

Landscape Change at the Confluence: From Lewis and Clark to the Present

By John L. Allen



In a natural landscape like the Great Plains, devoid of major topographic features, the important and sometimes sacred landmarks are the isolated buttes, the rare hills, and the junctions of great rivers. The **confluence** of the Missouri and Yellowstone Rivers (southwest of Williston in McKenzie County) served for centuries as one of the most important landmarks between the great cultural center of the Mandan and Hidatsa villages near the Missouri's northern bend and the Great Falls of the Missouri in central Montana. The confluence was a key point in the geography of the original inhabitants of the Great Plains—a point of centrality and demarcation in the establishment of tribal territory. The confluence has also been an important landmark for the white settlers of the plains. Indeed, for the first Euro-Americans to venture onto the plains in the early nineteenth century, the confluence was a landmark of geographical and operational importance. It was at the confluence that Meriwether Lewis and William Clark reunited their two halves of the **Corps of Discovery** during their return trip of 1806 and it was at the confluence that the American explorers met two hunters from Illinois, bound for the Rockies to take beaver—the first of the **mountain men**. At the confluence the American Fur Company built Fort Union to preside over the trade in buffalo hides and beaver and other pelts in the upper Missouri valley region for decades. Today the confluence of these two great rivers is an important symbolic junction between the Missouri River, one of the continent's most heavily modified and managed streams, and the Yellowstone, one of its last great free-flowing rivers. Given the historic and prehistoric significance of the Missouri-Yellowstone confluence, it seems proper to focus an examination of landscape change over the last two centuries upon the region for which the junction of those two great rivers provides a center.

In looking at various interpretations of landscape change in the American West, we can clearly distinguish **two traditions**, or ideas about the West, with some suggestion that a third tradition is currently in the process of being shaped.

First, an idea widely accepted by the mid-nineteenth century was the notion of the West as **pristine wilderness**, occupied at low population levels by people who inhabited the earth in harmony with the environment and made no more mark upon it than the beasts of the forests and prairies.¹ In this tradition, the Indians are replaced by agriculturalists and others of European stock and the wilderness begins to shrink. The pervasiveness of this invented tradition is so great that it is accepted not just by European Americans but by many American Indians who persist in the belief that their relation-

ship with nature was so beneficent and symbiotic that the concept of pre-European management of ecosystems is, quite literally, unthinkable.²

By the middle years of the twentieth century, a second idea or tradition had begun to develop. Based largely on the work of geographers and anthropologists, this new tradition began to attract followers rapidly and, by the end of the twentieth century, had become institutionalized in works such as Shepard Krech's *The Ecological Indian*, a remarkable book that makes a powerful case for Indian **management and alteration of ecosystems** well before the first Europeans arrived on American shores.³

We are currently seeing the development of a third idea about landscape based in work by envi-

ronmental scientists and political activists who, increasingly, see the West as neither pristine wilderness nor managed ecosystem but, forgetting past events, concentrate on the present to characterize the West as a **ravaged ecosystem** so significantly modified by Euro-American settlement that it bears no resemblance to the landscape of the past, even as recently as the end of the nineteenth or beginning of the twentieth centuries.⁴

If, as suggested earlier, we can use the expedition of Lewis and Clark as a benchmark to establish the landscape qualities of the confluence region in the early nineteenth century, does an examination of the written records of the Corps of Discovery provide us with evidence to support any of these interpretations of the relationship between humans and the Great Plains environment, particularly that in the vicinity of the confluence? Unfortunately, the answer is “no” and such evidence is lacking—at least in a direct sense. Lewis and Clark and the other journalists from whom we obtain our benchmark data on the landscape of the early 1800s, after all, adhered to the tradition of Indians as occupying a pristine wilderness.⁵ They also believed in the tradition of heroic European forefathers who conquered the howling wilderness and created

American civilization while moving to the edge of that civilization the wild beasts and Indians who had lived there earlier.⁶ As such, there is little reference in the Lewis and Clark journals to Indian interactions with the environment—except in the most offhanded kinds of ways. The captains simply did not know any way to think about Indians as shapers and modifiers of the environment. But the asides they do insert from time to time can be important indirect evidence of the validity of the managed ecosystem tradition. There are, for examples, dozens of references in the journals of Lewis and Clark to the use of fire by indigenous people,⁷ but it is clear that neither of the captains fully understood what Indian burning practices meant for the creation and maintenance of grassland environments in the Great Plains. Similarly, there are many references in the journals to Indian hunting practices that may have been exploitative rather than conservative. The **buffalo jump** is an example. In this method of hunting, Indians stampeded perhaps hundreds of bison to the edge of a cliff over which the animals tumbled to their deaths. The captains were terrific observers and recorders of a world that was new to them, and we can learn a lot—even if indirectly—from their painstaking journal entries.

Figure 1. Upper Missouri, Dakota, detail from a painting by Philippe Régis de Trobriand, circa 1867–1869, near today's Garrison, North Dakota. (SHSND 12469)



In what follows, I'd like to begin an exploration of my own to see to what extent the experience of Lewis and Clark can teach us things about which of the three invented traditions—pristine wilderness, managed ecosystem, or ravaged ecosystem—has more validity as revealed truth. Or perhaps we will discover that each of the traditions has some degree of acceptability, a series of smaller truths rather than one great one. My interest is in reconstructing the landscape of the plains as it was at the time of Lewis and Clark by utilizing the evidence in their journals and in assessing the nature of change in that landscape from their time to the present through the use of such graphic historical documents as are available to me. I will attempt to do so without making value judgments about those changes.

We need first to understand that the confluence region was in the midst of significant cultural and biological change in the late eighteenth and early nineteenth centuries and that what the Corps of Discovery encountered was, in many ways, a landscape in flux. We also need to discuss, albeit briefly and using evidence exclusively from the journals, the perceptions of the confluence region on the part of the captains and the other journal keepers; what did these initial Euro-American observers think of the northern plains in terms of land quality, water availability, wildlife, terrain, and other geographical features? Understanding their perceptions—or, in many cases, their preconceptions—of the regional environment helps us to interpret the landscape descriptions that are our benchmark evidence for the characteristics of the northern plains environment of the early nineteenth century.⁸ Most important, in this section, I will engage in some extended commentary of the human actions that shaped the world seen by Lewis and Clark but not necessarily understood by them or reported in their journal entries. For example, was the vegetation of the plains entirely natural, a response solely to soil and climate conditions, or had it been shaped by human action as much as by changes in climate and soil? In this examination of the landscape of the confluence region in the opening years of the nineteenth century, we will evaluate

the most dominant elements of the plains environment: the varied grassland and woodland vegetation, the incredibly abundant wildlife populations, the water on the land, the controlling climate, and the culture of the indigenous peoples of the plains who, as we will see, played no small role in helping to shape the landscape in which they lived.

