly or scarcely keeled, rarely reduced to rudimentary projections, broadly to narrowly perforate or less often not, cilia absent or 1-3.

Species Description: Plants small to medium-sized, green to light green, glossy. Stems 0.5-2.5 cm. Leaves ± spreading, lanceolate to ovate-lanceolate, 0.9-1.5 mm; margins serrulate to serrate in distal 1/3; costa subpercurrent; distal medial laminal cells rhombic to rhomboidal, 45-95 µm, walls thin. Specialized asexual reproduction usually present when sterile; axillary gemmae 2-8, elongate, , yellow, pink, or green, leaf primordia at apex and lower, laminate. Sexual condition dioicous; perigonial leaves ovate; perichaetial leaves scarcely differentiated, ovate-lanceolate. Seta orange-brown. Capsuleinclined 95-180°, brown to stramineous, pyriform, neck 1/3 urn length; exothecial cells short-rectangular, walls sinuate; stomata superficial; annulus present; operculum convex-conic; exostome teeth yellow-brown, narrowly triangular-acute; endostome hyaline, basal membrane 1/2 exostome length, segments distinctly keeled, broadly perforate, cilia short to rudimentary. Spores 16-23 µm, finely roughened. Author: A. Jonathan Shaw.

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).

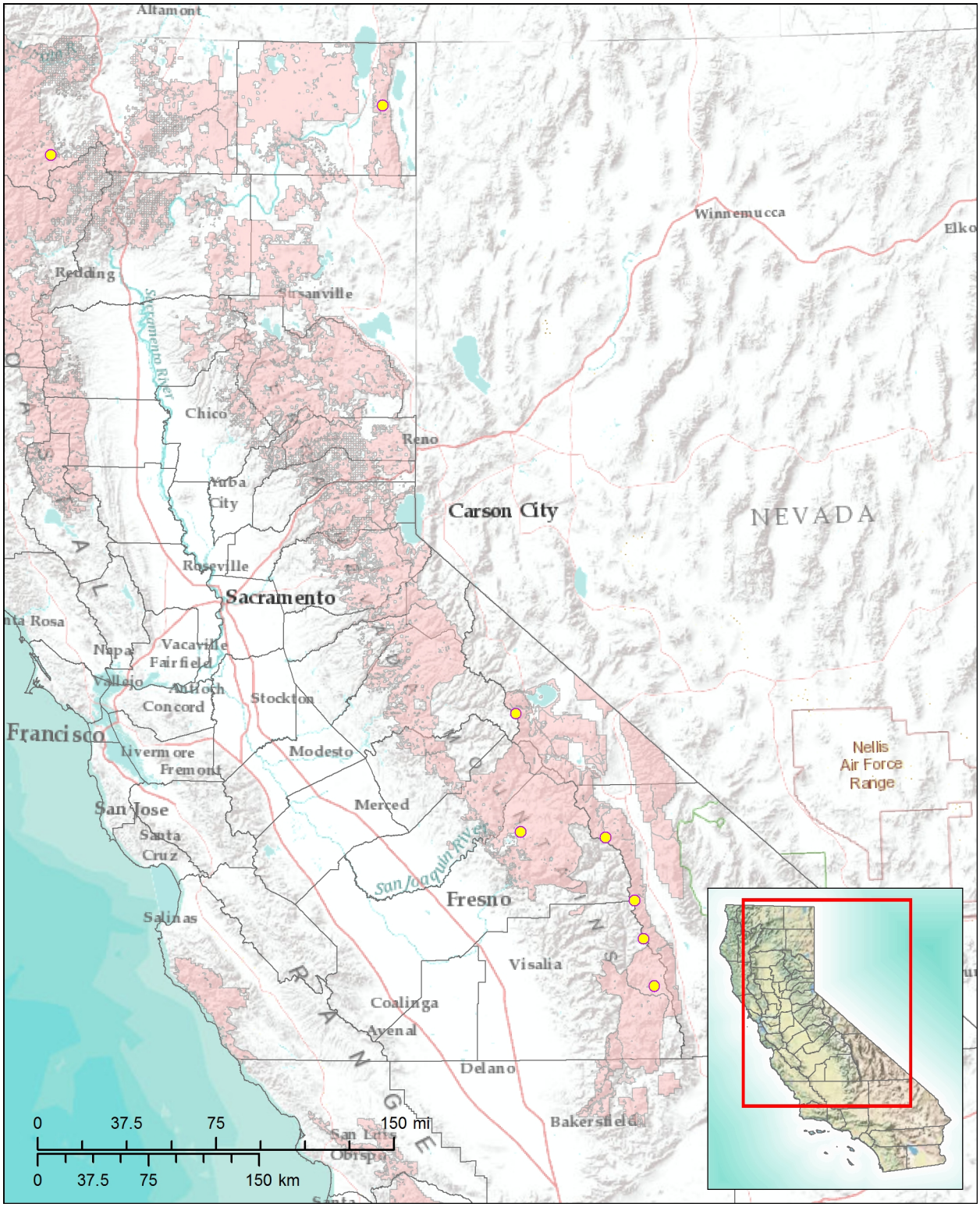
State Listing	G-rank	S-rank	CRPR	R5 FSS	NFP SM	CA BLM
CA: Not listed NV: Not listed OR: Not listed	G3	CA: S3 NV: Not listed OR: S1	2B.3	Not listed	Not listed	Not listed

