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A NEW VARIETY OF *LOMATIUM RAVENII* (APIACEAE) FROM THE NORTHERN GREAT BASIN AND ADJACENT OWYHEE REGION

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ABSTRACT

Variability in the group of *Lomatium* species comprising *L. nevadense*, *L. ravenii*, and *L. foeniculaceum* has led to conflicting classification schemes. While some taxonomists have treated *L. ravenii* as a distinct species made up of all the populations from California, Nevada, Idaho, and Oregon, others considered *L. ravenii* to be nothing more than a morphological extreme of *L. nevadense.* We examined morphological and phylogenetic data from across the range of *L. ravenii*, concluding that variation in the species warrants varietal distinction. Non-metric multidimensional scaling analysis of 29 populations shows two distinct groups—one from the vicinity of Ravendale, California, and one from the rest of the range in California, Nevada, Oregon, and Idaho. Phylogenetic analysis of the ITS, *rps16* intron, and cpDNA *rpl32-trnL*$_{UAG}$ genes from seven populations supports these two groups. We refer to the geographically widespread population as **Lomatium ravenii** var. **paiutense** and recommend reassessment of the conservation status of the more narrowly endemic Ravendale populations.

Key words: Apiaceae, California, Great Basin, *Lomatium nevadense*, *Lomatium ravenii*, Nevada, Oregon, Owyhee, Paiute, Ravendale.

INTRODUCTION

Lomatium ravenii was first described from specimens obtained in the vicinity of Ravendale, Lassen County, California (Mathias and Constance 1959). Mathias and Constance considered the new species most closely related to *L. foeniculaceum* var. *macdougalii* (as *L. macdougalii* J.M.Coult. & Rose) and *L. nevadense*. The white-flowered *Lomatium ravenii* can be easily distinguished from the yellow-flowered *L. foeniculaceum* var. *macdougalii*, but both taxa have highly dissected leaves with small, numerous segments. *Lomatium ravenii* is harder to distinguish from the similarly white-flowered *L. nevadense*, which is itself a decidedly variable species. In general, *L. ravenii* has leaves that are more dissected and have narrower ultimate leaf segments than those of *L. nevadense*.

Mathias and Constance noted that *L. ravenii* was known only from the type locality of Ravendale, but that it, or something similar, occurred in Harney and Malheur counties of southeastern Oregon. Collections from The College of Idaho (CIC) and University of Nevada (UNR) herbaria show that *ravenii*-like plants grow in Owyhee County of southwestern Idaho and in the counties of north and central Nevada. Detailed examination of herbarium specimens from throughout the range of *L. ravenii* uncovered differences between the populations collected in Ravendale and the populations collected from throughout Nevada, Oregon, and Idaho (Carlson et al. 2011). The Ravendale populations appear more robust than other populations. They are taller and have more branches, while the populations collected elsewhere are typically small, low-growing plants with few branches. Another distinct difference is evident in the leaves. While all populations of *L. ravenii* have highly dissected leaves, the Ravendale populations exhibit linear ultimate leaf divisions that are much longer and narrower than those seen in the Nevada, Oregon, and Idaho populations (K. Carlson, D. Mansfield, J. Smith, pers. obs.).

The high degree of variability exhibited by this group of *Lomatium* species has led to conflicting classifications in the primary floristic treatments for the area. Constance (1993) treated *L. ravenii* as a distinct species comprising all the populations from California, Nevada, Idaho, and Oregon. Cronquist et al. (1997) interpreted the differences between *L. ravenii* and *L. nevadense*, particularly in the leaves, as being continuous rather than discrete; therefore, they considered *L. ravenii* to be nothing more than a morphological extreme within the variation of *L. nevadense*.

A recent study (Carlson et al. 2011) using phenetic analyses of morphology and phylogenetic analyses of chloroplast and nuclear gene sequences clearly showed that *L. ravenii* and *L. nevadense* are not closely related. Carlson et al. (2011) also provided evidence that the populations of *L. ravenii* collected from the type locality of Ravendale were different morphologically from *L. nevadense*, and one individual from the type locality was phylogenetically sister to a clade of all other populations of *L. ravenii* collected elsewhere. However, the sample size in that study was low, with only one Ravendale population of *L. ravenii* available for the phylogenetic sampling. The purpose of this research is to determine whether varietal distinction is warranted between populations of *L. ravenii* from Ravendale and those collected elsewhere. We added herbarium specimens from UNR to the pool of specimens used in the original study. Two additional leaf samples were collected from the vicinity of Ravendale for use in the phylogenetic analyses.

MATERIALS AND METHODS

Morphological Analyses

A total of 29 herbarium specimens labeled as *L. ravenii* were used in the morphological analyses, covering the geographic range of the species: 10 specimens from CIC, eight from UC/JEPS (including an isotype), and 11 from UNR. Seven of these specimens (three from Ravendale and four from the remaining distribution range) were vouchers for samples used in the phylogenetic analyses. Ten specimens of *L. nevadense* from CIC were also included as it is a clearly defined, unrelated species and would help "root" the different *L. ravenii* populations (Appendix 1).

A total of 27 characters were measured on each specimen (Table 1). Most characters were root and leaf features as these appeared to best help differentiate among the various populations. In two instances, herbarium sheets of *L. ravenii* from UC/JEPS had both glabrous and hirtellous plants on the same sheet. In such cases, we treated the glabrous and hirtellous forms as different populations. In another instance, one sheet of *L. ravenii* from UNR had unusual leaves and bracts. These plants were also treated as different populations. All data were analyzed using non-metric multidimensional scaling (NMS—Rohlf 2004), as outlined in Carlson et al. (2011). Missing data comprised 12% of the data cells (1% not counting fruit).

In addition, Mann-Whitney tests were performed on quantitative characters to see if there was a statistically significant difference between the values recorded for the Ravendale populations and those recorded for the populations collected elsewhere. Mann-Whitney tests were used in place of *t*-tests because the data did not show a normal distribution. All statistical tests were carried out using SigmaPlot 11.0 (Systat Software, Inc., San Jose, CA).

Table 1. Character list for morphological analysis.