There are sufficient references in the journals to such processes and events as tribal migrations, trading relationships, competition for territory, and open conflicts to suggest that, whether Lewis and Clark understood it or not, the plains landscape was one in cultural flux and, therefore in biological change as well. Three primary components of the cultural landscape of the northern plains most characterize the changes that were taking place at the time the Corps of Discovery passed through the confluence region: 1) **changing tribal locations**; 2) the **advent of horse culture**; 3) and the **impact of the early fur trade**.⁹

The first of these is easily understood: as **European traders** and trade goods advanced upon the plains from the north and east, those tribes that first acquired European technologies—particularly firearms—began expanding westward, increasing the size of their territories and moving into the rich buffalo hunting grounds of the plains. Thus the Sioux, originally an eastern woodlands people, moved into the Missouri valley and beyond, displacing the Crows and Arapahoes who in turn moved farther west, displacing the Shoshones from the plains into the Rockies.¹⁰

From 1650 on, tribal locations on the plains were unstable. They were certainly unstable at the time of Lewis and Clark and made more so by the recent advent of horse culture. The increased mobility brought about by the increasing adoption of the horse as a beast of burden and as a source of transportation not only contributed to shifting tribal territories but also to ecological change. By 1750 the horse was found as far north as southern Alberta and British Columbia. Horses altered hunting, migration, ceremonial, and other aspects of life on the plains. In the northern plains, keeping large

horse herds alive in the wintertime meant stripping off the outer bark of cottonwood and other riparian trees for the nutritious cambium layer underneath. This killed large numbers of cottonwoods, and by the time of Lewis and Clark, the distribution of cottonwood trees was far smaller than it had been just a century before.

It is not known to what extent the horse increased the ability of Indians to extract buffalo from the environment, but there are hints that buffalo kills increased significantly between 1700 and 1800.¹¹ At least some of the increased bison kill was a consequence of the early fur trade. Records from the **Hudson's Bay Company** and Northwest Company from the mid-1700s onward indicate a flourishing trade between the British fur posts or "factories" in the Saskatchewan drainage basin and the upper Missouri valley.¹² European goods were exchanged for peltries, especially beaver and wolf, and buffalo robes. The great buffalo herds of the northern plains were probably already in decline as a consequence of the robe trade, even before Lewis and Clark.¹³

The reaction of the journalists of the Corps of Discovery to the northern plains environment was neither subtle nor subdued. It was, rather, unabashedly enthusiastic. We might have expected this from men who were hunters, and the

enthusiasm of such a man, Sergeant Patrick Gass, is explainable. "A person by going to one of the hills may have a view as far as the eye can reach without any obstruction . . . and enjoy the most delightful prospects,"¹⁴ Gass wrote; his view of the plains environment is a favorable one. Meriwether Lewis described the area of the Missouri-Yellowstone confluence as follows: "I had a most pleasing view of the country, particularly of the wide and fertile vallies formed by the Missouri and Yellowstone river, . . . meandering for many miles in their passage through these delightfull tracts of country . . . the whol face of the country was covered with herd of Buffaloe, Elk & Antelopes; deer are also abundant."¹⁵ William Clark described the confluence landscape as "a butifull low leavel plain . . . emence numbers of antelopes in the forks of the river. Buffalow & Elk & Deer is also plenty beaver is in every bend."¹⁶ It must be kept in mind that both captains came from the farming tradition of the Virginia Piedmont and Ohio valley—and when they describe land as "beautiful" they are speaking not just in an aesthetic context but a utilitarian one. Even after a long winter at Fort Mandan, Meriwether Lewis, in a letter to his mother that he must have known would also reach the president, wrote that "This immense river so far as we have yet ascended waters one of the fairest portion of the globe, nor do I believe that there is in the universe a similar extent of country, equally



Figure 2. Herd of bison near Lake Jessie. (SHSND, 917.8 Un3r V12-p59)

fertile, well-water[ed] and intersected by such a number of navigable streams.¹⁷ The responses to the northern plains environment were reflections of the Jeffersonian view of the western interior as the Garden of the World, shared by the two captains.¹⁸ But in most instances, the impression received from the journals is that the highly favorable view of the northern plains was the consequence of an environment that was, in the early nineteenth century, truly an abundant one.

The Landscape of the Confluence Region in 1804–06

Vegetation

The environment of the northern great plains was dominated by grasses. The most important is *Buchloe dactyloides*, called **buffalo grass** from its dietary and spatial association with the bison. As many as a dozen other grass species were present, but it was the hardy and nutritious buffalo grass that made the northern plains an area of wildlife abundance. The persistent presence of fire in the environment was important in grassland maintenance. Grasses are peculiarly adapted to both fire and drought because so much of the plant lies below the soil's surface. And where both fire and drought are present, grasses are also. The question, of course, is whether fires were natural (from lightning strikes) or man-made. Evidence from the journals of Lewis and Clark suggests the latter, and that evidence is supported by other contemporary observers of Indian burning practices.¹⁹ In addition to fire and burning, the continual grazing and soil disturbance by the largest and smallest of the dominant plains mammals were important. **Bison** grazed the grasses, trampled the soil, and contributed to soil aeration and opening of the nutrient cycle. Prairie dogs, also significant grazers that out-numbered the buffalo several thousand to one, performed much like bison in mixing soil and contributing to the diversity of the grassland ecosystem.²⁰

On the drier and higher margins of the plains, shrubs such as sagebrush, buckbrush, and grease-

wood were common. These plants provided forage for animals like mule deer, whitetail, and prong-horn antelope. The shrub communities were also maintained by fire, probably set intentionally by human hunters, since native peoples knew that younger shrubs were more nutritious than aging ones and burning off old growth to promote new was an age-old cycle of vegetative renewal on the plains. In moister draws and valleys where water collected after rainfall or in sheltered areas where less precipitation was lost to evaporation, tree species grew readily in the plains. Cottonwoods, alders, and willows grew along watercourses. Cedars and junipers and aspen grew in hilly areas and pockets of water concentration. These plants, too, provided a source of food and shelter for the abundant plains wildlife—and like grasses and shrubs, they were maintained by burning.

Wildlife and Livestock

Nearly half of all animal species identified by the captains during their entire journey were indigenous (native) to the plains.²¹ The American explorers, already accustomed to an abundant wildlife environment east of the Mississippi, were nevertheless rendered nearly speechless by the huge herds of animals on the plains. The ecological dominant on the plains was, of course, the bison.

