

ROAD-RUNNER

# Deserted Deserts?

*The thirteenth in Nature Magazine's series of educational inserts*

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*Animal drawings by M. Hope Sawyer: Plant drawings by Elizabeth L. Burkmyer*

**M**ORE than twenty times I have gone from the East Coast to the Pacific Coast, passing through desert areas by Pullman, day coach, and automobile, by night and by day, in winter and in summer. Often I could stop for a few hours, days, or weeks in a desert. I have never prospected for gold in a desert, or dragged my bones through a cactus thicket in search of water. I have never been lost in a desert sand storm, shot off a toe because of a rattle-snake bite, or gone blind from the light reflected by desert sand dunes.



CACTUS WREN

In spite of having missed such experiences, I feel that I know enough about our deserts to wish to share my convictions that deserts are worth knowing better. There is no need here to review the details of desert formation; textbooks will supply these.

Neither can we give attention to all the interesting plants and animals there found in abundance. Earlier articles in Nature Magazine have dealt with some spectacular desert species. The fourth insert of this series treated the desert tortoise, the horned toad, the fence lizard, the chuckwalla, the gila monster and some close relatives of other desert reptiles. The seventh discussed such desert beasts of burden as the burro and the camel. The sixth dealt with some minerals common in desert lands.

The plants and animals selected for consideration here are those that I have seen in deserts or semi-arid regions, and which seem to be most commonly mentioned by those who know these areas best. The species selected are not always the most common (in some deserts they may be absent) but they, or the signs they leave, are generally conspicuous in one sort of desert or another.

Shortly before writing this article, I was driving through what seemed to be a deserted desert when we saw an antelope just a short distance away. Naturally, we stopped to investigate, but the story of this antelope is not half so important as some other things associated with it. The antelope moved off and we followed as well as we could. Things began to happen in what had seemed to be

a deserted land. Within fifty feet of the road, we started eight jack rabbits. Lizards scuttled into the sage brush. Two magpies flew up from an inconspicuous rabbit carcass. Ants swarmed over little hills that had escaped our attention, and the sands were marked with tracks that could not possibly have been seen from the moving car. Some distance farther on, we came upon the body of a coyote at the edge of the road. As we slowed to look, a live coyote moved silently off into the brush. In one mile through that stretch of desert I counted the remains of one hundred and ninety jack rabbits that were being pressed steadily into the hot asphalt on which they had attempted to match wits and speed with an automobile. How



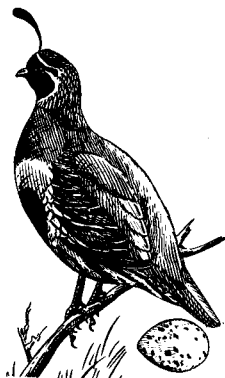
ELF OWL

can anyone feel that a desert is deserted? Why step on the accelerator when going through a desert and thus miss chances to observe its life?

Whether the desert you visit is in southern Idaho and eastern Oregon, or in the Mohave, the Sonoran, or the Colorado desert regions, it is not deserted if you give it a chance to show itself to you at different seasons, and at different hours.

You cannot judge a desert animal by its behavior in captivity. It may be difficult to activate a horned toad in a terrarium, but on the hot sands of a Utah desert it vanishes before your eyes with incredible speed. A tarantula that a college chum kept on his desk near mine would crawl leisurely around his collar and over his hands, but one of this spider's kin that I met in a southern California desert had plenty of "git up an' git" to it. There must be something to life in sand exposed to sun that makes a spider, a horned toad, or a human, behave differently than when life has been stimulated only by sunlight refracted through the glass and shades of a northern laboratory window.

While all deserts are for the most part more poorly supplied with usable water than the non-desert stretches, the reasons for this may vary and the signs of these differences



GAMBEL'S QUAIL



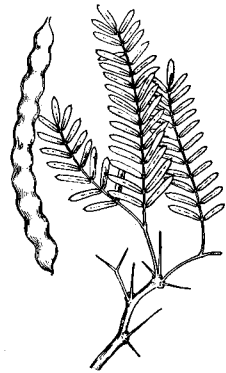
BURROWING OWL



SAGEBRUSH



MISTLETOE



MESQUITE



CREOSOTE BUSH

may be conspicuous. One who knows the Sonoran desert may have one picture that he thinks is representative. Others, who form their concepts of deserts from Oregon, Utah, or the Salton Sea, may have different pictures. Each may be right. With the development of great hydroelectric and irrigation projects, many desert attributes are disappearing. Some of this land will be improved by the change; much will not. What are the signs by which the casual visitor may recognize the possibilities of a particular area?

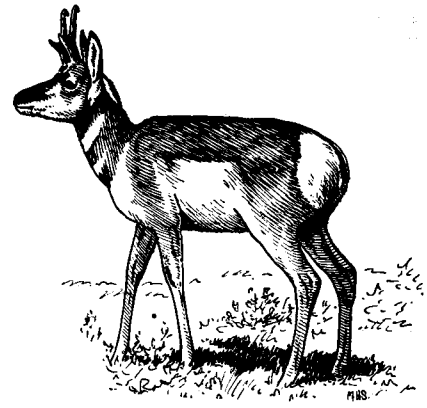
Where true greasewood and shadscale grow most conspicuously we may be reasonably sure of the presence of alkali, either at the surface or at a depth of a foot. The upper foot of soil may be too dry in summer to sustain ordinary plants, and the alkali deeper down may prevent many deep-rooted species from surviving. The result is that the only plants that can continue to exist are those like the true greasewood and the shadscale. If such soils are irrigated and the alkali is washed out, they are generally able to support some kinds of crops and therefore irrigation is practicable. In the true salt flats, where the soil may be wet with salt water to the surface, it would be unwise to attempt it.

