



NEW COMBINATIONS IN *LOMATIUM* (APIACEAE, SUBFAMILY APIOIDEAE)

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Molecular and morphological phylogenetic analyses indicate that many of the perennial endemic genera of North American Apiaceae are either polyphyletic or nested within paraphyletic groups. In light of these results, taxonomic changes are needed to ensure that ongoing efforts to prepare state, regional, and continental floristic treatments of Apiaceae reflect recent findings. Thus, six new combinations are made to accommodate the movement of five taxa from their current assignment into the genus *Lomatium* and the elevation of one variety of *Lomatium* to the level of species; ***Lomatium lithosolamans***, ***Lomatium tenuissimum***, ***Lomatium fusiformis***, ***Lomatium linearifolium***, ***Lomatium multifidum***, and ***Lomatium planosum***.

Keywords: *Cymopterus*, *Orogenia*, Perennial Endemic North American clade, *Tauschia*.

The Perennial Endemic North American (PENA) clade of Apiaceae is a monophyletic group of 21 genera (~200 taxa) that occurs primarily in the western USA (Nesom 2012; George *et al.* 2014) representing one of the largest endemic plant radiations in North America. The PENA clade includes many edaphic specialists and occurs in areas that are characterized by high environmental heterogeneity, such as the California Floristic Province and the Intermountain Region. Despite its size and importance in the western flora, the evolution of the PENA clade is poorly understood, a fact reflected in the artificiality of its genera. Ten genera are poly- or paraphyletic and another six are nested within paraphyletic groups (Downie *et al.* 2002; Sun *et al.* 2004; Sun & Downie 2004, 2010a, b; George *et al.* 2014). Previous classifications have relied heavily on fruit characters as is typical for Apiaceae, but studies of the PENA clade suggest that these and many other characters traditionally used to define taxa have undergone repeated cycles of convergent or parallel evolution (Sun & Downie 2010b; George *et al.* 2014).

Ultimately, a well resolved phylogenetic hypothesis of the PENA clade would provide a framework for defining monophyletic genera. A full phylogenetic analysis would also provide opportunities to investigate character state evolution, the impacts of environmental factors (soil, climate, habitat, etc.) on speciation, modes of speciation, and correlations between morphology and abiotic factors. However, completion of a fully sampled, well supported and resolved phylogenetic hypothesis for the entire group is still many years away. However, as regional and continental level floristic works proceed it is essential to make nomenclatural changes for those species that 1) have strong molecular phylogenetic signal placing them in another genus, or 2) have biological properties that justify elevation to species status.

We recognize that in some cases, future phylogenetic analyses may result in further name changes. However, the nomenclatural changes proposed here are based on our best current understanding of these plants and are essential for improving the clarity of forthcoming works (e.g. Flora of North America, vol. 13; New Flora of the Pacific Northwest).

New Combinations

1. *Lomatium lithosolamans* J.F. Sm. & Feist, *nom. nov.* *Tauschia hooveri* Mathias & Constance (1943: 65-67); non *Lomatium hooveri* (Mathias & Constance 1942: 153–154) Constance & Ertter (1996: 519). Type:—USA. Washington: Yakima County, near Cowiche, *R.F. Hoover 5689* (holotype UC!, isotype WTU!).

Notes: Phylogenetic analyses indicate that *Tauschia* Schlechtendal (1835: 607) is polyphyletic (Downie *et al.* 2002; Sun *et al.* 2010a, b; George *et al.* 2014; Feist *et al.* 2013). The type of the genus, *T. nudicaulis* Schlechtendal (1835: 608), occurs in Mexico and preliminary data indicate that the Mexican species of *Tauschia* comprise a clade distinct from the American *Tauschia* (Feist *et al.* 2013). Therefore the Mexican species will retain the name *Tauschia* and all species north of Mexico will need to be transferred to other genera. Sufficient data exist to transfer *Tauschia hooverii* and *Tauschia tenuissima* (Geyer ex Hooker 1847: 235) Mathias & Constance (1973: 73) at this time.

The molecular phylogenetic analyses of George *et al.* (2014) place *Tauschia hooveri* as sister to *Lomatium canbyi* (Coulter & Rose 1888: 78–79) Coulter & Rose (1900: 210) with moderate bootstrap support, and nested within a well-supported clade comprised almost entirely of *Lomatium* Rafinesque (1819: 101) species. The combination for *Tauschia hooveri* in *Lomatium* is already occupied [*L. hooveri* (Mathias & Constance) Constance & Ertter] necessitating a replacement name, in this case denoting the xeric, rocky, shallow soils where the species occurs.

2. *Lomatium tenuissimum* (Geyer ex Hook.) Feist & G.M. Plunkett, *comb. nov.* *Peucedanum tenuissimum* Geyer ex Hooker (1847: 235); *Tauschia tenuissima* (Geyer ex Hook.) Mathias & Constance (1973: 73). Type:—USA. In the wet swampy small prairies, (high cold region) surrounded by high mountains, Coeur d'Alene country, May, fl. white, *C.A. Geyer 302* (types K!, BM, V).

