ALPINE FLORA OF CERRO MOHINORA, CHIHUAHUA, MEXICO

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ABSTRACT

An annotated, vouchered checklist for the only known alpine-subalpine plant community in the Sierra Madre Occidental of Mexico, Cerro Mohinora of southwest Chihuahua, is presented. Contrary to former reports of a sparse timberline vegetation on Cerro Mohinora, we document a relatively diverse vascular flora, including 79 species that represent 63 genera and 33 families. Based on the species composition of this flora, the vegetation shares minimal biogeographic affinities with alpine vegetation in the Sierra Madre Oriental of Northeast Mexico (7.2% Sorensen Index; comparing Mohinora with the collective floras of Sierra La Viga, Coahuilon, Cerro Potosí, and Peña Nevada). Only nine timberline species of Mohinora occur in similar habitats in the high mountains of northeast Mexico, suggesting enduring isolation through time, even during pluvial periods of the Pleistocene. Cerro Mohinora shares about half that index of similarity with alpine vegetation in Mexico's volcanic belt (3.6% Sorensen Index; comparing Mohinora with the collective floras of Popocatepetl, Iztaccihuatl and Nevado de Toluca).

RESUMEN

Se presenta un listado florístico basado en colecciones vegetales para el único refugio alpino conocido en la Sierra Madre Occidental de México, Cerro Mohinora, en el suroeste de Chihuahua. A pesar de reportes históricos que describen una flora con pocas especies en este sitio, reportamos una comunidad vegetal que soporta una flora diversa con 79 especies, 63 géneros, y 33 familias. Basada en la composición de especies de esta flora, la vegetación alpina de Cerro Mohinora demuestra afinidades fitogeográficas mínimas con la vegetación alpina de la Sierra Madre Oriental. Se calcula un índice de similitud de 7.2% (Sorensen) entre la flora de Mohinora y las de Sierra La Viga, Coahuilon, Cerro Potosí, y Peña Nevada. Solamente nueve especies alpinas de Cerro Mohinora se encuentran en las montañas altas del Nordeste de México, indicando un aislamiento permanente, aun durante ciclos pluviales durante el Pleistoceno. La zona alpina de Cerro Mohinora demuestra aun menos afinidades con floras similares en la zona neovolcánica, demostrando un índice de similitud (Sorensen) de 3.6% entre la zona alpina de Mohinora y los zacatonales de Popocatepetl, Iztaccihuatl y el Nevado de Toluca.

INTRODUCTION

Studies on the alpine floras of Mexico focus primarily on highly specialized timberline elements that inhabit basaltic substrates above 4000 m on the 19° latitude parallel (Zone III, Fig. 1), including those of the Cofre de Perote, Iztaccihuatl, Malinche, Nevado de Colima, Nevado de Toluca, Pico de Orizaba, and Popocatepetl (Purpus 1907; Beaman 1962, 1965; Lauer & Klaus 1975; Narave 1985; Almeida-Leñero et al. 1994, 2004; Gimenez de Azcarate & Escamilla 1999). Beaman & Andresen (1966) expanded the scope of alpine studies by comparing the floristic composition of these volcanic peaks with an isolated community of alpine plants in Northeast Mexico, where timberline communities of Cerro Potosí occur on limestone substrates in the Sierra Madre Oriental of Nuevo Leon. This northern site exhibits closer phytogeographic affinities to forb-dominated montane plant communities of the southern Rocky Mountains than with grass-dominated, timberline vegetation ('zacatonales') across Mexico's volcanic belt (Beaman 1965; Rzedowski 1975; Narave 1985; Almeida-Leñero et al. 2004). Later explorations of Northeast Mexico by McDonald (1990, 1993) discovered six additional alpine sites in the region (three sites indicated in Fig. 1 on account of the close proximity of four timberline zones), between which a considerable number of autochthonous (McDonald 1993, Table 23.1), narrow endemic species occur.