Where drainage is poor, as in some of the deserts of Utah and in the Salton Sea region, or in different areas in some sixteen of our western states, alkali is an important problem in agriculture. In some thirteen percent of the lands irrigated it is such a serious problem that crop production is impossible or unprofitable. Such areas should not have been reclaimed, but should have been left to satisfy the interests of naturalists and wildlife, if for no other reason. Nature Magazine has repeatedly advocated a sane policy in this connection.

Alkali soils are those that include enough concentration of any soluble salt to injure crop plants. This includes the chlorides, sulphates, carbonates and nitrates of sodium, potassium, and magnesium, and the chloride and nitrate of calcium. Even the valuable fertilizer sodium nitrate may, if sufficiently abundant, be considered as responsible for an alkali soil. The carbonates of sodium and potassium are true alkalis and, if there is sufficient organic matter in the soil, may produce a dark or even a black incrustation on the soil ordinarily considered as "black alkali". The other alkalis produce a white incrustation and are spoken of as "white alkali".

Obviously, many types of desert are possible where so many true alkalis and neutral salts are involved in their formation. With each variation, we get conditions favorable to a different group of plants. With each different set of plants, we get a different set of animals living on or associated with those plants. There really is no such thing as "the desert"; there are many different kinds of deserts.

The question of air in the soil is almost as important in determining the nature of a desert as the amount of water. Unless roots can get air they cannot grow. While mesquite roots can grow where the soil atmosphere has less than three percent of oxygen, cactus roots stop growing under this condition. If, then, we find cactus giving way to mesquite, we may guess that the soil may be more compacted; that it will be more difficult for burrowing animals to work, and that even though the water supply may be less near the surface where the cactuses are found, there may be more interesting animals present. This does not imply that a mesquite desert is



PRONGHORN ANTELOPE



KANGAROO RAT



JOSHUA TREE



SHADSCALE

deserted by animals, but that animals will probably be different in the loose soils where cactuses flourish.

This looseness of soil creates another type of desert when the soil is sandy instead of being composed of finer softer materials. Unless it is anchored by plants, it may be constantly shifting with the winds, and form dunes. Plants, to survive, must be able to live with

much of their tops buried, or with much of their roots exposed. This shift may be alternated from year to year as the crests of the dunes pass on. Such a desert, of course, calls for a different type of animal life.

All of these changes, which provide animals with, or deprive them of, their homes, also affect their supply of food and of water. Most of those able to exist get along well without water as such. The water they need may be formed in the processes of digestion. They get along very well. In fact, they are not able to survive where there is much water, so we need not pity them because of the seemingly harsh environment in which we find them. A kangaroo rat would be nearly as unhappy swimming as a brook trout would be leaping around a cholla trunk. Neither could eat, sleep or rear young in an environment ideal for the other. We must recognize the eternal fitness of things that Nature has worked out in different places, and not try to make the world over to suit the desires of any one type.

Many of the deserts of the southwest are conspicuous because of cactuses and the creosote bushes. These areas have little value for grazing either by domestic animals or by the wild ruminants, although they do support many smaller mammals, birds and reptiles. The creosote bush often grows so evenly spaced as to appear to have been set out. Because of its tremendously deep root system, it can survive in almost rainless regions for as long as three years. Because of this hardiness, it has little competition and often forms a pure stand. It is probably the most widespread and conspicuous of our southwestern desert shrubs. Its leaves are evergreen, resinous, fragrant and resistant to drying. It, too, bears the name of greasewood, but the difference between it and the true greasewood should be obvious from the sketches. As indicated in the charts, its presence marks definitely the line between two divisions of the Lower Sonoran Life zone, and can be

used to trace old shorelines in the valleys where the plants live.

When rain does come to a desert characterized by creosote bush, startling things happen. If there has been a winter rain in such an area, the bushes burst into yellow bloom in April and May. Shortly after, the fruits appear.

During this time, the desert looks most undesert-like.

Not only do the perennial creosote bushes make a showing but the ground yields a host of showy annuals.

At this time, the "dead" sticks of ocotillo burst at their tips in flaming red blooms, and if cactuses are present they surprise one by flowering. Yuccas like the Spanish dagger and the Joshua tree spout great flower clusters. Desert lilies, white with bluish-green bands down the middle of each petal; desert evening primroses that turn from white to pink as they age; flame-colored or yellow Mariposa lilies; delicate, greenish white, or reddish desert verbenas, and abronias; green and yellow-stemmed and purple- or white-flowered squaw cabbage, *Stanleya elata*—these are only a few of the plants that appear after a rainfall in different areas. All of these are spectacular and conspicuous for short periods, but they must be seen at their best to give the desert its due.

We must not assume from this description of a desert in flower that such areas merit exploration only at this spectacular period. Even in the Sonoran desert, at its drier times, one finds the taller plants as interesting as those on the ground.

