

**REVISITING TAXONOMIC PROBLEMS
IN CAPITATE *ERIOGONUM* (POLYGONACEAE)
FROM IDAHO, OREGON, AND MONTANA**

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ABSTRACT

Here we focus on clarifying the taxonomy of capitate members of *Eriogonum* with distributions north of the Snake River Plain in Oregon, Idaho, and Montana. We performed a multivariate morphometric analysis of nine features from multiple capitate species from the region. Our results confirm species-rank recognition of *E. mancum* Rydb. and *E. scopulorum* Reveal, as currently defined. Additionally, two other discrete groups were recovered from our morphometric analyses. We recognize *Eriogonum capistratum* Reveal and propose ***Eriogonum muhlickii*** (Reveal) Mansfield, Corbin, and Grady, **comb. et stat. nov.**, as representative of these groups. The clarified species circumscriptions will focus conservation efforts for these and other rare taxa in the region.

North America is home to several species-rich plant genera, namely *Carex*, *Astragalus*, *Penstemon*, and *Eriogonum*. Of these, only *Penstemon* and *Eriogonum* are native exclusively to North America (Reveal 2005). *Eriogonum* (Polygonaceae) typifies one of the more impressive mega-genera, with over 250 species currently recognized. Infrageneric classification aids in the understanding of relationships within such a large genus. While useful, the subgeneric taxonomy in *Eriogonum* is widely accepted to be non-monophyletic (Pearman et al. 2021; Grady 2012; Kempton 2012). Until the subgeneric classification is aligned with evolutionary history, previous taxonomy can still prove insightful if applied with caution.

The largest subgenus in *Eriogonum*, subg. *Eucycla* (Nutt.) Kuntze, encompasses over 40% of the species diversity within the genus. All members of this subgenus are perennial but vary in growth form and inflorescence structure. Within the subg. *Eucycla*, various sections and “complexes” have been proposed and discussed (Stokes 1936; Reveal 1978, 2005). Mat-forming perennials with capitate inflorescences comprise roughly a quarter of this subgenus. Reveal has variously referred to them as *Eriogonum* sect. *Capitata* or as part of the “*E. brevicaulis* complex.” Molecular phylogenetic analyses have not shown this group to be monophyletic, much like the subgeneric classification system (Grady 2012; Kempton 2012). Despite the demonstrated non-monophyly of this group, the capitate members of subgenus *Eucycla* are an enigmatic collection of species, many of which are edaphic specialists or of conservation concern (Reveal 1981, 1985, 1989; Reveal et al. 2002; Reveal & Björk 2004; Grady & Reveal 2011; Brown & Mansfield 2017; McClinton et al. 2020, 2022).

Capitate *Eriogonum* species north of the Great Basin have a long and convoluted taxonomic history (see study group definition in Materials and Methods section). Capitate members of *Eriogonum* north of the Snake River Plain have been variously recognized as different species since Gray (1867) first published the binomial *Eriogonum chrysocephalum*. Watson (1880) followed with the recognition of *Eriogonum ochrocephalum*. Rydberg (1917) then separated northern taxa into *Eriogonum chrysocephalum* subsp. *chrysops* and *Eriogonum mancum*. *Eriogonum chrysops* was then subsumed as a variety of *E. ochrocephalum* (Stokes 1936), while Peck (1941) later included it within the widespread species *E. ovalifolium*. Two species of *Eriogonum* within this complex were included in the Flora of the Pacific Northwest, *E. chrysops* and *E. mancum* (Hitchcock et al. 1964). Reveal later added the following taxa: *Eriogonum scopulorum*, *Eriogonum crosbyae*, *Eriogonum capistratum* var. *capistratum*, *E. capistratum* var. *muhlickii*, *E. capistratum* var. *welshii*, *Eriogonum meledonum*, and *Eriogonum verrucosum* (1972, 1981, 1989).

Reveal's treatment of *Eriogonum* in the Flora of North America (2005) maintained *E. chrysops*, *E. mancum*, and *E. scopulorum* as species, but *E. meledonum*, *E. verrucosum*, and the three varieties of *E. capistratum* were included in a now widespread *E. crosbyae*. Reveal discussed the various "phases" of *E. crosbyae*, as previously recognized, while including this caveat "Final resolution of the taxonomy awaits further study." Less than a decade later, Reveal shifted these taxa into *E. mancum* for his treatment of *Eriogonum* in the *Eriogonum Manual* for the *Eriogonum Society* (2014).

The second edition of the Flora of the Pacific Northwest resurrected *Eriogonum capistratum*, while maintaining recognition of *E. mancum* and *E. scopulorum*. *Eriogonum crosbyae* and *E. chrysops* were not addressed as they occur outside of the range of the Pacific Northwest (Giblin et al. 2018).

We provide a summary of the shifting taxonomy presented by various authors (Table 1). Unless indicated otherwise, the taxonomy of the Flora of North America is followed, as this covers the full geographic range of the group of interest (Reveal 2005).

With such obvious taxonomic instability and confusion surrounding this group of northern capitate species of *Eriogonum*, a morphological assessment is warranted. Due to habitat loss and other conservation concerns, the need to investigate the taxonomic status of this group is pressing. We hypothesize that (1) multivariate analyses of morphological traits can distinguish discrete taxa within the northern capitate *Eriogonum* species, and (2) the northern capitate group of *Eriogonum* includes distinct evolutionary lineages worthy of taxonomic recognition.

Table 1. Summary of recent taxonomic history of selected members of northern capitate members of *Eriogonum* from Idaho, Montana, and Oregon.

Flora of the Pacific Northwest (1964) and prior treatments	Reveal (1972, 1981, 1989)	Flora of North America – Reveal (2005)	Intermountain Flora vol. 2A – Reveal (2012) and <i>Eriogonum Manual</i> – Reveal (2014)	Flora of the Pacific Northwest 2 nd Ed. (2018)
<i>E. chrysops</i>	<i>E. chrysops</i>	<i>E. chrysops</i>	<i>E. chrysops</i>	not treated
<i>E. mancum</i>	<i>E. mancum</i>	<i>E. mancum</i>	<i>E. mancum</i>	<i>E. mancum</i>
	<i>E. scopulorum</i>	<i>E. scopulorum</i>	<i>E. scopulorum</i>	<i>E. scopulorum</i>
	<i>E. crosbyae</i>	<i>E. crosbyae</i>	<i>E. crosbyae</i>	not treated
	<i>E. capistratum</i> var. <i>capistratum</i>	<i>E. crosbyae</i> s.l.	<i>E. mancum</i> s.l.	<i>E. capistratum</i>
	<i>E. capistratum</i> var. <i>muhlickii</i>	<i>E. crosbyae</i> s.l.	<i>E. mancum</i> s.l.	<i>E. capistratum</i>
	<i>E. capistratum</i> var. <i>welshii</i>	<i>E. crosbyae</i> s.l.	<i>E. mancum</i> s.l.	<i>E. capistratum</i>
	<i>E. meledonum</i>	<i>E. crosbyae</i> s.l.	<i>E. mancum</i> s.l.	<i>E. capistratum</i>
	<i>E. verrucosum</i>	<i>E. crosbyae</i> s.l.	<i>E. mancum</i> s.l.	<i>E. capistratum</i>