1. Petal color: 0 yellow; 1 white.
2. Anther color: 0 yellow; 1 purple.
3. Herbage pubescence: 0 absent; 1 present.
4. Herbage pubescence density: 0 no hair; 1 scarce, a few scattered hairs; 2 more widespread, but still not dense; 3 dense.
5. Bractlet pubescence: 0 absent; 1 present.
6. Bractlet pubescence density: 0 no hair; 1 scarce, a few scattered hairs; 2 more widespread, but still not dense; 3 dense.
7. Bractlet length/width ratio.
8. Bractlet scarious margin width (mm).
9. Fruit length/width ratio.
10. Fruit lateral wing width (mm).
11. Mature fruit pubescence: 0 absent; 1 present.
12. Mature fruit pubescence density: 0 no hair; 1 scarce, a few scattered hairs; 2 more widespread, but still not dense; 3 dense.
13. Leaf segment length (mm).
14. Petiole length at anthesis (mm).
15. Blade width at broadest point (mm).
16. Number of leaf divisions.
17. Ultimate segment length/width ratio.
18. Ultimate cluster length (mm).
19. Distance between ultimate rachis (mm).
20. Tiniest of all segments constricted at base: 0 not constricted; 1 constricted.
21. Number of stems.
22. Root narrowing or swelling below crown: 0 narrowing; 1 swelling.
23. Distinct swelling at end of root: 0 absent; 1 present.
24. Diameter of root swelling (mm).
25. Root swelling length/width ratio.
26. Top of root swelling tapered or flat: 0 tapered; 1 flat.
27. Persistence of old leaf bases: 0 none; 1 very few, scattered; 2 moderate, covering much of the stem base; 3 dense, entire stem base surrounded by several tightly packed layers.

Phylogenetic Analyses

During the spring and summer of 2007, we collected leaf material for DNA extraction from four populations of *L. ravenii* growing in southeastern Oregon and southwestern Idaho. Three populations of *L. ravenii* collected near Ravendale were provided to us as well. *Orogenia linearifolia* was used as the outgroup in all analyses. DNA was extracted from silica-dried leaf material (28–200 mesh silica gel desiccant) of one individual plant using the Qiagen DNeasy Plant Mini Kit (Valencia, CA) according to manufacturer's instructions. See Appendix 1 for the source of all sequences.

The DNA regions (ITS, *rps16* intron, and *rpl32-trnL*$_{UAG}$) were amplified and sequenced following the methods of Carlson et al. (2011). Sequences were aligned manually. The partition homogeneity test (Farris et al. 1994) was performed as implemented in PAUP*4.0 b10 (Swofford 2002) with 10,000 bootstrap replicates (using a heuristic search, simple addition, and no branch swapping). The cpDNA and ITS regions were treated as separate partitions. Phylogenetic trees were estimated using maximum parsimony (MP), maximum likelihood (ML), and Bayesian inference (BI) to allow for comparison of tree topologies. Support for trees was estimated using the bootstrap (Felsenstein 1985), with both MP and ML, and posterior probabilities with BI. Parameters for the MP, ML, bootstrap, and BI analyses follow those of Carlson et al. (2011), except that two independent 10-million replicates were run in the BI analyses and the two runs were compared using AWTY (Nylander et al. 2007) and indels were not rescored for this analysis.

RESULTS

Morphological Analyses

Results of the NMS analysis show *L. ravenii* divided into two clear groups (Fig. 1). The bottom group of specimens ("Ravendale variety") is spread out across Axis I, but all fall at negative values along Axis II. These are the populations that are robust and branched, with long, narrow ultimate leaf segments collected in the vicinity of Ravendale. The difference between the hirtellous and glabrous variants is apparent, with the glabrous variants having the most negative values on Axis II; yet both variants are clearly distinguishable from the upper group of *L. ravenii* specimens in Fig. 1.

The top group of specimens in Fig. 1 consists of all other populations of *L. ravenii* collected from Oregon, Idaho, Nevada, and California ("widespread variety"). These specimens are also spread out across Axis I, but are more tightly clustered along Axis II. They tend to fall at positive values on Axis II. Characters distinguishing the two groups identified in Fig. 1 are listed in Table 2.

The population falling at the most negative value on Axis II in this group (marked by an asterisk in Fig. 1) was collected in

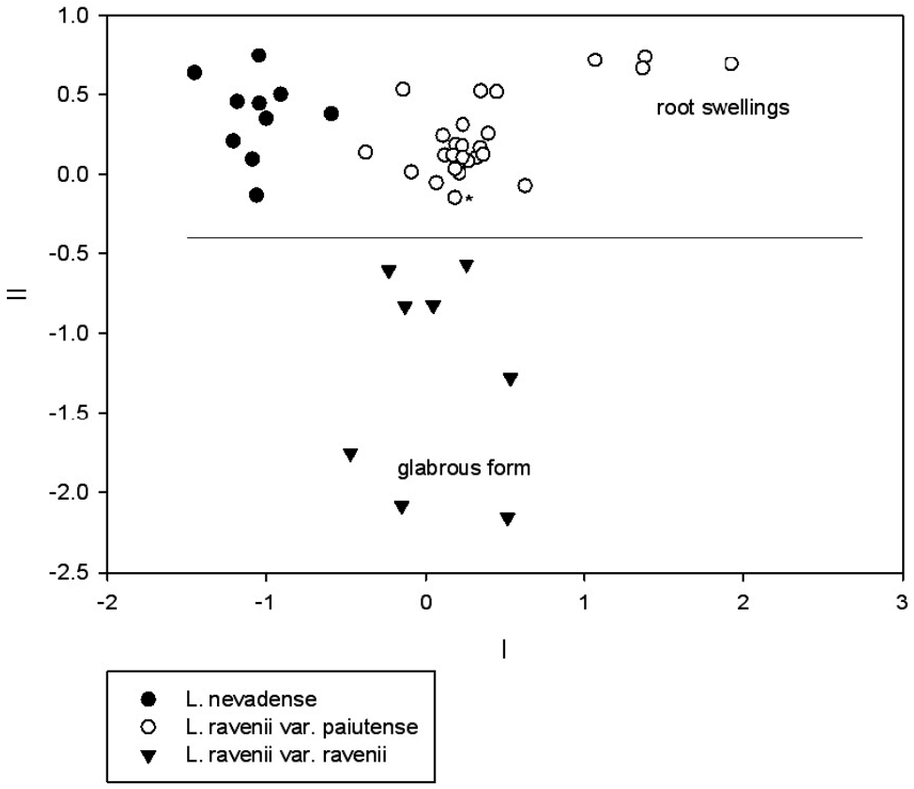

Fig. 1. Non-metric multidimensional scaling results from the morphological analysis. The asterisk marks a population of *Lomatium ravenii* collected in Washoe County, Nevada that shares characteristics of both **L. ravenii** var. **paiutense** and *L. ravenii* var. *ravenii*.

Washoe County, Nevada. It is most similar to the "Ravendale variety", with which it shares long, linear ultimate leaf segments, but it appears to be more like the "widespread variety" of *L. ravenii* occurring in Idaho, Oregon, and Nevada, based on this analysis. It is also interesting to note the small cluster of four populations that falls at the highest positive values on both Axis I and Axis II. These four populations share the root swelling morphology that is sometimes present in this species (Constance 1993; Carlson et al. 2011).

Lomatium nevadense, which was included in this analysis for reference, groups independently of either "varieties" of *L. ravenii*. It falls at the most negative values of Axis I and at mostly positive values on Axis II.

