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A NEW SPECIES OF *LEWISIA* (MONTIACEAE) FROM THE SOUTHEASTERN KLAMATH MOUNTAINS, CALIFORNIA

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ABSTRACT

Lewisia taylorii J.O'Brien, C.M.Guilliams, S.A.Puentes, & L.Lindstrand (Montiaceae) is described as a new species from northern California. The new taxon is a low, scapose perennial herb growing from a short, thick, single or multi-branched fleshy taproot. When discovered, the taxon best fit the description of *L. kelloggii* K.Brandegee subsp. *hutchisonii* Dempster, though morphological traits visible in the field suggested it might be a novel species. Recent morphometric and genetic analysis confirmed this suspicion. The new species is currently known from four general areas in the eastern Klamath Ranges of northeastern Trinity and northwestern Shasta counties, where it occurs on open, often disturbed gravelly-shaley slopes in conifer forest habitat. We describe the morphological and habitat characteristics for *L. taylorii* and distinguishing characters of *L. taylorii* and *L. kelloggii*.

Key Words: Bragdon Formation, California endemic, *Lewisia taylorii*, Montiaceae, northeastern Trinity County, northwestern Shasta County, southeastern Klamath Mountains, Trinity Lewisia.

The genus *Lewisia* Pursh consists of 18 species known from western North America, 16 in flora, many hybrids and cultivars, and three other described species (Miller and Dempster 2012a). Twenty-four *Lewisia* taxa are recognized in California (Miller and Dempster 2012a), 13 of which occur in northern California (Miller and Dempster 2012a, Janeway 2022). We identified numerous *Lewisia* occurrences at several locations in northeastern Trinity County, California during 2010 and 2011 while conducting botanical surveys supporting timberland management. These *Lewisia* occurred on open, often disturbed, forest slopes with gravelly-shaley substrates and most closely matched the descriptions at the time of *L. kelloggii* K.Brandegee (Dempster 1993) and subsequently *L. kelloggii* subsp. *hutchisonii* Dempster (Dempster 1996; Miller and Dempster 2012b) but did not entirely fit those descriptions based on several morphologic characters.

In 2011, we initiated systematic data and tissue collection across the range of the unknown *Lewisia* from Trinity County, as well as *L. kelloggii*, for morphometric and phylogenetic studies. Our results show clear morphologic and phylogentic distinctions between the unknown *Lewisia* and *L. kelloggii*, warranting description of a new *Lewisia* species and further demonstrating recircumscription of *L. kelloggii* may be needed. The broader taxonomic study of the *L. kelloggii* group is currently underway (Guilliams et al. unpublished data), but we here make available the name for the distinctive new species of *Lewisia* from Trinity County.

TAXONOMIC TREATMENT

Lewisia taylorii J.O'Brien, C.M.Guilliams, S.A.Puentes, & L.Lindstrand, sp. nov. (Figs. 1, 2B, C, D, E, F)—Type: USA, CA, Trinity Co., ridgeline in southwestern portion of Billie Gulch, one mile north of Jackass Peak, 40.97545, −122.63158, 896 m (2940 ft), 17 May 2023, *L. Lindstrand III 21488* (holotype: CAS; isotypes: CHSC, DAV, GH, HUM, JEPS, SBBG, SPIF, US).

Low, scapose, succulent, glabrous perennial herb with a taproot, 3–7 cm tall (all measurements taken from fresh specimens). **Taproot** single or multi-branched, brown to reddish brown, cortex white, surface of stele pale yellow to pink or orange, increasingly so towards the top, subterranean. **Leaves** many, dense-rosetted, 24–84(105) mm long, 5–20(37) mm wide, obovate or elliptic, leathery, entire, abruptly narrowed to long petiole, tip obtuse to retuse. **Inflorescence** stems several, scape (11)19–46(90) mm pulling the flower below ground after anthesis, 1-flowered; flowers often exserted from leaves; bracts 2, 5–18(26) mm, lanceolate to linear lanceolate, closely subtending, ± like sepals, margins usually entire to less-commonly eglandular toothed, 0–8(12) teeth in the upper quarter to upper half; pedicel 0. **Flower** sepals 2 (seemingly 4 because of/due to the 2 bracts), 8–17(24) mm, lance-oblong, margins usually entire to less-commonly eglandular toothed, 0–6(13) teeth in the upper quarter to upper half; petals 7–11, 21–46 mm

