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## ENDEMISM IN THE FLORA OF CALIFORNIA

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The most conspicuous feature of the flora of California is the endemism that marks it as distinct from that of most parts of the world. Because of the close inter-relationship among many genera and species, it is puzzling and interesting. Evolution still seems to be progressing since distinctive limits are often so uncertain.

As it would be impossible and impractical to name or even enumerate the endemic species in many genera, because of the diversity of opinion as to criteria for specific limits, the genera only will be considered.

The plan is to take these genera in the order in which the families of plants native in California are generally arranged. Of course, state boundaries mean nothing to plants and it is to be expected that genera distinctly Californian will have species crossing the border. The northern part of Lower California is similar to and really ecologically a part of San Diego County. A similar situation occurs in the adjacent counties of Del Norte, the most northern in California along the coast, and Curry and Josephine counties in southern Oregon. Desert plants cross over into Arizona and Nevada. Nevada also has some of the California species on the east side of the Sierra Nevada boundary.

Among the ferns and fern allies no endemic genera occur. In the Gymnosperms, *Sequoia* Endl. is the only one, with two species growing in limited areas in California, the coast species, *S. sempervirens* (Lamb.) Endl. extending into southern Oregon, adjacent to Del Norte County. This genus was represented in preglacial times by many species in the Northern Hemisphere where their fossil representatives have been unearthed. With the Sequoias are also *Torreya* Arn., *Lithocarpus* Sarg. and *Umbellularia* Nees. The two former have widely separated species

in the Northern Hemisphere, the last related to *Ocotea* Aubl., a genus of *Lauraceae* with a wide distribution chiefly in the Southern Hemisphere; *Umbellularia* extends north into Pacific coastal areas.

Among the families of the Monocotyledons, *Liliaceae* is the only one with endemic genera, namely, the monotype *Odontostomum* Torr., *Muilla* S. Wats. and *Chlorogalum* Kunth, the last two with several species. *Stropholirion* Torr. has two species, one exclusively Californian and the other in Del Norte County and the adjacent counties of Oregon.

The *Brodiaea* group of inter-related genera is essentially Californian, although represented by a few species in neighboring states. The following genera have been considered distinct: *Bloomeria* Kell., *Calliprora* Lindl., *Hesperoscordum* Lindl., *Triteleia* Lindl., *Hookera* Salisb., *Stropholirion* Torr., *Brevoortia* Wood and *Dichelostemma* (Torr.) Wood. Whether or not any agreement can eventually be attained as to the status of these genera, the group is essentially Californian. *Allium* L., *Lilium* L., *Calochortus* Pursh and *Fritillaria* L. are rich in endemic species.

Among the *Apetalae*, *Polygonaceae* alone has endemic genera, namely: *Nemacaulis* Nutt., *Hollisteria* S. Wats. and *Gilmania* Coville. All are monotypic. *Eriogonum* Michx., *Chorizanthe* R. Br., *Oxytheca* Nutt. and *Polygonum* L. abound in endemic species. Many species, especially of *Eriogonum* and *Chorizanthe*, become conspicuous in the landscape where they monopolize an area, giving color or a filmy effect that is very lovely.

The greatest number of families is in the *Choripetalae*. *Portulacaceae*, *Caryophyllaceae*, *Ranunculaceae* and *Berberidaceae* have no genera restricted to California.

*Oreobroma* Howell, of the *Portulacaceae*, segregated from *Lewisia* Pursh, has many beautiful species, especially from the Northern California-Southern Oregon region. Known in gardens as *Lewisia*, they are among the choicest and most beautiful rock-garden plants. *Paeonia* L., a genus well known in cultivation, belonging to the *Ranunculaceae*, has two species in California, but is not found elsewhere in the western hemisphere, so it would seem to be one of the preglacial survivors. Endemic species occur in many genera of the *Ranunculaceae*, especially in *Delphinium* L. *Vancouveria* Morr. & Decne. and *Achlys* DC. of the *Berberidaceae* are Pacific Coast endemics and occur in California only in the northern part.

Endemism predominates in the *Papaveraceae* in both genera

and species. Monotypic are *Canbya* Parry ex Gray and *Stylo-mecon* G. Taylor. The latter has been referred to *Papaver* L. and *Meconopsis* Vig. Diss. (ex DC.). The endemic genera represented by several closely related species are *Romneya* Harvey, *Dendromecon* Benth., *Hesperomecon* Greene and *Meconella* Nutt. Several of these genera have species crossing into adjacent states, but they are essentially Californian. The evolutionary urge is strongly marked in this family, especially among the species. E. L. Greene in Pittonia V. describes with elaborate keys 122 species of *Eschscholzia* and 52 of *Platystemon*. Both Jepson and Abrams recognize only seven of *Eschscholzia* and but one *Platystemon*.

