



State of the Park Report

Rocky Mountain National Park

Colorado



December 2017

On the cover: Hallett Peak reflected in Dream Lake. NPS Photo.

Disclaimer. This State of the Park report summarizes the current condition of park resources, visitor experience, and park infrastructure as assessed by a combination of available factual information and the expert opinion and professional judgment of park staff and subject matter experts. The [internet version](#) of this report provides additional details and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytic approaches used in data collection and assessments of condition. This report provides evaluations of status and trends based on interpretation by NPS scientists and managers of both quantitative and non-quantitative assessments and observations. Future condition ratings may differ from findings in this report as new data and knowledge become available. The park superintendent approved the publication of this report.

Executive Summary

The mission of the National Park Service is to preserve unimpaired the natural and cultural resources and values of national parks for the enjoyment, education, and inspiration of this and future generations. NPS Management Policies (2006) state that “The Service will also strive to ensure that park resources and values are passed on to future generations in a condition that is as good as, or better than, the conditions that exist today.” As part of the stewardship of national parks for the American people, the NPS has begun to develop State of the Park reports to assess the overall status and trends of each park’s resources. The NPS will use this information to improve park priority setting and to synthesize and communicate complex park condition information to the public in a clear and simple way.

The purpose of this State of the Park report is to:

- Provide to visitors and the American public a snapshot of the status and trend in the condition of a park’s priority resources and values;
- Summarize and communicate complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format;
- Highlight park stewardship activities and accomplishments to maintain or improve the State of the Park;
- Identify key issues and challenges facing the park to help inform park management planning.

The purpose of Rocky Mountain National Park (ROMO) is to preserve the high-elevation ecosystems and wilderness character of the southern Rocky Mountains within its borders and to provide the freest recreational use of and access to the park’s scenic beauties, wildlife, natural features and processes, and cultural objects.

Significance statements express why the park’s resources and values are important enough to warrant national park unit designation. Rocky Mountain National Park is significant because:

- Rocky Mountain National Park provides exceptional access to wild places for visitors to recreate and experience solitude and outstanding scenic beauty. Trail Ridge Road, the highest continuous paved road in the United States, and the extensive trail system bring visitors to the doorstep of a variety of wilderness-based recreational opportunities.
- Fragile alpine tundra encompasses one-third of Rocky Mountain National Park, one of the largest examples of alpine tundra ecosystems protected in the contiguous United States.
- Glaciers and flowing fresh water carved the landscapes of Rocky Mountain National Park. The park is the source of several river systems, including the Colorado River and the Cache la Poudre, Colorado’s first and only designated wild and scenic river.
- The dramatic elevation range within the park boundary, which spans from 7,600 feet to 14,259 feet and straddles the Continental Divide, allows for diverse terrestrial and aquatic ecosystems, varied plant and animal communities and a variety of ecological processes. The park is designated as a United Nations Educational, Scientific, and Cultural (UNESCO) international biosphere reserve and globally important bird area, with portions of the park’s montane, subalpine, and alpine ecosystems managed as research natural areas for scientific and educational purposes.
- The mountainous landscape of Rocky Mountain National Park has drawn people to the area for thousands of years. Visitors can see remnants of the different ways people have used this land over time, ranging from prehistoric big game drives to dude ranching to recreational tourism.

The summary table, below, and the supporting information that follows, provide an overall assessment of the condition of priority resources and values at Rocky Mountain National Park based on scientific and scholarly studies and expert opinion. The internet version of this report, available at <https://www.nps.gov/stateoftheparks/romo/>, provides additional detail and sources of information about the resources summarized in this report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in the assessments. Reference conditions that represent “healthy” ecosystem parameters, and regulatory standards (such as those related to air or water quality) provide the rationale to describe current resource status. In coming years, rapidly evolving information regarding climate change and associated effects will inform our goals for managing park resources, and may alter how we measure the trend in condition of park resources. Thus, reference conditions, regulatory standards, and/or our judgment about resource status or trend may evolve as the rate of climate change accelerates and we respond to novel conditions. In this context, the status and trends documented here provide a useful point-in-time baseline to inform our understanding of emerging change, as well as a synthesis to share as we build broader climate change response strategies with partners.

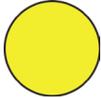
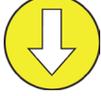
The status and trend symbols used in the summary table below and throughout this report are summarized in the following key. The background color represents the current condition status, the direction of the arrow summarizes the trend in condition, and the

thickness of the outside line represents the degree of confidence in the assessment. In some cases, the arrow is omitted because data are not sufficient for calculating a trend (e.g., data from a one-time inventory or insufficient sample size).

Condition Status		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Unchanging		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low

State of the Park Summary Table

Priority Resource or Value	Condition Status/Trend	Rationale
Natural Resources web ▶		
Air Quality		Rocky Mountain National Park is designated a Class I area by the Clean Air Act Amendment of 1977, providing special protection for air quality, sensitive ecosystems, and clean, clear views. Despite these protections, overall air quality in the park warrants significant concern. Scenic views are sometimes obscured by air pollution-caused haze. The park area east of the Continental Divide falls within an area designated by the Environmental Protection Agency (EPA) as nonattainment (not meeting) for the ground-level ozone standard. Ozone often reaches levels that can make breathing difficult for sensitive groups and can cause injury to ozone-sensitive plants. Some park vegetation communities and surface waters are susceptible to nutrient enrichment and acidification effects of excess nitrogen and sulfur deposition. Airborne toxics, including mercury and pesticides, dissolved in rain or snow accumulate in park wildlife, resulting in reduced foraging efficiency, survival, and reproductive success.
Geology and Soils		Understanding the relationships between geologic and biological components of park ecosystems is vital to understanding, managing, and protecting natural resources and ecosystems. The park collects data and develops maps of geologic and soil inventories, to help manage risk from hazards such as landslides. The status of geologic and soil data, information, and knowledge at the park is good.
Water Quantity and Quality		Water quality in the park has been degraded by contaminants and warming temperatures. High-elevation waters are degraded by nitrogen deposition and pollution from pesticides and other airborne contaminants. Rapid climate change is affecting the precipitation regime, which in turn affects the atmospheric deposition and concentration of pollutants. Water temperature, which affects aquatic species such as cutthroat trout, has warmed above state water quality criteria for cold water fisheries in many stream reaches. The geomorphic character of park waterways has been altered by extreme flood events, damage to riparian vegetation from overbrowsing, and the loss of beaver, among other factors. The extent of glaciers is expected to decline with warming temperatures.

Priority Resource or Value	Condition Status/Trend	Rationale
Freshwater Communities		<p>Historical records suggest that most, if not all of the 147 lakes in the park were originally fishless, but over 40 currently have fish, which negatively impacts native ecosystems. This condition is improving as many previously stocked lakes are reverting to a fishless condition and recovering their native species. Most aquatic macroinvertebrate communities in streams are intact and of higher quality. Only a few, higher use front-country areas, have aquatic macroinvertebrate communities with lower than expected species diversity.</p> <p>Physical habitat in riparian areas, such as stream beds and canopy cover, are in good condition at select sites in the park, although some sites have slightly elevated amounts of fine sediments, which can be detrimental to aquatic species. Large woody debris, another important component of physical habitat, may be less common in some park streams due to timber harvest before the park was established and/or complex fire histories.</p>
Wetland Communities		<p>Wetlands are biodiversity hotspots, comprising just 4–5% of the park’s area but supporting a much larger proportion of its flora and fauna. The overall condition of wetlands in the park warrants significant concern. Data collected from 2007 to 2009 suggest that 42% to 49% of the park’s riparian and wet meadow wetlands were in a human-disturbed or non-reference condition, especially at low elevations. Riparian willow habitat, important to native species such as elk, beaver, birds, and butterflies, has declined substantially; however, temporary fencing constructed to promote restoration by reducing overbrowsing has improved willow height and cover in some areas. Approximately 31% of fens in the park, a distinct type of wetland fed by groundwater and that accumulates peat, are in a degraded condition.</p>
Alpine Ecosystems		<p>Alpine vegetation communities occur above 11,400 feet in the park and comprise about one-third of its area. Most alpine plants are strongly limited by harsh conditions and nutrient availability, making the alpine tundra more sensitive to human impacts than other habitats. The condition of alpine vegetation communities in the park warrants moderate concern. Visitor trampling, increased nitrogen deposition, and previous livestock and current wildlife grazing have altered the alpine landscape. Some data also suggest that the relative proportions of grasses, shrubs, and trees will shift if nitrogen deposition and temperature continue to increase, fundamentally altering the alpine life zone.</p>
Sub-alpine Ecosystems		<p>In the subalpine life zone, shifts in forest structure and composition caused by a range of stressors warrants moderate concern. Limber pine, a keystone species, is declining from drought, white pine blister rust, and outbreaks of mountain pine beetle. While the density of mountain pine beetles in the park has recently decreased, other species of bark beetle are increasing in Colorado, and their overall activity exceeds historical levels. Subalpine tree stand dynamics are shifting in response to changing climate, altered land use, and altered disturbance regimes, resulting in changes such as an increased abundance of shade tolerant species like Douglas fir and subalpine fir.</p>
Montane Ecosystems		<p>The condition of montane upland shrub communities warrants moderate concern. Previous research suggests that the combination of fire and post-fire elk browsing in portions of elk winter range had a negative effect on these imperiled plant communities when elk populations were overabundant. Monitoring from 2006 to 2013, however, found that shrub cover on elk winter range was stable and that the objectives of the Elk and Vegetation Management Plan have been met since 2009. Other threats to these shrub stands include past fire suppression and invasion by nonnative plants, which is increasing in the montane zone.</p>

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Native Species of Concern		The majority of the 10 native species of concern identified for the park have low population numbers and are in a condition that warrants moderate or significant concern. Exceptions are elk and rare plants. The abundance of elk using park winter range is good, although chronic wasting disease is more prevalent in the park than in adjacent areas outside of it. The park has no federally listed endangered plant species and rare plants appear to be in good condition. Several other native species of concern are faced with declining population numbers and disease, such as cutthroat trout, amphibians, and bighorn sheep. Warming temperatures are affecting ptarmigan through changing nesting phenology, as well as pika, through the impacts of altered snowpack on their habitat. Little is known about park invertebrates. Changes to food sources are affecting both the black bear, which are consuming more human food and trash, as well as the beaver, which are still affected by decades of overabundant elk.
Exotic Species		Invasive, exotic plants are increasing in abundance and distribution in the park, especially east of the Continental Divide and in lower elevation montane and riparian habitats. Nonnative trout, such as brook trout, brown trout, and Yellowstone cutthroat trout are found in lakes and streams in all major drainages of the park. An increasing number of new species are being documented in the park, including turkeys, collared doves, and fox squirrels.
Land Use and Ecosystem Processes		<p>The overall condition of undisturbed and undeveloped land, habitat connectivity, and natural fire in the park is good. Nearly 95% of the park is designated wilderness, and about 62% of the park is adjacent to national forest. Many non-historic structures have been removed and replaced by native vegetation. The natural landscape connectivity/setting of the park (0.956 out of 1) scores higher than the Southern Rockies Ecoregion overall (0.924). This measure has declined slightly, however, and is likely to decline further by 2030.</p> <p>Fire frequency and severity for the majority of the park is thought to be within the historical range of variability, although total acres burned in the last decade increased dramatically over historical levels, and development in and around the park limits the park's ability to manage wildland fire for ecological purposes.</p>
Dark Night Sky		The NPS Night Sky Program characterizes a park's photic environment—the physical amount and character of light at a particular location—by measuring both anthropogenic and natural light. All-sky Light Pollution Ratio (ALR) is a measure of light pollution calculated as the ratio of median Anthropogenic Sky Glow to average Natural Sky Luminance. ALR for Rocky Mountain National Park is 0.54, which is considered a moderate condition.
Acoustic Environment		Using a national noise pollution model, the condition of the acoustic environment is assessed by determining how much man-made noise contributes to the acoustic environment. This measure is referred to as the <i>mean acoustic impact level</i> . Impact is measured in A-weighted decibels (dBA). The mean acoustic impact level at the park is 1.1 dBA, meaning that the acoustic environment is in good condition.
Cultural Resources web ▶		
Archeological Resources		Most archeological investigations conducted in the park are triggered in response to infrastructure development by Section 106 of the National Historic Preservation Act. Purely research-focused investigations are fewer and funding is sporadic. Archeological information would be improved through the development of a centralized park archeological database and the preparation of a comprehensive Archeological Overview and Assessment. Approximately 14% of the park has been inventoried for archeological resources. Based on NPS ASMIS records, only 4% of the 829 documented archeological sites contain current condition information.

Priority Resource or Value	Condition Status/Trend	Rationale
Cultural Anthropology		A comprehensive approach to ethnographic research is needed to further define and determine resources and/or places of special concern to current tribal groups and/or other non-native cultural groups. An ethnographic overview and assessment study is suggested to document baseline cultural anthropology data for the full spectrum of park resources and traditionally associated tribes and communities.
Cultural Landscapes		Two cultural landscapes have been formally documented: the Moraine Park Museum/Discovery Center and Amphitheater Cultural Landscape Inventory, and the McGraw Ranch Cultural Landscape Inventory. Cultural Landscape Reports (CLRs) are needed for both landscapes. The park also has 10 cultural landscapes that need completed Cultural Landscape Inventories (CLI) and completed CLRs. 100% of the park's cultural landscapes are located within administrative areas that are critical in maintaining park operations.
Historic Structures		The List of Classified Structures (LCS) contains 168 structures. It is unknown how many of these structures are listed in the National Register of Historic Places (NRHP), or have been formally determined eligible for listing. The LCS, State Historical Preservation Office (SHPO) database, park geodatabase, and NPS Facilities Management database contain conflicting information about historic structures within the park. Initial efforts to verify the datasets indicate that 58% of structures (179 of 305) have been evaluated for inclusion in the NRHP and 28% (85 of 305) of those evaluated are listed in the NRHP. It is estimated that there are an additional few hundred structures that have not been evaluated and documented for the LCS. Information about historic structures would be improved through the development of a centralized park database and the preparation of Historic Structure Reports (HSRs) and Preservation Plans for significant historic structures.
History		The park has neglected its own history by not accumulating or creating historical records. Many baseline documents are needed to properly manage and understand the history and cultural resources of the park. The park archives are the exception, in that the park central files are cataloged and are accessible for research.
Museum Collections		Museum collections are stored in a museum storage facility near Estes Park, Colorado maintained by professional museum staff. The collection contains over 39,000 natural history specimens, 27,000 historical and archeological artifacts, and over 900,000 archival records. Twenty-nine buildings have museum objects on exhibit and 20 non-federal repositories have museum objects on loan. The natural and cultural resource management records are currently being processed and cataloged into the archives. Existing museum management records are of poor quality.
Visitor Experience web ▶		
Number of Visitors		The total of 4,155,916 visitors to the park in 2015 is higher than that of 2014 (3,434,751) and 2013 (2,991,141) and also higher than the 10-year average of 3,215,787 visitors for 2006–2015. Using the 10-year average, park visitation has increased 29 percent, which warrants moderate concern as park managers wrestle with the impacts associated with the significant increase in day-use. Rocky Mountain National Park ranked third among national parks for annual visitation (Source: NPS Stats).

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Visitor Satisfaction		<p>Based on the standard visitor satisfaction survey conducted each year, the percentage of visitors satisfied in FY14 was 99.0%, which is higher than the average for the previous five years (98.6%) and ten years (98.0%) (Source: 2014 Visitor Survey Card Data Report). This survey asks only general questions about the overall quality of park facilities, services, and recreational opportunities, and does not directly address issues related to park management.</p> <p>In 2015 the park received 23 complaints about wait times for shuttle buses, and 21 complaints requesting shuttle bus service earlier in the season. The park also received complaints about entrance station wait times and lack of campsite availability. These complaints can all be tied to the increased number of park visitors (Source: ROMO Visitor Comment Forms received 2015).</p>
Visitor Impacts to Resources		<p>Visitation to the park has increased dramatically within the last two years. In areas with high visitor use, park managers are concerned about negative impacts to park resources and visitor experience.</p>
Visitor Services		<p>Rocky Mountain National Park sets a high standard for quality interpretive programming. Extensive training, coaching, and mentoring are provided to each field interpreter to ensure the best experience for visitors and to increase advocates of the park and its resources.</p> <p>Limited staffing and reliance on seasonal positions does not allow for as many formal ranger programs during the spring (March into April) or fall (early Oct. through Nov.), when the park has many visitors. Visitation in these “shoulder” seasons is increasing, and the park is currently unable to offer these visitors any traditional programs. Visitation has increased while interpretive programming and staffing have not kept pace.</p>
Interpretive Media – Brochures, Exhibits, Signs, and Website		<p>The park’s official website received over 8.5 million views and 6.7 million visitors in 2015, a 12% increase over 2014. It was the eighth most visited park website in the entire NPS.</p> <p>ROMO has a strong social media presence that grows stronger daily. The park has a Facebook page (509,000 followers, fifth most followed NPS page), an Instagram account (154,000 followers, fifth most followed NPS account), a Twitter account (18,800 followers, tenth most followed NPS account), and YouTube and Flickr pages for distributing videos and photos (Source ROMO Media Specialist).</p>
Scenic Resources		<p>Most scenic views in and around the park are generally high quality; however views are of moderate concern due to air quality impacts on visibility. A significant number of visitors come to the park to view the scenery, and scenery is a fundamental resource and value included in the park’s Foundation Document. The park has experienced some recent development adjacent to the park that has affected scenic views but general land use around the park should mostly retain the important qualities of the views. Gateway communities and counties have adopted land use and development codes that include provisions for protecting ridgelines and highly visible locations outside the park from development that could harm important viewsheds.</p>

Priority Resource or Value	Condition Status/Trend	Rationale
<p>Universal Access</p>		<p>The park currently offers a wide range of activities and experiences for visitors with mobility impairments and limitations. These include several trails, campgrounds, picnic areas, wildlife viewing areas, and scenic overlooks that meet Architectural Barriers Act (ABA) requirements. All park visitor centers and most restrooms are accessible. A number of park programs, such as ranger led hikes and talks are accessible and are identified in the park newspaper. Programs are modified, when possible, depending on visitor’s individual needs. Numerous projects have been identified and are awaiting funding to continue to improve accessible experiences.</p> <p>The park has been providing some sort of shuttle service in the Bear Lake corridor since the 1970s. The modern era of that service started in 2000 and continues today. More comfortable and inviting buses with established shuttle stops and shelters along the routes make this system much more successful and useful.</p> <p>Access to the park via public transportation from Colorado’s Front Range (the major metropolitan area) is non-existent.</p>
<p>Safety</p>		<p>The park continues to remain in the top five national parks for Search and Rescue (SAR) activity within the nation. The level and frequency of incidents has remained active and steady over the past few years. However, the visitor protection staff members, who have the primary responsibility for managing incidents, have experienced both a decline in staffing levels and increasing demands in activity areas such as law enforcement due to the continued increase in park visitation. These competing demands continue to diminish the operational capacity for responding and managing complex SAR incidents.</p>
<p>Partnerships</p>		<p>The park works closely with several partners on various projects. The Rocky Mountain Conservancy has been our partner and advocate since 1931. They have raised over \$30 million since the mid-1980s to support a variety of projects including educational programs, trails, land acquisition, and the construction of the Fall River Visitor Center.</p> <p>Groups include the Estes Park League of Women Voters, who lobbied Congress to pass a scenic over-flight ban to preserve the natural sounds of the park’s wilderness and the Towns of Grand Lake and Estes Park, and Boulder, Grand and Larimer Counties who have been supportive on a variety of issues including the park’s wilderness designation. Others like the Estes Valley Land Trust are working to protect land near and adjacent to the park from incompatible development. The park also has strong working relationships with other federal and state agencies, area universities, and local tourism organizations.</p> <p>In recent years the park has established strong partnerships with protected areas in other countries that share similar resources and issues. The park has a robust Sister Park relationship with Tatras National Park in Poland and Slovakia and also with MonteVerde, Costa Rica.</p>
<p>Park Infrastructure web ▶</p>		
<p>Overall Facility Condition Index</p>		<p>The 1,111 assets at Rocky Mountain National Park have an overall FCI of 0.080, which is Good based on industry and NPS standards. The FCI is the product of the cost of repairing an asset, such as a building, road, trail, or water system, divided by the cost of replacing it.</p>

Priority Resource or Value	Condition Status/Trend	Rationale
<p>Park Carbon Footprint</p>		<p>ROMO belongs to a network of National Parks that are putting climate friendly behavior at the forefront of sustainability planning. The park’s climate action plan describes commitments to reduce emissions of greenhouse gases at the park by 2016. Combined emissions of 12,824 metric tons of carbon dioxide equivalent (MTCO₂E) from park and concessioner operations and visitor activities within the park during the 2005 baseline year were roughly equivalent to the emissions from the energy use of 1,170 households each year (according to the EPA Greenhouse Gas Equivalencies Calculator).</p>
<p>Wilderness Character and Stewardship web ▶</p>		
<p>Overall Wilderness Character</p>		<p>The Wilderness of Rocky Mountain National Park largely remains an area where natural processes predominate and where scenic beauty provides inspiration and enjoyment for park visitors. Approximately 95% of the park is designated as wilderness. The vast majority of this park wilderness was designated in 2009. The current rapid increase in wilderness visitation and a projected steady increase in regional population levels provide challenges to all qualities of wilderness character. Management actions such as exotic plant control, the construction of temporary elk enclosures, and the restoration of the area impacted by the 2003 Grand Ditch Breach are examples of actions that have short term negative impacts to wilderness character and are intended to lead to a long term decrease in human caused effects.</p>
<p>Wilderness Stewardship</p>		<p>Key wilderness information is available in the Rocky Mountain National Park 2013 Foundation Document and park Geographic Information System database. Wilderness character is consistently incorporated into park management operations. Wilderness planning documents are in place or in preparation. The park received two NPS Intermountain Region wilderness awards in 2014. Dave Pettebone, the Wilderness Program Manager at the time, was awarded the “Wilderness Champion” award and the Resources Stewardship Division was awarded the “Leader in Wilderness Stewardship” award.</p>

Summary of Stewardship Activities and Key Accomplishments to Maintain or Improve Priority Resource Condition

The list below provides examples of stewardship activities and accomplishments by park staff and partners to maintain or improve the condition of priority park resources and values for this and future generations:

Natural Resources

- Air quality – ROMO, the Colorado Department of Public Health and the Environment (CDPHE) and the Environmental Protection Agency (EPA) are collaboratively working to implement the August 2007 Nitrogen Deposition Reduction Plan (NDRP). Since that time, the agencies have also been working with agricultural stakeholders to better understand the sources and mechanisms of nitrogen transport and deposition on fragile alpine tundra ecosystems. Recent accomplishments have been testing implementation of a voluntary early warning system of predicted upslope weather events that allows agricultural producers to conduct best management practices that reduce the transport of atmospheric nitrogen and ammonia compounds to alpine tundra in the park.
- Elk management – Over the past 2 decades the park has made great strides toward managing elk populations and beginning to restore degraded habitat. The winter population size meets the objectives of the [Elk and Vegetation Management Plan](#) and steady progress is being made toward meeting objectives for vegetation conditions.
- Exotic Vegetation Treatment and Restoration – Despite efforts to reduce the abundance, distribution, and number of exotic plant species in the park, invasive plants such as cheatgrass and Canada thistle continue to spread, even in previously undisturbed habitats. New exotic, invasive plant species are also being discovered, particularly in lower elevation habitats where more human disturbance occurs. Over the last few years, exotic plant management crews have treated thousands of acres of exotic plant infestations each year. Recent conditions and discovery of new exotic plants have prompted the need for the park to develop an Environmental Assessment on a proposed new exotic management plan that can eradicate exotic plant infestations and prevent their spread throughout the park.
- Grand Ditch – On May 30, 2003, the Grand Ditch, a trans-basin water diversion canal in the northwest corner of the park, breached its bank. The breach caused a 48,000 cubic yard mud and rock slide that damaged about 22 acres and 1.5 miles of riparian, upland, and wetland habitat in the Lulu Creek and the headwaters of the Colorado River. After completing an Environmental Impact Statement in 2013, the NPS began stabilization of the hillslope immediately below the canal in 2016.
- Fire management – ROMO has experienced more wildfire (as measured by acres burned) in the last 6 years than in the previous century. The largest of these fires, the Fern Lake fire of 2012, was just less than 3,500 acres. A previously completed hazardous fuels reduction project allowed firefighters to safely engage the Fern Lake fire, preventing it from leaving the park and burning onto developed private property. The park completed a new Fire Management Plan in 2012. In addition, the park recently hosted an interagency workshop to discuss wildfire response in mountain pine beetle impacted dead tree stands in the southern Rocky Mountains.
- Science-based management – The park has moved toward science-based natural resource management with the development of the Continental Divide Research Learning Center, a broad program of research on park ecosystems, and implementation of long-term Vital Signs monitoring across the park. These programs aim to provide credible scientific data and analysis in a form that is most useful for protecting and restoring ecological integrity of park ecosystems.
- Black bear program – Research in the mid-2000s indicated that the black bear population in ROMO was becoming more food-conditioned and habituated to human-use areas. In response, the park has increased and improved bear-resistant facilities and increased education of both staff and visitors.
- The Cutthroat Trout – Over the last decade, the natural distribution of cutthroat trout subspecies throughout Colorado has become better understood. The park has funded research to understand where genetically distinct lineages occur both in ROMO and throughout the State. Based on this emerging information, ROMO staff is assisting in the process to draft a Recovery Outline for the Greenback cutthroat trout. This document will guide proposed fisheries management actions in the park that support recovery of this subspecies.
- Forestry program – More than 90% of the forested acres within ROMO have been impacted by bark beetles, resulting in stands of dead trees and a serious threat to the safety of visitors and employees. Visitors, employees, and infrastructure are protected through actions guided by the Standards and Protocols for Frontcountry Hazard Tree Management (2011). This document provides a systematic approach for detecting, mitigating, and disposing of hazard trees, protects high-value trees in developed high-use areas, and minimizes the cost and potential resource damage associated with hazard tree management.

Cultural Resources

- In 2015, the Continental Divide Research Learning Center (CDRLC) funded a 3-year Ice Patch Archeology Project at ROMO spearheaded by Dr. Jason LaBelle at Colorado State University (CSU). The project goal is to survey ice patches previously identified by Craig Lee (2010) and document and analyze fragile paleobiological and/or cultural resources recently exposed in receding ice patches.
- The ROMO historic preservation crew is one of few in the NPS that provide historic window preservation and restoration services for the National Park Service.
- The historic preservation crew at ROMO has been involved in the NPS Preservation and Skills Training (PAST) program for over 10 years. The PAST Program provides opportunities for NPS employees to learn traditional trade skills.
- The historic preservation crew provides training opportunities to youth in historic preservation through the Rocky Mountain Conservancy (RMC) Youth Corps. This provides hands-on learning with experts.
- The park hosted a 3-day Mission 66-Era Resources Work Group in September 2015. Participants included the NPS Intermountain Region Cultural Resources staff, the Colorado State Historic Preservation Office, the Public Lands History Center (PLHC) at Colorado State University (CSU), and ROMO Facilities Management and Cultural Resources staff. This resulted in a better understanding of significant NPS Mission 66-Era historical resources located within the park and provided guidance for managing the resources for the future.

