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A NEW SPECIES OF *PHACELIA* (HYDROPHYLLACEAE) FROM THE SOUTHEASTERN KLAMATH MOUNTAINS, CALIFORNIA

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ABSTRACT

Phacelia damnationensis Kierstead et al. (Hydrophyllaceae) is described as a new species from northern California. The new taxon is a large, perennial, multi-stemmed, generally upright, leafy plant growing from a branched woody caudex. Morphologically it appears most closely related to *Phacelia* Juss. sect. *Baretiana* Walden & R.Patt., which contains three other species: *P. bolanderi* A.Gray, *P. hydrophylloides* Torr. ex A.Gray, and *P. procera* A.Gray. This new species is currently known from five general areas in the eastern Klamath Ranges of Shasta County, where it occurs on disturbed open, rocky slopes in conifer forest habitat. We describe the morphological and habitat characteristics for *P. damnationensis*, another in a series of recently discovered vascular plant taxa endemic to the eastern Klamath Ranges and include an updated species key to *Phacelia* sect. *Baretiana*.

Key Words: California endemic, Damnation Pass Phacelia, Hydrophyllaceae, *Phacelia damnationensis*, southeastern Klamath Mountains, western Shasta County.

The genus *Phacelia* includes ~210 North American species, 154 of which occur in California (Walden et al. 2013). The recognized *Phacelia* taxonomic subgroups (Walden and Patterson 2012) are classified by Patterson et al. (2012) and Walden et al. (2013) into three groups in California: (1) biennials and perennials from a ±woody taproot or branched caudex, (2) annuals from slender taproot with deeply lobed to compound cauline leaf blades, and (3) annuals from slender taproot with entire to shallowly lobed cauline leaf blades. A startling unidentified, large, leafy perennial *Phacelia* of Group 1 was discovered on 08 July 2019 on the northern and eastern slopes of Damnation Peak during botanical surveys following the 2018 Carr and Delta Fires in Shasta County, California. This *Phacelia* occurred on open forest slopes with rocky, shaly substrates and most closely matched the *The Jepson Manual* (Patterson et al. 2012) and Jepson eFlora (Walden et al. 2013) descriptions of *P. procera* A.Gray and *P. bolanderi* A.Gray, but did not fit either species based on stamen and corolla characters, seed count, and habit. Photographs and a general description were sent to a *Phacelia* expert and coauthor of the genus treatment for the *Flora of North America*. She concurred that it was an undescribed taxon and not previously collected (G. Walden, California Department of Food and Agriculture personal communication). We found the plant at two additional localities in the vicinity of Damnation Peak on 10 July 2019, followed by three localities from the vicinity of nearby Dog Creek Mountain on 16 July 2019. Following additional reconnaissance, the species was found at 57 localities by October 2019.

DESCRIPTION AND DIAGNOSIS

Phacelia damnationensis Kierstead, Lindstrand & M.J.Lenz, sp. nov. (Figs. 1, 2B, C, D, E, F) "Damnation Pass Phacelia"—Type: USA, **California**, Shasta Co., North of Damnation Pass, 40.95577°, –122.52304°; 1415 m (4642 ft), 8 July 2019, *J. K. Nelson 2019-009 with M. Lenz* (holotype: JEPS; isotypes: CAS, CHSC, DAV, GH, RSA, US).

Multi-stemmed perennial herb 30–91 cm from branched woody caudex. **Stem** decumbent to ascending, brittle, very glandular-hairy, leaving a brown varnish on fingers and plant press paper. **Leaf** petiole 2–39 mm, glandular-hairy; blade 9–95 mm, ovate, coarsely toothed, glandular-hairy, older leaves slightly oblique at base. **Inflorescence** panicle-like, generally ±open proximally, glandular-hairy. **Flower** calyx lobes 4–6 mm, 6–8 mm in fruit, oblong to ovate, glandular-hairy; corolla 5–8 mm, bell-shaped, cream to apple-green with occasional lavender tinge, slightly reflexed at anthesis, limb 7–9 mm diam, brownish-purple corolla scales fused to filament bases, oblong, scales 1–1.5 mm, oblong to ovate; stamens 8–11 mm, exserted, filaments sparsely villous with straggly, sparse long wavy hairs, white-light green, aging brown, pollen light purple; style 9–11