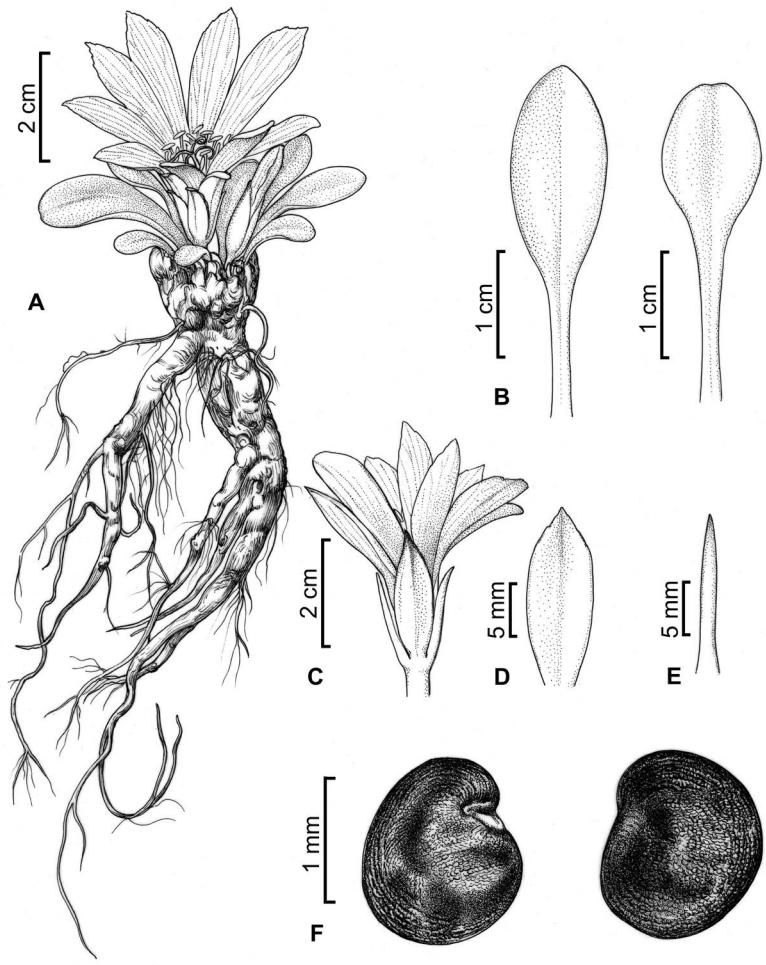

FIG. 1. *Lewisia taylorii*. A. Overall plant showing inflorescence and fleshy taproot. B. Representative leaf shapes. C. Inflorescence showing bract and sepal arrangement. D. Sepal. E. Bract. F. Tuberculate seed.

long, oblanceolate, white or pinkish white, tip rounded, retuse, or apiculate, ± notched or toothed at tip; stamens 17–40; anther 1–2(3) mm, pink; style 5–20 mm, stigmas 3–6; pollen yellow; ovary superior, pink; nectary yellow. **Fruit** a circumscissile capsule, persisting below ground and releasing seeds by decomposition, 8 mm. **Seed** disk shaped, black, shiny, tuberculate, 9–14, 1x1–2x2 mm.

Paratypes. USA, California, **Shasta Co.**, ridgeline east of Trinity Lake between Bear Gulch and Nelson Creek, along the Trinity/Shasta County boundary, 40.96651, −122.60073, 1219 m (4000 ft), 6 June 2023, *S.A. Puentes s.n. with S.C. Puentes* (CAS, CHSC, DAV, GH, HUM, JEPS, RSA, SBBG, SPIF, US); **Trinity Co.**, ridgeline east of Trinity Lake and west of Squirrel Gulch. 41.00319, −122.66547, 944 m (3100 ft), 11 May 2023, *L. Lindstrand III 21487 with A. Hayes, K. Ashdown, and T. Baugh* (CAS, CHSC, DAV, HUM, JEPS, RSA, SPIF); ridgeline at headwaters of Squirrel Gulch, approximately 5.5 miles northeast of Trinity Center, 41.05621, −122.65395, 1158 m (3800 ft), 22 May 2023, *M.J. Henwood 3015 with L. Lindstrand III* (CAS, CHSC, DAV, HUM, JEPS, RSA, SBBG, SPIF); ridgeline along southern headwaters of Hobel Creek, approximately 3.5 mi. southwest of Trinity Center, 40.93789, −122.73223, 960 m (3150 ft), 31 May 2023, *L. Lindstrand III 21492* (CAS, CHSC, HUM, JEPS, MO, RSA, SPIF); ridgeline east of Trinity Lake and west of Squirrel Gulch, 41.00319, −122.66547, 944 m (3100 ft), 31 May 2023, *L. Lindstrand III 21493* (CAS, HUM, JEPS, SBBG, SPIF); open hillside and roadcut bank located east Trinity Lake and east of Cedar Creek, 41.05227, −122.64349, 1094 m (3590 ft), 16 June 2010, *J. O'Brien s.n. with S.A. Puentes* (SPIF); open hillside and roadcut bank located east of Trinity Lake and east of Cedar Creek, 41.05232, −122.64358, 1090 m (3575 ft), 25 June 2010, *J. O'Brien s.n. with S.A. Puentes* (SPIF); open ridgeline and ATV trail east of Trinity Lake and west of Squirrel Flat, 41.00487,

