

The Vegetation of the Mojave and Colorado Deserts

by Leah Gardner

Introduction

Many travelers perceive the California desert as little more than a desolate wasteland, inhabited by a monotonous expanse of creosote bush (*Larrea tridentata*). But spending time off the beaten path, with a greater attention to detail, uncovers an amazing diversity of plant life which exhibits a fascinating array of adaptations to the challenges of surviving in the desert. Variations of climate, substrate, and elevation support a patchwork of different vegetation associations and many of the species are found only here in the California Desert ecoregion.

The flora of the California deserts is of relatively recent origin, developing in response to rapid drying and warming trends over the past 10,000 years. Species now restricted to the high elevations of the desert mountains, such as pinyon pine (*Pinus monophylla*, *P. edulis*) and juniper (*Juniperus* sp.), were widespread throughout the lowlands when the dry basins we see today were filled with freshwater lakes. The heat- and drought-tolerant species that dominate today's desert landscapes were confined to lower elevations and more southerly latitudes before expanding their range along with the increasing temperatures and decreasing rainfall patterns.

Contrasts between the Mojave and Colorado Deserts

The California Desert province is divided into the Mojave and Colorado Deserts, a division based on climate and latitude. The Mojave receives less summer rainfall and endures longer periods of freezing temperatures than the Colorado Desert with its more southern location, lower elevation and exposure to a summer monsoon rainfall pattern. Precipitation also increases with elevation so that greater plant diversity and abundance can be found in the desert mountains. Thus, variations occur north to south and east to west across the landscape.

The Mojave Desert supports an estimated 2500 plant taxa, with over 200 of them endemic to California (Barbour et al., 2007). The Colorado Desert is roughly half as rich in species. Some distinctive plants of the Colorado Desert that are not found elsewhere in California - and thus considered indicator species - include ocotillo (*Fouquieria splendens*), ironwood (*Olneya tesota*), desert lavender (*Hyptis emoryi*), desert agave (*Agave deserti*), chuparosa (*Justicia californica*), and California fan palm (*Washingtonia filifera*) (Baldwin, 2002). Joshua tree (*Yucca brevifolia*) and Mojave yucca (*Yucca schidigera*) are considered indicator species for the Mojave region.

The transition zone between the Colorado and Mojave deserts occurs approximately between Banning to the west and Needles to the East (Barbour, et

al., 1991). South of this imaginary line, plants distinctive to the Colorado Desert become more prevalent. However, many species cross this imaginary line, making the transition zone a subtle blending rather than a sharp contrast.

The Mojave Desert

The Mojave is the smallest and driest of the four North American deserts, covering approximately 50,000 square miles including portions in Nevada, Arizona, and Utah (MacKay, 2003). The region is topographically diverse, composed of a series of mountains and valleys as part of the Basin and Range Geomorphic Province. Elevations range from 282 feet below sea level in Death Valley to high mountain peaks above 11,000 feet, but generally lie between 2,000 and 6,000 feet. It is often considered a transitional zone between the Great Basin to the north and the Colorado Desert to the south, exhibiting some of the characteristics of each region.

The division between the eastern and western Mojave Desert runs through the Cadiz and Bristol Dry Lake valleys, up through Broadwell Dry Lake and Soda Lake, then north through Death Valley (Barbour, 2007). The Mojave is a rainshadow desert, with most of the precipitation intercepted by the Sierra Nevada Mountains. The western Mojave receives an average of 5 inches of precipitation annually during the winter months, while the eastern Mojave receives half of its rainfall during the summer months. Winter temperatures are too cold in the Mojave for most species of cacti. The growing season lasts between 200 and 300 days.

The Colorado Desert

The Colorado Desert refers to the portion of the larger Sonoran Desert lying in the Lower Colorado River Valley of southeastern California. Most of the Colorado Desert lies between sea level to 3,000 feet, with a low point of 275 feet below sea level in the Salton Trough and high peaks reaching nearly 10,000 feet. Encompassing approximately 7 million acres, the Colorado is lower, flatter, and warmer than the Mojave (Hickman, 1993). The Colorado Desert's latitude, low elevation, and proximity to the sea give it a subtropical desert climate with infrequent freezing temperatures. With precipitation blocked by the Peninsular Range, a meager 2-3 inches of rain falls on the Colorado River Valley. Most of it comes in winter, but some of the summer monsoonal rain from Arizona and Mexico spills over into this region (Spellenberg, 2002). Summer temperatures can exceed 120 degrees and the growing season lasts from 250 to 350 days.

