

NATURAL AND OTHER RESOURCES AND ISSUES OF CONCERN

Entrance Area of Mesa Verde National Park

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INTRODUCTION

The Entrance Area of Mesa Verde National Park consists of approximately two square miles at the extreme north end of the park from Point Lookout northward. Ecologically, however, the area extends outward from this core in each direction, encompassing other park lands such as the Switchback Road and the Knife Edge, as well as state, BLM, and private lands to the east, west, and north. This point is best illustrated in mobile and large, free-ranging species such as mule deer, elk, mountain lion, black bear, golden eagle, peregrine falcon, and others.

Additionally, the whole Entrance Area constitutes a very important wildlife migration corridor. The shale hills that extend northward from the park's north escarpment connect across U.S. 160 to the mountains of the San Juan National Forest along Summit Ridge immediately north of the park entrance. Furthermore, the Entrance Area was named a "Mule Deer and Elk Critical Winter Range" by the Colorado Division of Wildlife and Bureau of Land Management, which are defined as "...key concentration areas that support and sustain a large percentage of the total wintering populations. They are extremely important for annual survival during harsh winters. Disturbances may place unnecessary stress on wintering big game herds and cause undue mortality of mature animals and the following season's fawn and calf crop." The BLM places stipulations in these areas where exploration, drilling, and other developmental activities will be allowed only from May 1 to November 30.

During the winter of 2000, definitive planning began for the construction of the Cultural Center and accompanying facilities. The park's Natural Resource staff identified resource issues and assessed potential impacts to park natural resources from developing various alternative construction sites. Based on all factors considered, this "Value Analysis" generally identified two preferred site locations, both of them within the Entrance Area. One site area is located nearer U.S. 160 and the other is closer to the park's existing entrance station. The two sites have similar, but not equal impacts to natural resources. Based on our current knowledge of the Entrance Area, the Natural Resource staff determined that resource impacts are minimized next to U.S. 160 and those impacts incrementally increase and expand as the siting moves south, deeper into the park. Concern was raised during the Value Analysis process that this assessment of natural resource impacts was based on limited "anecdotal" information and; therefore, the degree of differences in resource impacts between the two sites were exaggerated. In response, this report was generated to show how well the natural resources of the Entrance Area are known and that our assessment really was based on a sound body of knowledge generated by our own hard work and that of other professionals over many years. The second purpose of this report is to provide the basis for resource impact assessments to be included in a NEPA planning document (Environmental Assessment) for the Cultural Center due out later this year.

It was in reply to an earlier proposal to construct the Mesa Verde Cultural Center (a large and comprehensive visitor center, administrative offices, curatorial facilities, utilities, parking, and other developments at the park entrance) when the park's Natural Resource staff began a series of studies in the Entrance Area starting in 1988. Prior to that time a Plant Production Plot had been monitored since 1983 and general wildlife sightings were being recorded. In 1994, construction interest intensified as did Natural Resource inventories, surveys, and monitoring.

This report briefly summarizes approximately 20 years of data gathering in the Entrance Area. The work was conducted by park Natural Resource staff and by outside researchers. Although special funding for this work was requested, none was received. Some work conducted earlier than 1988 pertaining to the Entrance Area includes paleontological surveys and a report by Dr. Mary Griffitts beginning in 1979, a small mammal survey by Charles Douglas completed in 1965, and geologic mapping and a report by Wanek of USGS in 1959.

The various studies are diverse and comprehensive. The following categories have been investigated: faunal resources, floral resources and habitat types, geologic, paleontologic, and soil resources, water resources, and oral history relating to natural resources and development.

GEOLOGICAL, PALEONTOLOGICAL, AND SOIL STUDIES

1. **Geologic Strata Mapping for GIS Entry (1979 to 2000).** Dr. Mary Griffiths, working primarily as a volunteer, began her work in the Entrance Area examining the Mancos Shale. In 1999 the base maps were drafted and the data entered onto GIS in 2000.

A detailed bedrock geology was drafted for the six 7.5 topographic quads of the park. GIS entry was completed in 2000. During this work, Marilyn Colyer assisted Dr. Griffiths in access and measurements. Colyer found a distinct correlation between ponderosa pine occurrence and the Greenhorn Limestone member of the Mancos Shale. Several understory species, such as narrowleaf buckwheat and Patterson's milkvetch also correlate with this layer. Another phenomenon of interest was the occurrence of Oregon grape following fractures in the shale. These fractures are associated with a small anticline running north and south through the Entrance Area and are thought to be associated with the divide between Mud Creek and McElmo Creek drainages. The anticline runs to Summit Ridge and possibly ties in to Turkey Knoll, an igneous plug on the rim of Lost Canyon. Another feature that we examined was a rimmed and symmetrical crater about two miles north of the Entrance Area. This is suspected to be a meteor crater.

2. **Paleontologic Surveys.** Dr. Mary Griffiths primarily is an invertebrate paleontologist and her first work in the park, beginning in 1979 through 1999, centered on the Mancos Shale, which is particularly fossil rich. The Entrance Area is the only portion of the park that protects the well-known fossil member known as Juan Lopez.

At this time 131 species of fossil invertebrates have been found in the Mancos Shale Formation, mostly in the Juana Lopez member in the Entrance Area. A distinctive oyster bed, with an older larger oyster and a younger smaller oyster, outcrops in three locations within the Entrance Area. The fossil species include brachiopods, cephalopods, bivalves, gastropods, a crinoid, an annelid worm, ray teeth, and shark's teeth. In addition to the invertebrate species we examined some fossilized trees of the Juan Lopez on a knoll top near the park. Mancos Shale has very limited records of plant remains.

3. **Stratigraphic Framework of the Mancos Shale.** In 1985 Mark Leckie and James Kirkland conducted an intensive survey of the park's Mancos Shale to determine distinctive layers of the 2,000-foot thick formation.

The team trenched the entire 2,000 feet from the Dakota Sandstone to the Point Lookout Sandstone. This ambitious undertaking provided a means to delineate between members and associated fossils. The analysis was supplemented by gamma ray analysis. A comprehensive report was produced. The study was followed by a tour here by the Colorado Geologic Society.

4. **Point Lookout Sandstone Structure in Southwest Colorado.** In 1985 Robin Wright examined the entire thickness of Point Lookout Sandstone on Point Lookout, the location of the type locality. The Four Corners is considered an area of onlap and offlap of the shallow inland sea during Cretaceous times.

The interbedding of sandstone and shale layers was examined and measured. This was accomplished as the researchers rappelled off of Point Lookout.

5. **Geologic Fuel Resources of Mesa Verde National Park.** Alexander Wanek of USGS completed this map and report in 1959. His work touches on all phases on the area geology and his map includes igneous outcrops, alluvial deposits, and the four major formations of the area.

This work has served as the primary publication of Mesa Verde geology to date.

6. **Quaternary Terrace Digital Map.** Michael Fortwengler, funded by the NPS Geologic Resources Division, produced a computerized map of three terrace layers that represent Quaternary landforms. Dr. Mary Gillam assisted with this work. Michael used digital photos, updated aerial photos, and video photos to complete his work in 1998.

Fortwengler, Gillam, and Colyer also made three trips onto the high terrace on Weber Mountain that correlates with the Boulder Nest. This large terrace runs up East Canyon, up Weber Canyon, up Mancos Canyon, along the park's North Escarpment, and down the Mancos Canyon as far as Grass Canyon. Presently it is believed to have been formed by a series of landslides. Its level may have been controlled by the Point Lookout Sandstone in the stream channel of the Mancos River. Aging of the terrace remains to be accomplished. A video of the entire bench along the escarpments was filmed from a helicopter. A report was written describing the bench building process that is thought to entail landslides onto an ancient floodplain. The Boulder Nest is an example of this major bench feature.

7. **Entrance Anticline Study.** In 1992 Bill Orgish, a local miner and geologist, surveyed the position of Dakota Sandstone in terms of water table. This level relates to the small north-south anticline in the Entrance Area. The survey ran along U.S. 160.

