

5-YEAR REVIEW

Sidalcea pedata (Pedate checker-mallow)

GENERAL INFORMATION

Species: *Sidalcea pedata* (pedate checker-mallow)

Date listed under the Endangered Species Act: August 31, 1984

FR citation(s): USFWS 1984 (49 FR 34497)

Classification: Endangered

BACKGROUND

Under the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), the U.S. Fish and Wildlife Service's (USFWS), referred to as "we" in this document, maintain lists of endangered and threatened wildlife and plant species (referred to as the List) in the Code of Federal Regulations (CFR) at 50 CFR 17.11 (for wildlife) and 17.12 (for plants). Section 4(c)(2)(A) of the Act requires us to review each listed species' status at least once every 5 years.

Most recent status review: USFWS 2011. *Sidalcea pedata* (pedate checker-mallow); 5-year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, Department of the Interior. 35 pp.

We initiated a status review for *Sidalcea pedata* in 2009. The review was finalized on March 18, 2011, and recommended no change in status.

FR Notice citation announcing this status review: On January 27, 2020, we published a *Federal Register* notice announcing initiation of the 5-year review of this species, and the opening of a 60-day comment period to receive information (85 FR 4692, USFWS 2020, pp. 4692–4694). We received no information about *Sidalcea pedata*.

ASSESSMENT

Information acquired since the last status review:

This 5-year review was conducted by the USFWS Carlsbad Fish and Wildlife Office. Data for this review were solicited from the public and interested parties through a *Federal Register* notice announcing this review on January 27, 2020 (USFWS 2020, entire). We also contacted State and Federal partners and species experts to request any data or information we should consider in our review. Additionally, we conducted a literature search and a review of information in our files.

SUMMARY OF NEW INFORMATION SINCE 2011:

Biology and distribution

Since 2011, no studies have examined *Sidalcea pedata* biology, life history, or genetics. We have new information from 2015 to 2020 annual monitoring at the Baldwin Lake Ecological Reserve (Reserve), and from site visits to other occurrences:

1. In 2015, *Sidalcea pedata* surveys were conducted at Little Metcalf Meadow (IERCD 2015; Dudek 2018, p. 5; Figures 3 and 4). Dudek (2018, pp. 2–5) also assessed site conditions, characterizing hydrological modifications and species composition.
2. In 2016, University of Redlands faculty and students documented *Sidalcea pedata* at Metcalf Meadows [California Natural Diversity Database (CNDDDB) Element Occurrence (EO) 17] (Hook 2017) (Table 1).
3. In 2017, several areas were surveyed below the Big Bear Lake ordinary high water mark, owned by the Big Bear Municipal Water District (Table 1).
4. In 2018, 2019, and 2020, the California Department of Fish and Wildlife (CDFW) counted or observed *Sidalcea pedata* at Baldwin Lake, and visited several other EOs (Burton 2018, unpaginated; Burton 2019, unpaginated; Bjerke 2020, unpaginated) (Table 1).
5. In 2020, U.S. Forest Service (USFS) botanists visited nine *Sidalcea pedata* occupied meadows, and documented 1,600 plants among all meadows. They collected seed for *ex situ* conservation, and tissue for genetic studies (USFS 2020).

Based on new information we have updated the *Sidalcea pedata* occurrence table and added an additional occurrence that was not considered in the 2011 5-year review (Table 1). Changes to occurrence status between 2011 and 2021 are:

1. Three EOs (CNDDDB EO 8, 12, and 22) were presumed extant in 2011, and are validated as extant because plants have been reported at those occurrences since 2011.
2. Former CNDDDB EOs 10 and 19 are now part of CNDDDB EO 5.
3. CNDDDB EO 11 was considered extirpated in 2011, but was reported extant in 2017. In 2017, Lowry and Smith reported *Sidalcea pedata* from near Grout Bay Meadow (EO 11) (Taylor 2020, pers. comm.). This occurrence is below the historical lake level (Taylor 2020, pers. comm.).
4. CNDDDB EO 21 was presumed extant in 2011 (but noted as possibly extirpated), but is now considered possibly extirpated due to development.

5. CNDDDB EOs 23 and 24, and an occurrence in Group Bay were considered extant in 2011. Since EOs 23 and 24 have not been observed since 2000 (CDFW 2020, pp. 21–22), we now consider them presumed extant. Likewise, we do not have new information from the Grout Bay occurrence since 2011, so we consider it presumed extant.
6. CNDDDB EO 31 was not considered in 2011. This occurrence was reported by Wood and Ray in 2010 (CCH2 2021).