These animals had evolved to take advantage of several abandoned ecological niches following the end of glaciation and were, in a sense, a “weed” species that drove out or confined spatially many potential competitors.²² The best and most recent attempts at bison population reconstruction place the size of the great plains herds at somewhere around thirty to thirty-five million in 1800, a figure that may represent some decline from several centuries before, proceeding from the introduction of the buffalo robe trade in the 1600s. By 1800, when Lewis and Clark first encountered the species, the range of the bison was also somewhat restricted from its earlier pre-contact extent. Where, in 1600 and possibly even 1700, bison had ranged from western Pennsylvania and New York to the Great Basin, by 1800, nearly all North American bison

were located between the Missouri River and the Rocky Mountains or in the woodland-grassland transition zone in the Canadian plains.²³

Also inhabiting the plains in great numbers were other ungulates (having hooves): antelope, elk, deer, and in the broken areas of the northern plains, bighorn sheep. Second in numbers to the bison with herds of between eighteen and twenty million animals were the pronghorn antelope (*Antilocapra americana*), an animal more closely related to the goat than Old World antelopes. The American elk or wapiti (*Cervus*) also ranged widely across the plains. Like the buffalo this animal was in demand for both meat and robes, and its numbers and range may have diminished somewhat between 1500 and 1800. Once abundant in the Ohio Valley, elk were largely gone from that area by 1800. But nearly ten million still roamed the plains west of the Missouri. Both mule deer and whitetail deer were part of the faunal inventory, frequently inhabiting brushy country generally avoided by the buffalo. Deer and elk were browsers rather than grazers and continued to thrive in the plains environment because they did not compete with the bison for grasses. Similarly, bighorn sheep, occupying breaks along major river valleys like the Yellowstone and

Missouri, ranged in terrain generally avoided by bison populations and, hence, were not competitors with the great herds of this ecologically dominant animal. Finally, among the large grass-eating animals was the horse, which Indians fed with cottonwood bark, contributing to the decline in that vegetative community. But many wild horses also existed and they, too, exerted an impact on grasses and shrubs. Because they were not as efficient grazers or browsers as bison, elk, deer, and other ungulates—horses probably exerted impacts on the landscape far beyond what their numbers would have indicated.

Literally billions of birds were part of the faunal inventory of the plains, including birds like pelicans and gulls, more often thought of as coastal species. The abundant rivers, streams, ponds, kettleholes, and wetlands provided a ready habitat for water fowl. The grasslands and riparian (riverbank) vegetation of cottonwood groves and willow and alder thickets provided habitat for thrushes, larks, and other songbirds. And, at the top of the food chain were the great raptors: golden and bald eagles, a dozen different hawks, and several falcons including the peregrine and prairie falcons. Also present among



Figure 3. The “well watered” Missouri River Valley as it appeared in the 1950s, as the waters of the Missouri began to back up behind the nearly completed Garrison Dam. (SHSND 0760-016)

the bird populations were the large food species: grouse, turkeys, ducks, and geese. These provided an important dietary supplement for both predators and people, and their presence was also an indication of a diverse ecosystem in balance.

Wildlife abundance, particularly of hoofed animals (ungulates), suggests an abundant predator population: bears, wolves, coyotes, cats, and smaller predators abounded in the northern plains. The dominant predator and scavenger was the grizzly, the most conservative and aristocratic of plains predators. A conservative/aristocratic species is one that reproduces slowly, resides near the top of the food chain, and occupies considerable territory. One adult male grizzly may have occupied a territory of over one hundred square miles—and brooked few invasions of his turf. Lewis and Clark noted a number of encounters with grizzlies.²⁴

If the largest of the northern plains carnivores elicited nearly as many mentions in the journals of Lewis and Clark as did the largest of the herbivores, the smallest of the grass-eaters was not a focal point of the captains' descriptions of the northern plains. These smallest grass-eaters, the **prairie dogs**, were the most numerous mammals on the plains and exerted significant impact on the plains environment. Like the bison, they played a crucial role in the maintenance of the grasslands through grazing and soil disturbance.²⁵

Among the most interesting questions facing Lewis and Clark was the uneven distribution of animals in an environment of apparent uniformity. Why were some areas of the northern plains more heavily populated with bison and other plains animals while other areas were nearly empty? A variety of conventional explanations for population numbers and distribution can be used to try to explain this uneven distribution, but none of these are satisfactory for the northern plains in the early nineteenth century. We know, for example, that bison populations fluctuated in both numbers and location with climatic variations, with both numbers and range diminishing in times of drought. But we also know that the climate during the captains'

crossing of the northern plains was in a wet cycle and should have supported large animal populations everywhere.²⁶ Ecologists have developed some new ideas to explain the variable distribution of animals in the northern plains and Rockies at the time of Lewis and Clark that depend on human behavior. In areas where territorial conflict existed between Indian tribes and in which, as a consequence, no tribes occupied permanent locations, wildlife were abundant because they were hunted less. Think of Kentucky, once known as the Dark and Bloody Ground of conflict between Creeks and Shawnees, and a region of unparalleled wildlife abundance east of the Mississippi; that abundance was one of the chief attractions of the area to people like Daniel Boone. In those uncontested areas more permanently occupied by humans, on the other hand, a **"game sink"** exists where few animals are found. Using the dates of the Lewis and Clark Expedition and the commentary in the journals as evidence, anthropologist Paul Martin has suggested that the faunal abundance of the northern plains in the confluence region of the Missouri-Yellowstone junction was the consequence of conflict.²⁷ This was an area contested between Mandan-Hidatsa-Arikara peoples to the east, eastern and Teton Sioux on the southeast, Crows, Cheyennes, and Arapahoes to the south, and Assiniboines, Gros Ventres, and Blackfeet to the north. As a result of conflict over territory, permanent habitations of any of these peoples were on the periphery of the area and the result was faunal abundance. Conversely, the scarcity of game in the northern Rockies was the result of the more permanent location and more clearly defined territories of the Shoshones, Nez Percés, Salish and others who had, at the time of Lewis and Clark, basically hunted out most large-game species from the northern Rockies. Nor was this game sink the only instance in which humans contributed to a change in animal populations. The fur trade, operating out of posts in the Saskatchewan basin as well as St. Louis, had already begun to impact the confluence. Hunters took small, fur-bearing animals along with wolf, bear, and buffalo, and the result may have been a decreasing population among these animals at the time of the expedition.

Water

In the early nineteenth century, the commonly held view of water availability was more a function of the presence of rivers than it was the presence of rainfall.²⁸ Our present concept of the drainage basin that contributes water to rivers through the catchment process was largely absent from the thinking of Lewis and Clark, as was the concept that the soil moisture necessary for plant growth came from precipitation rather than the existence of surface streams. To them, the fact that rivers like the Missouri and Yellowstone flowed through the northern plains was sufficient to suggest that this was prime farmland and the journals are replete with the phrases “well-watered,” meaning the existence of streams on the land but also meaning that this land was suitable for agricultural development by the American farmers that Jefferson viewed as the backbone of the Republic.