Any bunch of plant material high on some shrub is worth investigating. Most of them may be balls of desert mistletoe, but some of them may be nests of birds or of mammals. Similar balls, not so high, may be nests of cactus wrens, or verdins, or other birds. If large and not round, they may be nests of road-runners.

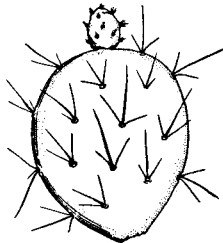
The mistletoe spheres have many interesting stories associated with them. If we think of them only as parasites, destroying, injuring, or at least robbing their hosts, which have a hard enough time of it anyway, we might condemn them. But if we recognize that their berries are wet, and form the major food and water supply of many of the birds of the region, we may feel differently. Here is a plant that, in a sense, forces other (Continued on page 92)



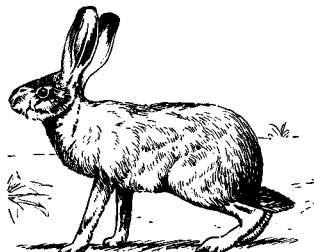
GREASEWOOD



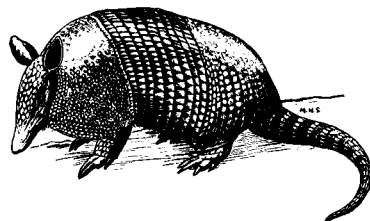
RUSSIAN THISTLE



PRICKLY PEAR CACTUS



CALIFORNIA JACK RABBIT



NINE-BANDED ARMADILLO

COMMON NAME SCIENTIFIC NAME	CALIFORNIA JACK RABBIT <i>Lepus californicus</i>	DESERT KANGAROO RAT <i>Dipodomys deserti</i>	NINE-BANDED ARMADILLO <i>Dasypus novemcinctus</i>	PRONGHORN ANTELOPE <i>Antilocapra americana</i>
<b>DESCRIPTION</b>	Length, about 2 feet, with 4-inch tail and 5½-inch hind foot. Weight, to nearly 6 pounds. Female, with well developed fluff of long soft hair on belly. Color, dark brown with white patches on forehead, around eyes, on back of ears; top of tail and tips of back of ears black; paler, in summer.	Length, to 13 inches, of which 7½ is tail. Forelegs, small, and hind legs, long, the hind foot measuring over 2 inches long and having but 4 toes. Ears, short and rounded. Eyes, large and beautiful. Cheek pouches, well developed. Whiskers, long and conspicuous. Color, bluish, fawn colored above and gleaming white beneath, even on tail and tail tuft.	Length, to 28 inches with tail about 1 foot. Weight, to 15 pounds. Body covered with bony plates with 7 to 9 movable joints around the middle permitting animal to curl into a ball. Color, variegated flesh, gray and black. Snout, ears and claws, long. Toes, 4 on front feet, 5 on hind.	Length, to over 4 feet, with 3½-inch tail. Standing 3 feet at shoulder and 4 feet to top of head. Weight of buck, about 100 pounds; of doe, around 90 pounds. Horns hollow on a bony core like goat's but branched and shed each year like a deer; also 4 teats and woolly under-hair like a deer. Each foot with two hoofs. Color, tan and white with bucks darker.
<b>RELATIVES AND RANGE</b>	Order Lagomorpha. Family Leporidae. Black-tailed Jack, <i>Lepus californicus</i> , Nebraska and Texas to California and Washington. Common on open grasslands particularly in extensive ranges, not in woods or swamps. White-tailed Jack, <i>L. campestris</i> . Gray in summer, white in winter. Northern and western states from western Wisconsin to California.	Order Rodentia. Family Heteromyidae. Probably nearly a hundred kinds of kangaroo rats known, ranging from southern western Canada to middle Mexico. A square mile may support 1,000 animals. Common in warmer zones of western North America; this species in western Nevada, Arizona and eastern California.	Order Edentata or Xenarthra. Family Dasypodidae. Found among vegetation near rocky country where caves may be accessible. From sea-level to 10,000 feet elevation, from the lower Rio Grande River country, and south into Mexico. North to 33° latitude in Texas and adjoining parts of Louisiana. Usually confined to semiarid.	Ungulates of the Family Antilocapridae. Southern Alberta and Saskatchewan through western Dakotas, Nebraska, Kansas and Texas into northern Mexico and west through Lower California, southeastern California, Nevada, southeastern Oregon and southern Idaho. Individuals, 2 or 3 square miles.