Visitor Experience

- In FY 2015, Rocky Mountain National Park had the 10th largest park-based volunteer program in the National Park Service. That year, 2,173 volunteers contributed 110,025 hours of service. This is equivalent to over 50 full time employees, with labor valued at \$2,538,277.
- The park's Junior Ranger program continues to grow. Since the development of a Junior Ranger Headquarters, 5,000–7,000 kids experience an activity each year. In comparison, prior to 2011, only about 2,000 visitors participated in ranger-led youth programs. In that same time period, the Junior Ranger booklet program has grown from 30,000 to 45,000 books distributed annually.
- The Search and Rescue Program has saved many lives over the years with many successful missions. The program received the Department of the Interior Unit Award for a 2014 incident response.
- The Rocky Mountain Conservancy has been a park partner and advocate since 1931, raising over \$30 million since the 1980s in support of varied projects, including educational programs, land acquisition, and trail creation and maintenance.

Park Infrastructure

- The park completed rehabilitation of the main water system for the Colorado River District (west unit) of the park including the treatment, storage, and water distribution systems. This included 3,700 feet of new fill and distribution lines, installation of 13 service taps, tank cleaning and recoating, and treatment process enhancements.
- A new laundry facility was completed for park employees and volunteers.
- The Holzwarth parking lot was paved in 2014 and all sections of associated road and parking lots were slurry sealed in 2015.
- The Timber Creek Campground's main road, 4 loops, and 100 parking sites were recently resealed.
- A 350-foot section of Trail Ridge Road above switchback #3 that had become undermined was stabilized in 2015.
- Over the last 10 years, the park has replaced and constructed 13 new roadside vault toilets using the most up-to-date and sanitary building materials.
- Sustainable trail construction in the sub-alpine and alpine tundra continues to be a park priority. Trails face exposure to extreme weather patterns, high winds and poor soils, and high visitor use causing severe erosion. Because of this, the trails program has been focused on high quality construction with a 100–200 year life cycle in mind. The result has been a sustainable trail expected to remain in service for decades and longer.

- Over the last 10 years, the park has put a priority focus on the rehabilitation of two main roadways in the park, Trail Ridge Road and Bear Lake Road. Trail Ridge Road is the highest continuous motorway in the United States, with more than eight miles located at 11,000 feet above sea level, and a maximum elevation of 12,183 feet. These projects involved the assistance of the Federal Highways program for funding, design, and project management. In all, the park has been able to reconstruct 77.4 miles of paved roads along with several retaining and drainage structures, returning these assets to a new condition.
- On September 12th, 2013 the park received a record amount of rainfall. Accumulation ranged from 2 inches to over 18 inches across the Front Range of Colorado. The annual average rainfall amount for this area is approximately 20 inches. Average September precipitation east of the Continental Divide is below 2 inches. Damage in the park was wide-spread on the east side of the continental divide. Repairs are ongoing.

Wilderness Character and Stewardship

- ROMO, joined by our gateway communities, the Colorado Governor and our congressional delegation, celebrated formal designation of the majority of the park as Wilderness in 2009.
- The park provided a variety of special programs to celebrate the 50th anniversary of the Wilderness Act in 2014.
- The park received two NPS Intermountain Region wilderness awards in 2014. Dave Pettebone, the Wilderness Program Manager, was awarded the “Wilderness Champion” award and the Resources Stewardship Division was awarded the “Leader in Wilderness Stewardship” award.
- Park staff has developed an innovative program to provide training and encourage the utilization of a variety of traditional tools and skills to maintain wilderness character including the use of cross cut saws, axes, hand tools, and pack stock (including llamas).
- Wilderness themes are incorporated into many park interpretive programs to increase visitor’s appreciation and stewardship.
- Park research activities are consistently reviewed to minimize impacts to wilderness character while optimizing information to inform wilderness management. Novel research methods such as GPS site marking, fecal sampling of wildlife species for genetic analysis, and the use of photography to “mark and recapture” boreal toads have been utilized by researchers and park staff to minimize impacts to wilderness character.

Key Issues and Challenges for Consideration in Management Planning

The park’s Foundation Document was completed in 2013, which identified challenges and opportunities for current and future management planning. These are still relevant today, and include the park’s highest priorities of visitation, climate change, and relevancy to future generations:

- Day use visitation within the park has increased 32% since 2014, and 40% since 2012. The park received its highest annual visitation in 2016, with more than 4.5 million visitors. Rocky is the fourth most visited national park in the system, resulting in natural and cultural resource degradation, crowding, congestion, and a diminished visitor experience. In addition, budgets and staffing have not kept up with the visitation increase, resulting in operational capacity and safety deficiencies.
- Climate change is the largest environmental issue in our human history, in terms of both scale and scope, and our capacity to address this is not keeping pace with the burgeoning threat to park resources.
- Relevancy of the park to future generations continues to be a challenge, and while we have made some progress exposing new and diverse visitors to the park, it has been difficult determining how to retain them as future stewards and integrating diversity within the workforce.

Day Use Visitation

Over the last four years visitation has increased 40%, to more than 4.5 million visitors per year. This has resulted in congestion, resource damage, significant safety issues and diminished visitor experience—including long lines of traffic on highways 34 and 36 leading up to Estes Park, long lines at entrance gates and at shuttle stops; overwhelmed restroom facilities and backcountry sites; crowded trailheads and social trailing. Park operational capacity has declined over the last six years: staff, both employees and volunteers, have consistently been overwhelmed. Visitation has significantly increased in each month of the year. The top six visitation

days in 2016 were in September and October, representing a shift from our normal July expectations. The park can no longer manage as a summer park with “shoulder seasons” and needs to look at a year-round model of operation. Impacts to natural resources and visitor safety are widespread.

For the long term, addressing day use will require a thoughtful and community-engaged planning process. To set the foundation for this planning effort, in early 2016 the leadership team began engaging the local communities about visitor use management issues and challenges. In the fall of 2016, an NPS transportation planner was assigned to the park to research visitor use management planning efforts and strategies being conducted by other parks with similar overcrowding issues, and to develop a draft strategy for creating a short term Bear Lake Corridor Action Plan, as well as a framework and funding strategy for a longer term parkwide strategy.

Climate Change

The park celebrated the 100th birthday of its designation in 2015. During this time, the park experienced more large fires in the last five years than in the previous ninety-five years combined. The Fern Lake Fire, a human-caused fire that began in October 2012, endured during the driest November on record in more than one hundred years, and burned through winter and over snow. Because of large expanses of beetle-killed forests (a phenomenon related to climate change), indirect firefighting tactics were needed as a primary firefighting approach to mitigate risks to firefighters.

Less than one year later, in September 2013, the park experienced one of the largest rain events in its history, resulting in floods that erased roads and infrastructure from the park to the Front Range of Colorado. The area became part of a national disaster area, and recovery continues today. Geologists observed that the last time the soils of this region were this saturated was during postglacial melting thousands of years ago.

The park can expect more of these extreme events as a consequence of climate change, even though the precise link to climate change is less certain. While it is impossible to predict when and where extreme weather events will occur, the park has the capacity to better prepare for these events and to work under the assumption that they will occur more regularly. Fire managers now recognize that fires can and do occur in any season in ROMO. As infrastructure was repaired and replaced after the 2013 flood, larger, more flood-resistant designs were chosen.

Beyond extreme weather events, Rocky recognizes many other significant ecological responses to longer-term patterns of climate change, such as the continental impacts of the mountain pine beetle to forests. The recent outbreak of pine bark beetles is unprecedented in its size and severity. At Rocky, over 90% of the pine forests have been impacted to some degree. Drought, a decrease in severe winter low temperatures, and longer growing seasons are all contributing factors. Currently a second beetle outbreak, of spruce bark beetles, is severely impacting the subalpine spruce forests of the park. Non-native invasive plants are also appearing at increasing elevations in the park. Cheatgrass, which was limited to the lowest elevations of the park twenty years ago, is now spreading to areas above 9,500' in elevation, moving more than two thousand feet in elevation in just ten years.

How the park communicates science within the park, integrates it with our collective culture, and communicates it with the public matters more than ever. Among the park's biggest challenges for responding to climate change is communicating the impact of climate change on a personal level, telling the story in biologically and culturally meaningful ways in order to increase understanding and support from the public.

Workforce Engagement

Rocky is looking to make new, positive strides to improve workforce engagement, empower staff, improve communications across all levels, and ensure accountability and recognition. Servicewide, Employee Viewpoint Survey results have been declining each year, highlighting the need to place a high priority on improving the workplace environment. Focusing on staff engagement and development is the right thing to do, and long overdue. These efforts will be a work in progress and continually evolving.

Relevancy

The NPS cannot achieve its mission unless we reflect the face of the nation, which means we must do a much better job to attract diverse staff, visitors, and advocates. We must work within a framework of trust, respect, and inclusion that is responsive to, and a valued part of, contemporary American society.

Although Rocky is only 1.5 hours from the major metropolitan area of Denver, visitors and park supporters are not diverse or reflective of the national population. The park is engaging with underserved audiences and youth through various initiatives and partners, including youth programs and student work programs, but there is a long way to go and a current lack of capacity to adequately address this issue. Similarly, the diversity of park staff has improved, but more progress needs to be made. Improving the diversity of park staff will increase national park advocacy amongst more user groups, and provide a welcome and familiar face that will help attract more diverse visitation.

Chapter 1. Introduction

The purpose of this State of the Park report for Rocky Mountain National Park is to assess the overall condition of the park's priority resources and values, to communicate complex park condition information to visitors and the American public in a clear and simple way, and to inform visitors and other stakeholders about stewardship actions being taken by park staff to maintain or improve the condition of priority park resources for future generations. The State of the Park report uses a standardized approach to focus attention on the priority resources and values of the park based on the park's purpose and significance, as described in the park's Foundation Document or General Management Plan. The report:

- Provides to visitors and the American public a snapshot of the status and trend in the condition of a park's priority resources and values.
- Summarizes and communicates complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format.
- Highlights park stewardship activities and accomplishments to maintain or improve the state of the park.
- Identifies key issues and challenges facing the park to inform park management planning.

The process of identifying priority park resources by park staff and partners, tracking their condition, organizing and synthesizing data and information, and communicating the results will be closely coordinated with the park planning process, including natural and cultural resource condition assessments and Resource Stewardship Strategy development. The term "priority resources" is used to identify the fundamental and other important resources and values for the park, based on a park's purpose and significance within the National Park System, as documented in the park's foundation document and other planning documents. This report summarizes and communicates the overall condition of priority park resources and values based on the available scientific and scholarly information and expert opinion, irrespective of the ability of the park superintendent or the National Park Service to influence it.

The purpose of the Rocky Mountain National Park (ROMO) is to preserve the high-elevation ecosystems and wilderness character of the southern Rocky Mountains within its borders and to provide the freest recreational use of and access to the park's scenic beauties, wildlife, natural features and processes, and cultural objects.

Significance statements express why Rocky Mountain National Park resources and values are important enough to merit national park unit designation. Statements of significance describe why an area is important within a global, national, regional, and systemwide context. These statements are linked to the purpose of the park unit, and are supported by data, research, and consensus. Significance statements describe the distinctive nature of the park and inform management decisions, focusing efforts on preserving and protecting the most important resources and values of the park unit.

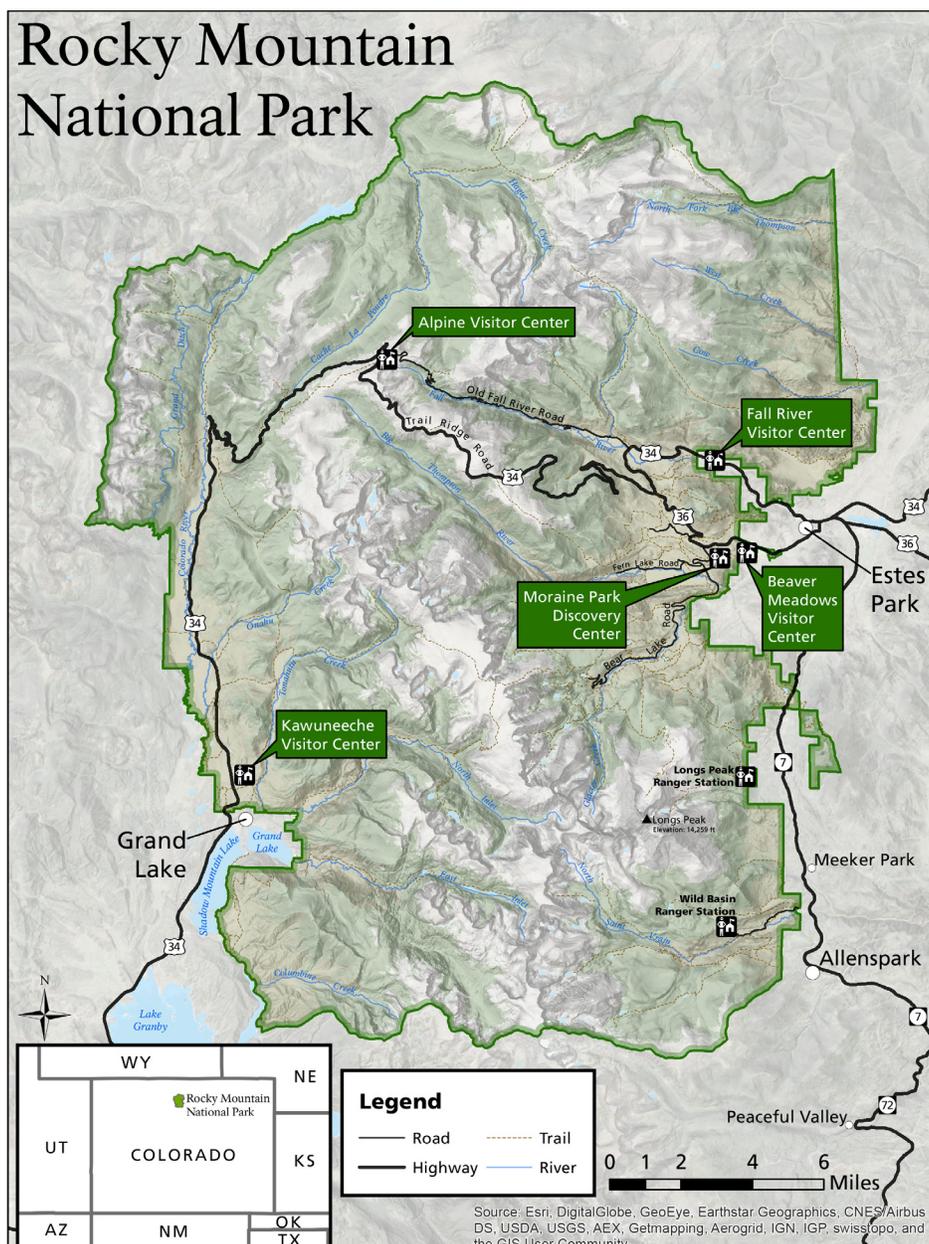
- Rocky Mountain National Park provides exceptional access to wild places for visitors to recreate and experience solitude and outstanding scenic beauty. Trail Ridge Road, the highest continuous paved road in the United States, and the extensive trail system bring visitors to the doorstep of a variety of wilderness-based recreational opportunities.
- Fragile alpine tundra encompasses one-third of Rocky Mountain National Park, one of the largest examples of alpine tundra ecosystems protected in the contiguous United States.
- Glaciers and flowing fresh water carved the landscapes of Rocky Mountain National Park. The park is the source of several river systems, including the Colorado River and the Cache la Poudre, Colorado's first and only designated Wild and Scenic River.
- The dramatic elevation range within the park boundary, which spans from 7,600 feet to 14,259 feet and straddles the Continental Divide, allows for diverse terrestrial and aquatic ecosystems, varied plant and animal communities and a variety of ecological processes. The park is designated as a United Nations Educational, Scientific, and Cultural (UNESCO) international biosphere reserve and globally important bird area, with portions of the park's montane, subalpine, and alpine ecosystems managed as research natural areas for scientific and educational purposes.
- The mountainous landscape of Rocky Mountain National Park has drawn people to the area for thousands of years. Visitors can see remnants of the different ways people have used this land over time, ranging from prehistoric big game drives to dude ranching to recreational tourism.

Established by Congress on January 26, 1915, Rocky Mountain National Park encompasses 265,761 acres or 415 square miles of the scenic southern Rocky Mountains of Colorado. Nearly one-third of the park is above treeline, or higher than 11,400 feet in elevation. Seventy-two named peaks rise above 12,000 feet, with the high point being the expansive summit of Longs Peak at 14,259 feet.

The mountains provide Rocky Mountain National Park with its sense of wonder and inspiration, and support a diversity of ecosystems, including montane, subalpine, and alpine biological communities. Rocky Mountain National Park ranks as one of America’s premier wildlife watching destinations, showcasing elk, bighorn sheep, mule deer, moose, black bears, coyotes, cougars, eagles, hawks, ptarmigan, and scores of smaller animals. The lands now known as Rocky Mountain National Park have been home to humans for at least 10,000 years. The park’s archeology and historic structures environment illustrates the history of the park from American Indian use, to homesteader ranches, to its growth through the rustic phase which includes work by the Civilian Conservation Corps, and up to the Mission 66 period when parks were being updated to keep up with the burgeoning tourism industry that arrived after World War II ended.

In 1986, 75 miles of the Cache la Poudre River were designated as part of the National Wild and Scenic Rivers System. In 2009, Congress designated the Rocky Mountain National Park Wilderness Area, covering about 252,085 acres, or 95% of the park.

Rocky Mountain National Park’s wide range of elevations and habitats offer a wide variety of opportunities for visitors, including hiking, backpacking, horseback riding, front country and backcountry camping, mountain climbing, angling, bird-watching, photography, snowshoeing and cross-country skiing. Visitors can also drive Trail Ridge Road, which topping out at 12,183 feet is the highest, continuous, paved road in the United States. In 2012, a total of 3,394,326 recreational visits were recorded in the park, making Rocky Mountain National Park the 23rd most visited park unit, and the 5th most visited national park in the National Park System.



Map of the Park

Chapter 2. State of the Park

The State of the Park is summarized below for five categories—Natural Resources, Cultural Resources, Visitor Experience, Park Infrastructure, and Wilderness Character—based on a synthesis of the park’s monitoring, evaluation, management, and information programs, and expert opinion. Brief resource summaries are provided below for a selection of the priority resources and values of the park. Clicking on the [web](#) ► symbol found in the tables and resource briefs below will take you to the internet site that contains content associated with specific topics in the report.

The scientific and scholarly reports, publications, datasets, methodologies, and other information that were used as the basis for the assessments of resource condition are referenced and linked throughout the report and through the [internet version of this report](#) that is linked to the NPS [IRMA data system](#) (Integrated Resource Management Applications). The internet version of each report provides additional detail and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in data collection and the assessments of condition. Resource condition assessments reported in this State of the Park report involve expert opinion and the professional judgment of park staff and subject matter experts involved in developing the report. This expert opinion and professional judgment derive from the in-depth knowledge and expertise of park and regional staff gained from their being involved in the day-to-day practice of all aspects of park stewardship and from the professional experience of the participating subject matter experts. This expert opinion and professional judgment utilized available factual information for the analyses and conclusions presented in this report. This State of the Park report was developed in a park-convened workshop.

The status and trends documented in Chapter 2 provide a useful point-in-time baseline measured against reference conditions that represent “healthy” ecosystem parameters, or regulatory standards (such as those related to air or water quality). We also note that climate change adaptation requires us to continue to learn from the past, but attempting to manage for conditions based on our understanding of the historical “natural” range of variation will be increasingly futile in many locations. Thus, these reference conditions, and/or our judgment about resource condition or trend may evolve as the rate of climate change accelerates and we respond to novel conditions ([McWerthy 2010](#)). Our management must be even more “forward looking,” to anticipate plausible but unprecedented conditions, also recognizing there will be surprises. In this context, we will incorporate climate considerations in our decision processes and management planning as we consider adaptation options that may deviate from traditional practices.

2.1. Natural Resources

Air Quality				web ►
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale	
Visibility	Haze index		<p>Visibility is a measure of how far and how well we can see a distant and varied scene, including the form, contrast detail, and color of features. Particles in the atmosphere—from both natural and human-caused sources (e.g., smoke, industry, power plants, dust)—scatter and absorb light, creating a haze that impairs scenic views.</p> <p>Visibility warrants moderate concern. This status is based on NPS Air Resource Division benchmarks and the 2010–2014 estimated visibility on mid-range days of 3.1 deciviews (dv) above the estimated natural conditions of 2.9 dv. Data from the park IMPROVE (Interagency Monitoring of Protected Visual Environments) visibility monitoring site indicates that during the 2005–2014 decade, the trend in visibility improved on the 20% clearest days and remained relatively unchanged (no statistically significant trend) on 20% haziest days, resulting in an overall unchanging visibility trend. The Clean Air Act visibility goal requires visibility improvement on the 20% haziest days, with no degradation on the 20% clearest days. (continued on next page)</p>	

Air Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visibility (continued)	Haze index (continued)	 (continued)	(continued) The degree of confidence in visibility status and trend at ROMO is high because there is an in-park visibility monitor (IMPROVE Site ID: ROMO1, CO; NPS-ARD 2016) with long-term monitoring data.
Ozone	Human health: Annual 4th-highest 8-hour concentration		<p>Ozone is a respiratory irritant, causing coughing, sinus inflammation, chest pains, scratchy throat, lung damage, and reduced immune system functions. Children, the elderly, people with existing health problems, and active adults are most vulnerable.</p> <p>Human health risk from ground-level ozone warrants significant concern. This status is based on NPS Air Resource Division 2010–2014 estimated ozone concentration of 75.0 parts per billion (ppb). The park area east of the Continental Divide is designated by the Environmental Protection Agency (EPA) as nonattainment (not meeting) for the ground-level ozone standard of 70. For the 2005–2014 decade, the trend in ozone concentration remained relatively unchanged (no statistically significant trend).</p> <p>The degree of confidence in the status and trend of human health risk from ground-level ozone is high because there is a nearby ozone monitor (AQS Monitor ID: 080690007, CO; NPS-ARD 2016).</p>
	Vegetation health: 3-month maximum 12-hour W126		<p>In addition to being a concern to human health, long-term exposures to ozone can cause injury to ozone-sensitive plants. There are many ozone-sensitive plants in the park, including: cutleaf coneflowers (<i>Rudbeckia laciniata</i>), quaking aspen (<i>Populus tremuloides</i>), Scouler’s willow (<i>Salix scouleriana</i>), white sagebrush (<i>Artemisia ludoviciana</i>), and Canadian goldenrod (<i>Solidago canadensis</i>).</p> <p>Vegetation health risk from ground-level ozone warrants significant concern. This status is based on NPS Air Resource Division benchmarks and the 2010–2014 estimated W126 metric of 18.6 parts per million-hours (ppm-hrs). The W126 metric relates plant response to ozone exposure during daylight hours over the growing season.</p> <p>A risk assessment concluded that plants in ROMO are at low risk for ozone damage (Kohut 2004, Kohut 2007, Kohut 2012). However, foliar injury to cutleaf coneflowers have been documented (Kohut 2012). For the 2005–2014 decade, the trend in the ozone damage metric remained relatively unchanged.</p> <p>The degree of confidence in the status and trend of vegetation health risk from ground-level ozone is high because there is an in-park ozone monitor (AQS Monitor ID: 080690007, CO; NPS-ARD 2016).</p>

Air Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wet Deposition	Nitrogen wet deposition		<p>Three-quarters of the park is above 9,000 feet elevation. These high elevation ecosystems are especially susceptible to excess nitrogen deposition. Ecosystem changes from excess nitrogen include shifts in species of aquatic plants, shifts in alpine tundra plant communities, reduced biodiversity, decreased water quality, increased potential for insect and disease outbreaks, and decreased ability of natural ecosystems to respond to changing climate conditions. Ecosystems at ROMO were rated as having very high sensitivity to nutrient-enrichment effects (Sullivan et al. 2011c, Sullivan et al. 2011d). Excess nitrogen can also cause invasive exotic plant species to grow faster and out-compete native vegetation (Blett and Eckert 2013, Bobbink et al. 2010). Additional vegetation communities are at risk for harmful effects (NADP-TDEP 2014, Pardo et al. 2011).</p> <p>Wet nitrogen deposition warrants significant concern. This status is based on exceedance of the park's high elevation ecosystem critical load and resource management goal listed in the Rocky Mountain National Park Nitrogen Deposition Reduction Plan 2007, Rocky Mountain National Park Initiative: 2012 Nitrogen Deposition Milestone Report.</p> <p>The park's high elevation lake system critical load is 1.5 kilograms of nitrogen per hectare per year (kg N/ha/yr), which is the rate of deposition that unnatural changes begin to occur. The 5-year average (2010–2014) of wet nitrogen deposition is 3.3 (kg N/ha/yr) and would need to be reduced below the critical load to prevent injury.</p> <p>For the period of record (1984–2014) at Loch Vale in the park, the trend in the wet nitrogen deposition in rain and snow remained relatively unchanged (no statistically significant trend). However, wet nitrogen deposition at the park's Beaver Meadows (1981–2014) increased. Similarly, in more recent years (2008–2014), wet nitrogen deposition at Loch Vale remained relatively unchanged while deposition at Beaver Meadows increased.</p> <p>The degree of confidence in the wet nitrogen status and trend is high because of the on-site deposition monitors (NADP Monitor ID: CO98, CO; CO19, CO).</p>

Air Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wet Deposition (continued)	Sulfur wet deposition		<p>Acidification of soils and streams from wet sulfur deposition can result in changes in community structure, biodiversity, reproduction, and decomposition. Ecosystems at ROMO were rated as having very high sensitivity to acidification based on conditions including steep slopes, high elevation lakes, and headwater streams (Sullivan et al. 2011a, Sullivan et al. 2011b).</p> <p>Wet sulfur deposition warrants significant concern. This status is based on NPS Air Resources Division benchmarks and the 2010–2014 estimated 0.5 to 1.6 kilograms per hectare per year (kg/ha/yr) range of wet sulfur deposition. To maintain the highest level of protection in the park, the maximum of this range (1.6 kg/ha/yr) is used to determine the significant concern, and is a level that normally warrants moderate concern. However, the condition has been elevated to significant concern because ecosystems at Rocky Mountain NP may be very highly sensitive to acidification effects. For the 2005–2014 decade, the trend in the wet sulfur concentrations in rain and snow improved.</p> <p>The degree of confidence in the wet sulfur status and trend is high because of the in-park deposition monitor (NADP Monitor ID: CO98, CO); NPS-ARD 2016).</p>
	Mercury/toxics deposition		<p>High mercury concentrations in birds, mammals, amphibians, and fish can result in reduced foraging efficiency, and reduced survival, and reproductive success. Elevated levels of mercury in humans can affect the brain, kidneys, and reproductive function. Wet and dry atmospheric deposition can lead to mercury loadings in water bodies and bioaccumulate through the food chain.</p> <p>Mercury deposition warrants significant concern. The 2011–2013 estimated wet mercury deposition was very high at the park, ranging from 4.9 to 15.1 micrograms per square meter (NPS-ARD 2016), and predicted methylmercury concentrations in surface waters was moderate, ranging from 0.025 to 0.059 to nanograms per liter (USGS 2015). To maintain the greatest level of protection, the highest values for both factors were compared to NPS Air Resource Division benchmarks to determine the significant concern status.</p> <p>Studies indicate that pesticide and mercury concentrations in some fish from ROMO exceed human and/or wildlife health thresholds (Eagles-Smith 2014). In addition, Flanagan Pritz et al. (2014) reported that current-use pesticides (chlorpyrifos, dacthal, endosulfans) are particularly high in fish from parks in the Rockies (including ROMO) and Sierra Nevada, as compared to burdens in fish from parks in Alaska and the Cascades.</p> <p>The degree of confidence in the mercury/toxics deposition status is low because wet deposition and methylmercury concentration estimates are based on interpolated or modeled data rather than in-park studies. In addition, there are few park-specific studies that examine contaminant levels for species that live in ROMO.</p>

Air Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Dry Deposition</p>	<p>Snow chemistry (ammonium, nitrate, sulfate, mercury)</p>		<p>Dry atmospheric deposition in snowpack represents a significant proportion of the total annual deposition in the Rocky Mountains. Measuring nutrients and other pollutants in snow tracks these compounds that are later released into the soil, groundwater, and streams during the summer months. Ecosystems in Rocky Mountain NP were rated as having very high sensitivity to nutrient-enrichment effects (Sullivan et al. 2011c, Sullivan et al. 2011d).</p> <p>The condition of dry deposition in snow in the park warrants significant concern. Snowpacks in 2015 generally had well-below-average- to near-average snow water equivalent, which affects the concentration of pollutants. Snowpacks are sampled from late February through early April, and snow-water equivalent measured on April 1, near the end of sampling, ranged from 26% to 91% of normal conditions across the region. At most regional sites monitored during 1993–2015, snowpack nitrate and sulfate concentrations for 2015 were lower than the 23-year averages, whereas the majority of snowpack ammonium concentrations in the region were greater than the historical mean. This is consistent with 20-year (1993–2012) regional trends that show statistically significant (p-value <0.01) decreasing trends of nitrate and sulfate concentrations and statistically significant (p-value <0.01) increasing trends in ammonium concentrations across the Rocky Mountain region. The regional mean total mercury concentration in the snowpack for 2015 was slightly less than the historical mean; however, the regional trend (2001–2015) in total mercury concentration is not statistically significant. See the USGS website for information on this snowpack monitoring program.</p> <p>Confidence is high for this indicator because of the long-term record and because sampling is carried out throughout the Rocky Mountains, providing broad context for results in ROMO.</p>

Geology and Soils


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Geologic resource inventory and mapping		<p>Understanding the relationships between geologic and biological (plants and animals) components of park ecosystems is vital to understanding, managing, and protecting natural resources and ecosystems. The Geologic Resources Inventory (GRI) helps make this connection by providing information on geologic resources and their management in relation to other resources in the park. In addition, this information is important for understanding and managing risks from geologic hazards (e.g., landslides) and for managing park infrastructure.</p> <p>ROMO has a current (2004) parkwide geologic map, an unpublished GIS geospatial dataset (2013), and a short paleontological resource inventory (2004).</p> <p>Gold mining occurred in the park in the 1880s in the Longs Peak Mining District on the east side of the park (Butler 2006). Mining-related equipment (cabins, drills, picks, ore wagons) were removed from the park in the 1930s by the Civilian Conservation Corps, and all mine-openings were closed or backfilled in the 1960s.</p>
	Soil resource inventory and mapping		<p>Soil is the unconsolidated portion of the earth's crust modified through physical, chemical, and biotic processes into a medium capable of supporting plant growth. Soil properties influence the biotic and physical infrastructure of ecosystems and the landscape.</p> <p>ROMO has a parkwide digital soil survey dataset (updated in 2013) that meets the standards and specifications of the NPS Soil Resources Inventory. This dataset is generally the most detailed level of soil geographic data developed by the National Cooperative Soil Survey and consists of georeferenced digital map and attribute data. The map data include a detailed and field verified inventory of soils.</p>

Water Quantity and Quality


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Rocky Mountain National Park streams are high-elevation systems with cold clear waters naturally high in dissolved oxygen and low in nutrients. These conditions support coldwater fish species such as greenback and Colorado River cutthroat trout.