In addition to serving as the source that watered the land, rivers also, in the view of Lewis and Clark, provided the primary mechanism for transportation.²⁹ In fact, northern plains streams other than the Missouri and Yellowstone were not really capable of navigation nor did they water the lands through which they flowed. But at the time of Lewis and Clark they provided an abundant riparian environment for plants and animals and, in that sense, formed the lifeblood of the plains.

Of all plains environments, the most diverse and abundant were the **riparian zones**.³⁰ River floods laid down rich deposits of alluvium in which cottonwoods and other riparian species quickly rooted. Indeed, spring floods support the growth and the distribution of cottonwoods. Riparian zones provided food and cover for wildlife, and seasonal shelter for the winter homes of many Indian tribes. After the arrival of the horse, the cottonwood trees which were abundant on river banks provided bark for winter forage for the Indians’ horses; these riparian vegetation systems were undergoing change at the time of Lewis and Clark.

In addition to plains streams, abundant surface water existed outside of river channels. Much of the plains was pocked with depressions—created by wind, water, and, in some cases, melting glacial ice. In these depressions water collected over thousands of years, some of it seeping into the rich underground aquifers and some of it remaining at the surface to provide habitat for waterfowl and waterside vegetation. In many areas, the groundwater was so close to the surface that ponds actually represented the top surface of the water table. One of the more ironic features of the plains is that an area of water scarcity should also be an area of water abundance in geological ones.

Figure 4. The Hidatsa villages along the Knife River, circa mid-1830s, as described in oral history and depicted by Sitting Rabbit, a Mandan, in 1906. Note the gardens planted along the river. Per-acre production of corn and other foods in gardens such as these far exceeded that produced by Euro-American farms in the eastern United States. (SHSND 673)



Terrain and Soil

The landscape of the plains is not flat. During the period of glacial melt some 10,000 years ago, waters carried onto the plains from the melting Rocky Mountain glaciers carved deep valleys in a landscape covered with deep glacial deposits of sediment. The best example of valley formation is the valley of the Missouri itself, but other plains streams carved similar, if smaller, valleys into the face of the plains.

Between the river valleys (the interfluvial areas) are the uplands of the plains rising five hundred feet and more above the bottoms of the river valleys. Here the sedimentary rocks that make up the foundation of the plains are exposed as surface limestone and sandstones, usually light in color. Much of the geological observation of Lewis and Clark focused on these interfluvial areas where minerals of utilitarian value would be located.³¹ The single exception to that was their frequent commentary on “coal” appearing in the river bluffs of both the Yellowstone and Missouri near the confluence. Much of their coal was lignite; but they often mistook dark-colored shale beds for coal.

In general terms, the captains’ descriptions of terrain were limited to common descriptors (bluffs, “fine plains,” “broken country,” etc.) without a discussion of origin, and their commentary on soil was almost always concerned with agricultural fertility or barrenness. Of all the scientific contributions of the expedition, those having to do with geology, geomorphology, and soil science are the most limited: this is to be expected since lacking sufficient geologic training, the captains’ descriptions of terrain and soil could not match their taxonomic (classification) details on plants and animals.³²

Climate

The climate of the northern plains has three primary characteristics: (1) variability from year to year, (2) the presence of seasonal temperature extremes, (3) and an ever-present wind—all of which were predominantly mentioned in the

journals of the Corps of Discovery. Location in the continental interior assures wide temperature range swing between cold winters and hot summers. During the winter at Fort Mandan, for example, temperatures in the forty-degrees-below-zero range were not uncommon, and during the summer in Montana, Clark recorded many days in the 100-degree range. The climate is also semiarid. The lack of precipitation when compared with areas farther east is manifested in two ways: lower average precipitation and higher variability. In western North Dakota or eastern Montana, average annual precipitation may have been fifteen inches with dry years of five and wet years of twenty. Simply put, frequent and periodic drought is and was a characteristic of the northern plains climate.

The northern plains is also a region of cyclogenesis, it spawns some of the traveling low- and high-pressure systems that characterize weather and climate in the mid-latitudes. Situated between the cold, continental air masses of Canada and the warm, moist air of the southern continental interior and the Gulf of Mexico, the plains are so located as to foster the movement of air mass, or wind. It is worth noting that in Clark’s original distance and time estimates, he had figured to get to the Pacific and back in a single traveling season. Wind was one of the factors that forced significant readjustments in those estimates as the expedition’s journey progressed westward.³³

Cultures

Most northern plains people were hunters at the time of Lewis and Clark. But the Mandans and Hidatsas living on the eastern margins of the confluence region cultivated the classic American Indian crop complex of maize, beans, and squash. These hand-cultivated crops on small plots produced incredible abundance so that they had sufficient plant foods to supply the visitors and themselves as well. The amount of food produced per acre at the Mandan and Hidatsa villages was about 250 percent of the caloric value per acre produced in highly productive eastern Pennsylva-

nia in 1800.³⁴ Agricultural Indians lived a largely sedentary lifestyle allowing for accumulation of material goods.

Far more plains tribes hunted than farmed. Hunters were nomadic, following game animals particularly the buffalo. Their lives were changing rapidly in 1800 in response to the recent introduction of the horse, the advent of European trading goods; and an increased trade demand for **buffalo robes** and other products of the hunt. Hunting cultures were also remarkably adapted to the seasonality of the plains climate. Where winter was a time of hardship, spring and summer was a time of plenty, a time of abundance to be enjoyed—but also to be managed through firing the prairies and other mechanisms of environmental control practiced by native peoples. The summer hunt and harvest was designed not just to feed the village during the months of high environmental productivity but during the winter as well. Were there also some subtle ecological manipulations of bison and other large ungulate populations during the summer hunts? Certainly neither Lewis and Clark nor other early observers noted such—but it is not beyond the realm of possibility.³⁵

Although the northern plains as a region was undergoing change at the time of the Lewis and Clark Expedition, it could in no way be characterized as a ravaged ecosystem. But neither was it, as the nineteenth-century historians had it, a pristine wilderness simply waiting for the clever hands and tools of Euro-Americans to tame it and make it yield forth its abundance. It was a managed and productive ecosystem: one in which native peoples exerted controls and influence over those things they could. Particularly in their use of fire as a tool of vegetative management, we now know that Indians managed the northern plains environment. But Indians were also capable of behaving like any other group of human beings in an abundant environment and practiced wasteful and profligate (reckless) use of resources—the buffalo jump is a classic example. However, with a small and widely dispersed population, their overall impact was relatively limited.³⁶

The Changing Landscapes of the Confluence Region, 1800–2000

Let us turn now to a cataloging of the changes that have taken place on the northern plains since the time of Lewis and Clark, using the historical records, including photography, to define the nature and scope of the transition of the northern plains from a managed ecosystem inhabited largely by hunting and gathering peoples to an ecosystem characterized by a higher level of management and manipulation. In looking at geographical change through time on the plains, we will use the same six landscape categories—vegetation, animals, water, landforms and soil, climate, and cultures—that we used for our reconstruction of the northern plains at the time of Lewis and Clark.

