Chapter 5. Black Canyon of the Gunnison National Monument

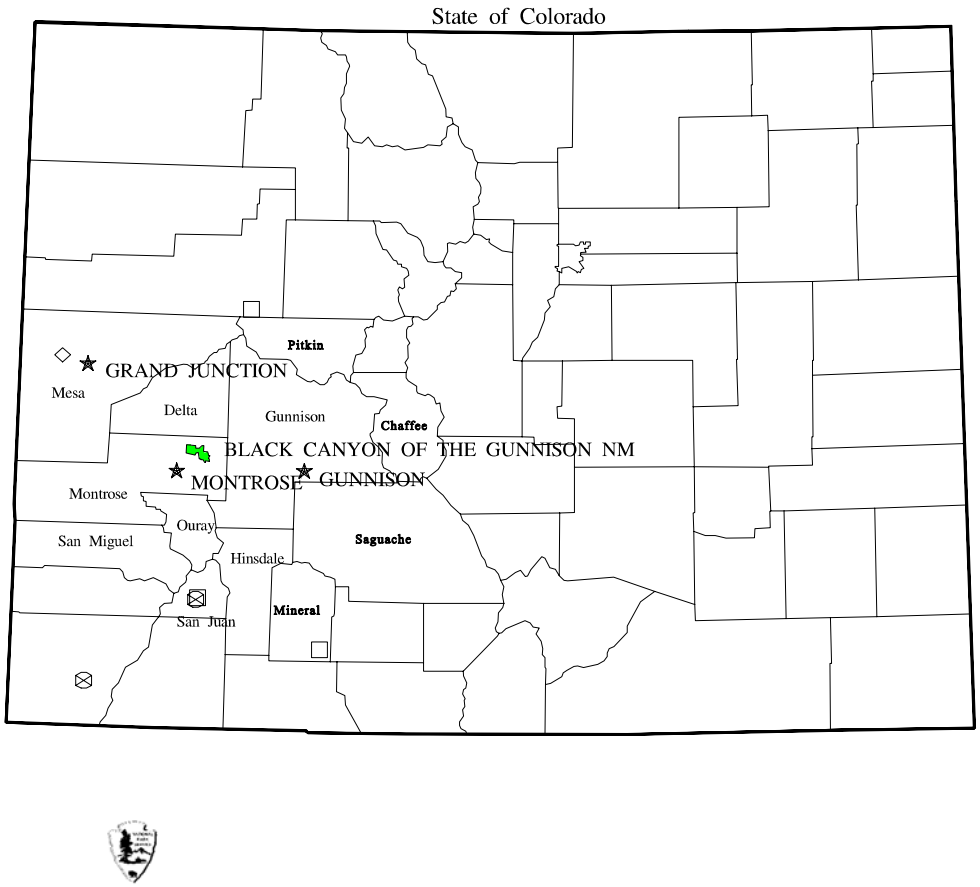
Introduction

Black Canyon of Gunnison National Monument was added to the National Park System in 1933 and today encompasses 8,407 ha, with all but 50 ha under Federal ownership (Figure 5-1). Today, 4,526 ha inside the Monument are protected as wilderness. Elevation ranges from 1660 m on the Gunnison River where it leaves the Monument to 2755 m on the North Rim. The Monument is located in west-central Colorado, about 35 km east of Montrose, on the central eastern most edge of the Colorado Plateau. The Black Canyon of the Gunnison is 85 km long, but only 18 km of the gorge lies within Black Canyon of Gunnison National Monument. The gorge averages 600 m deep with a maximum depth of 740 m. The Monument was created to protect the natural wonders of a canyon that has the "greatest combination of depth, narrowness, sheerness of any canyon in North America."

Geology and Soils

The geological history of the Black Canyon of the Gunnison is complex, with some formations dating back almost 2 billion years. Most of the exposed rock on the walls of the canyon are schist and gneiss that date to the Precambrian Era, similar to those exposed in the Grand Canyon in Arizona. These Precambrian strata experienced several cycles of burial by sediment and erosion of the resulting sedimentary rock. Only the sedimentary caps from the Triassic and Jurassic Periods remain, and these can be seen on the northeast rim region of the Canyon. During the Cretaceous Period, deposition during the advance and subsequent retreat of the Cretaceous Seaway produced Dakota Sandstone that caps mesas of the Monument, as well as the Mancos Shale exposed to the west of the Canyon. At the end of the Cretaceous, mountain building forces uplifted and tilted the region, and volcano activity in the Tertiary Period modified and shaped the landscape and the course of the ancestral Gunnison River. Eventually, the southern arc of a depressed ring-like syncline became the path of what is today the Gunnison River. In the past 2 million years the Gunnison River has cut through these Tertiary Period volcanic and Mesozoic Era sedimentary deposits and then into the harder Precambrian rock that underlies the region (Chronic 1988).

Figure 5-1. Location of Black Canyon of the Gunnison National Monument.