MATERIALS AND METHODS

Study group. Initially we considered all capitate, mat-forming perennials with monomorphic tepals in *Eriogonum* subg. *Eucycla* with ranges in Idaho, Oregon, western Montana, and northern Nevada (Table 2). A preliminary examination of 98 specimens at the Idaho YHB Working Session (Corbin 2019) allowed us to clearly distinguish, based on morphological features, *Eriogonum calcareum*, *E. brevicaulis*, and *E. soliceps*. A preliminary analysis of remaining taxa in Table 2 revealed four apparent groups. One of these groups displays a morphological continuum among *E. crosbyae* vars. *crosbyae* and *mystrium*, *E. prociduum* var. *prociduum*, *E. capistratum* vars. *capistratum* and *welshii*, *E. meledonum*, *E. verrucosum*, *E. chrysops*, and *E. “War Eagle”* (see Reveal 2012). Among this morphologically continuous group, we observed a large geographic discontinuity between a core group of populations north of the Snake River Plain and those south and west of it. Our study focuses on the northern group of potential taxa, including *E. mancum*, *E. scopulorum*, *E. crosbyae* “capistratum phase,” *E. crosbyae* “meledonum phase,” *E. crosbyae* “muhlickii phase,” *E. crosbyae* “welshii phase,” and *E. crosbyae* “verrucosum phase.” Populations for each of these are limited to the mountainous areas north of the Snake River Plain in eastern Oregon, Idaho, and western Montana. Henceforth, we refer to this group as the “northern capitate *Eriogonum* group.”

Table 2. Taxa included in initial overview. Taxa of focus (the northern capitate *Eriogonum* group) in morphometric analyses indicated with *.

Terminal taxon examined	Relevant synonyms	Range
<i>E. brevicaulis</i> Nuttall var. <i>bannockense</i> (S. Stokes) Reveal	n/a	ID, NV, UT, WY
<i>E. brevicaulis</i> Nuttall var. <i>laxifolium</i> (Torrey & A. Gray) Reveal	n/a	ID, NV, UT
<i>E. calcareum</i> (S. Stokes) Grady & Reveal var. <i>calcareum</i> M. Peck	<i>E. ochrocephalum</i> var. <i>calcareum</i>	ID, NV, OR
<i>E. calcareum</i> (S. Stokes) Grady & Reveal var. <i>sceptrum</i> (Reveal) Reveal & Mansfield	<i>E. ochrocephalum</i> var. <i>sceptrum</i>	ID
* <i>E. capistratum</i> Reveal var. <i>capistratum</i> Reveal	<i>E. crosbyae</i> s.l., <i>E. mancum</i> s.l.	ID
* <i>E. capistratum</i> Reveal var. <i>muhlickii</i> Reveal	<i>E. crosbyae</i> s.l., <i>E. mancum</i> s.l.	MT
* <i>E. capistratum</i> Reveal var. <i>welshii</i> Reveal	<i>E. crosbyae</i> s.l., <i>E. mancum</i> s.l.	ID
<i>E. chrysops</i> Rydberg	n/a	OR
<i>E. crosbyae</i> Reveal var. <i>crosbyae</i>	n/a	NV, OR
<i>E. crosbyae</i> Reveal var. <i>mystrium</i> Grady & Reveal	<i>E. prociduum</i> var. <i>mystrium</i>	ID, NV, OR
* <i>E. mancum</i> Rydberg	n/a	ID, MT
* <i>E. meledonum</i> Reveal	<i>E. crosbyae</i> s.l., <i>E. mancum</i> s.l.	ID
<i>E. prociduum</i> Reveal	n/a	CA, NV, OR
* <i>E. scopulorum</i> Reveal	n/a	ID, OR
<i>E. soliceps</i> Reveal & Björk	n/a	ID, MT
* <i>E. verrucosum</i> Reveal	<i>E. crosbyae</i> s.l., <i>E. mancum</i> s.l.	ID

Data collection and analysis. All specimens of the terminal taxa shown in Table 2 were obtained from the following herbaria: BBLM, CIC, ID, IDS, MONTU, OSC, SRP, WS, WTU. At the Idaho YHB Working Session, 15 botanists (including the three authors) collected data on 21 features from 98 herbarium specimens selected from the extended group of taxa (Corbin 2019). This initial examination allowed us to refine which taxa (as described above) and which features to focus on for a more detailed analysis. We subsequently hand-measured or characterized nine features on 133 herbarium specimens representing all putative taxa of the northern capitate *Eriogonum* group (Appendix 1). The features are as follows: leaf length, leaf width, scape pubescence, scape glands, involucre pubescence, involucre glands, yellow tepal pigment, red tepal pigment, and tepal glands. Variables that might otherwise be qualitative were scored on a semi-quantitative scale in which two of the authors independently assessed the visual estimations to calibrate the scale (Table 3). All data were

collected by a single individual. Raw data were log-transformed to meet the assumptions of the analyses. Values of 0 were replaced by 0.03 for the log-transformations. Data were then standardized by subtracting the mean and dividing by the standard deviation to account for the differences in units among varied data types in this dataset. A Principal Components Analysis (PCA) was performed to determine which characters contributed most to variation and to ascertain clusters that could be tested as putative morphological taxa. A linear discriminant analysis (Canonical Variables Analysis—CVA) was performed using clusters evident in the PCA as putative taxa to test the number of specimens in each cluster group that were classified correctly. All analyses were performed using PAST 4.08 (Hammer et al. 2001).

Table 3. Features measured or characterized for multivariate analyses.

Feature	Units; level of precision	Description
Leaf length	Millimeter; 0.1	Mean of 5 leaves per specimen
Leaf width	Millimeter; 0.1	Mean of 5 leaves per specimen
Scape pubescence	0= none 1=sparse 2=dense; 0.1	Visually estimated
Scape glands	0=none/nearly 1= several evident, 2=many; 0.1	Visually estimated
Involucre pubescence	0= none 1=sparse 2=dense; 0.1	Visually estimated
Involucre glands	0=none/nearly 1= several evident, 2=many; 0.1	Visually estimated
Yellow tepal pigment	0= none evident 1=strong pigmentation; 0.1	Visually estimated
Red tepal pigment	0=none evident 1=strong pigmentation; 0.1	Visually estimated
Tepal glands	0=none/nearly 1= several evident, 2=many; 0.1	Visually estimated

RESULTS

The log-transformed and standardized data of the nine morphological variables from 133 specimens of the northern capitulate *Eriogonum* species were analyzed in a PCA (Fig. 1). Axis 1 explains 45.7% of the variation in the data set. Variables that explain the greatest variation in axis 1 are scape glands ($r = 0.92$), involucre glands ($r = 0.87$) and involucre non-glandular hairs ($r = -0.78$). Axis 2 explains 21.2% of the variation, while tepal pigmentation explains the greatest variation on that axis ($r = 0.72$ for yellow pigmentation; $r = -0.75$ for red pigmentation). The four polygons shown in the PCA (Fig. 1) correspond to putative taxa. The putative taxa are '*E. capistratum*', '*E. muhlickii*', *E. mancum*, and *E. scopulorum*. The putative taxa *E. scopulorum* and *E. mancum* include all specimens identified to those respective taxa by at least one annotation. The '*E. capistratum*' group included specimens with a variety of names on the labels including *E. capistratum* var. *welshii*, *E. capistratum* var. *capistratum* (those with glabrous scapes), some *E. meledonum*, and *E. verrucosum* (and relevant synonyms—see Tables 1 & 2). The '*E. muhlickii*' group included specimens identified as either *E. capistratum* var. *muhlickii* or *E. capistratum* var. *capistratum* (those with glandular scapes), or some *E. meledonum*. These four putative taxa were assigned in a discriminant analysis (CVA) to test for accuracy of classification (Fig. 2). The CVA axis 1 explains 61.6% of the variation and CVA axis 2 explains 37.6%. The CVA correctly classified all except one specimen into the four putative taxa. That exception (Reveal 3674) was grouped with '*E. capistratum*' but was classified as '*E. muhlickii*'.

