Added to California Rare Plant Rank 4.3 of the CNPS Inventory on 31 December 2019

Rare Plant Status Review: *Claytonia serpenticola*
Proposed Addition to California Rare Plant Rank 4.3, G3 / S3
Aaron E. Sims (CNPS) and Roxanne Bittman (CNDDB)
15 October 2019

This species review is being expedited though a challenge cost share agreement between the California Native Plant Society and the USDA Forest Service, Pacific Southwest Region. Aside from being advanced as part of this agreement, the process, content, and information provided herein is not altered, modified, or developed differently in any way or form compared to other status reviews developed by CNPS.

Background
Claytonia serpenticola T.R. Stoughton is a perennial herb in the Montiaceae that is known from the Klamath-Siskiyou region of northwestern California in the North Coast Ranges (Humboldt, Shasta, Siskiyou, and Trinity cos.) north to the Siskiyou Mountains in southern Oregon (Jackson County). It was recently described by Stoughton et al. (2017) and is therefore not included in *The Jepson Manual* (Chambers 1993), *The Jepson Manual, Second Edition* (Miller and Chambers 2012), or *Flora of North America North of Mexico* (Miller 2004). *Claytonia serpenticola* is morphologically similar to the broad interpretation of *C. lanceolata* (sensu Miller and Chambers 2006), but differs in its ecological setting, alternate leaf arrangement, and by the shape, number, and venation of its cauline leaves. The discovery of this distinct species in the Klamath-Siskiyou region occurred during preliminary molecular analyses when DNA sequences for *C. lanceolata* did not resolve as sister to other sequences. Upon examining the specimen sampled, Stoughton et al. (2017) found the diagnostic feature of this lineage as plants that have alternate cauline leaves and axillary (vs. strictly solitary/terminal) inflorescences. “The more common condition for *C. lanceolata* s. l. is to have an opposite pair of cauline leaves and Pursh (1814) mentions specifically in the original description that *C. lanceolata* has a solitary inflorescence.” (Stoughton et al. 2017). The specific epithet, *serpenticola*, refers to the tendency of this species to be associated with serpentine soils (Stoughton et al. 2017).

Taxonomy
“At least in northern California, *C. serpenticola* is diagnosable by its propensity to have inflorescences that emerge from the axils of its cauline leaves. This diagnostic feature has been observed to occur only rarely in populations of *C. lanceolata* or *C. obovata*, and only in areas where these taxa grow in sympatry with *C. serpenticola* (T. Stoughton pers. obs.). Some morphological variation was observed within and among populations identified here as *C. serpenticola*, perhaps reflecting morphological evidence of hybridization with close congeners, particularly in areas of sympatry with *C. obovata*. Nevertheless, *C. serpenticola* is a diagnosable taxon worthy of recognition at the rank of species.” (Stoughton et al. 2017). See Stoughton et al. (2017) for a taxonomic key and Table 1 in Appendix II for additional characters used to differentiate *C. serpenticola* from other taxa in the *Claytonia lanceolata* species complex in California.

Ecology
Claytonia serpenticola occurs on xeric, stony, generally north-facing slopes comprised of mafic substrates (e.g. gabbro, peridotite, serpentine) that are sometimes mixed with sedimentary rocks

such as shale. It is most often in openings of mixed-coniferous and subalpine coniferous forests from approximately 1,000 to 2,450 meters in elevation (Stoughton et al. 2017). Based on herbarium collection records, *C. serpenticola* is known to flower from April to June, with an uncommon late blooming period into July in California (CCH1 2019). It has been described from forests containing white fir, pine, incense cedar, Douglas-fir, sugar pine, and mountain hemlock, as well as from forests of Western white pine and Shasta red fir. Sometimes there is sparse understory composed of *Ceanothus cuneatus* and *Eriogonum congdonii* (CCH1 2019).