Phylogenetic Analyses

Amplification products were obtained for all regions. Sequences for ITS ranged in length from 698 to 728 bp. However, numerous ambiguities at the beginnings and ends of our sequences forced us to shorten the sequences, yielding an aligned matrix length of 562 bp. Within the cpDNA, the *rps16* intron spanned 839–870 bp, with an aligned length of 900 bp, and the *rpl32-trnL*$_{UAG}$ region spanned 895–1182 bp, with an aligned length of 1177 bp. The partition homogeneity test (P = 0.0671) did not find significant differences between the two partitions, so a combined analysis of the nuclear and chloroplast DNA regions was performed, with a total sequence length of 2639 bp.

Maximum parsimony analysis resulted in 1472 trees of 587 steps (CI = 0.65, RI = 0.78). Maximum likelihood and BI trees yielded topologies that were in complete topological congruence with the MP trees. Output from AWTY analyses showed that the independent runs of each dataset are close in parameter (tree) space, leading us to conclude that the two separate runs approximated the same target (tree) distribution. The strict consensus of the MP trees is presented in Fig. 2. In this tree, all populations of *L. ravenii* are monophyletic (MP bootstrap = 79, ML bootstrap = 94, BI posterior probability = 100), with the populations from Ravendale forming a monophyletic group sister to another monophyletic group that unites the individuals from outside California.

DISCUSSION

Results of both the morphological and phylogenetic analyses suggest that two different entities, to be treated here as varieties, exist within *L. ravenii*. One variety consists of the populations collected in the vicinity of Ravendale, Lassen County, California. These populations tend to be relatively tall and robust, often with many branches, and are less hirtellous than populations elsewhere (Table 2). The most distinctive characteristic of this variety, however, is the presence of long, linear, highly divided ultimate leaf segments (Table 2, Fig. 3).

The second variety consists of all other populations from throughout southwestern Idaho, southeastern Oregon, western Utah, northern and central Nevada, and northeastern

Table 2. Quantitative distinctions between *L. ravenii* var. *ravenii* and **L. ravenii** var. **paiutense**. Values are means ± standard deviations. Medians were compared using a Mann-Whitney rank test. Differences significant at $P < 0.05$ are indicated with a "*"; those significant at $P < 0.001$ are indicated with a "**" ($N_{ravenii} = 8$; $N_{paiutense} = 26$).

Character	var. **paiutense**	var. *ravenii*	Significance
Herbage pubescence	1.00 ± 0.00	0.63 ± 0.52	**
Herbage pubescence density	2.81 ± 0.40	1.50 ± 1.31	**
Bractlet pubescence	1.00 ± 0.00	0.25 ± 0.46	**
Bractlet pubescence density	2.23 ± 0.82	0.25 ± 0.46	**
Bractlet length/width	4.05 ± 1.25	4.80 ± 0.92	
Bractlet margin width	0.20 ± 0.12	0.24 ± 0.08	
Leaflet segment length	25.69 ± 6.41	32.88 ± 16.59	
Petiole length at anthesis	6.15 ± 8.00	4.93 ± 5.54	
Blade width at broadest	34.35 ± 8.26	27.25 ± 10.50	
Ultimate segment length/width	2.12 ± 0.55	3.75 ± 0.71	**
Length of ultimate clusters	3.58 ± 1.21	4.00 ± 0.54	*
Distance between ultimate rachises	2.12 ± 0.68	2.88 ± 1.13	*
Number of stems	1.12 ± 0.21	1.93 ± 0.75	*
Old leaf bases persisting	1.46 ± 0.51	2.38 ± 0.52	**

California. These populations tend to be relatively diminutive, grow along the ground, and have few branches. The ultimate leaf segments are shorter with more rounded apices than those of the Ravendale populations (Table 2, Fig. 4).

The phylogenetic analyses indicate that *L. ravenii* is well supported as a monophyletic species and that the three Ravendale individuals form a clade that is sister to the other populations sampled (Fig. 2). These results agree with the morphology and demonstrate that the Ravendale populations are phylogenetically distinct from all other populations of *L. ravenii* sampled. Although hirtellous forms of the "Ravendale variety" were used in the phylogenetic analysis, there is clearly variation in the density of hairs within populations of both varieties.

Based on these morphological, phylogenetic, and geographic differences, we believe varietal distinction of the "widespread variety" is warranted. The new variety is named **L. ravenii** var. **paiutense** to reflect its expansive distribution across the northern Great Basin and Owyhee Uplands, like that of the Native American group for which it is named.

Taxonomic Treatment

LOMATIUM RAVENII Mathias & Constance var. **paiutense** K.Carlson & D.Mansfield, var. nov.—TYPE: USA. Oregon: Malheur Co., 0.5 mi N of Hwy 95 on a dirt road 37.2 mi SW of Jordan Valley, ca. 2 mi SW of Rome, dry flat area, growing with sagebrush, Sandberg's bluegrass, assorted forbs, and weeds in rocky, clay soil, 42°49.743′N, 117°40.755′W, 3650 ft, 8 May 2008, *K. Carlson w/E. Valdes 076* (holotype CIC).

Lomatium ravenii 'typicus' primo adspectu maxime simile, sed habitus curtus nec validus, procerus, sed stipes pauci nec plures, sed segmentes folios breves, teres, nec substrictus, oblongus.

Plants 0.3–1.5 dm at anthesis; perennial, acaulescent, the root deep-seated, occasionally with a swollen base, 1–3 cm in diameter, that gradually elongates into a slender upper portion, sometimes branching into 2–3 stems; pseudoscape occasionally present. Herbage rather densely hirtellous, appearing gray-green in color. Leaves generally ovate in outline, 2–5 cm long and 2–6 cm wide, tripinnately compound, dissected, segments 1–3 (–4) mm long and 1 mm wide or less, obovate to oblong or elliptic in outline with a mucronulate tip; peduncles spreading along ground, mostly 1–6 cm long at maturity; petioles 2–12 (–25) mm, much shorter than the blade and sheathed most of the length. Inflorescence at anthesis fairly compact, the rays elongating unequally but usually not becoming readily distinguishable from one another, pedicels 2–15 mm long at maturity. Involucel of moderately to densely hirtellous bractlets, lanceolate, generally 3–5 mm long, sometimes purplish in color with a narrow scarious margin. Petals white or purplish-white, glabrous; anthers purple, sometimes fading to cream on herbarium sheets. Fruit generally more orbicular than ovate, 3–6 mm wide and 4–8 mm long, scarcely to moderately hirtellous with lateral wings narrower than the body (Fig. 4).