The four groups (putative taxa) recovered from the multivariate analyses displayed parapatric geographic distributions (Fig. 3), which can also be seen as a longitudinal gradient from western Montana to eastern Oregon across Idaho (Fig. 4).

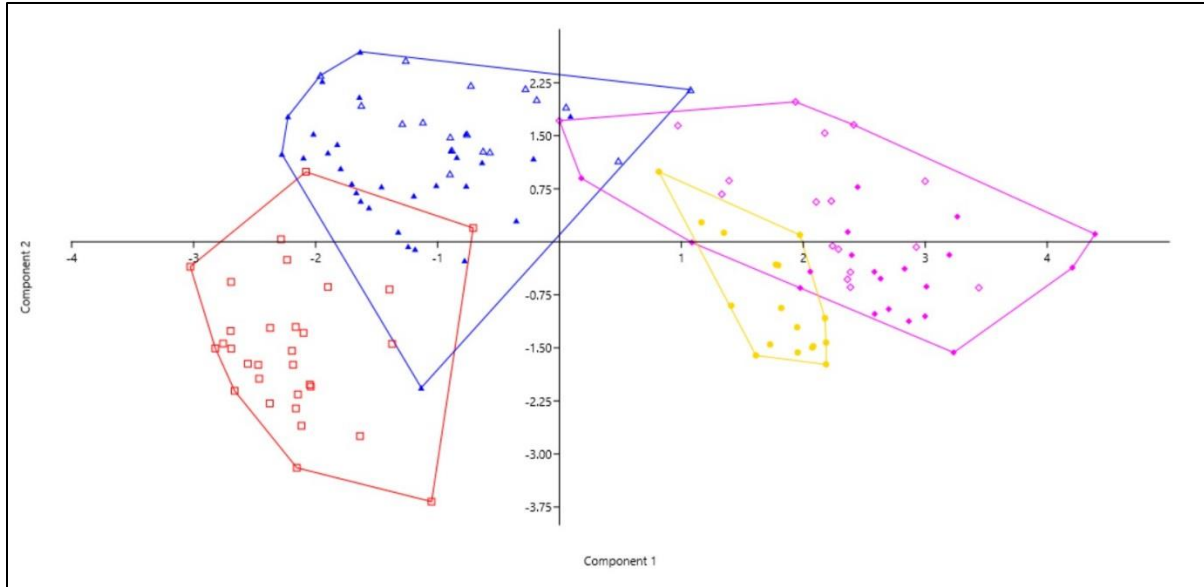


Figure 1. PCA of 133 specimens examined in the northern capitate *Eriogonum* group — *E. mancum*—red squares; *E. capistratum* - blue triangles (glabrous-scaped *E. capistratum* var. *capistratum* - solid triangles; *E. capistratum* var. *welshii* - open triangles); *E. muhlickii* - pink diamonds (*E. capistratum* var. *muhlickii* - open diamonds; glandular-scaped *E. capistratum* var. *capistratum* – solid diamonds); *E. scopulorum*—yellow circles.

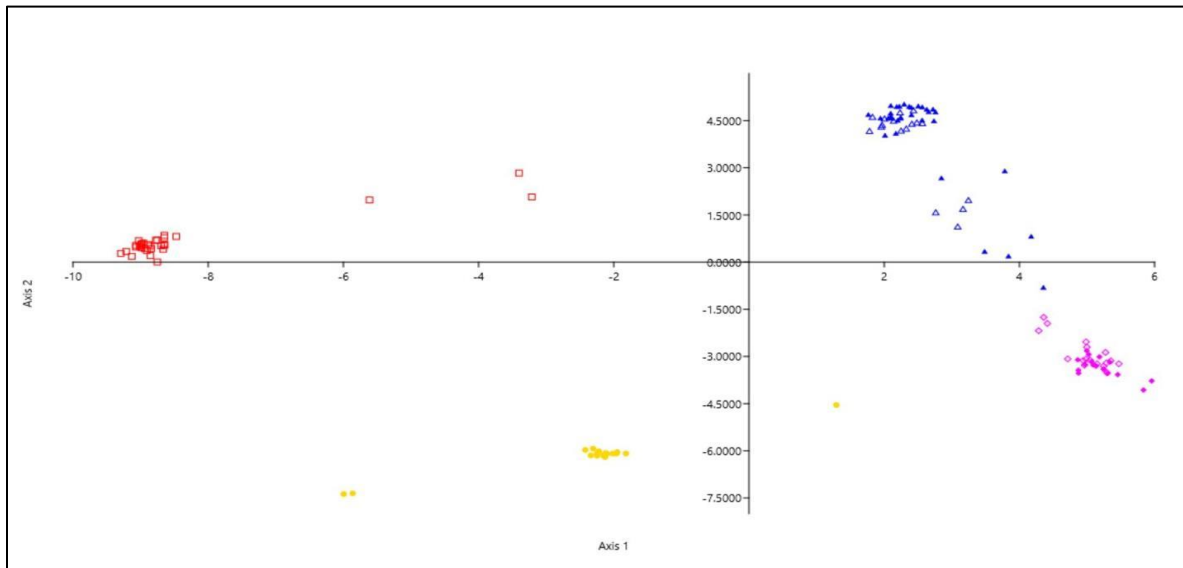


Figure 2. Linear discriminant analysis (Canonical Variables Analysis—CVA) of 133 specimens examined in the northern capitate *Eriogonum* group — *E. mancum*—red squares; *E. capistratum* - blue triangles (glabrous-scaped *E. capistratum* var. *capistratum* - solid triangles; *E. capistratum* var. *welshii* - open triangles); *E. muhlickii* - pink diamonds (*E. capistratum* var. *muhlickii* - open diamonds; glandular-scaped *E. capistratum* var. *capistratum* – solid diamonds); *E. scopulorum*—yellow circles.