Vegetation

The greatest single change in the northern plains landscape has been the transition from subsistence farming and hunting to the world's greatest commercial agricultural system, based on corn, wheat, and livestock. This transformation has been responsible for a cultural and economic system that feeds a significant portion of the world, provides homes and livelihoods to millions, and defines for many of us who call ourselves Westerners some of the most basic elements of our culture. But the costs of this transformation have been high: soil erosion, loss of biodiversity, perhaps even climate change.

The first crop in this great transformation of the inventory of the northern plains plants was a native, the Indian corn or **maize** that had been the staple of native farming systems in the Americas for at least three thousand years. In the hands of commercial farmers, for whom surplus production meant survival, corn became a crop that robbed the soil of nutrients and demanded ever-increasing amounts of fertilizer and water. Where rainfall was insufficient, but water from river sources was available, irrigation systems developed to feed the thirst of the corn. **Irrigation** increased soil salinity and, in a great irony, the dryland soils of some areas became



Figure 5. Where water was available, commercial farmers raising corn quickly developed irrigation systems. The original caption for this picture reads: “R.L. Williamson, Buford, N. Dak. Irrigation of Corn on Missouri River Bottoms.” (SHSND 0096-205)

less productive as they become more waterlogged. By the middle of the twentieth century, new irrigation systems drew water from aquifers deposited during the great glacial melt of the terminal Pleistocene. In some areas of the northern plains, these are now almost gone. Where irrigation is not possible, **wheat**, a non-native grass, becomes the crop of choice. Wheat farms measured in sections or square miles began to develop, and dryland farming techniques allowed the opening of land that never before had been used for farming.³⁷

The first entry of this European-style farming into the eastern margins of the northern plains was relatively modest and unobtrusive. But in the years following the Civil War, a new wave of migrants swept onto the plains. Americans from eastern states and immigrants from Europe had enormous land hunger which was fueled by a public land system designed to get the most land into the hands of the public in as short a period of time as possible, and railroad promotional literature that spoke of the new Garden of the World. The railroad, the sod house, the windmill, barbed



Figure 6. This 1930s North Dakota photograph shows some of the consequences of breaking the prairie when the rains stop and shallow-rooted grain crops can no longer hold the soil. (SHSND 0351-02)

wire, and the heavy-wheeled plow made it possible to cultivate the garden.³⁸ The ideal of public land distribution was to give everyone who wanted it a “little house on the prairie” surrounded by agricultural bounty. Though more homesteaders failed than succeeded, farmers continued to break the prairie, where deep plowing of prairie grasses and

their replacement by wheat or corn represents both an opening of the closed-nutrient cycle and a simplification of the ecosystem.³⁹

At first, machine agriculture and the replacement of grass with crops was fueled by draft animal power. But by the end of the nineteenth century, the motive power had become steam allowing even more land to be broken. In the stable ecosystem of the plains before European-style agriculture, the deep roots of grasses held the soil in place during the periodic droughts that are part of the plains environment. Shallow-rooted corn or wheat, planted annually, could not hold the soil; when the **drought** of the 1930s came, the result was soil erosion by wind—in such quantities that dust clouds from the Dakotas reached the city streets of New York and Philadelphia. The stark photographic images of the Dirty Thirties speak for themselves.

Lessons learned during the **Dust Bowl**, including contour plowing, planting shelterbelts of trees to cut down the impact of wind, and plowing fields at right angles to the prevailing winds contributed to a more stable agricultural system that was more ecologically sound. New and larger machines became part of this system, and more and more land went into agricultural production. Americans have recently become alarmed at decreases in farmland, but today twice as much farmland exists in the lands between the Yellowstone and Missouri Rivers as existed in 1930.⁴⁰ In addition, other new technologies invaded the plains. Pesticides, herbicides, insecticides and fertilizers all increased production, but not without cost. Farming proves the validity of what ecologists call the **TANSTAAFL principle**: “there ain’t no such thing as a free lunch.” Increased production meant increased demands on soil fertility and water. Lands never before broken were plowed and planted in response to the new



Figure 7. Breaking the prairie with the heavy wheeled plow. This promotional photograph from the William H. Brown Company praises the “rich dirt” of North Dakota and urges readers, “Better get some before it’s gone.” It is estimated that the Brown Land Company sold over 150,000 acres in North Dakota between 1901 and 1943. (SHSND 0090-0011)

technologies of post World War II years, especially in Lewis and Clark country in Montana. There on the high and dry plains of the Missouri and Yellowstone basins, new patterns on the land have developed, awaiting the next great drought.

It is not just the replacement of grasses by wheat and corn that symbolizes the transformation of the plains vegetative landscape. Significant change has also taken place in nongrass species. Some of the change is the result of the invasion of exotic species: in some counties on the plains, 30 percent or more of the vegetation is either nonnative exotics such as Russian olive, tamarisk, cheat grass, or native plants such as sagebrush with a significant increase in distribution and range over the last two centuries.⁴¹ Much of this is the consequence of changes in animal populations: the elimination of the practice of feeding Indian ponies on the inner bark of cottonwoods has allowed that tree species to stage a significant recovery in the Missouri and Yellowstone river valleys where periodic floods exist to lay down the alluvial soil necessary for cottonwood germination. Elsewhere, the replacement of buffalo, deer, elk, and other ungulates with domesticated species such as cattle and sheep, has contributed to the increase of shrubs at the expense of grasses. Where too many domesticated animals occupy the land without the chance for the migrations common to wild herds of buffalo, deer and elk, the land is overgrazed and grasses give way to shrubs. The shrubs themselves provide forage for animal populations—but in the absence of fire, the shrubs age and lose their nutrient capacity.⁴²

Wildlife and Livestock

Of all the symbolism of the northern plains, nothing is more mythic than the existence of the huge bison herds and their destruction. It should be noted that this near-extirmination of the buffalo was not entirely conscious government policy, it was partly the consequence of private greed. It should also be noted that, of the millions of buffalo killed solely for their hides, native peoples participating in the bison hide trade killed a significant number.⁴³ Dieback among the other plains animals as well suggests

other factors were involved. In some instances, overhunting played an important role. Pronghorn were easy to hunt and kill, and their numbers were reduced to a few thousand by 1900. Similarly, the number of mule deer and whitetail diminished, and the elk were driven from the northern plains into the mountains, as were the bighorn sheep and the grizzly. Some of the reduction in animal populations was the consequence of over-hunting. More commonly, however, wild animals simply could not compete with the domestic species and fences that blocked the ancient migration patterns and broke the genetic pool of thousands of years into fragments, thereby exposing wild animals to domestic diseases.⁴⁴ Among native plains animals, population reduction and diminishing ranges continue to be the rule rather than the exception. Prairie dogs, whose massive numbers and voracious appetites for grass had helped to maintain the grassland environment, are now scarce in many areas.⁴⁵ Throughout the plains, the competition between domestic and wild animals ends up with the wild animals being relegated to marginal environments.

