THE PRAIRIE

LAND AND LIFE

by

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INTRODUCTION

Less than a century ago, a continuous expanse of grasslands extended westward across North Dakota to the foothills of the Rocky Mountains in Montana. The grasslands stretched all the way from Mexico northward to central Canada (fig. 1). Today, even though nearly a third of North Dakota and much of eastern Montana is still untilled grassland, only a few areas of unaltered native grasses are left. As a result of overgrazing and plowing of the land in arid regions, some species of grass and native herbs have become rare. Our grasslands have probably been mistreated more than any other area inhabited by man. The grizzly bear, the wapiti or American elk, the black-footed ferret, the plains wolf, the prairie chicken, and the passenger pigeon, all of which once populated the prairie, are now rare or extinct.

Here, on our National Grasslands, the prairie is preserved much as it has been since prehistoric times. What was it like here several hundred years ago? On the open plains the grass stretched as far as the eye could see, green in the rainy season, brown in the dry season. A common scene on a cool, spring morning might have included a herd of pronghorn in the distance, jack rabbits returning to their resting places, a wolf or coyote trotting to its den, several small birds flying overhead and singing, and perhaps a prairie dog or ground squirrel sitting upright at its burrow. We might have heard the booming of prairie chickens on their dancing grounds in the midst of a land rich in spring flowers—anemones, pasqueflowers, buttercups, vetch, and wild onion. Perhaps we might have seen a herd of bison grazing on the greener parts of the range, areas where, the previous autumn, a prairie fire had removed the heavy growth of dry grasses. In late winter, the blackened ash and stubble absorbed the sun's heat, warmed the ground, and contributed to an early growth of grass, providing the best available pasturage.

The prairie environment is a balance of many factors. They include the geology, climate, and soils of the grasslands, and the plants and animals that are at home there.

GEOLOGY

The materials beneath the prairies of western North Dakota and eastern Montana were deposited in lakes, ponds, and swamps adjacent to ancient streams that flowed here during the Paleocene Epoch about 65 million years ago. The sediments consist mainly of layers of fine-grained sand, silt, and clay that look and feel like rock when they are dry, but disintegrate in water.

In Paleocene time, the Rocky Mountains were still young, and rivers and streams flowed swiftly away from them, carrying large amounts of sediment: gravel, sand, silt, and clay. To the east of the mountains, the land became more gentle, and the rivers lost their carrying power as their velocity decreased. They dropped the gravel and coarse sand near the mountains, but the finer materials, such as clay, silt, and fine sand, were carried farther eastward to eastern Montana and the Dakotas. These materials were not deposited uniformly or in a blanket-like manner, but, rather, as the rivers and streams meandered from side to side, they were deposited in one place for a few years and somewhere else a few years later.