Orgish found an uplift of the Dakota Sandstone of about 300 feet topping out at the Entrance overpass. The beds then fall toward Mud Creek before resuming the dip to the LaPlata Mountains of approximately three degrees.

8. **Drill Records of Gas Wells in Entrance Area.** Beginning in the 1930's Fred Haller drilled three wells in an attempt to hit water just east of the Entrance. Instead he hit natural gas and since that time several other wells were drilled to extract gas. The park staff has begun the process of examining these records to determine the depth of the Dakota Sandstone. This work relates to the Entrance Area anticline.

This work is in the initial stages in early 2000. Some of these records are available on microfiche at San Juan College in Farmington, New Mexico.

9. **Soils Map.** The Natural Resource Conservation Service was contracted to map park soils in 1990. At the Entrance Area they drilled and sampled the soil for chemical testing. The data is presently being entered into GIS.

During this work the soil scientists found the soil in the sagebrush valley just south of the Entrance Station to be 30 feet deep. This is unusually deep and, according to their experience, this valley should be grassland. Also, during this survey the NRCS recommended against construction of the visitor center in the saddle just west of the Entrance Station. This was the first proposed site because of the spectacular view. The soils specialists concluded that Mancos Shale would not provide a stable setting for large construction.

10. **Soil Testing.** Chemical analysis of park soils has been part of the Natural Resource program since 1985. Soils are sampled from representative major geologic outcrops and habitat types. Also, soils are sampled in relationship to special plant sites. The analysis includes a routine chemical package plus heavy metals and selenium.

In the Entrance area we have sampled the sites near the plant production plot, the fossil oysterbed shale layer, the floodplain below the Boulder Nest, and the hill where the wild hollyhock grows. The production plot soil, which is at the southern end of the brome field, is an admixture of Point Lookout Sandstone and Mancos Shale and shows a relatively normal chemical balance for plant growth. As would be expected, the oyster layer is high in calcium. The wild hollyhock hill's soil, which was sampled five years after a fire, was still high in nitrogen, phosphorus, potassium, and also was high in selenium and strontium. The Boulder Nest floodplain showed extremely high readings of heavy metals and salts. The areas listed above all represent various layers or mixtures of the Mancos Shale, an marine deposit that is known to show high salt levels and to be very corrosive to metals. Mancos Shale also has high levels of selenium and can be detrimental to wildlife when water from the shale layers is impounded, thereby concentrating the selenium. Also, selenium readily leaches out of Mancos Shale based soils when irrigated as has been shown in Mancos Valley fields.

So not only does Mancos Shale show various undesirable traits for building, such as swelling, shifting, and erosion, it also has several chemical properties that must be recognized in planning to reduce on-site and down-stream adverse impacts to water quality and biota.

CLIMATIC ENVIRONMENT

1. **Hygrothermograph Station.** In 1994 the park installed a hygrothermograph monitoring station to relate temperature and humidity to the Chapin Mesa weather station. We had no staff to maintain an official weather station there.

The hygrothermograph data indicated that the Entrance Area is wetter and warmer than the Chapin Mesa weather station site, which is at the same elevation. According to local homesteaders of this area, Hallerville Ridge, as the Entrance Area ridge is called locally, generally receives more precipitation than the Mancos Valley and Montezuma Valley. Also, it stands to reason that the ridge would experience good cold air drainage. According to these early farmers, the dryland farming and gardening was excellent in this area. The Stevenson Family, Haller Family, Mallet Family, and Allum Family were the people who lived in this area.

Soil Temperature/Moisture Stations. In 1984 the Soil Conservation Service (NRCS) assisted park Natural Resource staff in installing a soil temperature and moisture monitoring station in a pinyon-juniper woodland site near the entrance picnic area. In 1994 park staff installed two more soil temperature/moisture stations. One was on a steep south-facing slope of the northwest shale hill and the second was on a steep north-facing slope of the same hill. All stations are in half shade. At all stations, gypsum probes measure conditions at depths of 4 inches, 12 inches, 20 inches, and 40 inches. Readings were taken monthly until 1998. Since that year readings were taken in April at the time of high moisture, through the summer, and also in the late fall.

The base Entrance Area monitoring station is located in deep loam underlain by Mancos Shale, which retains moisture. This station has shown deep moisture to be held at 40 inches for several years, even through a year of extreme drought in 1996. The loam layer readily absorbs the moisture and also releases moisture to plants. The moisture readings were higher here than at the Chapin Mesa station at the same elevation. This correlates with the increased precipitation along the Entrance ridge. The results of the south facing slope station had interesting readings. Temperatures were 5 to 7 degrees Fahrenheit warmer than the Entrance base station, but the moisture was maintained at an unexpectedly high level. This was due to the bentonitic nature of the soil that holds moisture and because of the sparse vegetation. The north-facing slope had similar readings as the base station.

WATER RESOURCES

1. **Water Quality Program.** Natural Resource staff began a water quality sampling program in 1983. Water Site 73 by U.S. 160 in the Entrance Area was one of the five standard sites that would be sampled annually for chemical analysis. This water site was chosen to represent Mancos Shale. In 1993 bacterial analysis was added and the site was sampled once annually. Other natural springs in the Entrance Area, such as at the base of the Switchback Road below the Boulder Nest and in gullies along the waterline to the west, have similar readings. Water flow rate has been measured at these water sites periodically over the past fifteen years.

Water Site 73, along U.S. 160 west of the park entrance, may have a warm water source. In January 1992, when the air temperature measured 5 Fahrenheit degrees below zero, the spring head had no ice, measured 33 degrees Fahrenheit, and had a lush growth of green algae. The readings here and at other lower Mancos Shale springs show an extremely high mineral content. Iron, magnesium, calcium, chlorine, sulfate, manganese, zinc, nickel, strontium, chromium, and boron are particularly high. The pH is nearly neutral at 7.0. The bacterial analysis ranges greatly depending on the year and conditions. The total count of coliform bacteria ranges from 190 to 24,000 per 100 milliliters. The count of fecal bacteria ranges from 7 to 50 per 100 milliliter. Also, we have noted that the only invertebrates in Water Site 73 is surface water striders. Apparently the water is so highly mineralized that aquatic invertebrates are restricted. This water site supports a rich growth of sedges, rushes, and cattails. Animals such as deer, coyotes, blackbirds, Lincoln sparrows, and certainly others use the water. A study of this water site would be of particular interest to determine the source of such a considerable flow and with a warm temperature association. The spring is in a gully that runs north into the dip. What interrupts the water table here to bring this spring to the surface is not known.

2. **Floodplain Survey and Water Site Review.** In 1994, the Natural Resource staff requested Technical Assistance from the Water Resources Division. Two technicians visited the Entrance Area. One examined the potential of high runoff on areas adjacent to the shale hills. The other examined three water sites in the area and considered the possibility of alteration of these water sites if the proposed visitor center were constructed.

In regard to the floodplain study it was recommended that no construction be done within a quarter mile of the shale hills or in gully drainages since Mancos Shale is relatively impermeable and experiences high runoff rates. Also, it was pointed out that a large parking lot and building would add to flooding concerns. The study also recommended against the proposed water tank that was to be placed on the south-facing slope of the southwest shale hill. This site would be unstable for the tank, roadway, and pipeline.

The water site survey recommended that no water disposal be discharged to the west since this might alter Water Site 73.

FLORAL RESOURCES

1. **GIS Vegetation Map.** Dr. Lisa Floyd-Hanna completed the park vegetation map in 1992 delineating 16 vegetation classes. The map was accomplished using satellite photos and ground surveys for species composition.

The satellite photo originally had 64 classes, but this was consolidated to 16 classes. In the Entrance Area particularly, this was a serious loss of information due to the reduction of classes. Within the area's two square miles we find six major native plant communities. These are pinyon-juniper, Gambel's oak, fendlerbush stands, mountain shrub stands consisting of four deciduous shrubs, sagebrush valleys, and shale barrens with a sparse cover of buckwheat and saltbush. These communities are distinct and, in this area, they are very important components of the environment.