SWAP:	NNHP:	NNPS:	ORBIC:	OCS:	IUCN:
Not listed	Not listed	Not listed	3: Review	Not listed	Not listed

Expanded abbreviations and citations: State Listing=California Endangered Species Act Listing (CDFW 2017b), 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 2017a; NatureServe 2017); S-rank=Subnational (state or province-level) Conservation Status (CDFW 2017a; NatureServe 2017; NNHP 2017; ORBIC 2016); CRPR=California Rare Plant Rank (CNPS 2017); 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: Broadly distributed in western North America and also found in Europe. Representatives of this taxon are found in Alaska, Colorado, Idaho, New Mexico, Nevada, Oregon, Utah, Washington, and California (Shaw 2014). Occurrences in California are found in Modoc, Siskiyou, Fresno, Inyo, Tuolumne, and Tulare counties. Element occurrence one, three,

and six (EO 1, EO 3, and EO 6) are found within the Inyo NF. Another two occurrences are found within five miles of the Inyo NF. Element occurrence four (EO 4) is found in the Klamath NF. One occurrence (EO 5) is found on the Sierra NF, and an additional occurrence is found within the Modoc NF (CNDDB 2017).



Basemap Sources: Main map: Esri, DeLorme, USGS, NOAA, NPS. California inset map: ©2013 National Geographic Society, i-cubed.

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	BAKEOVEN MEADOW.	Tulare	Monache Mountain (3611822)	CNDDB, May 2017 (EO 1)	15-Jul-1950	ONLY SOURCE OF INFORMATION FOR THIS SITE IS A 1950 HOWELL COLLECTION. NEEDS FIELDWORK.		Inyo NF	8100
2	ABOVE PRIMROSE LAKE.	Tulare	Mount Whitney (3611853)	CNDDB, May 2017 (EO 2)	24-Jul-1949	SITE BASED ON A 1949 HOWELL COLLECTION. NEEDS FIELDWORK.		NPS - Sequoia/Kings Canyon NP	11700
3	ABOVE ROBINSON LAKE, S OF ONION VALLEY.	Inyo	Kearsarge Peak (3611873)	CNDDB, May 2017 (EO 3)	Unknown	SITE BASED ON A NORRIS COLLECTION. NEEDS FIELDWORK.		Inyo NF	
4	BINGHAM LAKE.	Siskiyou	Eaton Peak (4112238)	CNDDB, May 2017 (EO 4)	Unknown	SITE BASED ON A MCGREW COLLECTION. NEEDS FIELDWORK.		Klamath NF	

