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Nature Notes: *Restoration*

Contents

Biotechnician Lee Vaughn uses a horsepack spraying system to help eradicate Canada thistle in the Badlands Wilderness Area. NPS photo by Sandee Dingman

Restoration of a Good Idea

William R. Supernaugh, Superintendent, Badlands National Park

This is our report to you, stockholders in our nation's system of National Parks, from the Board of Directors and CEO of one of the most interesting and varied units administered by the National Park Service.

I am very pleased to introduce *Nature Notes*, an occasional publication highlighting some of the natural and cultural resource programs at Badlands National Park. This, our premier issue, focuses on a range of restoration efforts that have been undertaken in recent years. It is particularly fitting that *restoration* has been chosen to usher in this publication as Badlands works toward restoring the native plants and animals to this historic landscape. Efforts to introduce visitors to the natural history of parks has always been part of our mission, and similar *Nature Notes* made their debut at areas such as Yosemite and Grand Canyon National Parks in an effort to introduce the public to the early parks and their resources. More recently, parks such as Crater Lake and Yellowstone reintroduced this format to again provide a deeper understanding of the active research and resource management programs in these parks. We too are "restoring" this past practice.

National parks seldom come into the public arena in an unaltered state and Badlands has certainly not been an exception. Years of human activity have changed the landscape from what it once was. The native prairie was replaced with domestic crops, precious water diverted or impounded, and sparse timber harvested. Similarly, because of past human endeavors to eke out a living in these marginal lands, the wildlife population has suffered. Animals that were viewed as competitors for scarce resources such as grass and water, or whose presence was considered a threat to life and livelihood, were vigorously pursued.

By the time Badlands National Monument - and later Badlands National Park - was established, the land had been significantly altered from its natural state. Bison and bighorn sheep were gone, wolves were a distant memory, black-footed ferrets were on the brink of extinction and non-native grasses and forbs were widely distributed throughout the park. It has taken many years of effort by many scientists, resource managers, and technicians but we are turning the corner in our combined efforts to re-create, to the natural appearance and components of this mixed-grass prairie ecosystem administered by the National Park System.

Join me in reading of the history, small victories, and future plans envisioned by the staff at Badlands National Park and our cooperating agencies, organizations and supporters. Share our vision for restoring this small part of the Northern Great Plains. Your purchase of this publication has made you a partner in these efforts. This is our report to you, stockholders in our nation's system of National Parks, from the Board of Directors and CEO of one of the most interesting and varied units administered by the National Park Service. Welcome to our outdoor boardroom - I hope you find the report of our progress as uplifting as I have.

Cover Photograph: Bob Crayton of Integrated Weed Control and Biological Technician Mark Slovek examine biological control insects placed in Canada thistle patches.

NPS photo by Sandee Dingman

Why "Restoration"?

Brian C. Kenner, Chief, Natural Resource Management

If we can show some success, perhaps we'll not only provide a glimpse into our collective pasts, we will show people a way of living with our natural environment instead of struggling against it.

With the theme of this inaugural issue of *Nature Notes* being ***restoration***, we highlight the importance of restoring what was once the wild, forbidding Badlands recorded in explorers' journals and described in American Indian stories. Long before the concept of a *national park* ever entered the American conscious, this land was part of a vast prairie ecosystem that stretched from the Rockies to the Mississippi, from central Canada to Texas. Tens of millions of bison roamed long distances and millions of prairie dogs populated huge "towns" in a vast sea of grass. The diversity of life in this nearly incomprehensible landscape awes today's citizens, most of whom are accustomed to only small remnants - token samples of the Great Plains before European settlement.

Even further back—a few million years—the plains were wetter, with elephant-sized Titanotheres, rhino-sized Archeotheriums, and sheep-sized oreodonts populating the vast open. As these animals gave way to their ecological successors over great periods of time, their bones remained, buried and preserved as fossils. These remnants of past life are now being exposed as wind and rains slowly reduce the Badlands back into a flat plain.

The ancient ones cannot be restored — nothing remains but those fossils. We can only simulate or recreate in drawings and models. We have to guess at what the landscape may have looked like back then, populated with strange creatures and plants. But we can restore, to some degree, the remnants of the recent past: bison, prairie dogs, black-footed ferrets, and mixed grass prairie. That is the burden the American people have placed on their National Park Service: to restore, to the extent possible within the confined boundaries of the national parks, the pre-European settlement landscapes and ecosystems.

Through our research and resource management activities, we, the staff of Badlands National Park, attempt to provide a vignette of the Great Plains as it was back when only native peoples knew it; before bison were slaughtered to near extinction; before prairie dogs were shot and poisoned to a fraction of a percent of what they once were; before the grass was plowed under and the prairie fenced. This restoration will never be complete. It is an ongoing effort, sometimes requiring heavy-handed techniques, such as pesticides for exotic plants, reintroductions of native animals. Other techniques include incorporating natural processes, like fire and native animal grazing. All require compromise. If we can show some success, perhaps we'll not only provide a glimpse into our collective pasts, we will show people a way of living *with* our natural environment instead of struggling *against* it.

As you read these stories of restoration, recognize that while they represent our current best efforts, our scientific knowledge of ecosystems and their function continues to grow. Our methods will surely change and improve as our knowledge grows. Restoration is a *process* rather than an achievable goal, but it is one of the most important endeavors we as park managers can undertake.

Restoring the Native Mixed-grass Prairie of Badlands National Park

Sandee Dingman, Natural Resource Management Specialist

Every species of plant, animal, fungi, bacteria and other organism has a home in some part of the world, where it has existed for thousands of years as a result of natural forces and influences like climate, storms, moisture, fire, soils and species interactions. Over long periods of time, these and other physical and biological factors direct the distributions of organisms in nature. A native (indigenous) species is one that occurs in a particular region, ecosystem, and habitat without direct or indirect human actions. Species native to North America are generally recognized as those occurring on the continent prior to European settlement. Organisms are considered non-native (alien, exotic, foreign, introduced, non-indigenous) when they occur artificially in locations beyond their known historical natural ranges. Non-native can refer to species brought in from other continents, regions, ecosystems and even other habitats. Species exotic to the U.S. include those transported from Europe, Asia, Africa, South America, Australia and other parts of the world. It also includes any species moved by people from one locality in the U.S. to a new one. (Plant Conservation Alliance, Alien Plant Working Group)

Located on the Great Plains in southwest - ern South Dakota, Badlands National Park includes one of the largest expanses of prairie managed by the National Park Service. The landscape is characterized by badlands erosion features and mixed-grass prairie interspersed with swales, draws, and drainages containing trees and shrubs. This mosaic of grasslands, shrublands, and woodlands is only a remnant of a vast ecosystem that once stretched from Texas to Canada. Due to the rarity of large prairies, the management and restoration of the park's prairie resources have become increasingly important.