2. **Plant Relevés.** In 1992 Natural Resource staff began running plant relevés in the various plant communities of the Entrance Area. A relevé is an efficient method to quickly determine species composition and relative cover in non-permanent plots.

The relevés gave us data that pointed to the diversity and distinction of the seven major plant communities in the Entrance Area. These are the six listed above plus the introduced brome field adjacent to the park road. From this data we were able to make important correlations with faunal uses of the area. These studies also took into consideration several areas of plant association with particular layers of Mancos Shale. Some of these very tight associations are listed below:

<i>Juana Lopez topped with sandstone</i>	<i>Pinyon-juniper</i>
<i>Above oyster layer</i>	<i>Mormon tea</i>
<i>Below oyster layer</i>	<i>Patterson's milkvetch</i>
<i>On oyster layer</i>	<i>Narrowleaf buckwheat</i>
<i>Lower Juana Lopez</i>	<i>Littlehead clover</i>
<i>Lower Mancos Shale, salty</i>	<i>Greasewood, two groove milkvetch</i>
<i>Base of shale hills, water concentration</i>	<i>Gambel's oak</i>

Other relevés have given us data on the following stand types that are not found anywhere else in the park. The dense stands of Gambel's oak that ring the shale hills due to concentration of water percolating down from the steep slopes are somewhat different than Gambel's oak on top of the cuesta. In this case the oak is so thick that there is almost no understory and it is almost impossible for a human to penetrate. The mountain shrub complex here is the finest example of that vegetative community that can be found anywhere. The mixture of Gambel's oak, Utah serviceberry, mountain mahogany, and fendlerbush reaches heights of twenty feet and also has relatively large diameter stems. Both of these vegetation types afford cover for songbirds, cottontail rabbits, and unknown species of mice. The relevés also gathered data on the shale buckwheat and saltbush community that is found on the steep shale slopes. Salina wildrye and some forbs that are not found anywhere else in the park are part of this vegetation type. In this type the total

vegetative cover is less than 50% except during wet springs when a variety of annuals appear for a few weeks.

3. **Permanent Plant Plots.** As part of a park-wide study called the Plant Production Study, a plant plot was set up in a sagebrush slope in the Entrance Area. The Plant Production Study relates soil types, annual climatic conditions, and elevation. The entire study entailed twelve plots throughout the park. The Entrance Area plot was monitored from 1987 to 1995. This plot was discontinued because smooth brome had invaded the plot to such an extent that the original purpose could no longer be pursued. Because we wished to continue monitoring the Entrance Area soils and climate, in 1996 we set up a new Plant Production plot in the large west sagebrush valley where smooth brome was not present.

The species composition of the Entrance Area Plant Plot included understory species that were not found in any other plant plot. These were New Mexico groundsel, Arizona gumweed, meadow needle-and-thread grass, and prostrate low penstemon. Also, it had a high density of yarrow and no cactus or yucca. Over the fourteen years of monitoring, grass had increased, indicating that it was trending to a higher sere of more grass and less sagebrush. According to the Natural Resource Conservation Service, the deep, rich soil valleys that we find in the Entrance Area should support grassland. Cattle grazing was terminated in the Entrance Area in 1964; however, the west sagebrush valley was still being impacted by trespass sheep grazing until 1995 when a fence extension was built.

4. **Non-native Plant Listing and GIS Mapping.** In 1994 a list of all non-native species was prepared. The list included common name, scientific name, year of appearance, approximate acreage, location, source, and treatment (if treated). The list included species within the two square miles of the Entrance Area and also species along U.S. 160. The list was updated in 1999.

There presently are 22 species of non-native flora in the Entrance Area, more than anywhere else in the park of the same acreage, except along the Mancos River where seeds readily float from the Mancos Valley down the river. Twelve of the non-native species in the Entrance Area are known to have come from highway and waterline revegetation programs; two of the species are known to have come with road gravel; and the rest are of unknown origin or accidental. The presence of livestock and residential, commercial, and other developments on the Entrance Area also contribute to high numbers of invasive alien species.

In 1998 and 1999 Natural Resource staff began GPS mapping disturbed and weedy areas of the Entrance Area and along the Switchback Road. Due to technical difficulties of satellite reception under Point Lookout, not all of the data was transferable for mapping. This work is continuing.

5. **Non-native Plant Control.** Beginning in 1994 we began control of non-native plant species within the Entrance Area. Both chemical controls and biological controls were employed.

Park staff applied herbicides on musk thistle along the newly installed waterline in the Entrance Area. We hired two contractors to spray musk thistle, Canada thistle, diffuse knapweed, and spreading pepperweed. This is an ongoing program since the problem persists. Dr. Deborah Kendall was contracted in 1995 to release the musk thistle crown weevil along the waterline in the western portion of the Entrance Area. Monitoring has shown a 70 percent reduction of musk thistle in the sagebrush valley where the insects were released.

6. **State Champion Utah Juniper Tree.** In 1993 during a session hand picking native seeds for revegetation, Natural Resource staff located a huge Utah juniper tree only about a hundred yards west of the park entrance kiosk.

This tree measured 5 feet and 2 inches in diameter and 42 feet tall. Other measurements included crown circumference, number of major limbs, general health, and environmental setting. Measurements were sent in to the Colorado State Forest Service and we received a report back stating that this tree in the Entrance Area is the state champion Utah juniper. Another Utah juniper only slightly smaller was found a year later at Rock Springs.

7. **Tree Ring Dating of Entrance Area Trees.** Beginning in 1988 Natural Resource staff began dating trees of special interest, either those of exceptionally large size or of other interest. We sampled some very large trees: Utah juniper, Rocky Mountain juniper, and pinyon pine, on the waterline along the Switchback Road, along the waterline to the west, and also along an old road. A very large serviceberry and a couple of oaks also were sampled.

The results of the sampling were astounding. The dates of trees with a two to three foot diameter ranged between 600 to 900 years old. In the oyster beds where these old trees grew, competitive vegetation cover is sparse with much barren ground between the trees and apparently it will not carry a fire.

8. **Fire History in the Entrance Area.** Dr. Lisa Floyd-Hanna and Dr. William Romme did very little fire history in the Entrance Area when they conducted their study from 1991 through 1993. However, we do have modern fire records that date back to 1928 and we have some information on lightning strikes. The first recorded fire in the Entrance Area was in 1936.

Between 1928 and 1999 the park has responded to 22 fires in the Entrance Area. In 1951 28 acres burned from a human caused fire that was started on private land bordering the park on the east. In 1994 lightning started a 10-acre fire on ARAMark land north of the park. Twenty-one of the fires have been single tree or less than 1-acre fires. Natural Resource staff have surveyed about half of these fires for post-fire plant and animal recovery. The plant species of highest interest is the wild hollyhock, a Colorado State-listed Threatened and Endangered Species, which is a fire obligate.

9. **Seed Source for Meeker Plant Center.** Seeds of four species have been hand-picked in the Entrance Area for seed propagation under a National Park Service contract at the NRCS

Meeker Plant Center. These species will be used for revegetation along the park entrance road in Mancos Shale areas.

The following plant species were collected for seed propagation for later revegetation of Mancos Shale areas, during Federal Highways projects: Blazing star, Hayden's gilia, Salina wildrye, Four-winged saltbush, Blueleaf aster, and Patterson's milkvetch. The shale hills, being nearly inaccessible for historic livestock grazing, are a primary source of salina wildrye, which has been extirpated from most of its historic range in Southwest Colorado.

10. **Wild Hollyhock Survey, a Colorado Threatened and Endangered Species.** In the 1930's the wild hollyhock, *Iliamna rivularis*, was collected in the Entrance Area and in Navajo Canyon. Since then we can not find this species in Navajo Canyon and find five very small relic populations and one large population in the Entrance area. In 1994 we learned that plants of this genus are fire obligates and this provided us with a new tool to attempt to locate this very rare species.

