Stephenson Capron, Richard Brook, and Elizabeth Rieben

The High Plains

Land of Extremes

"...it is surprising how clearly the most distant objects can be distinguished. The atmosphere becomes so transparent that it is only the curvature of the earth's surface that limits the view from the highest points."

—JOHN LAMBERT, DESCRIBING THE HIGH PLAINS IN THE 1850s.

"The Great American Desert." In 1820, explorer Stephen Long used these words to describe the High Plains—an area of high-elevation, short- and mid-grass prairies at elevations of 600 to 1,500 meters found east of the Rocky Mountains. Except for the badland scenes in old Westerns, depicting endless distances of windswept and seemingly barren landscape, the High Plains have been generally overlooked, avoided, or misunderstood. Early nineteenth-century descriptions of the High Plains ranged from "green velvet" to "nothing but dirt and prickly pear cactus," illustrating the immense variability of the landscape.

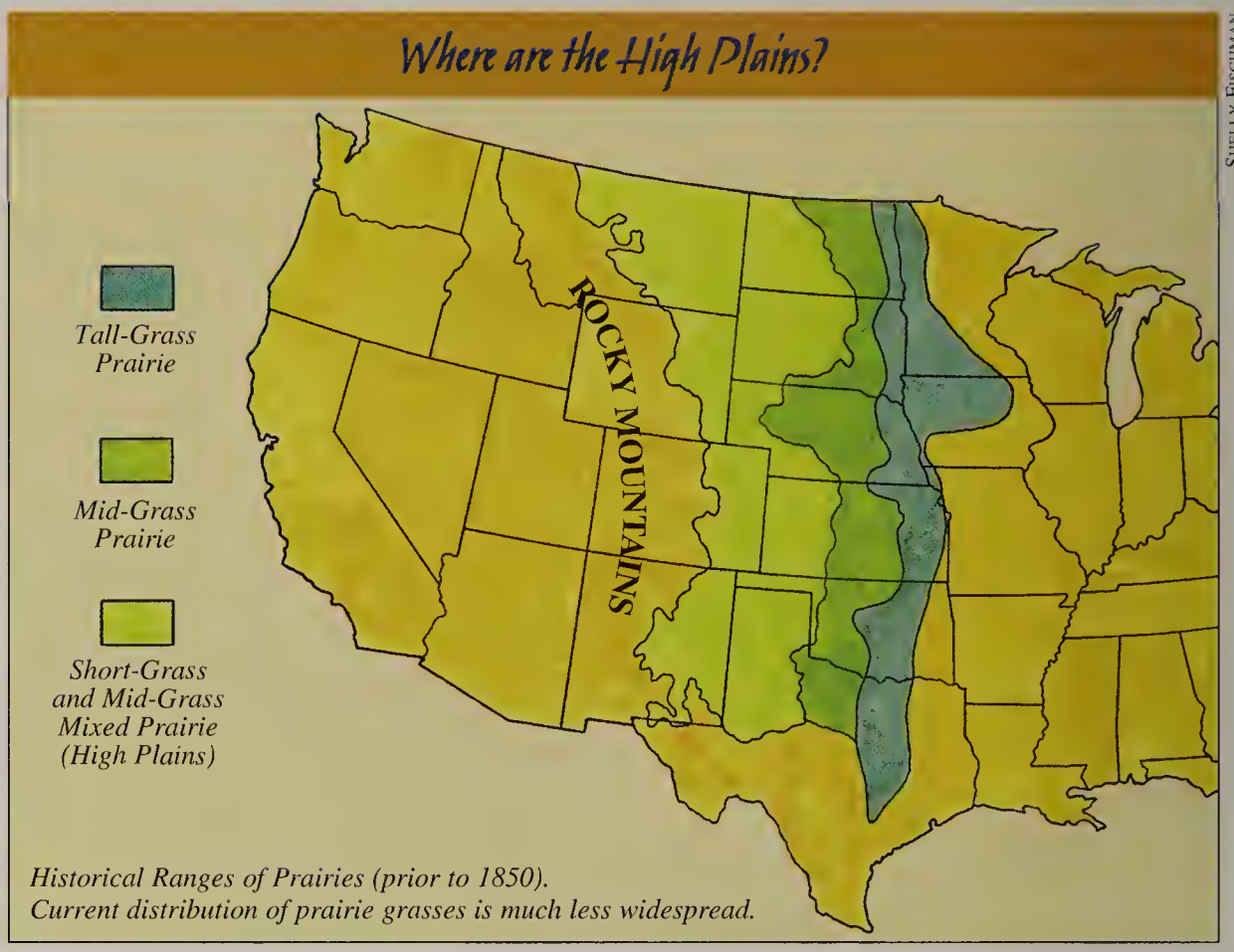
The area's inhospitable nature—scarcity of water and trees, high elevation, dramatic temperature changes, endless wind, and harsh climate—deterred all but the hardiest of homesteaders. For the most part, the High Plains were not considered a place to settle; most people were just passing through on their way farther West to the water-, mineral-, and lumber-rich Rocky Mountain and Pacific Coast areas.

But if you look beyond the apparent emptiness of the landscape, you will learn that the High Plains ecosystem, like all ecosystems, contains its own unique riches. Plants have evolved to be drought- and wind-resistant, and most have tough root systems to anchor the soil and to find and store water and nutrients underground. Many native animals live underground as a way to adapt to the harsh arid climate. Also found underground are valuable minerals and some of the largest coal seams in the world. This article and the accompanying foldout explore the unique characteristics of the High Plains ecosystem, primarily the northern portion, and what land managers and local communities are doing to improve and sustain the health and productivity of this vast grassland.

The eastern boundary of the High Plains is often cited as the 100th meridian or the 600-m contour or elevation line. But prairie vegetation boundaries are flexible, advancing or retreating in response to the weather. Located in the rain shadow of the Rocky Mountains, the High Plains is semi-arid, with precipitation averaging less than 50 cm per year. (By contrast, the tall-grass prairies of the Midwestern states receive as much as 100 cm of rain per year.)

During the winter, much of the annual precipitation in the High Plains occurs in the form of snow. Because of its location, the High Plains is subject to climatic extremes. Warm temperatures (above 21°C) one day can drop to below freezing the next.

Water is scarce in the High Plains. Rivers are few, and the water they contain is in high demand. Additional water can be found in several underground aquifers. The Ogallala Aquifer, North America's largest underground water source, lies beneath the western parts of Nebraska, Kansas, and Oklahoma, extending north into South Dakota, west into Wyoming, and south into New Mexico and Texas. These aquifers are like huge underground sponges made of porous sediments of sand and gravel eroded from the Rocky Mountains. Less-permeable sediments underneath the aquifers hold the water in place.



Historical Ranges of Prairies (prior to 1850).
Current distribution of prairie grasses is much less widespread.

SHELLY FISCHMAN

Grasses and Other Plants

The High Plains prairie is characterized by short and mid-mixed grasses that grow to less than 60 cm, responding to the reduced amount of water, cool temperatures, and resultant shorter growing season. These shorter grasses require less water and nutrients than the taller grasses found in the Midwest.

Soils are mostly deep, well drained, with loam and clay, supporting cool-season grasses, forbs, and shrubs. Dominant plant species of the High Plains include blue grama and green needle grass (bunch grasses), and buffalo grass and western wheatgrass (sod grasses). Their root systems make up 90 percent of the plant's mass.

A square meter of short-grass prairie can contain 12 or more plant species. In addition to grasses, the High Plains contain cushion plants, mat plants, and forbs. *Cushion plants*, like moss, also have large root systems that allow them to attach to rocky escarpments. *Mat plants*, such as sandwort, send their roots out in front of them. These compact plants have beautiful, fragile flowers that turn escarpments into natural rock gardens when they bloom. *Forbs* are herbaceous plants that grow less

BLM

Aster is one of many forbs preferred by wildlife on the High Plains.