To gain a better understanding of the park's prairie resources, a project was initiated to classify, describe, and create a digital, spatial database representative of the vegetation and land use occurring in the park. This project was undertaken as part of the National Park Service's inventory and monitoring program and was conducted by US Geological Survey's Biological Resource Division and the US Bureau of Reclamation's Remote Sensing and Geo- graphic Information System Group.

Vegetation map classes were determined through extensive field reconnaissance, data collection, and analysis in accordance with the National Vegetation Classification System. The vegetation map was created from photographic interpretation of aerial photography, then transferred to black - and- white USGS digital maps using a combination of on-screen digitizing and scanning techniques. (Von Loh et al, 1999).

The National Vegetation Classification System for the Badlands study area includes 28 natural and semi-natural associations and two complexes. The natural associations are comprised of four woodland, ten shrubland, six upland herbaceous/grassland, four wetland and four sparse vegetation types.

The results of the Vegetation Mapping project show that approximately 50% of the park is vegetated and 50% is unvegetated or sparsely vegetated. Of the total park area, approximately 36% is classified as Western Wheatgrass Alliance, dominated by western wheatgrass, blue grama, and threadleaf sedge. Most of the park's vegetation is natural, occurring in a mosaic of grasslands interspersed with woody draws and shrublands. However, 2.1% of the park's area is dominated by introduced grass species, primarily crested wheatgrass, Kentucky bluegrass, Japanese brome , downy brome, and smooth brome . This

Ecological restoration is an imprecise science that depends on innovative thinking and practical application to realize results. The park provides a living laboratory to try new restoration techniques.

Introduced Grassland vegetation class generally occurs in disturbed areas, such as roadsides, trailsides, former hay pastures, and former home sites (Von Loh et al, 1999). Other non-native species are interspersed, including perennial and biennial invasive weeds such as Canada thistle, musk thistle, bull thistle , Russian knapweed, spotted knapweed, field bindweed , yellow sweetclover, and common mullein as well as a number of annual, non-native forbs.

To restore the park's prairie ecosystem, the non-native components must be removed and native species must be re-established. Two projects are currently underway to accomplish this goal. First, the park's weed management program focuses on eradication or reduction of invasive forbs before they displace native species, alter ecosystem processes (such as nutrient cycling and fire regimes), or cause economic harm to adjacent agricultural lands. Second, the park's prescribed fire program is used to reduce the cool-season non-native grass species and increase the native grasses and forbs.

The targeted invasive forbs are Canada thistle, Russian knapweed, spotted knapweed, and common mullein. These targeted species are subjected to chemical, mechanical, and biological control efforts designed to eradicate new infestations and reduce established populations. Although yellow sweet clover is the most widespread weed species in the park, there are currently no practical controls that can be implemented in the park.

The most immediately effective tool is chemical.Three herbicides were selected based on effectiveness on the targeted species. Where and how each herbicide is used is based on the environmental conditions and access restrictions that exist where the herbicide will be applied. In large weed populations outside of the Badlands Wilderness Area herbicide is applied using a boomless sprayer mounted on an all-terrain vehicle. In populations inside the boundary of the Badlands Wilderness Area herbicide is applied using a horse-mounted sprayer system or backpack sprayers. In 2000, 535 hectares were treated with herbicide in the park (Dingman, 2001).

The park currently has six Canada thistle biological control sites in the park. Since 1996, three species of insects have been released to reduce the viability of established Canada thistle populations. *Urophora cardui* is a stem and shoot gall fly that lays eggs into stem tissue where the larvae cause the formation of a gall that depletes the stem's energy. *Larinus planus* is a seed- head weevil that lays eggs in the immature flower bud where larvae destroy the seed. *Ceutorhynchus litura* is a stem mining weevil whose larvae bore into the plant and mine the main stem (Crayton, 1999). Since 1996, 9600 biocontrol insects have been released in the park. Monitoring of biological control sites has found that where these insects have become established, there is a decrease in density of the Canada thistle population and seed production is reduced. Biological control is a particularly useful treatment in remote backcountry settings that are not easily accessible for herbicide application.

Mechanical control is primarily limited to common mullein. A biennial forb, mullein rosettes can be treated with herbicide during the first year of growth, or the immature seedhead can be removed during the second year of growth. To reduce the use of herbicide, the park favors removing the seedhead. Approximately 8 hectares were treated in 2000 (Dingman, 2001).

Prescribed fire is used to rejuvenate native grass and forb species while decreasing non-native grass species. Plants native to the area are adapted to fire and many depend on fire to remain a vital part of a healthy prairie. Natural ignitions, such as lightning strikes on dry fuels, occur most frequently in summer and early fall and cause an increase in most native grasses. Natural ignitions in spring are much less common and generally result in a decrease in grasses as the shoots are particularly vulnerable and the root reserves are low. This seasonal response to fire provides an opportunity to use prescribed fire to promote native species. Many non-native grass species emerge earlier than the native species, providing an opportunity to burn the prairie when the exotic grasses have started their annual growth cycle while the native species are still dormant. The effect is that the burned non-native species must use additional root reserves to grow

another shoot and compete with native species as the non-native species will re-emerge at the same time the native species emerge.

The park is divided into 27 prescribed fire units. As each burn is being planned, the species composition is analyzed. Burn units that contain large populations of non-native grasses are burned in the spring, while those burn units that are primarily native are burned in late summer or fall.

A slow moving backing fire applied for several consecutive seasons is particularly effective at reducing non-native grasses. The park's Roadside Prescribed Fire is using this strategy to reduce the smooth brome that grows adjacent to the park's Loop Road. In 2000, the first year of this multi-year project, approximately 300 acres were treated between the Prairie Winds Overlook and Quinn Road. Monitoring plots were established that allow resource managers to quantify the effect of the burning on relative cover of native and non-native grass species.

It is anticipated that three consecutive years of burning will be needed to yield measurable results. Germination test plots were used to determine the best way to interseed native grass seed into the burned brome monoculture. The test plots are designed to compare fall and spring planting, and drill and broadcast seeding methods. Results of the germination test plots will not be available until the 2001 growing season.

Restoration of the park's prairie is an on-going process. Ecological restoration is an imprecise science that depends on innovative thinking and practical application to realize results. The park provides a living laboratory to try new restoration techniques. As one of the largest mixed-grass prairies protected in the United States, Badlands National Park's prairie restoration effort helps preserve a piece of America's natural heritage for the benefit of park visitors as well the scientific community.

Prescribed fire is used seasonally in Badlands to control invasive species, such as smooth brome.

NPS photo by Aaron Kaye

Black-Footed Ferret Role and Restoration

Doug Albertson, Wildlife Biologist

Just as the impact of prairie dog population decline can be felt throughout the ecosystem, the success and educational opportunities that stem from the reintroduction of a single charismatic species have the potential to increase an overall public understanding of the importance of a diverse planet.