Representative specimens examined USA. CALIFORNIA: Lassen Co., E of Sierra Ordnance Depot near CA-NV state line, 9 May 1980, *G. Schoolcraft 232* (UC); Honey Lake Island, 6 May 1980, *G. Schoolcraft 218a* (UC); Modoc Co., Nevada border E of Eagleville, E side of Surprise Valley, 10 May 1993, *B. Bartholomew w/M. Gilbert & L. Skog 6453* (UC). IDAHO: Owyhee Co., N flank of Juniper Mt., 10 May 1987, *L. C. Smithman & C. Sherman 1762* (CIC); Hwy 51, 2 mi W of Grasmere, 10 Jun 2008, *D. Mansfield w/M. Markin 08136* (CIC); ridge above Currant Creek, South Mt., 8 May 1978, *P. L. Packard 78-20* (CIC); Mud Flat Rd., 20 May 1983, *L. C. Smithman & K. Simmons 0997* (CIC); Currant Creek, South Mt., 8 May 1978, *P. L. Packard 78-24* (CIC); 2 air mi NW of Star Ranch, 50 mi S of Jordan Valley (Oregon), 20 May 1987, *A. DeBolt 696* (CIC); NEVADA: Elko Co., Burner Hills, 1.4 air mi S of Mint Mine, 15 Jun 1982, *A. Tiehm & M. Williams 7176* (UNR); Spruce Mt. peak area, 27 Jun 1981, *A. Tiehm & M. Williams 6683* (UNR); Eureka Co., Fish Creek Range, Prospect Peak area SSW of Eureka, 26 Jun 1988, *A. Tiehm & S. Crisafulli 11807* (UNR); Humboldt Co., Bartlett Butte at SW end of Pine Forest Range, 26 May 1982, *A. Tiehm & M. Williams 7040* (UNR); Jackson Mts., ridge just S of Buff Peak, 27 May 1982, *A. Tiehm & M. Williams 7048* (UNR); Lander Co., Toiyabe Range, head of Big and Kingston Creeks, 16 Jul 1981, *B. T. Welsh* et al. *882* (UNR); 14 air mi SE of Austin, Cape Horn, 6 May 1978, *S. Goodrich 10898* (UNR); Nye Co., Timber Mt., 27 Jun 1979, *M. J. Williams & A. Tiehm 79-110-16* (UNR); Grant Range between Timber Mt. and Troy Peak, 27 Jun 1979, *A. Tiehm* et al. *5341* (UNR); Grant Range, N side of Timber Mt., 27 Jun 1979, *A. Tiehm* et al. *5336* (UNR); Pershing Co., S end of

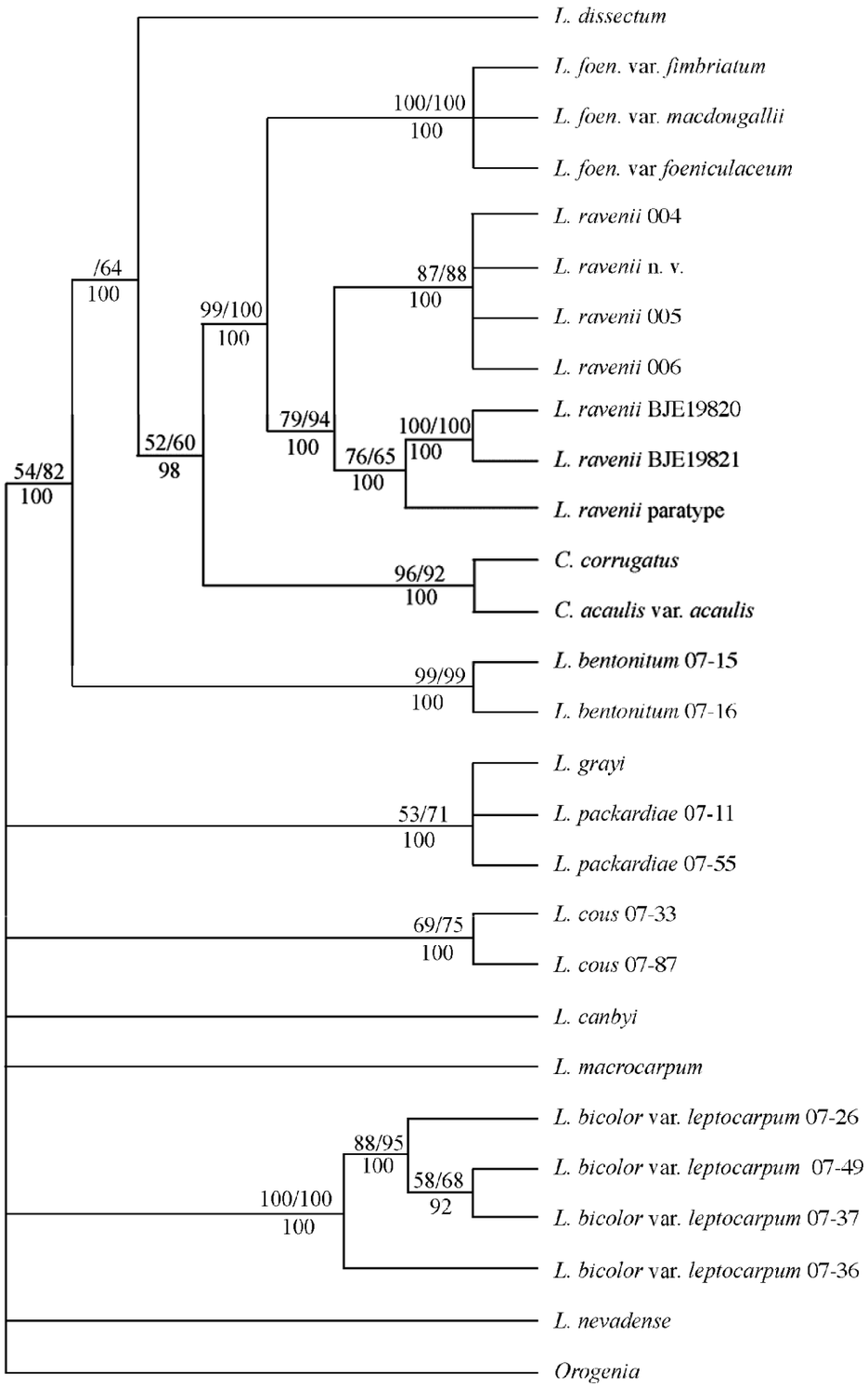

Fig. 2. Strict consensus of the maximum parsimony analysis with indels rescored (length = 587, CI = 0.65, RI = 0.78). Values above branches are maximum parsimony bootstrap before the slash and maximum likelihood bootstrap after. Values below the branches are Bayesian posterior probabilities. Numbers after species names indicate population identifiers (following Appendix 1) where more than one individual was sampled; n. v. indicates no voucher was made. *Lomatium foeniculaceum* is abbreviated as *L. foen.*