In summary, monitoring for *Sidalcea pedata* has occurred at 10 occurrences since 2011 (Table 1), providing new information about the species' presence and abundance. We reassessed our 2011 occurrence status determinations and updated the status of nine occurrences (Table 1), based on monitoring data, the date since last survey, and information in the CNDDDB. Finally, we have removed two occurrences (EOs 10 and 19) because they are now part of another EO.

Based on those updates, there are 25 occurrences of *Sidalcea pedata* (Figure 1; Table 2). Nine are extant, seven are presumed extant, one is possibly extirpated, and eight are extirpated. We have no new information that changes our understanding of *S. pedata* biology or spatial distribution, and so that information in our 2011 review remains accurate.

Threats

Our 2011, 5-year review discussed Factor A threats to *Sidalcea pedata* from development, off-highway vehicles, altered hydrology, and nonnative invasive plants; Factor C threats from grazing; and Factor E threats from recreational activities, fire suppression measures, reduced populations, and climate change and drought (USFWS 2011, pp. 10–21). This section summarizes new information about threats to *S. pedata* since 2011: (1) development, (2) altered hydrology, (3) off-highway vehicle use, (4) fire suppression, (5) nonnative plants, and (6) climate change. We also discuss new information related to a 2019 Biological Opinion we issued to the USFS.