Rec. #	Locality	County	Quad	Reference (Source)	Date Last Observed	Population Info	Threats	Land Manager	Elev. (ft.)
5	SOUTH FORK TAMARACK CREEK, HIGHWAY 168 BETWEEN SHAVER LAKE AND HUNTINGTON LAKE.	Fresno	Huntington Lake (3711922)	CNDDB, May 2017 (EO 5)	11-Jul-2000	ONLY SOURCE OF INFORMATION FOR THIS SITE IS A 2000 COLLECTION BY NORRIS. NEEDS FIELDWORK.		Sierra NF	7220
6	SW SIDE OF CHOCOLATE PEAK, JOHN MUIR WILDERNESS.	Inyo	Mt. Thompson (3711825)	CNDDB, May 2017 (EO 6)	08-Sep-2003	SITE BASED ON A 2003 LAEGER COLLECTION.		Inyo NF	10950
7	NEAR THE SUMMIT OF MOUNT DANA PEAK ALONG THE TRAIL TO THE SUMMIT.	Tuolumne	Mount Dana (3711982)	CNDDB, May 2017 (EO 7)	12-Aug-2009	SITE BASED ON A 2009 TAYLOR COLLECTION.		NPS - Yosemite NP	12015
8	N SLOPE OF BALD MOUNTAIN, WARNER MOUNTAINS.	Modoc	Payne Peak (4112053)	CNDDB, May 2017 (EO 8)	17-Aug-2008	SITE BASED ON TWO 2008 JANEWAY COLLECTIONS.		Modoc NF	7800

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:	1,3,6	3	0	1	n/a	08-Sep-2003	2	3
Klamath:	4	1	0	n/a	n/a	n/a	0	1
Lake Tahoe Basin MU:	-	-	-	-	-	-	-	0
Lassen:	-	-	-	-	-	-	-	0
Los Padres:	-	-	-	-	-	-	-	0
Mendocino:	-	-	-	-	-	-	-	0
Modoc:	8	1	0	1	0	17-Aug-2008	0	1
Plumas:	-	-	-	-	-	-	-	0
San Bernardino:	-	-	-	-	-	-	-	0
Sequoia:	-	-	-	-	-	-	-	0
Shasta-Trinity:	-	-	-	-	-	-	-	0
Sierra:	5	1	0	1	0	11-Jul-2000	0	1
Six Rivers:	-	-	-	-	-	-	-	0
Stanislaus:	-	-	-	-	-	-	-	0
Tahoe:	-	-	-	-	-	-	-	0
Totals:	N/A	6	0	3	0	N/A	2	6

Demographic and Population Trends: The earliest occurrence records are based on collections from 1949 (EO 2) and 1950 (EO 1), at high elevations in Tulare County (Mt. Whitney and Monarch Mountain, respectively). These historic element occurrences have not been revisited since the time of their original documentation. The most recent occurrences (EO 7 and EO 8) are from the late 2000's and were documented in Tulare County (Yosemite NP,

within 5 mi. of Inyo NF in similar habitat to EO 2) and Modoc County (Modoc NF). All records appear to have been visited once, at a time when vouchers were being collected (CNDDB 2017).

Life History: *Pohlia tundrae* is a dioicous and acrocarpous moss with capsules that mature between June and August (Shaw 2014). It has a compact growth form and produces short stems. Leaves develop and display a distinctive sheen when dried. *Pohlia tundrae* often occurs alongside *P. drummondii* in alpine habitats. The two plants are difficult to distinguish, but *P. tundrae* seldom produces sporophytes and often has abundant gemmae in the axils of its leaves (Shaw 1981a). Within populations there is generally an inverse relationship between gemmae and sporophyte production, where populations that produce large numbers of gemmae generally produce limited numbers of sporophytes. In most situations, species of *Pohlia* form smaller populations in rock crevices or pockets of exposed mineral soil (Shaw 1981b).

Diversity: *Pohlia* is group of 85 species that are distributed worldwide in both the northern and southern hemispheres. There are 32 species in the North American flora. There are gemmiferous (capacity to reproduce asexually from gametophytic propagules) and non-gemmiferous taxa. An isozyme analysis of 11 taxa determined that gemmiferous taxa form a complex of entities that are more similar to each other than non-gemmiferous taxa are. This study classified gemmiferous entities as a complex of microspecies. It was also stated that gemmiferous taxa have nearly identical sporophytes and that differences between taxa are largely observed on gametophytic tissue (Shaw 1999).