By the end of the 1800s, the new ecological dominants on the plains were domesticated livestock, especially cattle and sheep. After the huge herd losses following the blizzards of the late 1880s, ranchers began enclosing their lands, counting their stock, and controlling the migration patterns of cattle and sheep from lowland valleys in the winter to high altitude, subalpine meadows in the summer. This new livestock system, based upon the enclosure of land, would not have been possible without the availability of public lands upon which stockmen could graze their cattle and sheep at extremely low fees.⁴⁶ In the wintertime, livestock were fed on native hays produced in river bottoms. This pattern was ecologically sustainable—as long as plenty of public land remained available. But the proximity of livestock raising to crop raising meant that a “better” way of producing beef was possible on the plains. The **feedlot system**, long confined to the Corn Belt of the Ohio and Mississippi valleys, was introduced to the plains after 1945, and open-range livestock raising became increasingly less viable. Unlike the open range, the

feedlot system is not ecologically sustainable for any appreciable length of time. But the feedlots have become a fixture of the plains landscape.

Sheep replace cattle in the poorer plains counties where grasses are less nutritious, less abundant, and where more brush country exists. Sheep can thrive where cattle cannot, and even more land came under grazing as sheep moved on to the plains in the 1800s. With the introduction of sheep, overgrazing became more of a problem and short-grass prairies, in many areas, gave way to sagebrush flats.

Water

Most of the transformation of the plains over the last two centuries is dependent upon new ways of using and controlling water, though in the plains environment, defined climatically by water scarcity, the ways of wasting water are numerous. **Pivot irrigation**, one of the most significant agricultural

technologies of the last half century, wastes water by throwing it into the air before it reaches the soil and exposing it to air that is so dry it can absorb water like a sponge. Evaporation rates from the surfaces of reservoirs are so high in the plains states that as much as 25 percent of the water that flows into a reservoir is lost through evaporation, and the water that flows from reservoirs to farmers' fields is saltier than the water that flowed into the reservoir's upper end. And, of course, we use enormous quantities of water for recreational purposes, such as golf courses, swimming pools, and waterslides.

The most far-reaching of all transformations of the plains hydrologic environment is that of **damming rivers**. The environmental consequences of damming are huge. We dam rivers for irrigation water, power generation, and flood control. In doing so, we alter the action of running water and, ultimately, the face of the land itself. Dams were originally viewed as a means of local economic development, providing jobs to populations



Figure 8. Modern agricultural practices on the North Dakota prairies include both strip farming and pivot irrigation. (Courtesy Neil Howe)



Figure 9. The Garrison Dam nears completion, circa 1950s. (*Institute for Regional Studies, NDSU, Fargo, 69-01-01*)

increasingly displaced from agricultural work by increasingly effective machines and increasingly larger farms that placed family farms and farming families in jeopardy.⁴⁷ Among the major streams of the Great Plains, only the Yellowstone is, so far, undammed.

Terrain and Soil

Damming streams changes the configuration of river valleys, but it is only one of several alterations on the face of the land made by interfering with free-flowing rivers. For example, straightening a river's natural meandering course—the process known as “**channelization**”—to make navigation safer or to reduce the flow onto adjacent lands dramatically changes the work running water does

in carrying and depositing material. Even where they do not actually carry transportation loads, rivers mark highways and railroad routes. Hence, river valleys are perhaps the most significantly modified portions of the plains landscape. Only agriculture, among the land uses on the plains, impacts more acreage than does transportation. Highways carry traffic over great distances, and the necessity of having that high-speed flow in as straight a line as possible has meant the permanent alteration of river valleys through channelization, bridging, and bank hardening. All of these processes have speeded up the flow of water across the landscape, and the net result of that is increased erosion. River and road stage a perpetual struggle for dominance of the valley. And roads nearly always win. In order to elimi-

nate flooding of the roads, rivers are prevented from doing what they do best: flowing freely and altering their courses to shape the land.⁴⁸

Poor farming practices also lead to erosion. Intensive cropping, machine cultivation, and the pressure of livestock produce soil compaction. Compacted soil forces water to run off the surface causing erosion. Dry farming methods, in which only half of the land is under any kind of cultivation at any one time, means that half of the farmland is exposed soil. Exposed soil is compacted by precipitation accelerating runoff and erosion.

Climate

The jury is still out on whether human activities have altered plains climates: variability of temperatures and precipitation is still the dominant feature of the plains climate, along with the ever-present wind. But human activities have certainly altered the impact of climate on the land. Replacing native grasses with domesticated ones has exposed the soil to erosion by wind, particularly during the regular drought cycles that are part of plains life. There is no such thing as normal weather on the plains, only long-term averages of heat and cold, wet and dry. During wet cycles, the environment produces abundance in both tame and wild grasses. In dry years, native grasses hold the soil, go dormant, and await the return of the rains, while single-season domestic grasses, like wheat, die rather than going dormant. Their disappearance exposes the land to wind erosion.

Cultures

The final transformations of the plains landscapes are cultural ones. The story of the decline of the American Indian is so well known that it scarce bears repeating. In the area of the northern plains where Lewis and Clark spent a winter with a vibrant Indian community, only a remnant is left—plaques and parks mark the sites of the village of She-he-ke and other Mandan and Hidatsa headmen who contributed so much

to the ultimate success of the Lewis and Clark Expedition. Signs of cultural transformation are everywhere in the northern plains. Evening around the campfire means something different that it once did, and a weekend spent in a recreational vehicle assures people that they are still in contact with the land. Where Lewis and Clark and their men struggled to portage around the Great Falls of the Missouri, weary recreational-vehicle travelers now find the Great Falls KOA campground. Most important for plains cultures, the economies have shifted from subsistence to commercial. Industry and agriculture have taken over from hunting, gathering, and subsistence farming. Urban competition means a continual cycle of replacement and abandonment of plains communities and cultures, so many plains inhabitants have lost both their sense of space and place.