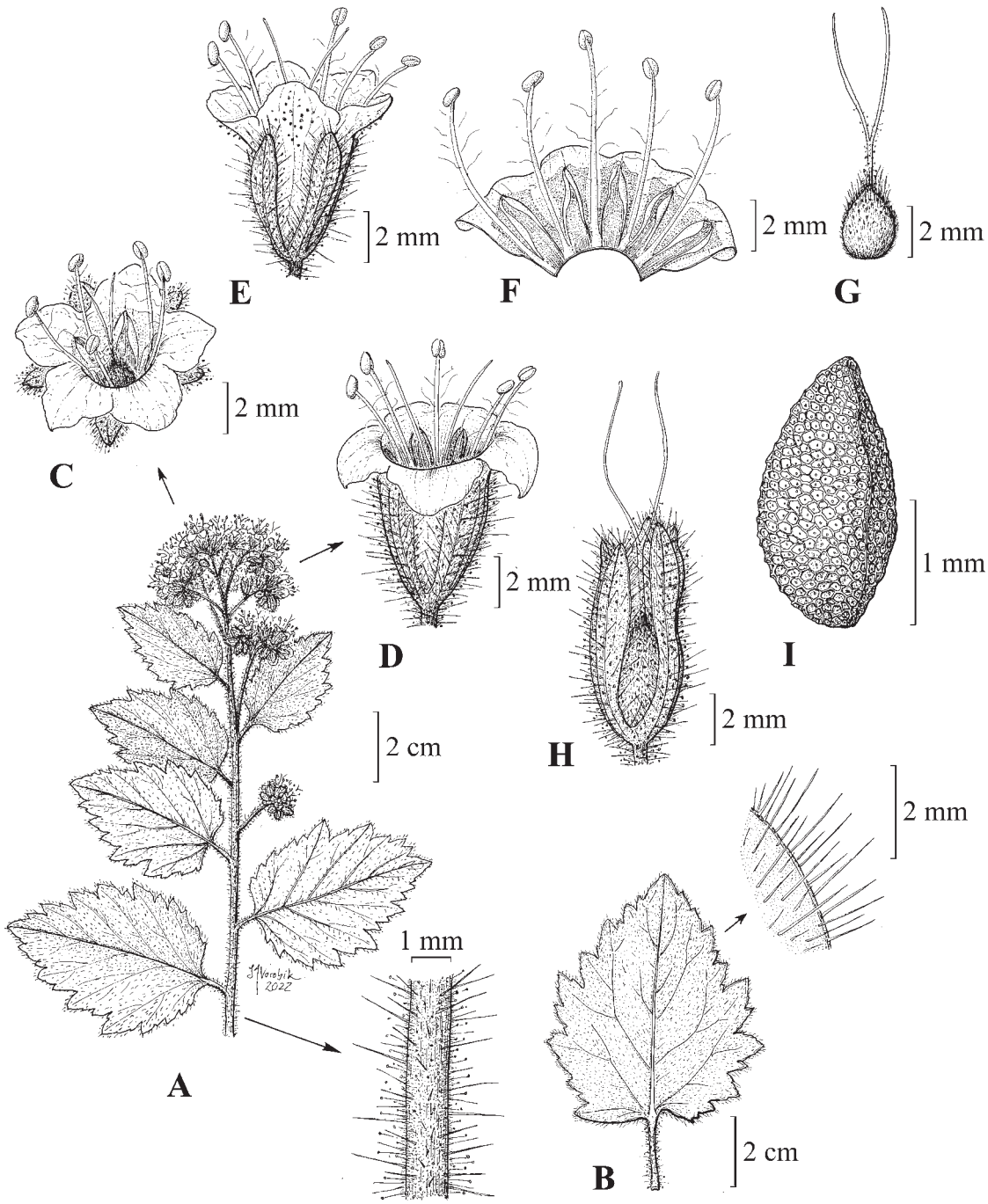

FIG. 1. *Phacelia damnationensis*. A. Flowering stem with closeup of vestiture. B. Glandular-hairy leaf. C. Top view of flower in full anthesis. D. Side view of flower in full anthesis, showing slightly reflexed corolla lobes. E. Flower in early anthesis showing glands on exterior of corolla lobes. F. Dissected flower showing scales, filaments, and anthers. G. Pistil. H. Fruit and calyx. I. Reticulate pitted seed.

mm, cleft 3/4, unbranched portion densely and uniformly pubescent with short, straight hairs. **Fruit** 3–5 mm, ovoid, strigillose, glandular. **Seed** 5–12, 1–2 mm, brown, reticulate pitted, ovoid, and angled.