Cactus and succulents are common throughout the greater Sonoran Desert, but southeastern California is too hot and dry to support the large columnar cactus such as Saguaro – *Carnegia gigantea* (a few populations occur near the Colorado River) – that

characterize the landscapes of Arizona. Trees in the legume family, such as honey mesquite (*Prosopis glandulosa*) and smoketree (*Psoralea argemone*), are also common in the greater Sonoran Desert, but in California are restricted to watercourses. Ocotillo (*Fouquieria splendens*) is often considered an indicator species for the Colorado Desert.

Plant Adaptations to Desert Conditions

Due to the low rainfall and high temperatures found in deserts, evaporation exceeds precipitation. To cope with this situation, desert plants have evolved a wide range of structural and physiological adaptations to minimize water loss. These drought-tolerant plants, called “xerophytes”, may escape, avoid, or endure drought conditions, resulting in a wide assortment of strange and beautiful plant forms.

Annuals: An annual plant germinates, grows, flowers, sets seed and dies within one year, avoiding drought in a dormant state within the seed. Annuals are also referred to as ephemerals due to their short life spans. Seeds of desert plants remain viable for long periods, only germinating when conditions are right. Winter ephemerals germinate and grow in response to sufficient fall and winter rainfall, while summer annuals respond to adequate amounts of summer monsoon rains, blooming in late summer and early fall when the rest of the desert plants are dormant. During most years, the annuals are absent or few. Rarely, perhaps once in a decade, above average precipitation triggers widespread germination of annual plants which blossom into spectacular carpets of wildflowers. One such event occurred in 2005 causing millions of tourists to descend on Death Valley to view the breathtaking spring floral displays .

Herbaceous Perennials– Herbaceous perennials are plants that live for more than one year, but their tops die back to an underground portion. The underground root may be enlarged into a bulb or tuber for storing extra carbohydrates. This allows them to avoid the drought by surviving underground during the hot, dry season. Examples of desert herbaceous perennials are jimson weed (*Datura wrightii*) and desert lily (*Hesperocallis undulata*).

Succulents – Succulent plants are able to store water in their leaves and stems and have a waxy coating to retard water loss. Leaf succulents may have a rosette form, such as in the yuccas and agaves. The leaves are arranged on the stem so as to funnel water towards the plant’s roots. Stem succulents have a cylindrical or spherical shape to reduce surface area relative to volume. Most stem succulents in North America are members of the cactus family. Further adaptations in the cactus family are the reduction of leaves to spines, ribs that can expand or contract for water storage, and a

special type of photosynthesis that allows the plants to open their pores only at night. Cactus with flat pads, such as beavertail (*Opuntia basilaris*), keep their pads angled for the least amount of exposure to the summer sun.

Shrubs – Shrubs are the most common life form in the California deserts and display the widest assortment of adaptations to drought and heat stress. Many are drought-deciduous, with the ability to drop their leaves to stop water loss when conditions become too unfavorable. Those that retain their leaves year round are the drought-enduring evergreen shrubs. They withstand the heat with diminished or divided leaf surfaces or have pale-colored or hairy leaves to reflect sunlight. Waxy coatings or very small pores to minimize water loss are also common adaptations. Leaves may also be oriented upright for minimum exposure to the sun. Look for a combination of these characteristics when examining desert shrubs.

Trees – Because of their larger structure, trees require greater amounts of water to survive and can only endure in the deserts where extra amounts of moisture are available – in desert mountains, washes, and riparian zones. “Phreatophyte” is a term applied to deep-rooted plants that obtain water from a permanent underground supply. Roots of honey mesquite (*Prosopis glandulosa*) can tap into water at a depth of 160 feet (Barbour, et al., 1991).

Vegetation Types

Plant assemblages are categorized into vegetation types based on a combination of life forms, dominant species, and habitat types. Several classification schemes have been developed by botanists over the years. The following is a simplified summary of currently accepted vegetation types for the Mojave and Colorado Deserts.

Desert Scrub – This vegetation type, dominated by woody shrubs, dominates most of the low elevation areas of both deserts. It can be further broken down by species associations.

Creosote Bush Scrub – Creosote Bush Scrub is the most common desert scrub type, covering approximately 60- 70% of the desert floors and alluvial fans across the Mojave and Colorado Deserts of California (Barbour, et al., 2007). Creosote bush is an evergreen shrub, able to withstand a wide range of conditions, but typically occurs in areas receiving between 2 to 8 inches of rainfall in both the Mojave and Colorado Deserts. Common associates include burro bush (*Ambrosia dumosa*), brittle bush (*Encelia farinosa*, *E. actoni*, *E. virginensis*), and cheesebush (*Hymenoclea salsola*). Mojave yucca (*Yucca schidigera*), silver

cholla (*Opuntia echinocarpa*), and beavertail cactus (*Opuntia basilaris*) are often encountered amid the broadly spaced shrubs.