The wild hollyhock is a fire obligate and thrives on certain kinds of disturbance. Beginning in 1995, we set up a program to survey recent wildland burns. After contacting seven prominent botanists, we found no recent records of this species in Colorado. In "Plants of Colorado," by Craighead (1955), this species is listed as common in Colorado, but apparently the populations have been severely reduced. Since some species of this group are sought after by cattle, we suspected cattle grazing might be an important factor in the reduction or elimination of the wild hollyhock. In our surveys we found six extant populations of wild hollyhock in the park. Four of these were on very steep slopes that would have been inaccessible to cattle during the early decades of this century when cattle grazing was prevalent in and around the park and throughout the county. Five of the populations were where roadwork or natural slumping had triggered seed germination. The sixth, and largest, was at the site of a 5-acre fire, known as the 1995 Slide Fire. Here we found the wild hollyhock was the dominant understory plant under a dense stand of oak sprouts on a steep north-facing slope.

Based on our extreme luck of finding such a tremendous stand of wild hollyhock in the Slide Fire, we began surveys of other burns in the Entrance Area. None were found in the other burns, but these areas were relatively level and accessible to historic grazing. In 1998 the park road crew gave us another bonus clue. In the spoils dirt that had been hauled from the Big Hill grew a single and beautiful wild hollyhock plant in Morefield Canyon below the sewer lagoons where the dirt had been dumped. This told us that there was a seed bank along the east escarpment. Our next objective is to collect seed of the wild hollyhock, experiment with germination, and attempt to restore it in Mancos Canyon, and elsewhere, where we believe it was eliminated by past grazing.

11. **Waterline Compliance Mitigation.** Beginning in 1992 and over a period of four years Natural Resource staff surveyed the entire waterline from the West Mancos Canyon water intake to the north end of Chapin Mesa. All species of concern, large and old trees, geologic features, paleontologic resources, water resources, and mitigation needs, such as fencing and weed control, were noted. The park staff also assisted with revegetation, such

as making seed mix recommendations, supervising seed collection, drilling seed, and supervising tree salvage, tree storage, and tree planting.

Resource concerns were reported to the project supervisor and the project engineer. This included several plant species, old trees, very large anthills that are thought to be decades old, nesting raptors, and water resources. Waterline facilities within the Entrance Area are the water treatment plant, the raw water line, and three branches of the main line, all of which underwent construction and required compliance, mitigation, and revegetation from 1990 through 1996.

12. **Compliance for Newly Acquired Land.** In 1998 Natural Resource staff surveyed 35 acres that had been acquired at that time by the Mesa Verde Foundation as a potential site for the Mesa Verde Cultural Center and visitor contact station. The land was thoroughly surveyed for any natural resources of concern.

This land had been heavily grazed for many years and much of the vegetative cover had been altered into an unnatural condition. We learned that the USDA Seed Bank Program planted this land in 1965. A good stand of several non-native dryland species had been planted there and grazing had been prohibited temporarily to allow for establishment. By 1971 the land was being grazed year around by horses and cattle. Rabbitbrush and sagebrush began invading the land and the grass cover was reduced to non-native smooth brome in a sparse cover. It must be said that prior to this program the land had been plowed and planted to wheat annually. At this time there already was little left in the way of native understory species. The primary natural resource concerns here include the partial blocking of an important wildlife corridor between the park and the LaPlata Mountains and also between north facing slopes, south facing slopes, and sagebrush valleys. The species of concern that we found during the survey is an occupied nest site of a sage thrasher. Sage thrashers are relatively rare in the Four Corners area and are associated with sagebrush flats. It is not known if sage thrashers nest here regularly or in any numbers.

13. **Species of Concern Map.** In February 2000 Natural Resources prepared a species of concern map relating to the Entrance Area.

Twenty-one floral, faunal, water, and geological resources are plotted on the map. This project relates to 18 years of data collection. Floral species on this list are:

- | | | |
|----------------------|--------------------------|---------------|
| • Wild hollyhock | Iliamna rivularis | State T & E |
| • Western wallflower | Erysimum inconspicuum | Park concern |
| • Littlehead clover | Trifolium gymnocarpum | State concern |
| • Red elderberry | Sambucus racemosus | Park concern |
| • Purple elderberry | Sambucus coerula | State concern |
| • Squaw-apple | Peraphyllum ramocissimum | State concern |

FAUNAL RESOURCES

1. **General Faunal Surveys.** Natural Resource staff made 47 field trips into various locations of the Entrance Area to conduct natural resource surveys. These surveys were directed to seasonal uses. All species were noted. Other natural resource issues were noted as well. Listed below are some of the faunal highlights of these surveys, which took place from 1986 to 1999.
 - a. *Cooper's hawk*—nesting territory; one site at the base of the Switchback Road, moved to a Douglas-fir grove north and under Mancos Overlook in 1999.
 - b. *Cooper's hawk*—a second nesting territory was found west of the Entrance Area along the waterline by Gully I on the waterline to the west.
 - c. *Golden eagle*—nesting territory; cliffs above the Boulder Nest and along the Knife Edge Trail cliffs; frequently seen hunting or soaring along the shale hills that run from Point Lookout to Summit Ridge.
 - d. *Swainson's hawks*—roost and hunt all along the foothills north of the cuesta during fall migration in October; we rarely observe Swainson's hawks elsewhere or at other times of the year.
 - e. *Northern harrier*—hunting ground; male and female seen throughout the year; nest site may not be far away.
 - f. *Short-eared owl*—possible nesting in gully bank east of Entrance Area; short-eared owls are rare in Southwest Colorado; the owl was seen flying from the gully cavity in 1985.
 - g. *Wild turkey*—a lek half mile north of U.S. 160; nest site along waterline to the west at Gully III; observed 1996 through 1999; wintering grounds are in fossil oyster beds east of Entrance Area.
 - h. *Sage thrasher*—a nesting territory in the newly acquired land east of the Entrance Area.
 - i. *Loggerhead shrike*—uncommon, on low ridges in dryland brushland west of the Entrance Area.
 - j. *Lazuli bunting*—occasionally nest in sagebrush savannas of the Entrance Area; rare on the cuesta; otherwise known in Mancos Canyon.
 - k. *Pinyon jay*—pine nut collection territory and caching grounds; high pinyon cover that often produces nuts; nuts are cached on steep south faces of shale hills; 50 to 200 pinyon jays seen working the area regularly over many years in September and October.

- l. Rosy finch—feeding grounds; flocks ranging from 20 to 300 rosy finches feeding on snow free south facing slopes during the winter.*
- m. Red fox—are occasionally seen here; red foxes are associated with the irrigated and riparian lands in Mancos and Montezuma Valleys.*
- n. Kit fox—are found on the shale hills that are almost never inhabited by coyotes; coyote tracks, signs, and sightings are almost always associated with the sagebrush valleys; the shale hills and ridges afford a haven for the kit fox, which is on the Colorado Watchlist.*
- o. Mexican vole—has been collected from the western wheatgrass/prickly pear grassland savannas; Mexican voles are Hypsithermal relics here, vestiges of a warmer period.*
- p. Abert squirrels—live in the dense pinyon-juniper woodlands in the Entrance Area where pinyon pines attain 50 percent cover and Utah juniper is much less; this type of woodland is adjacent to the shale hill bases; Abert squirrels are usually associated with ponderosa pine forest and their presence in the Mesa Verde pinyon woodlands is a noted anomaly for mammalogists.*
- q. Cottontail rabbits and blacktail jackrabbits—are cyclically abundant in the sagebrush valleys; during peak years the fresh droppings of these two animals are ubiquitous. There are few other places in the park where we find such a high density of lagomorphs as we find in the sagebrush valleys of the Entrance Area.*
- r. Elk—are found under the Big Hill area where a herd of eight took up year around residency in 1997. A herd of twelve became established under the North Escarpment just west of the Entrance Area following the heavy snow winter of 1979.*
- s. Mule deer—see #2 below.*
- t. Black bear—are seen in the Entrance Area annually from spring through the fall; this area certainly serves as a corridor along the shale hills to Summit Ridge; we also have found well developed day beds and concentrations of scats; in one case we found eighteen grass scats and two years in a row we found fifteen to twenty squaw-apple scat; we frequently find bear tracks at Water Site 77 along the eastern boundary of the Entrance Area.*
- u. Mountain lion—at least one or two live in the Entrance Area year around; this is reasonable because the deer also live here year around; a large male has been seen here for eight years, from 1992 to 2000; a female with cubs has been seen here occasionally; during the past ten years two mountain lions have been hit and killed on U.S. 160 in the Entrance Area, which again points to the importance of this migration corridor.*