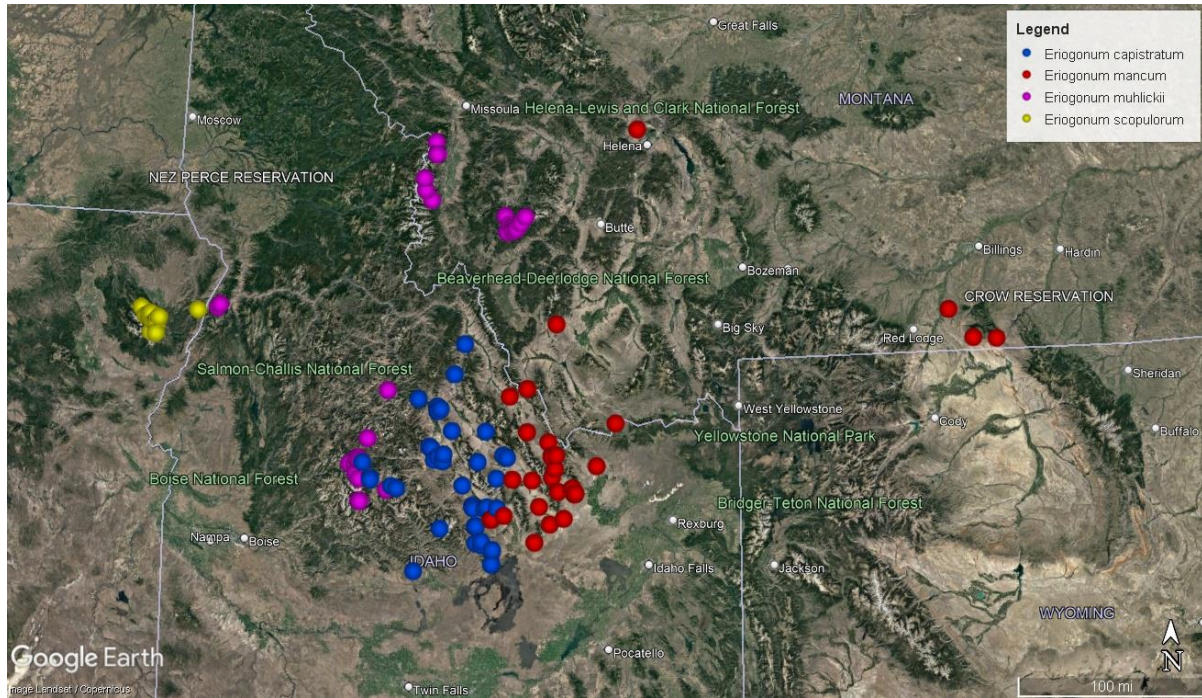


Figure 3. Distribution map of capitata *Eriogonum* species north of Snake River Plain: *E. scopulorum*—yellow pins; *E. muhlickii* (pink pins), *E. capistratum* (blue pins), *E. mancum* (red pins).

DISCUSSION

From the multivariate analyses of the morphological traits of the northern capitata *Eriogonum* group, four taxa show little overlap, with the discriminant analysis classifying correctly 132 of 133 specimens — the exception being #74 (see Appendix 1). That exception (*Reveal 3674*), classified by our study as *E. muhlickii* but by the CVA as *E. capistratum*, was collected in the central Sawtooth Valley by Reveal as the type of *E. meledonum*. Of the four other specimens from the Sawtooth Valley recognized by Reveal as *E. meledonum*, two (*Reveal 8393* and *Mansfield 10-551*), like *Reveal 3674*, were classified in our study as *E. muhlickii* and clearly possessed at least some glandular hairs on both the scape and the perianth. The other two specimens (*Christ 11362* and *Cronquist 2694*) referred to as *E. meledonum* by Reveal (Reveal 1989, 2014) are classified in our study as *E. capistratum*. Both these specimens lack scape glands, yet both possess glandular tepals.

All these Sawtooth Valley specimens recognized by Reveal as *Eriogonum meledonum* appear to represent a lower elevation intergradation between *E. capistratum* to the east and *E. muhlickii* to the north and west. Though the discriminant analysis result supports the four putative taxa (Fig. 2), there is some morphological overlap in other contact zones. For example, in the vicinity of the southern Pioneer Mountains, White Knob Mountains, and southern Lost River Mountains, *E. mancum* and *E. capistratum* are in proximity and specimens of two taxa can intergrade (Figs. 2 and 3). Similarly, both *E. scopulorum* and *E. muhlickii* are glandular-scaped, high elevation taxa that intergrade where in contact near Hells Canyon with some occasional pale yellow-flowered collections of *E. scopulorum* in the Wallowa Mountains.

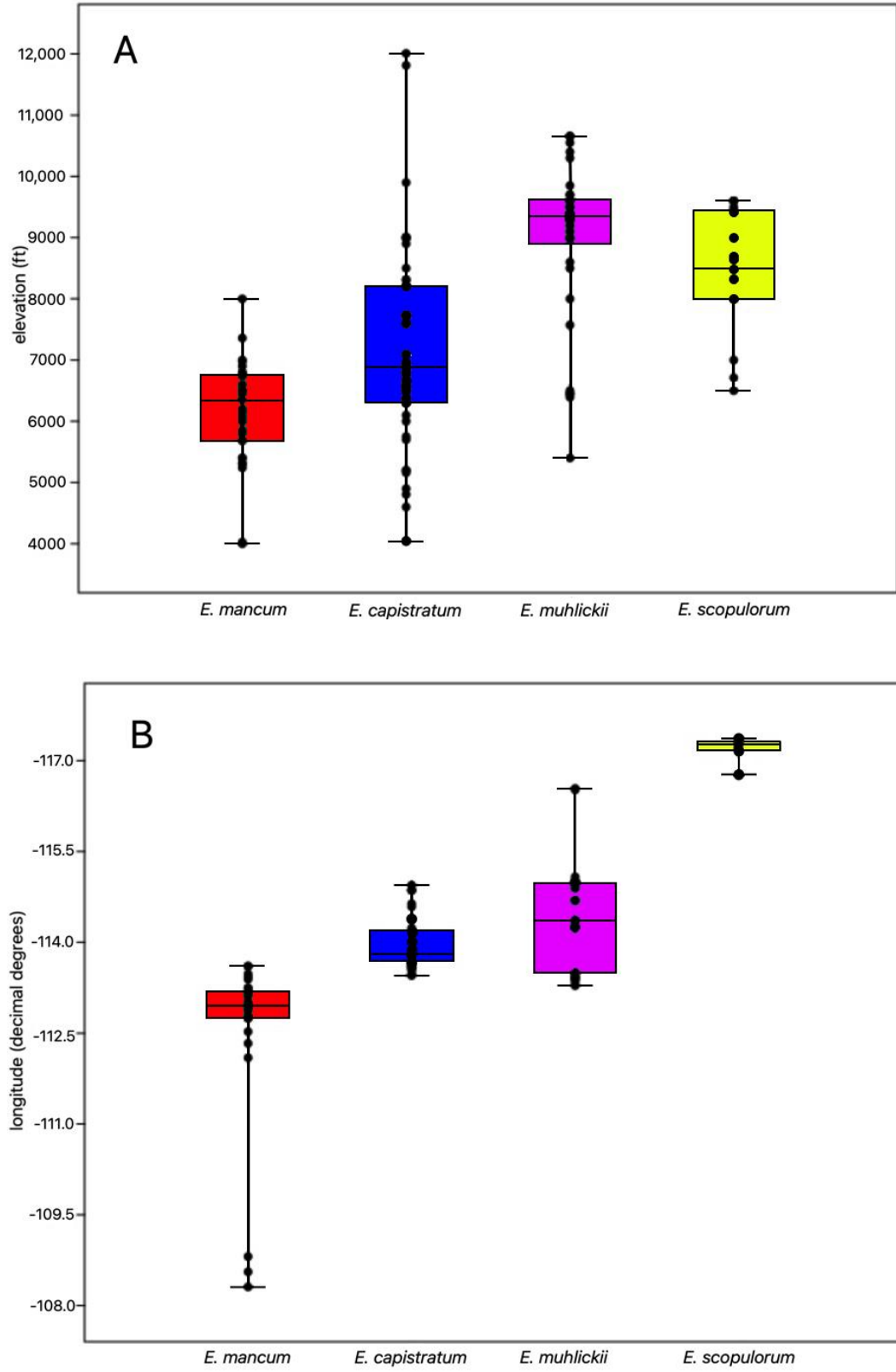


Figure 4. Elevational (a) and longitudinal (b) ranges for each species under study. Mean shown with middle black line, upper and lower quartiles indicated by colored box.

