THE PRAIRIE DOG OF THE NORTH AMERICAN
PLAINs, AND ITS RELATIONS WITH PLANTS,
SOIL, AND LAND USE.*

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The home of the blacktail prairie dog [Cynomys l. ludovicianus (Ord)] is the North American short-grass plains, which lie just east of the Rocky Mountains in a belt about 300 miles (450 kilometers) wide extending from latitude 30° to 50° N. These plains are high, gently-rolling, grasslands of the Great Plains physiographic province. The prairie dog has remained the most characteristic mammal of this region in spite of great changes caused by man. At first, primitive hunters burned the grass near their villages in order to drive game, and the effect was slight. But then, early in the sixteenth century, Spanish explorers introduced the horse, and the effects of man became varied and drastic. Troops of mustangs ran free, and the Indians soon learned to use them. Mounted Indians roamed the plains in pursuit of bison. Guns increased their hunting efficiency. Professional hunters completed destruction of the bison herds in the 1870's, shortly after the transcontinental railroad was established. Rapid transportation and the lure of free land brought thousands of settlers to the plains, where they took up homesteads and broke the sod.

Crops were poor, but the open-range cattle industry boomed. Vast herds of cattle were driven hundreds of miles from ranges to railheads. Exotic weeds were introduced, and these were spread by the moving stock. Then rangeland was fenced with barbed wire. The more arid ranges were opened to grazing by the use of

water troughs supplied by windmill-driven pumps. Fences and windmills thus augmented localized heavy grazing. The demand for wheat, especially in time of war, encouraged tillage of rangeland, and development of dry-farming methods served to increase the plowing of drier sites. Much of the tilled land proved marginal for grain, and it was abandoned to secondary plant succession. Evidently much of this land use improved conditions for the spread of prairie dogs, for the journals of Lewis and Clark, and of others who crossed the plains during the early 1800’s, show that there were few dog towns in a region where they later were common. Because prairie dogs ate crops planted near their towns, and because they flourished on the poorer rangelands, ranchers and government organizations launched poisoning campaigns against them. Over a period of 50 years, poisoning eradicated prairie dogs from vast areas.

On the plains that prairie dogs inhabit, precipitation is irregular and seldom totals more than 20 inches (50 centimeters) per year. Winters are cold, open, and dry. As in other semiarid regions, the dominant plants are short sod-forming perennial grasses. Typically, the short blue grama (*Bouteloua gracilis*) and shorter buffalo-grass (*Buchloe dactyloides*) are mixed to varying degrees with mid grasses, especially western wheatgrass (*Agropyron smithii*). On the east the short-grass plains are bordered by a lower, more humid, region where bluestems (*Andropogon* spp.) and other tall grasses are dominant.

Essentially, the blacktail dog is a stocky short-tailed squirrel, about one kilogram in weight, well adapted to burrowing in hard soil. Discrete groups of holes, rather evenly spaced, form « dog towns ». The population of a town is commonly four or five dogs per acre (10 to 12 per hectare) in winter. Near the end of winter pups are born, and about six weeks later they start to feed above ground. At that time the population increases, often to 10 or 15 per acre (25 or 35 per hectare), and the competition for food and space is high. During this period the dogs may dig new burrows outside of the former town limits, so that the town grows in area.

**Growth of towns.** — The rapid expansion of dog towns often alarms ranchers. One town in Wind Cave National Park grew tenfold, from 20 to 200 acres (eight to 80 hectares) over a period of four years. In his study of another town in that park, **King** (1955) noted that in spring some dogs took up residence more than 200 meters from their former burrows. On occasions, a few dogs...
Prairie dogs select their food minutely from a mixture of herbs.

Prairie dogs mounds favor the growth of certain annuals, such as mustard (*Brassica*).

**The Prairie Dog**
disperse as far as two miles, and some of these start new colonies. Yet, all of the towns in one area do not expand during the same year, and a single town may grow only during exceptional years.