WYOMING GAME AND FISH DEPARTMENT

Blue grama is a bunchgrass that grows in distinctive clumps. As many as 100 shoots can come up from a single plant. By contrast, buffalo grass is a sod grass, which produces horizontal stems called runners (stolons) and rhizomes. Runners inch along the ground surface and rhizomes go through the soil, extending their own roots and stems. (See illustration below)

abundantly on the short-grass prairie, but have beautiful flowers that transform the prairie in times of adequate rainfall. Forbs are a dominant seasonal food source for deer and pronghorn antelope.

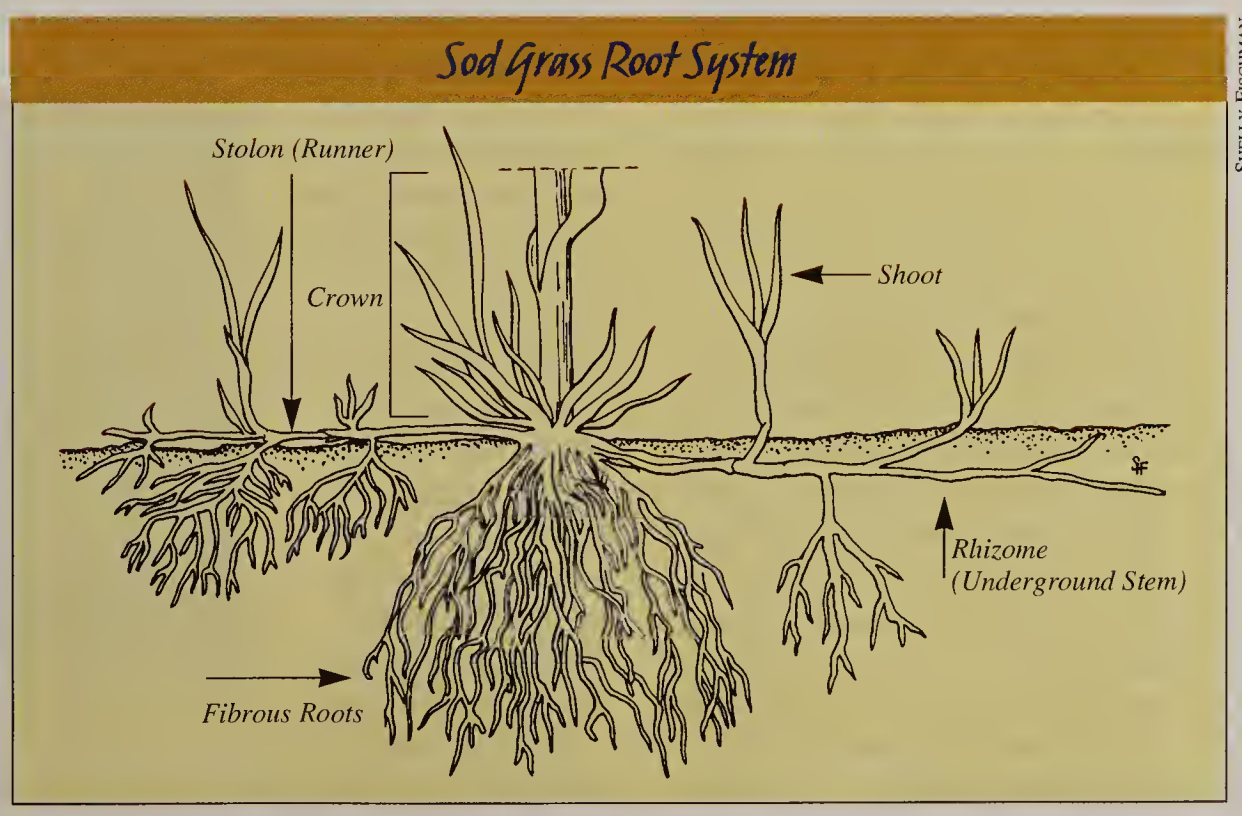
Most prairie plants are dormant during the extremes of summer heat and winter cold, growing only in late spring or early summer and again in the fall. This plant survival mechanism allows the High Plains to support the many forms of wildlife and insects that eat, nest, or hide in the plants.

The Prairie Dog Ecosystem

Early explorers of the High Plains referred to the dominant burrowing animal of the ecosystem as wild dogs of the prairie or the "prairy dog," because of the barking sound they make. These small rodents provide the anchor for vast plains ecosystems that are dependent on the complex systems of underground burrows the prairie dogs construct. This system of tunnels creates prairie dog "towns" or colonies teeming with a diversity of life. For example, prairie dogs churn up dirt, mixing topsoil with underlying soils, making it easier for forbs to propagate. Birds often congregate in and around the towns, attracted by the insects that are easily seen in the patches grazed by the prairie dogs. Larger animals such as deer and pronghorn antelope prefer to feed in prairie dog towns because they like the easily digested forbs and herbaceous plants that grow in the colonies. Some animal populations, such as burrowing owls and swift foxes, are actually declining in part because of the decline in prairie dog towns. The black-footed ferret, also dependent on prairie dog towns, declined to the point of near-extinction. For more information on the black-footed ferret and other animals that depend on the prairie dog ecosystem, see the back of the accompanying foldout.

Energy Source for the Nation

The High Plains is a major source of coal, oil, gas, and uranium for the nation. For example, the Powder River Basin in northeastern Wyoming and southeastern Montana is home to the largest low-sulfur coal reserves in the United States. (Low-sulfur coal burns cleaner than the high-sulfur coal found in the eastern United States.) The coal in the Powder River Basin is found in thick seams—horizontal layers of solid coal running for kilometers beneath the Earth's surface. Some of these seams are 30 m thick and close to the surface, so the coal can be mined at the surface without going underground. As a result, huge quantities of low-cost, high-quality coal can be shipped by rail to 24 states to generate electricity. Over half of the electricity in the United States comes from coal-fired power plants. In 1995, 24 Powder River Basin mines produced 286 million tons of coal.



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WYOMING GAME AND FISH DEPARTMENT

Black-tailed prairie dogs, once numerous on the High Plains, have suffered dramatic declines due to widespread eradication efforts.

WYOMING GAME AND FISH DEPARTMENT

Prairie dog towns support many plants and animals of the High Plains, including the burrowing owl, which depends on the good burrow habitat provided by the prairie dog.

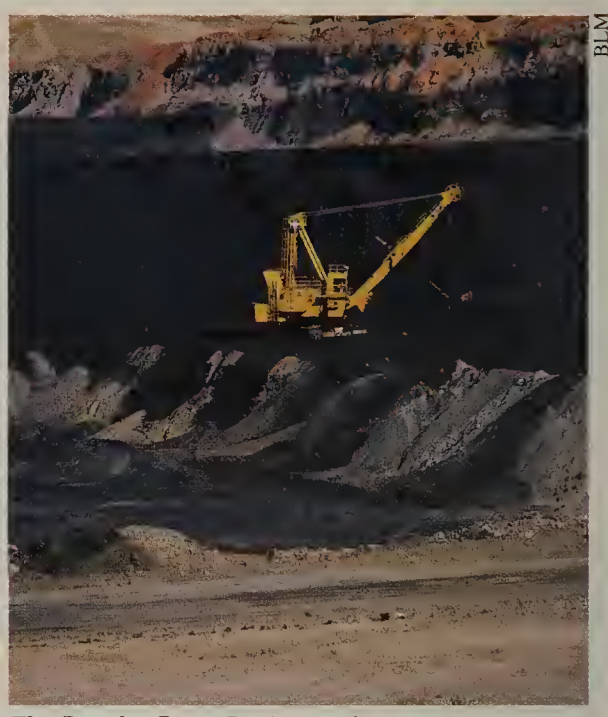
Clinker

The reddish siltstone rock that caps many ridges and buttes in the Powder River Basin is called "clinker" or "scoria." Clinker is rock that has been fused by the natural burning of underlying coal beds. Its red color is due to the oxidation, or rusting, of iron in the rock. The clinker, which covers about 4,200 km^2 of the basin, was formed by the burning of some 27 to 54 billion metric tons of coal within the past three million years. Some coal still burns today, sparked by range fires or spontaneous combustion.