The reputed “verrucosum phase” is not accorded taxonomic rank. The main feature Reveal (1989) used to distinguish *Eriogonum verrucosum* from other northern capitate species is the presence of densely pustulose tepals. However, during all phases of our study we only saw pustulose bumps on specimens inconsistently within collections and among collections from throughout the “*capistratum*” group with neither geographic nor taxonomic coherence. As such, we did not use that character in our study.

The taxonomic status of *Eriogonum scopulorum*, from the western portion of the study range, should remain unchanged. The combination of densely glandular scapes and glandular, pale yellow tepals differentiate this species in our analysis (Figs. 1 and 5). Additionally, *E. scopulorum* is isolated in the western portion of our study area, largely at high elevations in the Wallowa Mountains of northeastern Oregon and geographically separated from the yellow-flowered population near Hells Canyon in Idaho (Figs. 3 and 4). Since its initial description, no other taxonomic changes or synonyms associated with this taxon have been noted (Reveal 1972, 2005).

With the white to pink, glabrous tepals and floccose scapes, eastern populations within this capitate group can be segregated as *Eriogonum mancum* (Figs. 1 and 3). This largely corresponds to Reveal’s treatment in the Flora of North America (2005). The main exception is the disjunct population from the House Range in west-central Utah, as this is now segregated as a distinct species, *Eriogonum domitum* (Grady & Reveal 2011).

ERIOGONUM MUHLICKII (Reveal) Mansfield, Corbin, & Grady, **comb. et stat. nov.** *Eriogonum capistratum* Reveal var. *muhlickii* Reveal, *Phytologia* 66: 256. 1989. **TYPE: USA. Montana.** Ravalli Co.: Summit of St. Mary’s Peak, 7 air mi W of Stevensville, Bitterroot Range, ca. 9300 ft elev, 22 Aug 1974, *Reveal 3814* (holotype: US!; isotypes: BRY, MARY, MO, NY, OKL, RSA, UC, UTC). Figure 5B.

Eriogonum meledonum Reveal, *Phytologia* 66: 254. 1989. **TYPE: USA. Idaho.** Custer County: Along U.S. Highway 93, 9 mi SSE of Stanley and 2 mi N of Obsidian, elev. 6950 ft, 5 Jul 1974, *Reveal 3674* (holotype, US!; isotypes: BRY, CAS, COLO, GH, K, MO, NY, OSC, PH, RM, RSA, TEX, and elsewhere).

Herbs, matted caespitose, scapose perennials to 1.5 dm across; stems matted with persistent leaf bases; aerial flowering stems scape-like, 0.5–6 (9) cm, slightly to densely stipitate glandular and otherwise either glabrous to sparsely floccose or tomentose; leaves elliptic to oblanceolate or spatulate, densely tomentose, 7.5–26 mm long, 1.8–4.6 mm wide, blades 5–9 (14) mm long, margins revolute; inflorescences capitate on scapes to 9 cm long, stipitate glands evident; involucre campanulate, slightly to densely stipitate glandular, otherwise glabrous to hairy with non-glandular hairs; perianth monomorphic, bright yellow, stipitate glands present on surface of tepals.

Flowering July–August.

Distribution and habitat. *Eriogonum muhlickii* is found at elevations above 2400 m (8000 ft) in Sawtooth Mountains and Salmon River Mountains in central Idaho on granitic ridges, ledges, talus and gravels of the Idaho Batholith and in the Bitterroot and Anaconda/Pintlar Ranges of southwest Montana in similar habitats, on Idaho Batholith granite or sometimes on metamorphic rocks in the eastern end of the Anaconda/Pintlar range (Fig. 3). Populations can also be found that tend to be intermediate with *E. capistratum* in the Sawtooth Valley from 1800–2100 m (6000–7000 ft) on highly weathered granitic outcrops (see discussion).

Etymology. C.V. Muhlick (1903–1973) was the herbarium assistant at the University of Washington (WTU) and collecting partner of C.L. Hitchcock.

Eriogonum muhlickii is similar to *E. mancum*, *E. soliceps*, *E. capistratum* and *E. scopulorum* in its matted, caespitose growth form, capitate inflorescence, and monomorphic tepals but different from those in its combination of stipitate glands on the scapes and a bright yellow perianth.