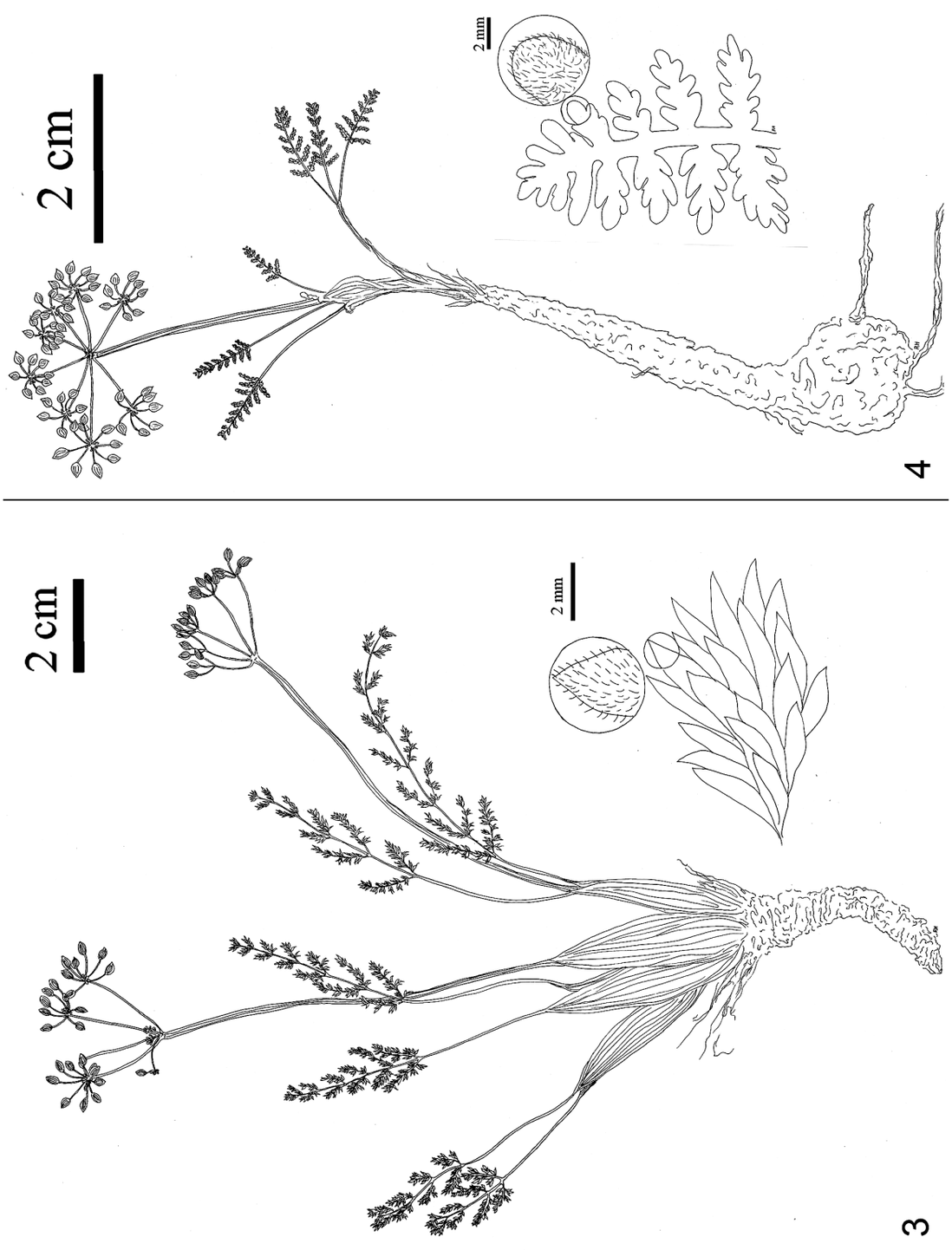

Fig. 3–4. Plant habit (left) and enlarged ultimate leaf segments (right) of the two *Lomatium ravenii* varieties.—3. *Lomatium ravenii* var. *ravenii*.—4. **Lomatium ravenii** var. **paiutense**. The 2 mm scale bars refer to the cluster of ultimate leaf segments.

