Galleta
Hilaria jamesii

Threeawn
Aristida longiseta

Ringtail
Bassariscus astutus
511

Least Chipmunk
Eutamias minimus
497

Desert Woodrat
Neotoma lepida
493

White-tailed Antelope Squirrel
Ammospermophilus leucurus
499

Sagebrush Lizard
Sceloporus graciosus
212

Tree Lizard
Urosaurus ornatus
205

Side-blotched Lizard
Uta stansburiana
202

Gopher Snake
Pituophis melanoleucus
263

Striped Whipsnake
Masticophis taeniatus
221

White-tailed Prairie Dog
Cynomys gunnisoni

Plateau Whiptail
Cnemidophorus velox

Western Whiptail
Cnemidophorus tigris
206

Glossy Snake
Arizona elegans
268

Night Snake
Hypsiglena torquata
267

The grass component is diverse. In many places, however, certain species are so abundant that they have been accorded the rank of a separate vegetation type. The association involving Galleta and Threeawn forms one of these groups, which occurs at about 5000 feet or slightly higher, in southeastern Utah.

Animals in the arid portion of the Plateau include species that also have wide distributions in either the grasslands or the Great Basin Desert. Of the species that are discussed in the context of other deserts, those occurring here include the Ringtail, the Least Chipmunk, the Desert Woodrat, the White-tailed Antelope Squirrel, and the Black-tailed Jack Rabbit. In addition, several desert reptile species are common, among them the Sagebrush, Collared, Tree, and Side-blotched lizards and the Gopher Snake and Striped Whipsnake. Unique to the area are the White-tailed Prairie Dog; the Plateau Whiptail, a handsome striped lizard with a bluish tail; and several subspecies of lizards and snakes. These characteristic subspecies include the Northern Whiptail, a form of the Western Whiptail; the Painted Desert Glossy Snake; the Mesa Verde Night Snake; and the Midget Faded Rattlesnake, a diminutive, pinkish form of the Western Rattlesnake.

The reptile and mammal species that are characteristic of the Great Basin Desert but do not occur on the Colorado Plateau underline by their absence the unique nature of the arid areas of the Plateau. These mammals include the Sagebrush Vole, the Kit Fox, Merriam's Kangaroo Rat, several species of pocket mice, the Chisel-toothed Kangaroo Rat, and both species of kangaroo mice. Of the missing reptiles, the most prominent are the Desert Horned Lizard, the Longnose Snake, the Ground Snake, the Zebratail Lizard, and the Patchnose Snake.

The birds here are generally those that are typical in the deserts or grasslands. Most of the species common in arid areas are included in this book.

Since the Colorado Plateau contains many mountains exceeding 11,000 feet in elevation, along with their associated montane floras and faunas, a significant part of the region's biota is beyond the purview of this book.

Although the coverage of the details of the Plateau given here is scant because the region is not a true desert, this field guide will be appropriate to use in locales marked by low elevation and sparse, shrubby vegetation. This superficial coverage is not meant to demean an area that is geologically among the most spectacular in the entire world. The Colorado Plateau offers an incredible experience, one that can be a welcome break as you tour the true deserts of North America.

THE MOJAVE DESERT

Like most other North American deserts, the Mojave Desert is contained in the Basin and Range Province. Many biologists have claimed that there is no Mojave Desert per se, but that in fact the area is really a transitional vegetation type wedged between the Great Basin Desert to the north and the Sonoran Desert to the south. This point of view has its strengths: Physiographically the Mojave Desert is clearly intermediate because it straddles two separate sections of the Basin and Range Province, the Great Basin Section to the north and the Sonoran Desert Section to the south. Since both of these Sections are simply subdivisions of the overall Basin and Range Province, there are obvious similarities between them; for example, both contain mountain ranges separated by basins that are generally drained internally and are accompanied by playas.

The two Sections also differ in some ways. In general, the basin floors of the Sonoran Desert are lower in elevation than those of the Great Basin. The Great Basin has base elevations of 4000 feet or higher, while elevations in the Sonoran section are usually quite a bit less than 3000 feet; in the extreme, they may be below sea level. The lowest point in the United States occurs in the Mojave Desert at Death Valley National Monument in California, where the elevation is 282 feet below sea level. This is in stark contrast to the 11,049-foot Telescope Peak in the Panamint Range just west of Badwater. The fact that the biological boundaries of the Mojave Desert do not coincide with the boundaries of one of the Sections defined by landscape physiography can be confusing. As you move to the south end of the Great Basin, there is a decrease in elevation—and rather an abrupt one. But you must travel even farther south at these lower elevations before you reach the Sonoran Desert Section boundary. On the other hand, the biologically based Great Basin Desert ends at the elevational break and the Mojave Desert commences. Thus, the physiographic and biological subdivisions do not coincide. Routes along two major highways make this somewhat clearer. Traveling from the Great Basin Desert near Tonopah, Nevada (6030 feet), you cross the area of the Great Basin Desert/Mojave Desert biological transition near Beatty, Nevada (3830 feet). Farther south, just past Las Vegas, Nevada (2200 feet), you approach the Great Basin Section/Sonoran Section physiographic boundary. A similar situation occurs traveling south along I-15 from Cedar City (5834 feet) in the Great Basin Desert of Utah down to St. George, Utah (2880) feet, obviously in the Mojave Desert. Farther south of St. George, in the Beaver Dam Wash area astride the Utah-Arizona border, you reach the lowest point in Utah (2350 feet), but it is still a bit farther south to the physiographic boundary.