- v. *Prairie rattlesnake*—are abundant near the Entrance parking lot, on the southeast shale hill, and also along the waterline directly west of the Entrance Area; we have observed up to four per quarter mile in all of these locations; their high population density is probably related to the high density of various rodents; the sandstone boulder caprock on the shale hills also provides denning sites.
 - w. *Collembola springtail*, or snow flea—are abundant throughout the Entrance Area; it is not uncommon to find over a hundred in a single deer print in the snow; these primitive insects are rarely seen on top of the cuesta and are almost never seen in other habitats in Southwest Colorado; we do not presently know what there is about the Entrance Area that is so favorable for *Collembola*.
 - x. *Scorpion*—have been found living in dry cracks of the Mancos Shale; although a few have been found on top of the cuesta, they are more frequently found in Mancos Shale terrain.
 - y. *Jerusalem crickets*—were rather commonly seen during the waterline surveys; we saw young and adults.
 - z. *Carolina wolf spiders*; also are rather common in the Entrance Area; they also are seen in Mancos Canyon and rarely seen on top of the cuesta; we believe that they prefer sandy or sandy loam soils for burrow construction; this large spider has suffered habitat reduction all over the Southwest.
2. **History of Mule Deer in the Entrance Area.** Park staff have maintained records of mule deer counts in the Entrance Area from 1960 through 2000. For the past 20 years, park staff also has recorded deer killed on the park road. For the past 12 years park staff also have recorded deer killed on U.S. 160. In 1978 three graduate students conducted separate studies on the movement of the deer; the second study related to density of mule deer; the third study related to habitat association of mule deer and these studies included deer in the Entrance Area. One study related to seasonal movement and habitat use.

Park records show that the mule deer population in the Entrance Area has dropped dramatically during the past 40 years. During the 1960's the spring and fall counts of from 50 to 70 deer were regularly made in the valley adjacent to the park road. During 1970 this number had dropped to about 40 deer in the same area. During the 1980's the average was from 30 to 35 deer. In the 1990's, especially after the hard winter of 1993, the number was 15 to 20. By 2000, the average number of deer here was fewer than 10 deer. This drop is thought to be related to human development in the wildlife corridor that connects the mountains and the Entrance Area that generally follows Summit Ridge. Also it is related to the increase of road kills along U.S. 160 due to increased traffic. Over 200 mule deer are killed annually between Mancos and Cortez. Another 40 to 50 are killed on the Summit Ridge road.

3. **Small Mammal Survey.** In 1992 and 1995 Natural Resource staff conducted small mammal surveys in four habitat types in the Entrance Area. The habitats sampled were pinyon-juniper woodland, grassland, sagebrush valley, and shale hill saltbush-buckwheat.

Trapping in the Entrance Area produced high species density and high species diversity. We had 18 to 25 percent trapping success rates compared to a usual success rate of 3 to 5 percent over the rest of the park. Five species of rodents were taken, which is a relatively rich mixture.

4. **Mexican Vole Study.** In 1997 Natural Resource staff collected specimens of Mexican vole from grassland savanna within the Entrance Area. These were sent to Dr. Mike Bogan for identification. Mexican voles are Hypsithermal relics from a past warmer period. The Mexican vole occurs in several isolated populations found from southern Arizona to the Four Corners area.

On the Mesa Verde cuesta, Mexican voles are found in canyon heads and in the sagebrush valleys of the Entrance Area. During the survey, vole runs were counted across a 5-acre area. We found a density of 23 systems per five acres. Also, we noted that Mexican voles constructed a grass nest nine inches below the ground surface 60 percent of the time and used tree trunk or root crown cavities for nest sites 4 percent of the time. Western wheatgrass, wild onion, and goldeneye were the dominant floral species within the five acres.

5. **Abert Squirrel Inventory.** During the 1980's we received several dozen sighting records of Abert squirrels in the pinyon woodland of the Entrance Area. In response to these sightings Natural Resource staff conducted a survey to determine density and limit of occurrence in this atypical habitat. Abert squirrels generally are associated with ponderosa pines, which have naturally lower terpene levels than do pinyon pines.

During the 1980's when precipitation was well above average, Abert squirrels were fairly common in the pinyon pine stands in the Entrance Area and along the high terrace along the North and East Escarpments. During this time of high precipitation the terpene levels may have been lower making the pinyon edible for the Abert squirrel. During the 1990's, when we had alternate wet and dry years, there were fewer signs or sightings of Abert squirrels in pinyon habitat.

6. **Small Mammal Survey.** During the Wetherill Mesa Archeological Project of the late 1950's and early 1960's, Charles Douglas was hired as the park zoologist. As his doctorate study Douglas conducted a small mammal survey throughout the park. Of his seven major study sites, the Entrance Area was selected to represent the sagebrush/pinyon-juniper habitat of the cuesta escarpment.

Seven species of small mammals were captured and identified from the Entrance Area during this study. Douglas found the density to be moderately high.

7. **Reptile and Amphibian Study.** As part of the park-wide herpetofauna study of 1997, Dr. Albert Spencer surveyed the Entrance Area and west of the Entrance Area. This survey

included pinyon-juniper woodland, sagebrush valleys, gullies with rocky slopes, and also a Juana Lopez shale ridge. Dr. Spencer also tabulated park records that span from 1982 to 1999. The resultant data was correlated with reptile habitat associations.

Dr. Spencer found the following herpetofaunal community.

- | | |
|-----------------------------------|-----------------------|
| • Sagebrush lizard | <i>abundant</i> |
| • Plateau lizard | <i>common</i> |
| • Striped whiptail lizard | <i>rare</i> |
| • Short-horned lizard | <i>abundant</i> |
| • Western terrestrial gartersnake | <i>locally common</i> |
| • Gophersnake | <i>uncommon</i> |
| • Rattlesnake | <i>common</i> |

The single striped whiptail lizard was found on the rocky bank of a gully that runs water intermittently. A single Woodhouse toad was found a mile west of the Entrance Area in a sagebrush flat, a half mile from any permanent water site. We have 1970's records of tiger salamanders breeding in a natural pool that was on the Boulder Nest terrace until 1978 when the pool was obliterated by road maintenance efforts. Also, we have records of tiger salamanders in the side drainages of Mud Creek.

8. **Non-native Faunal Reports.** Wildlife observations have shown the Entrance Area to have more species of non-native fauna than any other portion of the park. Natural Resource staff maintains records of all wildlife sightings and these are itemized in each of the park's Annual Reports.

The following species have been seen in the Entrance Area during the years from 1985 through 2000. Fortunately, either these species do not persist or they are transient within the park boundaries. As development increases outside the Entrance Area of the park, alien fauna will become more abundant, more species will become established, and some may begin breeding within park lands. The following species have been recorded.