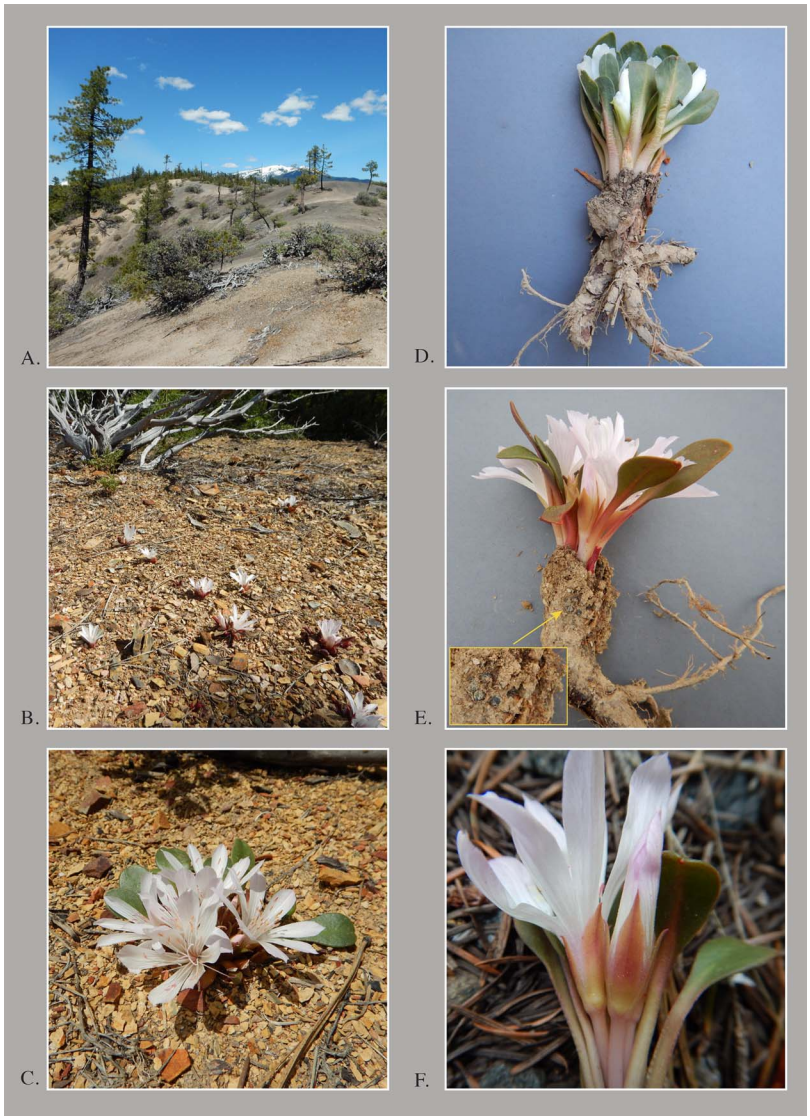

FIG. 2. *Lewisia taylorii*. A. Typical open, shaley ridgeline habitat near Squirrel Gulch. B. Multiple flowers in small gravelly opening near Bowerman Ridge at anthesis showing habit. C. Plant at anthesis near Cedar Creek. D. Rosette and multi-branched fleshy taproot. E. Base of plant showing new leaves, inflorescence, decomposed leaves, and mature seeds (see inset). F. Inflorescence showing sepals and bracts with non-glandular, entire to slightly toothed margins. Photos by Len Lindstrand III. Photo dates: A. 11 May 2023, B. 31 May 2023, C. 22 May 2023, D. and E. 14 May 2024, F. 31 May 2023.