Ecological dominos, the cause and effect principle of the natural world, is apparent at Badlands National Park. As one species disappears, another is impacted. Three animal species have been reintroduced to Badlands in hopes to restoring equilibrium to the prairie ecosystem, thus, keeping more domiinos from tumbling. In the reintroduction of the black-footed ferret we find the relationships between human impact and nature so vivid. The success of this program at Badlands is a reflection of the success and potential of the federal endangered species program.

History

The story of the black-footed ferret begins long before Badlands National Park (BNP) and the Endangered Species Act of 1966. It begins in the early 1900s, during a period of swift western settlement and the transformation of prairie into rangeland. As the prairie became cultivated, a loss of habitat for many prairie animals proved devastating. Areas occupied by prairie dog towns in the late 1800s totaled almost 700 million acres. By 1910, that figure had been reduced by nearly 90%. Among the animals affected was the black-tailed prairie dog, the main source of food for the black-footed ferret. Perceived as a pest to agriculturists, a rodentcide program was implemented in order to eradicate the prairie dog. While many carnivores prey on prairie dogs, black-footed ferrets are dependent upon them for food as well as shelter resulting in a double negative impact on these tiny members of the weasel family. As prairie dog colonies disappeared, so did the black-footed ferret.

Despite its role in American Indian culture, as well as a commodity for fur trappers, the ferret was not described until 1897 by John James Audubon and John Bachman. As expected from a predator dependent upon a specific prey, the black-footed ferret was originally dispersed over 10 states from Montana to Texas, roughly covering of the existing prairie dogs towns. By 1967, many biologists were convinced that the black-footed ferret (BFF) was totally extinct. A surprise discovery in 1981 of a small group of BFF in Meeteetse, Wyoming, had specialists scrambling to save them. When canine distemper threatened to destroy the survivors, the last 18 BFF were captured between the years of 1985-87 and transferred to Sybille (Wyoming) Wildlife Research and Conservation Education Center's breeding facility, operated by the U.S. Fish and Wildlife Service. The initial goal was to establish 10 self- sustaining populations across the ferret's historical range. In order to fulfill this goal, ferrets have been reintroduced to other federal and state lands.

Reintroduction

The 1994 release of a 36 individuals onto 42,000 acres in BNP has been followed up by vigorous management efforts. To date, there are about 125 BFF within the Conata Basin, which overlaps portions of BNP and Buffalo Gap National Grassland, administered by the U.S. Forest Service (USFS). Although there will be no more releases of captive-bred animals, several translocations between USFS and NPS lands in the Conata Basin will take place. "Translocating wild-borns is a much better option," says Brian Kenner, Chief of Resource Management at Badlands. "Wild born animals are better equipped to handle wild habitat." The Conata Basin/Badlands area has proven so successful for BFF that some animals have been translocated to the Cheyenne River Indian Reservation to assist with their reintroduction program.

Before being released into the wild, BFF are preconditioned within BNP. They are taught how to respond to predators, with such innovations as "robo-badger," a remote controlled device designed to introduce ferrets to this intimdating predator. Once ready to be reintroduced to the wild, they are first placed in a pen which is secure from predators but allows access to the prairie.

The intention is to have the ferrets adapt gradually to living in the natural environment. The park also incorporates predator management in the form of electrical fencing.

One main question may be why South Dakota and Badlands National Park in particular have been deemed a ferret-friendly area. In this region there are more contiguous prairie dog towns than almost anywhere else. This in turn has lead to the fact that there are more burrows per acre. Although sylvatic plague and canine distemper continue to be a concern for all reintroduction sites, the local population has remained healthy. "No one really knows why we haven't had the plague....We've just been fortunate to not have had an outbreak," comments Kenner.

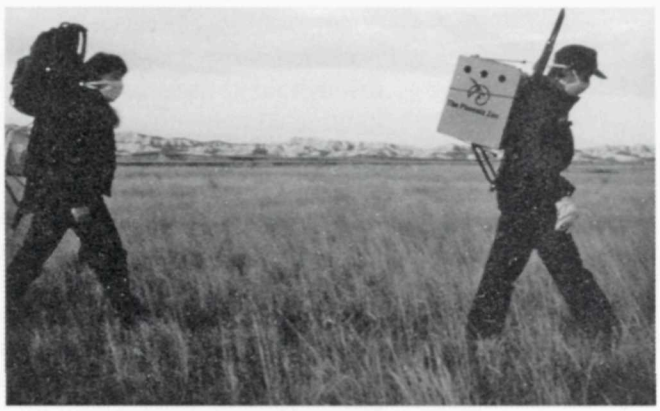
Current Management

Wildlife biologists use a system of identification involving spotlighting and transponder units. Each captive-bred ferret is tagged with a microchip beneath the skin. While out at night, the biologists will sweep a spotlight over an area to detect eye shine from a ferret. Once the ferret is seen, a transponder unit is placed on the burrow hole. Curious by nature, ferrets will pop their heads out of the hole, passing the microchip through the unit, allowing them to be identified. During mid to late August, biologists focus on identifying how many litters and wild-born kits there are. In early autumn, the main goal is to trap and mark any wild-born kits.

A grant from the Canon USA Corporation funds genetic research. Hair samples aid biologists to figure out how closely related wild ferrets are to the original captive-breds—as well as the general breeding behavior of the species. "This project may help....prevent genetic bottlenecking and increase the gene pool," says Kenner. The DNA of individuals may also prove useful in understanding the viability of the population.