*Tropidocarpum* Hook. and *Stanfordia* S. Wats. seem to be the only genera of *Cruciferae* not found outside California. *Heterodraba* Greene crosses the northern and southern boundaries but seems like a California endemic. *Draba* L. and *Arabis* L. have endemic species, but in *Streptanthus* Nutt. the number is remarkable and many are restricted to a small and limited area. The species seem to be in transition. In Vol. 1, Leaflets of Botanical Observation, E. L. Greene segregates *Streptanthus* into four Californian endemic genera and five more widely distributed. These of course overlap but indicate the remarkable inter-relationship.

Formerly included in *Sedum* in the *Crassulaceae*, but now considered distinct genera by some authors, are *Sedella* Britt. & Rose, *Hasseanthus* Rose and *Gormaniana* Britt., the two former restricted to California, the last more widely distributed. *Dudleya* Britt. & Rose and *Stylophyllum* Britt. & Rose are now classified as distinct. They have been included in *Cotyledon* L., a South African genus, and *Echeveria* DC., common in Mexico. While both cross state boundaries, and *Dudleya* has many species in Lower California, they are truly Californian endemics. The many species are so closely related that they are very difficult to distinguish and indicate a state of transition.

Among the many genera of *Saxifragaceae*, *Jepsonia* Small and *Peltiphyllum* Engler, both formerly included in *Saxifraga* L., are considered to be endemic; the former runs into Lower California and the latter into Oregon. *Bensonia* Abrams and Bacigalupi, a monotypic genus in southwestern Oregon, has not yet been found in California. Among the *Grossulariaceae* are many California endemics. In the *Philadelphus* group, *Carpenteria* Torr., a monotypic genus, is restricted to a limited area of the foothill

region of Fresno County. In almost all of the genera, endemism prevails among the species and several subdivisions of the old genera have been given generic rank in recent publications.

*Rosaceae* has but few endemic genera. *Lyonothamnus* Gray is restricted to the islands off the coast of Santa Barbara. The monotypic *Chamaebatia* Benth. forms a lovely ground-cover with flowers like a strawberry, fern-like leaves which have a viscid pubescence and a strong odor. *Adenostoma fasciculatum* H. & A. covers great areas and gives distinct color as it is a dominant shrub in the chaparral. The other species, *A. sparsifolium* Torr., is more tree-like, a species of Southern California which extends into Lower California. *Photinia* Lindl., a genus represented by many species in China and Japan, is considered by some botanists to include the Californian genus *Heteromeles* M. Roem. They are certainly closely related and the California plant so well known as Christmas berry is probably another preglacial survivor.

The California Pitcher Plant, *Darlingtonia californica* Torr., contrary to its name, is more abundant in southern Oregon. I have seen it in many widely separated localities in California but never in such rich abundance as in coastal Lane County in southern Oregon. Over acres of a marshy area, nothing could be seen but these pitcher-like leaves and the beautiful crimson and yellow open flowers on their long stems.

But one endemic genus, the monotypic *Pickeringia* Torr., is in the *Leguminosae*. This is a shrub with gray-green foliage, spiny stems and lovely crimson flowers, which inhabits the chaparral areas only. *Trifolium* L., *Lupinus* L. and *Astragalus* L. are remarkable for the number and complexity of the species. Great differences of opinion as to specific limits result, but in California many are truly distinct and endemic. The plants now included in the European genus *Lotus* L. were formerly classified by some authors under *Hosackia* Dougl. and *Syrmatium* Vog. These two genera are Californian endemics, although a few species cross the borders. The species are closely related. Among several families following, endemic genera are rare. Species of *Linum* L. are almost all endemic. *Cneoridium* Nutt., a monotypic genus of the *Rutaceae*, is endemic in the San Diego-Lower California region. The *Euphorbiaceae* have no endemic genus and the species are fairly well distributed. *Limnanthes* R. Br. has endemic species chiefly in California and Oregon. It belongs to the *Limnanthaceae*, a family of two genera, formerly classed with the *Geraniaceae*. *Rhamnaceae* has but one endemic

genus, namely *Adolphia* Meisn., monotypic in San Diego and Lower California. *Rhamnus* L. has two species with many varieties that have been considered species by some authors. In *Ceanothus* L., the number, complexity and beauty of the many species give the greatest interest to taxonomists among whom there has, so far, been no agreement. They are among the loveliest shrubs in California and many species monopolize areas to which they give color and character.

