4-21-1995

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LAHONTAN SAGEBRUSH (ARTEMISIA ARBUSCULA SSP. LONGICAULIS): A NEW TAXON

Alma H. Winward¹ and E. Durant McArthur²

Abstract.—A new subspecies of Artemisia arbuscula is described, A. arbuscula ssp. longicaulis Winward & McArthur, ssp. nov. This taxon is a landscape dominant in portions of northwestern Nevada and adjacent California and Oregon at elevations from 1050 to 2000 m on shallow or argillic (clayey) soils. It differs from A. arbuscula ssp. arbuscula in its long floral stalks and large leaves. Morphological, chemical, ecological, and cytological data suggest that it is of hybrid origin. It is hexaploid (6x). We hypothesize that 2x A. arbuscula ssp. arbuscula and 4x A. tridentata ssp. wyomingensis are its parents.

Key words: Nevada, taxonomy, chemotaxonomy, allopolyploid, hybrid, Tridentatae.

In preliminary reports we (Winward et al. 1986, 1991) provided a brief description of a new taxon of Artemisia found in northwestern Nevada and adjacent California and Oregon. We suggested referencing it by the common name Lahontan sagebrush pending a formal description. This paper provides that formal description and details concerning its taxonomy, distribution, general ecology, and origin.

Taxonomy

The new taxon is a member of subgenus Tridentatae of Artemisia, the true sagebrushes (Beetle 1960, McArthur et al. 1981, Shultz 1986). We suggested (Winward et al. 1986) that this taxon may have originated as a hybrid with parental lines consisting of low and big sagebrush (A. arbuscula and A. tridentata). Because of its general morphology and ecology, we suggested that it be considered a subspecies of A. arbuscula. Further studies indicate that this new taxon is in fact best treated as a subspecies of A. arbuscula.

The type specimen of A. arbuscula came from a collection along the arid plains of the Lewis (now known as the Snake) River (Nuttall 1841). Subsequent workers have submerged the species as a subspecies of big sagebrush, A. tridentata ssp. arbuscula (Hall and Clements 1923), or, in contrast, recognized a number of races and subspecies within the species (Ward 1953, Beetle 1960). Ward proposed that black sagebrush (A. nova) was best treated as a subspecies of A. arbuscula, but Beetle (1960) restored it to Nelson's (1900) original species status. Beetle (1960) recognized two subspecies of A. arbuscula, arbuscula and thermopola. His treatment has been generally accepted (Winward and Tisdale 1977, McArthur et al. 1981, Shultz 1986), although Winward (1950) has observed an unusual variant of A. arbuscula in eastern Oregon that reaches a height of 1 m. He suggested that further taxonomic treatment of A. arbuscula would be appropriate.

During the past few decades fieldworkers in western Nevada have observed a sagebrush that does not fit the existing Artemisia taxonomic keys. Brunner (1972) termed this sagebrush “wide-lobe” with the comment, “Dr. Beetle feels this may be an ecotype of A. tridentata ssp. wyomingensis. I concur.” Others have referred to it as “wonder sagebrush,” “junk sagebrush,” or “N” sagebrush (Winward et al. 1986). Accessions of two populations (Trough Springs, Humboldt County, NV, cultures U1 and U58 and Leonard Creek, Humboldt County, NV, culture U55) of this taxon were established in common gardens of the Forest Service’s Shrubland Biology and Restoration Research Work Unit at several locations around central Utah; there they were treated as an ecotype of A. tridentata ssp. wyomingensis following Beetle and Brunner (Brunner 1972;
Artemisia arbuscula ssp. longicaulis Winward & McArthur ssp. nov. Similis A. arbuscula ssp. arbuscula sed ramis floralibus multo longioribus et foliis magnioribus differt (Similar to A. arbuscula ssp. arbuscula except flower stalks are much longer and leaves are larger).

We chose the common name Lahontan sagebrush because the old shorelines of Pleistocene Lake Lahontan are one of the centers of its current distribution and may have provided the ecological setting for the taxon’s origin and development (Winward et al. 1986, 1991).

Type: Toulon, Pershing County, Nevada, USA, 1053 m, S. C. Sanderson and E. D. McArthur 1593, 21 August 1986. Holotype: BRY. Isotypes: OGDF, RENO, SSLP, and UTC. Other specimens examined:

- Nevada, Douglas Co., Topaz Lake, Sanderson & McArthur 1594, (SSLP, four sheets);
- Nevada, Humboldt Co., Golconda, Plummer s.n., 1985, (SSLP);
- Nevada, Humboldt Co., Leonard Creek, Plummer & McArthur; s.n., 3 October 1975, culture U55, (SSLP);
- Nevada, Humboldt Co., Trough Springs, Jackson Mountains, Plummer, Brunner, & McArthur, s.n., 3 October 1975, culture U1, (SSLP);
- Nevada, Humboldt Co., Trough Springs, Jackson Mountains, McArthur 1532, culture U1, (SSLP);
- Nevada, Humboldt Co., Trout Creek Basin, Jackson Mountains, McArthur 1501, (SSLP, two sheets);
- Nevada, Lyon Co., Dayton, Sanderson & McArthur 1595, (SSLP, two sheets);
- Nevada, Pershing Co., 6.4 km west of Toulon, McArthur & McArthur 1683, (SSLP two sheets);
- Nevada, Washoe Co., Mustang, McArthur & McArthur 1684, (SSLP);
- Oregon, Lake Co., 32 km east of Adell, Sanderson & McArthur 1590, (SSLP);
- Oregon, Malheur Co., near McDermitt, Nevada, Winward, s.n. 31 October 1986, (OGDF, two sheets, SSLP).