<b>LIFE HISTORY</b>	Probably polygamous, breeding in warmer months. Young, born 30 days after the mating, 1 to 5, well developed. Kept by mother in individual and separated spots and nursed about 7 weeks. Possibly 2 litters in the South but only one in the North. At birth, weigh 2 or 3 ounces, are well furred and have eyes open; ears and legs at first short but begin elongating at 10 days.	Social animals, though families commonly separate in tunnel homes. Underground tunnels with some entrances closed connect food storage, dung deposit; nesting rooms, (8" x 10" x 5") and extend over 3' underground. Nest lined with fine plant and animal material where in April or later 2 to 6 young are born. Dung of adults, thick ½-inch spindles.	Sexes in general resemble each other. Young, 4 to 8, born February to April, at first with soft flexible skins much unlike the hard shells of the adults; have eyes open when born and when able leave home den and follow mother about somewhat like little pigs.	Both sexes horned, the doe's smaller. In September and October bucks form harems of does won by fighting. Kids 2 or 3, born in May or June, scentless and able to walk; can outrun dog in 10 days. Mother defends young alone. Young follow mother at 3 weeks. In July, does and young make small herds joined in August by young bucks.
<b>FOOD AND HOME RELATIONSHIPS</b>	Strictly plant-eaters. Adults do not dig burrow or have home other than an area. May enter burrows to escape danger. Rarely social animals in any sense. Rarely drink, water being formed from food. Speeding blacktail may jump a dozen feet and leave tail mark on snow. Speeding whitetail may leap 20 feet and leave no tail mark. Speed, 28 miles an hour. All carnivores are their enemies but man particularly.	Food, probably solely plant material from which water is extracted so animals need never drink. Food of related banner-tail gathered and stored during journeys only at night when a rat may leap 8 feet at one jump and of course easily escape most mammal and bird enemies. Animals do not hibernate or migrate. Captive animals may fight by striking with hind legs and squeaking but never vicious among themselves.	Food, almost exclusively insects, chiefly ants and beetles mixed with earth. Droppings, like small clay marbles. Has poor sense of sight, excellent ability to smell and apparently is highly sensible to jarring of the earth. Can run with surprising speed to escape its many enemies. Largely nocturnal.	Food, entirely vegetable. Herds and individuals kept together by bucks or by family instinct helped by flashing white rump which serves as danger and recognition signal. Escape from enemies or fight. Speed to 32 miles an hour; can leap 4- or 5-foot fence. In winter, migrate to suitable grazing areas usually in herds.
<b>RELATIONS TO MAN</b>	Provides food for carnivores and for man. Fur also has some little value. Add "atmosphere" to the great open places but also serve as serious competitors with live stock for forage. Are controlled by great drives by hunters. Have many parasites and carry tularemia, which may be fatal to man. One square mile known to have supported 8,000 jacks.	Probably of little economic importance, but of tremendous interest. Make excellent pets. Help let air into desert soil and turn soil in making burrows often building large mounds of excavated soil. Might destroy grain if they were abundant in grain-growing territory but they are not. Should be known better to be thoroughly appreciated.	In some countries, are encouraged as destroyers of ants but in other places are disliked because they disturb gardens, even though the latter activity is evidently directed not at plant destruction but at plant enemies.	Beautiful animals relatively harmless, competitors with grazing animals for forage. Flesh good. Numbers in former times estimated at 40,000,000; latest estimate about 165,000. Worthy of more protection from hunters, at present their worst enemy. Enticed to within range of guns because of inordinate curiosity.