Distribution and Abundance
In California, *C. serpenticola* is known from 21 occurrences mostly throughout the Klamath Ranges (13 occurrences within Shasta, Siskiyou, and Trinity cos.), with a concentration of six occurrences from the Lassics in the outer North Coast ranges (Humboldt and Trinity cos.) and two occurrences in the high North Coast ranges (Horse Mountain and vicinity, Humboldt County). In Oregon, *C. serpenticola* is known from Observation Peak and Red Mountain within the Siskiyou Mountains of Jackson County. Only three occurrences of *C. serpenticola* are considered recent (occurrences not seen in 20 years are considered historical by CNDDB), but due to its distribution in remote, generally under-reported areas, this is not too much of a surprise, and it is expected that historical occurrences are extant due to limited to no land use change. Although known from only a handful of occurrences in California, its occurrences range across a rather large area and additional occurrences are expected to be found among and between collection records.

All California occurrences of *C. serpenticola* are within USDA Forest Service lands, with one occurrence in Klamath NF, one in Rogue River NF, 11 in Shasta-Trinity NF, and eight in Six Rivers NF.

Status and Threats
There are no known direct threats to *C. serpenticola*. Its occurrence wholly in USDA Forest Service lands should offer some protection from development and other threats in California. It was recommended for addition to California Rare Plant Rank 4 by Tommy Stoughton (pers. comm. 2019) based on his extensive field work and research on the *Claytonia lanceolata* species complex.

Summary
Based on the available information, CNPS and CNDDB recommend adding *C. serpenticola* to 4.3 of the CNPS Inventory. If knowledge on the distribution, threats, and rarity status of *C. serpenticola* changes in the future, we will re-evaluate its status at that time.

Recommended Actions
CNPS: Add *Claytonia serpenticola* to 4.3
CNDDB: Add *Claytonia serpenticola* to G3 / S3

Draft CNPS Inventory Record
Claytonia serpenticola T.R. Stoughton
serpentine spring beauty
Montiaceae
CRPR 4.3
Oregon

Sent to: NW, D. Jolles on 10/15/2019

Humboldt, Shasta, Siskiyou, Trinity
Black Lassic (634D) 4012335, Covington Mill (667A) 4012287, Siligo Peak (667B) 4012288, Grouse Mtn. (670C) 4012376, Seven Lakes Basin (682B) 4112224, Tangle Blue Lake (683B) 4112226, Whisky Bill Peak (683D) 4112215, Caribou Lake (684C) 4112218, Ycatapom Peak (684D) 4112217, Mount Eddy (699C) 4112234, South China Mtn. (700D) 4112235, Marble Mtn. (719C) 4112352, Kangaroo Mtn. (736B) 4112382
Upper montane coniferous forest, subalpine coniferous forest / rocky slopes, xeric, usually openings, usually serpentinite; elevation 1,000 to 2,450 meters.
Perennial herb. Blooms April to June (July)
See *Systematic Botany* 42(2):283-300 (2017) for original description.

Literature Cited

Chambers, K. L. 1993. *Claytonia* L. (Portulacaceae). Pp 898–900 *in* Hickman, J. C. (ed.), The Jepson manual: Higher plants of California. University of California Press, Berkeley, CA.

[CCH1] Consortium of California Herbaria 1. 2019. Data provided by the participants of the Consortium of California Herbaria. Regents of the University of California, Berkeley. Website http://ucjeps.berkeley.edu/consortium/ [accessed 24 September 2019].

Miller, J. M. 2004. *Claytonia* Linnaeus, *in* Flora of North America Editorial Committee (eds.), *Flora of North America North of Mexico, Volume 4*. Website http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=107275 [accessed 19 August 2019].

Miller, J. M. and K. L. Chambers. 2006. Systematics of *Claytonia* (Portulacaceae). *Systematic Botany Monographs* 78: 1–236. (Not seen.)

____. 2012. *Claytonia lanceolata*. *In*: Jepson Flora Project (eds.), *Jepson eFlora.* Website http://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=19622 [accessed 18 December 2018].