Clinker forms a distinct part of the ecosystem in the basin. Because soils formed from clinker are very permeable, they absorb rain and melting snow like a sponge and protect it from evaporation. Plants such as ponderosa pine and skunkbush sumac grow on clinker because of this stored water. Deer and elk herds graze over it, and some springs that emerge at the base of the clinker have water quality good enough to support trout.

Management Challenges

In addition to the challenges inherent in living in a harsh environment, the people of the High Plains face a number of management challenges to keep the land healthy and productive. Water is scarce; many riparian (streamside) areas are becoming depleted; and in some areas, native grasses are being crowded out by invasive weeds. Local communities are changing farming and ranching practices to address these challenges. For example, ranchers and other land managers are turning to new rotational or seasonal grazing practices to help protect sensitive riparian areas. They are stepping up efforts to control invasive weed species, and they are using carefully controlled fires to replace the natural cycles of disturbance once provided by natural fire and bison. (Fire and bison both kept the grasses clipped, lowering vegetative buildup. In addition, fire and manure add nitrogen to the soils, producing nitrogen-rich grasses.)



BLM

The Powder River Basin supplies over one quarter of the nation's coal. Black Thunder Mine, the largest coal mine in North America, is located in the High Plains.

Water Resources

Water, the lifeblood of the land, has always been a limiting factor in the settlement of the High Plains. The early farmer had a hard time coaxing crops from the plains until the windmill was used to harvest water from aquifers below the ground's surface. Approximately 90 percent of the water pumped from the Ogallala Aquifer is used for irrigation. Precipitation and surface streams replenish the aquifer,

ED HEFFERN, BLM

Clinker, the reddish rock, formed when coal beds burn naturally, caps the Rochelle Hills escarpment in Wyoming. Clinker traps water, which attracts plants and wildlife. It forms unique landscapes and ecosystems of its own in the northern High Plains.

but surface streams in the arid High Plains are sparse and many are ephemeral, wet only at certain times of the year. Because of the heavy demand for water and the slow replenishment rate, the average water level of the aquifer declined nearly 3 m between 1940 and 1980, then another 30 cm in the 1980s. Better water management and new technologies have helped to slow this depletion. However, greater efforts will be needed to ensure that the water levels in the aquifer stabilize.

SCOTT KAISER, MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

Haughian Ranch: At the local level, riparian areas in many places are beginning to rebound in response to new intensive management techniques. For example, owners of the Haughian Ranch in eastern Montana are working with federal, state, and local cooperators to improve the health of the riparian areas along historic Custer Creek. This ephemeral creek flows through the ranch, which is made up of 80,000 acres of private and public High Plains rangeland along the Yellowstone River. For 50 years, wild horses, cattle, and sheep had degraded the range and riparian areas by overgrazing and trampling streambanks, causing erosion and destroying fragile riparian plants. By staggering the grazing season of each pasture, keeping pasture sizes small, and varying the number of animals grazing each pasture, the Haughians were able to increase streambank vegetation, improve wildlife habitat, reduce erosion, and improve water quality.

Grazing

Before the High Plains were settled, bison and other wild herbivores grazed the prairies. Eventually, as settlers moved in, these native roamers had to compete with cattle and sheep. Early settlers often grazed too many sheep or cattle for too long a period in one place. Thus, overgrazing was very common at the turn of the century. Although management practices have steadily improved since then, overgrazing still causes serious problems in many areas. Where public rangelands are involved, Resource Advisory Councils provide opportunities for a wide range of interests at the state and community level to have a voice in the management of grazing practices. Through a collaborative decision-making process, these councils are playing a critical role in developing guidelines for ecological grazing on public rangelands.

Riparian Areas

Riparian areas are the green, vegetated areas that border streams and rivers in the otherwise arid and semi-arid West. The condition of these critical areas in much of the western United States has been poor throughout much of this century. In the High Plains, rivers and streams are not abundant, and the productive areas surrounding them are often fragile and extremely important to sustaining healthy populations of fish, wildlife, and plants. Yet, concentrations of cattle and sheep in riparian areas and lower water levels have put stress on the ecological integrity of these streams. Declining conditions in riparian areas in some parts of the High Plains also have contributed to the decline of rare moisture-loving plants such as the Ute Lady's Tresses, a threatened orchid found along streams or where mountains begin at the western edge of the plains. This delicate plant requires specific moisture, sunlight, and temperature levels to thrive. Public and private land managers are beginning to assess and improve the condition of riparian areas and are implementing conservation measures through cooperative efforts with local ranchers and others.

Fire Cycles

Fire has played a part in the prairie ecosystem for thousands of years. Fires are ignited naturally by lightning. Native Americans also learned to set fires to promote new growth of grasses or to drive wildlife for hunting purposes. Grassland ecosystems depend on fire to recycle carbon and nutrients into the soil and to influence plant composition. But fire suppression efforts since the early 1900s have changed the composition of many grassland communities, an example of how single-purpose management techniques, however well intentioned, can degrade natural systems. Controlled fires can improve the quality of grasslands by removing buildup of vegetative litter, warming soil temperatures, and assisting seed germination.

Some fires that were once suppressed are now allowed to burn as part of a natural cycle within forest and grassland ecosystems. In remote areas, some agencies allow wild land fires to burn where there is an approved plan, as long as the fires remain within "prescribed" limits. However, wildfires are still aggressively fought near populated areas.

As more and more communities recognize the importance of fire to a healthy grassland ecosystem, prescribed

fires are used increasingly as a management tool. Prescribed burns are planned and initiated by qualified professionals who are trained in using fire for resource management. Before any prescribed fires, burn plans must be approved. These plans must specify the objectives of the fire; location, size, and type of fire; how the fire will be started and controlled; how the smoke from the fire will be managed; and how the fire will be monitored and evaluated.

Weeds

Invasive weeds pose another threat to the High Plains ecosystem. These harmful and aggressive plants form monocultures (where one species replaces a diversity of species), reduce wildlife habitat, and degrade streams and ponds by displacing native grasses and plants that protect and hold the soil in place.

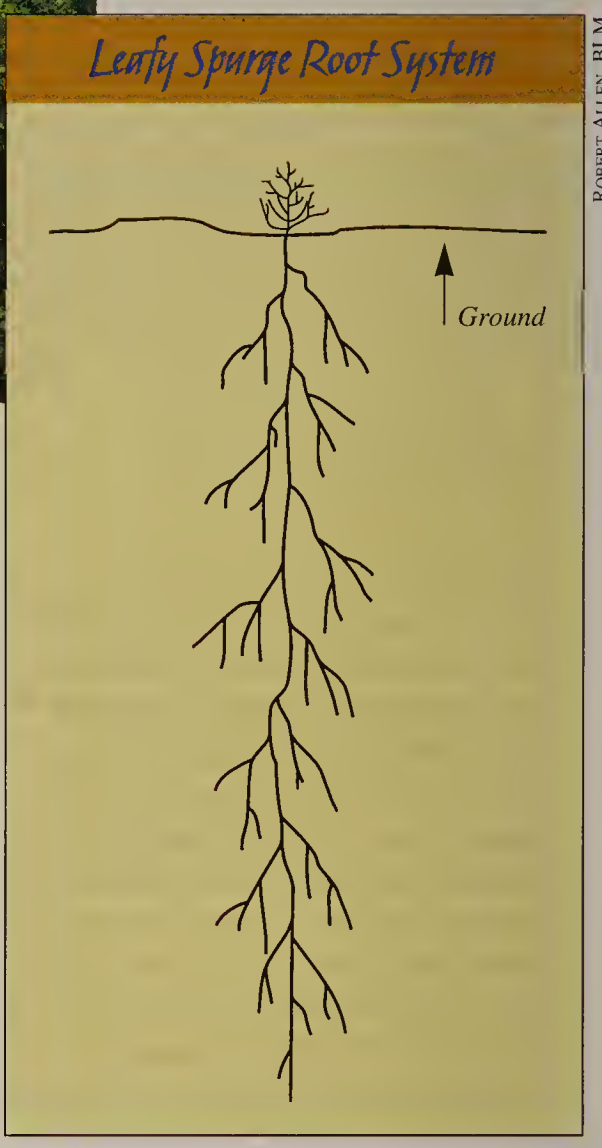
Weeds also greatly reduce the productivity of rangelands, affecting local economies throughout the High Plains. For example, leafy spurge, a very aggressive invasive weed, costs North Dakota about $75 million a year in damages due to lost livestock and agricultural production. Leafy spurge takes over rangelands and croplands. It reduces available forage and also is an irritant to the mouth and digestive tract, making some cattle sick.