Nutrients and other pollutants are deposited in rain (wet deposition) and snow (dry deposition) and enter park ecosystems, causing impacts to vegetation (e.g., through artificial fertilization) and aquatic systems (e.g., through acidification of park lakes and streams). Due to characteristics of the geology and soils in ROMO, studies indicate that park ecosystems have low capacity to buffer acidification from pollutants in park waters. In addition, some contaminants (some pesticides and mercury, for example) can “bio-accumulate” such that they are concentrated in animals higher on the food chain, which can cause reproductive failure and death. There are emerging concerns for other pollutants, e.g., endocrine disruptors, which are naturally occurring or man-made substances that may mimic or interfere with the function of hormones in humans and other animals.

There is evidence that atmospheric deposition of pollutants increases with elevation in ROMO. Long-term data and studies at select sites in the park (e.g., Loch Vale) provide an in-depth understanding of water quality dynamics in these watersheds. Less is known about water quality dynamics parkwide. A parkwide survey of stream ecological integrity that includes water quality monitoring is nearly complete (fieldwork will be completed in 2016). Additionally, long-term stream Vital Signs monitoring is underway that will complement site specific research and monitoring at Loch Vale and other sites.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Water Quality</p>	<p>Nutrients and major ions and select contaminants in high elevation watersheds and research sites, such as Loch Vale</p>		<p>Water quality is a fundamental component of healthy aquatic ecosystems and watersheds. It is also critical for human health and safety (for park visitors and for downstream communities that rely on waters originating at high elevations in ROMO). There is a long history of intensive water quality research in select high elevation sites in ROMO, especially Loch Vale. Much more is known about water quality related to known stressors, such as atmospheric deposition and climate change, at these sites, and how specific attributes such as vegetation, soils, and geology interact and impact water quality in these watersheds.</p> <p>The condition of water quality at high elevations and research sites warrants significant concern. Weather stations and stream gauges have been collecting data in the Loch Vale watershed, a 660 hectare (1,630 acre) alpine and subalpine catchment, since 1983 (Baron 1992). Studies that began in 1983 in the Loch Vale watershed (Baron 1992) and comparisons to other areas of the park have shown that soils, water, vegetation, and diatom communities have been altered by increased nitrogen availability (Baron et al. 2000; Wolfe et al. 2003; Baron 2006). Nitrogen deposition has affected many of the lakes in the park east of the Continental Divide, with a measurable increase in nitrate concentrations and reduced acid-neutralizing, or buffering, capacity (Baron et al. 2011). Historical and currently used pesticides are also polluting waters in the park. A recent study detected p,p'-DDT (the active ingredient in commercial dichlorodiphenylethene) in some fish in the park at concentrations that exceed the guidelines for human health and wildlife consumption (Flanagan Pritz et al. 2014). In addition there are emerging concerns for newer contaminants such as endocrine disruptors. Finally, rapid climate change is changing the timing and amount of rain and snowfall (Kunkel et al. 2013), which will affect atmospheric deposition and concentration of pollutants in park waters.</p> <p>(continued on next page)</p>

Water Quantity and Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Water Quality (continued)	Nutrients and major ions and select contaminants in high elevation watersheds and research sites, such as Loch Vale (continued)	 (continued)	<p>(continued)</p> <p>While the park and its partners have made significant progress in managing nutrient deposition, indications are that overall, water quality is declining.</p> <p>Long-term monitoring and research at Loch Vale and in other areas of the park provide solid scientific data on some pollutants (esp. nutrients). The lack of information on mercury and other emerging contaminants as well as uncertainty in how rapid climate change will affect pollution and park waters, however, makes confidence in this assessment moderate.</p>
	Nutrients and major ions and select contaminants in streams parkwide		<p>Water quality is a fundamental component of healthy aquatic ecosystems and watersheds. It is also critical for human health and safety (for park visitors and for downstream communities that rely on waters originating at high elevations in ROMO). Monitoring water quality parkwide, at all elevations, is important in order to understand how stressors such as atmospheric deposition and climate change may be interacting with vegetation, soils and geology across the entire park (especially west of the continental divide where less long-term research and monitoring has been conducted).</p> <p>The condition of nutrients, major ions, and select contaminants in streams parkwide warrants moderate concern. Summaries of historical water quality data across the park (Mast 2007) and unpublished preliminary 2014 and 2015 data (Schweiger et al. 2016) indicate there are few exceedances of state water quality standards in the park. Surface water in the park is dilute (low concentration of pollutants) and weakly buffered due to bedrock and a high degree of hydrologic flushing. Concentrations of sulfate and chloride (both often used as general indicators of anthropogenic disturbance) are similar to concentrations measured in local precipitation (Baron 1992) and thus suggest no or few issues. Metals (including copper, which was recently of potential concern to the state and EPA, NPS (2013b)) were either not detectable (i.e., in very low concentration) or if slightly elevated, likely associated with natural surficial geologic types. NPS monitoring data show that nutrients are also occasionally higher at select sites, although most increased nitrogen or phosphorous concentrations were associated with wetlands or had very low flow. Both conditions can naturally elevate these constituents.</p> <p>Confidence in this assessment is moderate; there have been many studies over the years but these had varying objectives and were not designed to monitor parkwide status and trends in stream waters. The long-term stream monitoring program is just beginning but will provide a high degree of confidence once it is fully implemented.</p>

Water Quantity and Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Water Quality (continued)	Water temperature		<p>Water temperature is a fundamental aspect of streams and affects the aquatic species that rely on stream ecosystems. Native fish such as greenback and Colorado River cutthroat trout are sensitive to increased water temperatures. In addition, as stream temperatures increase, nonnative species can invade park streams.</p> <p>The condition of water temperature warrants moderate concern. Site specific data from the last several years in ROMO suggest many stream reaches can experience elevated summer maximum water temperatures, often exceeding state water quality criteria for cold water fisheries (Schweiger et al. 2016). Trends in condition are likely declining; rapid climate change appears to be associated with a projected 0.19 °C increase per decade in mean annual lake surface temperature, a 4.7 °C increase per decade in lake ice-free days, and a 0.42 °C increase per decade in summer mean lake water temperatures through the 2080s (Roberts et al. unpublished data from 24 lakes in ROMO).</p> <p>The research and monitoring information for this indicator are based on published protocols and accepted scientific methods. However, the results are yet to be published, so confidence in the assessment is moderate.</p>
Geomorphology	Debris flows (frequency and intensity) Stream/river channel characteristics		<p>The channel morphology (including channel cross section and longitudinal gradient) of ROMO streams and rivers has developed in response to high topographic gradient of the Front Range, the long-term hydrological regime (including accumulation and release of water from snowpack) and the sediment load (dependent on the geology) of park drainage basins. Stream organisms including insects, fish and riparian vegetation are adapted to, and depend upon, the channel forms and hydrologic and sediment regimes of the park.</p> <p>Extreme rain or snowmelt runoff events are short-term or episodic disturbances (e.g., the Sept. 2013 floods and debris flows in ROMO) but often these are temporary and the streams recover over the following months or years (Lord 2009). Similarly, wildfires can affect the sediment regimes of a watershed and its streams but recovery will occur over months or years depending on the severity of the fire.</p> <p>Both frequency and intensity of debris flows and changes in stream/river channel characteristics warrant moderate concern. The 2013 floods resulted in the most recent example of damage from intense flooding, which included roads, trails, bridges, and park buildings. Heavily impacted drainages included: North Fork of the Big Thompson River, West Creek, Black Canyon Creek, Roaring River, Bighorn Creek, and Ouzel Creek, as well as the Twin Sisters area and along Old Fall River Road.</p> <p>(continued on next page)</p>

Water Quantity and Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Geomorphology (continued)	Debris flows (frequency and intensity) Stream/river channel characteristics (continued)	 (continued)	<p>(continued)</p> <p>The park has made progress in restoring riparian vegetation damaged by extensive browsing by uncontrolled elk populations. Given enough time and significant recovery of willows, beaver may become re-established in major park rivers (Big Thompson and the Upper Colorado, for example). This progress will help restore proper hydrologic functioning of these streams.</p> <p>However, with rapid climate change, the impacts of extreme runoff and fire events may become more important and damage long-term patterns of park stream geomorphology and hydrology to the detriment of the aquatic organisms that depend on park streams. Recent analyses indicate a shift toward earlier spring runoff and peak flows in Colorado (Clow 2010, Lukas et al. 2014), similar to those seen across the rest of the western U.S. (Stewart et al. 2005).</p> <p>Our confidence in this assessment is low given that little research on long-term geomorphology of park streams has been published. One study on the response of the Fall River to the 2013 flood was published as a thesis (Schutte 2015). There is also a study (by Sara Rathburn from CSU) in progress to address vulnerability of park drainages to debris flows begun after the 2013 floods.</p>
	Glacial extent		<p>While glaciers in ROMO are few and small, these remnant glaciers provide a barometer of how rapid climate change may be affecting the park.</p> <p>The condition of glacial extent warrants significant concern. Because of their small size, glaciers at ROMO are very sensitive to fluctuations in temperature and respond quickly to warming or cooling. However, due to the locations of the basins in which they reside, most of their accumulation is due to the redistribution of snow by wind or by avalanching, and the accumulation rates on the glaciers can be many times higher than the seasonal snowfall. Because of this, the glaciers are relatively insensitive to variations in snowfall. Variations in glacier mass are caused by changes in summer temperatures from year to year. Annual measurements in the changes of the mass of Andrews Glacier can be related directly to summer temperature. Warmer summer temperatures melt more ice than cooler summer temperatures (Hoffman et al. 2007). Temperature is projected to increase at ROMO between 2.8 and 4.7 °C by the end of 2100, and the projected increase varies by the IPCC scenario used (Gonzalez 2012). Rising temperatures will likely mean a decline in glacial extent.</p>

Water Quantity and Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Hydrology</p>	<p>Water rights Ditches and dams</p>		<p>Water rights are important for protecting instream flows for wildlife and fisheries, as well as for furnishing water supplies for visitor and staff services (restrooms, campgrounds, and concessionaires). Water diversions can adversely affect the availability of water in time, place, and amount to meet the consumptive and non-consumptive water needs of ROMO. In particular, such diversions can adversely affect the natural ecology of aquatic systems and disrupt stream channel formation and maintenance.</p> <p>The condition of water rights, ditches, and dams is of moderate concern. The park diverts water in support of many consumptive uses. To support these uses, the park holds a number of state law-based water rights as well as federal reserved rights. In addition to rights for consumptive uses of water, the park has instream flow water rights to protect in situ values such as fish, wildlife, recreation, and riparian vegetation. The majority of the park's consumptive and non-consumptive uses were decreed to the park through court adjudications completed in 1994 and 2000. The park also holds multiple rights for wells for consumptive uses.</p> <p>The park's rights are administered within the state water right system. Consequently, they are vulnerable to calls for curtailment by downstream senior right holders in the event that streamflow becomes inadequate to support all water rights in a given watershed. The park's location at the top of the watershed affords some protection as there are no upstream water rights holders; nevertheless, the park's uses have some degree of vulnerability based on the priority dates of the park's rights, drought, and climate change.</p> <p>In addition to the park's consumptive and non-consumptive uses of water, there are multiple water diversions from within the park for uses beyond park boundaries. Such uses and associated rights were established prior to creation of the park. These rights, with associated structures, present some degree of risk to park resources based on consumption of water and the presence of physical facilities. There are four water diversions (Grand Ditch, Harbison Ditch, MacGregor Ranch, and Copeland Lake) and three dams (Lily Lake, Sprague Lake, and Copeland Lake) operated within the park. Of these water diversions, the Grand Ditch is of particular ecological concern because of its length and location. The 15-mile ditch runs along the flanks of the Never Summer Mountains and diverts water to the east side of the Continental Divide rather than allowing it to flow into the upper reaches of the Colorado River. In addition, when diversions and dams fail, extensive resource damage can occur, as was the case in the most recent failure of the Grand Ditch in 2003. Approximately 22 acres of riparian, upland, and wetland habitats and 1.5 miles of stream were severely harmed. The process of restoring these habitats has begun. Though these pre-existing uses are to be respected, the risk associated with them can be reduced through special use permits. (continued on next page)</p>

Water Quantity and Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Hydrology (continued)	Water rights Ditches and dams (continued)	 (continued)	<p>(continued)</p> <p>The overall trend regarding the park's water rights is stable; the park's water uses are supported by state law-based rights and federal reserved rights. However, there are risks posed to the park's water uses and water-related resources by drought, climate change, the presence of third person water development within the park, and growing water demand beyond park boundaries.</p> <p>Rights held by third-parties within the park are expected to remain in use at current levels. Consequently, the effects of water consumption and the risks associated with physical facilities in the park will remain for the foreseeable future.</p>

Freshwater Communities


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Lakes	Native communities Aquatic macroinvertebrates		<p>When fish are introduced to naturally fishless waters, other species abundances shift, especially in aquatic insect communities. Evidence suggests that amphibians, birds, and other terrestrial species can be impacted by the presence of fish.</p> <p>The condition of lakes warrants significant management concern. ROMO contains approximately 147 lakes. Based on the presence of barriers and stocking records, it is believed that most, if not all, of these lakes were historically fishless. Nearly all lakes >1 acre in size were stocked with fish at some point in the last 150 years. Over 40 lakes currently have fish.</p> <p>The resource is improving and over time as many of the previously stocked lakes are reverting to a fishless condition and are in the process of recovering their native species composition and abundance (Lafrancois 2005). There is a limited number of studies and minimal long-term monitoring.</p>

Freshwater Communities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Streams	Aquatic macroinvertebrates		<p>Aquatic insects are critical components of streams because they are important food sources for fish and birds and other animals and for their contribution to biodiversity.</p> <p>The condition of park aquatic macroinvertebrates warrants moderate concern. Provisional 2014 and 2015 data (Schweiger et al. 2016) suggest that most macroinvertebrate communities in the park are intact and of higher quality. Metrics examining diversity and the sensitivity of benthic communities to nutrients indicate that only a few sites, purposefully chosen in more populated front country areas, have lower than expected species diversity.</p> <p>Data from both the Colorado Department of Health and Environment (CDPHE 2011) and the U.S. EPA (Stoddard et al. 2005) also indicate that for select sites in the park, indices of biotic integrity are above reference thresholds. However, additional work is needed to confirm that these patterns are relevant to park waters as a whole and/or at high elevation sites where shifts in thermal regimes and elevated nutrient deposition may already or could eventually impact species at the edge of their thermal niches (Giersch et al. 2015).</p> <p>Confidence in this assessment is moderate because the parkwide stream survey is not complete. Furthermore, the state and EPA assessments may be more appropriate for streams in developed areas rather than streams in wilderness.</p>
	Physical habitat and structure (e.g., woody debris, substrate)		<p>Streams provide habitat for breeding, feeding, and overwintering of aquatic species. Fine sediments such as silt and clay particles can be detrimental to aquatic species such as trout and insects, by interfering with their ability to function and breed successfully.</p> <p>The U.S. EPA (Stoddard et al. 2005) indicates that for select streams in the park, riparian human disturbance, relative bed stability, and canopy cover are in good or reference conditions. Some sites may have slightly elevated fine sediments, although in many cases, higher coverage of fine sediments can be attributed to natural causes such as flood events.</p> <p>Wohl and Cadol (2011) and Wohl and Goode (2008) provide detailed data on the dynamics of large woody debris in select watersheds in the park. Their results suggest that wood may be less common in some park streams relative to other similar regions of the world given reduced residence times in channels. This lack of wood is indirectly caused by timber harvest prior to the park's establishment and/or complex fire histories.</p> <p>The 2014–2015 NPS stream survey (Schweiger et al. 2016) includes the same U.S. EPA habitat measures cited above for over 50 sites in the park. When analyzed, these types of assessment will extend to the park as a whole. Confidence in this assessment is moderate since the parkwide survey is not yet complete.</p>

Wetland Communities


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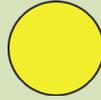
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Riparian and Wet Meadow Wetland Communities</p>	<p>Ecological integrity</p>		<p>Wetlands are biodiversity hotspots. More than 30% of the park's flora occurs in wetland habitats, which make up only 4–5% of the park's area. About 48% of the park's avian and 20% of its mammal species are commonly found in these wetland areas. In addition, wetlands provide many important ecosystem services such as flood mitigation, water purification, nutrient cycling, and groundwater recharge.</p> <p>The condition of riparian and wet meadow wetland communities in the park warrants significant concern. The NPS monitors the health and ecological integrity of wet meadow and riparian wetlands, including measures of vegetation cover, ground water hydrology, woody stem density, damage to woody stems by beaver and ungulates, and other anthropogenic and natural stressors (Schweiger et al. 2015). Data collected from 2007 to 2009 suggest that 42% to 49% (depending on type) of the park's riparian and wet meadow wetlands were in a human-disturbed condition. Undisturbed riparian and wet meadow wetlands in ROMO tend to occur at higher elevations. Low elevation wetlands tend to be heavily disturbed, especially in the broad valleys that make up elk winter range on the east side of the park and in the Kawuneeche Valley on the west side. The trend of wetland health is unknown until further data are collected.</p> <p>The future for riparian and wet meadow wetland communities in the park is unclear. While the park is working toward restoring wetlands on the elk winter range, and the winter elk population size is down, moose are expanding their range, increasing browsing pressure. More broadly, climate induced changes to the hydrology and vegetation in park wetlands may pose a serious threat to park riparian and wet meadow communities.</p>

Wetland Communities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Riparian and Wet Meadow Wetland Communities (continued)	Willow habitat		<p>Willows are the dominant woody shrubs in riparian areas in the park. They are an important food source for elk (Hobbs et al. 1981, Singer et al. 2002) and beaver (Baker and Cade 1995), and support a large number of bird and butterfly species relative to other habitat types (Connor 1993, Simonson et al. 2001).</p> <p>The condition of riparian willow habitat in the park warrants significant concern. Riparian willow declined drastically after European settlers arrived in the area and began removing them and draining areas for agriculture and development (Gysel 1960). After the park was established, riparian willow on the east side of the park declined further due to a variety of factors. This included a large reduction (69%) in surface water related to an almost complete loss (>90%) of beaver, and decades of browsing by overabundant elk (Packard 1947, Peinetti et al. 2000, Zeigenfuss et al. 2002, Cooper et al. 2003). On the west side of the park, tall willow cover declined by about 40% between 2001 and 2005 due to the combined effects of a native fungus and decreased peak stream flows, along with heavy browsing by elk and moose (Kaczynski et al. 2014).</p> <p>The trend in riparian willow is unclear. Temporary fences constructed beginning in 2008 to promote willow recovery in elk concentration areas resulted in increased willow height and cover by 2013; however, progress was limited inside some fences and in areas outside fences (Zeigenfuss and Johnson 2015).</p>
Fen Communities	Ecological integrity		<p>Fens are a relatively distinct wetland type that accumulates peat (organic soils formed under waterlogged conditions). Their hydrology is predominantly groundwater driven. Like other wetlands, they are biodiversity hotspots, and in ROMO, have a high percentage of rare plants.</p> <p>The condition of fens warrants moderate concern. Data collected from 2007 to 2009 suggest that around 31% of fens are in a human-disturbed or non-reference condition. Fens typically have intact vegetation, with few invasive species and a higher number of conservative species (a high number of conservative species indicates high habitat integrity) compared to wet meadows and riparian wetlands in ROMO.</p> <p>Confidence in the status assessment for fens is high because of the parkwide survey completed in 2010. Further monitoring is needed to assess trends in the condition of fens.</p>

Alpine Ecosystems


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Alpine Vegetation Communities</p>	<p>Species composition</p>		<p>This distinctive treeless alpine habitat (about one-third of the park), with easy access via Trail Ridge Road, is one of the park's most distinctive attractions. Alpine vegetation occurs above approximately 11,400 feet, where the vegetation is primarily grasses, sedges, wildflowers, and low growing shrubs. For most alpine plant species, growth and reproduction are strongly limited by harsh conditions and nutrient availability.</p> <p>The status of and potential threats to the alpine warrant moderate concern. Eight long-term monitoring plots on four park summits were established in 2009 to monitor trends in vascular plants and soil temperature as part of the Global Research Initiative in Alpine Environments (GLORIA) network. These plots had an average of 18 vascular plant species per square meter. Common dandelion, which was found in low abundance on the lowest peak, was the only exotic species.</p> <p>Although the alpine has been less affected by human activities in the park (less than other life zones) because of its relative inaccessibility and harsh climate, the alpine tundra is more sensitive to human impacts than other areas. Visitor trampling, increased nitrogen deposition, and previous livestock and current wildlife grazing have altered the alpine landscape.</p> <p>Experimental and monitoring data, along with paleoenvironmental records, suggest that grasses and shrubs will become more dominant over time and that other plant species, including trees, will begin to migrate upslope if nitrogen deposition and temperatures continue to increase. These changes would fundamentally alter the alpine life zone.</p> <p>The confidence in this assessment is moderate because these relatively few plots may or may not represent the condition of the alpine across the park, even though the GLORIA plots provide a good baseline of alpine vegetation information. The trend in alpine condition cannot be documented until further alpine data are collected and analyzed.</p>

Sub-alpine Ecosystems


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Limber Pine Communities</p>	<p>Blister rust infection Average density of live mature pines</p>		<p>Limber pine (<i>Pinus flexilis</i>) is a keystone species that maintains ecosystem structure, function, and biodiversity in the park. It defines the alpine treeline; grows on exposed sites too harsh for other tree species; often establishes on a site soon after disturbance; facilitates forest succession and the growth of understory species; aides in soil stabilization, snowpack retention and melt; and its seeds are a food source for birds, small mammals, and bears.</p> <p>In ROMO, the condition of limber pine warrants significant management concern. It is declining due to the interacting effects of recent severe droughts and the climate-exacerbated mountain pine beetle (<i>Dendroctonus ponderosae</i>) outbreak. It is also imminently threatened by the invasion of the nonnative pathogen, <i>Cronartium ribicola</i>, which causes the lethal disease white pine blister rust (WPBR) in five-needle white pines. WPBR was confirmed in the park in 2010 and is expected to spread, kill trees, and negatively impact biodiversity, ecosystem processes, and other park resources, compounding the effects of changing climate (Schoettle et al. 2014).</p> <p>The confidence in this assessment is high because of the quantity and quality of limber pine research that has been conducted in the park and elsewhere. Additionally, ROMO recently completed a limber pine conservation strategy.</p>
<p>Bark Beetles</p>	<p>Acres affected</p>		<p>Bark beetles are native insects that have shaped the forests of North America for thousands of years. Recent outbreaks of mountain pine beetle (<i>Dendroctonus ponderosae</i>) have resulted in extensive mortality of lodgepole pine throughout the park and elsewhere.</p> <p>Although population densities of mountain pine beetle have decreased in the park, populations of other bark beetles are increasing in Colorado. These species include Douglas-fir beetles (<i>Dendroctonus pseudotsugae</i>), spruce beetles (<i>Dendroctonus rufipennis</i>), and western balsam bark beetles (<i>Dryocoetes confusus</i>). These beetles are native to the southern Rockies; however, the extent of recent beetle activity is without historical precedent. Additionally, climate change is expected to intensify the impacts of future beetle activity.</p> <p>Confidence in this assessment is high as surveys of bark beetle activity on the Front Range are conducted on an annual basis.</p>

Sub-alpine Ecosystems (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Native Vegetation Communities	Shifts in tree stand dynamics and locations		<p>The subalpine life zone is home to a variety of native vegetation communities and is the most heavily forested of the three life zones in the park.</p> <p>The condition of native vegetation communities in ROMO warrants moderate concern. Shifts in forest structure and composition from changing climate, altered disturbance regimes, and altered land use are occurring and expected to increase in the coming decades. Recent studies have documented changes in forest structure and species migration over the past 40 years (Peet 1981, Esser 2015).</p> <p>The forest response to these changes has varied by species, by topographic position (northern vs. southern aspect), and by the presence of disturbances such as fire and mountain pine beetles (Esser 2015). While the stem density of some species has remained relatively unchanged, shade-tolerant species such as Douglas fir and subalpine fir have increased in abundance.</p> <p>Models predict and observational data suggest that as temperatures increase, subalpine trees will move upslope (Monahan et al. 2013, Esser 2015), but that disturbances such as fire, beetles, and white pine blister rust will be the primary drivers of patterns in forest distribution.</p>