<b>GAMBEL'S QUAIL</b> <i>Lophortyx gambeli</i>	<b>BURROWING OWL</b> <i>Speotyto cunicularia</i>	<b>ELF OWL</b> <i>Micropallas whitneyi</i>	<b>ROAD-RUNNER</b> <i>Geococcyx californicus</i>	<b>CACTUS WREN</b> <i>Heleodytes brunneicapillus</i>
<p>Length, to 10 inches; tail, 4 inches; wing, 4½ inches. Male, with 1½ inch black, curved plume on top of head, chestnut crown, pale slate-blue back and breast, black cheeks and throat and belly, and brown and white flanks. Female, duller without chestnut crown and with shorter plume.</p>	<p>Length, to 11 inches; tail, 3½ inches; bill, ½ inch; wing, 7 inches. Head, without ear tufts. Legs, long, nearly bare, and with bristly toes. Adults, brown with white and buff spots and bars. Tail, white-banded. Young, with plain brown upper parts, plainer appearance generally and with dark rather than a white throat band.</p>	<p>Length, to 6 inches; tail, 2 inches; wing, 4 inches. Shorter than the pygmy owls. Head without ear-tufts. Eyebrows, cravat and underparts, white; interrupted white collar, and wings with whitish spots; otherwise largely gray or brown speckled. Young, more brownish gray on top of head.</p>	<p>Length, to 2 feet; tail, 1 foot; wing, 7 inches. Bill, curved downward. Feathers, coarse. Upper parts brown and white streaked. Middle tail feathers, olive with purple gloss. Throat and belly, white. Eye, yellow to orange. Legs and feet, pale blue. Sexes, colored alike. Young, like adults but less conspicuously streaked.</p>	<p>Length, to 8 inches; tail, 3 inches; wing, 3½ inches. Females, slightly smaller than males. Tail, rounded. Feathers of back brown with white middle streaks. Tail feathers, brown and black. Underparts, white. Young, with back spotted instead of streaked, with white and black spots on chest smaller and duller.</p>
<p>Order Galliformes. Family Perdidae. In dry, hot valleys and bottom lands from southern California and Nevada to Arizona and southwestern Utah with stations in Texas and Mexico as well. Introduced and well established in southern Colorado.</p>	<p>Order Strigiformes. Family Strigidae. Western species breeds from southern British Columbia and Minnesota to Argentine and Chile though not continuously; migrates slightly in northern part of range in March, April and October. Florida species at home in central and southern Florida.</p>	<p>Order Strigiformes. Family Strigidae. Whitney's (southwestern), Texas (eastern), and Sanford's (California). Elf Owls range through southwestern United States and Mexico. Locally most abundant; not migratory. Haunts low, hot, dry, desert river bottoms and adjacent lands.</p>	<p>Order Cuculiformes. Family Cuculidae. California and Lower California east through Utah, Colorado, Kansas and Texas and tableland of northern Mexico in deserts and mesquite-covered arid and semiarid lands. Does not migrate.</p>	<p>Order Passeriformes. Family Troglodytidae. Desert regions of California, Nevada, Utah, Arizona, New Mexico and Texas and northern states of Mexico.</p>
<p>May be found with the scaled quail with which it may cross. Nests from June to August, the nest being a hollow, sometimes with lining, containing 10 to 12 white or buff brown, purple or pink spotted eggs; little chicks able to run about as soon as hatched. Coveys stay together until grown or longer.</p>	<p>After interesting courtship of caresses, low song and bows, nest is built in burrow underground, of fine materials. Here are laid from April to June, 6 to 11 smooth, glossy eggs, about 1 by 1½ inches; both parents incubate about 3 weeks. One yearly brood. Young almost naked, plumage developing and being molted by July. Adult molt, September.</p>	<p>Nests in holes made to 20 feet up sahuaro cactus by Gila woodpeckers or gilded flickers in May, laying 3 to 5 pure white, glossy, granulated eggs about 1 inch long; incubated 2 weeks by both parents, hatch at intervals into helpless young soon covered by white down. Molts, June and July; annual molt, in September and October.</p>	<p>Usually solitary but builds nest, usually unlined, about 1 foot in diameter of sticks and twigs 3 to 15 feet up in low tree or bush where it is concealed by vegetation. 4 to 6 unspotted, white or pale yellow eggs, about 1½ by 1½ inches; incubation beginning after few eggs are laid, lasts 18 days. Mother tries to entice enemies by feigning injury.</p>	<p>Birds nest in colonies with males building dummy nests in which they may roost. Nest, 6-inch globe of dried grasses with side entrance; may be used and remodelled in different years; sometimes lined with feathers; nests also used by mice and other animals. Eggs, 3 to 7, white or buff with many red-brown spots.</p>
<p>Food, from January to June almost wholly vegetable matter, including mistletoe berries, mesquite leaves, cactus fruit and seeds and other seeds. Summer food, essentially insects, principally grasshoppers, the young feeding almost exclusively on insects such as ants, leaf hoppers, stink bugs and aphids.</p>	<p>Food, almost wholly insects and scorpions, with some few lizards and small mammals and snakes, but principally grasshoppers. May live in prairie dog holes but hardly cooperatively and while rattlesnakes also live in burrows this is distinctly to disadvantage of owls and prairie dogs. May be active in daytime.</p>	<p>Food, almost entirely grasshoppers and other insects, and centipedes; all caught at night when the birds come from daytime hiding place in dense thicket or hole. Calls sound like chirp or like a squeak of a rubber toy. Possibly males are gregarious during the breeding season.</p>	<p>When 3 weeks old, young may begin catching their own food which is highly varied, including snakes, lizards, scorpions, tarantulas, insects, birds and their eggs, rats and small mammals or about 90% animal matter, caught by pursuit or stealth. Can run 18 miles per hour for short distances to escape many enemies particularly man.</p>	<p>Food essentially insects. Sing through the year but more commonly in summer a song described as like grinding two small millstones together. Nests placed in cactuses are perfectly protected by them from most enemies.</p>
<p>Protected by coloration which almost perfectly matches environment, and by ability to escape, flying at 60 feet per second; also by large broods which get good parental care during critical periods. Enemies include hawks, snakes, coyotes, and of course man. Useful in every conceivable manner and more than make up for the little grain eaten, by the insects destroyed through most of lifetime.</p>	<p>Unquestionably almost wholly useful to man's interests, and should be protected. However does not favor cultivated lands and ranges and constantly being reduced. Can be recognized easily by long legs, bobbing movements and short tail.</p>	<p>Probably entirely useful to man and his interests; so unique that bird deserves protection at all times; may be kept as pet but at such times refuses to eat other birds. Are probably less savage than pygmy owls; are also more nocturnal than pygmies. Almost entirely dependant on giant cactus.</p>	<p>Although campaigns have been organized to destroy road-runners as enemies of quail, these activities are ill-advised. Probably "not one meal in 1000" is of quail eggs and many include scorpions, rattlesnakes and other undesirable animals, particularly grasshoppers, which destroy valuable crops. Deserves much more protection than it gets.</p>	<p>Essentially a useful species and one of the birds that gives life and music to a desert at times of the day when it might otherwise seem too quiet and deserted.</p>

