The term «semiarid» as here used will for the most part relate to range lands in the western United States where the annual precipitation is less than 20 inches. Although grasslands are important, major emphasis in this paper will be placed on shrub types.

In addition to having low annual rainfall, semiarid regions of the western United States may be subjected to periods of severe drought. Consequently the vegetation is related to the amount of moisture and to the manner in which it is distributed. In fact, scientists familiar with semiarid regions have pointed out that very frequently it is the extremes, as for example the lowest rainfall years, rather than the averages that determine the vegetation and animal distribution.

The native Indian populations may have set fires and otherwise disturbed the vegetation in some areas. However, according to anthropologists, the pre-settlement Indian populations were low. In California they were estimated at less than 300,000. When this is compared with the 1950 census of 10,586,000 individuals, it is readily apparent that the native peoples had comparatively little impact on the plant and animal communities in that State.

A very important consideration in connection with the semiarid regions is that most of the usable acreage has been heavily grazed at some time by domestic livestock. Practically all of the western range land has been grazed for 80 years, and in the case of New Mexico and some
adjacent areas, for 300 years. According to a survey by the United States Forest Service, the cumulative results of a long period of grazing have had marked effect on the plant cover.

Plants preferred by livestock have been reduced in vigor by too close utilization and replaced in whole or in part by less palatable plants that could continue to produce seed. Continued overuse, especially by cattle, has resulted in the depletion of high-value perennial forage grasses and the invasion of annual grasses and other plants. Shrubs have increased over large areas, and some shrub types such as sagebrush (*Artemisia* spp) have spread into areas that were formerly grassland in character.

The changes in plant composition have had a marked effect on the ability of these semiarid lands to support livestock. In comparison with the virgin range, the present forage production in large areas is so reduced that about half as many animal units can be supported. Grazing by livestock has affected the habitat conditions for all forms of wildlife using these same lands. Although the vegetation on the semiarid areas has also been altered through fire, cultivation, irrigation, and other acts of man, the changes induced by grazing have been the most important.

A careful reading of the literature would reveal many references to show the changes that have occurred in the cover types and how these have affected the animal populations. However, for the purposes of this paper, a few examples appear to be sufficient.

**Effects on Rodents**

Studies on rodents in relation to cover changes in the semiarid range areas have revealed that depletion of forage cover through overgrazing results in more favorable environment for some species and less favorable for others. For example, work on the life history and ecology of jack rabbits (*Lepus alleni* and *L. californicus* spp. with relation to grazing in Arizona shows that these species become more abundant when heavy grazing has developed a secondary weed succession in types formerly in climax grassland. This may reflect the rabbits preference for a diet of annual weeds as well as a need for the greater visibility which the weed type permits.

Somewhat the same relationship was found in the case of the blacktailed prairie dog (*Cynomys ludovicianus*) on the Wichita Federal Game Refuge in Oklahoma. Through heavy grazing use the tall grass had been
replaced by short grass and weeds, a situation which seemed to favor the prairie dog. When grazing use was eliminated and the tall grass returned to the site, the prairie dogs gradually disappeared. In Arizona the opposite relationship appeared to prevail with Price and Bailey pocket mice (*Perognathus penicillatus pricei* and *P. baileyi baileyi*), for these animals were consistently more abundant on protected areas with good grass cover.

**Effects on Birds**

As with rodents, the reaction of birds to changes in the cover types may be either favorable or unfavorable. One study in central Arizona showed that in a grass-shrub habitat there was a 100% difference between the number of small birds on protected range and the number on adjacent overgrazed areas. The investigator suggested that this might be due primarily to the better cover on the protected area and secondarily to the increased plant and insect foods. Gambel quail (*Lophortyx gambeli*) declined on overgrazed range in Arizona because of depletion of both food and cover. Conversely, the habitat of the mourning dove (*Zenaidura macroura*) in Texas and Oklahoma appeared to be improved for that species where overgrazing resulted in replacement of grasses by annual weeds, such as doveweed (*Croton* sp.) and ragweed (*Ambrosia* sp.).

The author's observations in the woodland-chaparral type of California bear out those mentioned above. In a natural cover type of woodland-chaparral with intermingled grasslands, California quail (*L. californica*) were abundant but the mourning dove was uncommon. As a part of grazing management practices the woodland-chaparral was removed and occasional blue oaks (*Quercus douglasii*) retained. This change in cover resulted in the disappearance of quail and a marked increase of mourning doves and yellow-billed magpies (*Pica nuttalli*). While the land was being intensively grazed by goats to keep down woody sprout growth, turkey mullein (*Eremocarpus setigerus*), a good dove food, was abundant and doves were common. When grazing use was shifted to cattle and a high density of annual grass was permitted to mature on the stem, the turkey mullein disappeared and doves were much reduced.

**Effects on Deer**

It is well established that deer in many places and sometimes over large areas have responded to changes in cover. Actually, many of the best deer ranges are areas which have been disturbed by one factor or another and are in some stage of subclimax.
Much of the mule deer (Odocoileus hemionus spp.) range in the western United States is associated with sagebrush and other shrubs which are undoubtedly much more widespread now than they were before livestock grazing reduced the climax grass density and encouraged the invasion of shrubs. The history of many deer ranges in the West would indicate that the vegetation may continue to change. For example, the increase of browse over grass favored deer. Then, through continued overuse by deer and livestock, the browse, grass, and weeds may decline. On some areas where deer use an area exclusively, overbrowsing has resulted in a reduction of shrubs with an increase of perennial grasses. This relationship is also shown for white-tailed deer on the Edwards Plateau of Texas, where the increase of browse following depletion of the grass cover by excessive cattle and sheep use improved the deer habitat. More recently, close grazing in some sections by goats plus overpopulations of deer is resulting in depletion of the browse resources and consequently in destruction of much of the good deer range.