Paratypes. USA, California, **Shasta Co.**, Upper Slate Creek watershed, approx. 1 mi north of Damnation Peak and 0.40 mi east of Sanford Pass, 40.97667°, –122.53029°; 1280 m (4200 ft), 10 July

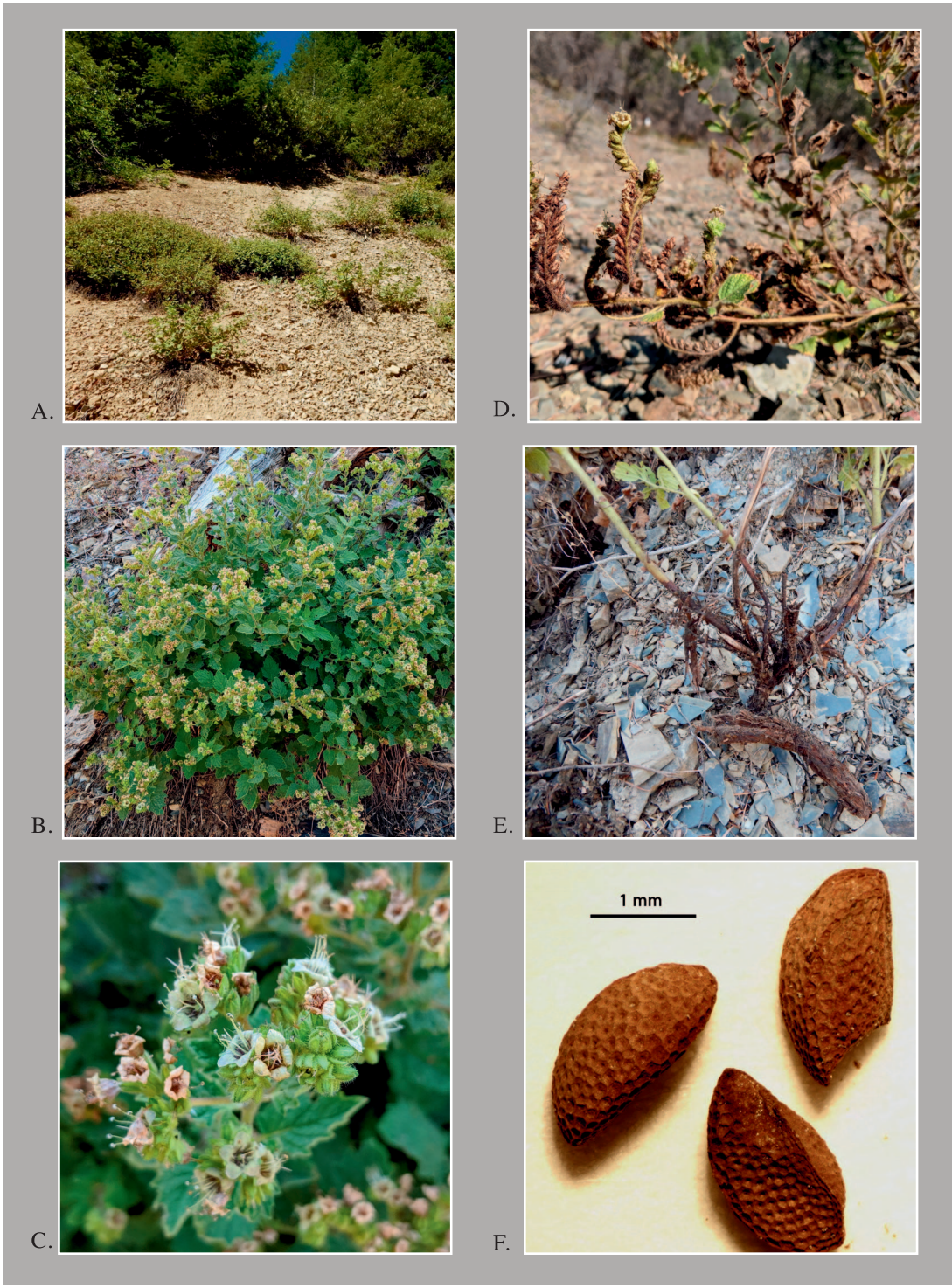

FIG. 2. *Phacelia damnationensis*. A. Habitat on open slope near Dog Creek Mountain. B. Habit of mature shrub at type locality. C. Inflorescence showing cream to apple-green corolla and exserted stamens at type locality. D. Branch in fruit showing glandular stems and leaves near Bohemotash Mountain. E. Woody caudex of mature shrub at type locality. F. Seed showing brown color and reticulate pitted surface. Photo credits: A, B, C, E: Len Lindstrand III; D: Julie A. Kierstead: F: Martin J. Lenz. Photo dates: A, B, C, 22 July 2019; D, 06 September 2019; E, 08 January 2020; F, 21 September 2021.