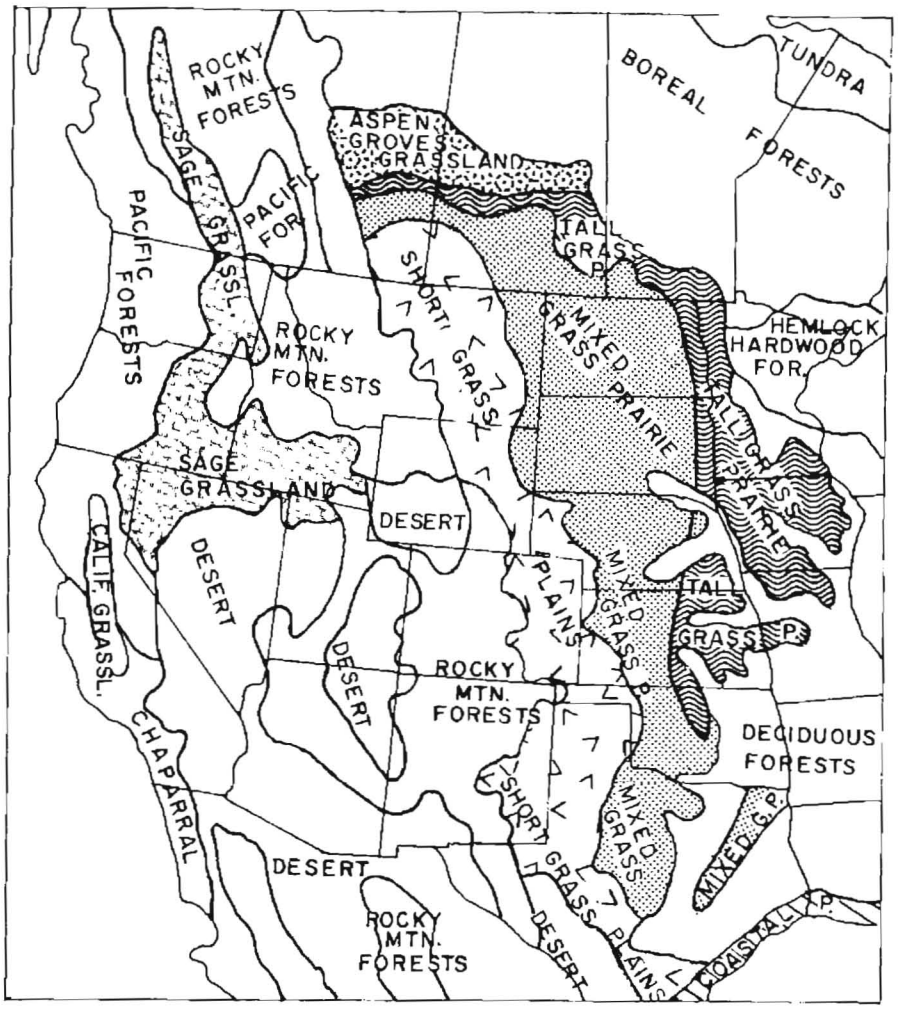

Figure 1. Map of the western United States and parts of Canada and Mexico showing the distribution of the main vegetation types.

After the rivers that delivered the sediment dried up, a long period of erosion began. By about two or three million years ago, the area was probably a gently rolling plain without badlands. A few scattered buttes interrupted the otherwise level horizon. The Little Missouri River flowed in a broad, shallow valley. The carving of the badlands in western North Dakota began when a glacier diverted the Little Missouri River about fifty miles north of Medora, causing it to flow eastward.

Figure 2. Gully forming in area where the cover of grass is thin. Photo by Bob Runner.

Prior to its diversion, the Little Missouri River flowed into the Yellowstone River, which, along with the Missouri River, flowed north into Canada and on to Hudson Bay. After its diversion by the glaciers, the Little Missouri River flowed over a shorter, steeper route than before. As a result, the river cut rapidly downward, causing extensive erosion and badlands development.

The erosion rate has not been constant, but depends on changes in the climate. The badlands have undergone many periods of erosion and deposition. During the past few hundred years, four separate periods of erosion and three periods of deposition have occurred. New gullies have been cut to their present depth since about 1936.

The grasslands continue to undergo the effects of geologic processes. Gullies are gradually working their way back from the Little Missouri River, carving fresh cuts wherever the grass cover is thin (fig. 2). Grass-free areas undergo rapid erosion. Conversely, lower areas, such as the hardwood draws, are receiving sediment from the nearby hillslopes, and only small amounts of this sediment are carried down the draws away from the immediate area.

A geologic process that has been particularly important in shaping this land is the formation of baked sediment known as *scoria* that forms as buried beds of lignite coal burn. Range fires probably ignited some of the lignite beds. Others may

have ignited spontaneously and lightning may have ignited some. Lignite beds are burning and forming the reddish-colored scoria at two locations in western North Dakota today.

CLIMATE

The main factor governing the rate at which erosion takes place is the climate, which also determines the type of vegetation that covers an area. The prairies are eroded most intensely when the climate is dry and warm because the grass cover is thin during these times.