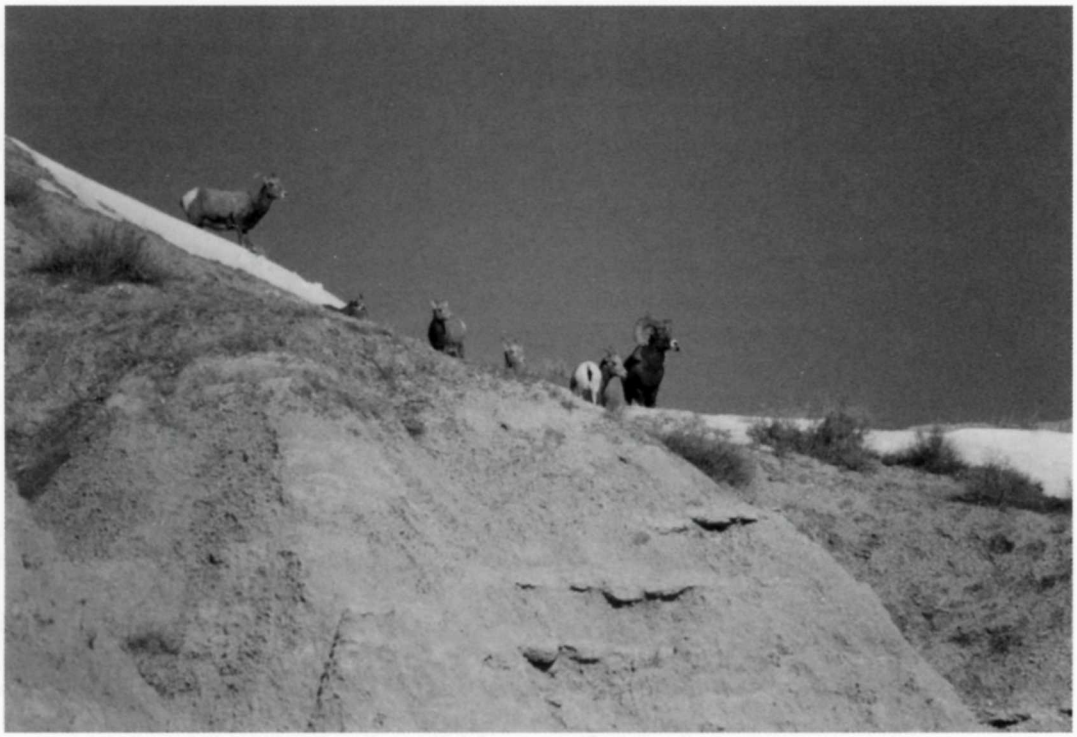
Although the decrease in prairie dog population was largely due to hunting, a new problem has arisen which is greatly affecting both the prairie dog population and the ferret reintroduction efforts. Invasive and exotic plant species continues to have a tremendous impact on the prairie ecosystem and all the animals that live within it. Canada thistle is a major player in the cast of non-native plant life. This plant is built to thrive in disturbed soil—such as those found in agricultural fields and prairie dog towns. Not only are ferrets struggling against the odds as an endangered animal, the black-tailed prairie dog is being considered as a candidate for threatened species status. The implications for an endangered carnivore that feeds on a threatened species are not only an interesting twist in the issue but a reminder of the terminal impacts humans have had on the environment.

Black-footed ferret reintroduction is far from being a completely accomplished resource management mission. The black-footed ferret seems to have been designated the "poster child" for all threatened species, both plant and animal, in the prairie ecosystem. Just as the impact of prairie dog population decline can be felt throughout the ecosystem, the success and educational opportunities that stem from the reintroduction of a single charismatic species have the potential to increase an overall public understanding of the importance of a diverse planet.



Due to the black-footed ferret's high susceptibility to disease, masks must be worn to avoid infecting them.

NPS photo by Marianne Mills



Native to the Badlands of South Dakota, bighorn sheep were hunted out of existence in the area in the 1920s, then reintroduced in 1964.

NPS photo by Julie Capra

Restoring Rocky Mountain Bighorn Sheep to the Badlands

Eddie Childers, Wildlife Biologist

Widespread population declines and local extinction during the past century eliminated bighorn sheep (*Ovis canadensis)* from most of their historical range in the western United States (Buechner, 1960). Reductions in numbers and distribution of bighorn sheep have been largely attributable to habitat alteration caused by human activities and land management practices (Bear and Jones, 1973; Wishart, 1978; Wakelyn, 1987). The Audubon's bighorn sheep (O. c. *auduboni*) once occupied suitable habitat throughout the Black Hills and Badlands of South Dakota. However, by 1925 the Audubon subspecies was considered extinct throughout its range as a result of overhunting combined with urban, mining and agrarian development.

In 1964, the National Park Service (NPS) cooperated with the South Dakota Department of Game, Fish and Parks (SDGFP) and the Colorado Division of Wildlife to reintroduce 27 Rocky Mountain bighorn sheep (*Ovis canadensis canadensis)* from the Pikes Peak, Colorado source herd into Badlands National Park. The goal of the agreement between the NPS and SDGFP was to establish a herd at Badlands National Park. Once established, animals could then be translocated to other areas of South Dakota initiating additional populations within suitable habitat within the Greater Badlands National Park Area as well as two locations in the northwest part of the state (Hjort and Hodgins, 1964). Following a 50% loss from this enclosed population attributed to *Pasteurella* infection during late-summer 1967, the remaining 14 bighorn sheep (2 ewes, 2 rams, 4 yearling ewes and 6 lambs) were released to the wild on August 31, 1967. For two years, periodic observations suggested that a band of 10-12 animals remained within 2 km of the release site.

During an aerial survey in September 1991, 30 bighorn sheep were observed in the South Unit of Badlands National Park, approximately 20 km south of the Pinnacles population. Qualitative accounts from local ranchers suggest that a small band had been established in the South Unit as early as 1981.

A period of heavy decline from 1995 to 1997 was attributed to an outbreak of Epizootic Hemorrhagic Disease (EHD). A November 2000 park-wide survey found the Badlands National Park population to be approximately 58-74 individuals occupying three separate habitat patches. One documented case of the often fatal Bluetongue disease was found from the carcass of a radio-collared ewe in the Cedar Pass Area in October 2000, and two other collared ewes were found dead in the South Unit during the November 2000 survey. Additionally, a pronghorn antelope was also found to have died in September 2000 of Bluetongue. While the Cedar Pass and Stronghold subpopulations appear stable, disease is a very real concern within Badlands National Park. Presently, the Pinnacles subpopulation has only 2 ewes and is in imminent danger of extirpation.

Ecologists with the USGS-BRD believe that restoration efforts at Badlands National Park to date have not been sufficient, since only 14 individuals comprised the founder population in 1967; optimal size for success of a species restoration has been documented at greater than 40 individuals. Several unoccupied suitable habitat patches in the Greater Badlands Ecosystem also remain. Conservation biologists recommend restorations only into very large blocks of suitable habitat likely to support a minimum of 300 animals. Only populations of this size retain genetic diversity, are more likely to recover and persist following a catastrophe such as an epizootic, and are predicted to persist with minimal management for 100 to 200 years.

Clearly there remains a need to intervene and assist in the establishment of a stable population of bighorn sheep in the Greater Badlands Ecosystem. Badlands biologists are working with SDGFP and Colorado Division of Wildlife to obtain 50 animals from populations in Colorado and the Black Hills to supplement the Badlands population.

The Greater Badlands Ecosystem comprises lands administered by several different state and federal agencies. The core bighorn sheep habitat is on public lands administered by the National Park Service as Badlands National Park. This includes the federally owned North Unit as well as the South Unit, tribal lands of the Pine Ridge Indian Reservation managed under an agreement with the Oglala Sioux Tribe (OST). Additional adjacent grasslands are administered by the USDA, Forest Service (USFS) as the Buffalo Gap National Grassland. The SDGFP has an interest in the establishment and perpetuation of a healthy, stable population of bighorn sheep in the Greater Badlands Ecosystem and will be a key partner in the translocation. Also, because sheep from Colorado are disbursed on a state-to-state basis, coordination through, and support of, SDGFP is critical.

