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Parmelia barrenoae, a macrolichen new to North America and Africa

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Abstract: The foliose lichen Parmelia barrenoae is newly reported for North America based on material collected throughout the western United States (California, Idaho, Oregon, and Washington) and for Africa based on material from the Middle Atlas mountain range of Morocco. In addition to morphology, ITS sequence data were examined to confirm the identity of North American material. The species was originally described from the Iberian Peninsula of Europe, and has not been reported from anywhere outside of that region since its description. A revised account of the species is provided in light of the additional material now available from geographically diverse populations.

Key words: Ascomycota, erose soralia, lichens, Parmelia barrenoae, Parmelia sulcata, Parmeliaceae, rDNA internal transcribed spacer

Parmelia barrenoae Divakar, M. C. Molina & A. Crespo

Previously known only from the central portion of the Iberian Peninsula (Divakar et al. 2005), *Parmelia barrenoae* was recently collected in Yosemite National Park (California, U.S.A.) as part of a National Park Service survey. The discovery of additional specimens from California at the New York Botanical Garden (NY) led us to initiate a larger search of the holdings of *Parmelia sulcata* Taylor from several other herbaria (DUKE, herb. Esslinger, and UCR). Our efforts were rewarded with the discovery of additional collections of *P. barrenoae* from North America (California, Idaho, Oregon, and Washington) as well as northern Africa (Morocco).

While the presence of this species in the Middle Atlas mountain range of Morocco is hardly surprising, given its reported abundance in the central portion of the Iberian Peninsula, the records from western North American were quite unexpected. To confirm the identity of North American material using molecular evidence, rDNA internal transcribed spacer (ITS) sequence data were generated from Lendemer 19720 using standardized protocols (Hodkinson & Lendemer 2010, Lendemer & Hodkinson 2009, 2010). According to a blastn search of NCBI's non-redundant nucleotide collection (Altschul et al. 1997), the ITS sequence of the North American sample (HM135205) is >99% similar to all other sequences of *Parmelia barrenoae* (n=8), differing at only one or two nucleotide sites. All other sequences in GenBank (including those generated from *P. sulcata*) are ≤96% similar to the North American *P. barrenoae* sequence.

The North American populations of *Parmelia barrenoae* that we have examined occurred in xeric conifer or conifer-oak forests at moderate elevations (ca. 450-2200 m.) in the western portion of the continent. These habitats are somewhat comparable to those described for European populations, although the records from Idaho, Oregon, and Washington demonstrate that this species is not exclusively Mediterranean (Divakar et al. 2005). The collections from northern Africa were made in typical Mediterranean conifer-oak forests at moderate elevations in the Middle Atlas mountain range.

In the past, *Parmelia barrenoae* has been most often confused with *P. sulcata* Taylor, which is common and widespread throughout most of North America (Brodo et al. 2001), because both species produce laminal soralia and salazinic acid. When describing *P. barrenoae*, Divakar et al. (2005) emphasized differences in the rhizines (i.e., simple/furcate in *P. barrenoae* vs. squarrose in *P. sulcata*; cf. figs. 1E-F) as the primary character separating the two species. These authors also outlined several additional morphological characters of *P. barrenoae*; however, these were neither described nor illustrated in detail. In light of the new collections reported here, representing a more geographically diverse sampling of populations than would have been available at the time of the description of *P. barrenoae*, we have further studied the morphological differences between these two species.

Based on our review, we confirm the utility of rhizine morphology in distinguishing the species. However, we have found that it can be difficult to ascertain whether squarrose rhizines are truly absent from some specimens, particularly older collections that have been damaged over time. Care must be taken to check for squarrose rhizines in the older central portions of all thalli that appear to lack them, since younger areas (particularly those near the lobe margins) can have predominantly simple rhizines.

We have also found that the ontogeny of the soralia in Parmelia barrenoae results in a distinctive gross morphology that is very different from that of P. sulcata. The soralia of P. barrenoae are often less abundant than those of P. sulcata and initiate as fissures in the cortex, arising from linear pseudocyphellae (fig. 1C). As the soralia develop, they erode marginally, quickly releasing the soredia and leaving the pale colored medulla exposed in stark contrast to the darker upper surface (fig. 1D). The resultant gross morphology (figs. 1A, D) is one in which the thallus appears contorted (i.e., revolute) by the deeply erose soralia with prominent reflexed cortical margins. This morphology contrasts strongly against that of P. sulcata in which the thallus is only rarely revolute and the soralia are abundant, remaining full and appearing erumpent because they do not quickly expel the soredia as they expand.