The climate has changed several times over the northern prairies since the end of the ice age about 10,000 years ago. Even in areas beyond the limit of glaciation, it was cool and moist when glaciers covered areas to the north and east. This cool, moist climate allowed the growth of mixed hardwood and coniferous forests, which probably persisted until about 8,500 years ago. Then the climate became warmer and drier and grasslands replaced the forests. The climate was probably at least as dry during much of the 4000-year period between 8,500 and 4,500 years ago as it was during the 1930s, and the northern plains were probably covered mainly by sage and short bunch grasses. Then, as now, the prairie extended eastward into Minnesota.

A shift to cooler and wetter conditions that began about 4,500 years ago and lasted 2,000 years, allowed woodland to spread over much of North Dakota, but probably not into eastern Montana. Between 2,500 and 1,200 years ago, the climate was generally warm and dry. A cooler, more humid climate that began about 1,200 years ago represented a partial return to conditions similar to those at the end of the ice age, and, although the glaciers expanded considerably in the Montana mountains several times during the past 1,200 years, they did not form in North Dakota or eastern Montana. During much of the past 1,200 years, the northern plains probably had somewhat more rainfall than they do today, but the relatively dry climate of the past 100 years has seen an expansion of midgrass prairie eastward across North Dakota.

Summer and autumn on the prairies today are pleasant with warm days and cool evenings. Sunshine is abundant and, even though about two-thirds of the annual precipitation falls during the summer season, prolonged rainy periods are uncommon. The wind seems to blow constantly over the prairies, and, during a hot spell in mid-summer, it may parch everything in several days. In contrast, a sudden winter cold front may drop the temperature 50 degrees in a few hours. Occasionally, a chinook, a flow of warm air from the Rocky Mountains, may melt a foot of snow overnight, although the effects of chinooks are generally greatly diminished by the time they reach as far eastward as the Dakotas. Sometimes, when a moisture-laden air mass from the Gulf of Mexico dumps several inches of rain in a few minutes, the loose sod gives way, causing new, raw gullies to form or already-existing ones to be greatly deepened. During drought periods, like the 1930s, the plant communities of the entire grasslands tend to shift eastward for a few years. At these times, the sod thins out as various grasses assume a bunch-grass habit. As bare ground is exposed between the clumps, a natural fallowing for water conservation is accomplished.

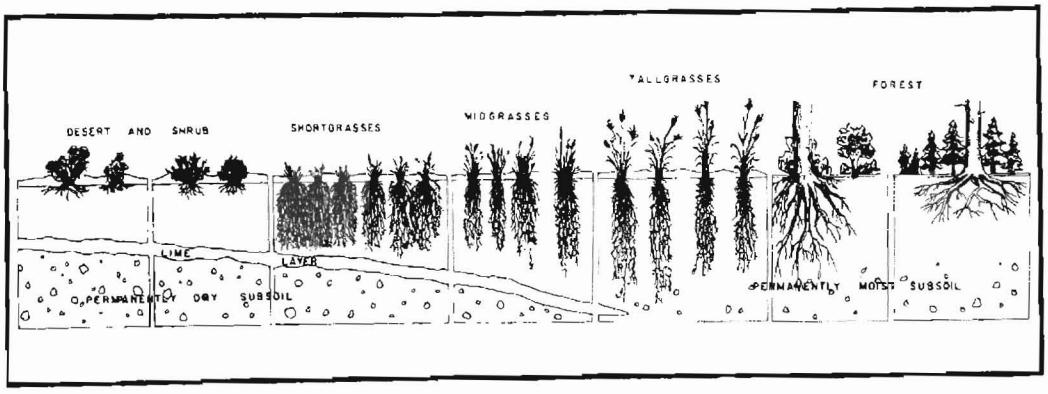

Figure 3. Cross-sectional drawing showing the change in vegetation with increasing moisture.

The prairies are sometimes the scene of violent tornadoes, thunderstorms, hailstorms, and blizzards. The worst blizzards, arriving here from Alberta on 60 mph winds with twenty-below and colder temperatures, probably decimated the ranks of even the hardy bison. The severe winter of 1888 destroyed over half of the range stock and convinced cattlemen that shelter had to be provided for livestock during the winter months.