The limits of some dog towns remain unchanged for many years. The outline of a 40-acre (16-hectare) town in Devils Tower National Monument did not change appreciably over a period of eight years, although the animals were not harmed by man. Static towns such as this are usually bordered by apparent barriers to movement, such as rocky ground, steep slopes, or tall plants. Again, nearly all the prairie dogs have disappeared from some thriving towns, leaving a « ghost town ». For example, in 1887 Vernon Bailey found a town with about 2000 holes but less than 100 dogs. The population of several dog towns in Theodore Roosevelt National Memorial Park decreased about 90 per cent during a single recent year. When natural decimations occur, the causes are seldom obvious, but food shortage, severe weather, disease, or predation are probably responsible.

Population regulation. — As developed by Errington, Lack, and others, the general theory of population regulation is that numbers of animals are determined by characteristics of their environment, and the population is kept near environmental capacity by predation, disease, and competition. These factors affect an increasing proportion of the population as numbers increase; that is, they are density-dependent factors. Presumably these principles apply to prairie dogs. In the dog town observed during three summers by King, the numbers of pups varied greatly from year to year (32, 3, 57), while the numbers of older dogs remained fairly constant (18, 25, 21); these trends suggest natural regulation of the population.

Prairie dogs bear one litter per year, averaging four to five pups. Whether food is abundant or scarce, the litter size of adults is about the same. But the litters of one-year-old females, bearing young for the first time, average about one less than those of adults. Thus, the average litter size for an entire dog town depends largely on the numbers of yearlings that breed. Examination of many animals indicated that where food is abundant nearly all yearlings become pregnant, even if they are small, but where food supply is poor, few or no yearlings produce young. With abundant food, many yearlings breed and population growth may be rapid.

Inasmuch as reproduction is more than adequate for population growth, limitation of numbers is principally
through mortality. On the town observed by King, the death rate during each of two years was about 40 per cent of the population. Food supply has important effects on mortality. If food is scarce in spring, when females are lactating and numbers are highest, one would expect high mortality of young and relatively low numbers in summer. In fall, the food supply dwindles. I found that in fall the weights of adults differed little from town to town, but that the weights of juveniles differed greatly. On most towns the fall weights of juveniles were about one-third less than those of adults, but on towns where numbers had been greatly reduced, so that food was abundant and competition light, juveniles sometimes attained adult size before the start of their first winter. In all probability, heavy dogs survive the winter better than those of light weight, and also have a higher rate of pregnancy.

Spectacular die-offs of small mammals are sometimes caused by disease. During a period of four years an epizootic of sylvatic plague killed approximately 95 per cent of of the Gunnison prairie dogs (C. g. gunnisoni) over an area of half a million acres (200 thousand hectares). Presumably the disease was spread by fleas from animal to animal through the loosely continuous population. Plague has been found in blacktail prairie dogs, but only in small areas. Presumably, in this species the separation of dog towns inhibits the transmission of disease from one colony to another.

*Predators and associates.* — Depending on their success in relation to numbers of prey, predators may be considered either generalized or specialized. When prey numbers fall, generalized predators turn to other prey, while specialized carnivores continue to take the same prey. The golden eagle (*Aquila chrysaetos*) is a generalized predator that can take a heavy toll of prairie dogs. If a nesting pair of eagles fed exclusively on prairie dogs, at the rate of three per day during incubation and six per day after the two young hatched, they would take more than 600 dogs during the nesting season of four months. Although it is improbable that eagles would feed exclusively on a single species, a study of bones at an eagle nest overlooking one dog town revealed that three-fourths of the prey was prairie dogs. Eagles and migratory hawks are common near many dog towns in winter, when the proportional effect of catching one rodent, sexually mature or nearly so, might be much greater than in spring, when young animals are the most available prey.
Generalized predators should not be expected to reduce prey numbers below a certain threshold of security, but by killing dogs that are vulnerable because of crowding or long distance from established burrows, generalized predators can probably retard population growth in spring, speed population decrease in fall, and hinder the expansion of towns and establishment of new towns. A century ago, the abundance of bison carcasses in winter, when prairie dogs were seldom above ground, might have sustained a high population of coyotes and wolves, which preyed on prairie dogs in spring and summer, when they were most active.

