

NEW COMBINATION IN *ASTRAGALUS* (FABACEAE)

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ABSTRACT

Recent molecular phylogenetic analyses have established that the four varieties of *Astragalus cusickii* are three distinct, monophyletic clades: *A. cusickii* var. *cusickii* and *A. cusickii* var. *flexilipes* form one clade, *A. cusickii* var. *sterilis* and *A. cusickii* var. *packardiae* each form the other two. Although relationships among the clades in the analyses are poorly resolved, they are also poorly resolved with respect to other recognized species in the genus. Morphological data provide unique synapomorphies for each of the clades and therefore we propose to recognize three distinct species, with *A. cusickii* var. *flexilipes* retained at the rank of variety. A new combination brings *A. cusickii* var. *packardiae* to species rank, as ***Astragalus packardiae*** (Barneby) J.F. Sm. & Zimmers, **comb. nov.**, whereas *A. sterilis* has already been published.

Astragalus L. is a diverse group of approximately 2500 species (Frodin 2004; Lock & Schrire 2005; Mabberley 2008) and has a rich diversity in four geographic areas (southwest and south-central Asia, the Sino-Himalayan region, the Mediterranean Basin, and western North America; in addition the Andes in South America have at least 100 species. Second to Eurasia in terms of species diversity is the New World, with approximately 400–450 species. The Intermountain Region of western North America (Barneby 1989) is especially diverse, and an estimated 70 species of *Astragalus* can be found in Idaho alone, including several endemic taxa (Mancuso 1999). The monophyly of *Astragalus* sensu stricto has been well-supported (Sanderson 1991; Sanderson & Doyle 1993; Wojciechowski et al. 1993, 1999), but many species-level relationships within the genus remain poorly resolved and most species in the Old World had not been revised since the late 19th century (Bunge 1868, 1869; Taubert 1894) until only recently (Podlech & Zarre 2013).

A recent phylogenetic analysis focusing on the four varieties of *Astragalus cusickii* A. Gray (1878) determined that the group could be divided into three monophyletic groups (Zimmers et al. 2017); *A. cusickii* var. *sterilis* (Barneby) Barneby (1989), *A. cusickii* var. *packardiae* Barneby (1989), and *A. cusickii* var. *cusickii*/*A. cusickii* var. *flexilipes* Barneby (1956). Relationships among the three clades and other species of *Astragalus* were not strongly supported, and additional tests could not reject a single monophyletic *A. cusickii*. However, the same tests could not reject a single monophyletic clade that included all four varieties of *A. cusickii* as well as *A. whitneyi* A. Gray (1865), which has always been recognized as a distinct species from *A. cusickii*. Given that closely related species are likely to be monophyletic (Scherson et al. 2005; Zimmers et al. 2017), we elevate two of the varieties of *A. cusickii* to species rank, based on the unified species concept (a monophyletic group diagnosably distinct from close relatives; de Queiroz 2005). This concept has been selected because (1) monophyly can be assessed, (2) morphological differences are known and presumably are the result of inheritance from a common ancestor, and (3) few studies address the breeding system of these plants. Recent studies of species in *Astragalus* have also employed monophyly with diagnosable differences between populations as the criteria for recognizing species (Scherson et al. 2008; Riahi et al. 2011). Therefore, we recognize *A. cusickii* var. *packardiae* and *A. cusickii* var. *sterilis* at the rank of species and make the new combination for *A. packardiae* here.

Astragalus packardiae (Barneby) J.F. Sm. & Zimmers, **comb. nov.** *Astragalus cusickii* A. Gray var. *packardiae* Barneby, *Intermtn. Fl., Fabales*, 3B: 79. 1989. **TYPE: USA. Idaho.** Payette Co.: on a small tributary of Dry Creek, 18 May 1980, *J. Grimes & P.L. Packard 1583* (holotype NY; isotype CIC!).

Astragalus cusickii is a sparsely leafy, multi-stemmed, perennial forb found in western Idaho, eastern Oregon, and the extreme southeast corner of Washington. *Astragalus cusickii* var. *cusickii* has the widest geographic distribution of the four varieties. It is found in western Idaho, eastern Oregon, and southeast Washington, although with a concentration in the Hells Canyon area. *Astragalus cusickii* var. *flexilipes* appears to be only weakly differentiated from *A. cusickii* var. *cusickii* by subtle morphological differences: small, purplish flowers, and oblique, half-ellipsoid pods (Barneby 1989). The distribution of *A. sterilis* Barneby (1949) is limited to a small geographic area in southeastern Oregon and adjacent southwestern Idaho. This variety is distinguished by its smaller leaflets and bright red mottling on its pods. It is considered rare and of conservation concern in both Oregon and Idaho. *Astragalus packardiae* is distinguished by its relative paucity of leaves on the stems, particularly distally, its relatively small purplish flowers, and its small, narrow pods. It is considered one of the rarest plant taxa in Idaho, restricted to an approximately 10 square-mile area in Payette County, Idaho (Mancuso 1999). It has become a high priority conservation concern due to its limited geographic distribution, small population size, habitat decline, and vulnerability of its habitat to multiple, ongoing disturbances and threats (Mancuso 2016).

Astragalus sterilis was originally described at specific rank (Barneby 1949). It was only with the publication of *The Intermountain Flora* that Barneby (1989) moved *A. sterilis* to the rank of variety and described *A. cusickii* var. *packardiae*. In the discussion of the treatment for *A. cusickii*, Barneby acknowledged that recent collections had led him to change his view of *A. sterilis* as a distinct species defined by "its rhizomatous, subterranean caudex (resembling that of *A. ceramicus*) which gave rise to colonies of solitary or paired, short, and densely branched stems" to a distinct ecotype differentiated from typical *A. cusickii* only by "uniformly very short leaflets, and by the bright mottling of the pod, a syndrome too weak to support specific status." He also recognized that *A. cusickii* var. *flexilipes* was only weakly differentiated from the type variety and that *A. cusickii* var. *packardiae* was similar to *A. cusickii* var. *flexilipes* but was highly localized and differentiated by the loss of leaflets in the upper leaves and the narrowly and symmetrically ellipsoid fruit. Despite his views of the ranking of these taxa, Barneby (1989) clearly recognized morphological differences of both *A. sterilis* and *A. packardiae*.

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