Soils vary across the Monument, determined in large part by geologic substrate (mostly volcanic or sedimentary). About 80% of the soils are Argiborolls and Cryoborolls (cold soils with a surficial layer high in organic matter and a deeper layer enriched in clay). In the southwestern portion of the Monument, Haplargids (clayey, dry soils) and Torriorthents (hot, poorly developed soils) are common.

Climate

The Black Canyon of Gunnison National Monument lies in the transition zone between the semidesert plateau and temperate montane climate zones. Mean annual precipitation is about 350 mm while temperatures range from -8 ^{o}C in the winter to over 30 ^{o}C in the summer.

Vegetation

Most of the Monument is characterized by a dwarf tree/deciduous shrub brushland that includes Gambel oak (*Quercus gambelii*) and serviceberry (*Amelanchier alnifolia*), with lesser amounts of mountain mahogany (*Cercocarpus montanus*), sagebrush (*Artemisia tridentata*) and rabbitbrush (*Chrysothamnus* spp.). The Pinyon (*Pinus edulis*)/juniper (*Juniperus utahensis*) community also contains the previously mentioned species and Morman tea (*Ephedra viridis*), as well as several species of grasses and forbs. A third dominant plant community in the Monument is the inner-canyon-slope community, composed of some brushland species (including some Douglas-fir (*Pseudotsuga menziesii*) and aspen (*Populus tremuloides*)) and a greater abundance of other shrubs such as fendlerbush (*Fendlera rupicola*), *Rosa* spp., rock spirea (*Holodiscus dumosus*), snowberry (*Symphoricarpos* spp.), currant and gooseberry (*Ribes* spp.) and chokecherry (*Prunus virginiana*). There are no known Threatened and Endangered Plant Species (Threatened and Endangered Species Information Institute 1993) or NPS species of concern. Species lists for Black Canyon of the Gunnison are provided in NPFlora for vascular plants and NPLichen and Wetmore (1983) for lichens.

Air Quality

Air quality monitoring for Black Canyon of the Gunnison consists of data from 1995 and 1996 for ozone (passive sampling), and camera monitoring of visibility from February 1985 through December of 1993.

Emissions

Table 5-1 provides summaries for emissions of carbon monoxide (CO), ammonia (NH_3), nitrogen oxides (NO_x), volatile organic compounds (VOC), particulate matter (PM), and sulfur oxides (SO_x) for 12 counties surrounding Black Canyon of the Gunnison. The major source of SO_x in Mesa County is the Cameo Plant of Public Service Company. No information is available to relate these emissions to local air quality at Black Canyon of the Gunnison, or to apportion the air quality impairment of Black Canyon of the Gunnison to local and regional sources. These emission rates are similar to other regions of the Colorado Plateau that are removed from major urban centers. The only major local point source of pollution is a Louisiana Pacific wafer board plant in Olathe. Emissions from this plant may reduce visibility within the Monument, but no quantitative assessment has been made.

Table 5-1. 1994 Emissions (tons/day) for counties surrounding Black Canyon of the Gunnison National Monument (Radian 1994).

County	CO	NH_3	NO_x	VOC	PM	SO_x
Chaffee, CO	26.93	0.63	3.06	7.75	13.52	0.51
Delta, CO	46.97	1.52	5.89	11.94	65.41	0.59
Gunnison, CO	19.17	2.16	2.02	31.01	11.30	0.24
Hinsdale, CO	1.56	0.38	0.13	5.00	0.69	0.02
Mesa, CO	118.43	2.94	25.60	32.81	196.73	8.98
Mineral, CO	2.75	0.31	0.25	6.42	1.37	0.03
Montrose, CO	49.71	2.34	6.56	22.03	95.16	1.90
Ouray, CO	5.50	0.49	0.62	4.81	19.82	0.07
Pitkin, CO	19.87	0.46	2.81	6.2	10.13	0.25

Saguache, CO	10.52	1.94	1.23	26.26	6.05	0.12
San Juan, CO	2.04	0.13	0.26	1.53	13.46	0.03
San Miguel, CO	11.48	0.74	1.32	10.62	45.24	0.11

Air Pollutant Concentrations and Atmospheric Deposition

Almost no monitoring of air concentrations has occurred at Black Canyon of the Gunnison. The concentration of ozone (using a passive sampler) in the summer of 1995 averaged 44 ppb on a weekly basis, with a maximum weekly average of 53 ppb.

In general, air chemistry for Black Canyon of the Gunnison may be similar to that of Mesa Verde (Chapter 11), and the NADP deposition data for Mesa Verde may be the most representative for Black Canyon of the Gunnison National Monument. However, the air shed for Black Canyon of the Gunnison probably differs enough from that of Mesa Verde that on-site monitoring of deposition rates would be useful.

Visibility

A camera was used at Black Canyon of the Gunnison. The Monument is not an IMPROVE site, so no compilation of measured extinction or reconstructed extinction are available. As with air chemistry, visibility may be most similar to Mesa Verde National Park (Chapter 11).