Of the mammals specialized to catch prey in their burrows, the most common on dog towns is the badger (*Taxidea taxus*). One of these prodigious diggers can excavate several prairie dog burrows during a single night. Sometimes they chase prairie dogs on the surface by day. The black-footed ferret (*Mustela nigripes*) appears to be well suited to pursuing prairie dogs in their burrows, but it is so rare that little is known of its habits. Hundreds of rattlesnakes (*Crotalus v. viridis*) may den for the winter on a single dog town. Inasmuch as both snakes and pups emerge from burrows at about the same time in spring, there is strong possibility that the rattlesnakes feed on young prairie dogs.

The activities of prairie dogs make the open plains more favorable to several other small animals, such as the plains cottontail (*Sylvilagus auduboni baileyi*). One investigator found that these rabbits were several times more abundant on dog towns than on adjacent sites, apparently because the holes were necessary as refuges. The broadleafed herbs near burrows may also attract rabbits, as well as seed-eating birds such as mourning doves (*Zenaidura macroura*). Small diurnal burrowing owls (*Speotyto cunicularia*), which prey mostly on large insects, hide in burrows and often nest there. Mounds built by colonies of seed-storing harvester ants (*Pogonomyrmex occidentalis*) dot many dog towns, and both ants and prairie dogs sometimes start their excavations at the diggings of the other. Through their effects on vegetation, prairie dogs influence the abundance of ants, for there are few ant hills in solid short-grass cover but many in the next lower stage of vegetation, which is characterized by threeawn grass (*Aristida*).

**Relations to soil.** — The location of dog towns depends much upon soil and topography. Sandy and rocky soils, hilltops and wet bottoms, are unfavorable. Most towns are situated on fine to medium-textured deep alluvial
soils on uplands or well-drained river benches. The surface of a dog town is nearly flat, with a gentle slope of from two to five per cent. Few burrows are dug on slopes steeper than 15 per cent. In semiarid regions prairie dogs are most abundant on the moister sites, such as the bottoms of swales, the foot of slopes, and the vicinity of water. These sites may be attractive because of the succulent vegetation, rather than the soil moisture.

Like other burrowing rodents, prairie dogs modify the soil by raising earth from deep underground and by adding organic matter. Commonly the soil in burrow mounds amounts to four tons per acre. But in some areas there are low mounds, about six meters wide and half a meter thick, which appear to be the result of the work of prairie dogs or other burrowing mammals over a period of decades. Where these mounds occur on dog towns, frequently there are burrow entrances on the crests. Formation of similar mounds in western North America (Mima mounds) has been attributed to burrowing rodents, especially pocket gophers (Thomomys), which may raise four tons of soil per acre (ten tons per hectare) annually.

On long-established sections of a dog town, the number of burrows remains constant. There are about 25 holes per acre (60 per hectare) on most towns, but where food is abundant there may be more than twice this many, and where food is scarce there may be fewer than 10 holes per acre (25 per hectare). This density is influenced by the food supply in spring, when new holes are started. One investigator dug out 12 complete burrows, which had 25 entrances and an average of seven meters of passageways per entrance. The volume of the burrows was equivalent to over 700 gallons (2600 liters) of water. These holes were less than two meters in depth, but others have been found to be 4.5 meters deep. Digging alters the texture of the soil, generally loosening it and thus increasing its water-holding capacity. Prairie dog mounds preserve moisture in the underlying soil, so that mounds often bear the first green vegetation in spring. In addition, the deep holes increase the rate of soil formation by allowing air and water to penetrate into the unmodified parent material.

Burrowing rodents add organic matter to the soil in the form of their feces, urine, and carcasses. On one town carcasses amounted to about five pounds per acre (5.6 kilograms per hectare) per year. Probably a prairie dog deposits several times its weight in feces each year. This quantity is difficult to measure because dung beetles
quickly dispose of the droppings. Sections of burrows are sometimes plugged solid with feces. The plants that prairie dogs cut down are added to mulch and humus, and some are carried underground for building nests. But as prairie dogs do not store food, they inter a much smaller quantity of plants than do kangaroo rats (Dipodomys) or other storing rodents.