- a. *Emus—over 50 emus were released by a private party six miles west of the park in November 1997; three of these entered the park Entrance Area, one was chased away, one perished, and the third one moved on. Two more emus trampled a trail along the park fence on the west side of the Entrance and apparently these two, along with the remainder, did not make it through March and April, which was unusually cold and wet. Two of the emus were shot by Russell Hindmarsh, whose land is a mile west of the Entrance, because he did not want them tearing his fences down and three others were shot farther west and they were butchered for the meat.*
- b. *Rock doves—an average of 70 rock doves are bred in a housetop about one mile east of the Entrance. These birds occasionally fly over the park lands and although never have been seen to land in the park, we have witnessed a peregrine falcon, no doubt from a local park eyrie, diving at the flock of rock doves.*

- c. *European starlings*—an average of 15 starlings inhabit the Stevenson farmstead and feedlot adjacent to the park on the northeast corner. These birds have not been seen over the park, but if they move into cavity nest sites in the park pinyon-juniper woodland, they can become a serious problem for native cavity nesters.
 - d. *House sparrows*—a small flock of these non-natives have been observed at Kampark. They are not expected to enter the park often in its present condition, but if the Cultural Center is constructed, it is likely that they will inhabit the parking lots to gather food scraps.
 - e. *Peafowl*—a single peacock was seen in 1997 at the Entrance Area. It may have come from a nearby residence. It was seen only one time.
 - f. *Alligator*—a single six-foot alligator surprised the proprietors of Kampark in August 1996. Apparently it had escaped from a camper and was seen running loose on the edges of the camping area. Someday we may find skeletal remains of this animal. In the meantime, no one knows where this animal went, but it is unlikely to have survived a winter on its own.
 - g. *Domestic sheep*—Over the past 20 years we have found remains of three domestic sheep in the Entrance Area. Stanley Hindmarsh runs sheep on his land west of the park and these probably were from his land. Even though the Entrance is fenced with field wire, the animals may enter the park via several washed out gullies. Predators may have killed the sheep or they may have failed to locate water in the park.
 - h. *Feral cats*—Over the past 20 years we have known of approximately 20 feral cats that persist in the park for two to five years each in the Entrance Area. One female produced a litter of four kittens in a woodpile of the Entrance house. Eventually these cats disappear, probably killed by the bobcats or other predators that are in the area.
 - i. *Moose*—A single moose was sighted by Mr. Henniman, park neighbor to the east. This animal was seen in Henniman's pasture in June 1999 and it moved over the tree-covered ridge and into the park. In August 1996 a bull moose was observed crossing U.S. 160 and moving into the park at Water Site 73. Colorado Division of Wildlife had released 20 moose at Creede, Colorado the previous year. This was probably the same animal that had been seen from Weber Reservoir and Spring Creek at the base of the LaPlata Mountains to Towaoc and Hovenweep. It was finally captured in Cortez and returned to Creede. Since the initial release a small herd of moose have become established on the Pine River and this may be the source of the 1999 moose.
9. **Bird Surveys, Spring and Fall Migration.** San Juan Bird Survey and Natural Resource staff conducted bird surveys in 1992 through 1997. These surveys were done with a team in each of five major habitat types, one of these being the pinyon-juniper/sagebrush complex/mountain shrub complex of the Entrance Area. Bird species and densities were tabulated for each habitat type.

Species diversity was found to be higher in the Entrance Area than in any other habitat except the Mancos Canyon corridor. The area of survey ran from the Switchback Road to

the entrance trailer and along the waterline to the west. Five species of warblers, four species of flycatchers, six species of diurnal raptors, and many other species were observed. Besides the diverse niches in the Entrance Area, the other factor that brings birds to this area is their temporary rest stop as they approach the escarpments. During the fall survey we have noted during several years that this area has a high activity of pinyon nut harvest for the following reasons. All three jay species live here; pinyon trees are the dominant tree; the deep water storing clay loams allow for nut crops more frequently than some soils; and the barren south facing slopes provide a caching place for the pinyon jay harvests. We have observed from 80 to 300 pinyon jays working the area in late September and early October.

10. **Breeding Bird Survey: Species of Concern.** In 1995 Susan Allerton conducted a breeding bird survey, concentrating on the black-throated gray warbler, which was listed as a Colorado Species of Concern. This species had been put on a special listing due to impacts on its Latin American wintering grounds and also due to the reduction of the North American pinyon-juniper woodland where it nests. This study was undertaken at the request of the park.

Of five survey sites over the park, Susan found the highest density of black-throated gray warblers in the Entrance Area. She also recorded all other nesting bird species for each area. Again, the Entrance Area had a higher species diversity than any other pinyon-juniper woodland area in the park. Also, she found the black-throated gray warbler in the pinyon-juniper and mountain shrub complex throughout the Entrance Area.

11. **Breeding Bird Survey: National Program.** Beginning in 1995 Natural Resource staff joined the National BBS program. This program follows a standardized protocol to detect long-term trends of breeding birds over the United States. The survey is conducted annually at the peak of the breeding season annually.

In the Entrance Area we found an expected representation of bird species breeding in the surveyed area. However, in addition to the species usually found on top of the cuesta, we found several species that do not occur during nesting season on the cuesta or are rare there. These are lazuli bunting, western kingbird, loggerhead shrike, sage thrasher, American crow, house finch, European starling, Brewer's blackbird, and red-winged blackbird.

12. **Owl Survey.** In 1988 Natural Resource staff began an owl calling program. This program entails calling for owls at selected and standardized sites that are about half a mile apart. The calling was done monthly from January through May.

In the Entrance Area we have found great horned owls and northern saw-whet owls to the west and to the east of the park road. We have rarely had long-eared owl responses along the Switchback Road. In addition to the responded calls we record sightings each year. We have collected castings from beneath roost sites and we have found great horned owls dead on the road four times during the past twelve years near the U.S. 160 overpass. In 1987, Natural Resource staff sighted a female great horned owl and two fledglings on the eastern shale hills. The nest may have been in a shale hill cavity or in one of the 40-foot

tall pinyon trees there. There is an even greater number of owl species in upper Morefield Canyon, with the addition of northern pigmy owl and flammulated owl, and it may be that these species seasonally move down to hunt over the Entrance Area or even nest there.

13. **Turkey Leks.** Wild turkeys were reestablished in the park in February 1990. By April 1996 we knew of two leks, where turkeys gather for courtship and mating, within a half-mile southeast and a half-mile northwest of the Entrance Area. A third lek was used for one year only about two miles east of the Entrance Area. From these important locations, usually clearings and high points and with high visibility, the hens spread out, moving over a mile to nesting territories.

The park's Natural Resource staff continues to monitor the activity of leks here as well as in three other park locations. Also, we record data on nesting territories, wintering grounds, and roosts. At this time we have three flocks of turkeys, totaling from 35 to 45 turkeys, in and around the Entrance Area. The dense, tall oak brush provides acorns for winter food. The pinyon trees, which reach to 40 feet in height, which is higher than average for the park, are regularly used as roost trees. The barren fossil oyster beds of the Entrance Area are important winter grounds since they are significantly warmer than many habitats in the park.

14. **Pinyon Jay Cache Sites.** Over the past 15 years, park Natural Resource staff have observed pinyon jay flocks caching pinyon nuts in the Entrance Area. Also, we have recorded above average crops of pinyon nuts in this area where the woodland is 85 percent pinyon and 15 percent Utah juniper and also where the deep loam between the shale hills has high moisture retention.

The long-term monitoring of pinyon nut caching has been recorded. We have found that pinyon jays flocks ranging from 60 to 300 birds cache pinyon nuts on the barren, snow-free south faces of the shale hills all along the bases of the North and East Escarpment, as well as on the south face of Weber Mountain. Reportedly pinyon jays carry 30 to 35 nuts per load in their gullet. Also, we observed use of the pinyon litter under the woodland as cache sites by western scrub-jays, where they cache one to three nuts per peck hole. (Other birds that inhabit these steep, rather barren slopes are flocks of rosy finches, in flocks up to 400 birds, feeding on the snow-free faces during winters of deep snow.)

15. **Raptor Nesting and Hunting Territories.** Since 1980, Natural Resource staff have maintained records of raptor nesting and hunting territories on a park-wide basis. Including the cliffs of the North and East Escarpment we have recorded nests of six raptor species. Raptors have large hunting territories around their nests, so nest sites next to the Entrance Area represent birds that use this habitat none the less.