2019, *L. Lindstrand III 21276* (CAS, CHSC, JEPS, SPIF); Along Road #1 5.8 road-km east of crossing of Stoddard Creek, 2.6 air-km west of Bohemotash Mountain, 40.78944°, –122.50111°; 1243 m (4077 ft), 2 September 2019, *L. P. Janeway 13177* (CHSC); Ridgeline at headwaters of South Fork Backbone Creek, 40.79243°, –122.50318°; 1249 m (4100 ft), 10 July 2019, *L. Lindstrand III 21287 with J. Kierstead* (CAS, JEPS, CHSC, SPIF); Northwest slope of Schell Mountain, 40.85907°, –122.53468°; 1365 m (4480 ft), 24 September 2019, *J. K. Nelson 2019-049 with M. Lenz*, *L. Sims*, *A. Sims*, *J. Whitt*, and *M. Zickgraf* (CAS); Ridgeline above South Fork Hazel Creek, approx. 1.7 mi west of Tombstone Mountain, 41.04947°, –122.28576°; 1005 m (3300 ft), 21 November 2019, *L. Lindstrand III 21295 with M. Henwood* (CAS, CHSC, DAV, HUM, JEPS, SPIF); Ridgeline above South Fork Hazel Creek, approx. 1.7 mi west of Tombstone Mountain, 41.04947°, –122.28576°; 1005 m (3300 ft), 7 July 2020, *L. Lindstrand III 21337* (CAS, CHSC, DAV, HUM, JEPS, RSA, SPIF); French Ridge, northern slope of Dog Creek Mountain, 40.90343°, –122.51577°; 1158 m (3800 ft), 8 July 2020, *L. Lindstrand III 21342* (CAS, CHSC, DAV, HUM, JEPS, RSA, SPIF); Northwest slope of Schell Mountain, 40.85901° –122.53534°; 1371 m (4500 ft), 8 July 2020, *L. Lindstrand III 21343* (CAS, CHSC, JEPS, SPIF); Headwaters of Lunch Gulch, approx. 1 mi southwest of Damnation Peak and 0.5 mi northeast of Damnation Pass, 40.94675°, –122.53430°; 1328 m (4360 ft), 8 July 2020, *L. Lindstrand III 21344* (CAS, CHSC, DAV, JEPS, SPIF); East slope of Damnation Peak, along ridge at headwaters of North Fork Dog Creek, type locality, 40.95753°, –122.52252°; 1402 m (4600 ft), 8 July 2020, *L. Lindstrand III 21345* (CAS, CHSC, DAV, HUM, JEPS, SPIF); ridge along headwaters of South Fork Slate Creek, approx. 1.2 mi north of Damnation Peak and 0.45 mi east of Sanford Pass, 40.97667°, –122.52949°; 1242 m (4075 ft), 8 July 2020, *L. Lindstrand III 21346* (CAS, CHSC, DAV, RSA, JEPS, SPIF); Ridgeline at headwaters of South Fork Backbone Creek and Fall Creek, 40.79236°, –122.50317°; 1249 m (4100 ft), 10 July 2020, *L. Lindstrand III 21347* (CAS, CHSC, DAV, JEPS, SPIF).

Relationships. Based on a preliminary molecular analysis and morphological characters, *Phacelia damnationensis* belongs to *Phacelia* Juss. sect. *Baretiana* Walden & R.Patt. (Walden and Patterson 2012), which contains three other species: *P. bolanderi*, *P. hydrophylloides* Torr. ex A.Gray, and *P. procera* (G. Walden, California Department of Food and Agriculture personal communication). The most distinctive morphological differences between *P. damnationensis* and these taxa include corolla size and color, fruit (capsule) size, and habit (Table 1).

Distribution and Habitat

Phacelia damnationensis occurs in the southeastern Klamath Mountains geomorphic province (Miles and Goudey 1997) in the upper Sacramento River watershed northwest of Shasta Lake and south of Dunsmuir, Shasta County, California. This area is characterized by mild, wet winters and hot, dry summers. The average annual precipitation is approximately 156 cm, occurring primarily as rainfall; average precipitation in the vicinity of the *Phacelia damnationensis* populations is 152–203 cm, with persistent snow above approximately 1219 m elevation. Average annual temperatures range from 10°C in winter to 32°C in summer, with high temperatures regularly exceeding 37°C. *Phacelia damnationensis* is currently known from four general areas on the divide between Clear Creek and the upper Sacramento River canyon in the vicinity of Damnation Peak, Dog Creek Mountain, Schell Mountain, and the ridgeline west of Bohemotash Mountain (Fig. 3). A fifth, disjunct occurrence is located in the South Fork Hazel Creek watershed west of Tombstone Mountain (Fig. 3). The type locality occurs on the eastern slope of Damnation Peak at the headwaters of the Dog Creek watershed.