While SDGFP supports Badlands National Park in supplementing the park population, they are trying to establish another herd in the Black Hills, and intend to translocate sheep to these areas first. Badlands National Park plans to translocate up to 50 bighorn sheep, primarily ewes to supplement existing populations in the Pinnacles and Cedar Pass areas in late fall or winter 2002 and 2003 if possible. Resource Management staff will work with South Dakota State University researchers to monitor the released and the resident sheep for habitat use and migratory movements for one year after the release and continue to monitor released and resident individuals for survival, reproduction, recruitment for two years post-release while continuing long-term monitoring of the sheep population. As an end result, the NPS hopes to restore a healthy population of bighorn sheep to Badlands National Park available for all to enjoy during many years to come.

Sowing the Seeds of Change: Education Through Ecological Restoration

Marianne Mills, Chief, Resource Education

Restoration relies on this basic tenet: When nothing is certain, everything is possible.

In *A Sand County Almanac*, Aldo Leopold wrote about extending the ethics governing human relations to encompass the natural world. His land ethic recognizes that just as people live in communities governed by laws and ethical behavior, they are also part of a natural community with its own natural laws. By restoring native ecosystems, we are able to engender the hope that human beings can be partners with natural ecosystems. This partnership not only restores the ecosystems, but also renews the humans engaged in this healing process. The Division of Resource Education at Badlands National Park is developing an interdisciplinary approach to understanding the native North American prairie through a program entitled *The Evolving Prairie*. Four components will orient learners to Prairie Past (paleontology and geology), Prairie Present (mixed grass prairie ecosystem), Prairie Future (resource management), and Prairie Perspectives (the human interaction with the prairie of Badlands National Park). Using funding provided by National Park Foundation and the Exxon Corporation P.A.R.K.S. program (Parks as Resources for Knowledge in Science), Badlands has worked with area teachers to develop science-inquiry based activities.

One aspect of the program is a project to restore a native habitat in your community or in your backyard. Teachers can invigorate their classroom through interdisciplinary activities and research activities and develop balanced relationships with nature while taking positive action. Our motivation in this prairie partnership is to create opportunities for experiences with nature outside of the confines of national parks, dubbed by one naturalist "the civilized wilderness." We cannot expect people to act responsibly in an environment if they do not feel responsible for their role in the protection or preservation of the place. Taking part in the transformation of an altered landscape back into a natural habitat illustrates to students that their studies of science, math and related subjects are relevant in the real work and show them that they can make a difference.

Restoring a native ecosystem in your community, your school yard or in your backyard provides opportunities for:

- Children to develop knowledge and skills as they undertake an exciting, real-life project
- Teachers to use the broad context of restoring a small plot, perhaps in the school yard, to enliven teaching and learning that can weave through the curriculum from kindergarten through twelfth grade. From here, the students become the next generation of adults – and land managers.
- Schools are able to build cohesion within the school and create opportunities for meaningful community involvement.
- Institutions that restore a portion of their school yard to native grasses diversify the student's educational landscape while highlighting its educational mission.

A natural, biotic community is a complex system of living things, interacting with nonliving elements such as geology, hydrology and climate. Prior to pioneer settlement in North America, there was a rich array of ecosystems, each adapted to the conditions of its particular region. European settlement brought substantial change to the landscape. Acres of crops have replaced native ecosystems. Cities occupy areas once covered by forest and prairie. Waterways have been altered and many wetlands drained. Human pressures such as these have led to a decline of natural biodiversity all over the world. Today, it is estimated that less than 2% of the native North American prairie remains. It once covered over 50% of this nation. Ecological restoration has grown out of the recognition that biological diversity is essential to the health of the planet, and thus the health of our own species. Further, participation in restoration promotes the acceptance of responsibility for an ethical relation with the land.

You can work toward restoration of native plant populations anywhere. First, you must learn the ecology of the native landscape and the site you wish to plant. Choose a native community similar to your site in environmental factors such as exposure to sun, soil type temperature, and precipitation. Observe its daily and seasonal changes.

Start small and go slow. The educational value of the restoration comes from involving students in the process as much as in creating the final product. Build a coalition of interested people. Be sure to include school administrators, maintenance staff, parents and interested community members from the start.

Teachers and students take responsibility for small corner of the school yard. Families "manage" a portion of their yard differently. Community members work together to restore a plot of land in their town or neighborhood.

Remember, the process of changing an ecosystem takes time, as does the process of changing or successfully adapting a school's curriculum. Each takes root slowly, but both bear fruits eventually.

A restoration project, particularly in a school landscape, provides the opportunity to engage people in:

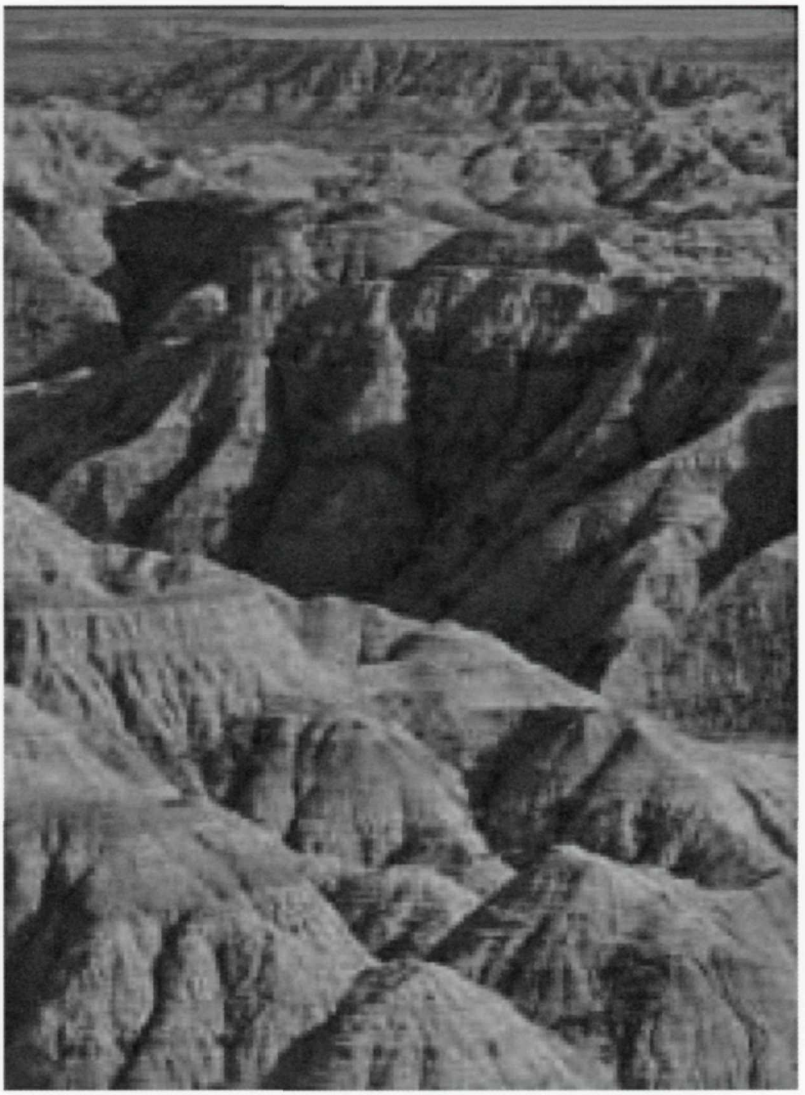
- Scientific inquiry in a meaningful context
- Hands-on, minds-on learning
- Real life, important decision that build confidence and resiliency
- Interdisciplinary learning in a broad context
- Work among peers, classes, grades and schools
- Community involvement through cooperative projects