COMMON NAME SCIENTIFIC NAME	JOSHUA TREE <i>Yucca brevifolia</i>	GREASEWOOD <i>Sarcobatus vermiculatus</i>	RUSSIAN THISTLE <i>Salsola kali</i>	SHADSCALE <i>Atriplex confertifolia</i>
DESCRIPTION	Height, to 30 feet; spread, to 20 feet. Branching trees with disc-like bases from which spread small fine tough roots that penetrate soil in all directions. Leaves crowded towards ends of the stout branching stems and persisting some time after they have died.	Low-branching but conspicuous shrub with somewhat spiny branchlets and bright green, rather thick leaves whose unbroken margins make them look somewhat like branches. In general, something like the gray shad-scale, and the purple-brown inkweed to which it is closely related. Roots, 6 to 7 feet deep.	Height, to 3 feet, with many-branching stems forming a huge globe. Leaves, alternate, stiff, usually prickle-tipped, about 1/2 inch long, with shorter sharp-pointed bracts at bases of older leaves. Young plants appear grass-like; old ones thistle-like.	Height, to 4 feet. A woody, spiny many-branched shrub which forms a great globe-like plant with some branches well supplied with egg-shaped, entire leaves and others naked or nearly so. Roots, deep and strong.
RANGE	In desert areas where there is at least an 8- or 10-inch annual rainfall. Nevada, Utah, northern Arizona and parts of California, forming forests in some places.	Arid deserts but usually where there is ground water within reach of long roots. Widely distributed and conspicuous in deserts of Utah, Nevada and California. Particularly in clay flats and salty areas.	Dry deserts or fields or waste lands, railroad embankments and meadows. Native of Asia but widely established in North America from Manitoba to California and east through New York.	In salt deserts and on exposed limestone commonly from Idaho to eastern California and northern Arizona, except in the Colorado desert, and of course wherever soil is unsuitable.
RELATIVES AND LIFE HISTORY	Class Monocotyledoneae. Family Liliaceae. May or may not flower each year, depending largely on rainfall and temperature. Formation of flowers from terminal buds stops growth in that direction and causes branching. Wind and small animals distribute seeds.	Class Dicotyledoneae. Family Chenopodiaceae. Flowers rather inconspicuously clustered at the base of some of the leaves. Each produces a single fruit which remains enclosed in a case when shed and blown by wind.	Class Dicotyledoneae. Family Chenopodiaceae. Flowers, in leaf axils, small, greenish, whitish or red, or pink, with 5-parted calyx which encloses mature fruit leaving a papery margin which helps in wind distribution. Fruits, reddish, top-shaped.	Class Dicotyledoneae. Family Chenopodiaceae. Flowers pistillate or staminate, relatively inconspicuous in the axils of the leaves, particularly towards the ends of the branches. Fruits enclosed in rounded wedge-shaped, thick calyx bracts and blown by wind, one-seeded.
FOOD RELATIONSHIPS	Parasitized by the boring beetle, <i>Scyphophorus yuccae</i> , by the larvae of the butterfly, <i>Megathymus yuccae</i> , and by other insects. The night lizard <i>Xantusia vigilis</i> is entirely dependent on the plant for food organisms and shelter.	Typical of undrained depressions of a salt desert, where it is associated with pickleweed, <i>Allenrolfea</i> , and salt grass, <i>Distichlis</i> . Geologists consider it an indicator of nearby ground water.	Green in midsummer when other desert plants are brown, but edible for cattle when young. Flowers in July and fruits mature by September when plants are too tough to be eaten and of course are generally inferior.	Once the leaves drop during the drier parts of the season the twigs soon turn to spines, these providing protection against the destruction natural by foraging animals.
PROTECTION AND ENEMIES	Protects itself by living where many competitors cannot live, by underground roots. Helps protect other organisms; at least 25 desert birds have been known to nest in these trees. Firm roots protect from wind destruction.	Loses little water and gets an adequate supply because of extensive root system. Indicates fair water content in surface part of soil which will be well drained in summer, with salty water below the first foot.	Plants can produce 100,000 fruits, which are spread from "tumbleweeds" which are blown by wind or carried by trains or motor cars over wide areas. Plants can survive conditions fatal to most species.	Possibly has some merit as forage but is more valuable as an index to the nature of the surrounding desert. Root system 2 to 3 feet deep and abundance of easily produced fruits guarantee its survival when these factors are combined with ability to survive presence of salt.
RELATIONSHIP TO MAN'S INTERESTS	Indians used red fine roots in basketry. The plants are among the most picturesque of desert plants and are gradually disappearing with changes caused by man. They should be better protected.	Cattlemen consider greasewood a valuable fall and early spring browse, but it is known to be so poisonous to sheep that whole flocks have been killed by it. Crop production without irrigation impossible where this grows.	In depression years, plants are cut green and salted and fed cattle but normally they are destroyed where possible by plowing, cultivating or burning. The ash has been used as an impure carbonate of soda known as "barilla".	Presence indicates probable a gravelly soil at least 2 to 3 feet deep, which dries in summer and may become salt at depth of foot, though not so above. Without irrigation, such land may produce crops; with irrigation and removal of alkali, it surely can.