Specimens examined: MOROCCO. MOYEN-ATLAS: Jbel Tazzeka, near Taza, conifer-oak forest; on Quercus, Culberson 15427 (DUKE); at Ifrane, 60 km S of Fes, near the summer palace of King Hassan; on Quercus, Culberson 15337 (DUKE). U.S.A. CALIFORNIA. MARIPOSA CO.: Yosemite National Park, near bottom of Bridal Veil Falls; 37°43.093'N, 119°38.864'W; ca. 1300 m. elev., on Umbellularia branches, Esslinger 18998 (herb. Esslinger), on talus rock, Esslinger 19008 (herb. Esslinger), on rock near stream, Esslinger 19016 (herb. Esslinger), bark of Pseudotsuga, Esslinger 19018 (herb. Esslinger), on branch of Abies, Lendemer 19720 (NY); Yosemite National Park, west end of Yosemite Valley, downstream of Pohono Bridge, on south side of river; 37.7162°N, 119.6662°W; ca. 1185 m. elev., on Cornus nuttallii, Esslinger 19052 & 19063 (herb. Esslinger), on branch fallen from above, Esslinger 19060 (herb. Esslinger), on Pseudotsuga bark, Esslinger 19068 (herb. Esslinger), on young Abies, Esslinger 19069 (herb. Esslinger). RIVERSIDE CO.: Peninsular Range, San Bernardino National Forest, San Jacinto Mountains, near FS 4S21, midway to Vista Point, Lake Fulmor, mesic chaparral with oaks and pines surrounding granite outcrop; 33.783°N, 116.781°W; ca. 1685 m. elev., on granite, Lendemer 14859 with K. Knudsen (NY); San Jacinto Mountains, South Ridge, boulders among conifers and oaks; 2184 m. elev., on granite boulder, K. Knudsen 533 et al. (UCR); San Mateo Wilderness Area, Tenaja Canyon, scrub oak woodland with N-exposure; 550 m. elev., on scrub oak, K. Knudsen 445 (NY, UCR); San Mateo Wilderness Area, Santa Ana Mountains, oak woodland; 590 m. elev., rough bark of large central boles of Quercus agrifolia, K. Knudsen 413 (UCR). SAN BERNADINO CO.: Peninsular Range, San Bernardino National Forest, San Bernardino Mountains, gorge on N-slope along CA 38, Big Bear Lake, conifer/oak woodland with granite outcrops; 34.159°N, 116.941°W; ca. 2124 m. elev., on granite, Lendemer 14973 with K. Knudsen (NY). SAN DIEGO CO.: between Julian and the Cuyamaca Reservoir; on fallen branch of Quercus, Culberson 16036 (DUKE). TUOLUMNE CO.: Yosemite National Park, 1 km E of Hodgdon Meadow along Old Big Oak Flat Road where it crosses Hazel Green Creek; 37°47.5591'N, 119°50.8437'W; ca. 1385 m. elev., on Cornus nuttallii, Esslinger 18848 (herb. Esslinger); Yosemite National Park, pullout on Hetch Hetchy access road just east of Poopanaut Dome, south rim of Tuolumne River Canyon; 37°54.215'N, 119°50.026'W; ca. 1470 m. elev., on shady rock, Esslinger 18905 (herb. Esslinger). IDAHO. KOOTENAI CO.: near the S end of Lower Twin Lake; 47º 51'N, 116º 52'W; 715 m. elev., on bark of Populus, Esslinger 161 (herb. Esslinger). LATAH CO.: N side of Paradise Ridge; 46º 41'N, 116º 51'W; 885 m. elev., on bark of Alnus, Esslinger 1788a, 1788b (herb. Esslinger); ca. 7 km NE of Kendrick, along the road to Linden; 46º 39'N, 116º 34'W; ca. 460 m. elev., on bark of Crataegus,

Esslinger 260 (herb. Esslinger). VALLEY CO.: near Duffy Lane 3 air miles W of Cascade; 116º 07'N, 44º 30'W; ca. 1370 m. elev., on Amelanchier, Rosentreter 7094 (herb. Esslinger). OREGON. WALLOWA CO.: ca. 12 km S of Imnaha along Hat Point Road; 45º 30.7'N, 116º 46'W; ca. 1800 m. elev.; on dead branches of Picea, Esslinger 16218 (herb. Esslinger). WASHINGTON. SPOKANE CO.: vic. Turnbull Game Refuge; 47º 25'N, 117º 37'W; ca. 700 m, on bark of aspen, Simms SL-156a (herb. Esslinger). WHITMAN CO.: on the N side of Kamiak Butte; 46º 51'N, 117º 09'W; on moss over rock; Esslinger 1783 (herb. Esslinger).