The effects of native rodents on soil movement are part of the normal geologic process of erosion. Insofar as rodents increase water-holding capacity of the soil, they retard erosion. But by bringing stable soil to the surface, where it weathers, they accelerate erosion. On a typical dog town with 25 holes per acre (60 per hectare), the amount of bare soil exposed on the mound and the area around it is less than three per cent of the total area (mounds one meter in diameter, bare ground for half a meter surrounding each mound, and half-bared ground extending two-thirds of a meter beyond). On the gently sloping short-grass range where most prairie dogs occur, this amount of denudation probably does not cause severe soil washing. But where cover is poor, as in pastures depleted by excessive grazing, prairie dogs bare a higher percentage of ground and they often feed destructively by digging. In short, where harmful erosion has started, prairie dogs may augment it as a secondary effect, but they are rarely a primary cause of harmful erosion. On the contrary, on poor range the effect of prairie dogs may be to favor the spread of short perennial grasses, which protect the soil.

*Effects on annual forage crop.* — The influences of rodents on plants are of two principal kinds; first, the obvious immediate effects of eating, cutting or trampling, and second, the subtle ultimate effects on the relative abundance of various plant species. The first effect, which the rancher views as loss of forage that should have fattened his cattle, is the only one considered in conventional food-habits studies. Significant studies of the food habits of rodents are rare, for the kinds of foods eaten depend on the changing needs of the animals and on the changing quantity, quality, and availability of foods. On rangelands of the central plains, I observed the general seasonal use of food by prairie dogs to be as follows. During the dry winter, when food was scarce, they ate stolons of dry buffalograss and avidly sought the few succulent plants, such as pricklypear (*Opuntia polyacantha*) and saltbush (*Atriplex canescens*). They also ate large seeds, which lay on the ground, and dug shallow pits to expose the roots of forbs (herbs other than
grasses). In spring I found green grass in prairie dog stomachs before I found it on the range. They also ate the earliest forbs, and by late spring the favorite foods were Russian thistle (*Salsola kali*) and summerceypress (*Kochia scoparia*). When forbs grew tall in summer, the dogs cut them down. They also cut tall stalks of blue grama and western wheatgrass, nibbled the white basal portions, and discarded the rest. But in fall they rarely cut tall blades of grass, which by then had started to dry. Instead, the dogs ate the green basal parts of short grasses, the leaves of late-green forbs, and the seeds of dry forbs. Gradually they turned to digging for roots and to eating cactus and other winter foods. In general, during the year prairie dogs choose the most nutritious parts of the changing array of foods. Blue grama blades are high in protein in June, when many are cut, but low in September, when few are cut. In fall, forage shrubs are much higher in protein than grasses. These shrubs, and the seeds of forbs, are important in fattening the animals for winter.

At the summer rate of feeding, an adult prairie dog eats about 100 grams of green food a day. On this basis, a population of five adults and four young (common for one acre) could eat in a month enough to feed a cow for a day (about 50 pounds or 22 kilograms). But such comparisons between widely different animals give a false picture of food competition and relative effects on vegetation. Quantities eaten have little ecological significance unless related to food availability, and this is difficult to measure. Furthermore, rodents eat much that is unavailable or distasteful to cattle, they select and cut far more minutely, and they do not trample vegetation and soil in the manner of hoofed mammals. In addition, everything that prairie dogs eat is eventually returned to the soil, whereas the forage eaten by cattle is converted to beefsteak and consumed at distant markets.

On much of the semiarid plains, cattle are kept off the range during the cold months, to prevent excessive damage to vegetation. Although prairie dogs occupy the range during the cold months, their effects are alleviated by the facts that they eat little when above ground, and that they may not come above ground during periods of many days. Some kinds of ground squirrels (*Citellus*) escape the rigors of winter by hibernating for months, but apparently the blacktail prairie dog does not. It has been shown experimentally, however, that lack of succulent food can induce periods of dormancy in these
animals. Observations on other rodents have shown
that fatness is usually necessary for hibernation. Ap­
parently, then, food supply is closely related to the
extent of winter dormancy and feeding activity. Nutri­tive differences might cause the wide differences in
winter activity observed on various dog towns. Feeding
during cold months, when vegetation is minimal, may
include destruction of roots. On the other hand, clipping
of grass blades during the cold months, when most food
is stored in the roots, may be less destructive than
clipping in summer, when most food is in the blades.
As in other seasons, destructive winter feeding is least
where food supply is ample.