Conclusion

Which of the ideas with which we began this journey is the more appropriate of the plains environment? Certainly the plains is not, nor has it ever been, the pristine wilderness envisaged by the nineteenth-century historians. This leaves the last two choices. Two hundred years ago the plains was probably a managed ecosystem, occupied by small numbers of people who lived, not necessarily in harmony with the environment, but in cooperation with it. I would argue that the confluence region is still a managed ecosystem, different in degree and scale but not really in intent from the northern plains of Lewis's and Clark's time. People are still using the resource base to make a living, albeit in some very different and more intensive ways now than was the case two hundred years ago. I am not prepared to call the northern plains a ravaged ecosystem. At the same time, we cannot help but recognize the change that has taken place since Lewis and Clark.

We must, of course, recognize that the past is a different country and we couldn't return to the plains of 200 years ago, even if we wanted to. The

idea of a **Buffalo Commons**⁴⁹ may be attractive in theory but is unworkable in application. Nevertheless, it is interesting to contemplate what the northern plains were like at the time of Lewis and Clark.

I promised at the outset to make no value judgments on the fact that such changes have taken place, that this is all gone. But, my God, wouldn't it have been something to see!

About the Author

John L. Allen is professor emeritus of geography at the University of Wyoming. He is the author of numerous publications on the exploration of the American West, including *Passage Through the Garden* (1975), reprinted by Dover (1991) using its subtitle, *Lewis and Clark and the Image of the American Northwest*.

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1. See William Denevan, "Pristine Myth: The Landscapes of the Americas in 1492," *Annals of the Association of American Geographers* 82 (November 1992): 369–385.
2. Shepard Krech 171, *Ecological Indian: Myth and History* (New York: W.W. Norton, 1999): 15–28.
3. Krech's work has been received with enthusiasm by environmental historians and historical geographers, many of whom had begun questioning the invented tradition of the "ecological Indian" a decade or more ago. Krech's work has also been castigated by American Indian advocates. In April 2002 a conference entitled "The Ecological Indian" was held at the American Heritage Center of the University of Wyoming. With the exception of Krech's own defense of his thesis, the speakers—nearly all of whom were American Indians—raised objections to his contentions but offered no refuting evidence.
4. Perhaps the first major work to suggest major and irreversible damage to the American environment by modern agricultural techniques was Leo Marx's *Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964): see particularly his epilogue, "Garden of Ashes." Similar approaches, much more specific to the Missouri valley, have been taken by Daniel B. Botkin in *Our Natural History: The Lessons of Lewis and Clark* (New York: Grosset/Putnam, 1995) and in his *Passage of Discovery: The American Rivers Guide to the Missouri River of Lewis and Clark* (New York: Perigee Books, 1999).
5. In addition to Lewis and Clark, a number of enlisted men kept journals during all or part of the journey. These journals are all contained, along with the more comprehensive daily entries of the captains, in the magisterial new edition of *The Journals of the Lewis & Clark Expedition* edited by Gary E. Moulton, and produced in thirteen volumes by the University of Nebraska Press (1983–2001). (Hereafter *The Journals*.)
6. John L. Allen, "Horizons of Romance: Invention of the Romantic Tradition of the American West," *Journal of Historical Geography* 18 (January 1992): 27–40.
7. The best source for landscape commentary by the captains and other journal keepers is the new Moulton edition of *The Journals*. The most relevant volumes for discussion of the Missouri-Yellowstone confluence region are volume 4 (pages 7–182) for the westbound journey in 1805 and volume 8 (pages 161–336) for the return journey in 1806.
8. To try to examine the full range of preconceived notions about the plains environment in an essay-length work is impossible. I modestly recommend that the reader interested in this topic consult the following study: John Logan Allen, *Lewis and Clark and the Image of the American Northwest* (New York: Dover Publications, 1991). This is a reprint of the original hardcover edition, published by the University of Illinois Press in 1975 as *Passage Through the Garden: Lewis and Clark and the Image of the American Northwest*.
9. A useful source for this argument is Douglas B. Barnforth, *Ecology and Human Organization on the Great Plains* (New York: Plenum Press, 1988); also helpful is the same author's "Historical Documents and Bison Ecology on the Plains," *Plains Anthropologist* 32, no. 115 (Feb. 1987): 1–16.
10. An excellent new source for the period is Theodore Binnema, *Common and Contested Ground: A Human and Environmental History of the Northwest Plains* (Norman: University of Oklahoma Press, 2001); see also Binnema's dissertation "Common and Contested Ground: A History of the Northwestern Plains from A.D. 200 to 1806," Ph.D. dissertation, University of Alberta, 1998.
11. See Dan Flores, "Bison Ecology and Bison Diplomacy: The Southern Plains from 1800 to 1850," *Journal of American History* 78 (September 1991): 465–85.
12. See John L. Allen, "Canadian Fur Trade and the Exploration of Western North America, 1797–1851," in *A Continent Comprehended*, vol. 3 of *North American Exploration*, ed. John L. Allen (Lincoln: University of Nebraska Press, 1997), 75–131.
13. Andrew C. Isenberg, "Towards a Policy of Destruction: Buffaloes, Law, and the Market," *Great Plains Quarterly* 12 (Fall 1992): 227–241.
14. Moulton, *The Journals*, vol. 10, *Journal of Patrick Gass*, 34–35.
15. Moulton, *The Journals*, vol. 4, 67.
16. Moulton, *The Journals*, vol. 4, 74–75.
17. Lewis to Lucy Marks, March 31, 1805. Printed in Donald Dean Jackson, *Letters of the Lewis and Clark Expedition with Related Documents 1783–1854*, 2 vols, 2d edition (Urbana: University of Illinois Press, 1978), II: 222–225.
18. For commentary on Jefferson's view of the West, particularly the "Garden of the World" concept, see Allen, *Lewis and Clark and the Image of the American Northwest*, 110–115; and John L. Allen, "Imagining the West: The View from Monticello," in *Thomas Jefferson and the Changing West: From Conquest to Conservation*, edited with an introduction by James P. Ronda (St. Louis: Missouri Historical Society, and Albuquerque: University of New Mexico Press, 1997), 3–23.
19. The two most contemporaneous observers with Lewis and Clark in the Missouri valley were Henry Brackenridge and John Bradbury. Both commented on Indian burning practices; see Henry M. Brackenridge, *Journal of a Voyage Up the Missouri River in 1811*, vol. VI of *Early Western Travels*, ed. Reuben Gold