Efforts are under way to attack problem weeds in the High Plains such as musk thistle, Canada thistle, field bindweed, leafy spurge, Russian knapweed, and salt cedar (also known as tamarisk).

Methods of controlling weeds include biological (introducing a natural predator, typically a species-specific insect), chemical (spraying with herbicides), cultural (controlled grazing), and manual (hand pulling). But weed scientists and land managers agree that early detection and quick control of small weed infestations are the most effective approaches.

STEVE DEWEY

Leafy Spurge, a pesky weed common in the High Plains, takes over large areas, causing economic and ecological damage. It can have a root system that extends for 6 m or more.



ROBERT ALLEN, BLM

Mining

The Powder River Basin is home to North America's largest coal mines. Mining this extensive brings concerns about the effects on the long-term health of the ecosystem, including erosion, groundwater quality, and wildlife habitat. The challenge is to ensure that permitted mining activities are environmentally acceptable. Years of environmental studies are providing new information on how to design mines in order to minimize ecological damage. Tougher coal mining and environmental regulations over the past two decades now require mining companies to address ecological concerns by developing comprehensive plans, which are reviewed through public hearings and other forums. As a result, some mining activities are altered during certain wildlife migration, breeding, or nesting periods to protect wildlife such as deer, elk, and waterfowl. Reclamation, the process of restoring the land after mining, is also a required part of the process. Before and during mining, the topsoil is stockpiled. After mining is completed, the land is graded to approximate the original contour. Topsoil is then spread and native vegetation planted.

In Conclusion

Even though the High Plains contains many unique ecological systems, it shares common components with every other ecosystem—variations in size and scale, connections between the living and nonliving components, a diversity of living things, mechanisms to achieve a balance, and cycles and change over time. When students begin to understand these elements, they will be better prepared as adult citizens to make decisions that will sustain the integrity of ecological systems over the long term, whether they live in the city or in the vast grasslands of the High Plains.

For the Classroom

Groundwater Movement

The Ogallala Aquifer of the High Plains is approximately the size of California and contains an estimated 4 quadrillion liters (4 with 15 zeros after it) of water.

Water that accumulates beneath the surface of the Earth is called groundwater. Contrary to popular belief, groundwater does not form underground "rivers," but is actually found in the small spaces and cracks between rocks and other material such as sand and gravel. Groundwater supplies about 38 percent of the water used for agriculture in the United States.

Water enters aquifers by soaking down into the ground through a process called "percolation." For water to move in an aquifer, the pores between rock materials and fractures in rock must be connected. The capacity of rock material to transmit water is called "permeability." Water moves through different materials at different rates—faster through gravel, slower through sand, and much slower through clay. Therefore, gravel is more permeable than sand, which is more permeable than clay.

If hazardous waste, chemicals, heavy metals, or oil collect on the surface of the ground, rain or runoff percolating into the soil can carry these substances into the groundwater.

The following activity involves learning how water moves through rock material such as sand, gravel, and clay.

Materials: You will need three clear 16–20-oz plastic soda bottles with holes punched in the bottom (or three clear plastic cups with holes punched in the bottom); equal amounts of gravel, sand, and clay; a magnifying glass; and a graduated cylinder for measuring water.

Procedure: Ask students to predict how water will move through gravel, sand, and clay. Then have students test their hypothesis by placing gravel, sand, and clay in the three soda bottles or plastic cups. The material should fill the containers to a depth of about 8 cm. Have students look closely at each container (a handheld magnifying glass works well). To demonstrate how groundwater moves through underground rock formations, pour about 120–240 mL of water (or colored water) into each container and discuss the results. Which container emptied the fastest? (the container with the gravel) Which emptied the slowest? (the one with clay) Ask the students how the different materials would influence water movement in natural systems.

Energy Resources

Many important energy resources are found in the High Plains. Energy resources are classified as nonrenewable or renewable. Nonrenewable resources take a long time to replace, such as coal, which takes millions of years to form. Renewable resources can be replaced in a much shorter time, such as trees, which can be grown relatively quickly. Some renewable energy resources are perpetual, such as solar energy, wind, and tides.

Have students compile a list of activities they do that require energy. Then ask the class to break up into groups of three or more students, assign several of the activities from the list to each group, and have each group prepare a report answering the following questions:

- What type(s) of energy is used for each activity?
- Where does the energy come from?
- How is the energy delivered from its source?
- What are the environmental consequences?

Once the report is complete, groups should report back to the entire class. Students should take notes on each group's report.

Wind Energy

One of the distinguishing characteristics of the High Plains is the endless wind. In some states, wind is being harnessed to generate electricity.

Wind is moving air caused by differences in air pressure. Air moves from areas of greater density (pressure) to areas of lesser density. An area of greater air pressure surrounded by lesser air pressure is called a high. An area of air pressure that is lower than the surrounding area is called a low. Winds blow into a low because the air is less dense there.

In locating sites for a possible wind farm (a collection of windmills used to produce electricity), many factors must be considered: the constancy of the wind, its velocity (speed), the distance to carrier lines, and accessibility.

As with any energy source, wind energy has advantages and disadvantages. It does not cause air pollution and it will never be used up. On the other hand, hundreds or even thousands of wind turbines are necessary to produce significant amounts of energy. This takes up a lot of space, and some people do not like the appearance of so many turbines on the landscape.

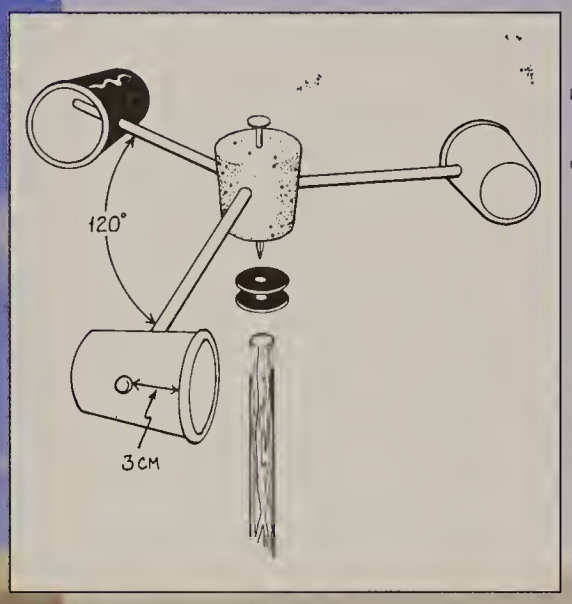
In the following activity, students imagine that they are planning a wind farm. To select a site for the wind farm, students construct anemometers to measure wind speed and compare measurements of average wind speeds.

Materials: You will need three plastic cups (about 8 oz), three knitting needles, a large cork, a wooden pole or 1/2"–3/4" dowel, a hammer, a nail 3 cm longer than the cork, two metal washers, and a bright-colored marker.

Procedure: 1. Have students use a knitting needle to make two holes on opposite sides of each plastic

cup, 3 cm from the top. Push a knitting needle through the holes in each cup, then push the ends of the knitting needles into the sides of the cork. Make sure that the cups are equally spaced around the cork.

2. Push the nail through the center of the cork so the point sticks out of the bottom. Put the washers on the end of the nail, then hammer the nail into the top of the dowel so the cork can spin around freely.



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3. Have students use the marker to mark a bright spot on the bottom of one cup. This will enable them to count the revolutions.

4. Choose a section of the schoolyard, or perhaps a park near the school, where the wind farm will be located. Assign each team about six sites to test for wind speed.

5. At each site, the team should set up the anemometer they have constructed and count the number of revolutions per minute caused by the wind. Students should note the exact location of each of the test sites and draw a map.