Elevations at the known 57 localities range from 975 to 1426 m. Most of these localities occur in the Bragdon Formation geologic unit, while localities in the vicinity of Damnation Peak also occur on Copley Greenstone (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). The Copley Greenstone is early Devonian in age and features andesitic and basaltic volcanic breccia, tuff, and pillow lavas (Irwin 1994).

The *Phacelia damnationensis* populations are associated with open, rocky, gravelly, mountain slopes in coniferous forest habitats (Fig. 2A). The type locality consists of a natural shaly talus slope, as does the southernmost occurrence west of Bohemotash Mountain. These steep talus slopes are distinctively sparsely vegetated, compared with adjacent forest. Several occurrences are on rock outcrops and open rocky slopes with partial forest overstory. These locations appear to be the plant's natural habitat, which allows it to largely escape the direct effects of wildfire. As its habitat became dissected with roads in the past century, the species likely adapted by establishing on roadcuts and shoulders of native surface forest roads and adjacent slopes, former skid trails from previous timber harvest, and conifer forest plantations established following timberland management activities. The species occurrences are found on all aspects, and the overstory canopy cover at these locations is open except for portions of the Hazel Creek and Dog Creek Mountain occurrences, which include moderate shade. Commonly associated species include *Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*,

TABLE 1. MORPHOLOGICAL AND ECOLOGICAL CHARACTERS OF *PHACELIA DAMNATIONENSIS* AND RELATED *PHACELIA* SECT. *BARETIANA* SPECIES. CaRH = High Cascade Range; NW = Northwestern California; SNH = High Sierra Nevada; KR = Klamath Ranges; seKR = Southeastern Klamath Ranges; NCoRH = High North Coast Ranges; nSNH = Northern High Sierra Nevada.

Character	*Phacelia damnationensis*	*Phacelia hydrophylloides*	*Phacelia bolanderi*	*Phacelia procera*
Habit	Perennial herb 30–91 cm	Perennial herb 10–30 cm	Perennial herb 12–100 cm	Perennial herb 50–200 cm
Stem	Decumbent to ascending, brittle, glandular-hairy	Decumbent to ascending, hairy, generally not glandular	Decumbent to ascending, stiff-hairy, minutely glandular, hairs appressed distally	Erect, hairy
Leaves	Petioles 2–39 mm, glandular-hairy; blade 9–95 mm, ovate, coarsely toothed, glandular-hairy, older leaves slightly oblique at base	Petioles 5–50 mm; blade 15–60 mm, oblong to ovate, generally coarsely toothed or lobed, 1–2 lobes often deep	Petioles 10–110 mm, sparsely stiff-hairy; blade 30–120 mm, oblong to widely ovate, coarsely toothed or 2–lobed at base, minutely glandular	Petioles 10–40 mm; blade 50–120 mm, lanceolate to ovate, coarsely toothed to lobed
Inflorescence	Panicle-like, generally ±open proximally, glandular-hairy	Head-like, dense	Panicle-like, generally ±open proximally	Panicle-like, generally ±open proximally, minutely glandular-hairy
Flower–calyx lobes	4–6 mm, 6–8 mm in fruit, oblong to ovate, glandular-hairy	3–5 mm, 7–10 mm in fruit, narrowly oblong, soft appressed-hirsute to densely hispid and ciliate on margins	6–7 mm, 8–11 mm in fruit, linear to oblong, stiff-hairy, minutely glandular	3–5 mm, 7–8 mm in fruit, linear, minutely glandular-hairy
Flower–corolla	5–8 mm, bell-shaped, cream to apple-green with occasional lavender tinge, limb 7–9 mm diam, scales fused to filament bases, oblong	5–8 mm, bell-shaped, white to purple-blue, limb 6–8 mm diam., scales fused to filament bases, narrowly oblong	10–12 mm, subrotate to widely bell-shaped, pale blue to purple, throat brown in age, limb 10–20 mm diam., scales fused to filament bases, oblong	3–7 mm, ±bell-shaped, cream to green or brown-white, limb 3–7 mm diam., scales fused to filament bases, narrowly oblong
Flower–stamens	8–11 mm, exserted, filaments sparsely villous with straggly, sparse long wavy hairs, white-light green, aging brown, pollen light purple; style 9–11 mm, cleft 3/4, unbranched portion densely and uniformly pubescent with short, straight hairs	8–11 mm, exserted, glabrous, pollen purple; style 8–10 mm, cleft 3/4, glabrous	9–11 mm, = corolla or slightly exserted, base hairy; filaments, pollen purple; style 9–11 mm, = corolla or ±exserted, cleft 2/3, hairy at base	8–10 mm, exserted, hairy; style 6–10 mm, cleft 1/2
Fruit	3–5 mm, ovoid, strigillose, glandular	5–7 mm, ovoid, sparsely strigose	6–8 mm, ovoid, stiff-hairy	6–8 mm, ovoid, short-rough-hairy, glandular
Seed	5–12, 1–2 mm, brown, reticulate pitted, ovoid, and angled	3–8, 2–3 mm; surface net-like, pitted	30–60, 1–1.5 mm, pitted	Generally 12–16, ±2 mm, angled; surface net-like, pitted
Ecology	Rocky slopes, talus, roadsides, disturbed areas, conifer forest	Slopes, flats, meadows, conifer forest	Bluffs, canyons, slopes	Meadows, slopes, talus, conifer forest
Elevation	975–1426 m	1500–3100 m	<1400 m	1200–2200 m
CA Range	seKR	CaRH, SNH	NW	KR, NCoRH, CaRH, nSNH
Range Outside CA	N/A	OR, NV	OR	CA, ID, NV, OR, WA