The northern portion of the Sonoran Desert physiographic section—that area occupied by the Mojave Desert—differs from the rest of the Sonoran Desert Section in that its basins, for the most part, have internal drainages. In this, they resemble the basins of the Great Basin Province, and differ from the southern Sonoran Desert Section, which is traversed

by rivers connecting to the Gila and Colorado rivers. Obviously, where this is the case, internally draining basins no longer exist.

The low elevations of the Mojave Desert generally foster warmer year-round temperatures than those recorded in the Great Basin. Although freezing days do occur, the number of frost-free days still greatly exceeds 200 days a year, even in the extreme northern part of the Mojave Desert. Because of this moderate environment, agriculture is quite feasible where water is available. The early pioneers soon recognized this. The Mormons attempted to produce cotton in the area around St. George, Utah, giving this area its local nickname of Dixie. Summer air temperatures, which regularly approach 120° F, can be among the highest in the United States. The all-time recorded maximum air temperature for the United States—134° F—was recorded in Death Valley. Under Mojave Desert summer conditions, ground surface temperatures may reach 190° F.

Rainfall is scant. Total rainfall for most sites is less than six inches per year: In Las Vegas, Nevada, it is 4.13 inches; in Barstow, California, 4.25. It may be greater on the desert boundary; in St. George, Utah, for example, the average is 7.95 inches. Death Valley has an annual rainfall average of 1.7 inches, and in an average of two years out of fifty, no rainfall is recorded for twelve months. From sixty-five to ninety-eight percent of the total rainfall arrives in winter.

Warm temperatures and high winds cause high evaporation rates. Saline soils and bodies of saltwater, however, evaporate at rates lower than their freshwater counterparts. Thus, saline playas dry at a slower rate than an equivalent freshwater lake.

Plant Life

In general the vegetation of the Mojave Desert is dominated by low, widely spaced shrubs (plate 18), a growth form that develops in response to limited rainfall. In the spring, however, following winters of gentle rainfall, annual flowers make their ephemeral appearance as a kaleidoscope of colors on the landscape, a stark contrast to the Great Basin Desert. In some places, such as Lucerne Valley, California, eighty-two to eighty-eight percent of the plant species recorded on desert sites were annuals. In years of good rainfall, the density of annuals can exceed seventy plants per square yard on many sites, and may reach densities of four hundred or more per square yard in certain areas. There is no lack of diversity in this spring flora: 250 species of annuals occur in the Mojave Desert. Of that number, eighty percent are endemics, that is, their range of distribution is confined to the Mojave Desert.

In comparison with typical Great Basin Desert sites, the Mojave has more species of cacti. Most grow low to the ground and are thus not as conspicuous as Sonoran Desert species. However, when the Beavertail Cactus is covered with its brilliant magenta flowers, it is quite spectacular.

Species of yuccas also dominate some sites in the Mojave Desert. One of these, a treelike yucca, the Joshua-tree, is

Beavertail Cactus
Opuntia basilaris
41

Joshua-tree
Yucca brevifolia
326

virtually synonymous with the Mojave Desert in the minds of the traveler (and the cowboy-movie enthusiast). (The "tree's" common name, it is speculated, derives from the resemblance of its upraised limbs to the arms of Joshua leading the Israelites.) In fact, the Joshua-tree generally occurs on the biological edges of the Mojave—that is, at higher elevations—where it is a sign of transition. Nevertheless, its extremes of geographic distribution essentially outline the generally accepted boundaries of the Mojave Desert. The Joshua-tree reaches great densities and large sizes in some areas; a few reach nearly fifty feet in height. Two other yuccas are characteristic of many sites here, the Blue Yucca and the Mojave Yucca. Neither usually exceeds five feet in height.

It is convenient to divide the Mojave Desert into two general vegetation types, a northern half with close affinities to the Great Basin Desert and a southern half with similarities to the Sonoran Desert. This should not, however, belittle the relative uniqueness of the Mojave Desert as a vegetation type. Nearly one quarter of all the Mojave Desert plants are endemics. In addition to the Joshua-tree, endemic perennials with broad distributions in the Mojave include Parry Saltbush, Mojave Sage, and Woolly Bur Sage. Many local areas have their own endemic species. Searching for these narrowly distributed plants—rare both ecologically and geographically—can be a source of great enjoyment.

Blue Yucca
Yucca baccata
336

Mojave Yucca
Yucca schidigera
329

Parry Saltbush
Atriplex parryi

Mojave Sage
Salvia mohavensis

Woolly Bur Sage
Ambrosia eriocentra

By an accident of history, the Mojave-Great Basin desert transition has been as intensively studied as any other desert site in North America. From Mercury, Nevada, north for eighty miles there exists a bombing range and nuclear weapons test facility, the Nevada Test Site, that covers an area of 1350 square miles. The fauna and flora of this area have been scrutinized to establish the effects of radiation on natural communities. These studies have provided a vast legacy of information about the nature of the Mojave Desert.