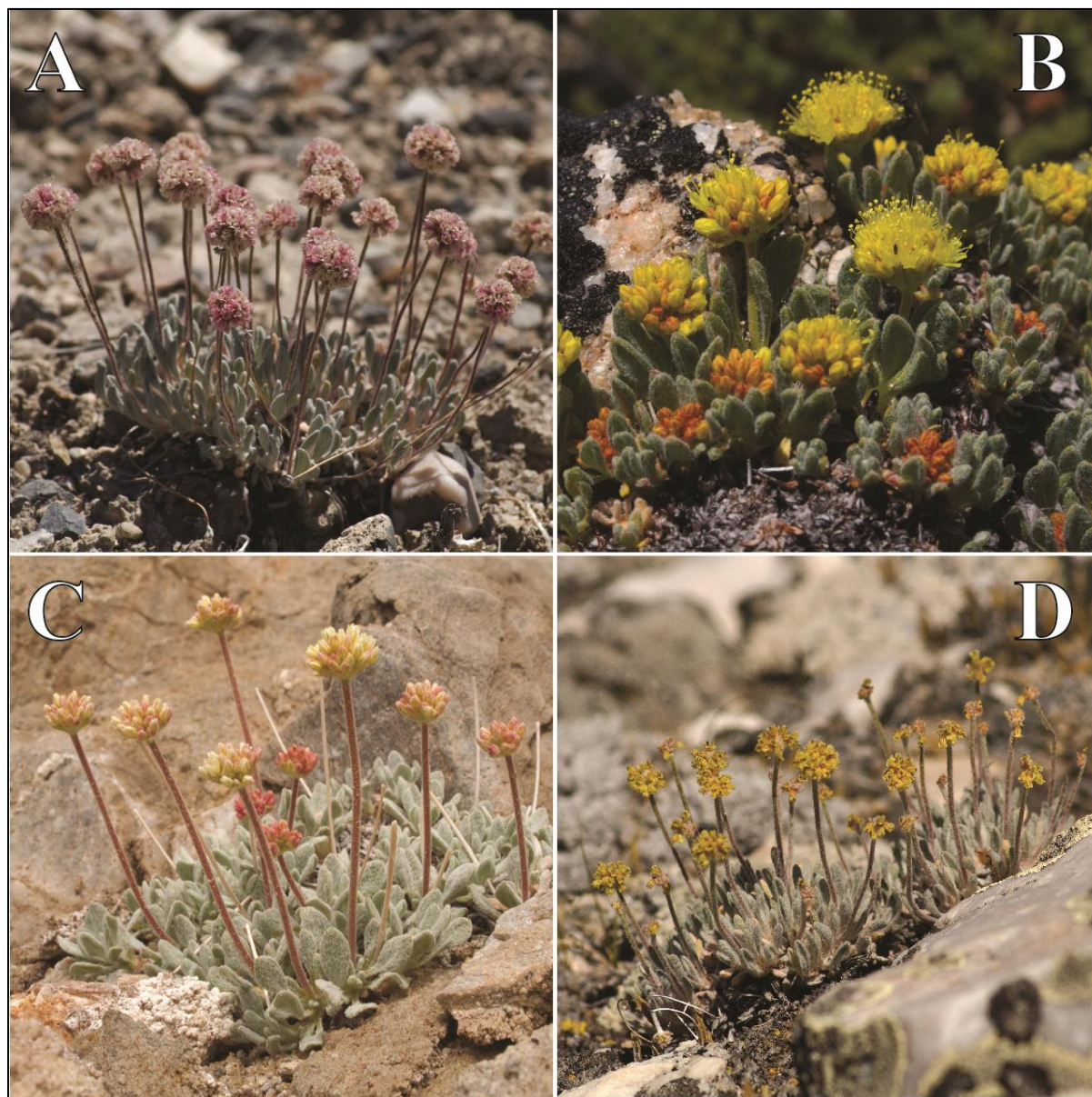


Figure 5. Four recognized species under study. A. *Eriogonum mancum*. B. *Eriogonum muhlickii*. C. *Eriogonum scopulorum*. D. *Eriogonum capistratum*.

ERIOGONUM CAPISTRATUM Reveal, *Phytologia* 66: 255. 1989. **TYPE: USA. Idaho.** Custer Co.: Antelope Pass, upper end of Copper Basin, on a ridge SW of the pass, elev. 9000 ft, 11 Jul 1976, *Reveal and Ertter 3876* (holotype, US!; isotypes: BRY, CAS, COLO, DUKE, F, MARY, MEXU, MICH, MO, NY, OKL, OSC, RM, RSA, TEX, UTC, and elsewhere). Figure 5D.

Eriogonum capistratum Reveal var. *welshii* Reveal, *Phytologia* 66: 256. 1989. **TYPE: USA. Idaho.** Custer Co.: Along the road to from Ellis to Howe, 38 mi S of May and 46 mi N of Howe, 6 mi S of Summit Reservoir and 8.9 mi N of the Butte Co. line, on low windswept barren gravelly clay upper slopes and ridgetops, ca. 6400 ft elev, 16 Jul 1976, *Reveal and Welsh 4501* (holotype: US!; isotypes: BRY, CAS, MEXU, MICH, MO, NY, OKL, RSA, TEX, UTC).

Eriogonum verrucosum Reveal, *Phytologia* 66: 253. 1989. **TYPE: USA. Idaho.** Custer Co.: On a low ridge and slopes W of the road up the East Fork of the Salmon River, 1.3 mi S of U.S. Highway 93, about 6 mi E of Clayton and about 20 mi SW of Challis, elev. 5700 ft, 6 Jul 1974, *Reveal 3678* (holotype: US!; isotypes: BRY, CAS, COLO, K, MO, NY, RM, RSA, TEX, WTU, and elsewhere).

Herbs, matted, caespitose, scapose perennials to 3 dm across; stems matted with persistent leaf bases; aerial flowering stems scape-like (1.5) 2.3–8 (10.5) cm, glabrous or sparsely floccose to tomentose; leaves elliptic to oblanceolate or spatulate, densely tomentose, (6.4) 16.8–33.7 mm long, 2.4–5.8 mm wide, blades (5) 9–17 (20) mm long, margins revolute; inflorescences capitate on scapes to 10 cm long, glabrous to floccose to tomentose; involucre campanulate, tomentose; perianth monomorphic, bright yellow, glabrous or stipitate glandular.

Flowering July–August.

Distribution and habitat. *Eriogonum capistratum* is limited to central Idaho, with collections from Blaine, Butte, Custer, and Lemhi counties. It ranges from the Salmon River Valley near the town of Salmon in the north, to the Pahsimeroi Mountains and Valley, Little Lost River Range and Valley, Big Lost River Valley, White Knob Mountains, Antelope Valley tributaries, to the edge of Craters of the Moon National Monument (southeast extent), White Cloud Mountains, Sawtooth Valley, Stanley Basin, and southwest to foothills west of the Wood River Valley. Only glabrous-scaped forms are found in the Pioneer and Soldier Mountains. Only floccose-tomentose forms are found in the White Cloud Mountains. Valleys and the White Knob Mountains have both glabrous and floccose-tomentose forms. The geology ranges from granitic Idaho Batholith to complex sedimentary (e.g. limestone) or volcanic (e.g. Challis volcanics or rhyolite) formations. Like many *Eriogonum* species, it is usually found in open, exposed, well-drained gravelly (or ashy) sites. These sites are found from high elevation ridges (over 12,000 feet elevation) to mid-elevation bluffs, ridges and slopes (down to about 5,200 feet elevation). The surrounding vegetation ranges from alpine communities (and occasionally whitebark pine or limber pine) to mixed conifer forests (primarily Douglas-fir or lodgepole pine, sometimes with ponderosa pine or subalpine fir) or mountain shrub communities (often *Artemisia* and/or *Atriplex* spp.). Herbaceous associates vary widely, but may include various *Astragalus*, *Phlox*, *Draba*, and/or grasses, with generally low cover.

Etymology. Per Reveal (1989): “from the Latin capistratus, tie with a halter or hitch, here fancifully applied to honor Dr. Charles Leo "Hitchy" Hitchcock, 1902-1986, monographer of numerous genera, author with others of the Vascular plants of the Pacific Northwest, long-time professor of botany at the University of Washington, and a student's best friend.”

Eriogonum capistratum is similar to *E. mancum*, *E. soliceps*, *E. scopulorum*, and *E. muhlickii* in being matted caespitose perennials with capitate inflorescences and monomorphic tepals but different from these in the combination of tomentose or glabrous scapes lacking stipitate glands, and a yellow perianth.

We have opted to recognize both taxa, *Eriogonum capistratum* and *E. muhlickii*, as species due to their distinct morphology as indicated by our morphometric analysis. These taxa are slightly more broadly defined, as compared to Reveal's initial description (1989).

Conclusion and conservation implications. The convoluted taxonomy of the northern capitate *Eriogonum* group is described above. Our morphological examination found difficulties with some of the characters that have been used to separate taxa within this group, which helps explain some of that confusion. We found that characters such as pustulose or verrucose tepals are unreliable and not consistently recognized by different observers looking at the same specimens. A character such as glabrous versus tomentose scapes was found to depend at least in part on phenology, with later season specimens sometimes becoming glabrate. Leaf and scape length seemed to correlate more strongly with elevation than with a presumed taxon grouping. The primary characteristics which seem to separate out putative taxa in our analysis (flower color and whether the scapes have stipitate glands), appear to be both relatively easy to consistently characterize and result in somewhat geographically consistent groupings.