Pinus ponderosa Lawson & C.Lawson, *Pinus lambertiana* Douglas, *Quercus chrysolepis* Liebm., *Notholithocarpus densiflorus* (Hook. & Arn.) Manos, C.H.Cannon & S.Oh var. *echinoides* (R.Br.ter) Manos, C.H.Cannon & S.Oh, *Ceanothus integerrimus* Hook. & Arn., *Arctostaphylos patula* Greene, and *Toxicodendron diversilobum* (Torr. & A.Gray) Greene. *Phacelia damnationensis* nearly always grows with *Draperia systyla* (A.Gray) Torr. ex A.Gray, a species with very similar infructescences, and sometimes can hide in plain sight as a result. Species names follow Baldwin et al. (2012) and Jepson Flora Project (2022).

The small geographic range of *P. damnationensis* is entirely within the range of *P. procera,* though the two have not been found to co-occur. The other two species in this section are well separated from *P. damnationensis* geographically, with *P. bolanderi* occurring in the western Klamath Ranges, and south along the North Coast and Outer North Coast Ranges to the vicinity of Sonoma; and *P. hydrophylloides* to the southeast, from Lassen Volcanic National Park in the High Southern Cascades, south into the High Southern Sierra Nevada (Fig. 4) (Table 1).

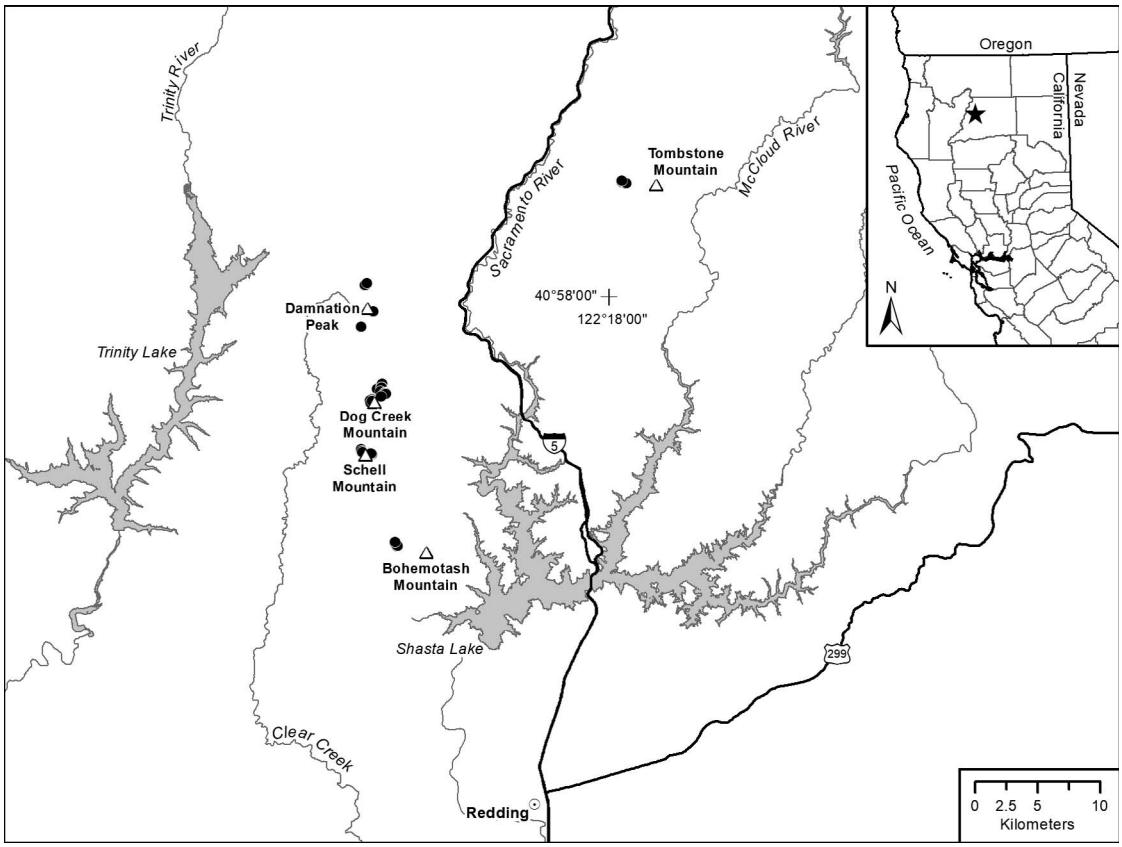

FIG. 3. *Phacelia damnationensis* localities (black dots), Shasta County, California. Triangles indicate general regions of occurrence.

ETYMOLOGY

The specific epithet *damnationensis* means "growing in or at Damnation", referring to Damnation Peak and the adjacent forest road leading to Damnation Pass, upon which the species was discovered. The road originally served as a logging railroad line included in the historic LaMoine Lumber & Trading Company railroad system. We suggest the common name "Damnation Pass Phacelia."

PHENOLOGY

Phacelia damnationensis stems emerge from a branched woody caudex during April and the plant flowers from mid-June to early-September, producing mature fruits by mid- to late-summer. The multiple above ground stems form dense patches to 1.5 m diam. These above ground stems wither and die with the onset of winter frost, leaving a distinctive thatch from which new growth emerges the following year, likely an adaptation to cold winter temperatures and persistent snow occurring at the species localities.

RARITY AND CONSERVATION STATUS

Phacelia damnationensis is endemic to the southeastern Klamath Mountains from the divide between Clear Creek and the upper Sacramento River canyon, and from the South Fork Hazel Creek watershed located on the east side of the upper Sacramento River canyon (Fig. 3). The species is currently known from nine occurrences at five general areas (Table 2) in the vicinity of Damnation Peak, Dog Creek Mountain, Schell Mountain, the ridgeline west of Bohemotash Mountain, and west of Tombstone Mountain. These nine occurrences range from three to 26 proximate localities, which range from a single 1 m diam. plant situated in a seasonal drainage to approximately 280 plants scattered over approximately 113 ha on a large ridgeline feature. Additional habitat is abundant in the vicinity of all occurrences, yet seemingly potential habitat is unoccupied by the *Phacelia*, though the habitat may be occupied by *Draperia systyla*, its most consistent associate. As reviewed earlier, potential habitat for this species appears limited to the Bragdon Formation and Copley Greenstone geology and further limited to disturbed open slopes with gravelly or shaly rock.