DISTRIBUTION AND ECOLOGY

Artemisia arbuscula ssp. longicaulis occurs on several hundred thousand hectares in northwestern Nevada and in adjacent areas of California and Oregon at elevations from about 1050 to 2000 m (Fig. 1). It often occurs in pure stands. It may also share dominance with other sagebrush taxa such as big sagebrush (A. tridentata ssp. tridentata and wyo­mingensis), low sagebrush (A. arbuscula ssp. arbuscula), and black sagebrush (A. nova). At lower elevations it is interspersed with salt desert shrub species such as shadscale (Atriplex confertifolia), Bailey greasewood (Sarcobatus baileyi), Mormon tea (Ephedra spp.), budsage (Artemisia spinescens), Shockley’s desert thorn (Lycium shockleyi), and horse­brush (Tetradymia spp.). Except for Artemisia, our taxonomy follows Welsh et al. (1993) and Mozingo (1987). The most common grass understory species at upper-elevation Lahontan sagebrush sites is bluebunch wheatgrass (Elymus spicatus). At lower elevations Thurber and desert needlegrasses (Stipa thurberiana and S. speciosa), and Indian ricegrass (Stipa hymenoides), bottlebrush squirreltail (Elymus elymoides), and Sandberg bluegrass (Poa secunda) are more common. Areas supporting A. arbuscula ssp. longicaulis receive between 175 and 350 mm of precipitation annually with most as winter precipitation. The frost-free season ranges from 90 to 110 days. Lahontan sagebrush grows most commonly on Aridisols, but at upper elevations it also occurs on Mollisols. Soil Conservation Service, U.S. Department of Agriculture, personnel have located A. arbuscula ssp. longicaulis on at least 17 soil series. Generally, these soils have low available water-holding capacities and a shallow depth to an argillic horizon and/or bedrock. These soils are similar to those of low sagebrush (A. arbuscula ssp. arbuscula) communities.
Fig 1. Extent of the known distribution of Artemisia arbuscula ssp. longicaulis.

General distributions of the three subspecies of A. arbuscula are as follows: ssp. arbuscula, western Wyoming and eastern Utah to eastern Washington and northeastern California; ssp. thermopola, western Wyoming and adjacent Idaho and northern Utah to northern Nevada and eastern Oregon; ssp. longicaulis, western Nevada, extending into adjacent California and Oregon.

Supporting Data and Discussion

Morphological, chemical, and cytological data are consistent with the hypothesis that A. arbuscula ssp. longicaulis is of hybrid origin, with A. arbuscula ssp. arbuscula as one parent and A. tridentata ssp. wyomingensis as the other parent. Hybridization and introgression are thought to have been important in the evolutionary development and differentiation of Tridentatae taxa (Ward 1953, Beetle 1960, McArthur et al. 1981, 1988). The following taxa are thought to have originated as hybrids:

- A. argillosa (A. cana ssp. viscidula × A. longiloba—Beetle 1959),

Figure 2 shows a polygonal representation of morphological features of the new subspecies and its putative parents, including permanent leaf width, length, and length/width ratio and flower and vegetative stalk lengths. Values are shown in Table 1. Morphological differences

A. arbuscula ssp. longicaulis
A. arbuscula ssp. arbuscula
A. tridentata ssp. wyomingensis

Fig. 2. Polygonal graph comparing morphological features of Artemisia arbuscula ssp. longicaulis and its putative parents, A. arbuscula ssp. arbuscula and A. tridentata ssp. wyomingensis. Data from Table 1: A = flower stalk length; B = vegetative stalk length; C = leaf width; D = leaf l/w ratio; E = leaf length.
**Table 1. Morphological measurements (means ± SD) of A. arbuscula ssp. arbuscula (ARAR), A. arbuscula ssp. longicaulis (ARAR1), and A. tridentata ssp. wyomingensis (ARTRw).**

<table>
<thead>
<tr>
<th></th>
<th>ARAR</th>
<th>ARAR1</th>
<th>ARTRw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower stalk length (cm)</td>
<td>16.4 ± 1.7</td>
<td>24.5 ± 3.4</td>
<td>10.4 ± 4.2</td>
</tr>
<tr>
<td>Vegetative stalk length (cm)</td>
<td>3.9 ± 0.8</td>
<td>5.7 ± 1.2</td>
<td>4.7 ± 2.4</td>
</tr>
<tr>
<td>Leaf length (mm)</td>
<td>7.9 ± 1.1</td>
<td>7.3 ± 1.0</td>
<td>8.3 ± 2.4</td>
</tr>
<tr>
<td>Leaf width (mm)</td>
<td>3.0 ± 0.4</td>
<td>3.4 ± 0.4</td>
<td>2.7 ± 0.6</td>
</tr>
<tr>
<td>Leaf L/H ratio</td>
<td>2.0</td>
<td>2.2</td>
<td>3.1</td>
</tr>
</tbody>
</table>