6. Back in the classroom, have the teams compare results and decide on the best site for the wind farm.

Extend the activity with the following discussion ideas:

- Find out from the power company how much electricity the average home uses and how many watts the average wind turbine produces.
- Ask students, "What are the environmental hazards of wind farms?"
- Have students research the question, "Is your state a good place to build wind-powered electrical-generating plants?" Students should be able to explain the criteria used to select a site. Alternatively, you can have students research different states and compare their findings.

About the Authors

Archaeologists Ranel Stephenson Capron and Richard Brook are actively involved with the Bureau of Land Management's (BLM's) environmental education programs. Elizabeth Rieben is a national environmental education coordinator for the BLM.

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Prairie Patterns

High Plains Ecosystem

Department of the Interior, Bureau of Land Management

Artwork and associated research by Shelly Fischman

Prairie

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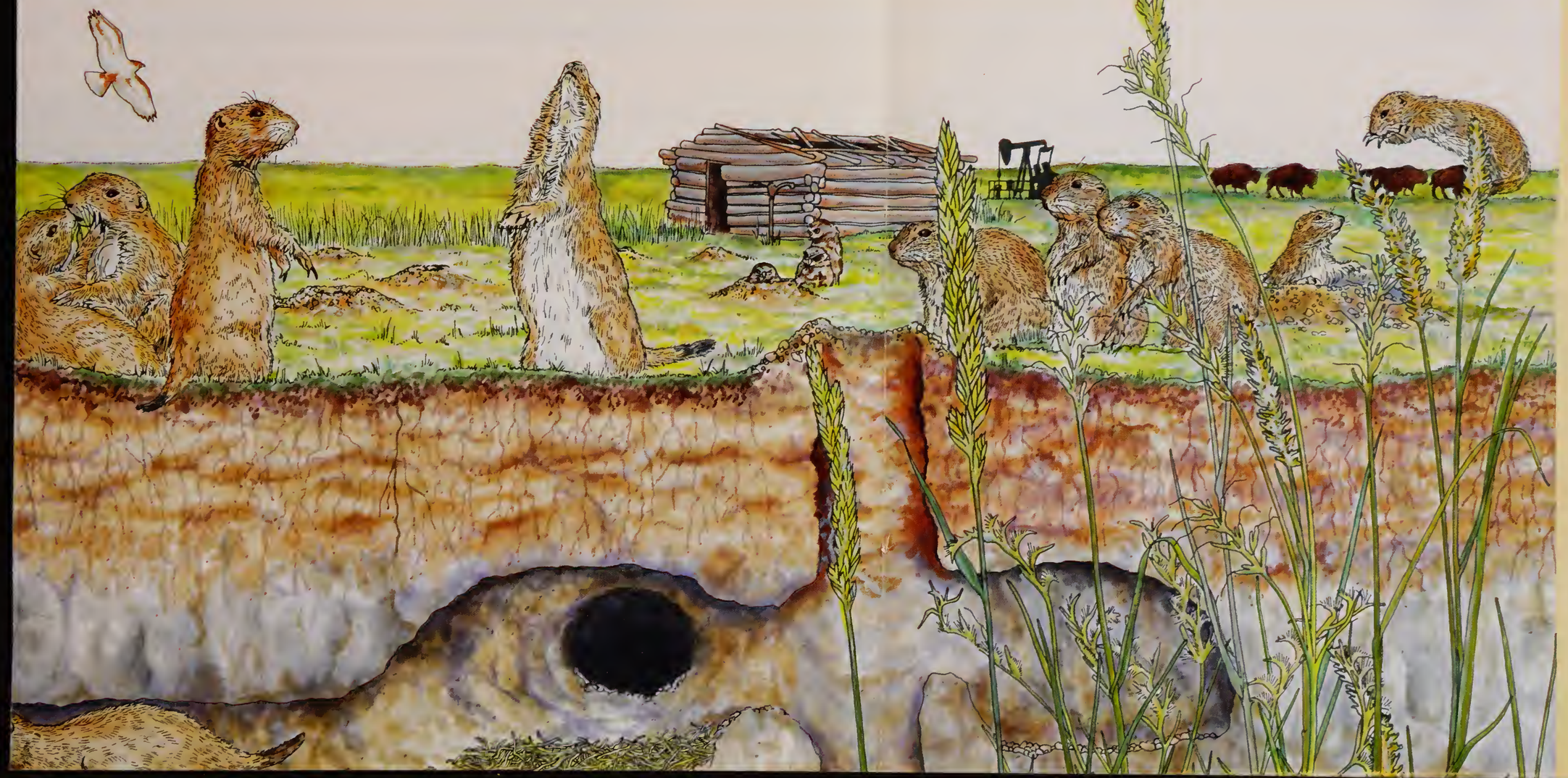

High Plains

Department of the Interior, Bureau of Land Management

Artwork and associated research by Shelly Fischman

The High Plains Ecosystem

The High Plains ecosystem includes a diversity of plants and animals. The prairie dog is extremely important to this system. Prairie dog colonies provide a year-round variety of food for many animals, while prairie dog burrows provide several plains animals with protection from predators, a place to raise young, and an escape from the harsh summer and winter climates. The range of the prairie dog was once estimated to cover 280 million hectares of western grasslands. But since 1900, farmers, ranchers, and the U.S. government launched extensive efforts to control and exterminate prairie dogs because they considered the animals a threat to agricultural livelihoods. Today, prairie dogs are found only on about 800,000 hectares in North America. With their decline has also come the decline in populations of other animals such as the black-footed ferret, the burrowing owl, and the swift fox—all suffering from habitat loss due to urban, industrial, and agricultural development.

SCIENCE & CHILDREN

ACTIVITY 1

The Question of Ferret Reintroduction on the Public Lands

The Prairie Dog. *Black-tailed prairie dogs are the most abundant of the five species of prairie dogs found in North America. They live in colonies or "towns," which can be as small as one-half hectare or as large as 400 hectares. They construct up to 20 burrow entrances per hectare, each leading to tunnels of up to 2 m deep.*

In this role-play activity, students consider the question of whether the black-footed ferret should be reintroduced on public lands. By presenting the positions of various interest groups to a mock town council meeting and working together to resolve conflicts over the proposed reintroduction of an endangered species, students are involved in resolving competing interests and turning a potential conflict into a collaborative effort.

The Scenario

In a hypothetical situation, the Bureau of Land Management (BLM) has approached the Smithdale Town Council regarding a proposal to reintroduce the black-footed ferret onto public lands near the town of Smithdale. The public lands identified for reintroduction fall within the ferret's historic range.

Concerned about the possible impact on adjacent private landowners and people who use the public lands, the BLM has asked the Smithdale Town Council to comment on the proposal. The council has scheduled a hearing to engage citizens in a public dialogue about the reintroduction of the black-footed ferret into its former range near the town of Smithdale.

Burrowing Owl. *The burrowing owl often lives in prairie dog burrows. They eat mostly insects, like beetles and grasshoppers, and small mammals such as mice and ground squirrels.*

Procedure

Give each student a copy of the background passage.

After students have read the passage, have them form groups of three to five students and give each group a photocopied "position card." Each group will represent one of the various community interests.

Ask students to prepare an argument for their position by researching how communities have handled the reintroduction of other species, such as the reintroduction of the gray wolf in the West or the red wolf in the East. Students also should find out what issues people are most concerned about and choose a spokesperson to present their argument.

Black-Footed Ferret. *The prairie dog is tied to one of the most endangered species in the world, the black-footed ferret. The only ferret native to North America, black-footed ferrets are members of the weasel family (Mustelidae), a distinction shared with weasels, martens, fishers, otters, minks, wolverines, and skunks.*

The "town council" can be composed of students (who also research the issue), teachers, or parent volunteers. Students may also want to elect their town council. For the "public meeting," have the Smithdale Town Council sit in front of the class. Give each group five minutes to state its position to the council, which can then question the spokesperson. Once every group has expressed its opinion, lead students in a general discussion about the issue.