Pursh, F. T. 1814. *Claytonia*. Pp. 175 *in* Flora Americae Septentrionalis; or, A systematic arrangement and description of the plants of North America. London, U. K.: White, Cochrance, and Co.

Stoughton, T. R., D. D. Jolles, and R. L. O'Quinn. 2017. The western spring beauties, *Claytonia lanceolata* (Montiaceae): A review and revised taxonomy for California. *Systematic Botany* 42(2): 283-300. (Original description.)

Sent to: NW, D. Jolles on 10/15/2019

APPENDIX I – BACKGROUND

The following is a general summary of the revised taxonomic treatment of the *Claytonia lanceolata* species complex in California published by Stoughton et al. (2017), with emphasis on taxa that are being reviewed for addition to the *CNPS Inventory of Rare and Endangered Plants of California*.

Recent field, taxonomic, and molecular work by Stoughton and Jolles (2013) and Stoughton et al. (2017) has led to a recircumscription of *C. lanceolata* var. *peirsonii* to *C. peirsonii* subsp. *peirsonii*, along with the description of three additional subspecies, *C. peirsonii* subsp. *bernardinus*, subsp. *californacis*, and subsp. *yorkii*, which are all rare and concurrently under review for addition to the CNPS Inventory. As a result of their work, the taxonomic recognition of *Claytonia obovata* (formerly treated as a synonym of *C. lanceolata*) was also resurrected by Stoughton et al. (2017), and a new taxon, *C. serpenticola* was described; both occurring in the Klamath-Siskiyou region of northern California and southwestern Oregon. Lastly, Stoughton et al. (2017) also newly described *C. panamintensis*, a species known in California only from the Panamint Mountains of Death Valley National Park, but ranging more widely across southern Nevada. All three of these latter *Claytonia* species (*C. obovata*, *C. panamintensis*, and *C. serpenticola*) are undergoing status reviews for addition to the CNPS Inventory.

In 2013, Stoughton and Jolles reported on the discovery of new populations of *C. lanceolata* in southern California, and discussed the taxonomic uncertainties associated with the *C. lanceolata* species complex and the southern California var. *peirsonii*. Up to ten subspecific taxa have been described in the *C. lanceolata* complex (Davis 1966), with var. *peirsonii* being the only one known from southern California. Taxonomic uncertainty of var. *peirsonii* remained present for at least 25 years, evidenced in part by Chambers (1993), who considered variation in the group to be environmentally induced, and did not formerly recognize infraspecific taxa in his treatment of *Claytonia* in *The Jepson Manual*. As originally described, *C. lanceolata* var. *peirsonii* was considered to be restricted to the higher ridges of the eastern San Gabriel Mountains, distinguished by both its relative geographic isolation (at least 450 km away from other known conspecific populations) and by a primary inflorescence axis that is shortened as to make the inflorescence appear umbellate (Munz and Johnson 1923) (Stoughton and Jolles 2013). However, var. *peirsonii* was described from only two voucher specimens, indicating that variation within var. *peirsonii* was not well captured. After reviewing the entire collection of *C. lanceolata* specimens at RSA (including the holotype of var. *peirsonii*) and additional specimens at CAS/DS, HSC, UC/JEPS, and UNLV, Stoughton and Jolles (2013) found reason to believe that the southern California populations of *C. lanceolata*, including those in Kern and Inyo counties and in the Spring Mountains of Nevada, were unique and distinct from other alleged conspecific populations in northern California and adjacent northern Nevada. Their claim was also substantiated by detailed field observations of new populations discovered in the San Bernardino Mountains and all but two of the known locations in the San Gabriel Mountains, Panamint Range, and southern Sierra Nevada.