−122.66445, 954 m (3130 ft), 26 April 2011, *J. O'Brien s.n. with S.A. Puentes* (SPIF); open hillside and roadcut bank located east of Trinity Lake and east of Cedar Creek, 41.05260, −122.64349, 1077 m (3535 ft), 26 April 2011, *J. O'Brien s.n. with S.A. Puentes* (SPIF); ridgeline and old skid trails east of Trinity Lake between Squirrel Gulch and Cedar Creek, 41.05658, −122.65244, 1146 m (3760 ft), 26 April 2011, *J. O'Brien s.n. with S.A. Puentes* (SPIF); open ridgeline and dirt road east of Trinity Lake and west of Squirrel Gulch, just south of East Side Road, 41.01564, −122.66142, 845 m (2775 ft), 11 May 2011, *J. O'Brien s.n. with S.A. Puentes* (SPIF); open ridgeline and old skid trail east of Trinity Lake and west of Squirrel Gulch, just south of East Side Road, 41.01414, −122.66132, 864 m (2835 ft), 11 May 2011, *J. O'Brien s.n.* (SPIF); open hillside and roadcut bank located east of Trinity Lake and east of Cedar Creek, 41.05232, −122.64358, 1090 m (3575 ft), 14 June 2011, *J. O'Brien s.n. with S.A. Puentes* (SPIF).

Relationships and morphological distinctiveness. Following our 2010 and 2011 findings and subsequent data and tissue collection, our earliest molecular study was inconclusive (National Forest Genetics Laboratory 2012); however, we continued to locate the putative new

taxon during subsequent work in the area and to make measurements and collect tissues for additional molecular phylogenomic study. During 2018, we completed our morphometric dataset, with preliminary analyses strongly supporting the morphological distinctiveness of *L. taylorii* (Guilliams et al. unpublished data). In 2023, our broader phylogenomic investigation of the *L. kelloggii* group similarly demonstrated the evolutionary distinctiveness of *L. taylorii*, samples of which were recovered as a clade with maximum statistical support (maximum likelihood bootstrap value [ML BS] = 100) sister to a maximally-supported (ML BS = 100) clade of samples of *L. kelloggii*. Preliminary phylogenetic analyses show that *L. taylorii* is well-supported as sister to and evolutionarily distinct from *L. kelloggii*. These preliminary analyses consisted of a RAxML maximum likelihood analysis of a double digest Restriction Site Associated DNA sequencing (ddRADseq) dataset. The ddRADseq library preparations were performed at the Santa Barbara Botanic Garden following Tripp et al. (2017) and sequencing was performed by U.C. Riverside. Multiple phylogenetic analyses were performed that differed in taxon inclusion. The broadest analyses included nearly all recognized members of the genus *Lewisia* and were rooted with a sample of *Claytonia perfoliata* Donn ex. Willd. In nearly all cases, individual *Lewisia* taxa were represented by more than one sample. The phylogenetic distinctiveness of *L. taylorii* was consistent across datasets and analyses, irrespective of taxon inclusion (Guilliams et al. unpublished data).

Additionally, several morphological differences clearly separate the two taxa. The most distinctive morphological differences between these species lie in bract and sepal characters. *Lewisia taylorii* bracts and sepals are usually entire, or less-commonly few-toothed, and eglandular. *Lewisia kelloggii* has sepals and bracts that are usually many-toothed, rarely entire, and the teeth are gland-tipped. These characters are readily visible in the field. *Lewisia taylorii* also differs from *L. kelloggii* in having a greater number of stamens (average = 27 [range = 17–40] versus average = 17 [range = 8–36]) and shorter styles (average = 8.8 mm [range = 5–17 mm] versus average 21.1 mm [range = 0–32 mm]).