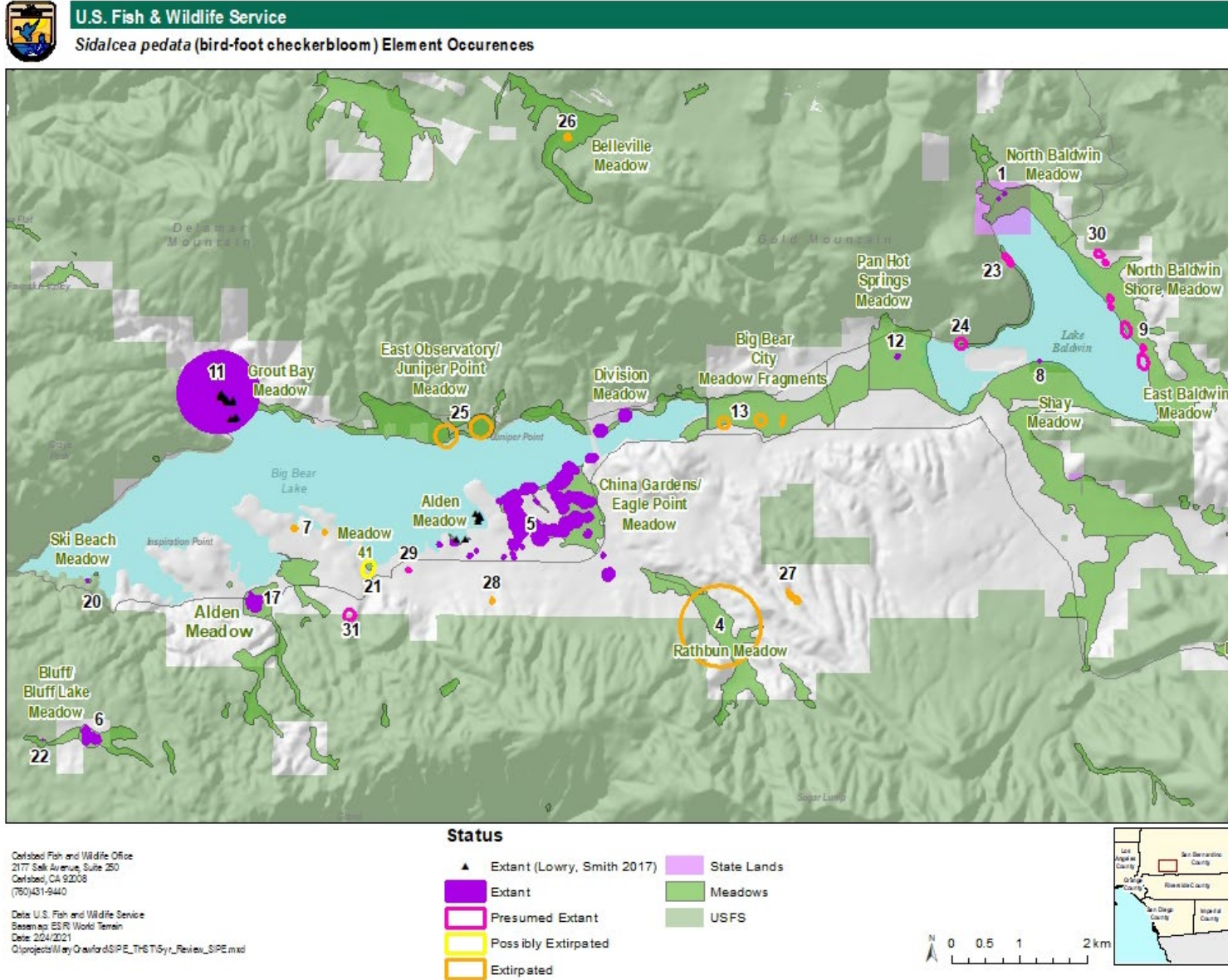


Figure 1. Map of *Sidalcea pedata* occurrences, showing occurrence status, the CNDDDB EO number, and the meadow name.

Table 1. *Sidalcea pedata* occurrence table, showing 2021 status and changes since the 2011 5-year review.

Area	2021 EO Number	Location	Meadow name	2021 Ownership	Extant at listing	2011 status	2021 status	2011–2021 Site visit summary (observation year, [plant count])	2011–2021 change summary
Baldwin Lake	1	Baldwin Lake - north end	North Baldwin Meadow	CDFW	Yes	Extant	Extant	2018 (248), 2019 (313), 2020 (50)	No change in EO or conservation status since 2011. New information from 3 CDFW site visits.
Big Bear Lake	2	Deer Lick	Possibly Camp Conifer Meadow	USFS, Private	No	Extirpated	Extirpated		No new information; no change in EO or conservation status since 2011.
Big Bear Lake	4	Bear Valley Golf Course	Rathburn Meadow	Private	No	Extirpated	Extirpated		No new information; no change in EO or conservation status since 2012.
Big Bear Lake	5	Big Bear Lake, West of Eagle Point, East of Stanfield Cutoff, Big Bear Lake	Eagle Point Meadow, China Gardens Meadow, Alden Meadow	Private	Yes	Extant	Extant	2012, 2014, 2017, and 2019 (no plant counts), 2020 (1,000)	Since 2011, plants have been reported in a new areas near this EO. In 2017, Lowry and Smith reported plants southwest of Eagle Point, just north of Alden Meadow in an area below the historical lake level (Taylor 2020, pers. comm.). There is a deed restriction over Lot K for the preservation of montane wet meadow habitat (Forest Properties 1992, p. 25). Former EOs 10 and 19 have been incorporated into this occurrence.
Bluff Lake	6	Bluff Lake Meadow	Bluff Meadow	The Widllands Conservancy	Yes	Extant	Extant	2011 (800), 2020 (100)	No change in EO or conservation status since 2011.

Area	2021 EO Number	Location	Meadow name	2021 Ownership	Extant at listing	2011 status	2021 status	2011–2021 Site visit summary (observation year, [plant count])	2011–2021 change summary
Big Bear Lake	7	Lakeview Drive, near Mallard Lagoon	Meadow 42, Meadow 44	Private	Yes	Extirpated	Extirpated	NA	No change in EO or conservation status since 2011.
Baldwin Lake	8	South of Baldwin Lake, Bear Valley, SBM	Shay Meadow	Big Bear Area Regional Wastewater Agency, USFS, Private	Yes	Presumed extant (significantly impacted)	Extant	2016, 2019 (no plant counts), 2020 (30)	BBCCSD (2016, p. 2) reported that <i>Sidalcea pedata</i> was present on a 3.17 acre mitigation site near the Big Bear Area Regional Wastewater Agency administration building. No flowers were seen during surveys in 2016. USFS reported 30 plants from the USFS-owned portion of this EO in 2020.
Baldwin Lake	9	Baldwin Lake-East Side; Vale Dr. South to Conchita Way	East Baldwin Meadow	Private, USFS	Yes	Presumed extant (may be extirpated)	Presumed extant	NA	No change in EO or conservation status.
Big Bear Lake	11	Fawnskin Meadow, SBM	Near Grout Bay Meadow	Big Bear Municipal Water District	No	Extirpated	Extant	2017 (13)	The area was surveyed by S. Lowry and D. Smith in 2017 (Taylor 2020, pers. comm.). They mapped 11 SIPE points in the area, representing at least 13 plants (plant counts were not provided for some points). Plants are on Big Bear Municipal Water District Property, below the Big Bear Lake ordinary high water mark