In the area of the test site, the transition from Creosote Bush-dominated hot desert communities to those dominated by Great Basin Desert species occurs. A good indicator of the change is the amount of annual rainfall. When the annual rainfall is less than 7¼", Creosote Bush communities dominate. Above that level, Big Sagebrush and Shadscale are more abundant. When rainfall is just at or close to the 7¼" level a truly transitional community occurs, one composed of Blackbrush, squawberries, *Lycium* species, and Hopsage. Blackbrush and Hopsage occur in the Great Basin; squawberries are more characteristic of the Sonoran Desert. Often all three of these communities may be found within a few yards of one another. Thus, one can see Great Basin and Mojave Desert sites, as well as the transitional communities, in a single well-planned stop.

Creosote Bush
Larrea tridentata
342

Big Sagebrush
Artemisia tridentata
353, 357

Shadscale
Atriplex confertifolia
346

Blackbrush
Coleogyne ramoisissima
348

Hopsage
Atriplex spinosa

The more characteristic hot desert sites, those dominated by Creosote Bush, are quite variable in composition. Part of this diversity is due to the fact that bajadas are very well developed in the Mojave Desert. Differences between plant communities at the top and at the bottom of a bajada can be stark

Desert Holly
Atriplex hymenelytra
358

Cattle Spinach
Atriplex polycarpa

At the very bottom of bajadas, where fine soils predominate, one of two saltbush species may form nearly pure stands. In areas with high percentages of carbonate rocks, Desert Holly exists in densities characteristically numbering fifty individuals per acre but sometimes reaching up to 250 plants. Where there is less carbonate, Cattle Spinach, a larger plant, predominates at about the same density.

As one moves up the bajada, Creosote Bush begins to appear, mixed in places with Cattle Spinach or Holly. Creosote Bush is found from 240 feet below sea level in Death Valley to over 4000 feet elsewhere—even to 5200 feet on southern exposures. Creosote Bush, a species that is related to the shrubs that dominate the Monte Desert of Agentina, occurs in all of the hot deserts of North America, its distribution coinciding nearly perfectly with their boundaries. In fact, Creosote Bush so dominates the hot deserts that their characteristic smell following warm rains is that of the plant's resinous leaves. Walking in a landscape steeped in this pungent odor is one of the great pleasures of my life.

The roots of Creosote Bush seem to require a relatively large amount of oxygen and to be unable to tolerate much salinity. As a result, the plant generally does not grow on fine or poorly aerated soils. Throughout the Mojave Desert, stands dominated by Creosote Bush cover more than seventy percent of the land surface. The presence of Creosote Bush is perhaps the best indication of your whereabouts in the transition zone between the Great Basin and the Mojave deserts: If Creosote Bush is present, you are in the Mojave.

It is difficult to count "individual" Creosote Bushes because the species readily reproduces vegetatively. Viewed from above, cloned individuals form a circle of shrubs, a growth pattern often called a fairy ring. This ring continues to expand over time, and its size has been used to estimate some surprising ages: Some clones have persisted for 9000 years!

Because of its wide distribution, Creosote Bush is found in association with a variety of other desert shrubs. This variety is even evident in what at first appear to be similar zones on different bajadas. One of the most common associations in the Mojave, as well as the Sonoran Desert, is represented by stands covering hundreds of acres dominated essentially only by Creosote Bush and a bur sage (*Ambrosia*). This *Larrea-Ambrosia* community also occurs on the flats. In the Mojave Desert the most common species occurring with Creosote Bush is White Bur Sage, but Woolly Bur Sage may also occur in certain areas. Another species that along with Creosote Bush dominates the middle to upper portions of bajadas is Brittlebush. Its leaves are a soft gray-green, and it is often covered with bright yellow flowers. If the brittle stems are cracked, they exude a highly pungent, clear-yellowish resin. Early missionaries burned this resinous material as incense in their churches and Indians chewed it or used it as a glue.

Volcanic formations are common in some sections of the Mojave Desert. At dusk, on volcanic sites where Brittlebush occurs, the shrub's gray-green leaves and bright yellow flowers

White Bur Sage
Ambrosia dumosa
355

Brittlebush
Encelia farinosa
136

stand out against the black volcanic rocks—a beautiful and exciting sight.

Other locally abundant shrubs associated with Creosote Bush and characteristic of the Mojave Desert bajadas include the white-flowered Spiny Menodora, found on rocky slopes and mesas; one of three lyciums (*Lycium pallidum, L. cooperi,* or *L. andersonii*), all of which produce bitter red berries eaten by animals and occasionally man; a Mormon tea (*Ephedra*); the purple-flowered Ratany; Goldenhead; and Fremont Dalea, a species comprised of five geographically separate varieties. In addition to these, some sites are dominated by Spiny Senna, a legume species usually associated with washes, which is leafless most of the year and thus must carry on photosynthesis in its stems. Further up the slope one finds another unusual shrub, the yellow Paperflower. Paperflower looks much like any other yellow-flowered shrub, but unlike most plants, it does not lose its dead flowers.