Distribution and Habitat

All known *L. taylorii* localities occur in the southeastern Klamath Mountains geomorphic province (Miles and Goudey 1997). Most occur in the Trinity River watershed in the vicinity of Trinity Lake, Trinity County, California. One locality, also in the vicinity of Trinity Lake, is in the upper Clear Creek watershed of Shasta County, California, near the Trinity County boundary. This area is characterized by mild, wet winters and hot, dry summers. The average annual precipitation is approximately 93 cm, occurring primarily as rainfall, with some snowfall in most winters. Average annual temperatures range from 1°C in winter to 32°C in summer. *Lewisia taylorii* is currently known from four general areas around Trinity Lake: Bowerman Ridge, Squirrel Gulch and Cedar Creek, the vicinity of Jackass Peak, and near Trinity Mountain (Fig. 3). The type locality is on the northern slope of Jackass Peak at the headwaters of Billie Gulch.

Elevations of the known localities range from 804–1237 m and all occur on the Bragdon Formation geologic unit (Irwin 1994). The Bragdon Formation is Mississippian in age and features interbedded dark shale, siltstone, sandstone, grit, and locally abundant pebble-conglomerate beds (Irwin 1994).

Lewisia taylorii populations occur on open gravelly-shaley mountain slopes in coniferous forest and chaparral (Fig. 2A). These occurrences are in forest openings and disturbed habitats including native surface forest road shoulders, skid trails from historic and recent timber harvest, and conifer forest plantations established following timberland management. They are also found on all aspects, level to very steep slopes, and include locations ranging from barren ridgelines to forests with moderate overstory canopy cover. Commonly associated species include *Arctostaphylos viscida* Parry, *Eriodictyon californicum* (Hook. & Arn.) Torr., *Pedicularis densiflora* Hook., *Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*, *Pinus attenuata* Lemmon, *Pinus lambertiana* Douglas, *Pinus ponderosa* P.Lawson & C.Lawson, *Quercus chrysolepis* Liebm., and *Quercus kelloggii* Newb. *Lewisia taylorii* commonly grows with *Allium falcifolium* Hook. & Arn., another species favoring these open and often disturbed habitats. Species names follow Baldwin et al. (2012) and the Jepson Flora Project (2024).

The geographic range of *L. taylorii* is outside the range of *L. kelloggii* and appears restricted to the eastern Klamath Ranges and the Trinity Mountains in the vicinity of Trinity Lake and the southwestern portion of the Bragdon Formation. While *L. kelloggii* also occurs in the Klamath Ranges, the ranges of the two species are not known to overlap. The nearest *L. kelloggii* occurrences in this region are approximately 17.7 and 67.5 km to the northeast and east, respectively, of the *L. taylorii* range (Fig. 4). From the Klamath Ranges, *L. kelloggii* also extends into the High Cascade Range and Northern High Sierra Nevada (Fig. 4).

Etymology

The specific epithet *taylorii* honors Dean W. Taylor, who inspired and prodded us to pursue describing this new taxon. We suggest the common name "Trinity Lewisia."

Phenology

Lewisia taylorii leaves emerge from a single or multi-branched fleshy taproot during mid- to late-April and the plant flowers from mid-May to mid-June, producing mature fruits by mid- to late-summer. The multiple above ground leaves form rosettes to 12 cm diam. These leaves wither and die with the onset of warm, dry weather, often at or before anthesis. The above