Habitat: A majority of occurrences are found in alpine boulder and rock fields with gravelly and damp soil (CNPS 2017; CPNWH 2017; CNDDB 2017). Formal descriptions indicate that it has a preference acidic and humus-rich soil (Shaw 2014). It is also found in a mountain meadow, along a gravelly and peaty creek, and on a moist to submerged sunny boulder in a stream running through a *Pinus contorta* forest (CPNWH 2017). Records indicate that *P. tundrae* occurs alongside *Ribes* sp., *Holodiscus* sp., *Monardella* sp., *Heuchera* sp., *Pinus contorta, Phyllodoce* sp., *Tsuga mertensiana*, *Abies lasiocarpa*, *Cassiope mertensiana, Bartramia ithyphylla, Abies amabilis, Pohlia ludwigii, Pinus albicaulis, Conostomum tetragonum*, and *Gymnomitrion* sp. (CNDDB 2017; Christy 2007).

Habitat Status or Trend: Alpine organisms like *P. tundrae* are vulnerable to a changing climate. Preference for a high elevation habitat leaves populations isolated in regions where suitable distributional shifts are unlikely (Christy 2007).

Capacity for the Species to Disperse: Direct information on the dispersal capacity of *P. tundrae* is unknown. Plants are often sterile and not releasing spores. Abundant gemmae are produced and released from vegetative tissue (Christy 2007). Gemmae (>300 μm) are substantially larger than spores (~20 μm) (Shaw 1981b).

Threats: Pacific Northwest habitat is generally remote and in buffered from direct threats. Rock climbing, hiking, and other trail activities may impact occurrences that are located near recreation areas. Air pollution and climate change are extended threats to these sensitive alpine organisms (Christy 2007).

Literature Cited

[BLM] Bureau of Land Management. 2010. Special Status Plants in California, Including BLM Designated Sensitive Species. February 8, 2010. Available at: https://www.blm.gov/ca/dir/pdfs/2010/im/CAIM2010-008ATT2B.pdf [accessed 25 May 2017].

[CDFG] California Department of Fish and Game. 2013. 24K Quads, SDE Feature Class. Index for 1:24,000-scale (24K), 7.5-minute by 7.5-minute, paper U.S. Geological Survey maps in California.

[CDFW] California Department of Fish and Wildlife. 2015. California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians; Volume II, Appendix C: Species of Greatest Conservation Need. Gonzales, A. G. and J. Hoshi (eds.). Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA. Available at: https://www.wildlife.ca.gov/swap/final [accessed 11 May 2017].

[CNDDB] California Department of Fish and Wildlife, Natural Diversity Database. 2017. RareFind 5 [Internet application] and CNDDB Maps and Data. Available at: https://www.wildlife.ca.gov/Data/CNDDB/Maps-and-Data [Government Version, June 2017].

[CDFW] California Department of Fish and Wildlife, Natural Diversity Database. 2017a. Special Vascular Plants, Bryophytes, and Lichens List. Quarterly publication. 126 pp.

____. 2017b. State and Federally Listed Endangered, Threatened, and Rare Plants of California. July 2017. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109390&inline [accessed 11 September 2017].

[CNPS] California Native Plant Society, Rare Plant Program. 2017. *Inventory of Rare and Endangered Plants of California* (online edition, v8-03 0.39). Website http://www.rareplants.cnps.org [accessed May 17, 2017].

[CPAD] California Protected Areas Database. 2016. Version 2016b1. GreenInfo Network. Available at: http://www.calands.org/.

Christy, J. A. 2007. *Pohlia tundrae*, Species Fact Sheet. Interagency Special Status/Sensitive Species Program (ISSSSP). Available at: https://www.fs.fed.us/r6/sfpnw/issssp/species-index/flora-bryophytes.shtml.

[IUCN] International Union for Conservation of Nature. 2017. The IUCN Red List of Threatened Species. Website http://www.iucnredlist.org/ [accessed 26 May 2017].

NatureServe. 2017. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Website http://explorer.natureserve.org [accessed 17 May 2017].