Here it should be emphasized that herbivorous wild animal populations may become excessive, exert harmful pressure on the environment, and thus by their own overuse make the habitat less desirable for themselves. Areas of deer overpopulations are specific examples of this situation, and they are all too common in the western United States.

Some of the foregoing discussion may have given the impression that in most instance depleted ranges provide more suitable habitat for animals than good range. Obviously this is not true for most species. A healthy habitat is one where the soil and its plant cover are in adjustment, and where a high level of productivity is obtained — in both desirable plant and animal life. Another point that should be reemphasized is that where livestock overgrazing has been a factor in the shift from grass to shrubs, continued overuse by livestock will, as with deer, reduce the browse supply.

CONTROL OF PREDATORS AND COMPETING ANIMALS

An indirect effect of grazing has been the destruction of animals which were regarded as being in conflict with the livestock industry. This involved the control of predatory species, such as wolves (Canis lupus) and coyotes (Canis latrans), as well as the control of prairie dogs (Cynomys spp) and other rodents which were thought to be in competition with the livestock for forage. Under the control programs the wolf has been eliminated from nearly
all semiarid areas, and the distribution of other species, such as the kit fox (*Vulpes macrotis* spp.), has been greatly reduced.

**CONTROL OF PLANTS COMPETING WITH FORAGE SPECIES**

In addition to the direct effect of grazing itself, other practices related to grazing can greatly modify faunal environment. One that has attracted much recent attention is the growing use of herbicides to kill or control shrubs and other plants considered undesirable from a grazing standpoint since they compete with desirable grasses. Because some herbicides can be readily applied from the air, they can be used on vast acreages. In addition, power machinery for the clearing of shrubs has come into much use on semiarid range lands.

Associated with shrub clearing is the reseeding of range lands. This often involves the removal of a portion of the shrubby growth and the planting of grasses. Reseeding is beneficial to wild animals where it provides more food, and under good range management lessens grazing pressures on depleted lands. Still another management tool which is being applied in some areas, and which may receive more attention in the future, is the use of fire as a land-clearing method. In California fire is not only used in certain chaparral areas to develop forage, but it is also attracting interest as a means of improving wildlife habitat, particularly for deer and quail.

**PROTECTION OF THE CALIFORNIA CONDOR**

A special case of faunal protection associated with semiarid regions is that of the California condor (*Gymno-gyps californianus*). This is one of the 13 birds listed by the International Union for the Protection of Nature as a vanishing species. At present probably fewer than 100 individuals remain, with a breeding territory apparently confined to a limited area on the Los Padres National Forest near Santa Barbara, California.

Although this species habitually nests in mountainous country, it ranges widely in quest of carrion for food. Before people settled the region, the birds undoubtedly ranged freely along the seacoast and in the San Joaquin Valley for food. As the livestock industry developed, the availability of carrion probably increased although human settlement also resulted in the destruction of Condor by hunters and others who killed them as trophies, or thought them undesirable. In recent years improved animal husbandry
has greatly reduced domestic animal losses, but the food supply seems adequate for the present reduced number of Condors. There remains, however, the danger that individual Condor will be shot or otherwise destroyed, since they continue to range widely in search of food.

Observations of the habitat requirements of the California Condor by the National Audubon Society and others have revealed that nesting is for the most part confined to some of the rougher bluff and cliff-like localities. Moreover, since the Condor requires five years to mature, nests every two or three years, and deposits one egg, its breeding potential is extremely low. Therefore, one of the most important management steps obviously would be to give adequate protection to the nesting area.

Acting on this advice, the Secretary of Agriculture set aside the small Sisquoc Condor Sanctuary in 1937, and later the much larger Sespe Sanctuary in 1947. The closure of these areas to public entry for the purpose of protecting nesting grounds of the vanishing Condor worked very well until the development of a new oil field to the north. Since there were old, still productive wells to the south of the Sespe Sanctuary, immediate interest arose in the oil possibilities of the area set aside for Condor protection.

Although the Secretary of Agriculture could prevent trespass on the Sanctuary for ordinary uses, he did not have authority to prevent oil exploration. It was, therefore, necessary to consider this matter with the Secretary of the Interior, who administers the oil leasing laws, and in cooperation with the National Audubon Society, the United States Fish and Wildlife Service, the petroleum industry, and others, to attempt to work out some sort of a withdrawal. After a series of hearings, studies, etc., the Secretary of the Interior issued an order on January 16, 1956, withdrawing the critical part of the Condor nesting area from surface occupancy in connection with mineral or oil exploration and extraction, and providing that on the adjacent territory occupancy would be permissible only under certain restrictions required by the U.S. Forest Service.

This account of the Condor situation has been included here because it clearly illustrates that the preservation of fauna cannot be considered apart from the uses of the land. It also illustrates that a sanctuary in and of itself is not always the answer, and this is especially true with a wide-ranging species such as the California Condor.