Means for each taxa are based on N = 8. Differences are significant by one-way analysis of variance (Woolf 1969) for flower stalk length (P < .01), vegetative stalk length (P < .05), and leaf length (P < .01) between ARAR and ARAR1. Data for ARTRw are from Winward (1979). Means from ARTRw were not statistically compared with the other taxa.

may be summarized as follows: (1) Flower stalk length averages 50% longer for A. arbuscula ssp. longicaulis than for A. arbuscula ssp. arbuscula and over twice as long as A. tridentata ssp. wyomingensis. (2) A. tridentata ssp. wyomingensis has longer, narrower leaves than the other taxa. (3) A. arbuscula ssp. longicaulis has larger leaves and a longer vegetative stalk than A. arbuscula ssp. arbuscula.

Wilt et al. (1992) compared 34 phenolic compounds from six taxa of *Tridentatae* including A. tridentata ssp. wyomingensis, A. arbuscula ssp. longicaulis (undescribed at the time and called by them "Lahontan" sagebrush), and A. arbuscula ssp. arbuscula. Their work demonstrated that typical high-pressure liquid chromatography patterns for A. arbuscula ssp. longicaulis and A. tridentata ssp. wyomingensis are remarkably similar (their Fig. 2). Representative chromatograms of those two taxa are the most similar of the six taxa studied (A. arbuscula ssp. arbuscula, A. noca, A. tridentata ssp. tridentata, A. t. ssp. caseyana, A. t. ssp. wyomingensis, and "Lahontan" sagebrush; Wilt et al. 1992). We analyzed the Wilt et al. (1992) frequency of detection of individual phenolics by assigning percent similarity values for each shared phenolic (Table 2). Those values are not dramatically different for A. arbuscula ssp. longicaulis in respect to the other five taxa, but A. arbuscula ssp. arbuscula and A. tridentata ssp. wyomingensis are the two most similar (at 54%) to A. arbuscula ssp. longicaulis. For total phenolics the Wilt et al. (1992) data are very close for A. arbuscula ssp. longicaulis and A. t. ssp. wyomingensis, closer than for any other two taxa examined.

A. arbuscula ssp. longicaulis is hexaploid, 6x = 2n = 54. McArthur et al. (1981) reported this taxon as A. tridentata ssp. wyomingensis "wide-robe" and gave chromosome counts as 2n = 36, 54 for two transplanted population samples growing in a common garden. We now suspect both valid A. tridentata ssp. wyomingensis and A. arbuscula ssp. longicaulis were growing in the accessional rows.

A. tridentata ssp. wyomingensis is uniformly tetraploid, 2n = 36 for the ca 70 populations that have been examined, and A. arbuscula ssp. longicaulis is uniformly hexaploid, n = 27 for seven populations including Trout Creek (McArthur 1501), Adell (Sanderson and McArthur 1590), Toulon (Sanderson and McArthur 1593), Topaz Lake (Sanderson and McArthur 1594), Dayton (Sanderson and McArthur 1595), and Mustang (McArthur and McArthur 1684) populations cited earlier in this report (McArthur et al. 1981, McArthur and Sanderson in review).


Sagebrush taxa hybridize naturally (McArthur et al. 1988). We propose that *A. arbuscula* ssp.
longicaulis is an allopolyplloid derivative from diploid, $n = 9$, A. arbuscula ssp. arbuscula, and tetraploid, $n = 18$, A. tridentata ssp. wyomingensis. A. arbuscula ssp. arbuscula occurs in both diploid and tetraploid populations in the northwestern Nevada area. Tetraploid A. tridentata ssp. wyomingensis also occurs there (McArthur and Sanderson in review). Population dynamics of sagebrush populations migrating in response to climatic change during the various phases of ancient Lake Lahontan and other pluvial lakes of the Lahontan basin (Morrison 1965) could have provided the opportunity for the origin and establishment of A. arbuscula ssp. longicaulis. Morphological, cytological, and chemical data are consistent with the hybrid origin hypothesis.

**Acknowledgments**

We thank Gary Brackey, Jim Brunner, Chu Ge-lin, Sherel Goodrich, Craig Plummer, Stewart Sanderson, Marty Wilt, and the late Perry Plummer for their help in various phases of this study. We thank field personnel of the Soil Conservation Service, U.S. Department of Agriculture, Nevada offices, who provided much of the information for Figure 1. We also appreciate assistance provided by the Pittman-Robertson W82R Wildlife Habitat Project and U.S. Department of Agriculture Cooperative State Research Service Grant 91-38300-6157.

**Literature Cited**


Received 1 March 1994
Accepted 11 August 1994