[NDF] Nevada Division of Forestry. 2012. NAC 527.010 List of fully protected species of native flora. April 2012. Available at: https://www.leg.state.nv.us/NAC/NAC-527.html#NAC527Sec010 [accessed 12 May 2017].

[NNHP] Nevada Natural Heritage Program. 2017. Species Lists. Department of Conservation and Natural Resources. Available at: http://heritage.nv.gov/species/lists.php [accessed 25 May 2017].

[ODA] Oregon Department of Agriculture. 2014. Oregon listed and candidate plants - complete list. Native Plant Conservation Program. August 13, 2014. Available at: https://data.oregon.gov/Natural-Resources/Oregon-listed-and-candidate-plants-complete-list/8s3k-ygh2 [accessed 25 May 2017].

[ODFW] Oregon Department of Fish and Wildlife. 2016. Oregon Conservation Strategy, Chapter 6: Strategy Species. Oregon Department of Fish and Wildlife, Salem, Oregon. PDF content last updated December 30, 2016. Available at: http://oregonconservationstrategy.org/ [accessed 25 May 2017].

[ORBIC] Oregon Biodiversity Information Center. 2016. Rare, Threatened and Endangered Species of Oregon. Institute for Natural Resources, Portland State University, Portland, OR. 130 pp. Available at: http://inr.oregonstate.edu/sites/inr.oregonstate.edu/files/2016-rte-book.pdf [accessed 25 May 2017].

Shaw, A. J. 1981b. Ecological diversification among nine species of *Pohlia* (Musci) in western North America. *Canadian Journal of Botany* 59: 2,359-2,378.

____. 1999. Genetic structure in relation to reproductive biology of 11 species of *Pohlia* Hedw. (Bryaceae). *Systematic Botany* 24(1): 85-94.

____. 1981a. *Pohlia andrewsii* and *P. tundrae*, two new arctic-alpine propaguliferous species from North America. *The Bryologist* 84(1): 65-74.

____. 2014. *Pohlia*. *In*: Flora of North America Editorial Committee (eds.), *Flora of North America North of Mexico, Vol. 28: Bryophyta, part 2*. New York and Oxford. Website http://www.efloras.org/.

Tropicos. 2017. Missouri Botanical Garden. Website http://www.tropicos.org [accessed 16 May 2017].

[USDA] U.S. Department of Agriculture Forest Service, Pacific Southwest Region. 2013. Regional Forester Sensitive Species List. Available at: http://www.fs.usda.gov/main/r5/plants-animals/plants [accessed 9 May 2017].

[USDA] U.S. Department of Agriculture Forest Service and U.S. Department of Interior Bureau of Land Management. 2001. List of Survey and Manage Species in Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures; as amended by Annual Species Reviews 2001-2003. Available at: https://www.blm.gov/or/plans/surveyandmanage/files/sm-fs-enc3-table1-1-dec2003wrtv.pdf [accessed 12 September 2017].

[USDA] U.S. Department of Agriculture, Natural Resources Conservation Service. 2017. PLANTS Database. Website http://plants.usda.gov/ [accessed 16 May 2017].

Persons Contacted:

Sanger, A., K. Bovee, D. Lepley, W. Boes, and H. Guenther. 2017. Lassen and Modoc National Forest botanists. Information submitted at Modoc/Lassen FS-SCC and IPA Workshop, Susanville, CA. 25-26 July 2017.

Taylor, D. Wm. 2017. Environmental contractor, Aptos, CA. Information submitted at Modoc/Lassen FS-SCC and IPA Workshop, Susanville, CA. 25-26 July 2017.

Author(s) and Date:

Steven Serkanic, Assistant Rare Plant Botanist, California Native Plant Society, (916) 447-2677 x218, sserkanic@cnps.org

Aaron E. Sims, Rare Plant Botanist, California Native Plant Society, (916) 324-3816, asims@cnps.org

January 17, 2018

Reviewer(s) and Date:

David Magney, Rare Plant Program Manager, California Native Plant Society, (916) 447-2677 ext. 205, dmagney@cnps.org. January 17, 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.