PRAIRIE SOILS

Soils that develop beneath the grasslands are the result of entirely different climatic conditions than those that develop forest soils (fig. 3). In general, the climate determines the type of vegetation that grows; the vegetation, in turn, develops the soil type. The geologic materials, be they silt, limestone, or granite, play only a minor role in determining either the vegetation or the soil and, given a particular climate, essentially the same soil will develop on all of these materials.

Much of the organic material in the soil beneath most naturally forested areas is composed of leaf fall and is supplied to a surface that has only a discontinuous cover of herbaceous (grassy) plants. This results in a loose, crumbly, and relatively well aerated layer of material. Only by mechanical processes, such as the activities of rodents and insects, can this material be carried down to mineral horizons. Grasses, on the other hand, form a much denser sod as they die down and accumulate. They also form a dense rooting network that commonly reaches a depth of up to six feet. The grasses die away and decay almost continuously so that humus, in a finely-graded form, is actually implanted in the soil by the vegetation. This penetration by roots and humus insures soil fertility regardless of differences in original parent material. Generally, grasses assimilate greater quantities of mineral

nutrients, particularly calcium, than do forest trees. The humus returned to the soil by grasses is therefore richer in nutrients than that in forest soils. As the humus decays, the nutrients are released, only to be caught up again by the efficient grass rooting systems. In this way, a rich nutrient cycle is maintained.

Wind and sun cause rapid evaporation from the actual surface of the soil beneath grasslands; and, even more important, the rapid transpiration from the grasses themselves causes them to draw on the soil-water around their roots. Even though summer is the wettest season over the prairies of western North Dakota and eastern Montana, the soil is subjected to efficient drying; and, over most of the area, rain rarely manages to percolate beneath root depth. The subsoil is almost permanently dry.

LIFE ON THE PRAIRIES

Plant Life

The prairie is mainly a grassland community dominated by herbs. The herbs include both grasses and forbs with grasses dominating. (Herbs are plants with no permanent parts above the ground as opposed to shrubs or trees. A forb is any herb that is not a grass or sedge.) Grassland vegetation is layered both below and above ground. In most grasslands the grasses are of two or more heights. In the tall-grass prairie, the grasses are two to six feet high; in the mixed prairie both relatively tall and short grasses occur, respectively, at one to two feet and eight inches to two feet high; in the short-grass plains, the grasses are from two inches to a foot high. The bunch-grass prairie may include both tall and short grasses, but the bunch grasses are commonly two feet to three feet high.

The mixed prairie of western North Dakota consists mainly of midgrasses, those that grow one to three feet high. The mixed prairie stands in contrast to the tall-grass prairie to the east where precipitation is greater, and to the short-grass plains in the drier areas to the west. Most of the midgrasses are bunch formers that do not produce deep, root-tangled sods like those of the tallgrasses. The most abundant and important midgrass, little bluestem, does form sod wherever it has sufficient moisture, but in most places it occurs in clumps.

Little bluestem grass originated somewhere in a warm climate to the south; and, for this reason, it grows best through the hot part of the summer. Other abundant midgrasses are needlegrass and June grass. They originated in a cool climate and grow best in the cool season early in the year, and again in the early autumn. The mixture of warm-season and cool-season grasses helps to insure the productivity of the prairies, regardless of when the rains come in any particular year.

Needlegrasses are important forages for grazing animals of the prairie. In early June, the yellowing stems of needlegrass are covered with seeds. Pick some of the slender pointed seeds and examine the five-inch twisted *awn* projecting from the tip of each seed. After a seed is shed, the first moisture causes the awn to straighten. Then, when it dries, the awn twists again and screws the seed into the soil, where it can germinate. Needle-and-thread, a common, closely-related species, has wavy or curled awns which, with the pointed seed, suggest a threaded needle. If you are wearing low shoes as you walk over the prairie, you may accumulate one or more of

these needles in your socks and, if you do, you may better appreciate the westerner's preference for boots. The Indians, when they dressed out a newly-killed bison, tried to avoid placing the carcass on an area of needle-and-thread grass, because, if the sharp needles got into the meat, they might make a painful mouthful later on.