Area	2021 EO Number	Location	Meadow name	2021 Ownership	Extant at listing	2011 status	2021 status	2011–2021 Site visit summary (observation year, [plant count])	2011–2021 change summary
Baldwin Lake	12	Pan Hot Springs, Baldwin lake- West end	Pan Hot Springs Meadow	Big Bear Community Services District, San Manuel Band of Serrano Mission Indians	Yes	Presumed Extant	Extant	2019 (no plant counts); 2020 (3)	The San Manuel Band of Serrano Mission Indians purchased part of the meadow in 2011. Ten acres of the BBCCSD-owned meadow is under deed restriction, as mitigation for 1990 impacts to meadow habitat (BBCCSD 2008, p. 14).
Big Bear Lake	13	Big Bear City Airport	Big Bear City Meadow Fragments	Big Bear Airport District, Private	Yes	Extirpated	Extirpated	NA	No change in EO or conservation status since 2011
Big Bear Lake	17	Hwy 18, South of Metcalf Bay, Presbyterian Conference Grounds, Drive-in Theater, Flea Market Site	Metcalf Meadow, Aspen Glen Meadow, Coldbrook Meadow, Meadow 38	San Bernardino Mountains Land Trust, Inland Empire Resources Conservation District, Private, USFS, Big Bear Municipal Water District	Yes	Extant (Declining)	Extant	2012, 2015, 2016, and 2017 (no plant counts), 2020 (300)	In 2015 and 2016, portions of this meadow were acquired for conservation. In 2017, Lowry and Smith documented <i>Sidalcea pedata</i> in an area north of Metcalf Meadow and east of Little Metcalf Meadow (Taylor 2020, pers. comm.).
Big Bear Lake	20	Old Ski Beach, Big Bear Lake, SBM	Ski Beach Meadow	USFS	Yes	Extant	Extant	2020 (40)	No change in EO or conservation status. Extant based on observations in 2020.

Area	2021 EO Number	Location	Meadow name	2021 Ownership	Extant at listing	2011 status	2021 status	2011–2021 Site visit summary (observation year, [plant count])	2011–2021 change summary
Big Bear Lake	21	Rathburn Meadows area	Meadow 41	Private	Yes	Presumed Extant (significant population loss if not extirpated)	Possibly extirpated	NA	This occurrence was presumed extant in 2011, but is possibly extirpated due to development.
Bluff Lake	22	Lodgepole Meadow; West of Bluff Lake along Siberia Creek	Bluff Lake Meadow	USFS	Yes	Presumed Extant	Extant	2016 (no plant count), 5 (2020)	No change in conservation status. Extant based on observations in 2016 and 2020.
Baldwin Lake	23	Hwy 18, North West side of Baldwin Lake	North Baldwin Shore Meadow	USFS	Yes	Extant	Presumed extant	NA	No new information; no change in EO or conservation status. The occurrence is presumed extant because it has not been observed since 2000.
Baldwin Lake	24	Hwy 18, North West side of Baldwin Lake	North Baldwin Shore Meadow	USFS, Big Bear City Community Services District	Yes	Extant	Presumed extant	NA	No new information; no change in conservation status. The occurrence is presumed extant because it has not been observed since 2000.
Big Bear Lake	25	Big Bear Ranger Station, South of Hwy 18 and North of Big Bear Lake	East Observatory Meadow, Juniper Point Meadow	USFS	No	Extirpated	Extirpated	NA	No new information; no change in EO or conservation status
Holcomb Valley	26	Belleville Meadow, North of Big Bear Lake	Belleville Meadow	USFS	Yes	Extirpated	Extirpated	NA	No new information; no change in EO or conservation status

Area	2021 EO Number	Location	Meadow name	2021 Ownership	Extant at listing	2011 status	2021 status	2011–2021 Site visit summary (observation year, [plant count])	2011–2021 change summary
Big Bear Lake	27	Villa Grove Pebble Plain, Moonridge, Bear Valley	NA	Private	No	Extirpated	Extirpated	NA	No new information; no change in EO or conservation status
Big Bear Lake	28	South of Big Bear High School, West side of Georgia Street, Big Bear Lake	NA	Private	No	Extirpated	Extirpated	NA	No new information; no change in EO or conservation status
Big Bear Lake	29	South West of Big Bear Lake Post office, North side of Beaver Lane	Meadow 45	Private	Yes	Presumed extant (small, robust population)	Presumed extant	NA	No new information; no change in EO or conservation status
Baldwin Lake	30	East side Baldwin Lake and Baldwin Lake Rd.	NA	Private	Yes	Presumed extant (may be extirpated)	Presumed extant	NA	No new information; no change in EO or conservation status. May be extirpated.
Big Bear Lake	31	South of Mill Creek Road and west of Talmadge Road	NA	USFS, Private	NA	NA	Presumed extant	2010, “scarce”	This occurrence was not included in the 2011 5-year review. It was reported by Wood and Ray in 2010 (CCH2 2021).
Big Bear Lake	NA	The front yard of a residence in Boulder Bay	NA	Private	Yes	Extant	Presumed extant	NA	No new information; no change in conservation status. Since the occurrence has not been observed for 10 years, we consider it presumed extant.