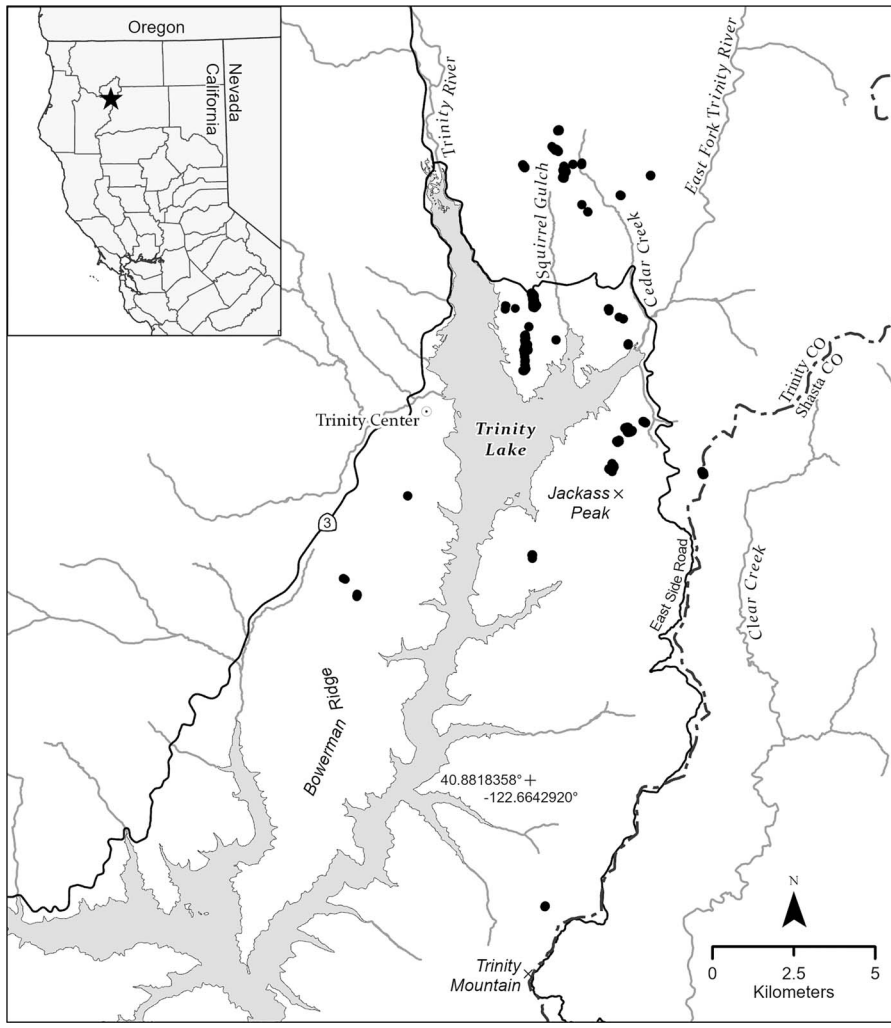

FIG. 3. *Lewisia taylorii* localities (black dots), Shasta and Trinity counties, California.

ground portion of the scape also shrinks after anthesis, pulling the flower back underground, effectively making the plant unnoticeable the remainder of the year. As fruits mature the capsule splits open around the sides, mainly underground, and the seeds release by decomposition of the fruit wall (Fig. 2E).

RARITY AND CONSERVATION STATUS

Lewisia taylorii is endemic to the western Trinity Mountains portion of the southeastern Klamath Ranges, east of the Trinity Alps. The species is currently known from 22 occurrences at four general areas around Trinity Lake: Bowerman Ridge, Squirrel Gulch and Cedar Creek, the vicinity of Jackass Peak, and near Trinity Mountain (Fig. 3; Table 1). These 22 occurrences range from a single location to 17 proximate localities, which range from several plants in a small forest opening to approximately 4200 plants scattered over approximately six ha (0.06 km^2) on a large, open ridgeline. It is unknown if additional occurrences were in areas flooded by formation of Trinity Lake; however, given the ridgetop habitats in which this species occurs and it's known distribution, the lowland areas flooded by the lake likely contained few, if any, occurrences. Additional habitat occurs in the vicinity of all localities, though potential habitat for this species appears limited to the Bragdon Formation and further limited to the northwestern portion of this geologic feature and open, gravelly-shaley forest slopes.

Lewisia taylorii occurrences are located in remote settings. Habitats at or near all known occurrences have been subject to historical and recent wildfire, forest road and fuelbreak construction, fire suppression disturbance, and historic or recent timberland management. These areas receive occasional to infrequent human visitation, mainly during hunting season and through various forest management. Three known occurrences