The overall effects of grazing animals on the forage
crop are often studied by means of exclosure plots fenced
to keep certain animals in or out. At the end of the
growing season, part or all of the annual forage crop
is clipped and weighed for comparisons. Using this
method, some studies have shown that the forage yield
on a fully protected plot is two or three times the yield on
a similar plot open to rodents. But some tests have
shown a higher yield on the plot with rodents than on
the protected plot. To plan, execute, and interpret a
valid eclosure experiment is difficult. A common error,
committed in one prairie dog study, is to use a newly
protected plot on previously grazed pasture as a « con­trol »
by which to judge potential forage production on the
rodent plot. Such a control usually has exceptionally
high forage production the first year or two after
protection, because of the vigor of plants after years of
grazing. Use of this standard magnifies the apparent
loss to rodents. In addition, weights of clippings at the
end of the growing season are a poor indicator of
nutritive values at the time the animals feed. A truer
picture of competition between rodents and cattle would
be gained through a study of the weight gains of cattle
on large pastures, with and without rodents, with several
replications, periodic reversals of experimental treat­
ments, and continuation over a period of many years so
as to bridge climatic cycles and to reveal effects on the
species composition of vegetation.

Effects on composition of vegetation. — On the
Great Plains, it is an established principle of range
management that grazing tends to change the relative
area covered by each kind of forage plant. Rodents also
affect the composition of vegetation. Prairie dogs tend
to make the vegetation heterogeneous. I found nearly
100 species of plants growing at one time on the dog

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town at Devils Tower. As no large hoofed mammals had grazed there for many years, this complexity was probably caused mainly by prairie dogs.

Some of the effects of rodents on vegetation can be judged by observation of the animals coupled with knowledge of plant responses. For example, prairie dogs cut blue grama and western wheatgrass in summer. Because wheatgrass is the taller, it loses a larger proportion of photosynthetic tissue and thus tends to decrease in relation to grama, and also to the shorter buffalograss. The relative abundance of these grasses from the center to the edge of many dog towns suggests these same effects. Inasmuch as these perennial grasses reproduce vegetatively, loss of their seed is of little importance. But when prairie dogs mow down annual grasses in spring, the seeds do not mature and the grasses do not reproduce. The result is that a dense stand of tall annual grass starts abruptly at the edge of the dog town. On one town, the border of a surrounding thick stand of Japanese brome (*Bromus japonicus*) gradually receded 100 meters over a period of seven years. Aside from the reduction of brome, the occurrence of grasses on this town changed little. The few rodent and rabbit exclosure experiments that were carried on for several years showed that the animals not only tended to decrease the proportion of some forage grasses, but also to increase others.

The influence of prairie dogs on the relative abundance of various forbs are difficult to judge because the stand of forbs changes greatly from year to year, and because the ecology of most non-forage range plants is poorly known. In some years the most prominent large annual forb on the plains is Russian thistle. This chenopod, introduced from Eurasia about 80 years ago, becomes spiny when mature. Then the root breaks and the plant rolls over the plains as a tumbleweed. Prairie dogs eat the thistle seedlings as soon as they appear in spring, and by early summer they cut down nearly all of the Russian thistle on their towns. This cutting has negligible effect on the prodigious crop of tiny seeds, but it prevents the formation of noxious tumbleweeds. Prairie dogs extract seeds from spiny pods and they fell some tall prickly weeds, but they seldom cut plants that contain bitter milk (such as *Euphorbia* and *Asclepias*). Avoidance of some weeds might tend to increase them, but feeding on one species does not always decrease its abundance. Amaranths, for example, are the commonest plants on prairie dog mounds; yet, they are favorite
foods. And on towns where pricklypear is by far the most common winter food, its abundance is no less than on the surrounding area.

Prairie dogs stunt shrubs by clipping the small branches and new shoots, so that once shrubs are browsed short by cattle, prairie dogs keep them low. On the dog town at Devils Tower, apparently prairie dogs alone have kept sagebrush (*Artemisia*) from growing more than a few inches tall; immediately surrounding the town this shrub grows four feet tall. On the southern plains, mesquite (*Prosopis juliflora*) grows on many dog towns. This thorny shrub or tree, a nuisance to cattlemen, has increased greatly during the past century, though the reasons for the increase are not clear. In some dog towns among mesquite trees I found abundant seedlings a few inches tall but no larger mesquite of shrub size. As many of the seedlings had been nibbled, I presumed that prairie dogs destroyed the seedlings before they grew to shrub size. If this presumption were valid, disappearance of prairie dogs should often be followed by an increase of mesquite. Such an increase did occur on a dog town from which the last prairie dogs disappeared in 1946. Photographs taken then showed no mesquite shrubs at the center of the town, but a photograph taken three years later showed a few mesquite shrubs two feet tall, and in 1955 I found several mesquite shrubs four feet tall at the site. These facts suggest that the present abundance of mesquite may be due, in part, to the reduction of prairie dogs by man.