Table 2. Summary of occurrence status between 2011 and 2021.

Occurrence status	2011 count of status	2021 count of status
Extant	9	9
Presumed extant	7	7
Possibly extirpated	0	1
Extirpated	10	8
Total number of occurrences	26	25

Development

In 2011, we reported that development was a substantial threat, impacting *Sidalcea pedata* habitat at 10 of the 16 extant occurrences (USFWS 2011, p. 10). Since 2011, parts of *S. pedata* EO 17 have received an elevated level of conservation:

1. In 2015, the majority of north and south Metcalf Meadow was acquired with section 6 funding, and is no longer at risk from development. The acquisition by the San Bernardino Mountains Land Trust conserved 17.1 acres (ac) [6.9 hectares (ha)] of habit in perpetuity (San Bernardino County 2015, unpaginated).
2. In 2015, part of Little Metcalf Meadow (northeast of Metcalf Meadow) was acquired by the Inland Empire Resources Conservation District (IERCD) as part of their in-lieu fee program (Dudek 2018, pp. 1–2).

Due to the acquisition of Metcalf Meadow and the partial acquisition of Little Metcalf Meadow, the threat of development at CNDDDB EO 17 has been partially ameliorated, but portions of the occurrence are still vulnerable to development. We do not have any reports of development in *Sidalcea pedata* habitat since the 2011 5-year review.

Alteration of hydrology

In 2011, we considered altered hydrology a threat to *Sidalcea pedata* at 14 of 16 occurrences (USFWS 2011, p. 12). This section summarizes new information about hydrology in Big Bear Valley. Refer to the 2011 5-year review (USFWS 2011, pp. 11–12) for discussion of the effects of altered hydrology on *S. pedata* plants and habitat.

The Big Bear area (i.e., the Big Bear Lake and Baldwin Lake surface water drainage basins, encompassing Big Bear Valley and Baldwin Lake) relies on water supply from springs on the edge of the ground-water basin, and from wells drilled into the ground-water basin (USGS 2012, p. 105). Local water agencies have constructed new wells to help meet increased water demand (USGS 2012, p. 105).

The U.S. Geological Survey (USGS) (2012, pp. 15–22) used satellite-based remote-sensing techniques and well monitoring data to study land subsidence in the Baldwin Lake and Big Bear sub-basins. Between 1992 and 2005, they reported both land-surface subsidence and uplift for an area between Big Bear and Baldwin Lakes—encompassing Pan Hot Springs Meadow and Big Bear City meadow fragments—but it was unclear whether the amount of deformation in this area was elastic or inelastic (USGS 2012, p. 22). For the Sugarloaf area—encompassing parts of Erwin Meadow—USGS reported both subsidence and uplift between 1993 and 2005; the results suggested that deformations in this area were elastic (recoverable) (USGS 2012, p. 22).

In the 2011 5-year review, we discussed the effects of altered hydrology on *Sidalcea pedata* plants and habitat. The 2012 USGS report provided new information about land subsidence or uplift near some *S. pedata*-occupied meadows, but we do not have new information about altered hydrology at specific occurrences, or about impacts to the species. Therefore, the new information in USGS (2012) does not alter the conclusion of our 2011 5-factor analysis (USFWS 2011, p. 12).

Off-highway vehicles

We have two reports of unauthorized off-highway vehicle (OHV) use in *Sidalcea pedata* habitat since 2011. Both incidents occurred at Metcalf Meadow.

1. In 2017, unauthorized OHV use caused damaged to Metcalf Meadow. During saturated conditions in April 2017, two vehicles trespassed into Metcalf Meadow (Hook 2017). A subsequent damage assessment indicated severe damage and ruts over about 2.97 ac (1.2 ha) of the meadow (Hook 2017).
2. Damage to Metcalf Meadow was also noted in 2018 (Krantz 2018, pers. comm.). The area has been fenced since that time (Krantz 2018, pers. comm.).