Students map the site to determine how best to design the restoration. As they determine a plant list for the site, they examine plant characteristics, perform soil test, and squeeze numbers into a realistic budget. They improve their skills in writing, art, computer technology and science as they develop signs, brochures or articles for the local paper. Inquiry-based research flourishes as students become deeply engaged in the restoration process. Opportunities for real hands-on learning involves all grades as the students celebrate the initial efforts of returning one small piece of land to its native habitat.

Leopold also wrote, "One of the penalties of an ecological education is that we condemn ourselves to a world of wound." When Leopold wrote that in the early 1960s, the science of ecology was considered a fad. The environmental movement and the declaration of Earth Day were yet to come. Each year, we learn more about the long-term impacts of our decisions on where to live, where to sow, and where to "leave alone." Through restoration projects such as this, people can take an active role in observing the larger context in which we function – water, air, soil, wildlife, and plants. Rather than the sense of hopelessness or blame sometimes woven into environmental education activities, students take an active role in management and decision making. Rather than Leopold's world of wound, we can work toward healing our ailing environment. Restoration relies on this basic tenet: When nothing is certain, everything is possible.

Park Ranger Greg Sandine prepares fifth grade students to explore the Badlands prairie

NPS photo by Marianne Mills



Badlands, SD

Abigail M. Sussman, Park Ranger

Ribbons of time thread themselves throughout this place
Age upon age upon age
And I am not really here
I can feel the past in the sediment
And taste time in the dust
I find solace in knowing that the sun will be here much longer than I
And my footprints will be erased
Because out here, we are irrelevant
Its just the rock and the rain and the wind
Age upon age upon age
And I am not really here

A Time for New Ideas: Looking Back Thirty Years to Badlands National Monument

By John W. and Joanne W. Stockert, Former Chief Park Naturalist and Wife

John Stockert served as the Chief Park Naturalist at Badlands National Monument from September, 1966 through September, 1971 when he transferred to Yellowstone National Park. John and Joanne remember their tenure in South Dakota fondly for the first Badlands National Park Nature Notes. Badlands National Monument was designated Badlands National Park in 1978.

Little did I know that the opportunities which a waited me over the next five years would dramatically influence my life . . .

During our lives we all occasionally make pivotal decisions that dramatically change the course of our individual destinies. One of those moments occurred in September 1966 when, as a park naturalist at Grand Canyon, I accepted a promotion to the Chief Park Naturalist position at what was then Badlands National Monument. This occurred prior to such positions being filled by those who applied for them. During those years, offer of an impending transfer was often sudden, out of the blue, when some unknown park manager decided you were the best available person to fill a particular slot. At that point in my career, little did I know that the opportunities which a waited me over the next five years would dramatically influence my life and future career opportunities.

My wife, Joanne, remembers the day we arrived at the park, on that last day of September 1966. It was overcast and chilly; the color of the sky, buttes and grass all looked about the same drab brown - quite depressing. So, we came to the Badlands like so many employees before us, almost in tears, and would leave in the same manner five exciting years later.

In those days, the Chief Park Naturalist was also in charge of the park's cooperating association, Badlands Natural History Association (BNHA). A non-profit organization dedicated to supporting public education on park resources, BNHA was formed in 1959 and incorporated in 1961. Just one of the original/founding board members, Ted Hustead – owner of the nationally

The Ben Reifel Visitor Center opened its doors in 1959 and continues to serve hundreds of thousands of visitors each year. Starting in 2003, the park will add a theater, new exhibits, and improved restrooms.

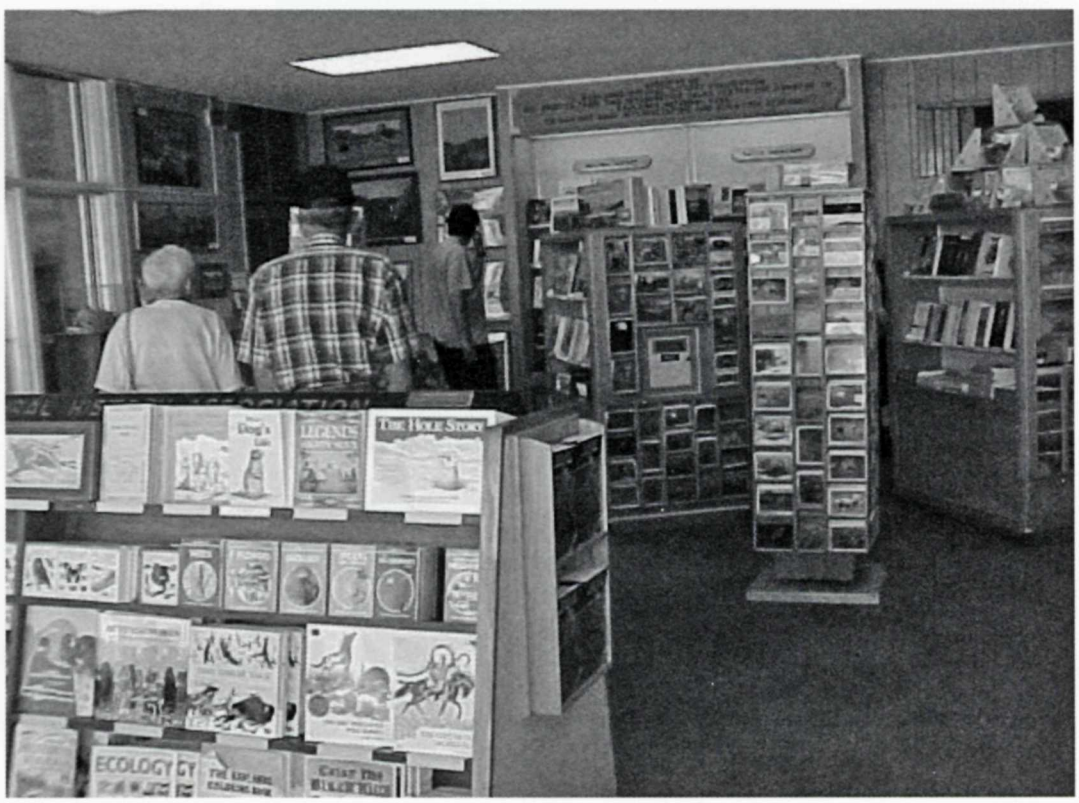
known Wall Drug – was still on the board. It was a privilege to work with that group because it provided insights into how they, as locally involved individuals who loved the area, were interested in increasing knowledge about the Badlands that in turn would enhance its enjoyment by park visitors.