To understand the relations between prairie dogs and vegetation, one should study them on grasslands undisturbed by cattle grazing or other land use. But such grasslands are rare. Even our national preserves have been modified. Wind Cave National Park, for example, was for many years overstocked with bison and elk, and the poisoning of some dog towns further altered natural relations. The dog town in Devils Tower National Monument is partly trampled by visitors, who feed the dogs until they are grotesquely fat. Still, that town has been protected from livestock grazing, so that its vegetation may indicate the heaviest effects that prairie dogs can produce at the site. It seems significant that the greatest number of dogs and the highest density of burrows in this town occurs in a belt of nearly pure buffalograss.

On the Wichita Mountains National Wildlife Refuge, near the edge of the tall grass prairie region, prairie
dogs occur on spots, patches, and fingers of buffalograss surrounded by taller grasses, mainly bluestems. Without long study one cannot judge the extent to which these patches are the cause, or the effect, of occupancy by prairie dogs. But as the disappearance of dogs from some towns was followed by an increase in tall grasses, it is probable that prairie dogs alone maintain the areas of short grass. I found no evidence, however, that prairie dogs alone would reduce the vegetation below the short-grass stage, even on semiarid range. A plot study of a mountain meadow species of prairie dog indicated that on weedy range prairie dogs caused an increase of grass. A similar effect of cattle has been noted on the Central Plains Experimental Range, where moderately grazed pastures have more grass and fewer forbs than protected plots. It is probable, therefore, that under certain conditions blacktail prairie dogs tend to speed recovery of depleted range to the short grass stage. On any range, the effects of prairie dogs tend to bring about the short-grass association, which is their optimum habitat.

Prairie dog habitat and grazing. — Environmental factors that favor the short-grass association also favor the prairie dog population. On the plains, the dominant influence on natural vegetation is cattle grazing. This tends to open up and shorten stands of tall perennial grass or shrubs which normally act as barriers to prairie dogs. In addition, cattle gather near water holes and other sites where they produce weedy trampled ground, which is often the site for a new dog town. Cattle grazing also affects the general forage composition. If the composition of forage on a site long protected from grazing is taken as excellent condition, the forage on similar sites can be judged as good, fair, or poor, depending on the proportion of desirable forage grasses. On this basis, most thriving dog towns occur on range in fair condition. On poor range dog towns are common but they are sparsely inhabited. On good to excellent range, dog towns almost never occur.

Grazing may change range condition. When utilization of forage is excessive, because of overstocking or grazing for too long a period during the year, it causes a downward trend in range condition. This excessive use may be called « overgrazing ». Conservative grazing, which usually means the removal of about half of the annual forage crop, tends to allow range condition to increase. Where climate permits a high proportion of mid and tall grasses, conservative grazing extends
vegetation unfavorable to prairie dogs. One author has suggested that, on sites where protected grass is tall and thick, cessation of grazing tends to make prairie dogs disappear, but no continuous studies have been made to support this view. In one study of ground squirrels (Citellus beecheyi) on a newly-protected annual grass range, however, the squirrels gradually disappeared over a period of six years.

On the central plains, low precipitation keeps vast areas of range in the short-grass stage favorable to prairie dogs, but dog towns occupy only a small percentage of the sites that appear favorable to them. Judged by early accounts, this condition existed before the plains were settled and before rodents were poisoned. I discovered no differences in vegetation that would account for this spotty distribution. An intensive survey of one large town revealed no consistent differences in the kind or coverage of plants on sites inhabited for three years and on sites newly occupied by prairie dogs. Both forbs and grasses were twice as abundant on the dog town as on an adjacent experimental pasture which was moderately grazed. At this site, conservative grazing did not seem to decrease the habitat of prairie dogs.