Still farther up the bajadas, Creosote Bush is associated with Joshua-tree (plates 16 and 17). In such stands, where water is a bit more plentiful than on the lower bajada, several grasses and shrubs may also be dominant. Grasses include Big Galleta and Bush Muhly, and even certain gramas (*Bouteloua*). Blackbrush may also occur with Joshua-tree and Creosote Bush at such sites, even though Joshua-trees usually occur on more sandy or loamy soils than does Blackbrush. A species that occurs in parts of the Great Basin, Turpentine Broom, is also found in this association. Turpentine Broom is related to the orange and its fruit, though small and greenish-yellow, has the dimpled surface of an orange.

This description of a bajada is, of course, merely ideal; numerous variants occur depending on local conditions. At high elevations (3500 to 4000 feet) and in places where soils are a sandy loam, Creosote Bush is associated with Anderson Lycium and Hopsage. In some regions, particularly along the western half of the Mojave Desert, Turpentine Bush may be abundant; in good years it is joined by dense populations of a biennial locoweed, Freckled Milkvetch.

Throughout the Mojave Desert, Creosote Bush is also associated with Shadscale, particularly on sites characterized by calcareous soils. Such communities contain a greater variety of conspicuous herbs and are the main places where the Diamond Cholla occurs. A cactus of a different form that can be found in this assemblage, and in others, is the Barrel Cactus. This species, which is very noticeable in southern Utah and Nevada on rock outcrops, seems to become established only in rare years of very favorable rainfall. The result is that many individual plants in a particular area will all be of the same age.

Small drainage channels or washes have their own mixture of species. These include Burrobush, a dense, rather soft, shrub with threadlike leaves that is often covered with white flowers. Catclaw also grows here. This species forms large shrubs, or even small trees, and occurs from the Mojave, through the Sonoran, and into the Chihuahuan Desert.

Spiny Menodora
Menodora spinescens

Ratany
Krameria parvifolia

Goldenhead
Acamptopappus schockleyi

Fremont Dalea
Dalea fremontii

Spiny Senna
Cassia armata

Paperflower
Psilostrophe cooperi
137

Big Galleta
Hilaria rigida

Bush Muhly
Muhlenbergia porteri

Turpentine Broom
Thamnosma montana
366

Anderson Lycium
Lycium andersonii
351

Hopsage
Atriplex spinosa

Turpentine Bush
Haplopappus cooperi

Freckled Milkvetch
Astragalus lentigenosus
163

Shadscale
Atriplex confertifolia
346

Diamond Cholla
Opuntia ramosissima

Barrel Cactus
Ferocactus acanthodes
122

Burrobush
Hymenoclea salsola
365

Catclaw
Acacia greggii
303, 317

Honey Mesquite
Prosopis glandulosa
308, 321

Screwbean Mesquite
Prosopis pubescens
302, 311, 320

Fremont Cottonwood
Populus fremontii

Arrow Weed
Pluchea sericea
344

Four-wing Saltbush
Atriplex canescens
352

Desert Willow
Chilopsis linearis
306

Seep Willow
Baccharis glutinosa

In the same habitat—and on sandy flats and sand dunes, and in many other places as well—one encounters a species found in all North American hot deserts, the Honey Mesquite. Mesquite is a very characteristic plant of the entire Southwest and was a significant plant to all of the region's early inhabitants. Today it has reached an unprecedented popularity as a pungent fuel for barbecuing.

In washes, or along rivers where there is even more water, native trees dominate. One desert-adapted form is Screwbean Mesquite, which has the genus's characteristic compound leaves. It is easily recognized by its tightly coiled pod, which resembles a stout spring one to two inches in length. Screwbean is a useful tree, providing browse for cattle and wildlife, and its serviceable wood is used in tool manufacture. Another tree, Fremont Cottonwood, has a wide distribution in the Southwest and may occur at elevations up to 6500 feet and in a variety of riparian habitats. Cottonwood requires water close to its roots, so early travelers used its presence to signal a good spot to dig for water in the sands of watercourses. Associated with the native Cottonwood are the tamarisks (*Tamarix*). Three species of this Old World genus have been introduced into the southeastern United States. Their leaves make them look very much like some conifers, although they are not related. They occur in enormous densities in many places and often tend to replace native species.

Two other species associated with moist areas are Arrow Weed and Four-wing Saltbush. Both require a somewhat saline environment. The Devil's Cornfield in Death Valley, for example, is a nearly pure stand of Arrow Weed. This species, however, is not confined to saline areas, and grows in virtually impenetrable thickets along many rivers in the arid Southwest. The straight stems of Arrow Weed were used by Indians as shafts for their arrows.

Other wash species include the Desert Willow, which has large, beautiful, aromatic flowers, and the Seep Willow, which requires more moisture and is usually found near streams, ditches, or other semi-permanent waters.

In the Mojave Desert, as elsewhere, the high salinity areas, particularly those that have high water tables, contain a mixture of salt-tolerant species similar to those described for the Great Basin.

Animal Life

Scientists at the University of Nevada-Las Vegas have found the following number of species in Creosote Bush-dominated communities in the Mojave Desert of southern Nevada: thirty species of reptiles (fifteen snakes, fourteen lizards, one turtle); thirty-three species of birds, eight of them permanent residents; and forty-four species of mammals. The total number of species found in Blackbrush-dominated communities is smaller: nineteen reptiles, twenty-six birds, and thirty-three mammals. The same Creosote Bush areas contained 256 species of plants, while the Blackbrush communities contained only 185 species.