Montane Ecosystems


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Upland Shrub Communities	Shifts in shrub stand dynamics		<p>Antelope bitterbrush (<i>Purshia tridentata</i>) and mountain sage brush (<i>Artemisia tridentata ssp. vaseyana</i>) communities in ROMO exhibit a high degree of biological diversity.</p> <p>The condition of montane upland shrub communities warrants moderate concern. A number of factors, including past fire suppression, current efforts to reintroduce fire to reduce hazardous fuels, elk browsing, and the invasion of nonnative species such as cheatgrass (<i>Bromus tectorum</i>), Canada thistle (<i>Cirsium arvense</i>), and yellow toadflax (<i>Linaria vulgaris</i>), currently threaten the long-term viability of these shrub stands. Previous research suggests that the combination of fire and post-fire elk browsing have had a negative effect on these imperiled plant communities when elk populations were overabundant. In recent years elk numbers have declined. Monitoring from 2006 to 2013 found that shrub cover on the elk winter range is stable and that the objectives of the Elk and Vegetation Management Plan for grazing levels on grasses and forbs have been met since 2009 (Zeigenfuss and Johnson 2015).</p> <p>(continued on next page)</p>

Montane Ecosystems (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Upland Shrub Communities (continued)	Shifts in shrub stand dynamics (continued)	 (continued)	(continued) While upland shrub cover and grazing levels are monitored on the elk range, the vulnerability of this habitat to the influences of climate change on ecosystem processes is poorly understood.
Aspen Communities	Presence and stand structure		<p>Aspen covers less than 5% of ROMO, but provides important habitat for a disproportionately large number of plant, butterfly, and bird species compared to other habitat types in the park (Mueggler 1985, Simonson et al. 2001, Turchi et al. 1995).</p> <p>The condition of aspen in the park warrants moderate concern. In forested areas, aspen is a species maintained by disturbances such as fire, which removes mature aspen and competing conifers, allowing the establishment of new aspen suckers. In the absence of disturbance, conifer species become established and eventually shade out and eliminate aspen stands. In contrast, in many montane meadows where aspen is not competing with conifers, new aspen are being lost as habitat is converted to grassland by decades of overbrowsing by elk (Olmsted 1979, Baker et al. 1997, Suzuki et al. 1999, Weisberg and Coughenour 2003, Zeigenfuss et al. 2008). The result is overmature, deteriorating stands (Baker et al. 1997, Suzuki et al. 1999, Binkley 2006).</p> <p>The trend in the condition of aspen in the park is unclear. As the bark beetle outbreak results in a more open forest canopy, aspen suckering will increase. This could potentially lead to stand regeneration if the level of ungulate browsing allows the growth of some new, young aspen trees. On elk winter range, the construction of temporary fences beginning in 2009 to promote aspen recovery resulted in a desired shift in aspen stem sizes toward younger trees. Sapling recruitment also increased from 13% to 26% by 2013. However, nearly all improvement in stand structure occurred inside fences, whereas stand structure was stagnant in unfenced areas, with many older trees and no replacement of small-diameter stems (Zeigenfuss and Johnson 2015).</p> <p>Aspen are monitored on the elk range, but no monitoring is conducted in forested areas. It is uncertain how aspen will respond to altered fire and disturbance patterns as climate changes.</p>

Montane Ecosystems (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Montane Forests and Woodlands	Exotic plants		<p>The montane life zone is home to a diverse array of native vegetation communities. Dry, south-facing slopes are often characterized by open stands of ponderosa pine (<i>Pinus ponderosa</i>), while dense stands of lodgepole pine (<i>Pinus contorta</i>) and Douglas-fir (<i>Pseudotsuga menziesii</i>) can be found on moist north-facing slopes.</p> <p>The condition of montane forests and woodlands in ROMO warrants moderate concern. As in the subalpine zone, the montane zone is experiencing shifts in forest structure and composition as a result of changing climatic conditions and altered disturbance regimes (Esser 2015). Exotic plants are also more prevalent in the montane zone than in subalpine and alpine environments. The number of exotic species and their total cover continue to increase throughout the park, particularly in the montane life zone.</p>

Native Species of Concern


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Beaver	Abundance and distribution		<p>Beaver are a keystone species that have profound effects on ecosystem structure and function (Naiman et al. 1988). Beaver modify their environment by cutting aspen and willow for food and construction material, and building dams that slow stream velocity, raise the water table, trap sediment, and increase nitrogen availability to willow (Naiman et al. 1988, Baker and Hill 2003).</p> <p>The condition of beaver populations in the park warrants significant concern. Once abundant in the park, beaver declined dramatically beginning in the 1940s as a result of trapping, and continued to decline for various reasons after trapping ceased (Packard 1947). In areas used by elk, intense browsing reduced the abundance of the tall willow that beaver rely on (Baker et al. 2004). Tularemia, a bacterial infection usually transmitted by insects, has been detected in beaver on both sides of the park, but its prevalence is not known. A comparison of beaver survey data from 1939 to 1940 and 1999 to 2000 showed that beaver abundance and distribution in the park were far below historical levels (Theobald et al. 2010). Surveys conducted in 2009–2010 suggested that beaver occupy only 10% of the most suitable streamside habitat in the park (Scherer et al. 2011).</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Elk	Winter range abundance and distribution		<p>Elk are an important native species that influence habitat for a variety of plants and animals. Elk are a major attraction for park visitors, with some of the highest visitation occurring during autumn due to the world-class opportunity to observe elk mating behavior.</p> <p>The current abundance and distribution of elk using the park winter range is in good condition. Elk that use the park are part of a regional population that ranges across park boundaries. The number of elk that inhabit the ROMO area has varied over the past century, ranging from about 50 animals that were translocated into the area in 1913–14 following local extirpation, to a peak population of about 3,200 animals in 2002. Since that time, the population has declined related to movements to new winter range areas east of the park and high hunter harvest outside the park. Additionally, 130 female elk were culled in the park in 2009–11 as part of the park’s Elk and Vegetation Management Plan. In 2015, the number of elk using the park winter range was estimated at about 300 individuals, with the decline in abundance appearing to have stabilized from 2013 to 2015 (Ketz et al. 2016). This is within the broad objective of 200–800 elk defined in the management plan (NPS 2007).</p> <p>Confidence in the elk distribution and abundance rating is high because it is based on annual population monitoring and modeling developed through research conducted by multiple agencies and academic institutions over the last two decades.</p>
	Chronic wasting disease		<p>Chronic wasting disease (CWD) is a disease that affects the brain in members of the deer family (elk, deer, and moose). There is no known treatment.</p> <p>The presence of chronic wasting disease in elk populations in the park warrants significant management concern. Prevalence of the disease in the park is higher than in adjacent areas outside the park. The proportion of cow elk infected with CWD fluctuated from 3 to 13% between 2008 and 2015. During this time, CWD was found to be the leading cause of mortality among female elk (Monello et al. 2014). Ongoing research is investigating cow elk survival rates, causes of mortality, and the potential for CWD to have a population level effect. The trend of chronic wasting disease prevalence in the park is unknown.</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ptarmigan	Presence/Absence Trends in well studied populations (Trail Ridge Road)		<p>The white-tailed ptarmigan in ROMO is important both for conservation concern and as a watchable wildlife species. The white-tailed ptarmigan is currently petitioned for federal listing, with a listing decision anticipated by September 30, 2018. While white-tailed ptarmigan at ROMO are currently loosely linked to other ptarmigan populations in Colorado, the Colorado subspecies is unique genetically, not well connected with ptarmigan in other parts of the range (Langin and Oyler-McCance et al. unpublished data), and may represent important genetic resources for the species as whole as Colorado ptarmigan may be better adapted to warmer temperatures. Ptarmigan also are important for the visitor experience in the alpine zone. According to a recent visitor survey, 73% of ROMO visitors participate in wildlife viewing and bird watching during their visit to the park. Much of this viewing occurs above treeline along Trail Ridge Road where ptarmigan occur.</p> <p>The condition of ptarmigan populations warrants significant concern and their condition is deteriorating. Ongoing research indicates the population only persists due to recruitment of juvenile ptarmigan from areas outside of Trail Ridge (i.e., the population is not currently self-sustaining because individuals in the Trail Ridge population do not survive or produce enough young for stable population growth [Wann et al. <i>in prep.</i>]). In addition, ptarmigan at ROMO have advanced their nesting phenology an average of 15 days since the mid-1970s (Wang et al. 2002). Advancing trends in nesting cycles are a concern because for many avian species, it has been shown that warming springs have created a mismatch between the time chicks emerge from nests and peak resource food abundance (Visser and Both 2005). Climate change scenarios predict that warming springs will continue.</p> <p>Confidence is moderate and is based on long-term monitoring data and extensive on-going research through partners at USGS and Colorado State University. However, research is limited to only a few areas in the park and it is unclear whether the studied populations are representative of other ptarmigan in the park.</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Invertebrates</p>	<p>Invertebrate biodiversity</p> <ul style="list-style-type: none"> • Butterflies/Moths • Aquatic insects • Ants 		<p>Insects and other invertebrates account for the largest proportion of diverse animals in ROMO. They are a critical prey item to support fish, amphibians, birds, and black bears, and are important for nutrient cycling in both aquatic and terrestrial ecosystems.</p> <p>The condition of invertebrates in the park is of moderate concern. Most invertebrate species present have not been identified and trends are unknown for virtually all invertebrate diversity in the park. Butterfly monitoring has documented 141 species of butterfly; the actual number of Lepidoptera (which includes butterflies and moths) in the park is estimated to be about 2,100 species. In five orders of aquatic insects, there are approximately 37 species of mayflies, 49 species of stoneflies, 84 species of caddis flies, 37 species of dragonflies, and at least 60 species of aquatic coleopterans, for a total of 267 species. Other invertebrates in the park include at least 39 species of crab, lobster, and shrimp; 10 species of slugs and snails, and an unknown number of nematode, roundworm, and tardigrade species. Little is known about spider diversity in the park (Patterson et al. 2015). Recent studies on ants indicate that the subfamilies and genera that occur in Colorado and were expected to occur in the park were indeed documented here (Szewczyk 2016).</p>
<p>Cutthroat Trout</p>	<p>Presence and distribution</p>		<p>The trout species native to ROMO are the greenback cutthroat trout (<i>Oncorhynchus clarkia stomias</i>) on the east side of the Continental Divide and the Colorado River cutthroat trout (<i>O. c. pleuriticus</i>) on the west side. The greenback is a federally threatened species and the Colorado River cutthroat is a State Species of Concern.</p> <p>The condition of cutthroat presence and distribution warrants significant concern. A recently published genetic study and a concurrent meristic study indicate that there is only one remaining greenback population (Metcalf et al. 2012). Another significant conclusion is the identification of two distinct lineages of cutthroat trout on the Western Slope of Colorado, one of which is the Colorado River cutthroat trout and the other is a newly identified lineage. The park currently has no greenback populations and only two known populations of Colorado River cutthroat trout in their native drainage.</p> <p>Whirling disease also poses a threat to cutthroat trout presence. In ROMO, whirling disease has been documented in most of the lower elevation rivers and streams; however, no cutthroat trout have been observed with the clinical signs of whirling disease (e.g., deformed spine, circular swimming, etc.). The disease has not exhibited population level effects on any cutthroat populations in the park.</p> <p>Cutthroat abundance and distribution in the park is stable. The park has been extensively surveyed and populations have been genetically tested.</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Other Native Fish	Contaminants in fish		<p>Contaminants are present in the park and can result in reduced foraging efficiency and survival, can induce male feminization, and can impair both reproductive and immune functions in trout.</p> <p>The threats from contaminants warrants significant concern. Two percent of fish in ROMO exceeded the fish toxicity threshold for mercury, while 15% of fish exceeded the highly sensitive avian health threshold (90 ng/g ww in whole-body)(Landers 2010). The current-use pesticide, chlordane, is found in concentrations in some individual fish exceeding the wildlife health threshold for kingfisher (Flanagan Pritz et al. 2014). Landers et al. (2008) first reported on male “intersex” fish (the presence of both male and female reproductive structures in the same fish), and Schreck and Kent (2013) similarly found intersex fish in 5 lakes in the park. The intersex condition commonly indicates exposure to contaminants.</p> <p>Contaminants appear to be increasing and their impacts to trout are already observed in the presence of intersex fish.</p>
	Temperature		<p>Native fish, such as greenback and Colorado River cutthroat trout, are sensitive to increased water temperatures. As stream temperatures increase, nonnative species can invade park streams.</p> <p>Site specific data from the last several years in ROMO suggest many stream reaches can experience elevated summer maximum water temperatures, often exceeding state water quality criteria for cold water fisheries (Schweiger et al. 2016). Trends in condition are likely declining; rapid climate change appears to be associated with a projected 0.19 °C increase per decade in mean annual lake surface temperature, a 4.7 °C increase per decade in lake ice-free days, and a 0.42 °C increase per decade in summer mean lake water temperatures through the 2080s (Roberts et al., unpublished data from 24 lakes in ROMO, Isaak 2010).</p> <p>Temperature data have only been actively collected in recent years, and the impacts associated with climate change are based on modeling and the actual future changes to water temperature are unknown.</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Black Bear	Abundance and health		<p>Black bear are important as a charismatic species for wildlife viewing and as a large predator within the park's ecosystems.</p> <p>Two intensive bear studies have taken place over the last 40 years. Comparisons between these studies indicate that female body condition improved, leading to higher survival of both sows and cubs. It is believed that the improved body condition is due to consuming 15 times more human food and trash as compared to 20 years ago (Baldwin and Bender 2007). If this trend continues, the black bear population is expected to grow. Because these changes are promulgated by unnatural conditions (i.e., human food and trash), this is considered a negative trend.</p> <p>This research, however, is over 10 years old and no current research is ongoing to confirm whether food consumption trends are changing or if the bear population is increasing.</p>
	Bear-human interactions		<p>Black bear are important as a charismatic species for wildlife viewing, large predator, and for their potential to cause conflicts with visitors and staff.</p> <p>Two intensive bear studies have taken place over the last 40 years. Comparisons between these studies indicate that bears are consuming 15 times more human food and trash as compared to 20 years ago (Baldwin and Bender 2007). Bears are also denning in areas closer to human activities. Park data suggest that, on average, bears are obtaining more food rewards than in the past, and property damage in the most recent year, 2015, had increased despite park efforts to increase bear-proof facilities.</p> <p>Trends are variable by year and no clear significant relationships have been documented. The continuing increase in visitors and, potentially, bears that are more habituated will likely increase the potential for conflict.</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Bighorn Sheep</p>	<p>Population trends, Eastside herd Population trends, Westside herd Presence of mountain goats Confirmed cases of <i>Pasteurella</i> spp. in ROMO herds or other indicators of illness or disease die-offs</p>		<p>Bighorn sheep play an important role as large herbivores in high elevation ecosystems. They are the wildlife icon of ROMO and the State of Colorado, and are highly sought for wildlife viewing by visitors.</p> <p>The condition of bighorn populations warrants significant concern. The populations in the park are very vulnerable to die-offs due to disease. Park records indicate that bighorn numbers were more than double current estimates just three decades ago. Highway 34 bisects access to the two major mineral licks for bighorn in the park, requiring specialized volunteer groups to manage traffic to facilitate bighorn road crossings. Despite these concerns, there are no signatures of a recent genetic bottleneck or inbreeding (Driscoll 2015).</p> <p>The trend for bighorn condition is stable, with the Eastside herd of bighorn sheep stable and potentially increasing (Schoenecker et al. 2015). The Westside sheep are less well studied; however, annual counts of ewes, yearlings, and lambs indicate that consistent recruitment is occurring. Of concern is a recent case (2015) of <i>Pasteurella</i> spp.-induced pneumonia that was confirmed in an adjacent herd (Big Thompson Canyon). Nonnative mountain goats are also a threat to bighorn as they can carry and transmit Johne's disease and are also more aggressive, outcompeting sheep for preferred foraging areas on shared ranges (Gross et al. 2000).</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Amphibians</p>	<p>Boreal toad N leopard frog Salamander fungus</p>		<p>Amphibians are key components of the park fauna as both predator and prey in food webs. They play a vital role in nutrient transfer from aquatic to terrestrial environments, as they rely on aquatic nutrients to sustain development from egg through metamorphosis and then rely mainly on terrestrial environments. The boreal toad is a state endangered species and is currently petitioned for federal listing.</p> <p>The condition of amphibian populations warrants significant concern and is declining in the park. Historically, the park contained 5 amphibian species. The Northern leopard frog was last confirmed in 1974 and may have suffered mortality and loss of populations due to the amphibian chytrid fungus <i>Batrachochytrium dendrobatidis</i> (Bd), a fungal pathogen that causes a fatal skin disease in amphibians. Bd has been credited as the cause of the recent and rapid declines of boreal toads within ROMO. Most known boreal toad breeding populations have Bd present and are declining or subsisting at low population levels. An emerging salamander chytrid fungus is not known to occur in the United States, but may threaten salamander populations and other amphibians. The status and trend of wood frog, boreal chorus frog, and tiger salamander are not known because they are not regularly monitored. USGS monitoring data indicate that 61% of amphibians nationwide are declining an average of 3.7% annually in the proportion of sites occupied. The park is monitoring boreal toad populations and is currently engaged in a boreal toad reintroduction effort.</p> <p>Confidence is high based on extensive, intensive monitoring data for boreal toads and continued absence of leopard frogs.</p>
<p>Rare Plants</p>	<p>Presence/Absence Maintenance of known populations</p>		<p>Maintaining biodiversity throughout the park is an important goal. Rare plants can be cryptic and generally more difficult to find, monitor, and protect.</p> <p>Rare plants are considered in good condition. Over 50 rare plants are confirmed in the park or could occur based on the presence of potential habitat. Rare plants that may occur have been identified and are the focus of surveys prior to any ground disturbing activity. An extensive rare plant survey occurred throughout the park in the late 1990s. No federally threatened or endangered plants occur in ROMO, and there is no evidence that species have gone extinct in the park. Surveys of existing populations of rare plants do not occur on a regular basis; therefore, no trend information is known.</p>

Native Species of Concern (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Pika</p>	<p>Presence/absence Habitat assessment Vulnerability to rapid climate change</p>		<p>The American pika, which inhabits mountain ecosystems in ROMO, is an indicator of the potential effects of climate change because of its sensitivity to summer heat and reliance on winter snowpack. There are two different subspecies of pikas in the park.</p> <p>The status of pika populations in ROMO warrants significant concern. ROMO pika may be vulnerable to climate change due to their need for sufficient snow cover, which provides thermal protection from cold, over-winter temperatures, and their need for sufficient habitat connectivity to maintain populations over time.</p> <p>Climate models predict higher temperatures throughout the year at ROMO and declining pika habitat suitability and connectivity between patches. The combination of these factors is likely to lead to significant declines of pika populations over the long term. Under various climate change models, the overall average likelihood that pikas will persist in a given area of ROMO drops from >75% to <40%, while the overall amount of habitat occupied by pikas declines from >80% to <20%. Some models predict complete extirpation by 2100 (Schwalm et al. 2016).</p> <p>ROMO pika vulnerability appears driven by a breakdown in habitat connectivity due to warming temperatures and a reduction in the amount of suitable habitat. Pika populations in the park might benefit from management actions, such as translocating pikas, which could mediate connectivity losses as climate change progresses. Continued monitoring will be important for tracking climate change impacts on this population (Jeffress et al. (2013) and Schwalm et al. (2016)).</p>

Resource Brief: Ptarmigan

The white-tailed ptarmigan (hereafter ptarmigan) population along Trail Ridge Road has been monitored nearly continuously since 1966 (1966–2000; 2010–2015), along with a nearby population at Mt. Evans, which is south of the park (1966–2015). These unique datasets are among the longest-running demographic studies of any avian species in North America and are valuable for conservation and management efforts. The U.S. Fish and Wildlife Service will use these datasets to inform their listing decision for the Colorado subspecies of ptarmigan (*L. l. altipetens*) under the Endangered Species Act which is anticipated by September 30, 2018.

The ptarmigan population along Trail Ridge Road began to severely decline in the mid-1970s and currently persist at very low densities. Ongoing research indicates the population only persists due to recruitment of juvenile ptarmigan from areas outside of the Trail Ridge area (i.e., the population is not currently self-sustaining because individuals in the Trail Ridge population do not survive or produce enough young for stable population growth [Wann et al. *in prep.*]). Wang et al. (2002) attributed the decline to warming winters, which may affect snow quality and roosting habitats. However, later work demonstrated that ptarmigan survival was only weakly related to winter temperatures at Mt. Evans (Wann et al. 2014), calling into question whether winter climate is the primary driver of the population decline at ROMO.

Reproduction (i.e., number of offspring produced per hen) is known to be affected by weather (Wann et al. 2016), and ptarmigan at ROMO advanced their nesting timing an average of 15 days since the mid-1970s (Wang et al. 2002). Nesting phenology is highly correlated with spring temperatures, and warming springs are thought to be the cause of earlier nesting at ROMO (Wann et al. 2016).

Advancing trends in phenology are a concern because it is not known if ptarmigan hens are tracking resource abundance through shifts in their timing of breeding. For many avian species, it has been shown that warming springs have created a mismatch between the time chicks emerge from nests and peak resource food abundance (Visser and Both 2005). Thus, chicks could be faced with less food resources if adjustments in nesting phenology are too great, or too little. Reproduction has significantly declined over the same period that nesting phenology advanced at ROMO.

An additional concern with warming springs is that the ptarmigan's feather color pattern changes as day length changes (Sharp and Moss 1981). If warming springs are reducing snow cover but ptarmigan are remaining white, survival may be adversely affected through increased predation.



A white-tailed ptarmigan. NPS Photo by Ann Schonlau.

Factors other than climate also may be responsible for regulating population size of ptarmigan at ROMO. Braun et al. (1991) posited that competition with elk (*Cervus canadensis*) for food resources was a major driver of the ptarmigan decline at ROMO, particularly due to loss of willow (*Salix* spp.). The majority of the ROMO elk (*Cervus elaphus*) population summers in the park's high-elevation alpine and subalpine meadows and willow (Bear 1989, Larkins et al. 1997). Baker and Hobbs (1982), observed elk selecting willow for 20% of foraging bites during summer, and elk fecal composition indicated willow comprised up to 80% of summer diets in 1996 and 1997 (Zeigenfuss, unpublished data). Willow cover and heights near Trail Ridge Road have been declining since the mid-1970s, while elk have increased, peaking in the late 1990s and early 2000s before declining in recent years (Zeigenfuss 2006, park records).

Willow is a critical food source for ptarmigan in the winter and spring, and the amount of willow is likely the major limiting factor for most ptarmigan populations (Braun et al. 1993). Body condition of ptarmigan captured in the spring at ROMO significantly declined beginning in the mid-1970s, and birds in poor body condition have the lowest survival rates (Wann et al. *in prep.*). These findings are in contrast to Mt. Evans, where the population is stable and willow appears to be of higher quality, highlighting the importance of understanding how habitat characteristics and potential interspecific competition (e.g., elk) shape food-resource constraints for ptarmigan. Although the reasons for ptarmigan declines remain unclear, the park is actively pursuing research to identify the mechanisms of decline and assist in identifying potential management actions to stabilize ptarmigan populations.

Resource Brief: Pika

The American pika (*Ochotona princeps*) is a charismatic indicator species of the potential effects of climate change on mountain ecosystems. Pikas are sensitive to summer heat and rely on winter snowpack for insulation from harsh winter temperatures.



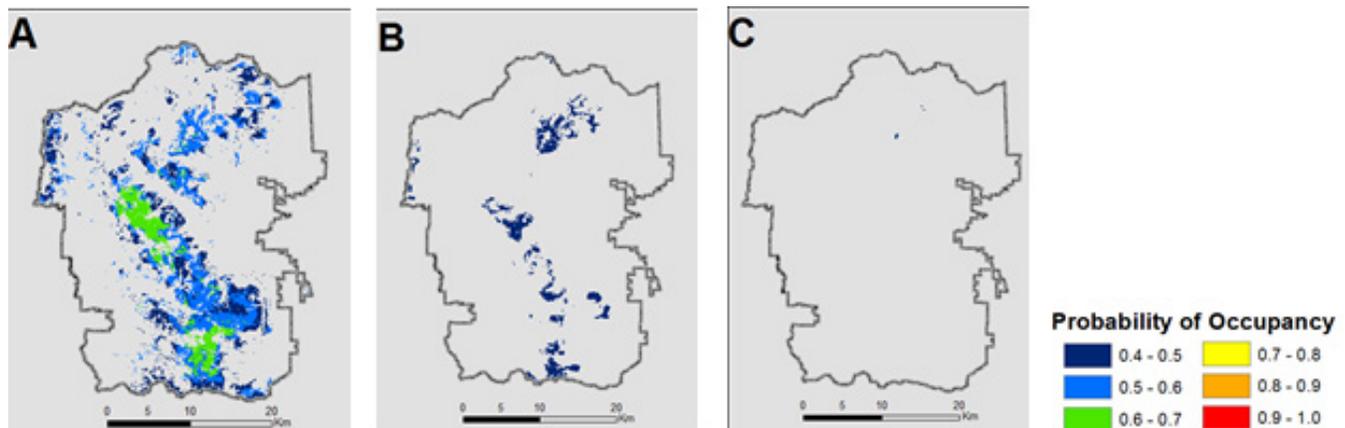
American pikas have an average body length of approximately 6–8 inches. NPS Photo by Neal Zaun.

The National Park Service collaborates with scientists from Oregon State University, University of Idaho, and University of Colorado-Boulder to study pika distribution, population connectivity and gene flow, and to evaluate the pika's vulnerability to climate change, as part of the Pikas in Peril program.

Rocky Mountain National Park is a unique site for pika research because there are two different subspecies of pikas within the park. The northern and southern Rocky Mountain lineages were once isolated from each other but currently coexist in the park and are likely interbreeding. Elevation is the main limitation to dispersal in the park, as pikas appear to avoid the lowest elevation areas because of heat stress. In the southern portion of the park, the warmer south and west facing slopes pose a significant barrier to animal movements and gene flow as well; both factors indicate that hotter temperatures may reduce pika dispersal. Genetic diversity at ROMO is high, indicating a large amount of well-connected habitat that supports a robust pika population.

Spatial configuration of habitat patches and habitat connectivity are important determinants of pika occupancy, as are temperature and precipitation during the cool season. In terms of the ROMO pika population's vulnerability to climate change, this indicates the potential importance of 1) sufficient snow cover providing thermal protection from cold temperatures for over-winter survival and 2) continued habitat connectivity. Climate models predict higher temperatures throughout the year at ROMO, declining habitat suitability, and declining connectivity between patches. The combination of these factors is likely to lead to significant declines of pika populations within the park. Overall, the average likelihood that pikas will persist in a given area of habitat drops from >75% to <40%, while the overall amount of habitat occupied by pikas declines from >80% to <20%, with some models predicting complete extirpation by 2100 (figure below).

Pikas at ROMO are vulnerable to extirpation due to climate change. This vulnerability appears driven by a break down in connectivity due to warming temperatures and the reduction of the amount of suitable habitat. Pika populations in the park may benefit from management actions that mediate connectivity losses as climate change progresses. Currently, genetic diversity, occupancy, and distribution are relatively high in the park, offering potential for resilience with adequate management. Continued monitoring will be important for tracking climate change impacts on this population.



Current occupancy (A) and two future (2071–2099) pika occupancy scenarios (B, C) in Rocky Mountain National Park. Future scenarios are based on two different models of potential human-driven carbon emissions. The pika population shows precipitous declines in both distribution and occupancy probability. By 2099, pikas are predicted to be restricted to less than 20% of their current distribution (B) or nearly extirpated (C).