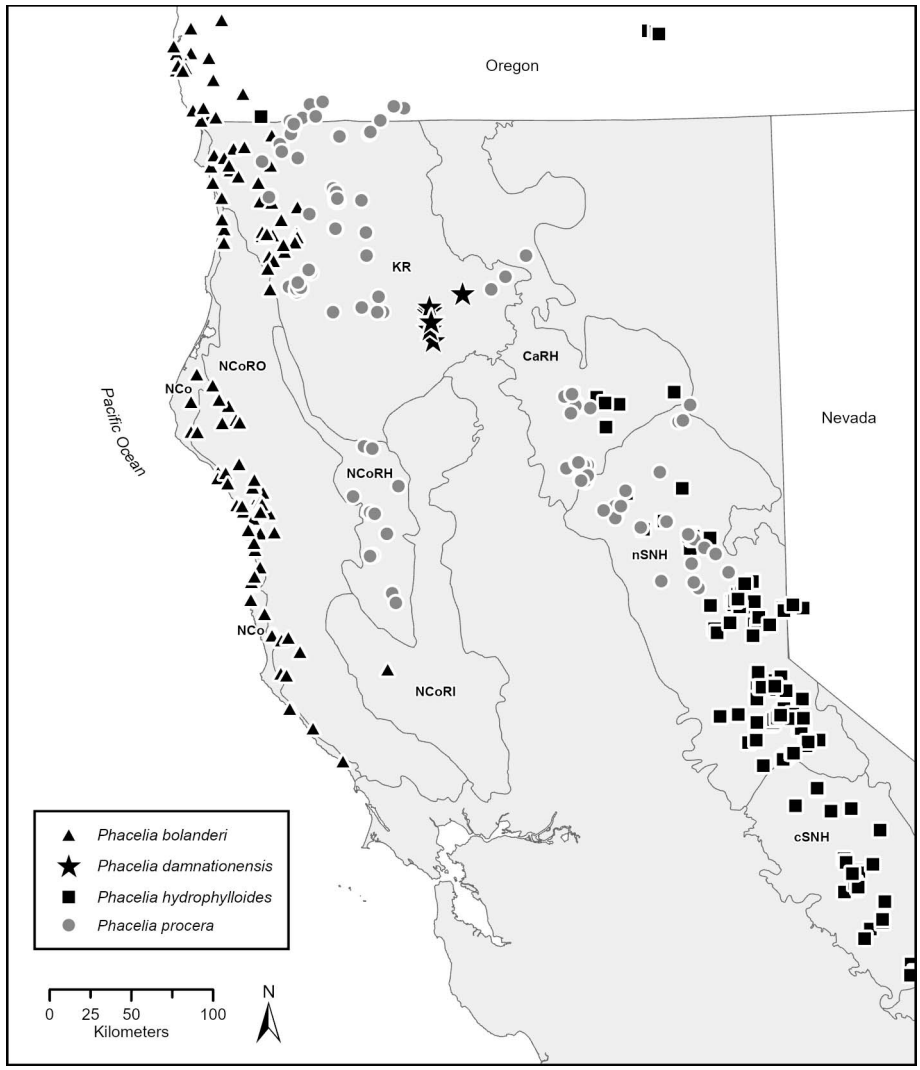

FIG. 4. Geographic range of *Phacelia damnationensis* and related *Phacelia* sect. *Baretiana* species in northern California and adjacent Oregon and Nevada. For California, biogeographic regions outlined and labeled are from the Jepson Flora Project (2022).

TABLE 2. KNOWN *PHACELIA DAMNATIONENSIS* DISTRIBUTION, SOUTHEASTERN KLAMATH MOUNTAINS, SHASTA COUNTY, CA, AS OF MARCH 2022. Occurrence is defined as groupings of proximate localities within 0.25 mi of one another.

General area	# Localities	# Occurrences
Damnation Peak	5	3
Dog Creek Mountain	32	2
Schell Mountain	8	2
Ridgeline west of Bohemotash Mountain	5	1
South Fork Hazel Creek watershed	7	1

Phacelia damnationensis occurrences are located in relatively remote settings. Habitats at or near all known occurrences have been subject to historical wildfire, forest road construction, logging, and recent disturbances from the 2018 Carr and Delta wildfires and subsequent timber salvage activities. These areas receive regular human visitation, particularly during hunting season and through various forest management activities. Activities in the immediate vicinity of most occurrences are limited due to the steep, open slope habitat. Five occurrences are on land managed by the U.S. Forest Service, three occur on private property, and one is on land managed by the Bureau of Land Management (BLM). Surrounding land use includes recreational activities (such as hunting and hiking), timberland management, and the BLM

occurrence is in a designated off-highway vehicle area. The open, rocky ridgetop locations in which these populations occur have been subject to timberland and other management activities and exposed to historical and recent wildfire. The species is adapted to wildfire, as we observed