Sensitivity of Plants

No visible signs of air pollution injury have been reported for vegetation in or near Black Canyon of the Gunnison. Only a few of the Monument's species have been tested under controlled conditions for sensitivity to pollutants, and none of these tests included genotypes representative of the plants in the Monument. Based on the ozone concentrations required to affect very sensitive plants (such as aspen), we expect that current ozone exposures could be high enough to affect some species. Current levels of ozone are probably too low to affect the conifers, and levels of SO_2 across the Colorado Plateau are far below any demonstrated threshold of sensitivity for any plants. In the absence of empirical evidence of any effects, no substantial problem is likely.

Water Quality

Black Canyon of the Gunnison National Monument is adjacent to the Curecanti National Recreation Area, with the Gunnison River flowing first through Curecanti National Recreation Area, via a series of reservoirs, then entering the Black Canyon of the Gunnison. Water quality sampling has been conducted in Curecanti National Recreation Area, both in the major reservoir (Blue Mesa Lake) and in a number of side streams draining into the Gunnison River (Long et al. 1995). Threats to these surface waters are associated with activities that increase turbidity and sediment loads, such as recreation, grazing and leakage from septic tanks. During these water quality surveys, ANC was not measured. The sensitivity of these waters can be inferred from pH and specific conductance [specific conductance is a measure of the total dissolved solids in waters. Conductivity is reported as either micro-ohms per centimeter or micro-Siemens per centimeter. These are equivalent values.] Water quality surveys within the adjacent Curecanti National Recreation Area indicate that there is a potential for non-point source runoff of N to streams in this area. We recommend there be an examination of the data sets to determine if excess nitrate is currently found in streams, especially during spring runoff. If high nitrate levels are found, there should be a watershed-level analysis of the sources of that N.

The lowest readings for both of these parameters were in Blue Creek, monitored in 1993 as having a range of pH values of 6.7-8.0 and a range of conductivities of 35-119 μS/cm, and Curecanti Creek, monitored in 1993 as having pH values of 6.7-8.0 and a range of conductivities of 35-107 μS/cm. This range of values indicates that even the tributary streams are well-buffered and unlikely to be affected by atmospheric deposition.

Recommendations for Future Monitoring and Research

General recommendations for Class I NPS areas of the Colorado Plateau are given in Chapter 14. No air quality monitoring occurs at Black Canyon of the Gunnison National Monument. Black Canyon of the Gunnison may be close enough to Mesa Verde to be represented by Mesa Verde's air quality patterns, but the intervening San Juan Mountains may cause substantial differences in the flow of air masses between these Class I areas. Therefore, we recommend:

- On-site monitoring of air quality be developed, including as a minimum some measurement of ozone concentrations (by continuous or passive methods) and atmospheric deposition.
- Acidification of surface waters in the Monument is unlikely due to the large solute loads in streams. We recommend that the Monument staff work with the USGS-NAWQA staff to determine if sensitive bedrock types are found within the Monument that might contain streams with low ANC. An extensive stream survey in these areas would be useful to determine the status of headwater streams. We do not expect that N deposition poses a threat to the streams in the Monument, but streams could be monitored to verify that concentrations of nitrate do not reach unexpectedly high levels.

Monument Summary

Black Canyon of the Gunnison National Monument lacks any substantial monitoring program, so it is difficult to determine any AQRV impacts. We suspect that visibility has been impaired by pollution on a substantial portion of days, as with the other Class I NPS areas of the Colorado Plateau. Current levels of pollution in southwestern Colorado are high enough to produce haze and obscure the important vistas at Mesa Verde National Park, and probably at Black Canyon of the Gunnison National Monument. Any increase in aerosols will undoubtedly impair visibility further; substantial reductions in aerosols would be needed to restore pristine conditions at Black Canyon of the Gunnison National Monument.

Little information has been collected on air pollution effects on the Monument's biota. No sign of air pollution impacts on plant or animal species has been reported; ozone concentrations are high enough that some impact is possible for sensitive plants, but SO_2 concentrations across the Colorado Plateau are too low to affect plants.

References

Chronic, H. 1988. Pages of Stone, Geology of Western National Parks & Monuments, 4: Grand Canyon and the Plateau Country. The Mountaineers, Seattle, Washington, 158 pp.

Long, B.A., Cudlip, L. and Smith, R. 1995. Water Quality Data Analysis and Interpretation, Curecanti National Recreation Area, NPS Water Resource Division Technical Report NPS/NRWRD/NRTR-95/68, December, 150 pp.

NPLichen Alphabetical Listing, May 1995.

NPFlora Alphabetical Listing, January 1994.

Radian Corporation. 1994. Development of an emissions inventory for assessing visual air quality in the western United States. Final report to the Grand Canyon Visibility Transport Commission and Project VARED. Radian Corporation, Sacramento, California.

Threatened and Endangered Species Information Institute. 1993. U.S. Threatened and Endangered Species, Volume 2, Plants.

Wetmore, C.M. 1983. Lichens of the Air Quality Class I National Parks. Final Report, National Park Service Contract CX 0001-2-0034, 158 pp. (James Bennet, NPS-AIR, Denver 80225).