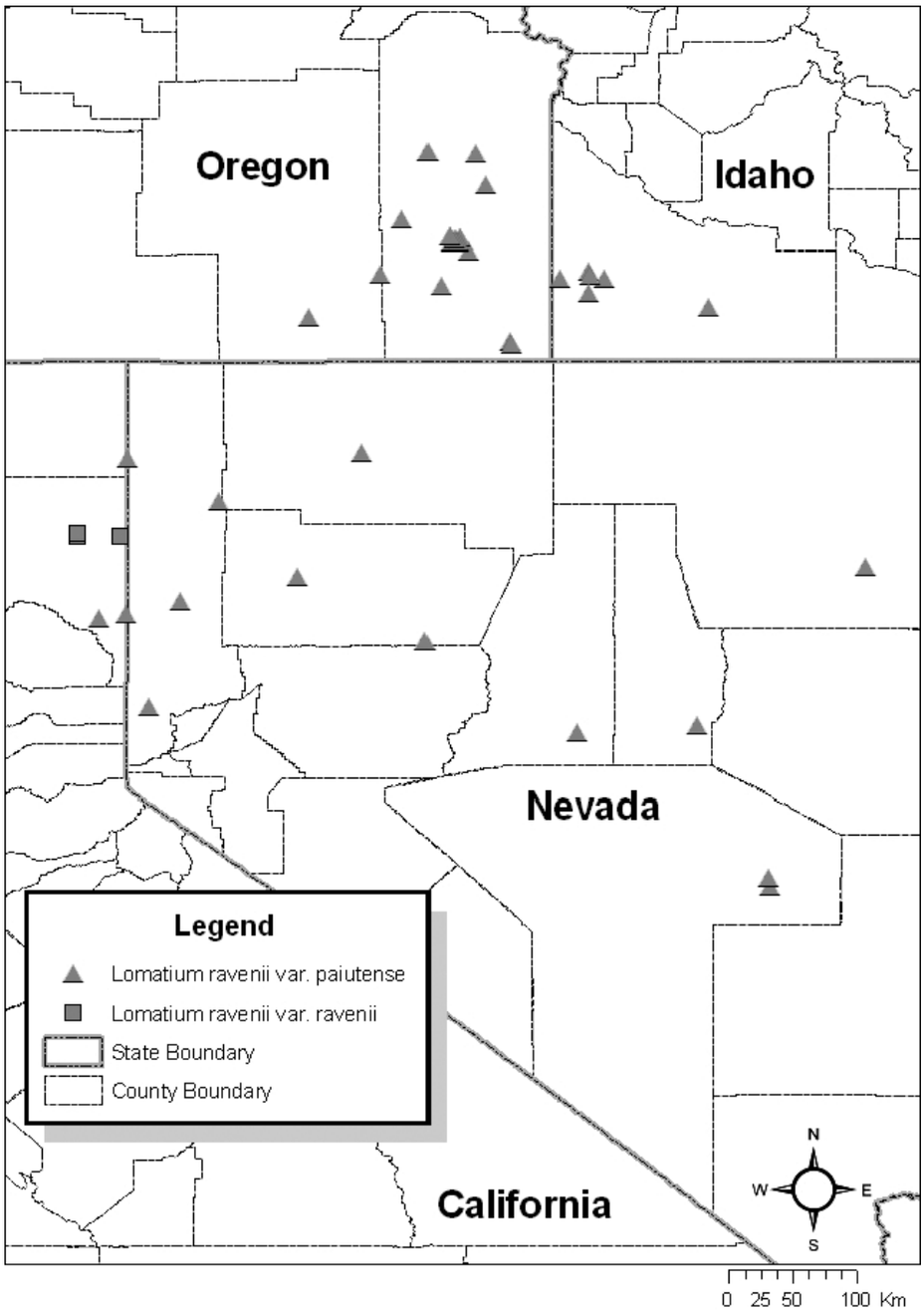

Fig. 5. Distribution of both varieties of *Lomatium ravenii* in Oregon, Idaho, California, and Nevada. *Lomatium ravenii* var. *ravenii* is limited to a small area in Lassen County, California. **Lomatium ravenii** var. **paiutense** is widespread throughout southeastern Oregon, southwestern Idaho, north-central Nevada, and barely into the northeastern corner of California.

the E Humboldt Range, 0.5 mi W of McKinney Pass, 21 May 1979, *A. Tiehm & L. Birdsey 4918* (UNR); Humboldt Range, unnamed peak N of Wright Peak, 20 Jun 1989, *A. Tiehm 12013* (UNR); N end of the Stillwater Range, Kitten Springs Rd., 22 May 1979, *A. Tiehm & L. Birdsey 4927* (UNR); Goldbanks Hills, 1.1 air mi N of Squaw Butte, 13 May 1993, *A. Tiehm 12059* (UNR); Washoe Co., near University of Nevada campus, *Kennedy & Grey* (UNR); Pyramid Lake Indian Res., S of Packard Mine, 15 May 1997, *A. Tiehm 12187* (UNR); Granite Range, Leadville Canyon along Hwy 34, 24 May 1982, *A. Tiehm & M. Williams 6976* (UNR); 1 mi W of road to Stead, 2 mi N of Reno, 11 Apr 1962, *M.-J. Demorest* (UNR). OREGON: Harney Co., Great Basin, 6 mi W of Coyote Lake, 28 May 2008, *N. Otting w/D. Brainerd 1577* (CIC); road to Serrano Point Ranch, 4 May 1975, *J. W. Grimes* et al. *55* (CIC); Fields-Denio Rd., 49 mi S of Hwy 78, 12 May 2001, *B. Moore w/C. Cook 63* (CIC); 1 mi N of road from Fields to Catlow Valley, 12 May 2006, *D. Mansfield 06002* (CIC); W edge of Alvord playa, S of Alvord Hot Springs, 31 May 1993, *D. Mansfield 93-92* (CIC); 0.5 mi E of Long Hollow Pass above Fields, 5 May 1992, *D. Mansfield 92-42a* (CIC);

Cottonwood Creek W of Fields-Denio Rd., 12 May 2001, *J. Wood w/J. Milan 103* (CIC); Malheur Co., 0.5 mi N of Crooked Creek Ranch, 17 Apr 2002, *H. Nielsen 2002013* (CIC); 1 mi E of West Little Owyhee River, ca. 2 mi S of Anderson Crossing, 14 May 2002, *H. Nielsen 2002294* (CIC); Owyhee Uplands, 27 May 2008, *D. Mansfield* et al. *08043* (CIC, UNR); headwaters of Dry Creek drainage, 30 May 2004, *N. Otting* et al. *806* (CIC); spur road to Crooked Creek Rd., 4 mi W of Rome, 1 Apr 2007, *K. Carlson w/D. Mansfield 005* (CIC); base of Rome Cliffs, 3 mi NW of Rome, 1 Apr 2007, *K. Carlson w/D. Mansfield 006* (CIC); ca. 0.5 mi N of Anderson Crossing, W side of West Little Owyhee River, 16 May 2002, *H. Nielsen 2002324* (CIC); 17 mi NW of Burns Junction, 19 May 1983, *K. S. Simmons 83-275* (CIC); ca. 4 mi S of Rome, 1 mi W of Owyhee River, 2 Jun 2005, *D. Mansfield 0573* (CIC); along Crooked Creek Ranch/Pipeline Rd., 17 Apr 2002, *H. Nielsen 2002010* (CIC); Crooked Creek, 5 air mi W of Rome, 29 May 2008, *N. Otting w/D. Brainerd 1599* (CIC); 1.5 mi N of Crooked Creek Ranch, 6 mi NW of Rome, 1 Apr 2007, *K. Carlson w/D. Mansfield 004* (CIC); Dry Creek Basin, 28.5 air mi S of Harper, 24 May 2003, *N. Otting 536* (CIC); base of Rome Cliffs, 28 May 1978, *P. L. Packard 78-83a* (CIC).

Phenology, Habitat, and Geographic Distribution

Flowers from early April to mid-May (mid-June at highest elevations) and fruits from mid-May to late June. Grows in gravelly or rocky volcanic soil with an underlying clay layer, commonly with *Artemisia tridentata* Nutt., *Ericameria nauseosa* (Pall. ex Pursh) G.L.Nesom & G.I.Baird, or *Atriplex confertifolia* (Torr. & Frém.) S.Watson, from ca. 880 to 1680 m elevation (2900–5500 ft) in the xeric basins of Oregon and Idaho, and up to ca. 3320 m elevation (10,900 ft) in the mountains of Nevada. Widespread across southeastern Oregon and southwestern Idaho, northeastern California, through adjacent Nevada, and into western Utah.

The two varieties of *L. ravenii* occupy different geographic regions (Fig. 5). *Lomatium ravenii* var. *ravenii* is found only in a small area around Ravendale, California. **Lomatium ravenii** var. **paiutense** is much more widespread. It grows throughout northern and central Nevada, southeastern Oregon, southwestern Idaho, and into western Utah. A few populations grow in far eastern Modoc and Lassen counties, California, but there does not appear to be geographic overlap with *L. ravenii* var. *ravenii*. A population exists in Washoe County, Nevada, that shares characteristics of both *L. ravenii* var. *ravenii* (long, linear ultimate segments) and **L. ravenii** var. **paiutense** (less robust, fewer branches). In the morphological analysis, this population more closely grouped with **L. ravenii** var. **paiutense** (Fig. 1).