Stoughton and Jolles (2013) also noted that preliminary molecular evidence indicated that the morphological variation of *C. lanceolata* found in differing regions in California and Nevada also had a genetic basis. Four years later, Stoughton et al. (2017) conducted a Bayesian phylogenetic inference using gene sequences available on GenBank, along with new sequences generated from collections within and outside of California. Their phylogenetic comparison included more than half of the tuberous, perennial *Claytonia* species, which encompasses *C.*

lanceolata. Stoughton et al. (2017) isolated genomic DNA from leaf material of 12 *C. lanceolata* samples. "Two or more individuals per taxon were used to sample multiple examples in the *C. lanceolata* species complex (15 total samples). Nine samples of other tuberous, perennial *Claytonia* were included as outgroups with respect to *C. lanceolata* s. l. Thirty-one total samples were used for the phylogenetic analysis, including more distant outgroups from *Claytonia* and *Lewisia*" (Stoughton et al. 2017).

In order to identify substrate affinity, Stoughton et al. (2017) collected parent rock material from selected field sites of *Claytonia* in California and southern Oregon. Slope aspect, geomorphic landform, associated species, elevation, and other local site information were also recorded at field sites. Lastly, five morphological characters (stem length, cauline leaf width, cauline leaf length/width ration, and peduncle length) were measured and used in a morphometric analysis. Results of their phylogenetic analysis were inconclusive with regards to monophyly of *C. lanceolata*, mostly due to an unresolved backbone separating major lineages within a clade that included all tuberous, perennial *Claytonia* sampled in their study. Furthermore, the use of nrITS in their study may have been problematic considering the possibilities of concerted evolution and multiple copies. However, although the results of their preliminary analysis did not permit new inferences regarding relationships among tuberous *Claytonia*, this was not a specified goal of their study, and instead their phylogenetic results fully complemented their morphological analysis of Californian taxa. Ultimately, the taxonomic and molecular work by Stoughton et al. (2017), coupled with that of Stoughton and Jolles (2013), elucidated some of the complex taxonomy and relationships surrounding *C. lanceolata* s. l. in California, and distinguished new taxa from each other by habitat (with many appearing to be edaphic-endemics), betalain pigmentation, inflorescence architecture, and morphology of cauline leaves, subterranean stems, and flowers.

Literature Cited

Chambers, K. L. 1993. *Claytonia* L. (Portulacaceae). Pp 898–900 *in* Hickman, J. C. (ed.), The Jepson manual: Higher plants of California. University of California Press, Berkeley, CA.

Davis, R. J. 1966. The North American perennial species of *Claytonia*. *Brittonia* 18: 285–303.

Munz, P. A. and I. M. Johnston. 1923. Miscellaneous notes on plants of Southern California—II. *Bulletin of the Torrey Botanical Club* 49(12): 352.

Stoughton, T. R. and D. D. Jolles. 2013. Discovery of *Claytonia lanceolata* var. *peirsonii* in the San Bernardino Mountains perpetuates a history of taxonomic uncertainty. *Aliso* 31(1): 35-42.

Stoughton, T. R., D. D. Jolles, and R. L. O'Quinn. 2017. The western spring beauties, *Claytonia lanceolata* (Montiaceae): A review and revised taxonomy for California. *Systematic Botany* 42(2): 283-300.

APPENDIX II – TABLES AND FIGURES

Table 1: Selected characters used to differentiate taxa in the *Claytonia lanceolata* species complex in California. Taxa are listed in same order of appearance as the taxonomic key provided in Stoughton et al. (2017), with the exception of the more recently described *C. crawfordii*. Light gray cells indicate duplicate entries to assist with making comparisons. (Table developed using characters from Stoughton et al. 2017 and 2018.)