None of the aforementioned studies make reference to the reconnaissance work of Donovan Correll (1960) and Howard Scott Gentry on an isolated peak of the Sierra Madre Occidental in Southwest Chihuahua (Fig. 1), Cerro Mohinora (25°57'29.31"N, 107°02'56.37"W), where Goldman (1951) had observed in 1898 a

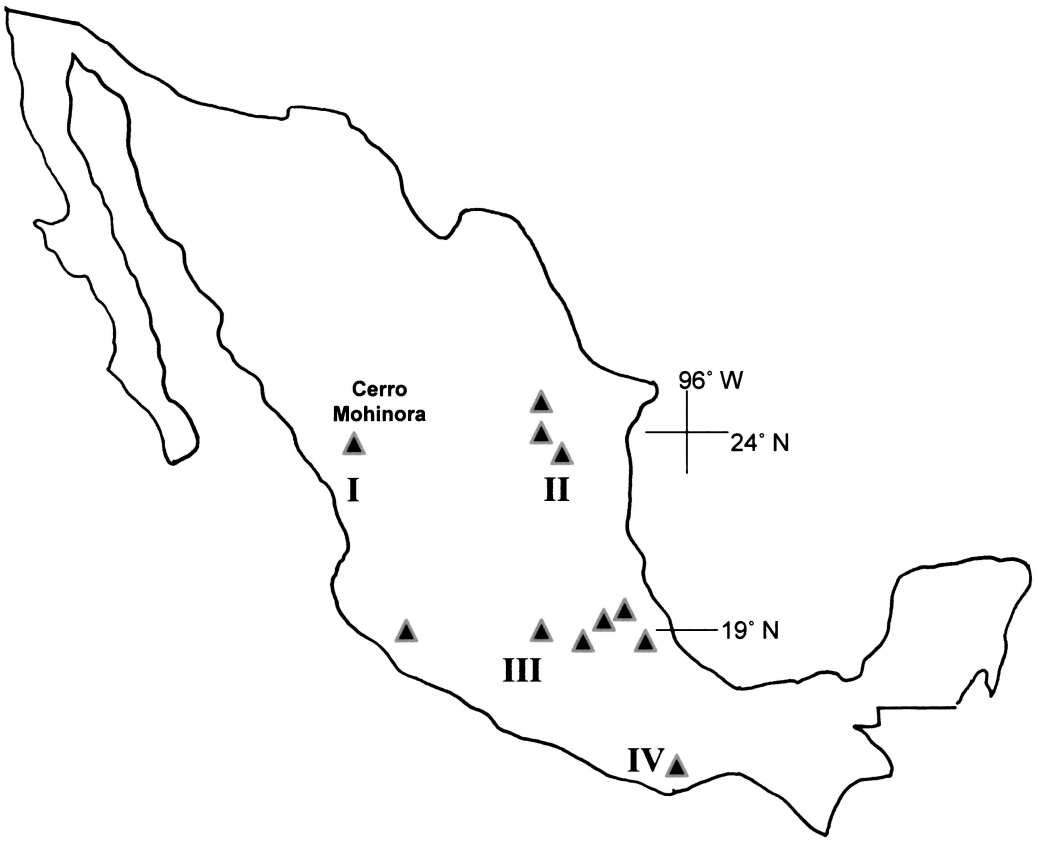

Fig. 1. Contemporary distribution of alpine-subalpine floras in Mexico. A single, relictual timberline vegetation occurs in the Sierra Madre Occidental (Zone I: Cerro Mohinora), as compared to a series of closely situated alpine refugia in the Sierra Madre Oriental (Zone II). The central volcanic belt traversing the 19° lat. meridian (Zone III) and an isolated, highly restricted alpine/subalpine site on Cerro Quiexobra of the Sierra Madre del Sur (Zone IV, in prep) harbor isolated and uniquely derived timberline vegetation.

snow-capped summit with stunted trees and 'open' forest. Arriving on the 16th of October, 1959, Correll reported a "disappointingly sparse" vegetation dominated by herbs and grasses on Cerro Mohinora's precipitous, rocky substrates (maximum altitude reports ranging from 3319–3900 m; Webb & Baker 1984). He attributed the peak's poor floristic composition to either goat grazing or a heavy frost that had already fallen by the time of his late arrival.