Resource Brief: Extirpated and Rare Species

The flora and fauna of the park are protected within its boundaries from hunting, trapping, and collecting. However, several native species were extirpated from the area before the park was established in 1915. Wolves and bison were present in the late 1800s, but largely gone by 1915. Grizzly bears were apparently more resilient; a few were seen in the park as late as the 1920s. Lynx and wolverines were also eliminated. Some of the bird species that were present historically are no longer seen in the park. For example, the yellow-billed cuckoo, which is dependent on dense riparian woodlands, has declined throughout the West (Carter 1998).

The effects of the absence of these species are hard to fully understand and describe. For example, the loss of apex predators such as wolves and grizzly bears had an outsized impact on park ecosystems through cascading effects on other wildlife and ecosystem processes. When wolves were eliminated from the area, elk populations had to be controlled by NPS to protect the elk winter range from overuse. In the 1960s, when NPS stopped controlling elk, populations exploded, with negative impacts to the health and viability of wetlands through overbrowsing willows and other woody plants. In turn, beaver, which also eat willows, declined to near extinction in the park. The loss of beaver contributed to changing the hydrology of park streams by reducing natural flood control as beaver dams slowly disappeared. The result was a lowered water table, erosion, and stream channelization. Impacts were not restricted to beavers; many birds, amphibians, and other wildlife species that depend on healthy wetlands for foraging and breeding habitat declined or disappeared.



Lynx in the snow. USDA Forest Service Photo.

There have been some recent successes for ROMO native species of concern. Peregrine falcons have come back from near extinction in the lower 48 and once again breed in the park. Bald eagles, once an endangered species in the continental United States, are now seen regularly over ROMO. Lynx, which were reintroduced in Colorado from 1999 to 2006, are rarely documented in the park. A wolverine, radio-tagged in Wyoming, spent time in ROMO several years ago before moving on.

Exotic Species


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Aquatic Invasive Species	Presence/Absence Distribution (spreading or contracting)		<p>Aquatic Invasive Species (AIS) are of concern because they displace native species.</p> <p>The AIS species of concern in the park include New Zealand mudsnails, zebra and quagga mussels. None of these species are known to occur in the park.</p> <p>The NPS monitors presence/absence of AIS annually at several sentinel sites within the park. Periodically, other streams across the park are including in monitoring for AIS.</p> <p>Confidence is low because although some monitoring has been conducted in the park, some AIS are difficult to detect.</p>
Other Recent Arrivals	Potential impacts from “new” (last 20 years) species to the park		<p>New species in the park that are likely present due to human introduction and development followed by subsequent range expansion are of concern because they may compete or prey upon native species, transfer disease, or cause a decline in habitat conditions.</p> <p>Many species that were not formally present in the park are now frequently observed. The impact of these recent arrivals to native species is unknown. Some of these species include turkeys, collared doves, and fox squirrels.</p> <p>Confidence is low because these species and their interactions with native flora and fauna are not documented or monitored.</p>
Nonnative Trout	Distribution of nonnative fish		<p>Most park waters were historically fishless, and the addition of a top predator to these systems disrupts the normal ecosystem processes. Additionally, introduction of nonnative fishes in lower elevation waters likely led to the extirpation of native cutthroat, and their continued presence makes these waters unsuitable for reintroduction of native species.</p> <p>The presence and distribution of nonnative trout is of moderate concern. Fish stocking with nonnative trout was prevalent prior to park formation and for the first 50 years of park management. Nonnative trout are located in lakes and streams in all major drainages of the park. Common nonnative fishes include brook trout, brown trout, and Yellowstone cutthroat trout.</p> <p>There are no current plans to restore any of these waters to their native assemblage (i.e., remove nonnative trout).</p> <p>Fish species distribution and past stocking records are well studied for the park through an interagency agreement with the FWS that has provided annual monitoring for over 40 years.</p>

Exotic Species (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Invasive/Exotic Plants	Number of species, Distribution and abundance		<p>Exotic plant species are of concern because they displace native vegetation, degrade wildlife habitat, reduce biological diversity, and alter natural processes such as fire.</p> <p>The number of exotic plant species and their distribution and abundance in the park warrants significant concern. Warming temperatures, increased ground disturbance due to fires and floods, and high levels of nitrogen deposition may facilitate increased ecological pressure from exotic species invasions. Of the 1,000 known vascular plant species in the park, more than 100 are exotic, including 42 that are considered invasive. Despite efforts to prevent the spread of invasive species, the number, distribution, and abundance of some species is growing. Invasive plants such as cheatgrass and Canada thistle can spread rapidly even in undisturbed areas. Once they have become established, eradicating them is expensive and extremely difficult. Monitoring has shown a trend of increasing frequency and cover of cheatgrass in the park since the 1990s (Bromberg et. al 2011). Exotic plants are more abundant east of the Continental Divide than west of it. They are most common at lower elevations in montane and riparian habitats, but they are also found above 10,500 ft in elevation (Theobald et al. 2010).</p> <p>Confidence in this rating is moderate because some level of monitoring is conducted annually, but coverage is not comprehensive.</p>

Resource Brief: Moose

Moose (*Alces alces*) are of management concern in the park. Historical records indicate that moose were occasional visitors to the area historically, but it is unlikely that there were reproducing populations (Armstrong 1987).

Moose were introduced to the North Park area northwest of ROMO in the late 1970s, and by 1980 had arrived in the Kawuneeche Valley on the west side of the park. Numbers grew and moose are now considered common throughout the Colorado River valley. There is no recent population estimate, but Dungan (2007) estimated approximately 100 moose inhabited the west side of the park in summer 2003, with roughly one-fourth of those residing in the Kawuneeche Valley. In the last decade sightings have become more common on the east side of the park, though numbers still appear to be low. The large increase in moose populations may be having a negative impact on willows and riparian communities.



A bull moose in a riparian meadow. NPS Photo.

Land Use and Ecosystem Processes


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Land Use</p>	<p>Human footprint (% land that is developed) Disturbed land Land ownership</p>		<p>The size and character of the human footprint and disturbance within and around the park affects park resources such as vegetation, wildlife, wildland fire, and soundscape.</p> <p>Land use disturbance in and around the park is relatively low, and as an indicator it is in good condition, especially considering its proximity to Denver and other Front Range cities. Of the 415 square miles in the park, approximately 2.9% are developed. This includes the park headquarters, residences, visitor centers, and parking lots at trailheads and campgrounds. Nearly 95% of the park area is designated wilderness. Many dams, lodges, and other non-historic structures have been removed so that these areas can be restored to native vegetation, including the former Hidden Valley Ski Area and Moraine Park Golf Course. However, designated wilderness does include evidence of human use, such as trails and backcountry campsites. It also includes cabins that concentrate visitor use, disturb wildlife, and require management, such as the removal of hazard trees and fire suppression.</p> <p>The park is surrounded by federal, state, and private lands, and by the towns of Estes Park, Allenspark, Glen Haven, Meeker Park, and Grand Lake. About 62% of the park boundary is adjacent to national forest, of which 70% is designated wilderness. In the surrounding area (9,450 km²) as of 2000, 24% of the land was privately owned and 89% of the private land was developed, with an average 0.323 homes per km²—more than four times as many as in 1940 (Theobald et al. 2010). The number of housing units has continued to grow since then, reaching more than 4,000 in the town of Estes Park, and twice that many in the entire Estes Valley.</p> <p>Confidence in the assessment is moderate because there is good data and information on land use and human disturbance in and near the park, but the relationship between land use and human disturbance and natural ecosystems and processes is not fully understood.</p>

Land Use and Ecosystem Processes (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Landscape Connectivity</p>	<p>Connectivity of natural landscapes</p>		<p>Connectivity of natural landscapes on a broad scale is an important aspect of parks and protected areas because it provides habitat connections important for long-term viability of plant and wildlife populations. Natural habitat connections facilitate migration and dispersal and help reduce vulnerability of populations to extirpation. Land use change and rapid climate change are important “stressors,” which, in combination, may accelerate the loss of habitat connectivity in and around ROMO.</p> <p>Landscape connectivity in the park is good. ROMO maintains natural landscapes that are placed within a key location to maintain connections to adjacent natural areas, especially to the north and west. The natural landscape connectivity/setting of ROMO (0.956 out of 1) scores higher than the Southern Rockies Ecoregion overall (0.924). It is also higher than Yosemite NP (0.952) but slightly less than Yellowstone NP (0.975). The mean score for ROMO has declined slightly from 0.958 to 0.956 (1992 to 2001) and will likely decline further to 0.947 (by 2030). See Theobald et al. (2010) for additional information on the landscape connectivity index.</p> <p>Confidence in this assessment is low due to 1) uncertainty in how all plants and animals in the region utilize and move through landscapes from pristine to highly disturbed areas, and 2) the uncertainty of future land use change in areas surrounding the park.</p>
<p>Fire</p>	<p>Area burned/year</p>		<p>Fire has been one of the most significant and frequent agents of change in the Rocky Mountains since the last glaciation. Periodic fires recycle nutrients back into the soil and contribute to the diversity of habitats in the park.</p> <p>The condition of natural fire in the park warrants moderate concern. The majority of the park is thought to be within the historical range of variability with respect to fire frequency and severity. However, more acres have burned in the park in the last decade than in the preceding 100 years. Development within and adjacent to the park limits the ability to manage natural wildland fires for ecological purposes.</p> <p>Confidence in this assessment is moderate due to the uncertainties associated with changing climate (e.g., snowpack levels, timing of spring run-off) and their impacts on fire frequency and severity.</p>

Resource Brief: Wildland Fire

Wildland fires are a natural, normal occurrence in the southern Rocky Mountains. While infrequent, large crown fires (>1,000 acres) can be expected to occur throughout the forested ecosystems of the upper montane and subalpine zones of the Colorado Front Range (e.g., Ehle and Baker 2003, Buechling and Baker 2004, Sibold et al. 2006). Due to their high intensity, these large fires are highly resistant to control by firefighters and can move great distances in short periods of time. What makes this problematic for Rocky Mountain National Park is the Wildland-Urban Interface (WUI) that exists along the boundary and downwind of the park. The WUI is described as the area where structures and other human improvements meet and intermingle with undeveloped wildland or vegetative fuels. For example, on the night of November 30, 2012, the Fern Lake fire advanced over 3 miles in a 45-minute period, prompting the evacuation of hundreds of homes adjacent to the park. Wildland fires have been a natural part of our forests for millennia; however, they pose a significant risk to the lives of our residents, infrastructure, real property, and the economic well-being of our communities.



Management ignited prescribed fire is used to reduce hazardous fuel loads and maintain the role of fire in Rocky Mountain National Park. NPS Photo.

have resulted in an increase in live fuel loading (understory grasses, forbs, and shrubs), along with greatly increased dead and down fuel loading, particularly large diameter material. These changes have created stands capable of sustaining very intense surface fire behavior. In addition, the dead trees left standing are unstable and cause a great risk to firefighters engaging in suppression operations.

Hazardous fuels reduction projects are a proven way to reduce risks to the people and communities adjacent to wildlands ((Agee and Skinner 2005). The Fern Lake fire of 2012 provided an excellent demonstration of a fuels treatment that aided suppression efforts. A 38-acre hazardous fuels reduction project completed in 2001 on the east end of the South Lateral Moraine allowed firefighters to safely engage the Fern Lake fire as it approached Bear Lake Road. As a result, firefighters were able to prevent the fire from crossing Bear Lake Road and leaving the park. Had the fire continued on the other side of the road, it would have continued into the developed area directly adjacent to the park and caused damage to homes and property. In addition to the direct effects of the fire, much of the Estes Valley would have been evacuated.

Despite the difficulty in measuring the success of fuels reduction treatments, this event provided an opportunity to compare the cost of fuels treatments with the potential costs resulting from a wildfire had the fuels treatment never happened. Using fire modeling software with the same weather conditions experienced on the night the Fern Lake fire made its advance towards Bear Lake Road, a fire perimeter was created with a size of 635 acres. This fire perimeter encompassed 247 structures in a densely populated area. In a joint project with the Federal Emergency Management Agency (FEMA), it was calculated that the value of these structures would have been \$36,270,810. In contrast, the cost of the 38-acre fuels treatment that likely prevented the Fern Lake fire from leaving the park was \$14,136.

This analysis only accounts for damage to assessed buildings and additional losses would be expected due to damages to infrastructure (e.g., roads, utilities). Additionally, a fire escaping the park would have triggered full evacuations of the majority of the Estes Valley, adding to the cost of a fire escaping the park. An estimated 5,452 households would have been evacuated, affecting 7,786 individuals.

ROMO has been working to reduce the risks of wildfire to values at risk for many years by implementing hazardous fuels reduction treatments. The park has accomplished 2,681 acres of critical fuels reduction treatments since 2000. However, changes in forest condition coupled with increased human caused fires are increasing the likelihood of wildfire occurrence well beyond the potential effectiveness of current treatments. This increased risk underscores the need to accelerate our efforts to reduce hazardous fuels in the WUI.

Approximately 7,254 people live within two miles of the park boundary (Colorado State Forest Service 2015). This number does not factor in the thousands of additional visitors to the park and adjacent communities (e.g., ROMO visitation exceeded 4 million in 2015). Virtually the entire park boundary has vegetation that can be expected to burn at some point in time. The park's forests are subject to a variety of disturbances (e.g., insects, wind, avalanches); however, historically fire has been the dominant natural disturbance type in our forests (Peet 1988). The majority of our forests are in some stage of recovery from prior disturbance and the current structure, species composition, and dynamics of many of our ecosystems are often the direct result of past fires (Peet 1981, Romme and Knight 1981, Romme et al. 2003).

To complicate matters, an increase in bark beetle activity over the last 10–15 years has resulted in the mortality of vast stands of trees across the park, particularly in lodgepole pine forests. On the west side of the park where beetle-caused mortality was most extensive, this has resulted in considerable alteration of the forest canopy. These changes in stand structure

Dark Night Sky


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Anthropogenic Light	Anthropogenic Light Ratio (ALR)		<p>The night sky has been a source of wonder, inspiration, and knowledge for thousands of years. Unfettered night skies with naturally occurring cycles of light and dark are integral to ecosystem function, as evidenced by the fact that nearly half the species on earth are nocturnal. Anthropogenic light ratio (ALR) is a measure of light pollution based on the ratio of average anthropogenic sky glow to average natural sky luminance.</p> <p>Night sky quality at Rocky Mountain National Park is moderate as measured by an all-sky ALR of 0.54. Modeled ALR over the entire park is 1.44. This modeled ALR is considered a moderate condition for non-urban parks. The higher model ALR value indicates that portions of the park are degraded by sky glow from urban centers, despite other regions of the park having higher quality.</p> <p>There is a declining trend in the condition of night sky quality based on modest population growth of the Denver metropolitan area (8%) and Boulder (5%), and rapid increase in other front range communities such as Loveland (10%) and Fort Collins (10%) (U.S. Census Bureau 2014).</p>

Resource Brief: Night Sky Resources at Rocky Mountain National Park

The night sky has been a source of wonder, inspiration, and knowledge for thousands of years. Unfettered night skies with naturally occurring cycles of light and dark are integral to ecosystem function, as evidenced by the fact that nearly half the species on earth are nocturnal. The quality of the nighttime environment is relevant to nearly every unit of the NPS system as the nighttime photic environment and its perception of it by humans (the lightscape) are both a natural and a cultural resource and are critical aspects of scenery, visitor enjoyment, and wilderness character.

Assessment

One way the Natural Sounds & Night Sky Division (NSNSD) scientists measure the quality of the photic environment is by measuring the median sky brightness levels across a park and comparing that value to average natural night sky luminance. This measure, called the All-sky Light Pollution Ratio (ALR), can be directly measured with ground based measurements, or by modeling when these data are unavailable (Duriscoe 2013). The GIS model, calibrated to ground based measurements in parks, is derived from the 2001 World Atlas of Night Sky Brightness, which depicts zenith sky brightness (the brightness directly above the observer). Anthropogenic light up to 200 kilometers from parks may degrade a park's night sky quality, and is considered in the neighborhood analysis. This impact is illustrated in the corresponding ALR map, with a 200 km ring around the park center.

The ALR thresholds are applied spatially to the park. For both urban and non-urban parks, the designated condition (green, amber, red) corresponds to the ALR level that exists in at least half of (median condition) the park's landscape (table below). Thus it is probable that a visitor will be able to experience the specified night sky quality. It is also probable that the majority of wildlife and habitats found within the park will exist under the specified night sky quality. For parks with lands managed as wilderness, the designated condition is based on the ALR level that exists in more than 90% of the wilderness area.

Condition and Functional Consequences

The ALR value at Rocky Mountain National Park is 0.54, with a modeled ALR over the entire park of 1.44. This is considered a moderate condition for non-urban parks. The higher model ALR value indicates that portions of the park are degraded by sky glow from urban centers, despite other regions of the park having higher quality. At these light levels, the Milky Way is visible but has typically lost some of its detail and is not visible as a complete band, especially when viewed in the eastern sky. Zodiacal light (or "false dawn," which is faint glow at the horizon just before dawn or just after dusk) is rarely seen. Anthropogenic light likely dominates light from natural celestial features, and shadows from distant lights may be seen.

Resource Brief: Night Sky Resources at Rocky Mountain National Park (continued)

Criteria for Impact

Two impact criteria were established to address the issue of urban and non-urban park night sky resources. Parks within urban areas, as designated by the U.S. Census Bureau, are considered less sensitive to the impact of anthropogenic light and are assessed using higher thresholds of impact. Parks outside of designated urban areas are considered more sensitive to the impact of anthropogenic light and are assessed using lower thresholds of impact. According to the U.S. Census Bureau, Rocky Mountain National Park is categorized as non-urban, or more sensitive ([U.S. Census Bureau 2010](#)). Learn more in the document [Recommended Indicators of Night Sky Quality](#), and the NPS Natural Sounds & Night Skies Division [website](#).

Thresholds for Level 1 and 2 Parks

Indicator	Threshold for Level 1 Parks – Non-Urban	Additional Threshold for Areas Managed as Wilderness	Threshold for Level 2 Parks – Urban
Anthropogenic Light Ratio (ALR)— Average Anthropogenic All-Sky Luminance : Average Natural All-Sky Luminance	ALR < 0.33 (<26 nL average anthropogenic light in sky) <i>At least half of park area should meet this criteria</i>	ALR < 0.33 (<26 nL average anthropogenic light in sky) <i>At least 90% of wilderness area should meet this criteria</i>	ALR < 2.00 (<156 nL average anthropogenic light in sky) <i>At least half of park area should meet this criteria</i>
Light flux is totaled above the horizon (the terrain is omitted) and the anthropogenic and natural components are expressed as a unitless ratio	ALR 0.33–2.00 (26–156 nL average anthropogenic light in sky) <i>At least half of park area should meet this criteria</i>	ALR 0.33–2.00 (26–156 nL average anthropogenic light in sky) <i>At least 90% of wilderness area should meet this criteria</i>	ALR 2.00–18.00 (156–1404 nL average anthropogenic light in sky) <i>At least half of park area should meet this criteria</i>
The average natural sky luminance is 78 nL	ALR > 2.00 (>156 nL average anthropogenic light in sky) <i>At least half of park area should meet this criteria</i>	ALR > 2.00 (>156 nL average anthropogenic light in sky) <i>At least 90% of wilderness area should meet this criteria</i>	ALR > 18.00 (>1404 nL average anthropogenic light in sky) <i>At least half of park area should meet this criteria</i>

Acoustic Environment				web ▶
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale	
Acoustic Impact Level	A modeled measure of the noise in decibels (dBA) contributed to the acoustic environment by man-made sources		<p>The quality of the acoustic environment affects visitor experience and ecological health. Acoustic resource condition, both natural and cultural, should be evaluated in relation to visitor enjoyment, wilderness character, ecosystem health, and wildlife interactions.</p> <p>The acoustic environment is in good condition. This condition is assessed by determining how much noise man-made sources contribute to the environment through the use of a national noise pollution model. The mean acoustic impact level at the park is 1.1 dBA (good condition). Overall, long-term projected increases in ground-based (Federal Highway Administration 2013) and commercial aircraft traffic (Federal Aviation Administration 2010) indicate a deteriorating trend in the quality of acoustic resources at this location.</p> <p>Confidence in the condition of the acoustic environment is considered high due to the availability of acoustic monitoring studies in the park (Kaliski et al. 2010, NPS 2013a).</p>	

Resource Brief: Acoustic Environment at Rocky Mountain National Park

To characterize the acoustic environment, the National Park Service has developed a national model of noise pollution (Mennitt et al. 2014). This model predicts the increase in sound level due to human activity on an average summer day. The model is based on measured sound levels from hundreds of national park sites and approximately 100 additional variables such as location, climate, vegetation, hydrology, wind speed, and proximity to noise sources such as roads, railroads, and airports. The model reveals how much quieter parks would be in the absence of human activities.

The quality of the acoustic environment affects visitor experience and ecological health. Acoustic resource condition, both natural and cultural, should be evaluated in relation to visitor enjoyment, wilderness character, ecosystem health, and wildlife interactions. Learn more in the document [Recommended indicators and thresholds of acoustic resources quality for NPS State of the Park Reports](#), the figures below, and the NPS Natural Sounds and Night Skies Division [website](#). In 2013, long-term acoustical measurements were gathered at three sites in the park to study before/after impacts of a change in the overflight patterns of commercial aircraft near the park. These measurements are summarized in a report available online ([NPS 2013a](#)). An additional transportation acoustics study was conducted in 2010 for the Bear Lake corridor (Kaliski et al. 2010). Finally, one site was monitored in the summer of 2012 in preparation for the 2012 BioBlitz event hosted at the park. The results of that effort are summarized in a snapshot report ([NPS 2013c](#)).

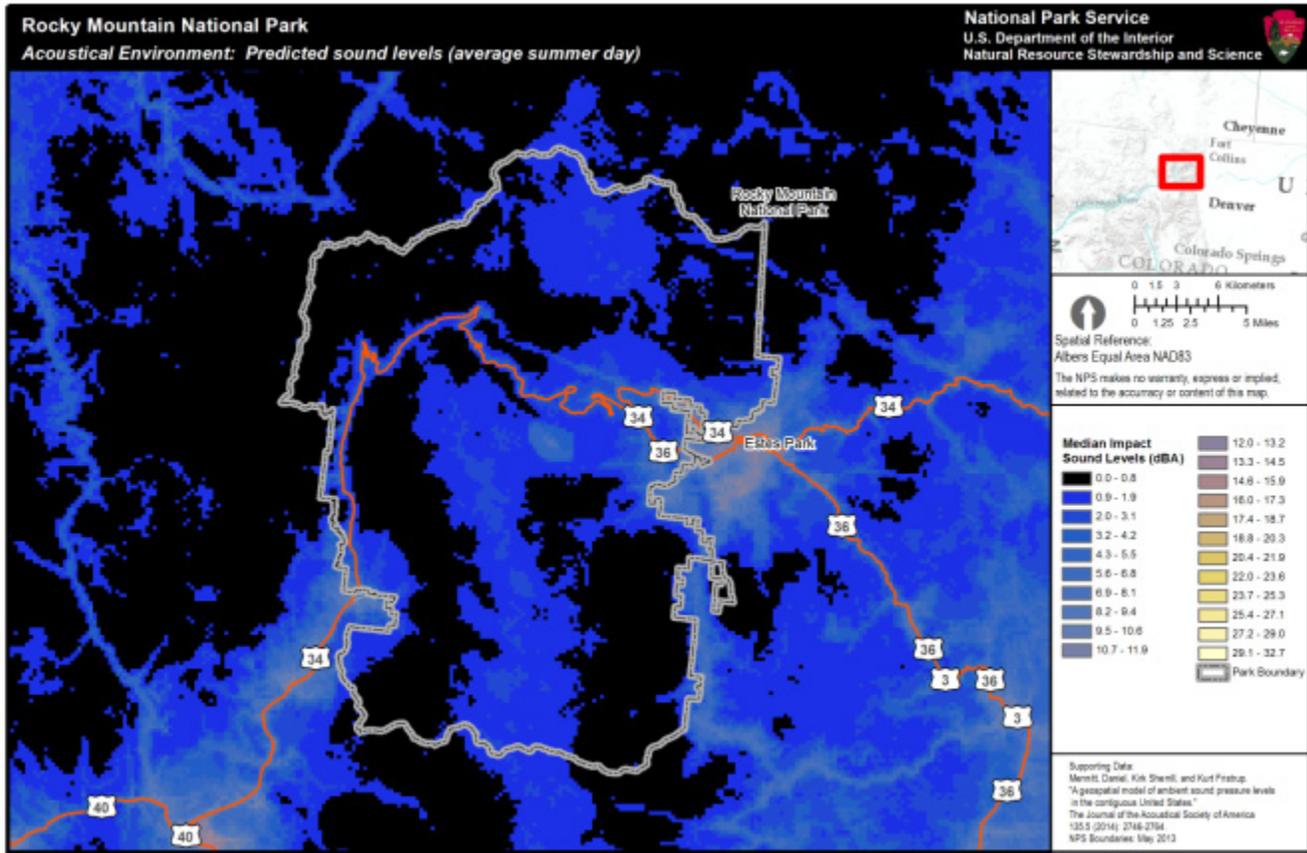
Criteria for Condition Status/Trend

For State of the Park Reports, NPS has established acoustic standards (green, amber, red) and two sets of impact criteria for urban parks and non-urban parks. A park's status (urban or non-urban) is based on data from the U.S. Census Bureau ([U.S. Census 2010](#)). Parks outside designated urban areas typically possess lower sound levels, and exhibit less divergence between existing sound levels and predicted natural sound levels. These quiet areas are highly susceptible to subtle noise intrusions. Park units inside designated urban areas typically experience more interference from noise sources. The majority of the park is located in non-urban areas, so condition thresholds for non-urban parks are listed in the table below. Just as smog limits one's ability to survey a landscape, noise reduces the area in which important sound cues can be heard. Therefore, thresholds in the table are also explained in terms of listening area.