Western wheatgrass,-which is also abundant over the northern prairies, can be easily recognized at a distance by its blue-green stands. Another cool-season species, western wheatgrass spreads by underground stems (*rhizomes*) over areas of bare soil to form loose sod. It is widely distributed and resistant to drought. The perennial grasses of the prairie may reach their full growth in three years and live for an additional ten to twenty years. They often develop a root system with a much larger bulk than that of the above-ground parts.

In each of the different prairie habitats, we find deep-rooted, flowering herbs, broad-leaved, nongrassy species known also as forbs. The forbs help to vary and brighten, through spring and summer, the greens, ripening yellows, and browns of the grasses. They decorate the open lands with successive bloomings until at last the September or October frosts close the growing season. Scattered over the range is every hue of yellow, blue, white, purple, brown, and pink. Each in its proper season and location, we find dotted gayfeather, long-headed coneflower, purple coneflower, prairie clover, phlox, yarrow, western wallflower, scoria lily, scarlet globemallow, yucca, leadplant, horsemint, fleabane, and a dazzling array of sunflowers, asters, and goldenrods. The Indians knew which plants had edible roots and berries. Among the best known of these are the prairie turnip or breadroot.

Low-growing, woody shrubs occur with the grasses and other herbs in many places. One is the wolfberry, known also as snowberry or buckbrush. Stands of wolfberry are commonly mixed with thickets of silver buffaloberry and silver berry, both of which flash a wave of white when they are blown in the wind causing the silvery undersides of their leaves to turn to the sun. The silvery surface is an adaptation to the arid environment caused by millions of tiny hairs that result in a *pubescent* surface, which helps the leaves to conserve water. Other silvery-leaved plants, including the sages, are also pubescent. Still other plants, like the prickly pear cactus, have adapted to the dry environment by growing thick-skinned leaves that retain moisture. Many of the thickest stands of shrubs are on steep, north-facing slopes, which offer cooler environments and slightly more favorable moisture conditions. Here we find abundant stands of chokecherry, juniper, and creeping cedar.

Grazing animals, such as the bison and pronghorn, were once common on the grasslands. All the native prairie plants were able to coexist with the grazing animals. The perennial grasses are productive enough to sustain the annual cropping of foliage and thrive in spite of it. Other plants of the grassland are unpalatable to the grazers, but this is a matter of degree, and all plants are probably acceptable to some members of the animal community, whether the feeders are insects, bison, or others.

Bird Life

The birds of the prairie show adaptations for life in the draws or on the open prairie. In the wooded draws we see the Rocky Mountain bluebird and the black-capped chickadee; at the edges of the draws are flickers, wrens, brown

thrashers, prairie warblers, and song sparrows. These birds of brush and woodland edges sing for us from perches in trees or, perhaps, from a chokecherry bush. On the nearby prairie may be a meadowlark, bobolink, or song sparrow singing from a swaying stem of a tall flower stalk. We may see grouse or partridge as we walk over the prairie. Other grassland birds sing for us as they fly over. They include the longspurs, horned larks, Sprague's pipit, lark buntings, and upland plovers. An eagle may soar far overhead and, toward evening, perhaps a nighthawk may be seen. If there is a slough nearby, we may see red-winged blackbirds, ducks, gulls, kingfishers, and any of several other water birds.

Animal Life

The largest native animals in the grasslands of western North Dakota and eastern Montana today are the mule deer and the white-tailed deer. They prefer the wooded draws where they both graze and browse (fig. 4). The two varieties of deer can be distinguished by their antlers; the white-tailed buck has tines from a main horizontal beam, while the mule buck has forked antlers. The number of tines on each antler does not indicate the age of the buck as is popularly believed.

Many of the grassland animals are extremely gregarious. The bison were often found in herds of 100,000 to 2,000,000 animals. Herds of up to 400 pronghorn were common a hundred years ago. Pronghorn, which are not true antelope, can sometimes be seen on the open prairie, where they browse on shrubs such as sage. Both bucks and does shed their hollow horns each autumn and grow new ones on the remaining bony core. Pronghorn can easily outrun most danger, as they are capable of speeds up to fifty-five miles an hour for short distances and forty miles an hour over considerable distances.

