Geographic Origins of the White Mountain Flora: an Analysis of the White Mountain Floristic Database

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Abstract. The White Mountains of eastern California and western Nevada lie near the intersection of two major floristic transition zones, providing an opportunity to study the effects of several different physiographic regions on a local flora. Such regions harbor distinct sets of taxa, or phytogeographic elements (PEs), which tend to segregate spatially and ecologically where they overlap. A total of 922 native and 157 exotic vascular plant taxa are analyzed for statistically significant segregation patterns that would suggest past sources and migration routes for the present flora. *Chi-square* tests demonstrate highly significant segregation ($p<0.0001$) of PEs along gradients of (in descending significance) moisture availability, altitude, local geographic restriction, and substrate texture, chemistry, and deposition. Many expected and some unexpected patterns are revealed.

Intermontane (208), Cordilleran (116), Transitional (northern Mojave, 107), and Sonoran (96) taxa are most common, and Columbian Plateau (22) and Endemic (11) taxa least. Compared with expected frequencies derived from the total flora,

the Boreal, Sonoran, Widespread, Exotic, and Sierran PEs (383 taxa) are most discordantly and narrowly segregated. There are three major trends: 1) Boreal, Sierran Rocky Mountain, and Beringian PEs segregate into moist, typically non-basic, high-elevation habitats in the north and east; 2) Widespread and Exotic PEs segregate into moist, typically alkaline, low-elevation habitats in the south and west; and 3) Sonoran, Transitional and Madrean PEs segregate into dry, typically basic, low-elevation habitats in the south and west. The Transitional PE shows a further trend toward carbonate-rock outcrop habitats. The Endemic, Intermontane, Columbian, Leeward (east-Sierran), and Cordilleran PEs (439 taxa) are most concordantly and widely distributed. The latter may include the more "typical" (ancient?) taxa of the region, upon which are superimposed the more discordant (younger?) taxa.

Groups of taxa restricted to the north and south ends of the range are mutually discordant in PE composition. A discordant western group which is enriched with southern and western PEs contrasts, however, with a highly concordant eastern group. This suggests that the Owens Valley to the west, rather than the Lahontan Trough to the east, has been a primary corridor for recent migrations into the area, as well as for introductions of exotic taxa. The abundance of Sierran taxa in the alpine suggests frequent dispersal across or above Owens Valley during glacial or interglacial periods. Several Boreal and northern Rocky Mountain taxa reach widely disjunct southwestern limits in the White Mountains, where they may have been isolated by post-Pleistocene encroachment of a more arid Lahontan Trough in western Nevada. Taxa from areas south of the White Mountains tend to segregate onto calcareous substrata.

Endemism is lower than expected for the size and diversity of the White Mountains. Endemic taxa occur at all elevations, with a statistically uncertain concentration in the alpine (4 taxa) and subalpine (3 taxa) zones. Wetlands harbor unusually high numbers of widespread native and exotic taxa. Forty-three (27.4 percent) of the exotic taxa are from adjacent Pacific, Sonoran, and other western PEs. This, along with an unusually high proportion of exotic taxa for such an isolated area (14.6 percent), demonstrates a high rate of disturbance and introduction in and around the White Mountains. Most of the exotic taxa are known only from one or a few small populations, though, and seem unlikely to spread further.

CONCLUSIONS

The White Mountains continue to present a phytogeographic picture similar in broad outline to what Mitchell [1973] discerned using two-thirds the present sample. That is, two strongly segregated groups—an element of Sierran, Boreal, and northern Rocky Mountain affinities at high elevations in the north, and a Sonoran-Mojavean and Madrean element at low elevations in the southwest—have encroached relatively recently on a third diverse, widely dispersed, and relatively ancient element of Intermontane and general Rocky Mountain affinities. A fourth element of highly vagile native and exotic taxa concentrates in the wetter portions of the south and west. There appears to be some evidence that a distinctive phytogeographic element occupies the transition zone between the Great Basin and Mojave-Sonoran deserts.

Editors' Note. The complete text of this study is currently submitted for publication in *Journal of Biogeography,* under the title *Spatial and ecologic segregation of phytogeographic elements in the White Mountains of California and Nevada.*