- a. *Golden eagle—nest site on Knife Edge at west end; known to be in use yearly from 1982 through 1999.*
- b. *Golden eagle—nest site on cliffs above Boulder Nest, using old red-tailed hawk nest; in use by eagle only in 1990.*

- c. *Red-tailed hawk*—nest sites on north and also on south ends of cliffs above Boulder Nest; in use from 1983 through 1989.
 - d. *Peregrine falcon*—an eyrie complex in the Entrance Area inside the park; in territory at least since 1978 and occupied yearly through 2000; these birds have fledged two to three young per year; in 1995 and 1996 there was also a "floating female" in the territory.
 - e. *Cooper's hawk*—nest site just outside of west boundary along waterline; nesting in tall pinyon tree.
 - f. *Cooper's hawk*—nest site at the base of the Switchback Road was occupied at least from 1990 through 1996; in 1999 we determined a new nest site in a Douglas-fir grove just north of Mancos Overlook; these may be alternating sites used by the same pair.
 - g. *Sharp-shinned hawk*—nest site just southwest of the Entrance trailer office; first detected in 1999. Also seen nesting at the Knife Edge trailhead in an oak thicket in 1998.
 - h. *Northern harrier*—a pair of these raptors have consistently been observed hunting over the sagebrush-brome valley near the Entrance gate; their nest site would be somewhere between the park road and Mud Creek judging from their path of travel.
 - i. *American kestrel*—a pair of these birds are seen frequently feeding over the Entrance Area; a nest was found in the top of a Utah juniper west of the Entrance Area.
 - j. *Swainson's hawk*—from two to five immature are seen annually in early October in the Entrance area and northeast to Mud Creek; these may be fall migrants or they may nest in the sagebrush/grasslands nearby.
16. **Colorado Bird Observatory: Habitat Study.** In 1999 Colorado Bird Observatory began a statewide program to obtain data on bird species and densities that are found in association with approximately 40 plant habitat types throughout the state.
- Susan Allerton, a local ornithologist, completed a survey of a scrub community on state land immediately west of the park Entrance Area. A total of 37 breeding species were located. This program will be repeated at regular intervals to detect trends.*
17. **Invertebrate Survey.** In 1998 through 2000 Dr. Boris Kondratieff conducted a park-wide survey of invertebrates, sampling various habitats and also the Chapin #5 Burn. His sampling includes the Entrance sagebrush valleys and pinyon-juniper woodlands. Specimens will be identified and entered into the Colorado State University entomological collection. Species lists will be sent to the park. Species collected will be identified at our request and biological significance assessments will be provided. Eventually Dr. Kondratieff will prepare a brochure to be contributed to the park that will detail some of our more interesting invertebrates. Among the associates who are assisting Dr. Kondratieff is Dr. Paul Oppler who is a world renowned Lepidopterist; that is, a specialist of moths and butterflies. Dr. Oppler has made some special surveys of the shale hills and ridges of the

Entrance Area searching for a type of butterfly that patrols high, windy points such as we find here.

During the first two years of collection over a dozen new species for the park have been found in the park and some of these have been found in the Entrance Area. In addition to this, several species that were collected indicate new range extensions.

18. **Gypsy Moth Traps.** From 1986 to 1992 Natural Resource staff installed gypsy moth traps in six park locations as a region-wide program to monitor for the possible invasion of gypsy moths. The Entrance Area and all developed areas where park visitors stop were selected for monitoring. The traps contained a pheromone intended to attract male moths and the floor of the trap was coated with a sticky entrapment surface. The traps were suspended in areas of native deciduous shrubs.

Because all visitors stop at the Entrance and because there is dense mountain shrub community here, this was an important area to check for the invasion of gypsy moths. During the seven years of monitoring no gypsy moths were detected. The nearest trapped gypsy moths were at Fort Collins on the Eastern Slope.

19. **Shale Scorpion Survey.** During the Leicke geologic study in the various layers of the Mancos Shale formation, several specimens of scorpions were reported. Following these reports, park Natural Resource staff conducted a survey of the Cortez layer to determine the association of scorpions within this shale layer.

It was found that a small gray scorpion lived in the dry cracks of the shale in the Cortez layer that outcrops in the western portion of the Entrance Area. Scorpions are rare in the Mesa Verde ecosystem. This scorpion makes use of the extensive crack system through the shale layer as a shelter and it feeds on other small invertebrates that inhabit this niche.

ORAL HISTORY

Historically, the following people have been closely associated with the Entrance Area. Marilyn Colyer interviewed them between 1980 and 1999. The audiotapes are stored at the Mesa Verde Research Center.

1. **Tom Stevenson.** Tom was born around 1910 and he lived on the family ranch near the Entrance Area all of his life. Stevenson, a local history buff, was interviewed three times and he also accompanied us on a portion of the waterline to point out certain features of the Haller-Mallet Ranch. He gave us a considerable amount of information about the gas and oil wells in the Mancos Valley and in the Entrance Area. In the 1940's, Fred Haller attempted to drill for water for Hallerville (now known as Point Lookout Service Station) and instead of striking water they found natural gas. Stevenson also told about Navajo forked stick hogans in an encampment that was inhabited during the 1930's and 1940's along the west border of the Entrance Area.
2. **Vida Haller-Mallet.** Vida was the daughter of Fred and Ida Haller who ran Hallerville. Many people who visited Mesa Verde National Park during the 1940's and 1950's stopped at Hallerville to get food and gasoline and especially to see Nehi, the bear who drank soda pop. Vida married George Mallet of Mancos. Before the Haller's were at the park entrance, they ran the Turkey Creek sawmill.
3. **Mary Mallet.** Mary, daughter of the Mallet's of the Mallet ranch in the Entrance Area, was interviewed when she was in a rest home in Fort Collins, Colorado. She never married and she was an area teacher for many years. She talked about her years growing up on the ranch.
4. **Russell Hindmarsh.** Hindmarsh is a rancher who presently runs cattle on private and BLM land west of the park entrance. Until the 1980's Hindmarsh had a large sheep herd that he wintered on the land near the park. Russell Hindmarsh and his brother Stanley have been associated with park staff, park wildlife, and other park issues from 1950's through the present. He is familiar with the historic settlement of the area, with water sites, and with other natural resource issues.
5. **Dudley Culp.** Culp's grandfather homesteaded directly west of the park entrance. This homestead was encountered during the waterline replacement. Dudley told of a jug shaped cistern at the homestead and this feature was not found during the archeological survey. Dudley was the only person that I have interviewed that knew of the Prater Trail that ascended the North Escarpment. He and his grandfather rode up it in the late 1930's and then would ride to the East Escarpment and down the Switchback Road, which was constructed in 1927-28.
6. **Nellie Allum.** Nellie currently lives about a mile east of the park entrance and she and her husband, Jack, have lived there since the 1940's. Nellie told me of fossil locations, wildlife occurrences, and historic settlement patterns. Also, she discussed how the Mancos Shale derived soil generally produced more wheat than the red loess, as her husband farmed both soil types.