At the Baldwin Lake Ecological Reserve, CDFW staff observed no evidence of OHV trespass or damage during surveys between 2015 and 2017 (CDFW 2018, p. 16). However, because of the damaged fence line along Highway 18, the meadow area is considered vulnerable to unauthorized OHV use (CDFW 2018, p. 7).

Fire suppression measures

In the 2011 5-year review, we discussed fuel zone maintenance and effects to *Sidalcea pedata* plants (USFWS 2011, p. 20). This section describes fire suppression activities and coordination since 2011.

In 2015, the Lake Fire burned approximately 31,359 ac (12,691 ha) in the San Bernardino Mountains (USFS 2015, p. 2). The fire did not burn any areas occupied by *Sidalcea pedata*. A retardant mixing site was set up at the Big Bear Area Regional Wastewater Agency sewage treatment plant, east of *S. pedata* CNDDDB EO 8 (USFS 2015, p. 67). No effects to plants were expected from retardant mixing operations, and no Burned Area Emergency Response treatments were planned at the site (USFS 2015, p. 68).

In 2017, CDFW and USFWS staff and local stakeholders met with local fire officials to identify areas with state and federally listed plants, with a focus on Metcalf Meadow (Brandt 2016, pers. comm., 2017, pers. comm.). During 2019 Eagle Point surveys, CDFW botanists communicated with a local resident who informed surveyors that annual mowing—within about a 20-foot buffer of surrounding homes—occurs around the perimeter of the meadow (Burton 2019, unpaginated). We do not have reports of whether mowing directly impacted *Sidalcea pedata* plants or habitat.

In 2017, the Holcomb Fire burned 1,503 ac (608 ha) in the San Bernardino Mountains northeast of Baldwin Lake (USFS 2017, pp. 2, 6). The fire did not burn any areas occupied by *Sidalcea pedata* (USFS 2017, pp. 23–24). The USFS initiated emergency consultation with us for 11 species, including *S. pedata*. USFS determined that fire suppression activities did not affect federally listed meadow plants. Burned Area Emergency Response treatments (fencing) were expected to be beneficial (USFS 2017, p. 28). CDFW biologists noted that a mud slide on the north side of Highway 18 occurred after the fire, but did not affect areas occupied by *S. pedata* (Burton 2019, unpaginated).

Nonnative plants

In 2011, nonnative plants threatened 14 of 16 *Sidalcea pedata* occurrences (USFWS 2011, p. 12). New information about this threat is available for *S. pedata* occurrences at the Baldwin Lake Ecological Reserve (CNDDDB EO 1) and Little Metcalf Meadow (CNDDDB EO 17). Over 3 years of monitoring at the Reserve, CDFW identified three nonnative species: *Bromus tectorum* (cheatgrass), *Ranunculus testiculatus* (tuberled crowfoot), and *Lepidium perfoliatum* (clasping pepperweed). They recommended that nonnative plant invasions be further monitored, and that weed removal efforts be implemented (CDFW 2018, pp. 5, 16).

Dudek (2018, pp. 2–5) assessed species composition at Little Metcalf Meadow (CNDDDB EO 17). Parts of the meadow are dominated by nonnative forbs and grasses, including *Sisymbrium altissimum* (tall tumbled mustard), *Melilotus officinalis* (yellow sweetclover), and *Bromus tectorum* (cheatgrass) (Dudek 2018, pp. 3–4).

We have no new information about nonnative species at other *Sidalcea pedata* occurrences.

Climate change and drought

The term “climate change” refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2013, p. 1450). Downscaled projections under several future climate scenarios are available for the southern California mountains, including across the range of *Sidalcea pedata*.

In 2011, we considered altered hydrology (which may be exacerbated by climate change) a rangewide threat to *Sidalcea pedata* (USFWS 2011, pp. 20–21).

Temperature changes

Southern California has already experienced a warming trend from 1951 to 2006 (Hall *et al.* 2018, p. 9). In the San Bernardino Mountains, Cal-Adapt models project increases in annual average maximum and minimum temperatures between a baseline time period (1961 to 1990) and an end of century period (2070 to 2090). Specifically, between 2070 and 2090, annual average maximum temperatures are projected to increase by 6.1 degrees Fahrenheit (°F) under Representative Concentration Pathway (RCP) 4.5, and by 8.9 °F under RCP 8.5 (CEC 2019). The frequency, duration, and intensity of heat waves is also expected to increase (Hall *et al.* 2018, p. 12; Kalansky *et al.* 2018, p. 21).