Blackbush Scrub – This vegetation association, dominated by Blackbush (*Coleogyne ramosissima*), gives the landscape a drab color across a range of elevations up to 5,000 feet. It can be found in large dense stands on north-facing slopes or as an understory with Joshua Tree Woodland or Pinyon-Juniper Woodland. Some of the associated species include Mormon tea (*Ephedra nevadensis*, *E. viridis*), hop-sage (*Grayia spinosa*), winter fat (*Krascheninnikovia lanata*) and horsebush (*Tetradymia stenolepis*). Though more common in the Mojave, Blackbush Scrub also occurs in the Colorado.

Saltbush Scrub and Shadscale Scrub – These communities are frequently associated with moderately alkaline soils. Dominant species of the Saltbush Scrub are comprised of several members of the *Atriplex* genus including saltbush (*Atriplex canescens*), shadscale (*A. confertifolia*), and allscale (*A. polycarpa*). These species, along with hop-sage and winter fat, make up the Shadscale Scrub vegetation community at higher elevations in the northern Mojave and around Death Valley.

Alkali Sink – In the lowest desert basins, water collects and evaporates, leaving behind salts and soils with a high pH. Plants that can live along the margins of the dry barren lake beds (playas) in these alkali sinks are called “halophytes”, literally meaning salt loving. Many of the halophytic shrubs possess fleshy leaves and stems. Examples of halophytes include saltgrass (*Distichlis spicata*), arrow-scale (*Atriplex phyllostegia*), iodine bush (*Allenrolfia occidentalis*), bush seepweed (*Suaeda moquinii*) and yerba mansa (*Anemopsis californica*).

Cactus Scrub – This community is dominated by a variety of cactus species alone or may be composed of a mixture of cacti, drought-deciduous shrubs, and succulents. Occurring on dry, rocky south-facing slopes, this plant association is found more commonly in the Colorado Desert than in the Mojave. The Mojave is home to over 20 species of cactus while the Colorado contains more than 125 species in the cactus family.

Joshua Tree Woodland - Joshua trees (*Yucca brevifolia*) are unique to the Mojave and are found between 2,500 and 4,500 feet in areas receiving 6 to 15 inches of rainfall. Other interesting plants found among these dramatic Mojave indicators are the Mojave yucca (*Yucca schidigera*), bladder sage (*Salazaria mexicana*), boxthorn (*Lycium andersonii*, *L. cooperi*), desert sage (*Salvia dorrii*), and many species of wild buckwheat

(*Eriogonum* spp.). The leaves of the Joshua tree are much shorter than those of the Mojave yucca, thus the name “brevi folia” (see photo). Cima Dome is home to one of the largest intact expanses of Joshua Tree Woodland in the world.

Pinyon-Juniper Woodland – An open woodland composed of pinyon pine, and junipers occurs above 4,500 feet where they can receive over 12 inches of precipitation annually, some of it falling as snow. These evergreen conifers were much more widespread throughout southeastern California in the past but have retreated to their mountain refuges as the climate dried and warmed. This woodland is also a common vegetation type in the mountains of the Great Basin. Shrubs found in the understory include many from the Great Basin such as sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), mountain mahogany (*Cercocarpus* sp.), and Mormon tea (*Ephedra viridis*).

Desert Dune – Sand dunes in the desert can absorb and store water like giant sponges. Plants growing on the dunes need to have deep roots to reach this valuable resource. They must also tolerate the challenges of heat, wind, abrasion, and sand movement. Plants tend to be widely scattered with low cover, except during the rare explosions of wildflowers during years of excessive precipitation. Dune plants include many of those common to other areas of the desert, as well as some found only on the dunes. Common dune plants are Honey mesquite, desert willow, desert sand-verbena (*Abronia villosa*), and desert evening-primrose (*Oenothera deltoidea*).

Plants found only on sand dunes and sand flats are referred to as psammophytic vegetation. They tend to be low-growing perennials and rhizomatous grasses. The Eureka Dunes are home to three endemic species found nowhere else: Eureka dunes grass (*Swallenia alexandrae*), Eureka Dunes evening-primrose (*Oenothera californica* ssp. *eurekensis*), and Eureka milkvetch (*Atriplex lentiginosus* var. *micans*). The Kelso Dunes, the largest dune system in the Mojave Desert, supports 75 indigenous species with several endemics. The Algodones Dunes, largest in the entire United States, host six unique taxa, including Peirson’s Milkvetch (*Astragalus magdalenae* var. *peirsonii*) (Barbour, et al., 2007).