Resource Brief: Acoustic Environment (continued)

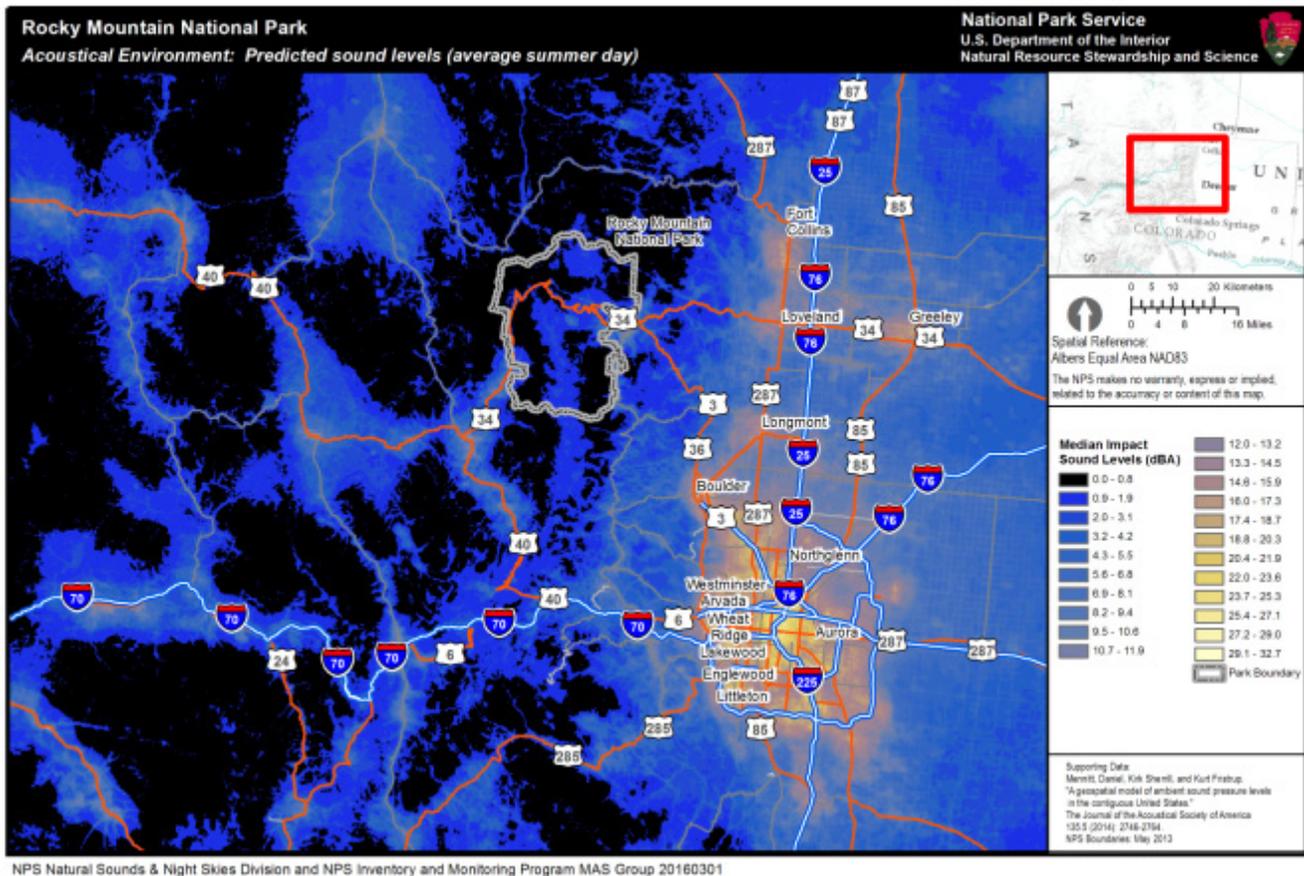
Condition thresholds for the acoustic environment in non-urban parks

Indicator	Threshold (dBA)
Acoustic Impact Level A modeled measure of the noise (in dBA) contributed to the acoustic environment by man-made sources.	Threshold ≤ 1.5 Listening area reduced by $\leq 30\%$
	$1.5 < \text{Threshold} \leq 3.0$ Listening area reduced by 30–50%
	$3.0 < \text{Threshold}$ Listening area reduced by $> 50\%$



Map of predicted acoustic impact levels in the park for an average summer day. The color scale indicates how much man-made noise increases the sound level (in A-weighted decibels, or dBA), with 270 meter resolution. Black or dark blue colors indicate low impacts while yellow or white colors indicate greater impacts. Note that this graphic may not reflect recent localized changes, such as new access roads or development.

Resource Brief: Acoustic Environment (continued)



Map of predicted acoustic impact levels in the park and the surrounding area for an average summer day. The color scale indicates how much man-made noise increases the sound level (in A-weighted decibels, or dBA), with 270 meter resolution. Black or dark blue colors indicate low impacts while yellow or white colors indicate greater impacts. Note that this graphic may not reflect recent localized changes, such as new access roads or development.

Resource Brief: Recent Climate Change Exposure of Rocky Mountain National Park

The climate in and around Rocky Mountain National Park is changing. To understand recent “climate change exposure” of national parks—that is, the magnitude and direction of ongoing changes in climate—we investigated how recent climate compares to historical conditions. This recently published research ([Monahan and Fisichelli 2014](#)) updates the basic climate inventories for 289 national park units. Here, we summarize results for ROMO, including areas within 30 km (18.6 mi) of the park’s boundary.

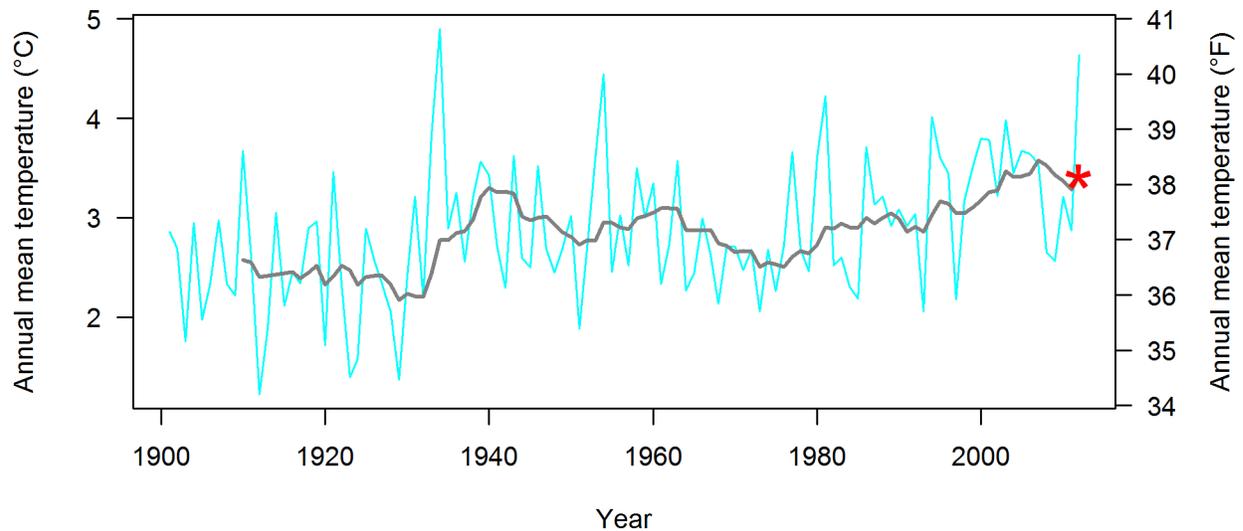
Observed trends:

Temperature: The past 10–30 years at ROMO, on average, have been “extreme warm” for 3 of 7 temperature variables ([Monahan and Fisichelli 2014](#)). This includes annual, summer, and maximum July temperatures. “Extreme warm” is defined as warmer than 95% of the historical range of conditions (1901–2012). See the first figure below for an example using annual temperature and the second figure below for results for all 7 temperature variables. No temperature variables were “extreme cold” over the past 10–30 years.

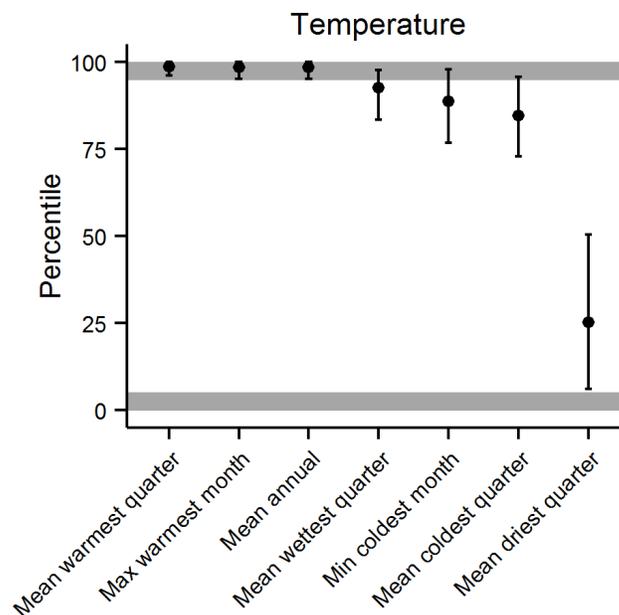
Precipitation: Precipitation of the past 10–30 years at Rocky Mountain, on average, has not been “extreme” for any of the 7 precipitation variables ([Monahan and Fisichelli 2014](#)).

These findings suggest that resources within the park are already experiencing relatively anomalous conditions.

Resource Brief: Recent Climate Change Exposure (continued)



Historical range of variability and recent annual mean temperature at Rocky Mountain National Park. The blue line shows temperature for each year, the gray line shows temperature averaged over progressive 10-year intervals, and the red asterisk shows the average temperature of the most recent 10-year moving window (2003–2012). Here, the most recent 10 years was warmer than 95% of the historical range of conditions (see next figure for more variables).



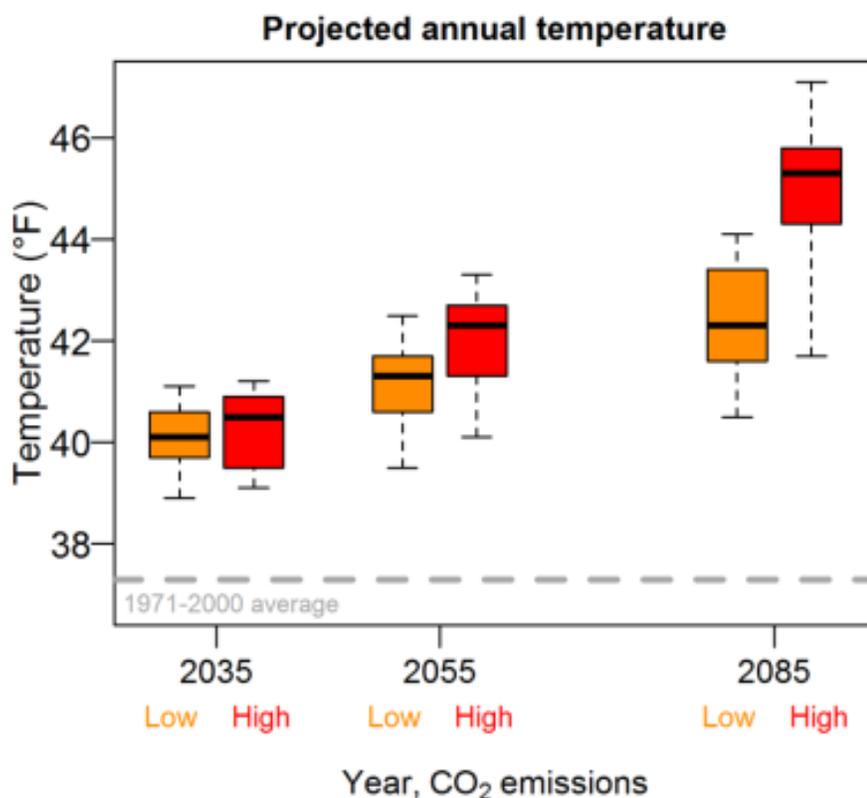
Recent temperature at Rocky Mountain National Park compared with the historical range of conditions. Black dots indicate average recent percentiles across the past 10, 20, and 30-year intervals. Variables are considered “extreme” if the average percentiles are <5th percentile or >95th percentile (i.e., the gray zones, where recent climate is pushing the limits of all observed climates since 1901). Black bars indicate the range of recent percentiles across 10, 20, and 30-year intervals.

Key points for interpreting these results:

- Recent climatic conditions are already shifting beyond the historical range of variability.
- Ongoing and future climate change will likely affect all aspects of park management, including natural and cultural resource protection, park operations, and visitor use and experience.
- Park management can use these findings to plan for future impacts of climate change.

Resource Brief: Future Climate Projections for Rocky Mountain National Park

Climate change impacts all aspects of park management from natural and cultural resource protection to park operations and visitor experience. Effective planning and management must be grounded in our comprehension of past dynamics as well as the realization that future conditions may shift beyond the historical range of variability. For example, at Rocky Mountain National Park, average annual temperature (30-year mean) is projected to be higher than the 1971–2000 average under all future time periods and greenhouse gas emissions pathways (see figure below). Climate change will manifest itself not only as shifts in mean conditions but also as changes in climate variability (e.g., more intense storms and drought). Within Rocky Mountain National Park, these changes may alter the future status, trend, and condition of many resources.



Historical and projected mean annual temperature for Rocky Mountain National Park. Historical data (1971–2000 average) are from Monahan and Fisichelli (2014). Projected climate change (30-year means) for the region including the park are for three future time periods centered on 2035 (2021–2050), 2055 (2041–2070), and 2085 (2070–2099) (Kunkle et al. 2013 NOAA Technical Report NESDIS 142-5). Two greenhouse gas emissions scenarios are presented: the **low** (B1) and **high** (A2) scenarios (IPCC 2007). Projected climate boxplots indicate the variability in future projections among 15 CMIP3 climate models. Values for the area including the park are based on the mean model output for that location and the range of climate model projections for the region: the bold horizontal black line represents the mean among all models, the upper and lower bounds of the boxes indicate the 25th and 75th percentile model output values, and the whiskers show the minimum and maximum values.

2.2. Cultural Resources

Cultural Resources provides stewardship for the history and continuity of human activity. This group works to identify, document, protect, and interpret the intangible and tangible evidence of humans with the environment. This division collaborates with the State Historic Preservation Office (SHPO), eleven culturally affiliated tribes, interested stakeholders, and the public to ensure that these fragile non-renewable cultural resources are protected in perpetuity for current and future generations. Museum and archival collections maintain objects and records for documentation and research.

Archeological Resources



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The park contains a rich array of archeological resources. Evidence of prehistoric occupation extends to the earliest Americans, the Clovis culture from about 10,000 years ago. Prehistoric trails, game drives, and tool manufacturing and food processing areas are recorded. More recent occupations include Ute and Arapaho, and Euro-Americans. In 2015, a well preserved brush shelter known as a wickiup was destroyed by visitors. The park would be better able to preserve and protect the archeological resources with a comprehensive data management plan and archeological monitoring program.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Archeological resources are identified and evaluated using appropriate anthropological and historical contexts.		A majority of the known archeological sites have been identified and documented by reputable university researchers and evaluated with appropriate regionally specific contexts. However, documentation is generally limited, to above ground observations and non-invasive field methodologies and artifact analysis. Subsurface testing of archeological sites and additional artifact analysis would yield a wealth of new information about the prehistoric and historic occupation of the park.
	Scope of archeological resources in the park is understood and a determination has been made whether or not they are a fundamental or other important resource.		Inventories conducted during the Statewide Archeological Inventory Project (SAIP) and subsequent investigations provide the park with an understanding of the breadth of archeological resources. The park Foundation Document (2013) identifies <i>Traces of Human Footprints</i> on the Landscape as a fundamental resource for the park.
	The distribution and types of archeology sites are understood.		With only 14% of the park inventoried for archeological resources, the park has minimal information about the distribution and site types located within the park.
	The environmental processes and human related impacts affecting site stability and condition are understood.		The park does not have an archeological site monitoring program in place and existing baseline condition information is outdated. The park has no way to understand the impact of increasing visitation on archeological resources or impacts due to climate change. Many popular trail corridors and backcountry campsite areas have never been surveyed for archeological resources and the impacts to valued resources in this area may never be understood.

Archeological Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Percentage of park intensively surveyed.		Approximately 14% of the park has been surveyed for archeological resources. This amounts to 37,025 acres of the park's total acreage (265,795 acres). However, a majority of these surveys were conducted by para-archeologists prior to 2000 and are inadequate. Many trail corridors and backcountry campsites have never been inventoried. The park has not pursued funding to complete additional surveys. Archeological inventories are generally completed for Section 106 purposes. Lack of baseline documentation warrants concern, given the inability to assess condition and/or adequate protection of unknown or undocumented resources. The park does not have the capacity to complete archeological surveys in house.
	Percentage of survey data included in the Geographic Information System (GIS) meeting current cultural resource standards.		The park GIS database contains information about the extent of surveys conducted within the park. Spatial data for survey level site documentation is poor. Sites are represented as a single point feature. Site boundaries and linear sites do not have spatial data.
	Percentage of archeological resources with complete, accurate, and reliable State site forms.		This is a very important question that the park should be able to answer. However, because the hard-copy archeological site records are not located in a centralized place and the park geodatabase, ASMIS database, and the SHPO database have conflicting data, the park is unable to ascertain the number of archeological resources that have been documented using state site forms. Existing state site form documentation is likely dated since the park has never actively monitored archeological resources.
	Percentage of archeological resources with complete, accurate, and reliable data in the Archeological Sites Management Information System (ASMIS).		Based on the ASMIS data, 4% of archeological resources have complete, accurate, and reliable data. Between FY 2014–2015 at least 10 new sites were identified and recorded and existing sites were revisited by contract archeologists during the survey of selected trail segments within the park. This new information has not yet been entered into ASMIS.
Documentation	Percentage of known sites with adequate National Register documentation.		Based on park ASMIS data, 2% of known archeological sites have adequate National Register Documentation.
	Percentage of known sites with Determination of Eligibility (DOE) documentation.		Based on park ASMIS data, 3% of known archeological sites have adequate Determination of Eligibility (DOE documentation).
	Percentage of archeological materials cleaned, conserved, studied, cataloged, and properly stored.		95% of artifacts are clean, cataloged, and stored in museum storage. Objects in storage are stable. 95% of objects have no catalog information in storage container with artifact. 35% of recent collections have been studied. 2% of the artifacts have been photo documented.

Archeological Resources (continued)

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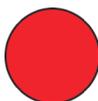
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Documentation (continued)	Percentage of records documenting archeological resource conservation, cataloging and storage maintained as a part of the archeological collection.		35% of accession and catalog records have poor or no information, 30% have limited, and 35% have good information. Many archeological collections are identified as HISTORY objects, rather than ARCHEOLOGY sub-category HISTORY objects.
	Park base maps are prepared showing the location and distribution of archeological resources, the nature and extent of archeological identification activities, and the types and degree of threats and damages.		The park is able to produce base maps that show the nature and extent of previous archeological surveys and the location and distribution of known archeological resources with a fair level of confidence. These maps depict archeological resources as point features and do not show the geographic extent of the individual site boundaries. The park does not have the baseline information necessary to identify the types and degree of threats and damages to archeological sites. The existing park geodatabase, ASMIS database, and SHPO database contain conflicting information.
	Percentage of archeological reports and publications entered in the Integrated Resource Management Applications (IRMA) database with appropriate restrictions for access to sensitive information.		Twelve reports are available on IRMA in Feb. 2016. At least 300 additional reports exist.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		The park funded multi-year, collaborative research project with Colorado State University (CSU) to inventory and document archeological sites recently uncovered by receding ice patches. A report on the findings of the first year of this study was disseminated to park managers and the project PI will talk about the project in a brown bag presentation for all park staff. The park is also collaborating with researchers at the University of Northern Colorado (UNC) to explore the prehistoric utilization of large game (bison, bighorn sheep, and moose) to reconstruct time-depth and residential persistence of species within the park to inform the future management of the species.
Certified Condition	Percentage of archeological resources certified as complete, accurate, and reliable in the Archeological Sites Management Information System (ASMIS) in good condition.		33% (n=271) of the identified archeological sites are listed in good condition, 40% (n=335) are listed as fair, 26% (n=212) are listed as poor, and 1% (n=11) lack condition information. However, the condition information in this dataset is dated, as only 30 sites have been assessed for condition within the past 5 years. The lack of current baseline condition information prevents the park from understanding the type (natural and cultural), frequency, and intensity of impacts to archeological resources.

Cultural Anthropology


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The NPS carries out programs and responsibilities that recognize the unique government-to-government relationship between Federal agencies and American Indian tribes, as well as understanding the contemporary importance of parks to other traditionally associated distinct cultural communities. Cultural Anthropologists help conduct ethnographic research, facilitate tribal consultation, and correspondence.

Anthropologic research facilitates collaboration with traditionally associated tribes and other park-associated cultural communities to identify and document traditional meanings and contemporary significance of cultural and natural resources including archeological sites, historic structures, museum objects, plants, animals, geological features, and landscapes.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's ethnographic resources to the historic context(s) for the park.		<p>Ethnographic studies were conducted in 1935 by R.L. Beals and 2004 by J.A. Brett. Oral Histories were recorded by S. McBeth in 2007.</p> <p>A sizable number of research reports remain to be added to research inventory. The park would benefit from an ethnographic overview and assessment study to document baseline cultural anthropology data for the full spectrum of park resources and traditionally associated tribes and communities. Comparative multi-disciplinary analysis is needed.</p>
	The scope of resources significant to affiliated groups associated with the park is understood and a determination has been made whether or not they are a fundamental resource or other important resource or value.		<p>The park acknowledges that ethnographic resources exist within the park, but had not put forth efforts to identify and document the resources to aid in our understanding and interpretation of these resources. Existing ethnographic studies focus almost exclusively on Native Americans. The park would benefit from an all-encompassing ethnographic study that includes other associated groups.</p>
Inventory	Appropriate studies and consultations document resources and uses, traditionally associated people, and other affected groups, and cultural affiliations.		<p>A comprehensive approach to ethnographic research has not been undertaken and is needed to further define and determine resources and/or places of special concern to current tribal groups and/or other non-native cultural groups. Furthermore, traditional knowledge is likely declining due to dwindling numbers of elders and practitioners of traditional lifeways.</p>
	Resources eligible for the National Register of Historic Places as Traditional Cultural Properties (TCPs) are identified.		<p>No inventory has been completed for the sole purpose of identifying and documenting TCPs. During consultations, tribal members have identified areas where TCPs may exist and expressed an interest in working with the park to identify and document these resources. No action has been taken.</p>

Cultural Anthropology (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
	Planning documents contain current information on traditional resource users and uses, the status of ethnographic data, and the legislative, regulatory, policy, or other bases for use.		The park lacks planning documents with current information on traditional resource users and uses. Ethnographic resources are limited and poorly represented in park management and planning activities.
Documentation	Percentage of cultural anthropology reports and publications entered in the Integrated Resource Management Applications (IRMA) database with appropriate restrictions for access to sensitive information.		IRMA contains twelve documents dating from 1935 to 2007. There are 100 documents and publications awaiting data entry.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		There is no on-going ethnographic research at the park. However, information gained during consultations with tribes is shared with park managers when it is appropriate. The park is actively seeking funding to complete additional ethnographic studies to aid the park in the protection and interpretation of these resources. Information sharing includes biennial research conference, brown bag lunch presentations, and interpretive programs.

Cultural Landscapes


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Cultural landscapes reflect our multi-generational ties to the land, with patterns that repeat and change to remind us of the depth of our roots and the unique character of our present. These places demonstrate our need to grow food, to build settlements and communities, to enjoy leisure and recreation, and to honor our deceased. Above all, these places demonstrate our continuing need to find our place within environmental and cultural surroundings. America's rich legacy is carried in its cultural landscapes; from scenic parkways to battlefields, formal gardens to cattle ranches, cemeteries to village squares, and pilgrimage routes to industrial areas.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Cultural landscapes are identified and evaluated using appropriate historical contexts.		<p>Previous efforts focused on the identification and listing of potential cultural landscapes in the Cultural Landscape Inventory (CLI) and did not provide appropriate documentation or evaluation. As a result, 23 potential landscapes were listed in the CLI and in subsequent years an additional 15 "potential" landscapes were identified, but not formally included in the CLI. Since 1999, the park has been trying to actively manage 2 fully documented cultural landscapes and 36 identified, but undocumented landscapes.</p> <p>In 2015, an interdisciplinary team at the park evaluated the 36 potential cultural landscapes to determine if their inclusion in the CLI was appropriate. The group recommended that twenty-six potential cultural landscapes were not viable candidates and that they be removed from the list. The park is working with IMR and the SHPO to remove the excess "potential" landscapes from the CLI and complete inventories for remaining ten landscapes.</p>
	Scope of cultural landscapes in the park is understood and a determination has been made whether or not they are a fundamental or other important resource.		As noted above, the park is actively working to identify the scope of cultural landscapes in the park. The park has not recognized cultural landscapes as a fundamental or important resource.
	Percentage of cultural landscape baseline documents with current and complete information.		17% (2 of 12) of the park's cultural landscapes have complete inventories. The Moraine Park Museum and Amphitheater, one of two complete landscapes has adequate baseline documentation. The McGraw Ranch landscape inventory is dated and the landscape was impacted by severe flooding in 2013. No cultural landscape reports (or treatment/preservation plans) have been completed for the two identified and documented cultural landscapes.
	Adequate research exists to document and preserve the cultural landscape's physical attributes, biotic systems and uses when those uses contribute to historical significance.		No research exists and none is planned for the future. The two landscapes with completed inventories need CLR's to ensure they are managed appropriately.

Cultural Landscapes (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Percentage of landscapes eligible for the National Register in the Cultural Landscapes Inventory (CLI) with certified complete, accurate and reliable data.		Two (5%) of the 23 cultural landscapes in the CLI have been evaluated for listing in the NRHP with SHPO concurrence. Because the CLI doesn't accurately reflect the park's identified cultural landscapes the question should be redirected to ask the percentage of landscapes eligible for the National Register with complete, accurate, and reliable data. The percentage increases to 17% when we move away from the CLI and examine the 12 landscapes that the park is actively managing.
	Percentage of Cultural Landscapes Inventory (CLI) data included in the Geographic Information System (GIS) meeting current cultural resource standards.		0% of CLI data is included in the park GIS database.
Documentation	Percentage of cultural landscapes with adequate National Register documentation.		No NRHP nominations have been completed for cultural landscapes. Of the two cultural landscapes identified and documented, cultural landscape reports (a CLR or treatment plan) have not been prepared for either property.
	Percentage of cultural landscapes with Determination of Eligibility (DOE) documentation.		17% (2 of 12) of cultural landscapes have determination of eligibility documentation (DOE), with SHPO concurrence. Three cultural landscape inventories were completed and submitted to the SHPO for consensus determination of eligibility in 2013; Holzwarth Trout Lodge, Utility Area/ Ptarmigan Lane CCC, and William Allen White. The SHPO declined and requested the documentation be submitted on National Register forms. To date the cultural landscapes have not been resubmitted.
	Percentage of cultural landscape reports and publications entered in the Integrated Resource Management Applications (IRMA) database.		IRMA contains 19 reports that mention cultural landscapes. Archival processing may reveal additional sources.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		The park has requested funding to complete the cultural landscape reports (CLRs) for the two completed inventories and cultural landscape inventories (CLIs) for the remaining 10 undocumented cultural landscapes. The completed CLRs and CLIs will be disseminated to park staff and serve as important planning documents.

Cultural Landscapes (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Certified Condition	Percentage of cultural landscapes certified as complete, accurate and reliable in the Cultural Landscapes Inventory (CLI) in good condition.		4% (1 of 23) of cultural landscapes listed in the CLI and are considered in good condition. As noted above, the CLI doesn't accurately reflect the park's identified cultural landscapes; the more useful question would be, what percentage of the park's cultural landscape with complete, accurate, and reliable data are in good condition. The percentage increases to 17% when we move away from the CLI and examine the 12 landscapes that the park is actively managing.

Historic Structures


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In the last five years, the Historic Preservation crew has completed major work on the exteriors of 30 designated historic structures and by 2022, 28 more will receive preservation treatment. Work is prioritized using a condition-based approach, requiring a condition assessment of each building. The small Historic Preservation crew has over forty years of experience, and is very passionate about the importance of preserving and saving these very valuable and irreplaceable pieces of the park's history. Caring for the ever growing list of age-eligible structures remains a challenge with limited staffing.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's historic structures to the historic context(s) for the park.		IRMA includes four reports. Archives include Ferrel Atkins Collection (Atkins 1964), non-extant structures, Lands, Historic Resource Study, Superintendent Monthly Reports 1915–1965 and Central Files.
	Historic Structures are identified and evaluated using historical contexts.		The LCS contains 168 structures for ROMO, the majority of which have been revisited within the past 5 years. These evaluations focused on condition assessment and updating photography. Eligibility determinations are inaccurate. It is estimated that a few hundred additional historic structures need to be evaluated and documented.
	Percentage of historic structure baseline documents with current and complete information.		A Preservation Plan was developed for the Beaver Meadows Visitor Center (NHL) in 2008. To date, this is the only structure with a current preservation plan. Historic Structure Reports (HSR) and Preservation/Treatment Plans are needed to ensure historic resources are adequately managed. It is estimated that 95% of the park's historic structures are in use and critical to maintaining park operations.
	Adequate research exists to document and preserve the historic structure's physical attributes that contribute to historical significance.		Buildings constructed in NPS Rustic Architectural Style are fairly well documented and preservation approaches are better defined and understood. Buildings constructed, moved, or acquired lack the necessary documentation and treatments are unique and approached on a case by case basis. Properties are continuing to be acquired.