Even aquatic habitats such as desert springs and marshes were found to contain as many as twenty species of fish and seven amphibians, and they drew as many as 202 bird species. These figures show that the Mojave contrasts sharply with the Great Basin Desert, which has fewer kinds of plants and animals. The reasons for these differences are not clear; however, the shorter growing season in the North may limit the diversity of plants, which in turn may limit the diversity of animals. In addition, animals that require intense sunshine might be precluded from inhabiting the Great Basin. The paucity of reptiles in the Great Basin, especially lizards, may be related to this as well.

Invertebrates

The vast majority of visible terrestrial invertebrates in the Mojave Desert are either insects or arachnids. Other groups of invertebrates are either so tiny (like protozoans or nematode worms) that they cannot be seen with the unaided eye, or they are dormant below ground, like desert snails. One exception occurs in certain areas, where millipedes and centipedes may be common, especially following rain and at night.

Of the arachnids, scorpions and spiders are the most often seen. Another group, the solpugids, or wind scorpions, are represented by numerous species but are mainly nocturnal. In the Mojave Desert one may encounter ten or more species of scorpions, but none of these can inflict a fatally toxic sting. In a particular area, spiders usually number from twenty to forty species, depending upon the habitat. The Western Widow is the only dangerous species. However, a relative of the notorious brown Recluse Spider of central and eastern North America does occur in the Mojave. This species is not known to be dangerous, but it must be assumed that all members of the genus can inject venom.

Western Widow
Loxosceles deserta

Two spiders frequently seen in the Mojave are the tarantulas (several species in the genus *Aphonopelma*), which despite their formidable appearance are innocuous, and a small spider of the genus *Diguetia;* the latter belongs to a family confined to the hot deserts of North America and the Monte of Argentina. All diguetid species build their webs in shrubs. The adults hide in a retreat shaped like an inverted cone and suspended in the web. Egg sacs are also hung, quite conspicuously, in the web. Crab and jumping spiders in shrubs, wolf spiders and funnel-web weavers on the ground, along with a number of comb-footed and orb-weaving species, make up the rest of the usual spider fauna.

Of the insects, the orthopterans (crickets, grasshoppers, locusts, and others), which are well adapted to the desert, are the most obvious day-active forms. Butterflies and moths, beetles, wasps, and bees and ants are also abundant, but often they are not as noticeable. In the Mojave, the most obvious species is the Pallid-winged Grasshopper. This species occurs in a variety of habitats from Canada to South America, and is often the most abundant species in North American deserts. Three species of Mojave Desert grasshoppers are regularly

Pallid-winged
Grasshopper
Trimerotropis pallidipennis
369

Creosote Bush Grasshopper
Bootettix argentatus
368

Desert Clicker Grasshopper
Ligurotettix coquilletti

Furnace Heat Lubber
Tytthoytle maculata

Cream Grasshopper
Cibolacris parviceps

associated with Creosote Bush. The yellow-green and silver Creosote Bush Grasshopper lives exclusively on Creosote Bush and is camouflaged to match its leaves. The small, gray-brown Desert Clicker Grasshopper sits on stems of Creosote and other desert shrubs emitting a loud *zip-zip-zip* call. The large, fast, and elusive Furnace Heat Lubber also occurs in association with Creosote Bush from 225 feet below sea level to over 4500 feet. A widespread, common species of open Mojave Desert sites in association with various plant species is the Cream Grasshopper, which often assumes the color of the ground surface. Numerous crickets and their relatives also can be seen and heard at night in the Mojave.

As in most arid areas, the tenebrionids, or darkling beetles, are the the most abundant ground-dwelling beetle species. As many as twelve to fifteen species can be found in some Creosote Bush or *Lycium*-dominated communities. Among the more common are *Cryptoglossa verrucosa* and *Eleodes armata*. Both of these large, dark beetles are opportunistic feeders, but in deserts probably mainly feed on plant detritus.

Ants and other hymenopterous insects occur commonly in the Mojave Desert. Interestingly, many truly desert ants are harvesters, among them the harvester ants in the genus *Pogonomyrmex*. Two of these, the California Harvester Ant and the Rough Harvester Ant, occur in several Mojave Desert vegetation types. Another harvester, *Veromessor pergandei*, is very common in both the Mojave and Sonoran deserts. Termites, while not often seen, are busy decomposing the wood of desert plants, and in many areas are extremely abundant.

California Harvester Ant
Pogonomyrmex californicus

Rough Harvester Ant
Pogonomyrmex rugosus
387

Fish

The diverse aquatic habitats contained in North America's deserts often come as a surprise to visitors. In places that have permanent water, fish occur in a considerable diversity. Some sites in the Mojave Desert are especially noted for their fish. Perhaps the best-known areas are those in Death Valley. Not long ago, ten fish species inhabited this area, but recently one species has become extinct. The remaining fish include five species of pupfish (*Cyprinodon*), the easiest group of species to observe in the National Monument; one species of killifish (*Empetrichthys*); two species of minnow, each in a different genus (*Gila* and *Rhinichthys*); and a sucker (*Catostomus*). One of the pupfish, the Cottonball Marsh Pupfish, lives in Cottonball Marsh, more than two hundred feet below sea level, in water that can be five times as saline as seawater. Eight of Death Valley's existing nine species are endemic to that aquatic system and half have populations that are threatened or endangered. While changes in water supplies, caused by agricultural irrigation, are part of the problem, the introduction of fish species, both native North American forms and exotics, poses the greatest threat at present, as it has in the past.