In recognition that the timberline vegetation of Cerro Mohinora had yet to be observed during the peak of flowering in late summer, the site was visited during the last two weeks of August in 1987 and 1988 by the authors to assess the floristic composition of the Sierra Madre Occidental's only known timberline flora. We observed a colorful and species-rich alpine vegetation on approximately 15 hectares upon the mountain's bald and adjacent declivities. Forbs and grasses dominate the timberline vegetation, representing 33 families, 63 genera, and 79 species, with an occasional intrusion of stunted pines (*Pinus cooperi* Blanco), junipers (*Juniperus blancoi* Martinez var. *huehuetentensis* R.P. Adams) and aspen (*Populus tremuloides* Michx.). The Asteraceae and Poaceae harbor more species than other vascular plant families (14 and 7 spp., respectively), followed by the Caryophyllaceae (4 spp.), Plantaginaceae (4 spp.), Apiaceae (3 spp.), Crassulaceae (3 spp.) and Primulaceae (3 spp.).

While the timberline floras of the Sierra Madre Oriental and Sierra Madre Occidental cover no more than

6 sq. kms in the present day, McDonald (1993) estimated approximately 5% of Mexico was covered by alpine vegetation during pluvial cycles of the Pleistocene. Based on the hypothesis that timberlines descend in altitude by around 1000 m during glacial cycles, the Sierra Madre Occidental likely harbored the largest, continuous extensions of timberline vegetation in Mexico during ice ages, ranging from central Sonora to southern Durango (McDonald 1993). In the present age, this refugium of highly specialized vegetation exhibits the narrowest distribution of all of Mexico's alpine habitats.

In anticipation of a comprehensive examination of the origins, floristic relationships, endemic composition, and historical biogeography of alpine vegetation throughout Mexico (McDonald & Feria, in prep), we present a floristic list for a rare and vulnerable plant community (by virtue of its narrow distribution) in the Sierra Madre Occidental. We compare this flora with a comparable vegetation type in Northeast Mexico (McDonald 1990) and that of Mexico's volcanic belt (Almeida et al. 2007), computing a 'Sorensen Index of Similarity' of only 7.2% between Cerro Mohinora and timberline vegetation of the Sierra Madre Oriental (SI = 2C/A + B: where A and C equal the number of species found at disjunct sites and C equals the number of species found at both locations). In comparing the floras of Cerro Mohinora with a floristic list for Popocatepetl, Iztaccihuatl, and the Nevado de Toluca, the Sorensen Index computes to a mere 3.6% similarity. In both cases, floristic evidence indicates that the cyclic expansion of alpine vegetation during pluvial periods of the Pleistocene allows for only limited floristic exchange between the Sierra Madre Occidental and other tall mountains of Mexico. These data add further support to the general assumption that timberlines descend around 1000 m during glacial maxima.

Given the distinctive and rare character of Cerro Mohinora's plant communities, the summit and ecologically intact surroundings merit some form of conservation status. It is noteworthy that only a single non-native species (*Poa annua*) was encountered in the region during the late 1980s, indicating a relatively pristine flora, albeit affected by the grazing of goats during the 1950s (fide Correll) and cows during our two forays. A road now leads to the top of the mountain to serve a microwave tower, thereby encouraging and facilitating increased human activities in this isolated region. Foresight and planning might protect this rare, endemic, and predictably fragile vegetation type from fires, grazing, trail erosion, and other forms of ecological damage suffered by alpine zones throughout Mexico (Gimenez de Azcarate & Escamilla 1999; Almeida-Lenero et al. 2007).

ANNOTATED CHECKLIST OF VASCULAR PLANT TAXA

Collector names are abbreviated as follows: **DSC** = Donovan S. Correll (TEX); **GN** = Guy Nesom (TEX); **HSG** = Howard S. Gentry (TEX); **JM** = Jorge Martínez (HUAA, XAL); **JAM** = J. Andrew McDonald (HUAA, TEX, XAL). Herbarium acronyms denote location of each collector's specimens.