Key to Varieties of L. ravenii

1a. Ultimate leaf segments linear to linear-oblong or linear-elliptic, (2.0) 2.2–4.0 × 0.4–0.5 (0.7) mm, generally >3.5× longer than wide, moderately hirtellous to glabrous; involucel bractlets glabrous or nearly so; plants (4) 8–20 (26) cm tall; stems (1) 2–4 (7); leaf bases generally persistent; known only in the vicinity of Ravendale, CA . . . . . var. *ravenii*

1b. Ultimate leaf segments elliptic to obovate-oblong or oblanceolate, (1.2) 1.5–2.6 (3.9) × (0.3) 0.5–0.8 (1.2) mm, generally <3.0× longer than wide, densely hirtellous; involucel bractlets hirtellous; plants (3) 5–15 (20) cm tall, stems 1–2 (3); leaf bases rarely persistent; widespread across southeastern OR, southwestern ID, northeastern CA (except Ravendale area), north-central NV, and western UT . . . . . var. **paiutense**

Conservation Status

Lomatium ravenii var. **paiutense** is widespread and not uncommon throughout its range. Although *Lomatium ravenii* is on both the California Native Plant Society and Oregon Natural Heritage lists, we believe that currently few special conservation concerns exist for **L. ravenii** var. **paiutense**. However, based on herbarium specimens *L. ravenii* var. *ravenii* appears to be restricted to the vicinity of Ravendale. It is unclear how abundant the typical variety is in the area. Though *L. ravenii* is currently on CNPS List 2.3, the range includes that of both varieties and the taxon illustrated is **L. ravenii** var. **paiutense**. Thus, *L. ravenii* var. *ravenii* is much rarer than previously thought. Surveys in Lassen and Modoc counties (and perhaps Washoe County, Nevada) are needed to document the distribution of *L. ravenii* var. *ravenii*, and conservation measures will need to be implemented.

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APPENDIX 1

Voucher (CIC accession number—otherwise denoted with herbarium acronym), location, and GenBank accession information for all specimens used in morphological and phylogenetic analyses. An asterisk denotes a population of **L. ravenii** var. **paiutense** that was collected in Washoe County, Nevada, that shares many characteristics with *L. ravenii* var. *ravenii*. Data are presented in the order of herbarium with accession number (and occasionally additional voucher information), location, and GenBank numbers for ITS, *rps16* intron, and *rpl32-trnL*$_{UAG}$, respectively, for each taxon. Bracketed information refers to taxon names used in Fig. 2.

Cymopterus acaulis var. *acaulis* (Pursh) Raf., CIC034363, Idaho, Canyon Co.: Map Rock Rd. S of Caldwell, 43.4530°N, 116.7336°W, HQ426080, HQ426131, HQ426106.

C. corrugatus M.E.Jones, CIC35388, Oregon, Malheur Co.: spur road S of Hwy 95, E of Crooked Cr., 42.8013°N, 117.7309°W, HQ426079, HQ426130, HQ426105.

Lomatium bentonitum K.Carlson & D.Mansfield, CIC034356 [*Mansfield 07-15*], Oregon, Malheur Co.: ½ mi NW of where McBride Cr. Rd. crosses Succor Cr., 43.3226°N, 117.1215°W, HQ426090, HQ426140, HQ426116; CIC034355 [*Mansfield 07-16*], Oregon, Malheur Co.: 60 m SE of Rockville School on McBride Cr. Rd., 43.3161°N, 117.1079°W, HQ426091, HQ426141, HQ426117.

L. bicolor (S.Watson) J.M.Coult. & Rose var. *leptocarpum* (Torr. & A.Gray) Schlessman, CIC034372 [*Mansfield 07-37*], Idaho, Elmore Co.: Hwy 68, ½ mi W of Camas Co. line, 43.3000°N, 115.0965°W, HQ426088, EF426684 (var. *bicolo*r), HQ426114; CIC034346 [*Mansfield 07-26*], Idaho, Adams Co.: between Hornet Cr. and Bear, 17 mi NW of Council, 44.8768°N, 116.6475°W, HQ426086, HQ426137, HQ426112; CIC034335 [*Mansfield 07-49*], Idaho, Elmore Co.: road to Anderson Ranch Reservoir, 4 mi W of Hwy 68, 43.3339°N, 115.4694°W, HQ426087, HQ426138, HQ426113; CIC034341 [*Mansfield 07-36*], Idaho, Owyhee Co.: Flattop Butte, 25 mi S of Marsing, 43.2372°N, 116.9466°W, HQ426089, HQ426139, HQ426115.

L. canbyi (J.M.Coult. & Rose) J.M.Coult. & Rose, CIC35386, Idaho, Owyhee Co.: 10 mi S of Oreana, 42.9339°N, 116.4247°W, HQ426098, HQ426146, HQ426124.

L. cous (S.Watson) J.M.Coult. & Rose, CIC034340 [*Mansfield 07-33*], Idaho, Adams Co.: 7 mi S of Bear, 44.9848°N, 116.6784°W, HQ426095, EF426702, HQ426121; CIC034503 [*Mansfield 07-87*], Oregon, Malheur Co.: ½ mi N of turnoff to Three Forks on Mud Flat Rd., 42.7058°N, 117.0402°W, HQ426097, HQ426145, HQ426123.

L. dissectum (Nutt.) Mathias & Constance var. *multifidum* (Nutt.) Mathias & Constance, CIC034672, Oregon, Malheur Co.: ½ mi toward W. Little Owyhee River from Hoppin Springs, HQ426075, EF426688, HQ426101.

L. foeniculaceum (Nutt.) J.M.Coult. & Rose var. *fimbriatum* (W.L.Theob.) B.Boivin, CIC35387, Oregon, Malheur Co.: Intersection of Hwy 95 and Chalk Basin Rd., 42.8168°N, 117.7116°W, HQ426076, HQ426127, HQ426102.

L. foeniculaceum var. *foeniculaceum*, *Hartman 85466* (RM), HQ426077, HQ426128, HQ426103.

L. foeniculaceum var. *macdougalii* (J.M.Coult. & Rose) Cronquist, CIC034364, Idaho, Canyon Co.: Map Rock Rd., S of Caldwell, 43.4530°N, 116.7336°W, HQ426078, HQ426129, HQ426104.

L. grayi (J.M.Coult. & Rose) J.M.Coult. & Rose, CIC034359, Oregon, Malheur Co.: Succor Cr. State Park, 1.5 mi S of northern border, 43.4784°N, 117.1261°W, HQ426092, AY72869, HQ426118.

L. macrocarpum (Hook. & Arn.) J.M.Coult. & Rose, CIC034359, Oregon, Malheur Co.: Succor Cr. State Park, 1.5 mi S of northern border, 43.4784°N, 117.1261°W, HQ426093, HQ426142, HQ426119.