individuals burned during the 2018 wildfires that responded with vigorous regrowth; however, we have not observed the typical "flush" of seedlings or abundant resprouting typically associated with "fire follower" species. *Phacelia damnationensis* is rare in terms of the number of known occurrences and narrow geographic distribution. However, based on the apparent tolerance, or even preference for disturbed habitats 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. Other extensive areas with potential habitat occur throughout the known species distribution. We recommend that *P. damnationensis* 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 (CDFW 2022) and the California Native Plant Society's Inventory of Rare and Endangered Plants of California (CNPS 2022).

Key to Phacelia sect. Baretiana

Key to species of *Phacelia* sect. *Baretiana* including *Phacelia damnationensis*, from Walden et al. 2013 (Jepson eFlora), modified leads in **bold**.

5. Inflorescence head-like, dense; stamens glabrous; plant 10–30 cm . . . . . *P. hydrophylloides*′
5′ Inflorescence panicle-like, generally ± open proximally; stamens hairy; plants generally >30 cm
   6. Plant decumbent to ascending to substrictly erect; leaf blades truncate to subcordate at base
      6B. Leaf blades obtuse at apex; corolla pale blue to purple, 10–12 mm, limb 10–20 mm diam., open-campanulate to subrotate, lobes spreading; seeds 30–60 . . . . . ***Phacelia bolanderi***′
      6B′ Leaf blades acute at apex; corolla cream to apple-green with occasional lavender tinge, 5–8 mm, limb 7–9 mm diam, campanulate, lobes reflexed; seeds 5–12 . . . . . ***Phacelia damnationensis***
   6′ Plant erect; leaf blades attenuate to auriculate at base . . . . . ***Phacelia procera***

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