Scientific name	Cauline leaves	Adaxial leaf surface	Inflorescence	Geology	Range
C. panamintensis	2-4, opposite at least proximally, 1-nerved elliptic to oblanceolate, distinctly petiolate	dark green (often at least weakly beet-red abaxially)	1-3, terminal and often also axillary, pedunculate, unibracteate, bracts 1-3 mm long	marble, sandstone, shale/slate	Panamint Mountains east to Spring Mountains of southern Nevada
C. serpenticola	2–4, alternate to subopposite, 1-nerved gen. > 5 x longer than wide, blades narrowly elliptic to lance linear	gen. greenish 1° veins at base, blades gen. similar in color on ab/adaxial surfaces	1-3, terminal and often also axillary, pedunculate, unibracteate, bract 1-2 mm long	gabbro, peridotite, serpentinite or shale	Klamath-Siskiyou, North Coast Ranges
C. lanceolata	2, opposite, 3-nerved gen. < 5 x as long as wide, ovate to lance ovate to lance linear	gen. greenish 1° veins at base, blades gen. similar in color on ab/adaxial surfaces	1(2), terminal (rarely also axillary), pedunculate, unibracteate, bracts 1-5 mm long	granite, rhyolite	Klamath-Siskiyou, central and northern Sierra Nevada
C. obovata	2(3), opposite, gen. 3-nerved with parallel veins equal in length, lateral veins converging with midrib at apex	gen. reddish 1° veins, not raised	1(2), terminal (rarely also axillary), sessile to short-pedunculate, unibracteate, bracts 1–3 mm long	graywacke, limestone, shale or gabbro, peridotite, serpentinite	Klamath-Siskiyou, North Coast Ranges

Scientific name	Cauline leaves	Adaxial leaf surface	Inflorescence	Geology	Range
C. peirsonii ssp. *bernardinus*	2-4, opposite at least proximally, 1-nerved often ≥ 6 x longer than wide, linear to lanceolate, sessile	gen reddish, sunken 1° veins; 2° veins of cauline leaves weakly if at all raised	1-3, terminal and often also axillary, sessile to short-pedunculate, unibracteate, bracts 1-3 mm long	limestone, marble	San Bernardino Mountains
C. peirsonii ssp. *yorkii*	2-4, opposite at least proximally, 1-nerved < 6 x longer than wide, gen. weakly pigmented on abaxial surfaces (reddish to purplish pigmentation often absent in stem and pedicels)	gen reddish, sunken 1° veins; 2° veins gen. noticeably raised	1-3, terminal and often also axillary, sessile to short-pedunculate, unibracteate, bract 1-3 mm long	rhyolite	southern Sierra Nevada
C. peirsonii ssp. *peirsonii*	2-4, opposite at least proximally, 1-nerved < 6 x longer than wide (gen. < 3.5 x as long as wide), variously shaped but gen. not oblanceolate, sessile	gen. reddish, sunken 1° veins (sometimes branched); 2° veins gen. noticeably raised	1-3, terminal and often also axillary, sessile to short-pedunculate, unibracteate, bracts 1-3 mm long	gneiss, granite, schist	San Gabriel Mountains
C. peirsonii ssp. *californacis*	2-4, opposite at least proximally, 1-nerved < 6 x longer than wide (gen. > 3.5 x as long as wide), gen. oblanceolate to elliptic, sessile	gen. reddish, sunken 1° veins; 2° veins gen. noticeably raised	1-3, terminal and often also axillary, sessile to short-pedunculate, unibracteate, bracts 1-3 mm long	limestone, marble	San Bernardino Mountains
C. crawfordii	narrower than *C. obovata*	2° veins gen. noticeably raised	1-3, terminal (rarely also axillary), elongate peduncle	volcanic	central Sierra Nevada

Sources:

Stoughton, T. R., D. D. Jolles, and R. L. O'Quinn. 2017. The western spring beauties, *Claytonia lanceolata* (Montiaceae): A review and revised taxonomy for California. *Systematic Botany* 42(2): 283-300.

Stoughton, T. R., R. Kriebel, D. D. Jolles, and R. L. O'Quinn. 2018. Next-generation lineage discovery: A case study of tuberous *Claytonia* L. *American Journal of Botany* 105(3): 536-548.

Sent to: NW, D. Jolles on 10/15/2019