Historic Structures (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Percentage of historic structures eligible for the National Register in the List of Classified Structures (LCS) with accurate, complete and reliable data.		This is a very important question that the park should be able to answer. However, because inventory and documentation records are not located in a centralized place and the park geodatabase, LCS database, and the SHPO database have conflicting data the park is unable to ascertain the percentage of historic structures eligible for the National Register in the LCS with accurate, complete, and reliable data.
	Percentage of List of Classified Structures (LCS) data included in the Geographic Information System (GIS) meeting current cultural resource standards.		Spatial data was updated for most historic structures and buildings listed on the LCS within the past 5 years. There is no spatial data for linear features (trails and roads). It is anticipated that GIS information will need to be collected for a few hundred additional historic structures that have yet to be evaluated and documented.
Documentation	Percentage of historic structures with adequate National Register documentation.		This is a very important question that the park should be able to answer. However, because inventory and documentation records are not located in a centralized place and the LCS database, and the SHPO databases have conflicting data the park is unable to know the percentage of historic structures with adequate National Register documentation. Initial efforts to verify the datasets indicate that 28% of structures (85 of 305) are listed in the NRHP. A majority of the NRHP documentation is not current.
	Percentage of historic structures with Determination of Eligibility (DOE) documentation.		This is a very important question that the park should be able to answer. However, because inventory and documentation records are not located in a centralized place and the park geodatabase, LCS database, and the SHPO database have conflicting data the park is unable to know how many structures have Determination of Eligibility (DOE) documentation. Initial efforts to verify the datasets indicate that 31% of historic structures (94 of 305) have DOE documentation. A majority of the DOE documentation is not current.
	Percentage of historic structure reports and publications entered in the Integrated Resource Management Applications (IRMA) database.		0%. There are no reports in IRMA.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		The park hosted an interdisciplinary and interagency Mission 66 Work Group to aid the park in identifying and managing NPS Mission 66 Era resources. The results of this work group were disseminated to park managers and partners. The Public Lands History Center (PLHC) at Colorado State University (CSU) has conducted research on historic structures at the park and the results have been disseminated at the ROMO Biennial Research Conference and at brown bag lunch presentations.

Historic Structures (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Certified Condition	Percentage of historic structures certified as complete, accurate and reliable in the List of Classified Structures (LCS) in good condition.		According to the LCS, 49% (83 of 168) of structures are in good condition. Maintenance and preservation of these structures is completed by facilities/maintenance staff. All of these structures are actively maintained and preserved within the confines of available staffing and funding. It is estimated that a few hundred additional historic structures remain to be evaluated and documented for the LCS.
	Percentage of historic structures in the Facility Management Software System (FMSS) with a Facility Condition Index (FCI) indicating good condition.		According to FMSS, 94 buildings and quarters identified as “historic” have a FCI rating of good condition. However, the park has identified that the number of “historic” buildings and quarters in FMSS conflict with other data sets, and thus do not accurately reflect the number of historic structures located within the park. Due to the unknown number of additional historic structures, no percentage is available.

Resource Brief: Civilian Conservation Corps Mess Hall

The NPS built the Mess Hall in 1926 to serve crews building Trail Ridge Road, which makes it one of the earliest NPS built structures in the park.

In 2014 the park completed a preservation project on the building to mitigate the rate of historic materials lost and to insure the structural integrity of the building. The building is located at a very popular picnic site on Trail Ridge Road.



Left: Before work began, rotted crowns on northeast corner of building; *Right:* Repairs to northeast corner, just needs primer and paint. NPS Photos.

History


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Rocky Mountain National Park was created to protect both natural and cultural resources side by side. Exploring the park's human past can tell us things about our role as park stewards now and in the future. The stories of the park began with the earliest inhabitants and will continue for generations. Rocky Mountain National Park stories include over 100 years of drama, adventure, suspense, and comedy. Some of the park's pioneers influenced park establishment, expansion, and current management.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the national significance and historical contexts for the park.		Numerous references are available regarding the history and development of ROMO. State universities, History Colorado, and the Denver Public Library have extensive references relevant to local and regional history. The park maintains multiple resources for staff to learn about the history of the park, including a library and park archives. Overall, there is an abundance of information but it is wildly scattered among facilities. The park lacks a consolidated, focused analysis of its administrative history and significance. The park relies on non-NPS produced research and literature pertaining to the park's history.
	Sufficient research is conducted to establish the reasons for park establishment and a history of the NPS management of the site.		Public Lands History Center (PLHC) at Colorado State University (CSU) continues to interpret park management records. Records are dispersed in park offices.
	Percentage of history baseline documents with current and complete information.		Zero documents with current information exist. The Administrative History is 50 years old (Musselman 1971); the Historic Furnishings Exhibit Plan is more than 35 years old.
Knowledge (continued)	Research supports cultural resource management.		The park has approached area university history programs to conduct research on its behalf. Permits have been issued, and coordinated efforts continue. Our research partners include the Rocky Mountain Conservancy and Cooperative Ecosystems Studies Unit (CESU).
	Research at the appropriate level of investigation (exhaustive, thorough, or limited) precedes planning decisions involving cultural resources.		Published historical materials are dated, with no schedule for upgrading and updating information. Federal records are dispersed in various park offices, limiting access. Limited records are stored in the museum waiting processing into the archives. Access to archives is improving, and staff orientation is improving.
	Research is conducted by qualified scholars.		Researchers are vetted as part of the Research Permit and Reporting System (RPRS), and are qualified researchers. In addition, park staff and community historians access the archives and park library, for programs, articles, and books.
Inventory	Cultural resources are inventoried and evaluated in consultation with State Historic Preservation Officers (SHPOs).		The park is actively seeking funding to complete Determinations of Eligibility (DOEs) and National Register nominations for historic structures. The park completed three DOEs for historic structures in 2015 and is in the process of updating National Register nominations for the Fall River Entrance Historic District and the Old Fall River Road.

History (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory (continued)	Research data are accessioned as part of the park's museum collection.		Research data are accessioned as part of the park's museum collection, and are scheduled for processing and cataloging into museum collection in 2017.
Documentation	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		The park hosted an interdisciplinary and interagency Mission 66 Work Group to aid the park in identifying and managing NPS Mission 66 Era resources. The results of this work group were disseminated to park managers and partners. The Public Lands History Center (PLHC) at Colorado State University (CSU) is currently conducting research on the park history and results will be disseminated at the ROMO Biennial Research Conference and through StoryMap online.

Resource Brief: Holzwarth Ranch Ice House

The Holzwarth Ranch Ice House was built around 1920. The ranch is located near the headwaters of the Colorado River and is significant for its association with the development of the ranching and resort industries. In 2014 the park completed a preservation project that included the limited replacement of logs. This is a good example of prioritizing repair needs, as work on this structure was not scheduled but concurrent years of heavy snowfall had greatly undermined its stability.



Photograph of the Ice House after the preservation project was completed. NPS Photo.

Museum Collections


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The museum collections at Rocky Mountain National Park include both cultural and natural history objects, as well as archives. The collection is inherently valuable for the information it provides about processes, events, and interactions among cultures, individuals and the environment. Placing objects and specimens within a broader context through research, analysis, and documentary records provides for greatest benefit and enjoyment of the public. Natural and cultural materials provide baseline data, serving as scientific and historical documentation of the park's resources and of the purpose for which ROMO was established.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research and analysis exists to understand the relationship of the park's museum collection to the historic context(s) for the park.		Early collections reflect exhibit interests rather than park significance. For example, fossils from Oregon and Montana and a painting of Saint Louis, MO. Natural history collections reflect current research interests, archeological collections reflect current knowledge of the resource, historic collections lack information about why they were collected and added to the collection. Review Accessions and Catalog records for completeness is ongoing. Significance is absent in most records, including deaccessions documentation. Analysis and correction of the museum catalog is occurring record by record.
	Scope of museum collection in the park is understood and a determination has been made whether or not they are a fundamental or other important resource.		The first Scope of Collections Statement (SOCS) was written in 2012 and was all-encompassing (Burchett 2012). Defining what objects are significant for inclusion in the collection will improve the collections quality. An updated SOCS with defined parameters is needed.
	Percentage of museum collection baseline documents with current and complete information.		20% of the park baseline documents for museum management are complete and current. 50% are out of date. Core documents guide the program and object preservation and protection, facilities housing collections, and access to them.
	Affected Native Americans are consulted regarding Native American human remains, associated or unassociated funerary objects, sacred objects, or objects of cultural patrimony in accordance with the Native Americans Graves Protection and Repatriation Act (NAGPRA).		NAGPRA repatriation in 2015 satisfied affected Native Americans by reducing Native American human remains, associated or unassociated funerary objects, sacred objects, or objects of cultural patrimony in museum collections.
	Park has an Inadvertent Discovery Plan that involves curatorial staff.		The park does not have an inadvertent discovery plan. Communication between Cultural Resource Specialist and Curator currently implements a de facto plan.

Museum Collections (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge (continued)	Museum curator is included in permit review and informed about park resource projects that may affect collections.		Museum curator is included in permit review and informed about park resource projects that may affect collections. The 2012 BioBlitz resulted in the collection of over 15,000 specimens and associated records that have not been cataloged yet. Permits were issued, collections were made, and the curator had limited involvement.
Inventory	Archival and manuscript collections are surveyed and described in the Interior Collections Management System (ICMS) and finding aids are produced.		The NPS Western Archeological and Conservation Center (WACC) staff processed all the park archives over the last ten years. The WACC team created finding aids and entered information in ICMS.
	Percentage of existing collection that is accessioned and cataloged.		90% of the existing collection is accessioned and we know where it came from and the collection is described. 60% of the collection is cataloged. Both of these percentages are up 10% from 2014. A survey of park records and archives to occur in 2017–2018 will result in additional materials backlog.
	Scope of Collection is consistently implemented; items or objects are researched to determine their appropriateness for inclusion in the museum/archive collection.		Since 2014, the SOCS has been consistently implemented. Documentation is added to accessions files and catalog records. Deaccessions are initiated to implement tight SOCS standards.
Documentation	Percentage of cataloged records with completed descriptive fields (beyond required fields).		Record by record, the park is improving the 25,000 catalog record descriptive fields. Improvements include the quality of data, spell check, and documenting condition of objects through digital imagery, description of condition, and importing individual object information from the 2015 Collection Condition Survey.
	Furnishings in historic structures are documented in a historic furnishings report.		The park has approximately 20 historic structures that contain exhibits. The Holzwarth Historic Site exhibit is the only site that has a Historic Furnishing Exhibit Plan. Furnishings located in historic structures that lack a Historic Furnishing Exhibit Plan needs to be evaluated or removed.
Certified Condition	Percentage of museum collection reported in Collection Management Report (CMR) and checklist report in good condition.		14,000 objects are summarized in the 2015 Collection Condition Survey (Bender and Senge 2015). 3,200 were identified (including 1,000 paper-based objects, 60 paintings, and 70 pieces of furniture) for further survey because they exhibited condition issues, with 70% requiring some level of conservation treatment. Many museum collection objects are stable in storage, but will require conservation treatment for exhibit or transport.

Museum Collections (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Certified Condition (continued)	Percentage of museum collection storage facilities in the Facility Management Software System (FMSS) with a Facility Condition Index (FCI) indicating good condition.		The number of facilities housing museum collections is 32 (2015), with 61% of those facilities in good condition. As objects are removed from inadequate facilities in 2016, the percentage will improve. 50% of museum collection storage facilities in the Facility Management Software System (FMSS) with a Facility Condition Index (FCI) indicating good condition. 17% are in fair condition, and 33% are in poor condition. 50% of the park's natural history collections are involved in long-term loans to non-federal repositories.

2.3. Visitor Experience

Visitor Numbers and Visitor Satisfaction

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Number of Visitors	Number of visitors per year		<p>The total of 4,517,585 visitors to the park in 2016 is higher than 2015 (4,155,916) and 2014 (3,434,751) and also higher than the 10-year average of 3,293,678 visitors for 2007–2016 (Source: NPS Stats). Park visitation in 2016 was 37 percent higher than the 10-year average, which warrants moderate concern as park managers wrestle with the impacts associated with the significant increase in day-use.</p> <p>Rocky Mountain National Park ranked fourth among national parks for annual visitation (2016) (Source: NPS Stats).</p>
Visitor Satisfaction	Percent of visitors who were satisfied with their visit		<p>Based on the standard visitor satisfaction survey conducted each year, the percentage of visitors satisfied in FY14 was 99.0%, which is higher than the average for the previous five years (98.6%) and ten years (98.0%) (Source: 2014 Visitor Survey Card Data Report). This survey asks only general questions about the overall quality of park facilities, services, and recreational opportunities, and does not directly address issues related to park management.</p> <p>In 2015 the park received 23 complaints about wait times for shuttle buses, and 21 complaints requesting shuttle bus service earlier in the season. The park also received complaints about entrance station wait times and lack of campsite availability. These complaints can all be tied to the increased number of park visitors (Source: ROMO Visitor Comment Forms received 2015).</p>

Visitor Impacts to Resources


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitation Impacts	Quantity of social trails		<p>Visitation to the park has increased dramatically within the last few years. In areas with high visitor use, park managers are concerned about negative impacts to park resources and visitor experience.</p> <p>Research conducted at sites in the Bear Lake Road corridor in 2008 and 2009 (before the dramatic increase in visitation) revealed numerous areas of intense ground disturbance at vistas, along lakeshores, and at other attraction sites where vegetation loss amounted to 82% to 92% of the disturbed area (D'Antonio 2010). In the same area informal trails are extensive. Fieldwork conducted in 2015 by Utah State University (D'Antonio 2015) revealed that new areas of impacts have appeared since 2008/2009, much of it related to the growing sport of bouldering. In 2015 there were 1,745 feet of new social trails in the Emerald Lake Area and 14,019 feet (2.7 miles) of new social trails in Chaos Canyon, both are considered world class bouldering areas. Social media has played a significant role in sharing information about Chaos Canyon. This has resulted in a significant increase in bouldering activity in this area.</p> <p>In 2015 the park received just two complaints from visitors about off trail impacts (Source: ROMO Visitor Comment Forms 2015).</p>
	Encounters with other visitors on trails		<p>Research conducted in 2008/2009 (before the dramatic increase in visitation) revealed that visitor standards of quality were violated at popular locations in the Bear Lake area (Newman et al. 2010). Visitor standards of quality were based on an acceptable number of People at One Time (PAOT). For example, at Emerald Lake, visitor standards for an acceptable number of PAOT were violated 52% of the time. The same research project demonstrated that no amount of tweaking of shuttle bus operations would resolve the issue. In 2015 the park received no complaints from visitors about crowded conditions on trails or at popular destinations.</p>
	Quantity of human waste observed/removed		<p>Between 2010 and 2015, a low of 17,850 gallons (2012) and a high of 30,525 gallons (2015) of human waste were pumped from vault toilets along the Bear Lake Road corridor. In 2015, four of the 19 backcountry campground privies with average retire and re-dig rates of once in every three to four years have shifted to re-digging yearly. In 2014 and 2015, added human waste removal service trips to the park's backcountry solar toilets had not been able to stay ahead of visitor use. A contractor service for the park's Trail Ridge vault toilets removes an average of 4,500 gallons of human waste per day. Increased evidence of uncontrolled human waste is observed by the park's climbing ranger staff.</p>

Visitor Impacts to Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitation Impacts (continued)	Water quality (unhealthful levels of <i>E. coli</i>)		<p>The Town of Estes Park measures <i>E. coli</i> levels in Glacier Creek at the intake to their water treatment plant. Glacier Creek originates inside the park and the only source of <i>E. coli</i> would come from the park. It is measured as the Most Probable Number (MPN) of coliforms in 100 mL of water.</p> <p>MPN values at the test site from July 2007 to March 2016 range from <1 to 240. MPN values are highest May through September, averaging 32.6 over the past nine years. Potential sources of <i>E. Coli</i> are human waste, wildlife, and horses. MPN values are lowest during the winter months, averaging 2.5 over the past years. Except for occasional spikes, levels of <i>E. coli</i> in Glacier Creek are low (Source: Town of Estes Park Public Works 2015).</p>
	Parking availability		<p>From mid-June through the September, trailhead parking lots fill early in the day on the east side of the park.</p> <p>The Glacier Gorge Trailhead parking lot fills by 6 a.m., Bear Lake Trailhead by 8:30 a.m. and the Park & Ride by 10:30 a.m. If visitors arrive after 11 a.m. and want to hike in the Bear Lake Road corridor their best option is to take the Hiker Shuttle from Estes Park. The Wild Basin Corridor parking areas fill by 10 a.m. The Alpine Visitor Center parking lot is full between 10 a.m. to 3 p.m. The Beaver Meadows Visitor Center parking lot is full much of the day. Most other trailheads on the east side are filled by noon.</p> <p>More than eighty percent of park visitors arrive through the east entrances of the park. Therefore, the west side of the park has more available parking. However, the parking lots at Kawuneeche Visitor Center and Milner Pass are full throughout the day during the summer and early fall.</p> <p>Shuttle buses run in the Bear Lake Road Corridor from late May through early October. During the late fall, winter, and early spring, the trailhead parking areas along the Bear Lake Road fill on weekends, as does the winter parking area in the Wild Basin area.</p>
	<ul style="list-style-type: none"> • Number of parking violations • Number of vandalism incidents 		<p>Off-road parking violations increased dramatically in 2015 commensurate with the significant increase in visitation.</p> <p>There has been an increasing number of incidents related to vandalism and graffiti appearing on park resources.</p>

Visitor Impacts to Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Non-Wilderness Recreational Opportunities	Campsite availability		Demand for front country camping at the park has exceeded supply for the last several years. There are three reservation campgrounds within the park representing about 440 campsites. These are Moraine Park, Glacier Basin, and Aspenglen. These campgrounds regularly fill six months in advance during the reservation season (Memorial Day Weekend through end of September). Moraine Park Campground remains open as a first-come, first-served campground once the reservation season has ended. Typically loops in that campground are closed off as demand decreases; however during that last two years record visitation has increased the demand for camping later into the year, and we have responded by keeping additional loops open into November. There are two additional campgrounds within the park that operate as first-come first-served campgrounds; Timber Creek and Longs Peak Campground (about 125 campsites) these typically fill by early afternoon each day during the peak visitation season. There are many visitors throughout the day that are turned away due to the lack of campsite availability. The park has not captured that number but many of the local area private and public campgrounds also run at or very near capacity during the peak visitation periods of the park.
Wilderness Recreational Opportunities	Wilderness campsite availability		The park has 219 designated wilderness campsites total. In 2016, 161 (73.5%) designated sites will be open and 58 (26.5%) designated sites will be closed. Closures are due to the presence of hazard trees caused by the bark beetle and spruce beetle outbreak, which means the supply of campsites is dwindling in the face of significant visitor demand. The most popular backcountry campsites (approximately 40) are reserved for 95% of the time from June through August each year. Backcountry camping is available at less popular campsites in the park and during the off-season.
Inholding Status	Ability to protect view shed		The park and partner organizations have successfully acquired three private inholding properties within the last year. On two of the properties the residential structures, utilities, and access roads will be removed, resulting in viewshed improvement. Most of the seasonal private cabins in the park are rustic in design and therefore do not have a significant impact on scenic vistas. Current private landowners have a strong attachment to the park and are willing to maintain the status quo. The park holds a conservation easement on the 1,200-acre MacGregor Ranch, which is operated as a historic cattle ranch. The ranch is within an important viewshed, and is protected from future development.

Visitor Impacts to Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Park Transportation System and Traffic Flow	Hours per day shuttles running over capacity		<p>Shuttles operate near or at capacity from 9:00am to 3:00pm most of the shuttle operating season. All of the trailhead parking within the Bear Lake corridor typically fills by 9:30am each day and shuttle use significantly increases at that time. Buses continually run full at a maximum capacity of 45 passengers each (28 seated and 17 standing) during that time. In the morning there are large numbers of queued visitors waiting to board buses from the park's Park and Ride facility for uphill destinations. Most usually have to wait two or three bus cycles to board. This is repeated later in the day for the downhill return. During these peak times, extra shuttles are added to address the increased demand. In 2015 the park used an additional 1,042 hours of unscheduled shuttle service to address the additional demands. Some of the additional hours were used to extend shuttle service beyond the scheduled Columbus Day ending and adding service for the remaining October weekends. The shuttle system in 2015 experienced a 25% increase in ridership over the 2014 season. In 2015 a total of 577,029 riders used the shuttle system and the single highest use day was the Sunday of Labor Day Weekend (September 6, 2015) with 9,100 riders on that day.</p>
	Entrance wait times		<p>While no formal study has been conducted on entrance station wait times at the park we do have a sense that during times of peak visitation the visitor experience is greatly diminished with heavy queuing entering the park. The impact of this is experienced more so at the Beaver Meadows and Fall River Entrances, since about 80% of visitors' begin their park visit entering through these entrances. The longest wait times are experienced during the fall weekends when vehicle counts are at their highest. At these times the park has experienced backups of over a mile in length, with traffic queuing from the Beaver Meadows Entrance down to beyond the Beaver Meadows Visitor Center. Impacts are greater at the Fall River Entrance as that entrance station sits near the park boundary and when traffic is queued up access to local businesses and residences is impacted. While less dramatic during the summer months, the high traffic volume still leads to increased wait times. For example at the Beaver Meadows Entrance, there was a 26% increase in vehicles in the month June in 2015 and a 27% increase in the month of July over the vehicle counts in 2014. The continued increases in vehicles lead to longer times when entrance station volumes reach capacity.</p>

Resource Brief: Increased Visitation and Day Use Challenges

Since 2012, visitation has increased approximately 39%, or over one million people, resulting in congestion, resource damage, significant safety issues and diminished visitor experience—such as long lines at the entrance gates and at shuttle stops; overwhelmed rest room facilities and backcountry sites; crowded trailheads and expansion of social trails. Park operational capacity has declined over the last five years. Visitation has significantly increased in each month of the year, many months setting new records in 2015. The top six visitation days in 2015, were in September and October, representing a shift from our normal July expectations. The park can no longer be managed as a park with high summer visitation and “shoulder seasons”; a year-round model of operation is necessary.

The park initiated the Hiker Shuttle Route between Estes Park and the park in 2006. In the last ten years ridership has increased 359 percent to 42,783 passengers in 2015. Prior to the availability of the Hiker Shuttle, parking capacity at popular trailheads and destinations along the Bear Lake Road served to cap visitor use. That cap no longer exists, giving rise to concerns about unintended impacts to natural resources and visitor experience.

A transportation study report projected in 2002 that visitation in Rocky Mountain National Park would exceed 4 million by 2010. For numerous reasons, which we assume relate primarily to the economy of the region, this did not happen. Between 2002 and 2012, visitation remained largely static, hovering around 3.1 million. However in 2013, we began to see increased visitation until it slumped in September due to local and regional flooding and soon to follow government shutdown. In 2014, park visitation grew to 3.4 million and in 2015, visitation caught up to the study’s 2010 projection of approximately 4.1 million visitors, and hit over 4.5 million in 2016. This dramatic shift in only two years presented significant challenges related to: operational capacity, visitor and staff safety, resource protection and visitor experience.

Since 2002’s projection for an increase of visitors, the park has addressed several significant issues that have buffered the immediate effects of the increase in visitation including:

- Investment of more than \$66 million Federal Lands Highway Program funds into a park road system that is now largely in a maintenance cycle
- Investment of approximately \$68 million Federal Lands Recreation Enhancement Act funds (gate fees) into projects of infrastructure and wildlife habitat that enhances park visitors experience every day
- Investment of hundreds of thousands of dollars, with diverse academic collaboration, in social science investigations focused on visitor experience and impacts in our most visited parts of the park
- Investment in operational leadership training for all staff to provide foundational tools for assessing risk and being safe during times of change
- Management of park finances to retain flexibility for adaptation to management needs

This “new norm” of visitation appears to be most immediately caused by low gasoline prices as travel to numerous national parks throughout the region has increased substantially. It is important to note that Rocky Mountain’s visitation has consistently been largely influenced by local and regional repeat visitation. The substantial and recent growth of population along the Front Range of Colorado (among the top-10 growing states with 85% of its population on the Front Range) suggests that even when gasoline prices rise, visitation will continue to be high.

Moreover, the 2002 transportation report projects more than 5 million visitors in 2020. Although the models that inform the projection are not perfect, it would be a mistake to ignore them given their relative accuracy. Observations of issues related to the dramatic increase in visitation include but are not limited to:

- Visitor and staff safety has been compromised through frequent traffic congestion issues and increased crime
- Illegal campfires more than doubled in 2015 (The Fern Lake Fire of 2012 was caused by an illegal campfire resulting in evacuations, loss of a private residential structure, and a cost of more than \$6 million)
- Backcountry and front country natural and cultural resources are experiencing increasing impacts
- Visitor complaints have increased significantly
- Property damage and vandalism have increased significantly

Resource Brief: Transportation System

Previous to establishing an improved transportation system in 2001, Rocky Mountain National Park visitor use surveys indicated that 39% of visitors felt “crowding” was an important problem and 23% of visitors stated finding a parking space was “extremely difficult.” The park has focused the Visitor Transportation System along the popular Bear Lake Corridor with two main routes. The Bear Lake Route moves visitors from the park’s transportation hub, known as the Park & Ride, to Bear Lake with stops at popular trailheads. The Moraine Park Route connects the park’s two main campgrounds to the Park & Ride. Beginning in 2006, the park, in conjunction with the Town of Estes Park, launched a pilot project to test an integrated visitor transportation system. That system continues today. Although the two systems are administered and contracted separately, they act as one seamless transportation system. The integrated system provides easy access from lodging establishments and the Town’s downtown Visitor Center to the downtown business district and the park during the peak season. As part of that system, the park operates a connecting route known as the “Hiker Shuttle.” The Hiker Shuttle is an express route that runs from the Estes Park Visitor Center to the park’s Beaver Meadows Visitor Center and on to the Park & Ride on the Bear Lake Road corridor. In 2015, over 45,000 people rode the Hiker Shuttle. The system has seen the use continuously increase since it began and in the 2015 shuttle season, 577,029 riders used the park’s shuttle system.



Park visitors view the elk rut along the road near Moraine Park in September. NPS Photo.



Clean diesel bus stops for passengers at Glacier Basin Campground. NPS Photo by Ann Schonlau.

Riding the shuttle provides an opportunity for visitors to reduce their fuel consumption, reduce traffic and parking congestion, and lets them enjoy the ride and views without driving themselves. The shuttle system enhanced the park’s hiking opportunities by creating a wide variety of loop hikes, allowing visitors to leave from one trailhead and come out at another, catching the shuttle to return to their vehicle.

In 2013, the park awarded a new shuttle contract, as part of that contract the park called for a “greening” of the fleet. This resulted in eight of the previous shuttle buses being retrofitted with clean diesel technology. These shuttles are equipped with Diesel Particulate Filter systems and now meet the EPA’s clean diesel standard. These retrofits have significantly reduced the fleet’s emissions. Two new hybrid buses have joined the fleet in the 2014 season. The addition of these hybrids has increase the overall fleet fuel efficiency by at least 11 percent.