The plowing of rangeland immediately sets back plant succession to an initial stage. Some years after the plowed ground is abandoned, it recovers to the short-grass stage that favors prairie dogs. On the central plains this recovery takes from 25 to 40 years. Fire, which reduces tall vegetation and sets back succession, might have similar effects. Droughts change forage composition in a manner similar to overgrazing and tend to make the better ranges favorable to prairie dogs. But as drought decreases the food supply of rodents, its first effect is probably to diminish prairie dog numbers.

Through observation of prairie dogs and native ungulates in parks and preserves, one can judge something of their relations under primitive conditions. Pronghorns (Antilocapra americana) often rest on dog towns in Wind Cave Park, perhaps because the vegetation is shorter there than on the surrounding area. Frequently they feed on dog towns, presumably because of the high proportion of forbs, their main food. Elk (Cervus canadensis) crop bluestems to a height of a few inches and thus reduce barriers to prairie dog movements. Bison seem to prefer the greener parts of gentle short-grass slopes, as prairie dogs do. Herds congregate on dog towns to rest and feed. On occasions a bison tears up a prairie dog mound with its horns and hoofs, then rolls...
on the spot, and starts a wallow. Wallows are circular depressions about three meters in diameter that may be filled with dust, mud, or a solid carpet of annual forbs. Probably the general range effects of bison are similar to those of cattle and tend to perpetuate and extend the short-grass association. Under primitive conditions, there may well have been a reciprocal ecologic relation between bison and prairie dogs, each tending to maintain short-grass cover dotted with patches of bare ground and forbs, which is the habitat of the other.

Rodent control. — Prairie dogs are killed as pests because they are potentially harmful to current production of crops and forage. But on rangeland, in long-term view, their effects may be beneficial rather than harmful, and their recreational values may outweigh slight range damage. Apparent damage can often be reduced by indirect methods such as change in grazing practices or encouragement of predators. But indirect methods have seldom been tried. Before 1900, ranchers poisoned prairie dogs by scattering strychnine-soaked grain and by pouring carbon bisulfide down their holes. Then, in the 1920's, a federal bureau commenced a campaign to poison prairie dogs wherever they were found. During the 1930's the main occupation of many public works camps was to poison range rodents. Following World War II, compound 1080 became the chief poison used, and year after year it was distributed on millions of acres on the plains. This poison has been so effective on blacktail prairie dogs that today a dog town is a curiosity.

Aside from killing prairie dogs, continuous distribution of compound 1080 has had other effects on animal communities. The chemical is extremely toxic and kills other grain-eating mammals, such as cottontails. The poison is stable, even in animal tissue, so that carnivores which feed on poisoned rodents are often killed. Coyotes (Canis latrans) have nearly disappeared from the plains because of secondary poisoning. In addition, application of poison brings about a cataclysmic alteration in the relative populations of different mammals, followed by various coactions between species and changes in their effects on plants and soils. Yet, apparently not one scientific study has been made of even the immediate effects of routine poisoning on all the influential mammals in a rangeland community. Would it not be wise to spend less effort on developing more lethal and persistent poisons, and more on discovering
methods of fostering desirable animal communities with least disruption of natural relationships?

As it is our most vital vegetation type, grassland deserves our deepest study and wisest use. Rodents are the most numerous grassland mammals, both in species and numbers, and they exert many influences on soils, vegetation, and other animals. Nevertheless, there are huge gaps in our knowledge of the most conspicuous rodents on our best-known grasslands. We lack, especially, knowledge of the long-term relations among plants and animals living under natural conditions. Particularly important are studies of semiarid grasslands, for continued misuse can turn these to deserts. But because of the extensive effects of past land use, we now lack grassland preserves suitable for this research. We need grassland preserves. On the semiarid plains, natural preserves should be large, perhaps a million acres (400 thousand hectares) in area, so as to minimize the effects of surrounding lands and to contain the natural movements of bison and other large mammals. This size is not excessive for land of low cost, especially where much of it is already government owned. In addition to their values as sites for research, grassland preserves would be perpetual standards against which we could judge the productive potential and degree of modification of other sites. Such preserves must be established soon, or the opportunity will be forever lost.

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