7. **Les Goff.** Les was an area resident all of his life. His parents homestead under the North Escarpment, south of Cortez. Les worked on the Wetherill Mesa Archeological Project and this was followed with a decade as the park electrician, retiring in the 1980's. During the interview he talked about various developments in the Entrance Area. These include the original Entrance gate, the Entrance house, the water system and septic tank system, and the old Fred Jeep shack along the eastern border of the Entrance.
8. **Bob Bangs.** Bob Bangs finished his time in the park as Buildings and Utilities Foreman. He retired in the early 1990's. Before that he was associated with the park since the 1940's as his father worked on the maintenance staff and the family lived in the park. Bob had many historic and more recent wildlife sightings, such as the now endangered Colorado pikeminnow in the Mancos River, a lynx at the Bang's Dolores Canyon ranch in the 1940's, a snake resembling a water moccasin at the Far View sewer lagoon, and other significant sightings. Also, Bob discussed historic development in the Entrance Area.
9. **Gertrude Noland.** Gertrude was the daughter of Mr. Rickner who is considered to be the first superintendent of Mesa Verde National Park. Gertrude married Edgar Noland whose family ran the Mancos Canyon trading post and were prominent pioneers in the Mancos Valley. She served as postmistress for the Mancos post office for two decades. Gertrude told of her father traveling by horse and buggy once a week along the Knife Edge and the rest of the primitive park road in the 1920's. Also, she talked of the telephone system at the Entrance to coordinate travel along the one-way Knife Edge road. Gertrude's sister married into the Jeep family who provided the park's concession services and they obtained some of their food supplies from park neighbors in the Entrance Area.
10. **William Winkler.** Bill was the son-in-law of Ansel Hall who was the second park concessionaire. Ansel, and later Bill, owned the brome field in the Entrance Area. In fact, he deliberately planted that area to non-native smooth brome and he also constructed the reservoir at the south end of the field. Bill remembers the Knife Edge telephone system, the windmill and cellar at the Mallet ranch, and some other features of this area. He has been interviewed by telephone, but he is scheduled to be interviewed on tape in 2000.
11. **Jack Bircher.** Jack is a life-long farmer on a large piece of land to the southeast of the Entrance Area. He discussed archeological sites on his land, farming successes and failures, wildlife, and weather changes. On his land there is a large archeological site running over a hundred yards along a ridge down the East Escarpment of the cuesta.
12. **Charles and Mary Hickman.** This couple has lived for over 60 years not far from the North Escarpment. They talked about the very early attempts to settle in this area. Also, they remember seeing several live gopher tortoises near their ranch and they discussed the large herds of domestic sheep, up to 12,000 head, that were run south of Cortez to the escarpment of the Mesa Verde cuesta up until the 1950's. Charles' brother observed sage grouse near the family ranch in the 1930's and 1940's.

CULTURAL AND MANAGERIAL

1. **Cultural Resources.** During the 20 years of working in the Entrance Area we have observed the following cultural sites that may or may not have been recorded officially.
 - a. *Old boundary markers—several styles, some being very old, are in place northwest of the entrance station. These reflect purchases and boundary changes over the past 60 years.*
 - b. *Forked stick teepees—these are reported to be along the west boundary, as told by Tom Stevenson. They may not be on park land.*
 - c. *Isolated metate—a Pueblo I or II metate, ground to a concave surface, is along the north-south road, northwest of the picnic area.*
 - d. *Archeological site—in the saddle between southeast shale hill and northeast shale hill; east of the entrance station.*
 - e. *Isolated pottery shards—along a side drainage to the west sagebrush valley.*
 - f. *Historic inscription—"J.E. Sheek" is inscribed in a large sandstone boulder along the ridge between the Southeast Shale Hill and Southwest Shale Hill. The date appears to be 1910 or 1916 in August. According the Ranger John Elias Sheek, who worked in the park from 1976 to 2000, this inscription may have been made by his father. The grandfather had the same initials but he had returned to Texas before either of the possible years. John's father stayed in the Mancos area until 1919.*
 - g. *Haller-Mallet Homesite—this homestead site has been examined in depth, accompanied by Tom Stevenson who pointed out several features of the site. Tom also pointed out a post with an insulator that was part of the Knife Edge telephone system.*
 - h. *Quarried rock for the park road—a small pile of shaped sandstone, for use in the park road culvert headings, was pointed out by Tom Stevenson. This site is south of the Haller-Mallet Homesite.*
 - i. *Navajo sweathouse—(this may be recorded in the archeological site files); it is located on the east face of the southwest shale hill, about half way up the slope.*
 - j. *Water storage tank—this large water tank is not buried. It is hidden by oak brush west of the picnic area. It provided water for the temporary campground that was in operation during the 1960's in the location of the picnic ground.*
 - k. *Road workers' encampment—same as the picnic ground. This site was originally used as a camp for a road crew in 1928-29 that was working on the park road. Some of the old green and blue glass and the very old cans in this area are undoubtedly from this period of use.*

1. *Old road around north side of northeast shale sill—this road runs around the base of this shale hill and we were told by Les Goff that it went to a shack used by Fred Jeep, early concessionaire's son.*
2. **Fence Construction.** The most recent fence that protects most of the Entrance Area was constructed in 1965. However, in 1992 it was found that domestic sheep had been freely trespassing into the western valley in the Entrance Area.

Natural Resource staff obtained \$2,000 to hire a contractor to construct a fence extending south of the waterline to a steep embankment. This has prevented trespass livestock. From 1985 through 1991, a YCC crew supervised by park staff continuously repaired the rest of the Entrance Area fence.

3. **Human Development.** During the past 15 years, the lands east, north, and west of the Entrance Area have experienced considerable development. Natural Resource staff has maintained a record of development.

In 1960 there were only two permanent homesteads from the park entrance to Mud Creek. By 1995 there were 42 homesites and three businesses in the same area. During the past five years, six more homes and a new business, a snake pit called Reptile Reserve, have been added. Also, Keith Gravel Pit has been in operation on County Road 37, adding heavy traffic, sedimentation to Mud Creek, smoke from the asphalt plant, and dust to the environment. The settlement between the park entrance and Cortez has been less active, but a new subdivision began development only two miles northwest of the park. The development north of the park is an 1,800-acre subdivision called Cedar Mesa and ultimately it will have an extreme impact on the park's natural resources, especially wide-ranging wildlife such as mountain lions, black bear, deer, and elk. This subdivision of several hundred potential homesites is located on the primary corridor between the LaPlata Mountains and the park.

CONCLUSION

As is clearly the case, Mesa Verde National Park's Natural Resource staff has compiled a large body of knowledge about the Entrance Area over the past many years. The information gathered strongly suggests that the Entrance Area has many important natural features and conditions that need to be preserved. Development of the Entrance Area from within and from without on adjoining and adjacent lands will have negative impacts to the natural resources of the area, both short-term and long-term. The resources under consideration include wildlife, vegetation, natural processes, and physical resources such as air, water, fossils, soils, natural sounds, and dark night skies. Impacts to daytime viewsheds are more complicated because as one viewshed is protected under one site placement, a different viewshed is harmed at the same time. The degree of these impacts will depend on the actual site placement and design characteristics.

One of the most important concerns with major new construction in the Entrance Area is the alteration of wildlife habitat and disruptions to wildlife movements between Mesa Verde National Park and the La Plata Mountains. This is a natural wildlife corridor and critical wintering ground for mule deer and elk. This issue must be at the top of the list when considering the placement of the Cultural Center and the resulting impacts to the park's natural resources. Additionally, the routing of traffic must be planned in a manner that offers the least disruption to faunal movements and reduces the risks of vehicle collisions with wildlife.

Placement of the Cultural Center development on already highly disturbed lands would limit adverse impacts to areas where few resources persist and avoid impacts to areas that remain in a healthy condition. Therefore, placement of the site nearer the open, heavily grazed area nearer U.S. 160 would have the least impact on natural resources. Conversely, placement of the Cultural Center development deeper inside the park would result in a noticeable, but unquantifiable increase in the degree and scope of impacts to natural resources. Furthermore, there would be increased risks to the development from natural processes such as flash flooding, soil instability, high intensity wildfire, and possibly from the more frequent presence of dangerous wildlife.

Mesa Verde National Park is not an island unless we make it one. Protecting park resources does not end at the park boundary. Not only does the NPS require us to make wise choices inside the park, but also to find compatible solutions to land use conflicts outside the park. No matter what site placement choice is made for the Cultural Center, we will need to:

1. Mitigate the direct impacts to park resources caused by construction and the introduction of high visitor and employee population densities to an area that has not experienced this before, and
2. Work hard towards convincing others to maintain what's left of the Entrance Area outside the park in an open healthy condition that compliments the protection of ecosystem resources shared with the park.

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