Precipitation changes

Climate change has already altered, and will continue to alter, the water cycle. Changes in the water cycle include: (1) changes in precipitation patterns and intensity; (2) changes in the incidence of drought; (3) widespread melting of snow and ice; (4) increasing evaporation; and (5) changes in soil moisture and runoff (USCGRP 2009, p. 41).

Precipitation in southern California is highly variable from year to year (Hall *et al.* 2018, p. 12; Kalansky *et al.* 2018, p. 24). Models of future precipitation generally project small mean changes relative to the historical variability, and the overall direction of future precipitation is unclear (Hall *et al.* 2018, p. 13). Models do project increases in extreme precipitation frequency and intensity (Polade *et al.* 2017, p. 7; Swain *et al.* 2018, p. 428), including increases in the frequency of atmospheric-river storms, which deliver intense precipitation and can cause severe flooding (Dettinger 2011, p. 519). However, droughts are also projected to become more frequent and intense, and will be exacerbated by higher temperatures (Kalansky *et al.* 2018, p. 25).

In Big Bear Valley (San Bernardino Mountains), average annual precipitation ranges from about 18 to 35 inches. Due to a rain shadow effect, precipitation generally decreases from west to east across the valley (USGS 2012, p. 4). Therefore, the effects of changing precipitation amount and timing will also likely differ at a relatively small scale in the San Bernardino Mountains.

Snowpack changes

Warming trends have already driven declines in mountain snowpack across the western United States (Mote *et al.* 2018, p. 4). Snowpack is affected by temperature and precipitation. In a warmer climate, a higher proportion of precipitation is expected to fall as rain rather than snow, and snowpack is expected to melt earlier and more quickly (Viers *et al.* 2013, p. 9, Dettinger *et al.* 2018, p. 21). Snow lines are also expected to rise (Dettinger *et al.* 2018, p. 21).

Sun *et al.* (2016, p. 93) used downscaled general circulation models under two scenarios to predict future snowfall and snowpack in the southern California mountains. Their models included the San Bernardino, San Jacinto, and Los Angeles County Mountains. They projected that under RCP 8.5, midcentury mean snowfall would be 30 percent lower than baseline snowfall, and that snowfall loss would be greatest at lower and mid-elevations (Sun *et al.* 2016, pp. 106–107). Projections of timing of snow-free date (i.e., how much earlier snow melts compared to baseline)

differed depending on the model used, but on average, the snow-free date occurred 16 days earlier (Sun *et al.* 2016, p. 108).

In addition to the projections of Sun *et al.* (2016), projected changes in snow water equivalence (the amount of water contained in snowpack) are available from Cal-Adapt. For the range of *Sidalcea pedata* in the San Bernardino Mountains, the Cal-Adapt models project reductions in snow water equivalence between a baseline time period (1961 to 1990) and an end of century period (2070 to 2090) (Table 3) (CEC 2019).

Snowpack provides groundwater recharge and streamflow to montane meadows (Viers *et al.* 2013, p. 11), and both factors could be affected by earlier runoff and reductions in snowpack. Precipitation in the form of rain runs off much more quickly than snow, and these increased but intermittent stream flows could alter meadow channel morphology and affect streambank stability (Viers *et al.* 2013, p. 11).

Table 3. Projected February Snow Water Equivalence for the range of *Sidalcea pedata* in the San Bernardino Mountains.¹

Year range	RCP 4.5 (inches ± standard deviation) projected February SWE	RCP 8.5 (inches ± standard deviation) projected February SWE
1950–2005 (observed)	2.12 ± 2.58	2.12 ± 2.58
2040–2069	1.13 ± 1.87	1.03 ± 1.94
2070–2099	0.87 ± 1.49	0.45 ± 0.82

¹ The values are the average of projections from four priority models (MIROC5, CanESM2, HadGEM2-ES, and ENRM-CM5) over a mid-century time period (2040–2069) and an end-of-century time period (2070–2099). Data from Cal-Adapt (CEC 2019)

Potential Effects of Climate Change on *Sidalcea pedata*.

The effects of climate change on *Sidalcea pedata* and its habitat have not been directly studied, and there is uncertainty in the predictions of downscaled climate models. However, the projected abiotic pressures resulting from climate change—increased temperature, changes in precipitation, and reduced snowpack and earlier runoff—could alter the hydrology of meadow habitat occupied by *S. pedata*. Changing hydrology could cause shifts in plant communities (Debinski *et al.* 2010, pp. 1677–1679), and make meadows more vulnerable to other impacts.

In Big Bear Valley (San Bernardino Mountains), total precipitation decreases from west to east across the valley (USGS 2012, p. 4), and the percentage of total precipitation as snowfall also varies depending on location within the valley (USGS 2012, p. 74). Therefore, the effects of future precipitation and snowpack changes will likely vary by meadow.