Birds. *Birds are attracted to prairie dog towns because the insects they eat are easily seen in the grazed patches. Plovers, killdeers, prairie-horned larks, and mead-owlarks can be found, as well as predatory birds such as ferrugi-nous hawks, red-tailed hawks, and sparrow hawks.*

Collaborative Problem Solving

Make sure students understand that each group has a valid concern, and that there is no "right" or "wrong" in this situation. After the public meeting, have students assemble in groups made up of one person from each of the interest groups, with the exception of the town council. Challenge each of these new groups to collaboratively come up with a recommendation on how the reintroduction of the black-footed ferret could be managed to have the least impact on the local community, while still allowing for the reintroduction of this species.

For Discussion

During their discussion, encourage students to consider the following questions:

- Would the reintroduction of the black-footed ferret improve the overall health of the ecosystem, and, if so, how?
- What are some things about the impacts to local communities that would be useful to know? Examples could include the economic impact to adjacent private landowners (normally, the BLM would not reintroduce the species on private lands although the species might naturally expand there), energy and mining companies, hunters and anglers, and cattle ranchers.
- What is the best use of this public land for human interests? For biological diversity? What solution could satisfy the needs of both?
- How do the values of the various interests differ?
- What can you give up or alter about your position?
- What if you knew the economic benefits and costs of some of the choices? Would that make a difference in your decision?
- How does the fact that the black-footed ferret was historically a part of the ecosystem affect your recommendation?

Each of the multi-interest groups should then present its solution, and the Smithdale Town Council can then vote on what to recommend to the BLM about the proposal. After the vote, discuss the pros and cons of the suggested solutions. Identify and list the benefits (if any) and the costs and liabilities (if any) resulting from the council's decision. Include effects on people, plants, and animals.

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To extend learning further, follow the same procedure for a similar resource issue currently under debate in your community. Contact constituent groups representing diverse opinions and ask them for prepared statements (500–1,000 words) summarizing their positions on the issue, or invite them to a debate in your classroom and continue to research the issue so that students can ask relevant questions.

Bison. *Millions of bison once roamed the plains. They still can be found in isolated areas. Studies have indicated that bison and pronghorn prefer to feed in prairie dog towns because the forbs and herbaceous plants there taste good. And luckily, these plants are good for them also, having a higher nitrogen level and greater digestibility.*

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Other Animals. *The prairie rattlesnake warns larger animals of its presence through its distinctive rattle, even though the snake itself is deaf. Its camouflaged pattern helps the prairie rattlesnake blend in with its surroundings. White-tailed deer are reclusive and usually found in the valleys along creeks and streams, while mule deer are often found on the badlands and open plains. Both types of deer can be found in the Black Hills of South Dakota and Wyoming. Elk can also be found in the Black Hills. Other animals readily seen in the High Plains are the red fox, coyote, golden eagle, cottontail rabbits, and jackrabbits.*

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Background

The black-footed ferret (*Mustela nigripes*) is considered the most endangered mammal in the country, and, in fact, by 1980 was believed to be extinct. In the late 1800s, however, an estimated 5.6 million of these animals were found throughout the Great Plains. As the prairie was settled, large stretches of native grassland were plowed into farmland, eliminating prairie dog habitats. This had a devastating effect on ferrets, whose lives revolve around prairie dog towns. Ferrets eat prairie dogs and live in prairie dog burrows, hunting mostly at night.

In many areas, poisoning programs wiped out large colonies of prairie dogs, leaving only small, isolated dog towns. As prairie dog numbers declined, black-footed ferrets nearly disappeared. By the 1950s, very few ferrets were left. The ferret was officially listed as an endangered species in 1967. By 1980, the species was thought to be extinct. However, in 1981 a small ferret population was discovered near Meeteetse, Wyoming. While this population peaked at about 130 animals in 1984, by 1986 canine distemper (thought to be transmitted through domestic animals but also carried by wild animals) had reduced it to 18 known animals. Worried about the ferret's ability to survive, biologists captured these few remaining animals and launched a successful captive-breeding program. The captive population has now increased to more than 400, and the animals have been reintroduced into Wyoming, Montana, South Dakota, and Arizona.

The goal of the program is to establish 10 free-ranging populations of black-footed ferrets, spread over the widest possible area within their former range. Each of these populations is to have 30 or more breeding adults. It is hoped that 1,500 free-ranging black-footed ferrets will live in the wild by the year 2010.

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Private landowners fear that activities on their own lands might be restricted. They want

- to cooperatively decide the number of and distribution of prairie dogs (and correspondingly ferrets) that may occur on privately owned and leased public-domain lands.
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Hunters fear that their legal rights to hunt in the area will be curtailed or eliminated. They want

- access to hunt for deer, antelope, sage grouse, and small game except in the actual vicinity of release cages during the release phase of reintroduction (one to five years).
- to be able to shoot prairie dogs, except in prairie dog towns where black-footed ferrets are in release cages or are establishing a new population (one to five years) and may suffer from a reduction in the prairie dogs, the ferrets' primary prey.
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Wildlife Biologists

Wildlife biologists would like to see the black-footed ferret restored to the wild so eventually it can be taken off the Endangered Species List. They want

- to build self-sustaining populations of ferrets at several locations so that captive-breeding facilities are no longer needed for reintroduction.
- to encourage the widest possible distribution of reintroduced black-footed ferret populations.
- to minimize the potential impact of canine distemper and other diseases common to carnivores to both ferrets and their primary prey, prairie dogs, by avoiding areas where the potential for this disease is greatest.
- to design the black-footed ferret management program to be compatible with existing ranch, livestock, and mineral-extraction operations so that neither lifestyles nor income potential are negatively affected.
- areas of at least 10,000 acres for each reintroduced ferret population that are relatively free of diseases, particularly canine distemper and plague, that could wipe out an entire colony.

Ranchers

Ranchers are concerned that livestock grazing will be restricted. They want

- to continue operations and activities associated with their private lands or leased public lands without fear of problems that could develop from the potential or actual accidental killing or displacement of an endangered species.
- assurance that prairie dogs, which are the black-footed ferret's primary prey, do not compete with livestock for the available forage (that is, that benefits to black-footed ferrets will not be placed ahead of ranchers' economic livelihoods).
- acknowledgment that grazing is compatible with the maintenance of prairie dogs.

ACTIVITY 2

Riparian Areas: Healthy or Unhealthy?

In this activity, students visit and make observations at a riparian area of a stream. Then, as a class, they think of projects that can make it a better home for wildlife, plants, and people.

Objectives

Students will be able to

- Develop skills in observing and collecting data about the environment of a stream.
- Apply this data in analyzing the health of the riparian areas along the stream.
- Consider actions they can take to improve the stream's condition.

Materials

You will need pencils, notebooks or clipboards for recording data, and a topographic map showing the location of the stream or river being studied.

Background

Riparian areas are the green, vegetated areas on each side of streams and rivers. They serve many important functions, including

- purifying water by removing sediments and other contaminants;
- reducing the risk of flooding and associated damage;
- reducing stream channel and streambank erosion;
- increasing available water and stream flow duration by holding water in stream banks and aquifers;
- supporting a diversity of plant and wildlife species;
- maintaining a habitat for healthy fish populations;
- providing water, forage, and shade for wildlife and livestock; and
- creating opportunities for recreationists to fish, camp, picnic, and enjoy other activities.

Scientists who study these areas recognize that the well-being of riparian areas affects the well-being of entire communities. Many riparian areas, however, have become damaged by cattle and sheep, logging and mining activities, road building, poor agricultural practices, removal of woody vegetation, pavement in urban areas, industrial use of streams, and recreation activities such as hiking, camping, boating, or biking.

Both animals and people are drawn to the water, especially in arid regions of the West. These popular areas become quickly degraded when overused, resulting in erosion and water pollution. Communities must balance the uses of these fragile areas in order to protect them for future generations.

Procedure

Before taking your students to study a stream, discuss the following concepts:

- Inventory: A listing of all the different kinds of plants and animals found in an area. The total number of organisms.
- Riparian: On or near a stream or river. Plants in a riparian ecosystem need to have their roots in the water or moist ground for much of the year.
- Flood Plain: An area near a stream or river that floods regularly. These areas hold floodwater, minimizing flood damage to other areas.
- Watershed: The larger geographic area that drains into a given stream, river, or body of water.