Cottonball Marsh Pupfish
Cyprinodon milleri

Amphibians and Reptiles

The Mojave Desert supports diverse reptile and amphibian

Desert Tortoise
Gopherus agassizi
169

life. One of the most conspicuous species is the Desert Tortoise, a vegetarian that is a protected species; it can be observed throughout the Mojave. These turtles are especially conspicuous in the spring, when they can be heard snorting or banging shells as they "fight" against rivals or potential mates. During the hottest portions of the day, the tortoises retreat to burrows or to soil depressions in the shade of shrubs.

Another spectacular find in small portions of the Mojave in southern Nevada and near St. George, Utah, is the Gila Monster, one of the two venomous lizards in the world. The Gila Monster is slow and not particularly aggressive, but it has a quick bite and can inflict a painful, though rarely if ever fatal, wound. Food for this lumbering saurian includes the eggs and young of ground-nesting birds, as well as young mammals. While you may see the tracks of Gila Monsters in sandy areas, these lizards are primarily nocturnal and most often dwell in sites that have nearby boulders. Despite their ponderous appearance Gila Monsters can travel more than a mile in just a few days.

Gila Monster
Heloderma suspectum
180

The Mojave Desert supports numerous lizards. In sandy areas dominated by Creosote Bush, the beautiful Desert Iguana is quite common, albeit wary. Primarily a herbivore, it also eats insects and even carrion, and may climb into bushes for a delicate brunch of flowers. Also in sandy areas, especially washes, you can get a glimpse of the speedy Zebratail Lizard. This lizard is especially conspicuous when it runs because it holds its tail erect. The underside of the tail is ivory-white, set off by black bands. When the lizard is at rest, however, with its tail flat, it "disappears," blending in with the ground. Nearly as quick, but proportionately more slim and less colorful, is the Western Whiptail.

Desert Iguana
Dipsosaurus dorsalis
188

Zebratail Lizard
Callisaurus draconoides
203

Western Whiptail
Cnemidophorus tigris
206

Western Banded Gecko
Coleonyx variegatus
176, 179

Desert Horned Lizard
Phrynosoma platyrhinos

Side-blotched Lizard
Uta stansburiana
202

Longnose Leopard Lizard
Gambelia wislizenii
191

Collared Lizard
Crotaphytus collaris
200, 201

Chuckwalla
Sauromalus obesus
189

Tree Lizard
Urosaurus ornatus
205

Brush Lizard
Urosaurus graciosus
190

Desert Spiny Lizard
Sceloporus magister
199

Also on the ground, but in the daytime and usually hidden under debris or stones is the beautiful Western Banded Gecko. This delicate, nocturnal species can have its skin peeled off by rough handling. The Desert Horned Lizard and the Side-blotched Lizard are abundant in the Mojave, as they are in the Great Basin. While the Horned Lizard eats insects, predominantly ants, I have seen them eat the fruits of *Lycium* in Nevada, causing me to abandon my entrenched conception of their diet.

Two lizard species that often use rocks for shelter or as vantage points occur from the Great Basin through the Mojave—the Longnose Leopard Lizard and the Collared Lizard. In even more extensively rocky areas where there are crevices, a spectacular lizard, the Chuckwalla, occurs; its scientific name means "the obese, terrible lizard." Actually, Chuckwallas are neither. They are docile herbivores, and the species name derives from their ability to inflate their bodies and wedge themselves in rock crevices, a protective device.

Shrubs and trees in the Mojave Desert provide a few lizard surprises. Two related species, the Tree Lizard and the Brush Lizard, both well camouflaged to look like branches or bark, are occasionally seen. Far more conpicuous is the Desert Spiny Lizard, a five- to six-inch species covered with rough scales. To