<b>MESQUITE</b> <i>Prosopis juliflora</i>	<b>DESERT MISTLETOE</b> <i>Phoradendron californicum</i>	<b>PRICKLY PEAR CACTUS</b> <i>Opuntia chlorotica</i>	<b>CREOSOTE BUSH</b> Covillea <i>Larrea divaricata</i>	<b>BIG SAGEBRUSH</b> <i>Artemisia tridentata</i>
<p>Height, to 30 feet as shrub or tree. Stems, tough, armed with branched hooks. Leaves, alternate, compound, bright green when new. Roots tough and often penetrating to depths of 60 feet for water.</p>	<p>Appear as great balls of twigs or as festooned drapes, the stems being green, somewhat rubbery, opposite-branched and growing as parasites on various plants usually high above the ground.</p>	<p>Height, to 8 feet with a trunk crowned with flat thick discs set at different angles, light green and armed with downward pointing, sharp, brittle, yellow spines. Roots, deep and finely branching from many larger roots. Leafless.</p>	<p>Height, to 10 feet or stunted to 2 feet. Leaves, evergreen, fragrant, particularly when wet, conspicuously dark green with a protecting resin varnish and associated with almost black stems which are slightly swollen at the nodes.</p>	<p>Height, to 10 feet. Stems, shrubby, much branched, tough, with mat of silvery gray hairs. Roots deep and tough. Leaves about 1 inch long and 1/2 inch wide, narrow, wedge-shaped, with 3 to 5 blunt teeth at end and broadest near end. Whole plant more or less fragrant when broken.</p>
<p>In dry places that may support little other vegetation where there is a deep water table. Colorado to Louisiana and west through southern California and south.</p>	<p>On mesquite and other members of the pea family, on creosote bush, ironwood, palo verde, condalia and other plants. In deserts of California and east to Arizona.</p>	<p>Commonly found singly in mountainous desert areas where land is rough from deserts of California, Nevada, New Mexico and Arizona. Related species under cultivation.</p>	<p>On light desert soils marking line between upper and lower divisions of Lower Sonoran Life Zone. One of most widespread, conspicuous desert plants in North America.</p>	<p>Commonest in high northern desert and 'sagebrush' areas often in pure stands. From southeastern California through Nevada, the Great Basin and the plains of Oregon, Idaho, and western Montana and Wyoming.</p>
<p>Class Dicotyledoneae. Family Leguminosae. Flowers, yellow, pea-like, appearing from April to June and attracting many bees which pollinate them. Fruits, many seeded, sweet-meated pods, which mature in September and October and may be wind-blown or animal-carried.</p>	<p>Class Dicotyledoneae. Family Loranthaceae. Staminate and pistillate flowers separate, the former smelling like apple blossoms when open and being visited by insects at evening. Berries, white spheres, present from November to April. Related closely to large-leaved mistletoe.</p>	<p>Class Dicotyledoneae. Family Cactaceae. Flowers, yellow, to 3 inches in diameter, pollinated by insects and producing purple-covered dry fruits, which are green within and edible and which contain many seeds. There are probably 250 or more species of this genus in America.</p>	<p>Class Dicotyledoneae. Family Zygophyllaceae. Flowers, large and yellow, appearing suddenly with rains in April and May, and suddenly producing furrv, white fruit balls which drop in late summer when plant becomes essentially dormant.</p>	<p>Class Dicotyledoneae. Family Compositae. Flowers, in heads about 1/8 inch in diameter crowded in clusters at branch tips and with stamens and pistils in same heads in same flowers. Ripe heads open and break off as units to be spread by wind particularly over hard snow.</p>
<p>Fruits, considered excellent food by Indians, and for domestic and wild animals. Indians made a cake by mashing fruits, sprinkling with water, shaping into cakes and baking in close-woven baskets under hot sand in the sun.</p>	<p>Gets entire sustenance from the host plant and supplies water to many birds which carry fruits and seeds to places where they may grow on new hosts. These for the most part resist attack rather well.</p>	<p>Both stems and fruit have nutritive value if they can be freed from the protective spines. Roots cannot survive soil atmosphere less than 3% oxygen. Stems do the work of leaves and store food and water.</p>	<p>Sweet scent adds flavor to food cooked over creosote bush fire. Leaves produce medicine used in Mexico for treating wounds, burns, rheumatism, tuberculosis and stomach troubles.</p>	<p>Plant survives drought by resting stage during which most or all of leaves are shed, producing scraggly appearance. Presence indicates light-textured soil, low run off, with no salt in first foot of soil or deeper.</p>
<p>Protects itself by its excessively long roots, which can survive in a soil atmosphere of 3% oxygen, which kills cactus roots. Also by rugged above-ground parts, which survive burying in sand. Has many parasites.</p>	<p>Inaccessible to most animals that would destroy the plants as a whole and produces fruit in such abundance, in such an attractive manner, that widespread distribution is guaranteed.</p>	<p>Protection by spines. Because of stored water, roots can extend themselves through dry soil to reach new supplies of water; can do this better if the soil is moistened. Some related species yield water to mules, which kick them open.</p>	<p>Galls caused by the gall midge <i>Asphondylia</i> make conspicuous walnut-sized swellings. Deep roots, quick fruiting season and response to rain permit plant to grow where others cannot.</p>	<p>Not many animals relish bitter taste. Nesting site for many desert birds. Purple galls, which look like velvet sponges in summer, are caused by the gall midge <i>Diarthronomyia</i>.</p>
<p>Wood, excellent fuel. Used in land classification to indicate land which will support 5 to 15 head of cattle per section and has considerable forage value at most times of the year.</p>	<p>Does some harm to forage trees but the Indians used to boil the fruits and eat them, and they are now eaten by desert quail, which are in turn eaten by man.</p>	<p>Fruits eaten by man and stems eaten by cattle and livestock when properly treated. The prickly pears have flattened joints while the chollas have cylindrical joints.</p>	<p>Used by man in land classification as an index that land unless irrigated has little or no value for grazing livestock. Sharing in this use are the associated cactuses and the gray burro-bush, <i>Franseria dumosa</i>.</p>	<p>Foliage is eaten by sheep and goats; principal food of sage-grouse; is rich in proteins and fats. Tea made from leaves is bitter and is used in treatment of colds, sore eyes and as hair tonic. Ripening seeds ground for meal by Cahuilla Indians. Wood excellent fuel for hot quick fire.</p>