With the exception of *Malacothamnus* Greene, which was included in *Malvastrum* by Asa Gray, no genus is endemic in *Malvaceae*. However, *Lavatera* L. has especial interest because of its distribution. A few endemic species occur on the islands off the coast of Southern and Lower California, the other species only in the Mediterranean region and Canary Islands, so that it would seem to be one of the preglacial survivors. *Sidalcea* Gray has many endemic species.

*Fremontia* Torr. represents the *Sterculiaceae* with several closely related species, one extending into the northern part of Lower California and one into Arizona. In the families that follow, no endemic genera occur. *Viola* L. has endemic species, *Frankenia* L. has two, *Helianthemum* Pers. related species and doubtful, *Hypericum concinnum* Benth. the only one in that family. Among the *Loasaceae* no endemic genera occur, but *Mentzelia* has several endemic species, some of uncertain status owing to close relationship.

Many genera, some endemic, have been included by Munz in *Oenothera* L. and within the group endemic species occur. *Epi-lobium* L., *Zauschneria* Presl, *Clarkia* Pursh and *Godetia* Spach are well represented by endemic species. *Cactaceae* are restricted to southern California and there are no endemics in the state.

*Rubiaceae*, *Caprifoliaceae*, *Valerianaceae* and *Campanulaceae* have no genera found only in California, but endemic species occur in all. In *Rubiaceae* there are many galiums. *Lobeliaceae*, by some authors included in *Campanulaceae*, has *Palmerella* Gray and *Parishella* Gray, the latter passing into Lower California. *Downingia* Torr. and *Nemacladus* Nutt. are in bordering states but have several inter-related endemic species. The former is a feature of the hog-wallows, those depressions which become shallow pools in the rainy season and dry up when the rains cease. They are frequent in the great valleys of California and often will be filled exclusively with one species of *Downingia*, clothing the area with a mantle of blue. Species of *Allocarya* of the *Boraginaceae* also love these depressions and when exclusive

color the ground white. *Mimulus* of the *Eunanus* section, of the *Scrophulariaceae*, is a lovely crimson. Each depression, too, may exhibit slight differences in the same species from others in hog-wallows in the same region.

*Lennoaceae* is a family of root-parasites with monotypic genera native in southern California, *Pholisma* Nutt. in the San Diego-Lower California region, and *Ammobroma* Torr. abundant in Mexico. *Ericaceae* and *Vacciniaceae* have no endemic genera. The species in *Arctostaphylos* L. are numerous and inter-related. Some species occur over extensive areas, sometimes exclusive and forming an especially Californian effect in the landscape. *Arbutus* L. has species in California, Arizona and Mexico, but otherwise is unknown in North America. Other species are in the Canary Islands and Mediterranean region and this distribution suggests preglacial occurrence. Several genera, such as *Comarostaphylis* Zucc. and *Xylococcus* Nutt. in the San Diego-Lower California area, are intermediates and have been included in *Arctostaphylos* by some authors.

The *Monotropaceae* have genera endemic in the Pacific Coast states but none is exclusively Californian. These are *Sarcodes* Torr., *Newberrya* Torr., *Pleuricospora* Gray and *Allotropa* T. & G.

*Primulaceae* has endemic species in *Dodecatheon* but no endemic genera. *Primula suffrutescens* Gray of the alpine zone is a woody-based species in a genus of chiefly herbaceous plants. *Plumbaginaceae*, *Styracaceae*, *Oleaceae* and *Gentianaceae* have no endemic genera. In *Gentianaceae*, *Centaurium* Hill, *Gentiana* L. and *Swertia* L. have endemic species. *Apocynaceae* has only one endemic genus, the lovely *Cycladenia* Benth.; *Asclepiadaceae* also only one, *Solanoa* Greene, which Gray included in *Gomphocarpus* but Jepson considers distinct. Several endemic species are in *Asclepias*. The species in *Convolvulus* are in a state of uncertainty and there are no endemic genera in the family.

In the *Polemoniaceae*, the diversity of opinion is due to the inter-related genera that have at one time all been included in *Gilia*. However, none is exclusively Californian but the numerous species in all entities and the beauty and abundance of the flowers over many areas produce one of the loveliest features in the landscape.

No endemic genera are in *Verbenaceae*, and only *Acanthomintha* Gray in *Labiatae*. The species in *Monardella* Benth. are variable and limits often indefinite; but some endemic species are quite distinct. *Audibertia* Benth., now included in *Salvia* L., is a common bee-plant in California. Many species of *Salvia*, most

of them endemic, are very abundant over areas where they give character to the landscape. *Antirrhinum* L., *Penstemon* Mitch., *Orthocarpus* Nutt., *Castilleja* Mutis, *Mimulus* L. and *Collinsia* Nutt. of *Scrophulariaceae* are rich in endemic species, some with innumerable individuals that color the ground, but the family has no endemic genus.