- Thwaites (Cleveland: A.H. Clark & Co., 1904): and John Bradbury, *Travels in the Interior of America*, vol. V of *Early Western Travels*, ed. Reuben Gold Thwaites (Cleveland: A.H. Clark & Co., 1904).
20. See Dan Flores, *Natural West: Environmental History in the Great Plains and the Rocky Mountains*, (Norman: University of Oklahoma Press, 2001), chapter 9–10 *et seq.*
 21. Kim Todd, *What's Lost, What's Left: A Status Report on the Plants and Animals of the Lewis and Clark Expedition* (San Francisco, Seattle, and Washington, D.C.: Sierra Club Publications, 2002) provides a comprehensive inventory of both the flora and fauna of the northern plains at the time of Lewis and Clark.
 22. Jerry N. McDonald, *North American Bison: Their Classification and Evolution* (Berkeley: University of California Press, 1981), 250–263.
 23. The standard reference on the North American bison is Frank Roe, *North American Buffalo: A Critical Study of the Species in Its Wild State* (Toronto: University of Toronto Press, 1951). In his first chapter, Roe provides maps showing the prehistoric and historic range of bison.
 24. An excellent reference on the relationship between the expedition and grizzlies may be found in Paul Schullery, *Lewis and Clark Among the Grizzlies: Legend and Legacy in the American West* (Guilford, Connecticut: Falcon Press, 2002).
 25. *Conserving Prairie Dog Ecosystems on the Northern Plains* (Bozeman, Montana: Predator Project, 1997), introduction; and *Restoring the Prairie Dog Ecosystem of the Great Plains: Learning from the Past to Ensure the Prairie Dog's Future* (Bozeman, Montana: Predator Conservation Alliance, 2001). This organization changed its name in 1999 and its most recent information is on its website: < www.keystoneconservation.us>
 26. G. Malcolm Lewis, “Three Centuries of Desert Concepts in the Cis-Rocky Mountain West,” *Journal of the West* 2, no. 4 (1963): 457–468; Merlin Lawson, “A Dendroclimatological Interpretation of the Great American Desert,” *Proceedings of the Association of American Geographers* 3 (1971): 109–114.
 27. Paul Martin and Christine Suter, “War Zones and Game Sinks in Lewis and Clark's West,” *Conservation Biology* 13 (Winter 1999): 36–45.
 28. For example, see Jefferson's thinking about rivers in his only book, *Notes on the State of Virginia* (London: John Stockdale, 1787).
 29. For an excellent account of the application of Jefferson's and Lewis and Clark's thinking about rivers as avenues of transportation, see Henry Nash Smith, *Virgin Land: The American West as Symbol and Myth* (Cambridge, Massachusetts: Harvard University Press, 1950), chapter 2, “Passage to India.”
 30. Daniel Botkin writes, “If any location on Lewis and Clark's journey matched the ideal view of the presettlement American West as a Garden of Eden rich in vegetation and wildlife, it was the confluence of the Yellowstone and Missouri Rivers, just east of today's Montana-North Dakota border.” See Botkin, *Passage of Discovery*, 163–164.
 31. Geological observations made in the vicinity of the Missouri-Yellowstone confluence may be found in Moulton, *The Journals*, vol. 4, 59–1000 *et seq.* The total commentary on geological formations, soil and rock types, doesn't amount to more than three full pages of this section of the journals.
 32. To this date, the single greatest deficiency in Lewis and Clark scholarship is in the area of the earth sciences. There simply has not been a study of the expedition's contributions to geology and climatology that matches the studies of its contributions to geography and cartography, ethnography, botany, and zoology. This deficiency may be remedied in part by John W. Hoganson and Edward C. Murphy, *Geology of the Lewis and Clark Trail in North Dakota* (Missoula, Montana: Mountain Press Publishing, 2003).
 33. Weather commentary may be found in almost every daily entry of the journals during the entire trip. But, as was the case with geology and soils, no explanations for weather events were featured in the captains' writings. Meteorology, like geology, was still very much in its infancy in the early nineteenth century. In his edition of *The Journals*, Moulton has consolidated the weather observations by month. For the time the captains were in the confluence region, see the weather observations in vol. 4, 91–96 (April 1805), 234–238 (May 1805), and 346–349 (June 1805).
 34. Much of the pioneering work on the abundance of American Indian agriculture has been done by my former colleague at the University of Connecticut, historian Karen Ordahl Kupperman (a native of North Dakota), now on the faculty at New York University. The percentage figures contained herein were in a personal communication from Dr. Kupperman. Details on American Indian agriculture may be found in her book, *Settling With the Indians: The Meeting of English and Indian Cultures in America, 1580–1640* (Totowa, New Jersey: Rowman and Littlefield and J.M. Dent, 1980).
 35. See Andrew C. Isenberg, *Destruction of the Bison: An Environmental History* (Cambridge: Cambridge University Press, 2000), 63–92.
 36. Flores and Krech suggest something more than “limited” impact on some animal populations, notably the buffalo, prior to Euro-American contact. See Flores, *Natural West*, chapter 5; and Krech, *Ecological Indian*, chapter 5.
 37. Smith, *Virgin Land*, 174–183,
 38. David Emmons, *Garden in the Grasslands: Boomer Literature of the Central Great Plains* (Lincoln: University of Nebraska Press, 1971) provides a vivid picture of both promotional literature and the settlement of the plains in the final half of the nineteenth century.
 39. In the context of the environment history of the plains, it is important to remember that many of these folks were a great deal closer chronologically to Lewis and Clark than they are to the present.
 40. John Fraser Hart, “Half a Century of Cropland Change,” *Geographical Review* 91 (July 2001): 525–543.
 41. Debra L. Donahue, *Western Range Revisited: Removing Livestock from Public Lands to Conserve Native Biodiversity* (Norman: University of Oklahoma Press, 1999), 11–30.
 42. Donahue, *Western Range Revisited*, 114–160.
 43. David J. Wishart, *Fur Trade of the American West, 1807–1840* (Lincoln: University of Nebraska Press, 1979), 213; Krech, *Ecological Indian*, 138–143; Flores, *Natural West*, 67–70.
 44. Flores, *Natural West*, 65–66; Isenberg, *Destruction of the Bison*, 129–30.
 45. Kim Todd, *What's Lost, What's Left*, “The Prairie Dog.”
 46. Donahue, *The Western Range Revisited*, 229–283.
 47. Donald Worster, *An Unsettled Country: Changing Landscapes of the American West* (Albuquerque: University of New Mexico Press, 1994), 31–54.
 48. Any university-level text on anthropogenic landform influences will carry ample information on this point. I recommend Andrew Goudie, *The Human Impact on the Natural Environment*, 5th edition (Cambridge, Massachusetts: MIT University Press, 2001), particularly chapters 5 and 6.
 49. Deborah and Frank Popper, “A Daring Proposal for Dealing with an Inevitable Disaster,” *Planning* 53 (December 1987): 12–18; by the same authors, “The Fate of the Plains,” *High Country News* 20 (1988): 15–19.