Leibergia orogenioides Coulter & Rose (1896: 575); *Cogswellia orogenioides* (J.M. Coult. & Rose) Jones (1908: 33); *Lomatium orogenioides* (J.M. Coult. & Rose) Mathias (1937: 242). Type:—USA. Idaho: Coeur d'Alene Mountains, 24 June 1895, *J.B. Leiberg 1027* (holotype WTU!, isotype OSC)

Notes: Molecular phylogenetic analyses place *Tauschia tenuissima* in a well-supported clade with *Lomatium bicolor* (Watson 1871: 129–130) Coulter & Rose (1900: 237), *Lomatium leptocarpum* (Torrey & Gray 1840: 626–627) Coulter & Rose (1900: 213) and *Lomatium swingerae* McNeill (2014: 395–400) and within a larger, well-supported clade of other *Lomatium* species (Feist *et al.* 2013; George *et al.* 2014). Mathias & Constance (1973) noted the similarity between *Tauschia hooveri* and *T. tenuissima* and discussed the option of including both in *Lomatium*. Therefore, we transfer *Tauschia tenuissima* to *Lomatium*. Although a combination within *Lomatium* already exists for *T. tenuissima* [i.e. *Lomatium orogenioides* (J.M. Coult. & Rose) Mathias], due to the priority of the original basionym, *Peucedanum tenuissima*, the correct combination is *Lomatium tenuissimum*. The basionym on which *Lomatium orogenioides* is based, *Leibergia orogenioides*, was described in 1896.

Mathias (1937) initially placed *Peucedanum tenuissimum* in synonymy with *Lomatium ambiguum* and it was only after Constance had a chance to examine the Geyer collection (Mathias & Constance 1973) that it was determined to be conspecific with *Leibergia orogenioides*.

3. *Lomatium fusiformis* (S. Watson) J.F. Sm. & Mansfield, *comb. nov.* *Orogenia fusiformis* Watson (1887: 474). Type:—USA. California: Plumas County, 1880, *Mrs. R. M. Austin s.n.* (holotype GH!).

4. *Lomatium linearifolium* (S. Watson) J.F. Sm. & Mansfield, *comb. nov.* *Orogenia linearifolia* Watson (1871: 120). Type:—USA. Utah: Wasatch Mountains, June 1869, *S. Watson 440* (holotype GH!).

Orogenia linearifolia S. Watson var. *lata* Payson (1915: 379–380). Type:—USA. Colorado: Tabeguache Basin, 1 June 1914, *E. Payson 369* (holotype RM!).

Notes: Earlier phylogenetic studies involving analyses of three molecular markers and morphology (Sun *et al.* 2010a, b) showed the genus *Orogenia* Watson (1871:120) to be monophyletic, but nested within a clade of *Lomatium* species. Upon examination of different material including many new taxa and additional molecular markers, George *et al.* (2014) reported that *Orogenia fusiformis* and *O. linearifolia*, the type and only other species in the genus, are not sister to one another. *Orogenia linearifolia* is placed in a well-supported clade that includes *Lomatium columbianum* Mathias & Constance (1942: 246) and *L. piperi* Coulter & Rose (1900: 211). This clade is nested within a much larger clade of *Lomatium* species that also includes *O. fusiformis*. Therefore, we transfer both species of *Orogenia* into *Lomatium*. *Orogenia fusiformis* var. *leibergii*

Coulter & Rose (1888: 92) is a synonym of *L. geyeri* (Watson 1878: 428) Coulter & Rose (1900: 209), and therefore is not synonymous or sympatric with *L. fusiformis*. With the transfers of *O. fusiformis* and *O. linearifolia*, the genus *Orogenia* is reduced to synonymy under *Lomatium*.

5. *Lomatium multifidum* (Nutt.) R.P. McNeill & Darrach, *comb. nov.* *Leptotaenia multifida* Nutt. in Torrey & Gray (1840: 630); *Leptotaenia dissecta* Nutt. var. *multifida* (Nutt.) Jepson (1923: 145); *Ferula multifida* (Nutt.) Gray (1868: 348); *Lomatium dissectum* (Nutt.) Mathias & Constance var. *multifidum* (Nutt.) Mathias & Constance (1942: 246). Type:—USA. Columbia Plains and Blue Mountains, *T. Nuttall s.n.* (type BM!).

Notes: *Lomatium dissectum* (Nutt.) Mathias & Constance (1942: 246) and *L. multifidum* have been treated as separate species and as varieties of a single species. The new combination is based on morphological differences, seasonal differences in fruit/flowering time, and limited geographic overlap of the taxa. In the few locations where the taxa co-occur, there are no individuals with intermediate morphological characteristics and there is distinct separation of the timing in fruiting and flowering. *Lomatium multifidum* occurs in shallow rocky soils, on slopes with a south aspect, or at lower elevations. *Lomatium dissectum* occurs in deep, mesic soils on slopes with a north aspect, or at higher elevation. *Lomatium multifidum* has yellow flowers, long pedicels, and glabrous peduncles, while *L. dissectum* has purple (rarely yellow with a purple tint) flowers with short pedicels, and glaucous peduncles. In addition, *L. multifidum* has already produced fruit while *L. dissectum* is still in flower.

6. *Lomatium planosum* (Oster.) Mansfield & S.R. Downie, *comb. nov.* *Aulospermum planosum* Osterhout (1903: 236); *Cymopterus planosus* (Oster.) Mathias (1936: 245). Type:—USA. Colorado: Eagle County, Collected along the Eagle River at Minturn, 5 June 1902, *G.E. Osterhout 2572* (holotype NY!).

Notes: Molecular phylogenetic analyses (George *et al.* 2014) place *Cymopterus planosus* in a large, well-supported clade with *Orogenia fusiformis*, *O. linearifolia*, *Lomatium nudicaule* (Pursh 1814[1813]: 196) Coulter & Rose (1900: 238), and a number of other *Lomatium* species. Sun & Downie (2004) also found *C. planosus* to be in a clade with *Orogenia fusiformis*, *O. linearifolia*, and other *Lomatium* species. Therefore this taxon is transferred to the genus *Lomatium*.

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