It soon became evident that an incredible amount of time was spent just keeping abreast of daily BNHA matters, such as bookkeeping, ordering sales items, making deposits, and inventorying. During that first full year on duty, BNHA matters took about 50% of my time, and my predecessor, Robert Grom, told me it was the same for him. In August 1970, Midge Johnston of Interior became the Association Clerk. Midge still works for BNHA, having served as a sales clerk, business manager, and now Executive Director of an operation that now grosses nearly $400,000 per year.

From the beginning it was obvious that BNHA sales must increase in order to fund the mushrooming long-term publications' effort. In 1966, gross sales were only $9,400, hardly enough to support a publishing program. We learned simple marketing techniques , such as having publications out where visitors could handle them, rather than under glass. By 1971 gross receipts had more than quadrupled to $36,940. However, the need for increased interpretive information about the Badlands was evident. *A History of Badlands National Monument and the White River Badlands of South Dakota* made its sales debut on June 3, 1968 and was also known as Bulletin No. 1. In 1989 it was replaced by *A Revelation Called The Badlands, Building A National Park, 1909 – 1939*, written by then Chief Park Naturalist Jay Shuler.

Bulletin No. 2, *Badlands - Its Life and Landscape* by local author Joy Keve Hauk went on sale on June 20, 1969, at the visitor center with the 70-year- old author autographing 120 copies sold that day - a wonderful and memorable event! *Badlands - Its Life and Landscape* remains in print

Badlands Natural History Association has grown from less than $500 per year in sales to over $400,000 through your support.



today and remains one of the top sellers for BNHA. In 1989, the author was posthumously inducted into the South Dakota Hall of Fame. By that time the book had already sold more than 100,000 copies. Other publications still in print produced during the our tenure include *Wildflowers of the Northern Plains and Black Hills* and *Badlands National Monument Road Guide*, (rewritten and republished in 2000 as *Badlands National Park Road Guide*)

Although developing publications was the primary emphasis during my tenure, other things were also attended to. The Cliff Shelf Nature Trail passes through one of the area's most interesting botanical, ecological, and geological features. In 1968 the path was improved for visitor safety with BNHA providing a trail guide. The only daily nature walks given initially were along the Cliff Shelf Nature Trail with an average attendance of 40, to more than 75 being the greatest. In 1968, an alternative guided- walk route was tried in the Badlands gullies across the main park road from the visitor center. Fifty-five showed up for that first walk which began at 6:30AM! An evening walk soon followed. Oddly, temperature had little effect on group size. Fossil cleaning demonstrations were also tried in July 1970 on the front porch of the visitor center, and were an immediate, overwhelming success. Their purpose was to allow visitors to see and handle fossils. Upwards of 200 or more per hour attended the activity. It became a regular demonstration in 1971. *[**Editor's Note:** These programs were discontinued in 1988 due to professional concerns on the quality of the fossil preparation and replaced with Fossil Talks.]* In 1965, the size of the amphitheater was increased to 300; yet nearly 50% of the programs exceeded this number, sometimes up to 400.

On a very hot day – close to one hundred degrees — in July 1970 my family and I were exploring a canyon bottom on the west end of Cuny Table and noticed that something was crunching under our feet. Upon digging down a little into flood debris, we found a thick layer of hailstones that had been preserved under the debris for about a week!

During 1971, more change than usual had come at the park. On August 16, Chief Park Naturalist Bill Dunmire of Yellowstone offered me a transfer and promotion to fill their West District Naturalist position, which included the Old Faithful area. On September 17th we left the Badlands and I reported for work at Yellowstone three days later.

Thus came the close of an intensely busy time, one of much growth, and a few sorrows developing near the end of the five years. In 1967, we added a second daughter to our family. Our oldest daughter, starting before age two, took an early interest in natural history. But like so many before us, we exited the Badlands with a bit of melancholy, leaving behind fond memories and many friends. The publication experiences would qualify me in part for a short term teaching experience in 1980 at the College of African Wildlife Management on Mount Kilimanjaro in Tanzania! Even today, 33 years later, we continue to know more of the individuals in and around the Badlands than we do at any other area in which we have lived!

Update from current Chief Park Naturalist Marianne Mills:
You may wonder how the Stockert memories relate to the restoration of Badlands National Park resources. You, the park visitors and supporters, are also resources of the park. As Mr. Stockert notes, we averaged 40 visitors on nature walks during his time and had standing room only at our evening programs.

In 2000, we averaged 12 visitors per nature walk and less than 100 at our evening programs. We hope to "restore" your presence at our park programs by inviting you to attend the summer roster of activities available from early June to Labor Day each year. In support of resource protection, our programs are planned to have minimal impact on the plants, animals, geologic, paleontologic, and cultural objects within the park; however, our programs are certainly not reaching as many as we can handle. For more information on our naturalist programs, join BNHA and receive a copy of our activity guide, *The Prairie Preamble*.

Holding Back the Years: Restoring Safety to the Loop Road

Greg Sandine, Park Ranger

Because this project was constructed through an area recognized as one of the world's most fantastic examples of erosion, it is expected that maintenance will be neither simple nor easy.

Roads provide the opportunity for over 270 million travelers to visit National Parks every year. Most parks have a designated road, or a series of interconnecting loops, to allow visitors to witness some of the most spectacular vistas a park has to offer. In Badlands National Park, this byway is known locally as the "Loop Road," a 30 mile drive of breathtaking scenery, connecting the park to Interstate 90.

So what happens when this vital artery within the park begins to literally slide into oblivion? Badlands National Park is renowned for its highly eroded landscape of soft sedimentary rock. For that reason, there are certain stretches of the Loop Road which are a highway engineer's worst nightmare. One such section of the road, near the crest of Cedar Pass near park headquarters, sits atop a geologic fault. The Cedar Pass slump, as it has come to be known, is quickly heading downhill - and carrying the road with it.