Figure 1. A Healthy Riparian Area

Figure 2. An Unhealthy Riparian Area

Next, distribute copies of Figures 1 and 2 and lead students in a discussion of the attributes of healthy and unhealthy riparian areas.

Healthy riparian areas are characterized by the following:

- banks are stable with no excessive erosion or sediment deposition;
- banks have heavy vegetation (could include trees) and overhang any running water; water is shaded;
- plants are vigorous; and
- channels are narrow and deep.

Attributes of unhealthy riparian areas include the following:

- poor vegetation growth or non-native, invasive plants are crowding out native species; and
- excessive bank erosion so that channels are too wide.

To the Field

Select a small stream, close to school if possible. Visit the site prior to setting up your field trip. Arrange for parents, teacher assistants, or volunteers to help supervise students. If you choose a site at a nature center or park, a resident naturalist (staff or volunteer) may be available to assist the students in identifying signs of animal life or identifying plants and other characteristics of the riparian area.

Prior to the trip, have students make data sheets for recording their observations. Headings should include "plants," "animals," "rocks," "soil," "water," and "other." Discuss with students that this exercise will help develop observation skills. Have students think about the connection between the selected stream and the larger geographic area—the watershed—and consider the source of the water flowing through the stream. Explain that a watershed is the land area that delivers runoff water and sediment to a major river and its tributaries. Using the topographic map, have students identify what watershed feeds the stream. Review the discussion questions below so students will know what to look for at the stream.

At the site, allow students time to make individual observations about the stream and its surroundings and record these observations on their data sheets. For example, under the heading "animals," students should record evidence that animals are living nearby and using the plants in the riparian community. Students should write down the names or descriptions of any animals they see within the study area. They should look for and record such things as footprints, scat (feces), holes in leaves or tree bark, cones that have the scales eaten, holes in acorns, webs, nests, and so on.

Back in the Classroom

Once you return to the classroom, you might ask the students the following questions for discussion:

- What did you notice about the stream environment?
- What types of plants increased in number as you approached the stream, and what plants decreased?
- What evidence of animals was present?
- What do the rocks in or near the stream tell you? (For example, exposed rocks with lighter and darker shades of coloration might indicate that the stream level is higher or lower at different times of the year.)
- What are the indicators that the riparian zone is healthy or unhealthy? (Stable or eroded banks, heavy or sparse vegetation, well-defined or poorly defined stream channels, diverse native plants or monocultures of invasive species.)
- What activities in the area might be threatening the health of the riparian area?
- What is the likely source of the water in the stream? What are some of the ways that water gets from a mountain top (melting snow) to the stream? Where does the water ultimately come from?
- How big is this watershed compared to other watersheds?
- How important is the stream in the environment? How important is the stream to the people who inhabit the area?

NOTE: If a field trip is not possible, an alternative activity could be conducted using photographs of various healthy and unhealthy riparian areas. Photograph nearby stream areas or contact a local office of the Bureau of Land Management or U.S. Forest Service to obtain photographs of riparian areas. These offices sometimes keep "before" and "after" photographs to document progress in restoring riparian areas. Have students assess the condition of the areas shown in the photographs using criteria listed above.

Finally, have students consider projects for improving the health of the stream and riparian areas they observed (for example, cleaning up trash and debris in and around riparian areas, planting vegetation along streams, stabilizing eroding streambanks). Consider the feasibility of implementing some of these measures, making sure to contact the proper land-managing authorities before initiating any projects, and consulting with experts on the benefits of the proposed measures.

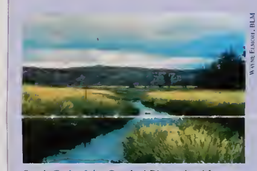
Before and After

Texas Creek in Colorado—unhealthy riparian area, 1976.

Texas Creek—healthy riparian area, after restoration, 1985.

Before and After

South Fork of the Crooked River in Oregon—unhealthy riparian area, 1976.



South Fork of the Crooked River—healthy riparian area, 1986.

Some Plants of the High Plains

Grasses. *Grasses in the High Plains have a specialized adaptation that allows the roots to store water. The roots of blue grama grass are extremely extensive, containing up to 90 percent of the plant's mass. The leaves extend only a few centimeters above the ground and the seed heads grow less than half a meter tall.*

Leafy Spurge. *Leafy spurge is not a native plant. Although it is pretty, it is an aggressive invader and has caused much economic damage throughout the West. Its extensive root system can reach 6 m underground, making it difficult to control.*

Soil. *Plants require soil for support and growth, their roots extracting nutrients and water stored in the soil. Microorganisms and animals live and burrow in it. The soil takes in and holds nitrogen and moisture from the atmosphere.*

Forbs. *Forbs are not grass but are herbaceous plants. Their beautiful flowers attract wildlife.*

Riparian Activity by Meg Heath, Jeanne Moe, Robert Ball, Clyde Johnson, Gary Thrash, Rick Ryan and John Beazley, BLM.

The High Pla

The High Plains ecosystem includes a diversity of plants and animals. The p
a year-round variety of food for many animals, while prairie dog burrows pr
young, and an escape from the harsh summer and winter climates. The range
grasslands. But since 1900, farmers, ranchers, and the U.S. government laur
considered the animals a threat to agricultural livelihoods. Today, prai
With their decline has also come the decline in populations of othe
the swift fox—all suffering from habitat loss due t

Birds. *Birds are attracted to prairie dog towns because the insects they eat are easily seen in the grazed patches. Plovers, killdeers, prairie-horned larks, and meadowlarks can be found, as well as predatory birds such as ferruginous hawks, red-tailed hawks, and sparrow hawks.*

ACTIVITY 1

The Question of Ferret Reintroduction on the Public Lands

The Prairie Dog. *Black-tailed prairie dogs are the most abundant of the five species of prairie dogs found in North America. They live in colonies or "towns," which can be as small as one-half hectare or as large as 400 hectares. They construct up to 20 burrow entrances per hectare, each leading to tunnels of up to 2 m deep.*

In this role-play activity, students consider the question of whether the black-footed ferret should be reintroduced on public lands. By presenting the positions of various interest groups to a mock town council meeting and working together to resolve conflicts over the proposed reintroduction of an endangered species, students are involved in resolving competing interests and turning a potential conflict into a collaborative effort.

The Scenario

In a hypothetical situation, the Bureau of Land Management (BLM) has approached the Smithdale Town Council regarding a proposal to reintroduce the black-footed ferret onto public lands near the town of Smithdale. The public lands identified for reintroduction fall within the ferret's historic range.

Concerned about the possible impact on adjacent private landowners and people who use the public lands, the BLM has asked the Smithdale Town Council to comment on the proposal. The council has scheduled a hearing to

Burrowing Owl. *The burrowing owl often lives in prairie dog burrows. They eat mostly insects, like*

Collaborative Problem Solving

Make sure students understand that each group has a valid concern, and that there is no "right" or "wrong" in this situation. After the public meeting, have students assemble in groups made up of one person from each of the interest groups, with the exception of the town council. Challenge each of these new groups to collaboratively come up with a recommendation on how the reintroduction of the black-footed ferret could be managed to have the least impact on the local community, while still allowing for the reintroduction of this species.

For Discussion

During their discussion, encourage students to consider the following questions:

- Would the reintroduction of the black-footed ferret improve the overall health of the ecosystem, and, if so, how?
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Extension

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ins Ecosystem

rairie dog is extremely important to this system. Prairie dog colonies provide
vide several plains animals with protection from predators, a place to raise
f the prairie dog was once estimated to cover 280 million hectares of western
ched extensive efforts to control and exterminate prairie dogs because they
rie dogs are found only on about 800,000 hectares in North America.
r animals such as the black-footed ferret, the burrowing owl, and
urban, industrial, and agricultural development.