Desert Night Lizard
Xantusia vigilis
183, 184

Great Basin Gopher Snake
Pituophis melanoleucus deserticola
263

Red Coachwhip
Masticophis flagellum
223, 229, 230, 233

Western Patchnose Snake
Salvadora hexalepis
218

Great Basin Rattlesnake
Crotalus viridis lutosus
258, 260

Sidewinder
Crotalus cerastes
252, 253

Speckled Rattlesnake
Crotalus mitchelli
251, 255

Mojave Rattlesnake
Crotalus scutulatus
259

California Kingsnake
Lampropeltis getulus californiae
234

Longnose Snake
Rhinocheilus lecontei
238, 247

Spotted Leafnose Snake
Phyllorhynchus decurtatus
265, 269

Western Blind Snake
Leptotyphlops humilis
226

Great Basin Spadefoot
Scaphiopus intermontanus
277

Southwestern Toad
Bufo microscaphus
279

escape, it races up trunks and noisily crashes through leaves and vegetation. At night, try searching the arms of Joshua-trees with a flashlight to see a uniquely desert species, the Desert Night Lizard. This lizard is almost as fragile as the gecko. Its one-and-one-half inch body is covered with velvetlike skin. During the day, the Night Lizard is most often found by turning over fallen branches of Joshua-tree on the ground, or within the stick nests of pack rats (*Neotoma*), which are often built around the base of a Joshua-tree.
Unlike the Great Basin Desert species, most Mojave Desert snakes are nocturnal. Nonetheless, an early morning walk could reveal a Great Basin Gopher Snake or a Striped Whipsnake, just as in the Great Basin. More common, however, is the Red Coachwhip, a fast, slender species with variable coloration. In sandy washes and other places you may see the Western Patchnose Snake, which has a strange enlarged triangular scale covering the front of its upper lip. In the Utah portion of the Mojave, you can still find the Great Basin Rattlesnake, which does not extend into the rest of the Mojave. However, three other rattlesnake species do occur in the Mojave. The Sidewinder, which has a conspicuous horn above each eye, dwells in areas of loose sandy soil, including relatively barren sand dunes. In more rocky areas the well-camouflaged Speckled Rattlesnake is sometimes seen. Both Sidewinders and Speckled Rattlesnakes are usually colored to match their background. Thus they may be gray, brown, white, or even red in specific areas. The third species, the Mojave Rattlesnake, is a yellow-green version of a Western Diamondback, but is more aggressive, has a much more potent venom, and thus is potentially an extremely dangerous snake: Avoid it. This species occurs primarily in open desert scrubland rather than in rocky areas.
Several of the snakes occasionally seen during the day are primarily nocturnal, such as the rattlers, but there is a specifically nocturnal group as well. In this group are some of the desert's most attractive serpents. The beautiful California Kingsnake, a subspecies of the Common Kingsnake, is among these. The red, black and yellowish-white banded Longnose Snake is active at night, along with the Spotted Leafnose Snake, another species with a "patched" nose. You may also see the common Glossy Snake or the Night Snake.
After a heavy rain, if you look hard, you might even see the primitive and very diminutive Western Blind Snake, a slender animal that has no neck constriction to delimit the head. This very secretive species is primarily subterranean.
Few amphibians occur in the areas dominated by Creosote Bush in the Mojave Desert, unless there is a source of water that persists long enough for larvae to complete their life cycle. In the northern parts of the Mojave, the Great Basin Spadefoot reaches its southernmost distribution; it can be fairly common locally. A toad of spotty distribution, the Southwestern Toad, primarily nocturnal, occurs in some areas along watercourses, especially those with sufficient water to support such trees as cottonwoods. Where permanent water

Northern Leopard Frog
Rana pipiens
286

Canyon Treefrog
Hyla arenicolor
272

Black-throated Sparrow
Amphispiza bilineata
610

Le Conte's Thrasher
Toxostoma lecontei
594

Northern Mockingbird
Mimus polyglottos
590

Cactus Wren
Campylorhynchus brunneicapillus
584

Gambel's Quail
Callipepla gambelii
547

Mourning Dove
Zenaida macroura
551

Greater Roadrunner
Geococcyx californianus
554

Common Raven
Corvus corax
582

Lesser Nighthawk
Chordeiles acutipennis
560

Phainopepla
Phainopepla nitens
595

Loggerhead Shrike
Lanius ludovicianus
596

Scott's Oriole
Icterus parisorum
616

Deer Mouse
Peromyscus maniculatus
489

exists, the Northern Leopard Frog can be seen. Finally, in isolated areas with permanent moisture, such as rocky stream beds, you will find the Canyon Treefrog, a species in a family (*Hylidae*) that is not at all typical of desert sites.

Birds
The numbers of bird species that breed in the low shrub areas of the Mojave Desert can be quite limited. In wet years, five species occurred as residents of a Creosote Bush-Lycium-White Burrobush area at the Nevada Test Site. These included the Black-throated Sparrow, Sage Sparrow, Brewer's Sparrow, Le Conte's Thrasher, and the Northern Mockingbird. In dry years, only Le Conte's Thrasher and the Black-throated Sparrow persisted.
On sites with a greater diversity of vegetation forms, the bird species list jumps rapidly. For example, in Joshua Tree National Monument, California, thirty-five species have been found across the spectrum of Creosote Bush types, and fifty species in the Joshua-tree zones. In deserts the presence of trees or large cacti is the principal element in increasing the number of bird species. Nevertheless, even the presence of smaller plants—chollas (*Opuntia*), for example—adds species; the Cactus Wren is one species that often builds its domed nests in these cacti. Other conspicuous Mojave Desert birds that you are likely to see include Gambel's Quail, Mourning Doves, Greater Roadrunners, and Common Ravens. At dusk, the Lesser Nighthawk is abundant in some spots. Smaller or less obvious birds include the Ash-throated Flycatcher and Black-tailed Gnatcatcher, both of which are likely to be seen where trees like mesquites or catclaws occur. Two other quite noticeable birds are the Phainopepla and the Loggerhead Shrike. Since shrikes require open ground for foraging, deserts are ideal spots for these gray, white, and black carnivores. The Phainopepla has a diverse diet. It takes insects on the wing, but also feeds on the berries of mistletoes such as *Phoradendron californicum*. In fact, Phainopepla are major dispersing agents for these parasitic plants, since the undigested seeds in their feces are deposited on tree branches. In areas where there are stands of Joshua-tree, Scott's Oriole, with its bright lemon-yellow and black plumage, is common.