Other prairie animals include the chipmunk, shrew, jackrabbit, cottontail, porcupine, and several varieties of mice, voles, and ground squirrels. Carnivorous animals of the prairie include the long-tailed weasel, red fox, raccoon, striped skunk, bobcat, badger, and coyote. Each of these animals is adapted to a certain life-style. The long-tailed weasel can slip in and out of mouseholes and capture prey ranging in size from the smallest rodents to cottontails. The coyote preys on birds and small mammals such as mice, ground squirrels, and rabbits. Occasionally, it will prey on prairie dogs.

The most characteristic burrowing rodent of the grasslands is the black-tailed prairie dog (fig. 5). Prairie dogs feed on both grasses and forbs of various kinds, and their disturbance of the sod promotes the growth of annual invaders, plants that grow best on bare soil. At one time, prairie dogs were extremely abundant on the prairies. One "town" in Texas at the turn of the century was estimated to cover 25,000 square miles and contain 400 million of the animals. Literally billions of prairie dogs inhabited the grasslands as recently as the last century, but intensive extermination campaigns by man have now reduced the great prairie-dog nations to a few scattered colonies.

Prairie dogs carry subsoil up and spread it on the surface, where it breaks down into soluble forms of plant food. The animals' burrows conduct air underground and make oxygen available to the many small living things that contribute to the enrichment of soils. The deep layers are loosened and fertilized with deposits of vegetation, droppings, and topsoil.

Figure 4. Wooded stream valley typical of the prairie. Notice the deer in the center of the picture. Photo by Bob Runner.

Several species of reptiles and amphibians are common on the prairie. They include the horned lizard, the leopard frog, and several varieties of turtles and snakes. The prairie rattlesnake is the only poisonous snake found in eastern Montana and North Dakota. It has two curved, hollow fangs that fold back against the roof of the mouth when they are not in use. These fangs connect to poison sacs. When the snake strikes, the fangs point forward, and muscular action forces the poison along the grooves of the fangs into the victim's flesh. The snake does not jump from the

Figure 5. Black-tailed prairie dog. Photo by Bob Runner.

ground, nor does it strike from a perfect coil. It cannot strike from a distance greater than one-half to three-fourths of its length.

SUMMARY

All the animals we see on the prairie are a part of the overall grasslands environment. Their lives are closely interwoven with one another and with their prairie home. That prairie home responds to the gradual changes that take place with time, changes in climate and human pressures and changes brought about by the animals and plants themselves.

Perhaps, after looking briefly at the intricate interrelationships of animals, soil, grass, and climate, we can begin to realize that no living thing can be long preserved away from its natural environment. Major changes in the environment cause the process of natural selection to take new directions and, given sufficient time, we will no longer have the same plant or animal that we had originally.

Our knowledge and the state of our science benefit when we preserve natural areas like our National Grasslands where plant and animal life are left to work out their existence as they always have. By doing this, we maintain the means to learn from our natural environment. We preserve the original plant and animal species to help us recall what life was like in times past and to provide us with a store of information to use for purposes still not apparent to us.

REFERENCES

Allen, Durwood L., 1967, The Life of Prairies and Plains: McGraw-Hill Book Company, New York, 232 p.

Bluemle, J. P., and Jacob, A. F., 1973, Geology Along the South Loop Road, Theodore Roosevelt National Memorial Park: North Dakota Geological Survey Educational Series 4, 16 p.

Burt, W. H., and Grossenheider, R. P., 1964, A Field Guide to the Mammals: Houghton-Mufflin Company, Boston, 284 p.

Costello, D. F., 1969, The Prairie World: Plants and Animals of the Grassland Sea: Thomas Y. Crowell, New York.

Johnson, J. R., and Nichols, J. T., 1970, Plants of South Dakota Grasslands: Agricultural Experiment Station, Bulletin 566, South Dakota State University, Brookings, 163 p.

Robbins, C. S., Brunn, Bertel, and Zim, H. S., 1966, A Guide to Field Identification: Birds of North America: Golden Press, New York, 340 p.