PTERIDOPHYTA

Woodsiaceae

Woodsia phillipsii Windham; *DSC & HSG 23164*

CONIFEROPHYTA

Cupressaceae

Juniperus blancoi Marti var. *huehuetentensis* R.P. Adams, S. González & M. González Elizondo; *JAM & JM 2351*

Pinaceae

Pinus cooperi Blanco; *JAM & JM 2349*

MAGNOLIOPHYTA

Apiaceae

Eryngium lemmonii J.M. Coult. & Rose; *JAM & JM 2364*
Ligusticum porteri J.M. Coult. & Rose; *JAM & JM 2404, JAM & GN 2471, GN & JAM 6458*
Tauschia edulis (S. Wats.) J.M. Coult. & Rose; *JAM & JM 2357*

Brassicaceae

Pennellia longifolia (Benth.) Rollins; *DSC & HSG 23167, JAM & JM 2353, JAM & GN 2480*
Draba rubricaulis Heller; *DSC & HSG 23160, JAM & JM 2405*

Caryophyllaceae

Arenaria lanuginosa (Michx.) Rohrb.; *DSC & HSG 23187, JAM & JM 2350, 2408, JAM & GN 2478*
Drymaria effusa var. *depressa* (Greene) J. Duke; *JAM & JM 2365*
Cerastium nutans Raf.; *JAM & JM 2366*
Silene laciniata Cav. var. *greggii* (A. Gray) Hitch. & Maguire; *DSC & HSG 23162, JAM & JM 2382, JAM & GN 2492*

Commelinaceae

Commelina cf. *tuberosa* L.; *JAM & JM 2377*
Tradescantia pygmaea Hunt; *JAM & JM 2378*

Compositae

Ageratina lemmonii (B.L. Rob.) King & Rob.; *JAM & JM 2374*
Correllia montana A.M. Powell; *JAM & JM 2346, JAM & GN 2479*
Dahlia sherffii Sorenson; *JAM & JM 2373*
Erigeron macdonaldii G.L. Nesom; *JAM & GN 2372*
Erigeron mohinorensis G.L. Nesom; *DSC & HSG 23151, JAM & JM 2371*
Erigeron rhizomactis G.L. Nesom; *JAM & JM 234X*
Galinsoga subdiscoidea Cronquist; *JAM & JM 2344, GN & JAM 6478*

Grindelia megalocephala (Fern.) G.L. Nesom; *JAM & JM 2347*
Senecio mohinorensis Greenm.; *DSC & HSG 23146, JAM & JM 2338*
Senecio umbraculifera S. Wats.; *DSC & HSG 23155, JAM & JM 2348*
Senecio scalaris Greenm. var. *scalaris*; *DSC & HSG 23144, JAM & JM 2342*
Stevia plummerae A. Gray var. *plummerae*; *JAM & JM 2339*
Verbesina longifolia A. Gray; *JAM & JM 2337*
Viguiera multiflora S.F. Blake var. *macrocephala* (Heiser) B.L. Turner; *JAM & JM 2375*

Crassulaceae
Sedum jaliscanum S. Wats.; *JAM & GN 2468*
Sedum chihuahuense S. Wats.; *DSC & HSG 23158, JAM & JM 2400, JAM & GN 2477*
Villadia pringlei Rose; *JAM & JM 2379T, JAM & GN 247*

Cyperaceae
Cyperus pennellii O'Neill & Ben. Ayers; *JAM & JM 2356* (XAL)
Cyperus fendlerianus Boeckeler; *JAM & JM 2397* (XAL)

Fabaceae
Lupinus barberi (C.P.Smith) Rafaill & Dunn; *JAM & JM 2354*
Lupinus montanus Kunth subsp. *glabrior* (S. Watson) Dunn & Harmon; *JAM & JM 2359*

Gentianaceae
Halenia recurva (Sm.) Allen; *JAM & JM 2396*
Gentianopsis macrantha (D. Don ex G. Don) Iltis; *DSC & HSG 23143*