Desert Wash Woodland or Microphyll Woodland – Washes occur in canyons and drainages subject to infrequent but sometimes severe flooding. Assemblages of shrubs and trees that can successfully establish in these conditions are found in and along the washes. Desert willow (*Chilopsis linearis*) and Catclaw (*Acacia greggii*), Honey mesquite, Smoketree (*Psorothamnus spinosus*), and Palo verde (*Cercidium floridum*) are examples of trees commonly found along desert washes. Wash shrubs include desert waterweed (*Baccharis sergiloides*), Bladderpod (*Isomeris arborea*), Chuparosa

(*Justicia californica*), desert lavender (*Hyptis emoryi*), and indigo bush (*Psoralea schottii*). The desert wash community is better developed in the Colorado Desert and often goes by the name “Microphyll Woodland” due to the dominance of small-leaved trees in the legume family. We will visit several washes on our field trip including San Felipe Wash and Fish Creek Wash.

Desert Riparian - Extensive riparian zones are found along some stretches of the Mojave, Colorado, and Amargosa Rivers where water is available year-round. Elsewhere, springs provide water for year-round creeks in isolated canyons of desert mountains. Cottonwoods (*Populus fremontii*), several species of willows (*Salix* spp.) and mesquite are the most common trees of the riparian areas. Desert broom (*Baccharis sarothroides*) is common along with many other shrubs, grasses and herbs.

Palm Oasis – The Palm Oasis is a special type of riparian community found only in the Colorado and Sonora Deserts. The California fan palm, *Washingtonia filifera*, is the dominant characteristic species although other riparian plants are present. Chuparosa is common in the understory, its red tubular flowers attracting hummingbirds during spring. Individual palms may grow up to 30 meters tall and live for 250 years or more. Palm groves are found along geologic faults where breaks in the bedrock allow fresh water, as hot or cold springs, to come to the surface. California fan palms are now commonly grown as ornamentals, but their natural distribution is limited to widely separated groves in southeastern California, southern Nevada, southern Arizona, and northwest Mexico. Several good examples of this rare ecological community can be accessed from Borrego Springs and throughout Anza Borrego State Park.

Invasive Species

The spread of invasive exotic plants and animals has become an urgent environmental threat throughout California, second only to habitat loss as the cause of species endangerment. While many non-native plants are not harmful, the noxious weeds crowd out native plants, compete with natives for limited resources, lower productivity for agriculture and grazing, and alter fire regimes. The worst culprits in our desert ecosystems are tumbleweed or Russian thistle (*Salsola tragus*), cheatgrass (*Bromus tectorum*), Saharan mustard (*Brassica tournefortii*), giant reed (*Arundo donax*), and tamarisk or saltcedar (*Tamarix ramosissima*).

The latter two weeds have overtaken riparian zones along river channels, irrigation canals, and other wetland habitats, eliminating native species by outcompeting with for water, increasing soil salinity, and decreasing habitat values. A prime example of this can be seen at the Cibola National Wildlife Refuge along the

Colorado River where native mesquite and willow have been almost totally supplanted by giant reed and tamarisk.

Saharan mustard is problematic in the Colorado Desert, especially in sensitive habitat areas, such as washes and dunes, in the Imperial Valley. In the Algodones Dunes, Saharan mustard is threatening several rare plant species (DoTomaso, et al., 2007). Cheatgrass is mostly a problem in the Great Basin but extends into the California deserts. Its presence provides a continuous cover, allowing the spread of wildfires in ecosystems that have not evolved adaptations to frequent fires. Two other exotic grasses, Arabian grass (*Schismus barbatus*) and Mediterranean grass (*Schismus arabicus*) are also common desert weeds.

Invasive species are not the only threat to native plants of the California deserts. Other threats include suburban expansion, power generation, military training, off-highway vehicles, grazing, mining, and agriculture – the latter due to both land conversion and the lowering of the water table (Barbour, et al., 1991). Once damaged, the desert is extremely slow to recover; natural revegetation can be measured in centuries.

But at least for the present, there are many beautiful intact desert ecosystems for us to enjoy and study. Large tracts of desert land are protected as national and state parks or monuments. With their unique assemblages of plants, geomorphological diversity, rich history, and wide open spaces, the Mojave and Colorado Deserts of California are waiting for us to explore, appreciate, and protect.

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