SCIENCE & CHILDREN

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ACTIVITY 2

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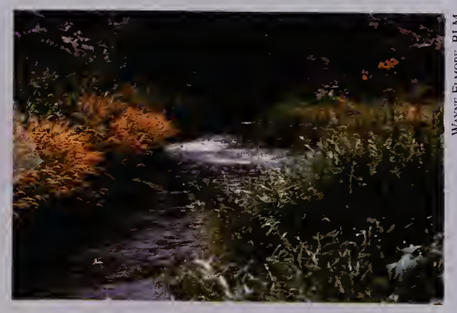
Before and After

WAYNE ELMORE, BLM

Texas Creek in Colorado—unhealthy riparian area, 1976.



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Texas Creek—healthy riparian area, after restoration, 1985.

Before and After

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South Fork of the Crooked River in Oregon—unhealthy riparian area, 1976.

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about the reintroduction of the black-footed ferret into its former range near the town of Smithdale.

Procedure

Give each student a copy of the background passage. After students have read the passage, have them form groups of three to five students and give each group a photocopied "position card." Each group will represent one of the various community interests. Ask students to prepare an argument for their position by researching how communities have handled the reintroduction of other species, such as the reintroduction of the gray wolf in the West or the red wolf in the East. Students also should find out what issues people are most concerned about and choose a spokesperson to present their argument.

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- to minimize the potential impact of canine distemper and other diseases common to carnivores to both ferrets and their primary prey, prairie dogs, by avoiding areas where the potential for this disease is greatest.
- to design the black-footed ferret management program to be compatible with existing ranch, livestock, and mineral-extraction operations so that neither lifestyles nor income potential are negatively affected.
- areas of at least 10,000 acres for each reintroduced ferret population that are relatively free of diseases, particularly canine distemper and plague, that could wipe out an entire colony.

Ranchers

Ranchers are concerned that livestock grazing will be restricted. They want

- to continue operations and activities associated with their private lands or leased public lands without fear of problems that could develop from the potential or actual accidental killing or displacement of an endangered species.
- assurance that prairie dogs, which are the black-footed ferret's primary prey, do not compete with livestock for the available forage (that is, that benefits to black-footed ferrets will not be placed ahead of ranchers' economic livelihoods).
- acknowledgment that grazing is compatible with the maintenance of prairie dogs.

and enjoy other activities.

Scientists who study these areas recognize that the well-being of riparian areas affects the well-being of entire communities. Many riparian areas, however, have become damaged by cattle and sheep, logging and mining activities, road building, poor agricultural practices, removal of woody vegetation, pavement in urban areas, industrial use of streams, and recreation activities such as hiking, camping, boating, or biking.

Both animals and people are drawn to the water, especially in arid regions of the West. These popular areas become quickly degraded when overused, resulting in erosion and water pollution. Communities must balance the uses of these fragile areas in order to protect them for future generations.

Procedure

Before taking your students to study a stream, discuss the following concepts:

- Inventory: A listing of all the different kinds of plants and animals found in an area. The total number of organisms.
- Riparian: On or near a stream or river. Plants in a riparian ecosystem need to have their roots in the water or moist ground for much of the year.
- Flood Plain: An area near a stream or river that floods regularly. These areas hold floodwater, minimizing flood damage to other areas.
- Watershed: The larger geographic area that drains into a given stream, river, or body of water.

Figure 1. A Healthy Riparian Area

Next, distribute copies of Figures 1 and 2 and lead students in a discussion of the attributes of healthy and unhealthy riparian areas.

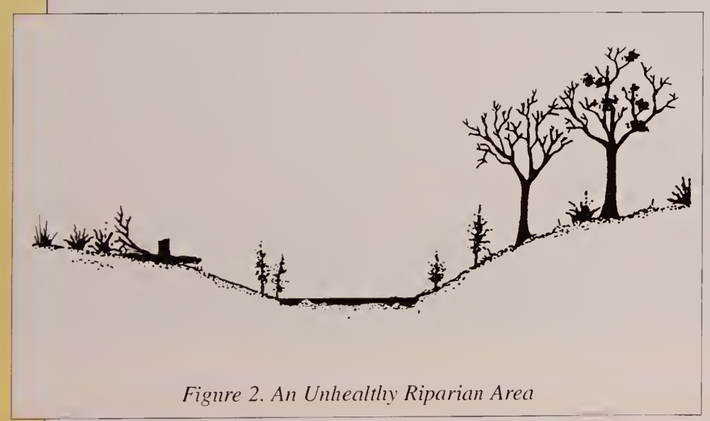


Figure 2. An Unhealthy Riparian Area

observations. Headings should include "plants," "animals," "rocks," "soil," "water," and "other." Discuss with students that this exercise will help develop observation skills. Have students think about the connection between the selected stream and the larger geographic area—the watershed—and consider the source of the water flowing through the stream. Explain that a watershed is the land area that delivers runoff water and sediment to a major river and its tributaries. Using the topographic map, have students identify what watershed feeds the stream. Review the discussion questions below so students will know what to look for at the stream.

At the site, allow students time to make individual observations about the stream and its surroundings and record these observations on their data sheets. For example, under the heading "animals," students should record evidence that animals are living nearby and using the plants in the riparian community. Students should write down the names or descriptions of any animals they see within the study area. They should look for and record such things as footprints, scat (feces), holes in leaves or tree bark, cones that have the scales eaten, holes in acorns, webs, nests, and so on.

Back in the Classroom

Once you return to the classroom, you might ask the students the following questions for discussion:

- What did you notice about the stream environment?
- What types of plants increased in number as you approached the stream, and what plants decreased?
- What evidence of animals was present?
- What do the rocks in or near the stream tell you? (For example, exposed rocks with lighter and darker shades of coloration might indicate that the stream level is higher or lower at different times of the year.)
- What are the indicators that the riparian zone is healthy or unhealthy? (Stable or eroded banks, heavy or sparse vegetation, well-defined or poorly defined stream channels, diverse native plants or monocultures of invasive species.)
- What activities in the area might be threatening the health of the riparian area?
- What is the likely source of the water in the stream? What are some of the ways that water gets from a mountain top (melting snow) to the stream? Where does the water ultimately come from?
- How big is this watershed compared to other watersheds?
- How important is the stream in the environment? How important is the stream to the people who inhabit the area?

NOTE: If a field trip is not possible, an alternative activity could be conducted using photographs of various healthy and unhealthy riparian areas. Photograph nearby stream areas or contact a local office of the Bureau of Land Management or U.S. Forest Service to obtain photographs of riparian areas. These offices sometimes keep "before" and "after" photographs to document progress in restoring riparian areas. Have students assess the condition of the areas shown in the photographs using criteria listed above.

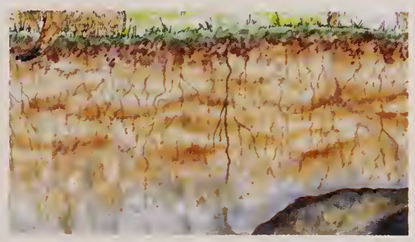
South Fork of the Crooked River—healthy riparian area, 1986.

students consider projects for improving the health of the stream and riparian areas they observed (for example, cleaning up trash and debris in and around riparian areas, planting vegetation along streams, stabilizing eroding streambanks). Consider the feasibility of implementing some of these measures, making sure to contact the proper land-managing authorities before initiating any projects, and consulting with experts on the benefits of the proposed measures.

Some Plants of the High Plains

Grasses. *Grasses in the High Plains have a specialized adaptation that allows the roots to store water. The roots of blue grama grass are extremely extensive, containing up to 90 percent of the plant's mass. The leaves extend only a few centimeters above the ground and the seed heads grow less than half a meter tall.*

Leafy Spurge. *Leafy spurge is not a native plant. Although it is pretty, it is an aggressive invader and has caused much economic damage throughout the West. Its extensive root system can reach 6 m underground, making it difficult to control.*



Soil. *Plants require soil for support and growth, their roots extracting nutrients and water stored in the soil. Microorganisms and animals live and burrow in it. The soil takes in and holds nitrogen and moisture from the atmosphere.*

Forbs. *Forbs are not grass but are herbaceous plants. Their beautiful flowers attract wildlife.*

Riparian Activity by Meg Heath, Jeanne Moe, Robert Ball, Clyde Johnson, Gary Thrash, Rick Ryan and John Beazby, BLM.