(Continued from page 87) plants to give of their water supply that animals may live.

In the northern desert regions, where the sagebrush rules supreme, life differs from that in the strongly alkaline deserts or the sand deserts. The soils are generally well drained and loamy rather than sandy. Such deserts may provide some forage, particularly for sheep. If the areas are grazed at the wrong time of the year, or too closely, much damage may result. Here is probably one of the greatest problems in adjusting private interest and public interest.

A sagebrush desert commonly grades off into grasslands rather than into forests, although in a sense a sagebrush cover is little more than a stunted forest. This is also true to some extent of the more southern varieties of desert. Temperature conditions may define the nature of a desert almost as much as the soil and humidity. In a desert like the Mohave, the surface of the soil may reach a temperature of 175 degrees F., however, the Weather Bureau maximum for Death Valley in the California Desert is 134 degrees F.

If an animal favors the high temperatures of day, as do many of the lizards, it may be active longer than if it prefers the intermediate temperature of dusk or dawn. This time limiting of animal activities may give the idea that a desert is truly deserted. Partly because desert animals, at least in the south, can live such protected lives, they are likely to have small families, but to live long. Naturally, their young come at the season when a suitable food supply is most abundant.

While many of the desert mammals dig in to keep cool in the daytime, many of the reptiles burrow to keep warm at night. Naturally, there are clashes of interest where burrows are left open day and night. Fights for burrows frequently ensue; sometimes between animals of the same kind; sometimes between close or distant relatives. Sometimes more than one kind of animal, or more than one animal of a kind, may live in the same burrow.

Kangaroo rats apparently occupy definite areas for their burrows. These they defend vigorously. The bannertail kangaroo rat puts its seeds and vegetable stores in burrows chiefly during the summer and autumn. The smaller kangaroo rat, a close neighbor, caches no food, and so must steal from its relative during hard times. Possibly because of this the bannertail is believed to kill the smaller species whenever it is found in the bannertail's burrow. Here is desert justice.

Of course, any part of the earth that can produce plants will have animals that will eat the plants, and animal-eaters will eat the plant-eaters. The deserts are no exception. Desert foxes, owls and coyotes roam over the areas at night, living on the smaller animals that are active at that time. In the day, hawks, some snakes, and road-runners forage. The smaller forms of animal life, like the insects, spiders, scorpions and centipedes, have their activities curtailed by each other, and, more especially at night, by the owls and bats. Quail, wrens, gnatcatchers and other desert birds feed on small things in the daytime. Not all of the creatures that feed on the smaller forms are themselves small. The armadillo, which is found in cer-

tain desert lands, subsists largely on ants. It, like the badger, digs into the burrows of its intended prey and takes what it wishes.

Small desert insects attack plants and either destroy them or cause them to form a great variety of galls. Gall wasps, gall flies and aphids are among these. Other diminutive creatures may remain dormant in the soil during long periods of drought. Fifty species of protozoans have been raised from soil that had experienced eight months of drought. Desert snails are able to close their shells and even produce secretions to prevent water-loss.

Most desert animals are so colored as to be inconspicuous. This is true of the antelope, the coyote, the ground squirrels, the lizards, and most of the birds. Obviously, this favors the continued existence of such as cannot seek a refuge under ground. Few adult butterflies or moths are to be seen during periods of drought, because of the few flowers found at that time.

So we find that our deserts are all different. Yet the counterpart of almost any desert may be found at some time of the year almost anywhere. The home plate on the backlot ball grounds has some of the qualities of a desert at some period. Its plants, such as the spotted spurge, may have a milky juice like some of its *Euphorbia* relatives of the more typical desert. Its animal associates may well be ants, and the ants may establish underground burrows to exist in comfortable temperatures.

These miniature temporary deserts may be inundated with floods of water, or exposed to intense drying conditions. The sidewalks of cities, and the miles of concrete and asphalt that connect them, may at times offer greater extremes of heat and of dryness than the most orthodox of deserts. Life is there for those who would seek it. The dandelion in the lawns and the desert evening primrose in the Mohave have much in common. Each promptly gets busy on its flowering. Each is stemless, or nearly so, and produces no useless tissues. One or the other may be seen by every reader of this magazine at some time of the year. The School Page gives further help in recognizing desert-like plants and animals in your own backyard.

Study of deserts may be extended through other sources. Popular and valuable books on deserts are available. One magazine is devoted solely to deserts.

We cannot give a complete bibliography of deserts here. For elementary school or junior high school *Desert Neighbors*, by Edith M. Patch and Carroll Lane Fenton, published by Macmillan, would be worth owning. Amateur naturalists, either in high school or at home, would welcome Gayle Pickwell's *Deserts* published by McGraw-Hill. Dr. Pickwell's book is so beautifully illustrated that it should be in every home and school library where there is any Nature interest at all. Other books deal with the birds, mammals, or wildflowers of the different states in which deserts are important. One book, *Desert Wild Flowers* by Edmund Jaeger, published by the Stanford University Press, cuts across state lines and pictures attractively the more common desert flowers. Many desert articles have appeared in Nature Magazine. Consult the index to the first ten years and subsequent volume indices.