Our analysis does not support the separation of *Eriogonum meledonum* or *E. verrucosum* as recognizable taxa. *Eriogonum meledonum* is currently on the Idaho Native Plant Society's list of Rare Plants, as are *E. soliceps* and *E. scopulorum*, but our work does not identify any *E. scopulorum* specimens from Idaho. Although *E. meledonum* does not appear appropriate for rare plant status under our concept of the northern capitate *Eriogonum* group, *E. muhlickii* and *E. mancum* could be considered rare in Idaho, and *E. capistratum*, which is limited to Idaho, should also be considered for conservation evaluation.

Key to northern capitate *Eriogonum* group in Idaho, Oregon, and Montana

1. Plants with a single floral involucre arising from the flowering stem **E. soliceps**
1. Plants with 2 or more involucres arising from the flowering stem.
 2. Scapes with stipitate glands evident, sometimes also with floccose hairs which may partially obscure some glands; plants typically over 2750 m, or in Sawtooth Valley, Idaho.
 3. Perianth bright yellow; plants north/east of the Snake River in Idaho and Montana **E. muhlickii**
 3. Perianth cream, sometimes with red or yellow tint; plants west of the Snake River in Wallowa Mountains, Oregon **E. scopulorum**
 2. Scapes floccose or glabrous, lacking stipitate glands; plants of all elevations.
 4. Perianth cream or reddish; scapes floccose, or only glabrous near White Knob Mountains; plants below 2450 m in east-central Idaho, SW Montana and NW Wyoming **E. mancum**
 4. Perianth yellow, sometimes with a red tint; scapes floccose or glabrous; plants of all elevations, restricted to Idaho **E. capistratum**

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Appendix 1. Specimens examined in this study

#	Taxon Gp	Collector	Collector #	Herbarium	Accession#	Latitude	Longitude	Elev ft	Type
1	mancum	Andersen	415	ID	70852	43.7912	-113.0049	5240	
2	mancum	Andersen	224	ID	70854	44.139	-112.9836	6500	
3	mancum	Atwood	13903	ID	102023	44.7315	-113.4286	5800	
4	mancum	Cholewa	926	ID	76611	43.8347	-112.8629	5680	
5	mancum	Gibson	47	ID	133894	45.2667	-112.9473	6740	
6	mancum	Goodrich	15433	ID	76777	44.0234	-112.7424	5400	
7	mancum	Henderson	2312	ID	166789	44.017	-112.7536	5300	
8	mancum	Henderson	2570	ID	69938	44.3032	-112.9878	6900	
9	mancum	Henderson	4175	ID	167084	44.0167	-112.7533	5400	
10	mancum	Henderson	4265	ID	74414	44.0331	-112.9213	6500	
11	mancum	Henderson	6178	ID	139912	44.0611	-112.7733	6150	
12	mancum	Irwin	992	ID	178040	43.8516	-113.4774	6071	
13	mancum	Lesica	9586	MONTU	132481	45.3268	-108.8113	4000	
14	mancum	Mancuso	1631	ID	118671	44.7892	-113.2459	7000	
15	mancum	Mancuso	2750	ID	139677	44.2239	-112.5259	6200	
16	mancum	Mancuso	2792	ID	139588	44.5393	-112.3312	7360	
17	mancum	Markow	10177a	ID	111737	44.3984	-113.0239	8000	
18	mancum	Moseley	259	ID	81588	44.0525	-112.7826	5700	
19	mancum	Nelson	77819	ID	161700	45.1098	-108.56	5850	
20	mancum	Nelson	77899	ID	161701	45.0954	-108.31	6800	
21	mancum	Reese	133	ID	73734	43.6563	-113.1612	6600	
22	mancum	Smith	13329	SRP	65504	44.1163	-113.19028	6791	
23	mancum	Tisdale	sn	ID	152200	44.3019	-112.9423	6758	
24	mancum	Tisdale	sn	ID	152199	44.2899	-112.9877	6758	
25	mancum	Williams	1740	SRP	65502	44.1203	-113.39084	6500	
26	mancum	Grady	457	WIS	v0421997	44.2026	-112.9537	6000	
27	mancum	Grady	467	WIS	v0421999	46.7052	-112.0936	4025	
28	mancum	Grady	459	WIS	v0421998	44.4711	-113.2451	6981	
29	mancum	Caicco	107	ID	76204	43.8213	-113.6122	6450	
30	mancum	Ertter	22658	CIC	56936	43.921	-113.116	5315	
31	mancum	Grady	454	WIS	v0421996	43.827	-113.599	6354	
32	capistratum	Baker	14224	ID	35891	43.4902	-113.6	7600	
33	capistratum	Baker	14163	ID	35924	43.4915	-113.6	7600	
34	capistratum	Corbin	1805	CIC	54902	43.4275	-114.3965	5160	
35	capistratum	Ertter	21919	CIC	55898	43.634	-113.7074	6630	
36	capistratum	Henderson	5259	ID	77098	43.7716	-113.7647	8900	
37	capistratum	Marx	2013-306	ID	169245	43.7494	-114.1312	12009	
38	capistratum	Reveal	3678	CIC	3166	44.6317	-114.1453	5700	
39	capistratum	Reveal	8316	ID	130344	43.5792	-113.5958	6675	
40	capistratum	Reveal	8389	ID	130579	44.2544	-114.2033	6350	