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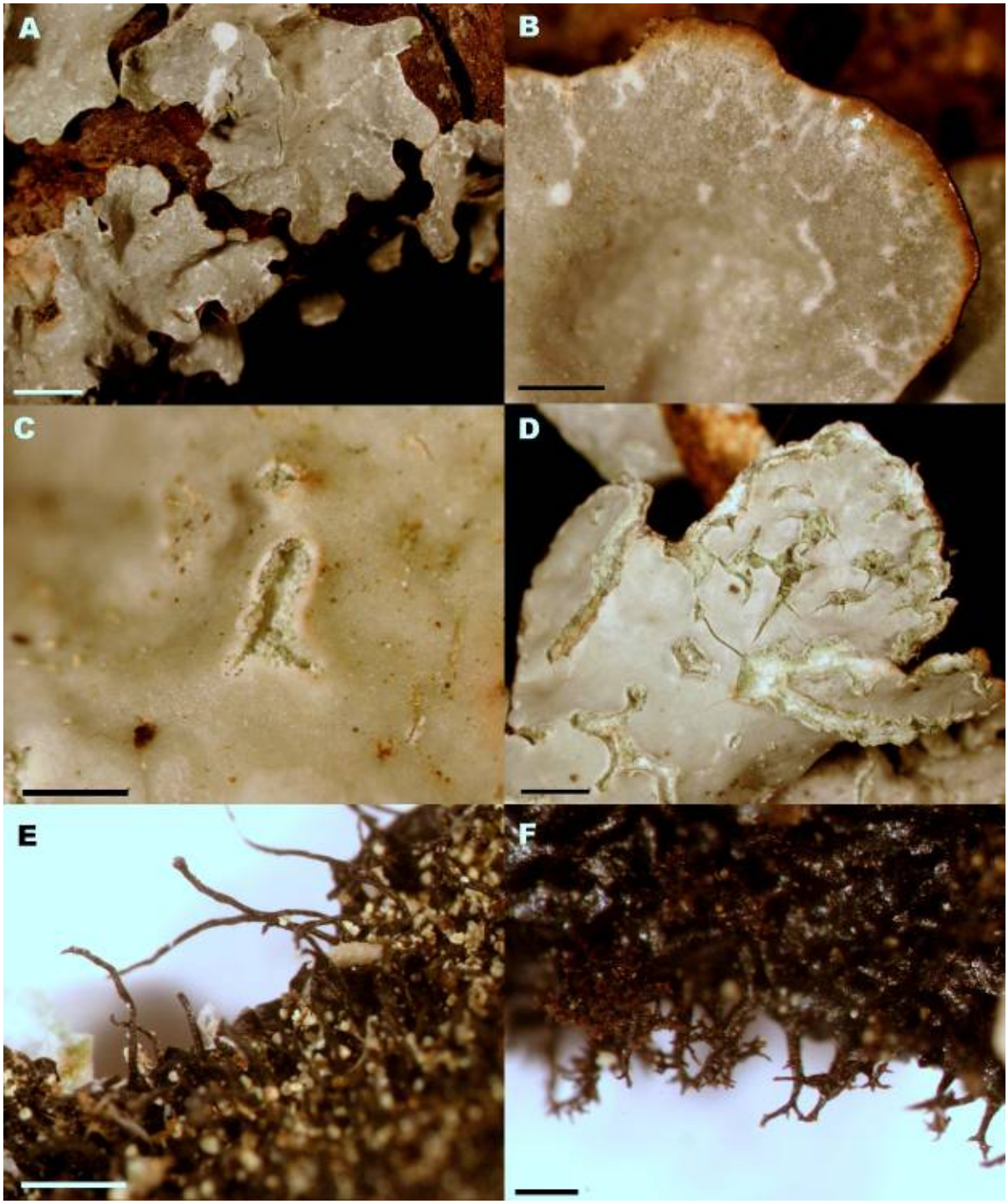

Figure 1. Parmelia barrenoae (A-E; all from Lendemer 19720) and comparison of rhizines with P. sulcata (F, from McGarrity s.n.). A, lobe morphology (scale = 2.0 mm). B, detail of lobe tip (scale = 0.5 mm). C, young soralium (scale = 0.5 mm). D, soralia (scale = 1.0 mm). E-F, comparison of rhizines in P. barrenoae (E) and P. sulcata (F) (scale = 0.2 and 0.5 mm respectively).