Mammals
Most hot desert sites contain ten to twelve species of mammals the size of a rabbit or smaller. The general types and the mixture of small mammals occurring in any one place are remarkably constant, though the exact species may vary from place to place, even within the same desert type. The list usually includes two kangaroo rats (*Dipodomys*), two pocket mice (*Perognathus*) of different sizes, a pack rat (*Neotoma*), a grasshopper mouse (*Onychomys*), the Deer Mouse, a diurnal ground squirrel (*Spermophilus* or *Ammospermophilus*), and a small (*Sylvilagus*) and a large (*Lepus*) rabbit.
The larger mammals usually include the same widespread species that inhabit all deserts, hot or cold: the Coyote, Badger, and Kit and Gray foxes. In the Mojave Desert, the

Bighorn Sheep
Ovis canadensis
526

Desert Cottontail
Sylvilagus audubonii
508

Black-tailed Jack Rabbit
Lepus californicus
509

White-tailed Antelope Squirrel
Ammospermophilus leucurus
499

Round-tailed Ground Squirrel
Spermophilus tereticaudus
504

Merriam's Kangaroo Rat
Dipodomys merriami
485

Desert Kangaroo Rat
Dipodomys deserti
484

Panamint Kangaroo Rat
Dipodomys panamintinus
482

Long-tailed Pocket Mouse
Perognathus formosus
475

Little Pocket Mouse
Perognathus longimembris
473

Southern Grasshopper Mouse
Onychomys torridus
488

Cactus Mouse
Peromyscus eremicus
492

Canyon Mouse
Peromyscus crinitus

Botta's Pocket Gopher
Thomomys bottae
469

Desert Shrew
Notiosorex crawfordi
470

Bighorn Sheep is also conspicuous, especially in some of our national parks and monuments. They rarely stray far from water and are most often associated with mountainous slopes. Because the small mammals of the Mojave Desert are generally nocturnal, daytime walks are not likely to yield much more than the Desert Cottontail, or the abundant Black-tailed Jack Rabbit. In some places you may see isolated individuals of the White-tailed Antelope Squirrel. This species is usually solitary and has the habit of flicking its tail to display its white underside, and of emitting a long, clear trill. It is by no means restricted to the desert and occurs well up into the Pinyon Pine zone. Another somewhat less flashy diurnal animal is the Round-tailed Ground Squirrel. Antelope (*Ammospermophilus*) and ground (*Spermophilus*) squirrels can be distinguished by the former's trait of running with the tail held vertically to expose its underparts.

Nighttime forays may yield the Merriam's Kangaroo Rat, a species that occurs in a wide variety of soil and vegetation types. More confined in terms of habitat is the sand-dwelling Desert Kangaroo Rat and of more limited geographic extent is the Panamint Kangaroo Rat. The two pocket mice most likely to be observed are the Long-tailed Pocket Mouse and the Little Pocket Mouse. Both of these nocturnal species also occur in the Great Basin; the Little Pocket Mouse, in particular, has an extensive Great Basin distribution. Both species are most obvious during the summer months, for they readily go into torpor during cool periods. Several other pocket mice occur locally but they are not likely to be encountered.

The final array of nocturnal forms includes the ubiquitous Deer Mouse, the Southern Grasshopper Mouse, and two other species of the genus *Peromyscus*. The Cactus Mouse is a rather large, white-footed mouse; instead of burrowing it seeks shelter under vegetation, in crevices, or in the holes of other animals. The Canyon Mouse is generally seen in rocky areas and does not occur in the Creosote Bush flats, which the Cactus Mouse may inhabit. The two species are superficially quite similar.

Two additional mammals should be mentioned. The conspicuous mounds of freshly turned, loose soil you see on a walk may have been created by Botta's Pocket Gopher. These creatures make their homes nearly anywhere that they can burrow—only rocky areas, where they cannot dig, or sand dunes, where their tunnels collapse, are outside of their range of habitats. They are often associated with the bases of shrubs. It is not likely you will see the animal itself because it usually remains below ground. The Desert Shrew is not very likely to be seen either, but can be abundant in some places. Its nests are often constructed in areas of dense vegetation. Occasionally you will scare one out by kicking the bases of yuccas.

Despite its physical rigors, the Mojave Desert is a treasure trove of biological diversity. There you can observe beautiful, even elegant, plants and curious animals, if you time your visit to avoid the hottest summer months, and if you take the time to search out the plants and animals.

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Beavertail Cactus 41
Birdcage Evening Primrose 93
Bladder Sage 75
Brittlebush 136
Buffalo Gourd 140
Chia 64
Chinchweed 133
Claret Cup Cactus 42
Climbing Milkweed 83
Common Ice Plant 88
Coulter's Lupine 72
Crescent Milkvetch 50
Cushion Cactus 40
Death Valley Sage 77
Desert Anemone 91
Desert Bell 70
Desert Candle 164
Desert Chicory 86
Desert Dandelion 125
Desert Five Spot 43
Desert Four O'Clock 52
Desert Globemallow 158
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Yellow Peppergrass 113
Yellow Spiny Daisy 131
Yellow Twining Snapdragon 116

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Desert Stalked Puffball 167

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