#	Taxon Gp	Collector	Collector #	Herbarium	Accession#	Latitude	Longitude	Elev ft	Type
41	capistratum	Reveal	8391	ID	130625	44.2978	-114.1055	6500	
42	capistratum	Wellner	1339	ID	88920	43.6468	-113.766	8200	
43	capistratum	Wellner	2302	ID	79066	44.3407	-114.235	5750	
44	capistratum	Reveal	3876	MONTU	87444	43.77	-113.766	9000	
45	capistratum	Reveal	3876	CIC	17872	43.77	-113.766	9000	
46	capistratum	Smith	17290	SRP	72731	43.7742	-113.7657	9012	
47	capistratum	Grady	448	WIS	v0422002	44.2808	-114.1626	6876	
48	capistratum	Grady	456	WIS	v0422004	43.5978	-113.5932	6571	
49	capistratum	Henderson	4347	ID	167238	44.353	-114.2566	5400	
50	capistratum	Atwood	10266	ID	113181	43.9073	-113.5489	6000	
51	capistratum	Bjork	sn	ID	125088	44.055	-114.64	9900	
52	capistratum	Caicco	165	ID	76324	43.9218	-113.798	8320	
53	capistratum	Christ	11362	ID	8636	44.2247	-114.9442	6300	
54	capistratum	Christ	12226	ID	20202	45.1116	-113.902	4040	
55	capistratum	Christ	17707	ID	74209	44.2471	-114.1117	6800	
56	capistratum	Christ	51-240	ID	56157	44.6473	-114.1789	5200	
57	capistratum	Christ	51-241	ID	56150	44.6473	-114.1789	5200	
58	capistratum	Cronquist	2694	IDS	9960	44.096	-114.8598	6600	
59	capistratum	Frey	8	IDS	73925	43.9192	-113.7986	8200	
60	capistratum	Henderson	4421	ID	76795	44.6148	-114.1789	4900	
61	capistratum	Henderson	4448	ID	167120	44.8893	-114.005	4600	
62	capistratum	Henderson	5161	ID	74053	43.9026	-113.7912	8300	
63	capistratum	Henderson	5200	ID	77096	44.4721	-114.0235	8200	
64	capistratum	Henderson	6311	ID	81017	44.7024	-114.377	8500	
65	capistratum	Irwin	5901	ID	178634	43.6582	-113.7044	6692	
66	capistratum	Mancuso	1405	ID	115054	44.4721	-113.6722	6100	
67	capistratum	Mansfield	20613	CIC	57416	44.2463	-113.7506	8980	
68	capistratum	Marx	2013-147	ID	169086	44.0397	-114.588	11815	
69	capistratum	McClanahan	20	IDS	73927	43.9192	-113.7986	8200	
70	capistratum	Nelson	1560	WS	298679	43.9147	-113.65	6700	
71	capistratum	Pfund	15	IDS	60375	43.8989	-113.6763	7700	
72	capistratum	Pfund	19	IDS	74015	44.0713	-113.9054	7100	
73	capistratum	Rawlings	2019.011	IDS	73999	43.9192	-113.7986	8200	
74	capistratum	Reveal	3674	CIC	4725	44.1103	-114.8601	6950	
75	capistratum	Reveal	4501	OSC	158365	44.28	-113.45	6400	type
76	capistratum	Smith	13486	IDS	72068	44.1262	-113.5556	7645	
77	capistratum	Grady	453	WIS	v0421995	44.2985	-113.4872	7057	
78	capistratum	Grady	444	WIS	v0422000	44.1107	-114.8612	6561	
79	capistratum	Grady	450	WIS	v0422003	44.615	-114.171	4806	
80	muhlickii	Reveal	8393	ID	130624	44.2539	-115.0039	6450	
81	muhlickii	Moseley	1353	ID	98096	44.2398	-114.9806	6500	

#	Taxon Gp	Collector	Collector #	Herbarium	Accession#	Latitude	Longitude	Elev ft	Type
82	muhlickii	Grady	446	WIS	v0422001	44.2531	-115.0051	6394	
83	muhlickii	Mansfield	10-551	CIC	40728	44.2585	-114.9862	6450	
84	muhlickii	Cory	1653	MONTU	78047	46.2449	-114.354	8500	
85	muhlickii	Hitchcock	15320	WS	174521	46.5107	-114.2431	9351	
86	muhlickii	Hitchcock	17100	WTU	114882	46.5107	-114.2433	9350	
87	muhlickii	Lackschewitz	52	MONTU	63341	46.1691	-114.2856	9100	
88	muhlickii	Lackschewitz	113	MONTU	60035	46.6016	-114.2548	9500	
89	muhlickii	Lackschewitz	2376	MONTU	65986	46.3307	-114.3717	8984	
90	muhlickii	Lackschewitz	3976	MONTU	70266	46.0594	-113.5003	9300	
91	muhlickii	Lackschewitz	4564	MONTU	73696	46.5116	-114.2433	9300	
92	muhlickii	Lackschewitz	4681	MONTU	72948	45.9602	-113.3825	9600	
93	muhlickii	Lackschewitz	5141	WTU	266614	45.9421	-113.479	9400	
94	muhlickii	Lackschewitz	5302	MONTU	74942	45.9499	-113.4176	8600	
95	muhlickii	Lackschewitz	5603	MONTU	75119	45.9769	-113.4178	9300	
96	muhlickii	Lackschewitz	5623	MONTU	74931	45.9769	-113.4178	9400	
97	muhlickii	Lackschewitz	6339	MONTU	76638	46.0052	-113.3353	9700	
98	muhlickii	Lesica	1845	MONTU	87402	46.0538	-113.2845	9700	
99	muhlickii	Lesica	8985	MONTU	130256	45.996	-113.45	9200	
100	muhlickii	Mincemoyer	528	MONTU	132665	45.9671	-113.388	9600	
101	muhlickii	Reveal	3814	IDS	5759	46.5118	-114.2429	9300	type
102	muhlickii	Grady	464	WIS	v0422005	46.5117	-114.244	9376	
103	muhlickii	Brunsfeld	1696	ID	73472	44.402	-114.8966	9400	
104	muhlickii	Hays	2738	ID	135022	45.3236	-116.5407	9280	
105	muhlickii	Henderson	7263	ID	96817	44.7603	-114.698	9600	
106	muhlickii	Hitchcock	5786	WTU	21111	43.942	-114.9737	9500	
107	muhlickii	Mann	70	ID	58834	44.207	-115.022	8000	
108	muhlickii	Mansfield	11-497	CIC	41656	44.1008	-114.9783	10300	
109	muhlickii	Mansfield	13-311	CIC	45549	44.1401	-115.011	10400	
110	muhlickii	Marx	2012-006	ID	169274	44.1414	-115.01	10661	
111	muhlickii	Marx	2013-119	SRP	55291	43.9378	-114.9714	10651	
112	muhlickii	Marx	2013-119	ID	169159	43.9378	-114.9714	10651	
113	muhlickii	Moseley	618	ID	87495	43.9354	-114.9645	10550	
114	muhlickii	Thompson	14010	WTU/JWT	9938	44.2114	-115.0818	9000	
115	muhlickii	Davidson	12593	SRP	52217	45.3478	-116.5182	7572	
116	muhlickii	Mancuso	4005	ID	171702	44.0256	-114.6905	9850	
117	scopulorum	Cusick	3204a	OSC	26400	45.2	-117.2	9000	
118	scopulorum	Johnson	sn	OSC	159364	45.1155	-117.2551	6710	
119	scopulorum	Kagan	7168708	OSC	168242	45.2292	-117.287	8300	
120	scopulorum	Kagan	8178905	OSC	185885	45.2311	-117.1722	9400	
121	scopulorum	Leach	sn	OSC	26401	45.1892	-117.2194	9600	
122	scopulorum	Mason	1672	OSC	125190	45.2442	-117.2787	9600	

#	Taxon Gp	Collector	Collector #	Herbarium	Accession#	Latitude	Longitude	Elev ft	Type
123	scopulorum	Mason	1673	OSC	26399	45.2442	-117.2787	9600	
124	scopulorum	N. Holmgren	2957	OSC	130132	45.2021	-117.1965	8500	type
125	scopulorum	Peck	17865	OSC	Willu169987	45.3	-116.753	6500	
126	scopulorum	Peck	17990	OSC	Willu	45.1792	-117.2037	7000	
127	scopulorum	Peck	22607	OSC	Willu	45.2347	-117.3172	8000	
128	scopulorum	Reid	626	OSC	170426	45.1875	-117.1965	8000	
129	scopulorum	Reid	824	OSC	170427	45.173	-117.1966	8000	
130	scopulorum	Woodland	1889	MONTU	79909	45.297	-117.3698	8500	
131	scopulorum	Woodland	2091	MONTU	79710	45.11	-117.198	8700	
132	scopulorum	Zika	10968	OSC	173254	45.2569	-117.2616	9500	
133	scopulorum	Grady	532	WIS	v0422007	45.1961	-117.2038	8635	