As we discussed in the 2011 5-year review (USFWS 2011, p. 21), changing precipitation type, amount, and timing could impact individual *Sidalcea pedata* at all life stages by reducing the amount of water available for germination, growth, and reproduction.

Climate change summary and conclusion

For this 5-year review, we have discussed projections from Sun *et al.* (2016, entire), reports from California’s Fourth Climate Change Assessment (Pierce *et al.* 2018, entire; Kalansky *et al.* 2018; Hall *et al.* 2018), and data from CalAdapt (CEC 2019). These models provide projections of future temperature, precipitation, and snowpack in the southern California mountains under two emissions scenarios (RCP 4.5 and 8.5).

In the 2011 5-year review, we outlined how drier conditions could affect *Sidalcea pedata* meadow habitat and individual plants (USFWS 2011, pp. 20–21). While we did not have enough information to make predictions about climate change effects to *S. pedata*, we considered climate change a threat to the species (USFWS 2011, pp. 20–21).

Since 2011, new climate projections are available for the range of *Sidalcea pedata*, but we do not have new information about the potential effects of those changes to the species (discussed in USFWS 2011, p. 21). Increasing temperatures, combined with greater precipitation extremes and earlier runoff, could cause drier conditions in montane meadow habitat, potentially decreasing *Sidalcea pedata* population resiliency. However, the new information does not alter the conclusion of our 2011 5-factor threats analysis.

Consultation on ongoing U.S. Forest Service activities

In 2019, we issued a biological opinion for the ongoing activities affecting 12 mountain plant species on the San Bernardino National Forest, including *Sidalcea pedata* (USFWS 2019). We discussed the general effects of nine USFS management programs on listed plants (USFWS 2019, pp. 18–26), and specific effects to *S. pedata* (USFWS 2019, pp. 84–87).

We determined that the implementation of the U.S. Forest Service’s Revised Land Resource Management Plan (Forest Plan; USFS 2006, entire) was not likely to jeopardize the continued existence of *Sidalcea pedata* (USFWS 2019, pp. 94–95). We reached that conclusion because (1) USFS has developed a Meadow Habitat Management Guide, which describes specific management strategies to promote recovery of montane meadow plants, and is consistent with the recovery plan for *S. pedata*, and (2) USFS will avoid and minimize impacts from management activities (USFWS 2019, p. 95). To avoid and minimize those impacts, the biological opinion incorporated multiple protective measures (USFWS 2019, pp. 9–12), in addition to measures already being implemented by USFS (USFWS 2019, Enclosure Appendix A).

Summary of threats

Since the 2011 5-year review, we have received new information about ongoing threats at *Sidalcea pedata* occurrences. The new information relates to the threats of (1) development, (2) altered hydrology, (3) fire suppression measures, (4) nonnative plants, and (5) climate

change. However, the new information does not alter the analysis or conclusions of our 2011 5-year review.

CONCLUSION:

In the 2011 5-year review, we recommended no status change for *Sidalcea pedata*. Since 2011, we have received new survey and monitoring information for *S. pedata*, and some new information about threats to *S. pedata*. We have updated the status of 9 occurrences based on the new information. Based on those updates, there are 25 occurrences of *Sidalcea pedata* (Table 2). Nine are extant, seven are presumed extant, one is possibly extirpated, and eight are extirpated.

The new information and updated occurrence status does not substantially alter the species' status or the results of our 5-factor analysis in the 2011 5-year review. Therefore, we conclude that *Sidalcea pedata* remains a federally endangered species.

RECOMMENDATIONS FOR FUTURE ACTIONS:

1. Continue to collect additional seed from *Sidalcea pedata* occurrences to expand the *ex situ* conservation seed bank at the California Botanic Garden (formerly Rancho Santa Ana Botanic Garden)
2. Study *Sidalcea pedata* population genetics, including levels of genetic diversity and differentiation within and among occurrences, and levels of inbreeding, relatedness, and ploidy. This information will allow us to assess levels of current genetic diversity and gene flow, assess whether genetic management is needed, and assess appropriate seed sources for potential future reintroduction or augmentation activities.
3. Develop a propagation protocol for *Sidalcea pedata*.
4. Coordinate with landowners to identify opportunities for conservation on private lands. Work with private landowners, local governments, and conservation organizations to conserve, manage, and enhance habitat for *Sidalcea pedata*.
5. Continue to monitor *Sidalcea pedata* occurrences.

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