Geraniaceae
Geranium wislizeni S. Wats.; *DSC & HSG 23159*
Geranium richardsonii James; *JAM & JM 2380*

Hydrophyllaceae
Phacelia platycarpa Cav.; *JAM & JM 2355*

Iridaceae
Sisyrinchium convolutum Nocca; *JAM & JM 2352*

Juncaceae
Luzula comosa Meyer; *DSC & HSG 23173, JAM & JM 2391, 2481, JAM & GN 2494*

Lamiaceae
Salvia microphylla Kunth; *JAM & JM 2385*
Stachys mohinora B.L. Turner; *DSC & HSG 23181, JAM & JM 2387, JAM & GN 2495*

Liliaceae
Calochortus venustulus Greene; *JAM & JM 2369*

Melianthaceae
Zigadenus cf. *elegans* Pursh; *JAM & JM 2410*

Montiaceae
Montia perfoliata (Donn ex Willd.) Howell; *JAM & JM 2368, JAM & GN 2474*

Onagraceae
Oenothera pubescens Willd. ex Spreng.; *JAM & JM 2367*

Orobanchaceae
Castilleja tenuifolia Mart. & Gal.; *DSC & HSG 23147*
Pedicularis chihuahuensis G.L. Nesom; *JAM & JM 2402*

Oxalidaceae
Oxalis decaphylla Kunth.; *JAM & JM 2409*

Piperaceae
Peperomia campylotropa A.W. Hill; *JAM & JM 2493*

Plantaginaceae
Penstemon barbatus (Cav.) Roth.; *JAM & JM 2386*
Penstemon campanulatus (Cav.) Willd.; *DSC & HSG 17996*
Penstemon mohinoranus Straw; *JAM & JM 2370*
Veronica peregrina L. ssp. *xalapensis* (Kunth) Penn.; *JAM & JM 2399*

Poaceae
Bromus ciliatus L.; *JAM & JM 2393, GN & JM 6474*
Deschampsia flexuosa (L.) Trin.; *DSC & HSG 23179, JAM & GN 2482*
Festuca hintoniana Alexeev; *JAM & GN 2475, 2489*
Festuca diclina S.J. Darbyshire; *JAM & JM 2392*
Koeleria pyramidata (Lam.) Beauv.; *DSC & HSC 23175, JAM & JM 2394*
Poa annua L.; *JAM & JM 2358*
Trisetum filifolium Scribn. ex Beal; *DSC & HSG 23176*

Polygonaceae
Rumex acetosella L.; *JAM & JM 2363*

Primulaceae
Dodecatheon pulchellum var. *pulchellum* (Raf.) Merr.; *JAM & GN 2490, GN & JAM 6460*
Dodecatheon ellisieae Standl.; *GN & JAM 6471*
Primula rusbyi Greene; *JAM & JM 2406, GN & JAM 6469*

Ranunculaceae
Ranunculus gentryanus Benson; *DSC & HSG 23156, JAM & JM 2362*
Thalictrum grandifolium S. Wats.; *JAM & JM 2383, JAM & GN 2470, GN & JAM 6457*

Rosaceae
Alchemilla aphanoides L.f.; *JAM & JM 2381*
Holodiscus discolor (Pursh) Maxim. var. *discolor*; *DSC & HSG 23182, JAM & JM 2403*

Rubiaceae
Galium uncinulatum DC.; *JAM & GN 2401, 2476*
Galium mexicanum Kunth subsp. *asperrimum* (A. Gray) Dempster; *JAM & JM 2388*

Salicaceae
Populus tremuloides Michx.; *DSC & HSG 23186*

Saxifragaceae
Heuchera sp. *JAM & JM 2389*
Saxifraga eriophora S. Wats.; *JAM & JM 2407*

Solanaceae
Solanum stolonifera Schtdl. & Bché; *JAM & JM 2389, 2420*
Solanum demissum Lindl.; *JAM & GN 2469*

Valerianaceae
Valeriana deltoidea Meyer; *JAM & JM 2361*

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