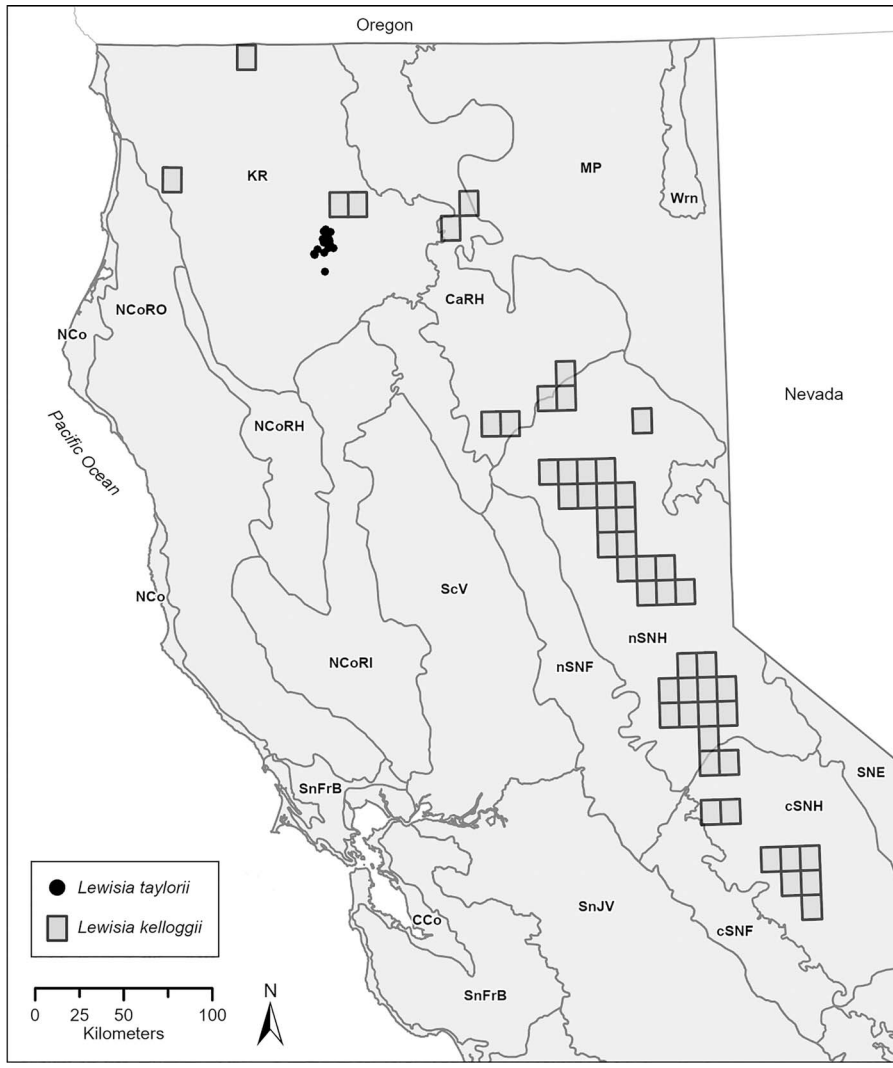

FIG. 4. Geographic range of *Lewisia taylorii* and *L. kelloggii*. *Lewisia kelloggii* occurrences are at USGS 7.5′ USGS quadrangle map level (CNPS 2024). Biogeographic regions outlined and labeled are from the Jepson Flora Project (2024).

are on land managed by the U.S. Forest Service (USFS), 15 occur on privately owned lands, and four are located on both USFS and private lands. Most of the occurrences on private property are subject to regular patrol and locked from public access. Surrounding land use includes recreational activities (such as boating, fishing, hunting, and hiking), timberland management, and rural residential. The species is adapted to wildfire and other disturbances, as our observations include numerous occurrences subject to historical and recent wildfire and timberland management activities. Besides the open, gravelly-shaley habitats in which they occur, potential adaptations to fire include the geophytic growth form and subterranean habit during the dry, hot summer and fall, when wildfires typically occur.

TABLE 1. KNOWN *LEWISIA TAYLORII* DISTRIBUTION, TRINITY AND SHASTA COUNTIES, CA, AS OF JANUARY 2024. Occurrence defined as groupings of proximate localities within 0.40 km (0.25 mi.).

General area	# Localities	# Occurrences
Bowerman Ridge	3	3
Squirrel Gulch/Cedar Creek	17	13
Jackass Peak	6	5
Trinity Mountain	1	1

Lewisia taylorii is rare in terms of the number of known occurrences and narrow geographic distribution; however, extensive areas with unsurveyed potential habitat occur throughout the known species range. Given the open, exposed habitats, persistence in disturbed areas, and relative remoteness of the populations, the species is not endangered or threatened at present. The species is, however, narrowly endemic, and uncommon

such that its status should be monitored, and efforts made to locate additional populations. Additionally, forest resource planning efforts should include management actions that maintain or enhance the open habitats in which the species occurs and address encroaching overstory vegetation into these areas. We recommend that *L. taylorii* be considered for a California Rare Plant Rank of 1B.3 (Plants Rare or Endangered in California and elsewhere, not very threatened in California; <20% of occurrences threatened/low degree and immediacy of threat or no current threats known) in the California Department of Fish and Wildlife Special Vascular Plants, Bryophytes, and Lichens list (California Natural Diversity Database 2024) and the California Native Plant Society's Inventory of Rare and Endangered Plants of California (California Native Plant Society 2024).

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