Loop Road History

During the 1920s, Peter Norbeck, U.S Senator from South Dakota, worked tirelessly to have the Badlands added to the rapidly growing list of national parks. Although the Badlands did not become an official unit of the Park Service until 1939, much of the work to achieve park status was accomplished during the 20's and 30's. Norbeck, who also designed the Needles Highway in the Black Hills, realized that if the State of South Dakota planned and built a road through the Badlands, the passage of a bill through Congress, designating the area as a national park or monument, would occur with less delay. Engineers from the South Dakota Department of Transportation began surveying the area, and found what they thought was a suitable route. Others, such as Ben Millard, did not agree with the route engineers had chosen, for it circumvented most of the rugged scenery of the Badlands Wall. Millard was a local businessman who operated the Cedar Pass Lodge, a very popular gathering area for big bands, such as Lawrence Welk. His primary interest was to provide visitors to the Badlands with the most breathtaking scenery the area had to offer. Eventually, a route was chosen which passed through most of these sections, albeit to the concern of many engineers. "Because this project was constructed through an area recognized as one of the world's most fantastic examples of erosion, it is expected that maintenance will be neither simple nor easy," stated one highway engineer. Some seventy years later, his words would have even greater relevance.

Why has it taken 70 years for the effects of the landslide to take hold? During the past several years, rainfall has been higher than the annual average of 15-17 inches. This extra moisture affects the Cedar Pass slump in different ways. As more rain falls, more weight builds up on the slope of the slump. The heavier the soil, the more movement that occurs along the slide scarp. In addition to adding weight to the soil, the water also acts as a lubricant, which causes the slide to move even faster. After heavy rainstorms, Park maintenance employees have gone to the slide only to find it had fallen as much as six inches over night, creating a dangerous situation for anyone travelling on the Loop road. Within a few years, overall maintenance costs for the Cedar Pass section of the road have almost doubled. Obviously, the time to be proactive about the disintegrating road was imminent. "Once the landslide kicks out too much into the ravines below, there won't be a road to maintain anymore. An engineering firm contracted by the Park theorized that this could happen within the next year if measures aren't taken to either move the road or stabilize the landslide," states Facility Manager Nick Koenigs.

Unique Synergy

The Park prepared an environmental assessment, considering three options for mitigating the effects of the landslide. Essential park operations were considered, including visitor safety, and the local economic community because this portion of the Loop road is used as a route for ranchers and farmers delivering their goods to South Dakota markets, and additionally

by school busses for students in Interior attending school in Wall or Kadoka. Copies of the Environmental Assessment can be obtained from the park upon request. The selected option was to buttress and stabilize the entire Cedar Pass landslide. How does one attempt to stop a landslide, a seemingly unstoppable force of gravity? Well, if about 10,000 dump trucks worth of soil is placed within the ravines of the slide, and packed to a certain density, theoretically the slide should slow down considerably, at least for the next five years or so. This should give enough time to plan and fund a rerouting of the Loop Road.

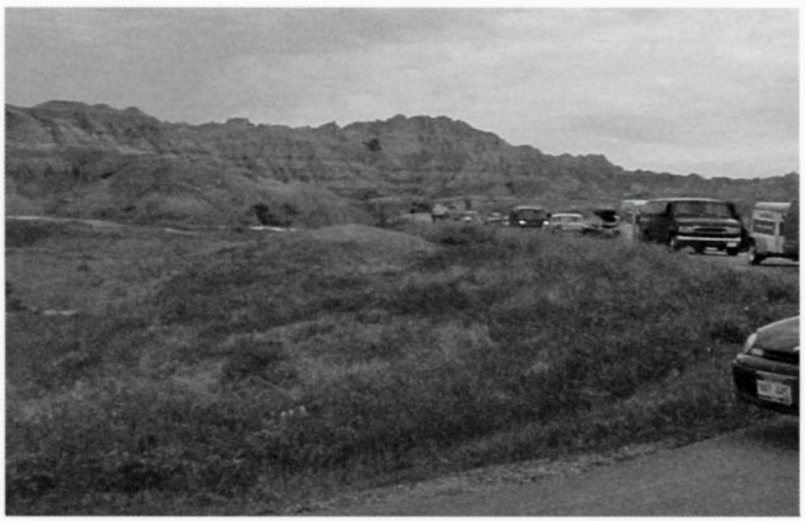
Funding for the buttressing project was difficult to obtain, even with the severity of the movement of the Cedar Pass slump. Fortunately, another proposed project within the park, the excavation of an eight-acre sewage lagoon, was to begin at the same time the buttressing would need to take place. As soil is excavated from the lagoon ponds, it will be trucked just over 1 mile to the Cedar Pass slump, where it will be dumped and compacted into the ravine located below the slide. Extensive drainage planes traversing the slope of the buttress will prevent water from speeding the landslide during future rainfall.

Park Superintendent Bill Supernaugh calls the blending of the sewage lagoon excavation and the buttressing infill "an elegant way to accomplish two critical projects within Badlands National Park. Since the park has outgrown it's current sewage lagoons, these two projects will allow the park to provide park visitors with the proper facilities, and in a safe manner in terms of the roads they travel on." Not to mention the synergy between the projects will save taxpayers tens of thousands of dollars, since soil would have been imported from outside the park for the buttressing project.

Down the Road

The buttressing project is expected to stabilize the Loop Road at Cedar Pass for the next five to ten years. That should provide enough time for the Badlands to acquire the necessary funding for the complete realignment of several miles of the road. The question remains, however, if the buttressing will ever stop a large-scale landslide. Given the choice, decision makers within the park would rather not pursue a "band-aid" project which may or may not work as intended. However, obligations to the visiting public, local businesses and schoolchildren made the buttress the only viable option until more permanent changes can be made.

Work on the buttress began in fall, 2000 and were completed by spring, 2001. So far, the Badlands Loop Road is intact. A General Management Plan is underway for the park that examines option on rerouting the Badlands Loop Road in case of failure. We humans must acknowledge that the forces of geology and gravity tend not to obey our wishes. This may be a case where humankind gets to learn another lesson from unpredictable forces of nature.



Over one million visitors travel the Badlands Loop Road each year in a wide variety of vehicles. Additionally, thousands of tons of commercial traffic take their toll on this landscape.

Take Your Place in Badlands History

Since its founding in 1959, Badlands Natural History Association (BNHA) has donated over $1 million to Badlands National Park. Primarily used to produce free publications and fund internships and resource management projects, BNHA raises these funds through the sales of publications, postcards, and other educational materials at park visitor centers.

You can support BNHA's efforts by becoming a member for $10 per calendar year. To join, call (605) 433 - 5245 and request a membership brochure or stop by the information desk at the Ben Reifel Visitor Center and ask to join.

Membership Benefits

- 15% discount on all purchased items at this and other national parks
- A copy of Nature Notes sent to you each year to keep you abreast of park activities
- A Badlands National Park cloisonne pin
- Invitations to special events

BNHA has a board of directors and conducts annual board meetings. Additionally, BNHA provides support for special projects, such as the renovation of the Ben Reifel Visitor Center, and assists the park in large fund raising projects. Take your place in Badlands history by joining today!

About *Nature Notes*

This publication is a collaboration between the divisions of Natural Resource Management and Resource Education at Badlands National Park. The intent of *Nature Notes* is to provide the visiting public with access to current research, resource management, and education activities funded through their tax dollars.

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