Among the *Hydrophyllaceae*, monotypic *Lemmonia* Gray and *Draperia* Torr. are endemic. Lincoln Constance in Madroño V. has made some changes in *Ellisia* L. and *Nemophila* L. He has restored *Eucrypta* Nutt., a monotypic endemic, formerly *Ellisia chrysanthemifolia* Benth. Into the genus *Pholistoma* Lilja he transfers *Ellisia membranacea* Benth., *Nemophila aurita* Lindl. and *N. racemosa* Nutt. These, if eventually adopted, will be endemic although *N. racemosa* is also in northern Lower California. *Phacelia* Juss., *Nemophila* Nutt. and *Eriodictyon* Benth. are rich in endemic species, abundant also in individuals wherever growing and a very noticeable feature in landscape coloring, often recognizable from afar.

The greatest diversity exists among authors as to the limiting factors in closely related genera in *Boraginaceae*. None of these entities, however, is restricted to California, but they are a perplexing problem. Among species, too, there is difficulty. *Amsinckia* Lehm. is the most hopeless. Wm. M. Suksdorf, in a revision in German, published at his own expense, describes more than 200 species. The four sections in which he places them seem fairly distinct from the character of the nutlets, and perhaps the only present solution is to reduce them to the four sections: *A. intermedia* F. & M. representing *Muricatae*; *A. spectabilis* F. & M., *Microcarpae*; *A. Douglasii* DC., *Tessellatae*; and *A. vernicosa* H. & A., the *Vernicosae*.

Endemic genera in the *Compositae* are fewer than one would expect in this large family. The following list includes all:

*Pentachaeta* Nutt. Southern to middle California.

*Lessingia* Cham. From northern to southern California and with one species in Arizona.

*Corethrogyne* DC. From southern to northern California and extending into Oregon along the coast.

*Whitneya* Gray. Monotypic perennial, a mountain species.

*Venegasia* DC. Monotypic perennial, Santa Barbara and southward.

*Monolopia* DC. Middle and southern California with several species.

*Blennosperma* Gray. Monotypic annual in wet places in middle California.

*Crockeria* Gray. Monotypic annual in alkaline areas, chiefly in the San Joaquin and Kings River Valleys.

*Eastwoodia* Bdg. Monotypic shrub in areas adjacent to the San Joaquin Valley and other hot areas in middle California.

*Tracyina* Blake. Monotypic in northern California.

*Phalacroseris* Gray. A mountain monotype.

*Raillardella* Gray. A mountain genus also in Nevada on the Sierra Nevada boundary.

The plants known in California as tar-weeds are very common. The following genera, which were formerly included in *Hemizonia*, are considered to be distinct by some authors, namely: *Centromadia* Greene, *Calycadenia* DC., and *Blepharizonia* (Gray) Greene. All are endemic. *Madia* Mol. is also South American with one similar species. *Hemizonella* Gray, of this group, is a small annual but not exclusively Californian.

Most of the genera of *Compositae* are widely distributed but many endemic species are among them.

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## VAUCHERIA SCHLEICHERI IN NORTH AMERICA

By JULES BRUNEL

In 1895, the Belgian botanist Émile de Wildeman, studying the Algae of J. Cl. Schleicher's herbarium at the University of Lausanne, found a new species of *Vaucheria*, which he named *V. Schleicheri* (1), after the name of the collector, a Swiss botanist who lived in the first decades of the 19th century. A good plate accompanied this original description.

Wildeman naturally knew nothing of the habitat of the new species, the label accompanying the specimen bearing only these words: *Conferva amphibia*  $\gamma$  *lucida*. *In fossis Vallesiae et Noville*. But he supposed it might have been collected in saline water, because there are salt springs in that part of the Valais where Schleicher lived and collected (fig. 1).

Heering (2), in 1921, included *V. Schleicheri* in his Siphonales of Central Europe, but his treatment is based entirely on the original description, nobody having found the plant again anywhere during the period 1895-1921. Wildeman's description and figures were carefully copied by Heering and an adequate key to species was prepared, enabling one to identify the plant with ease and certainty. The only difference between Wildeman's and Heering's descriptions lies in the fact that, whereas the former inferred that the habitat was inland brackish water, the German author affirmed that *V. Schleicheri* grew



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