L. nevadense (S.Watson) J.M.Coult. & Rose, CIC034424, Oregon, Harney Co.: 7.4 mi above Page Springs Campground, 42.7577°N, 118.7474°W, HQ426096, HQ426144, HQ426122; CIC029033, Oregon, Malheur Co.: 0.5 mi N of Anderson Crossing, 42.1353°N, 117.3203°W, —, —, —; CIC029032, Oregon, Malheur Co.: W side of Owyhee Canyon, 42.7608°N, 117.5041°W, —, —, —; CIC026183, Idaho, Owyhee Co.: between Duncan Cr. and Cottonwood Cr., 42.5129°N, 116.0700°W, —, —, —; CIC034478, Oregon, Harney Co.: 2 mi N of Steens Loop Rd., 42.7700°N, 118.6390°W, —, —, —; CIC029031, Oregon, Malheur Co.: Upper Dry Lake No. 1, 42.6675°N, 117.2402°W, —, —, —; CIC035528, Oregon, Malheur Co.: 10 mi N of McDermitt, NV, 42.2354°N, 117.7039°W, —, —, —; CIC035487, Oregon, Harney Co.: 20 mi SE of Folly Farm Playa, 42.8165°N, 118.4197°W, —, —, —; CIC035551, Oregon, Malheur Co.: Hwy 95 turnoff to Silver City and DeLamar Mine, 43.1343°N, 117.0443°W, —, —, —; CIC034484, Oregon, Harney Co.: 7.4 mi above Page Springs Campground, 42.7733°N, 118.7468°W, —, —, —.

L. packardiae Cronquist, CIC034360 [*Mansfield 07-11*], Oregon, Malheur Co.: 1.4 mi N of Succor Cr. State Park exclosure, 43.5151°N, 117.1297°W, HQ426094, HQ426143, HQ426120; CIC034270 [*Mansfield 07-55*], Idaho, Washington Co.: ½ mi N of Mann Cr. Reservoir, 44.4154°N, 116.9067°W, HQ426100, —, HQ426126.

L. ravenii Mathias & Constance var. **paiutense** K.Carlson & D.Mansfield, CIC033944, Oregon, Malheur Co.: headwaters of Dry Cr. drainage, 43.4620°N, 117.8928°W, —, —, —; CIC029029, Oregon, Malheur Co.: 2 mi S of Anderson Crossing, 42.1185°N, 117.3156°W, —, —, —; CIC031630, Oregon, Malheur Co.: Dry Creek Basin, 43.4513°N, 117.5614°W, —, —, —; CIC021098, Idaho, Owyhee Co.: N flank of Juniper Mtn., 42.5836°N, 116.9706°W, —, —, —; CIC035486, Oregon, Malheur Co.: 2 mi SW of Rome, 42.8291°N, 117.6793°W, —, —, —; CIC029025, Oregon, Malheur Co.: 0.5 mi N of Crooked Cr. Ranch, 42.8727°N, 117.7381°W, —, —, —; CIC35389 [*Carlson 004*], Oregon, Malheur Co.: 1.5 mi N of Crooked Cr. Ranch, 42.8729°N, 117.7382°W, HQ426081, HQ426132, HQ426107; CIC35390 [*Carlson 005*], Oregon, Malheur Co.: 4 mi W of Rome, 42.8476°N, 117.7018°W, HQ426083, HQ426134, HQ426109; CIC35391 [*Carlson 006*], Oregon, Malheur Co.: base of Rome Cliffs, 42.8594°N, 117.6734°W, HQ426084, HQ426135, HQ426110; no voucher [n. v.], Oregon, Malheur Co.: ½ mi S of Hwy 95, just E of Crooked Cr., 42.8013°N, 117.7309°W, HQ426082, HQ426133, HQ426108; CIC035513, Oregon, Malheur Co.: 5 mi S of Bowden Ranch Rd., 42.5316°N, 117.8038°W, —, —, —; UC1479583, California, Lassen Co.: E of Sierra Ordnance Depot, 40.2248°N, 120.0068°W, —, —, —; UC1608979, California, Modoc Co.: E of Eagleville, 41.317°N, 120.000°W, —, —, —; UC1479584, California, Lassen Co.: Honey Lake Island, 40.1956°N, 120.1951°W, —, —, —; UNR63734, Nevada, Nye Co.: ridge between Timber Mt. and Troy Peak, 38.319°N, 115.501°W, —, —, —; UNR067410, Nevada, Pershing Co.: N end of the Stillwater Range, 40.0354°N, 117.9173°W, —, —, —; UNR63616, Nevada, Washoe Co.: Leadville Canyon along Hwy 34, 41.0149°N, 119.3590°W, —, —, —; UNR70235*, Nevada, Washoe Co.: Pyramid Lake Indian Res., S of Packard Mine, 40.3116°N, 119.6301°W, —, —, —; UNR70529, Nevada, Pershing Co.: Goldbanks Hills 1.1 mi N of Squaw Butte, 40.4861°N, 118.8045°W, —, —, —; UNR63739, Nevada, Nye Co.: N side of Timber Mt., 38.378°N, 115.511°W, —, —, —; UNR065772, Nevada, Eureka Co.: Prospect Peak area SSW of Eureka, 39.4440°N, 116.0032°W, —, —, —; UNR44617, Nevada, Lander Co.:

junction of Hwy 50 and road to Conquest Mine, 39.3878°N, 116.8476°W, —, —, —; UNR63680, Nevada, Humboldt Co.: ridge just S of Buff Peak, 41.3579°N, 118.3582°W, —, —, —; UNR63070, Nevada, Elko Co.: Spruce Mt. Peak area, 40.5524°N, 114.8217°W, —, —, —; UNR21611, Nevada, Washoe Co.: 1 mi W of road to Stead A.F.B., 39.578°N, 119.850°W, —, —, —.

L. ravenii var. *ravenii*, JEPS28836, California, Lassen Co.: 1 mi S of Ravendale, 40.786°N, 120.353°W, —, —, —; UC1483812, California, Lassen Co.: S of Ravendale, 40.7652°N, 120.3454°W, —, —, —; UC1479582, California, Lassen Co.: W edge of Painters Flat, 40.7650°N, 120.0445°W, —, —, —; UC1199508, California, Lassen Co.: 1 mi S of Ravendale, 40.786°N, 120.353°W, TYPE, —, —, —; UC1228811, California, Lassen Co.: 1 mi S of Ravendale, 40.786°N, 120.353°W, —, —, —; CIC039493 [*BJE19820*], California, Lassen Co.: ~1 mi SSE of Ravendale, E side of Hwy 395, 40.7853°N, 120.3518°W, HQ426085, HQ426136, HQ426111; CIC039492 [*BJE19821*], California, Lassen Co.: ~2.8 mi SSE of Ravendale, W side of Hwy 395, 40.7643°N, 120.3377°W, JF795267, JF795269, JF795271; *G. Schoolcraft s.n.* [PARATYPE], JF795266, JF795268, JF795270.

Orogenia linearifolia S.Watson, CIC034349, Idaho, Adams Co.: between Hornet Cr. and Bear, 17 mi NW of Council, 44.8768°N, 116.6475°W, HQ426099, HQ426147, HQ426125.