Visitor Services


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Education Programs	Number and quality of programs, and number of participants		<p>The Next Generation Fund (NGF), established by the Rocky Mountain Conservancy in 2006, has allowed the Education and Outreach program at Rocky Mountain National Park to become sustainable. NGF funds Interns and Education Technicians who are the backbone of the program. The program serves kindergarten to undergraduate students and sponsored youth and adult groups. Although the number of programs requested and people served has varied slightly over the past ten years in spring and fall, there has been growth in the winter and summer. The program conducts a wide variety of youth and adult programs, ranging from curriculum based education programs in the park and at schools, to youth day camps, winter youth and adult group snowshoeing, and teacher training opportunities.</p> <p>In 2006, 228 programs for 9,098 visitors were provided. In 2015, 213 programs were conducted serving 10,875 visitors. The program has maintained a consistent level of service for many years. Program growth is constrained by budget, workspace and available housing (Source: ROMO Environmental Education Program).</p>
Ranger Programs	Number and quality of programs and attendance		<p>Rocky Mountain National Park sets a high standard for quality interpretive programming. Extensive training, coaching, and mentoring are provided to each field interpreter to ensure the best experience for visitors and to increase advocates of the park and its resources.</p> <p>In 2015, ROMO offered 171 programs per week during the busy summer season from mid-June through Labor Day including both east side and west side programs, which works out to be approximately 2,052 programs. These include very popular evening programs, patio talks, and guided walks. Spring and fall programs are also offered in lesser quantity at about 84 programs from the end of March to mid-June and 201 programs from Labor Day through October 12. Winter programs have grown in popularity with 96 programs being offered. Over the past 3 years, formal interpretive program attendance has averaged 57,000 visitors annually.</p> <p>Park staff continues to expand efforts to “meet visitors where they are” with roves and drop-in programs at various locations throughout the park.</p> <p>Limited staffing and reliance on seasonal positions does not allow for as many formal ranger programs during the spring (March into April) or fall (early Oct. through Nov.), when the park has many visitors. Visitation in these “shoulder” seasons is increasing, and the park is currently unable to offer these visitors any traditional programs. Visitation has increased while interpretive programming and staffing have not kept pace (Source: ROMO Division of Interpretation).</p>

Visitor Services (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Junior Ranger Programs</p>	<p>Number of programs and attendance</p>		<p>Visitor attendance at summer ranger-led junior ranger youth programs has increased significantly since implementation of a new visitor contact station called the Junior Ranger Headquarters (JRHQ) in 2011 and the reopening of Moraine Park Discovery Center (MPDC). These contact stations have also presented the opportunity to hire additional youth program staff. At JRHQ 4 ranger-led programs are offered each day of the summer for 8 weeks. There are also youth programs offered at MPDC and through the YMCA “Get outside; Play Learn Serve Work” partnership. Junior Ranger programs are also offered on the west side of the park at Kawuneeche Visitor Center.</p> <p>Prior to 2011, about 2,000 summer visitors participated in ranger-led youth programs and about 30,000 junior ranger activity books were handed out annually. Since then, between 40,000 and 45,000 junior ranger activity booklets are given out annually and ≈16,000 badges are awarded to kids who complete their booklets.</p> <p>With the 228 ranger-led youth programs are offered at JRHQ 5,000–7,000 kids experience an activity each year. Meanwhile, the YMCA partnership reaches 255 day campers with ranger-led programs and has awarded 124 badges! (Source: ROMO Division of Interpretation).</p>
<p>Special Events</p>	<p>Frequency of special events</p>		<p>In 2015, over 200 events highlighted the park’s Centennial Celebration year, emphasizing what has made Rocky beloved to so many over the past 100 years. Art displays, painting events, Night Sky presentations, birthday parties, Junior Ranger sing-alongs, special ranger programs, museum exhibits, parades, festivals, and much, much more provided plenty of opportunities for visitors to the park and surrounding communities to be part of the fun.</p> <p>In 2012, Rocky hosted a National Geographic BioBlitz utilizing the Town of Estes Park Fairgrounds.</p> <p>Due to the park’s high visitation, limited capacity to handle special events, and lack of available venues, there are no large annual events that take place in the park. The park has a lottery system for large bike tours. Ride the Rockies, with approximately 2,500 riders, comes through the park in mid-June about once every four years (Source: ROMO Centennial Coordinator and Public Information Office).</p>

Visitor Services (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Commercial Services	Number of visitors served		<p>There are a variety of commercial services provided in the park. Commercial services are private companies operating in the park either at the request of the park or using the park as a venue for their business. These businesses operate under two different agreements; concession contracts and Commercial Use Authorizations (CUA).</p> <p>There are 23 concession contracts covering guided horse rides, guided technical climbing, firewood sales in the campgrounds, and the park's largest concession operation Trail Ridge Store.</p> <p>The CUAs provide for mainly guided experiences in the park by businesses that use the park as a venue for their operations. CUA permitted activities available are: guided fly fishing, guided hiking and backpacking, photo portraits and workshops, wedding services, shuttle/van tours, llama packing, and bicycle tours. In 2015 there were 150 CUA permits issued. In recent years that number has continued to climb. As more and more visitors come to the park the attractiveness for business opportunities increases, and the increasing number of CUAs strain the park's ability to manage and monitor these operations.</p> <p>Combined, concession contracts and CUAs in the park serve an estimated 1 million visitors a year, with those companies having gross sales in the park around \$7.6 million in 2015.</p>

Resource Brief: Centennial Celebration

Rocky Mountain National Park turned 100 in 2015. Rocky followed other park Centennial celebration models and used a year-long period to incorporate centennial programs and events to ensure the most diverse and inclusive celebration possible. Rocky Mountain National Park was established on January 25, 1915 and dedicated on September 4, 1915. Therefore, a celebration period of September 3, 2014 through September 4, 2015 was set, using the park dedication month and day as a starting and ending point.

An Employee Tagline Contest was conducted yielding the centennial slogan: "Wilderness, Wildlife, Wonder." Beth Honea, a Rocky Mountain National Park volunteer, wrote that her winning submission represents "a nod to our recent wilderness designation, recognition of what many people visit the park to encounter, and the feeling they experience in their heart and soul in seeing Rocky for the first or the one hundredth time." This tagline, along with the 100th Anniversary Mission, "Honor the Past, Celebrate the Present, Inspire the Future," guided the 100th Anniversary celebration.

Close to 100 designs were submitted from all over the country for the 100th Anniversary Logo Contest. Carol Welker, the winning designer, used her strong childhood connections to the Estes Park area and her love of Rocky Mountain National Park to inspire her design. The logo was trademarked and owned by the Rocky Mountain Conservancy.

Local businesses and organizations were engaged throughout the planning and numerous events and ceremonies. Both Grand Lake and Estes Park formed committees to coordinate town events to celebrate the park's Centennial.

An official 100th Anniversary Song and official 100th Anniversary Poster were commissioned for the Centennial Celebration. A 100th Anniversary Film was released on January 26, 2015, for the 100th Anniversary of the signing of the park's enabling legislation.

A 100th Anniversary on-line yearbook was created in order to provide an opportunity for park employees, alumni, volunteers, and visitors to upload and share personal photographs and stories from the past 100 years. Numerous social media campaigns highlighted the park's centennial and were extremely popular. Interpretive programs highlighting the 100th Anniversary themes were offered throughout the celebration year.

Resource Brief: Centennial Celebration (continued)

Over 200 events highlighted the park’s Centennial Celebration year, emphasizing what has made Rocky beloved to so many over the past 100 years. Art displays, painting events, Night Sky presentations, birthday parties, Junior Ranger sing-alongs, special ranger programs, museum exhibits, parades, festivals, and much, much more provided plenty of opportunities for visitors to the park and surrounding communities to be part of the fun.

To conclude the year-long celebration, over 1,600 people attended the official Rededication Ceremony on September 4, at Glacier Basin Campground. The Estes Park Woman’s Club reprised their historic role as hostesses for the event serving birthday cake and cookies to event attendees. Entertainment was provided by Cowboy Brad Fitch who performed “Rocky Mountain High” and the official Centennial song “Rocky’s a Park for All.” Thirty students from the Estes Park schools repeated their historic role and sang “America the Beautiful.” Special remarks were made by Colorado Governor John Hickenlooper, Senator Mark Udall, Senator Cory Gardner, Director of the National Park Service Jon Jarvis, National Park Foundation President Will Shafroth, and, naturalist Enos Mills, who has been called the “Father of Rocky Mountain National Park” by the *Denver Post*. Park Superintendent Vaughn Baker was the master of ceremonies. All attendees of the event were sworn in by Director Jarvis as future stewards of Rocky Mountain National Park, ensuring another one hundred years of protection and enjoyment.

Some additional highlights of the Centennial year include:

- Over 15,000 attendees at Centennial Events
- 249 Centennial Volunteers giving 1,889 hours of volunteer work
- Over 40 Outreach presentations to groups throughout the Front Range
- Over 93 licensed Centennial products
- 36 cakes to share!

Throughout the year, people shared their love of Rocky Mountain National Park in person with park staff and on social media through stories, photographs, and personal recollections. The Centennial Celebration was an amazing, once in a lifetime occasion to pause and reflect on the sense of connection that so many people have had to a place like Rocky over its one hundred year history.



Rocky Mountain National Park staff celebrates the park’s Centennial at the official Rededication Ceremony at Glacier Basin Campground. NPS Photo.



Over 1,600 people attended the official Rededication Ceremony of Rocky Mountain National Park at Glacier Basin Campground on September 4, 2015; commemorating one hundred years since the park was dedicated in 1915. NPS Photo.

Interpretive Media – Brochures, Exhibits, Signs, and Website


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wayside Signs	Condition and currency of signs		Park waysides are in fair condition, but many are nearing their end of life (both in content and physical condition). A project is funded (FY17) to develop a wayside plan, design and install new waysides, and update and replace many existing waysides. All waysides are documented in FMSS with a condition assessment.
Park Directional Signs (off-site)	Usefulness, quantity, and placement		There are numerous park directional signs on interstate, state, and local highways leading to the park. Park directional signs exist on I-70 and I-25. Directional signs also exist on U.S. Highways 34 (in Loveland, Estes Park, Granby and Grand Lake), on U.S. Highway 36 (Longmont, Lyons and Estes Park), and U.S. Highway 40 (Granby). A directional sign was recently added on U.S. Highway 40 in Granby at the request of the Town of Grand Lake.
Park Directional Signs (on-site)	Usefulness, quantity, and placement		<p>Over the past five years, the park has been experimenting with the use of Variable Message Signs (VMS). First in a pilot project with the Town of Estes Park and the Federal Highways—Central Federal Lands Division, to promote parking in the Town and using the shuttle system to access the park. In 2013 the park purchased 3 VMS and an additional 2 signs in 2014 to provide real-time travel and parking information within the park. These sign have been used effectively along the Bear Lake Road to inform visitors of current parking conditions along the corridor and encourage park shuttle use. Their use contributed to a 25% increase in ridership for the park shuttles in 2015 while lessening the frustration of visitors looking for parking.</p> <p>In 2015, the park, along with the Town of Estes Park, used additional VMS along both highways 36 and 34 entering the Town to encourage park visitors to by-pass the congested downtown corridor and enter the park through the less utilized Fall River Entrance. The VMS were in place July through October. The park experienced a shift in traffic patterns through the signs use with a low in August of a daily average of 161 vehicles shifted and a high in September of a daily average of 327 vehicles shifted.</p>
Exhibits	Alpine Visitor Center		Exhibits are in good condition, though a few need updates.
	Beaver Meadows Visitor Center		The visitor center wasn't designed to house exhibits and lacks the space or layout for significant exhibits, with only a 3D map on the lower level and a few waysides outside the building. A flat screen monitor showing videos about the National Park Service Centennial was recently installed, a project is funded for a new 3D map, and new waysides are being designed for a walkway that runs around the outside of the auditorium. Being a National Historic Landmark limits the modifications possible.

Interpretive Media – Brochures, Exhibits, Signs, and Website (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Exhibits (continued)	Fall River Visitor Center		Exhibits are in good condition, although a few need updates. The RMC bookstore has recently been expanded and the downstairs has recently been upgraded with audience centered art activities and a new art exhibit for the NPS Centennial.
	Kawuneeche Visitor Center (KVC)		Exhibits at the KVC are the oldest in the park, having been designed and installed in 1990–1991, a quarter of a century ago. They lack interactivity or appeal to children. However, a project will soon be underway to re-design the interior of the KVC, including designing and installing new exhibits that will be relevant to a 21st-century audience.
	Moraine Park Discovery Center		Exhibits are dated and due to high use need annual maintenance to remain in fair condition, with a few needing updates.
Historic Sites	Holzwarth Historic Site		<p>Holzwarth Historic Site includes a handful of interpretive waysides that provide limited information about the site. Because visitors often visit the site at times when it is not staffed, hopes are to eventually expand the number of exterior exhibits at the site to provide more self-guided interpretation.</p> <p>The cabins themselves contain many exhibited original furnishings. Likewise, original farm implements are exhibited on the property. Condition assessments have shown that many of these items are experiencing significant deterioration and that present conservation efforts are inadequate to protect much of the collection. The park is working with conservation experts to develop more comprehensive cleaning and maintenance protocols to better preserve the site's historic objects.</p>
Print Media	Accuracy and availability of primary park publications		<p>Most important documents have been improved in the last five years, and primary publications are regularly updated. The newspaper was recently improved through a redesign. The Backcountry Wilderness Guide was moved to a completely web-based format and most handouts are available on the park website.</p> <p>The official park brochure was updated in 2014.</p>
Audio-visual Media	Orientation Films		The park orientation film, created in 2000, is a great introduction to and overview of the park. A new film was created for the Centennial and pairs beautiful imagery with up-to-date information and concerns.
	AV Equipment		Beaver Meadows Visitor Center equipment is fairly modern. Kawuneeche Visitor Center equipment is very out of date but will be updated in a funded project. Outdoor amphitheater systems are significantly out of date. Audio/video recording equipment is a mix of recently purchased modern equipment and outdated equipment that should be upgraded.

Interpretive Media – Brochures, Exhibits, Signs, and Website (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Digital Media	Website		Rocky's official website received over 8.5 million views and 6.7 million visitors in 2015, a 12% increase over 2014. It was the eighth most visited park website in the entire NPS. Pages offer both timely visitor information and deep content on park themes and projects. However, until recently, the site has been run as a collateral duty, and behind-the-scenes organization is lacking. A content strategy and re-design is being developed, but staff time is still limited. Additional staff is needed to maintain the site to an appropriate standard.
	Social Media		The park has a strong social media presence that grows stronger daily. The park has a Facebook page (509,000 followers, fifth most followed NPS page), an Instagram account (154,000 followers, fifth most followed NPS account), a Twitter account (18,800 followers, tenth most followed NPS account), and YouTube and Flickr pages for distributing videos and photos (Source ROMO Media Specialist).
	Other Technology/ Media		Proposals are being written to develop an app through Harpers Ferry Center and a parkwide status system that will drive webpages and visitor center monitors with live condition updates (road status, parking, campgrounds, and shuttles). A modern teleconferencing system was recently installed for use with distance learning programs. The park has limited Wi-Fi access and cellular coverage varies greatly throughout the park.

Scenic Resources


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Scenic Views	Scenic views quality & protection		While most scenic views in and around the park are generally high quality, views are of moderate concern due to air quality impacts on visibility. A significant number of visitors come to the park to view the scenery, and scenery is a fundamental resource and value included in the park's Foundation Document. The park has experienced some recent development adjacent to the park that has affected scenic views but general land use around the park should mostly retain the important qualities of the views. Gateway communities and counties have adopted land use and development codes that include provisions for protecting ridgelines and highly visible locations outside the park from development that could harm important viewsheds.

Universal Access


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Mobility</p>	<p>ABA compliance & Section 504</p>		<p>The park currently offers a wide range of activities and experiences for visitors with mobility impairments and limitations. These include several trails, campgrounds, picnic areas, wildlife viewing areas, and scenic overlooks that meet Architectural Barriers Act (ABA) requirements. All park visitor centers and most restrooms are accessible. A number of park programs, such as ranger led hikes and talks are accessible and are identified in the park newspaper. Programs are modified, when possible, depending on visitors' individual needs.</p> <p>Improvements to park facilities are continually being completed to improve access for visitors with mobility improvements. Most recently, the Lily Lake parking area was paved and a new boardwalk is planned at this trail to allow for better access. The park has completed several accessibility assessments for both facilities and programs, and is in the process of implementing recommendations from these assessments. Recently, a lift was added to Beaver Meadows Visitor Center to improve access between the first and second floors.</p> <p>Numerous projects have been identified and are awaiting funding to continue to improve accessible experiences. These include accessibility improvements for the Sprague Lake Trail, the Backcountry Office, several campgrounds, picnic areas, interpretive exhibits and visitor contact areas throughout the park. In addition, ABA requirements are implemented when facilities of any type are altered or constructed.</p> <p>The park has a need for better maintenance of designated accessible facilities, especially during winter weather events. Better oversight of accessibility improvements completed by contractors and park staff is also needed.</p>

Universal Access (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visual Accommodation	ABA compliance & Section 504		<p>A written description of the audio content is provided for park films. Visitor centers include a tactile map and some provide tactile and audio exhibits. Tactile objects are provided during many park programs. The primary park brochure is available in braille and large print formats.</p> <p>The park has completed several accessibility assessments, for both facilities and programs and is in the process of implementing recommendations from these assessments. Several projects that will improve access for those with visual impairments are underway or awaiting funding. These include improvements to the existing tactile maps, audio description of interpretive exhibits, and audio descriptions training for park interpretive staff.</p> <p>There is a need to provide more park brochures in alternative formats. There is also a need to provide more tactile elements on wayside exhibits. Media/ social media releases need to provide audio descriptions. Better communication with the public about available assistive technology is needed. At this time Rocky does not have the ability to meet these needs and we are not keeping pace with new regulations.</p>
Auditory Accommodation	ABA compliance & Section 504		<p>Closed captions are available for most audio/visual programs in the park and on the web. Assistive listening devices are available at Beaver Meadows Visitor Center and planned for Kawuneeche Visitor Center, and the park will schedule a sign language interpreter for visitors who provide advance notice.</p> <p>Better communication with the public about available assistive technology is needed. Social media releases should include open captions. Alternative formats should be explored for all audio communications.</p>

Universal Access (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Public Transportation</p>	<p>Access to and within ROMO via park funded shuttle system</p>		<p>The park has been providing some sort of shuttle service in the Bear Lake corridor since the 1970s. The modern era of that service started in 2000 and continues today. More comfortable and inviting buses with established shuttle stops and shelters along the routes make this system much more successful and useful. There are two main routes along the Bear Lake Road Corridor—Bear Lake and The Moraine Route. These allow visitors to park their vehicles at a trailhead or the park’s Park and Ride lot and access major hiking areas throughout the Bear Lake corridor. The shuttle service coupled with the hiking trails makes for a vast number of loop hiking opportunities, one of the keys to the system’s success. In 2006 the system was expanded to include a Hiker Shuttle Route that connects the park with the Town of Estes Park. In that same year, the Town started a shuttle system. This integrated system allows visitors to leave their vehicles at their lodging or simply park in town and access the park. Since the system started, ridership has continued to climb. 2015 was a record year for the shuttle system with 577,029 riders for the season, a 25% increase over 2014. While the system has been a success by allowing more visitors to access the popular Bear Lake area and reducing congestion and overall emissions, it has put more people into the resource. The park is currently looking at the impacts to the natural resources and the overall visitor experience in the Bear Lake area.</p> <p>Accessible transportation inside the park using the shuttle bus system is relatively easy to use. The difficulty lies in the shuttle stops direct linkage to accessible pathways and trails. For example, the shuttle stop at Sprague Lake does not currently connect directly to the accessible trails and pathways. This is due to the location of this stop being at the livery, a significant distance away from the Sprague Lake accessible trail.</p>

Universal Access (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Public Transportation (continued)	Access to ROMO via public transportation		<p>Access to the park via public transportation from Colorado's Front Range (the major metropolitan area) is non-existent. Access to the park from the Front Range is via private vehicle or private for hire transportation. The Town of Estes Park does operate a free shuttle system throughout the town during the summer, with the park providing a connection to the park, but that only serves visitors who are already in the local community. In 2015 a limited transit service operated in the Grand Lake and Granby, CO area with access to the park's west side. A few years ago the National Park Service facilitated a market research effort looking at public transit options from the Front Range to the park; it was not found to be feasible at that time.</p> <p>Accessible transportation within the community of Estes Park, Colorado is possible. However, connecting accessible transportation between Estes Park and the park is problematic.</p>
Multi-lingual Resources	Audio and Print Materials Bi-lingual staff		<p>The park orientation film is available en Español, and there are Junior Ranger booklets and a condensed visitor guide in Spanish. Demographic surveys are needed to understand our foreign language needs and create a plan and budget for offering other foreign language publications. Maps and signs are in English but use universal symbols.</p> <p>There are some bi-lingual staff members but few dedicated bi-lingual positions. The park is pursuing options for bi-lingual positions and internships.</p>

Safety


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Emergency Services	Search and Rescue (SAR) capacity		<p>The park continues to remain in the top five national parks for SAR activity within the nation. The level and frequency of incidents has remained active and steady over the past few years. However, the visitor protection staff members, who have the primary responsibility for managing incidents, have experienced both a decline in staffing levels and increasing demands in activity areas such as law enforcement due to the continued increase in park visitation. These competing demands continue to diminish the operational capacity for responding and managing complex SAR incidents.</p>

Safety (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Emergency Services (continued)	Aviation Operations		<p>The use of aircraft, particularly helicopters, in both emergency operations and projects continues to be in regular demand. There has been a decrease in the number of qualified aviation staff to manage these efforts due to a turnover in trained staff, and the continued demands from other program areas. As the park does not have a dedicated aviation program or helicopter, it continues to be a challenge to obtain helicopter resources when needed for operations.</p>
	Wildland Fire		<p>Wildland fire risk and activity continues to increase in the park. This is due to deteriorating forest conditions throughout the park due to the bark beetle activity of the past decade. Additionally, the continued increase in visitation has led to an increase in human-caused fires.</p> <p>Staffing and budget levels remain flat, and are projected to decline. The operational capacity is expected to decrease while the wildland fire activity is expected to continue to increase.</p> <p>The park has seen more fires in the past 6 years than in the previous 100 years. One of the most dramatic fires occurred in October of 2012.</p> <p>The Fern Lake Fire started in the park on October 9, 2012, from an illegal campfire. It started in the Forest Canyon area, largely inaccessible and untouched by fire for at least 800 years. Park fire managers knew from the beginning this fire was going to be a long-term event. There was limited opportunity to fight the fire directly because of high winds, steep terrain, and beetle-killed trees. Firefighters from across the country battled the fire for two months. November was the driest November in more than one hundred years in the park. On the night of November 30, and the early morning of December 1, strong winds pushed the fire more than three miles in thirty-five minutes, prompting evacuation orders. Through careful planning and rapid action, firefighters successfully prevented the fire from progressing across Bear Lake Road and leaving the park. The fire cost over \$6 million and was officially called out the following spring.</p> <p>Wildland fires in the park impact visitors due to closures and potential for evacuations. In addition, wildland fires also impact gateway communities due to evacuations, smoke, and potential for lost revenues due to park closures.</p>
	Emergency Medical Services (EMS)		<p>The EMS level of incidents continues to remain active and steady. The park has increased the number of advanced level trained EMS personnel, and also enjoys the support of local ambulance services for responses to emergencies in areas that have vehicle access. Backcountry EMS remains the responsibility of park staff, and those related challenges are reflected in the above section on SAR. Response times can be delayed due to heavy vehicle congestion. Availability of staff can be limited due to other ongoing incidents.</p>

Safety (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitor Safety & Law Enforcement	Recordable incidents		With the population growth in the Northern Colorado Front Range, and the recent dramatic increase in visitation to over four million annually, the park is experiencing rising levels of violations and increasing occurrence of more serious crimes and felonies. Reduced staffing levels have decreased the operational capacity for proactive patrol activities, leading to a more reactive patrol posture.
Staff Safety and Training	Number of staff trained		<p>The park has a Strategic Safety Plan (2014), an Employee Safety Team, an Employee Wellness Program, an Employee Safety Handbook (updated annually), and preventing illness and injury is incorporated into employee's performance plans.</p> <p>ROMO Safety Statement We believe that healthy, productive employees are our most important resource, and employee safety is our most important value. Rocky Mountain National Park strives to provide a safe and healthy work environment for all park service personnel including volunteers, contractors, and concessioners.</p> <p>2015 Safety Training</p> <ul style="list-style-type: none"> • Operational Leadership Training – 33 employees • CPR, First Aid, and AED training – wilderness first aid, 30 employees wilderness first aid; first aid/CPR 160 employees (approximately) • Job Hazard Analysis is developed prior to initiating work on many tasks, and is completed by the supervisor prior to starting work • Safety Training (electrical, confined space, hazard communication, hearing protection, respiratory protection, general safety – 320 employees (approximately) • Regular safety messages are given and distributed to staff members – Approximately 2 monthly

Resource Brief: Emergency Services and Law Enforcement

Rocky Mountain National Park is an area of exclusive federal jurisdiction, with increasing visitation exceeding 4.5 million visits a year. A large number of park visitors engage in high risk recreational activities such as technical rock climbing and ski-mountaineering in an alpine mountain/wilderness environment. Law enforcement related to activity continues to rise along with the population growth in nearby urban communities, and with the rising visitation levels. Park staff provides primary emergency services and public safety response, including Search and Rescue (SAR) and Law Enforcement.

- Visitation in the park has shifted from a seasonal pattern, to a year round activity level.
- This results in a large volume of SAR incidents each year. ROMO is consistently within the top five NPS units nationwide and is in the top two NPS Mountain Park units in the number of total SAR incidents per year. SAR incidents frequently occur in alpine terrain with the associated high risk of operating in that environment.
- The primary cause of accidents/incidents that require a SAR response is falling in steep terrain and human error (e.g., experience, judgment, fatigue).
- Aviation resources are not consistently available to assist with SAR.
- To effectively manage and respond to the large volume of SAR incidents, ROMO relies heavily on volunteer SAR Teams from surrounding counties.
- Visitor fatalities occur every year within the park.
- The frequency and severity of law enforcement incidents continues to rise. Criminal incidents occur throughout the year. Non-resource based types of incidents occur more regularly such as alcohol/drug related, disorderly conduct, and other disturbances to park visitors and resources.
- Higher visitation has led to more incidents of illegal campfires and other resource impacts resulting from high use and decreased patrol presence.
- Large scale incidents in the past few years such as wildland fire evacuations, floods, and special events require a significant time of park staff.
- Training and equipment requirements continue to increase in all program areas to meet the continued development of professional standards.
- Declining staff levels and increasing demands related to higher visitation have diminished the park's operational capacity for responding to the various incidents within the park.



NPS SAR team with assistance from local cooperators conducting a technical rescue operation in the Mills Glacier cirque of Longs Peak. NPS Photo.

Partnerships


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Volunteers	Number and hours contributed		<p>In FY15, 2,173 volunteers contributed 110,025 hours for a value in labor of \$2,538,277. ROMO has the 10th largest park-based volunteer program in the NPS. Volunteerism is on an upward trend, with 5% more hours contributed than in 2011. However, as volunteerism grows, concerns about the park's ability to manage and support the program also grow. Current housing and RV pads are insufficient to meet the park's need for volunteers and limited staff in the east and west side volunteer offices find it increasingly difficult to keep up with the administrative and supervisory aspects of the volunteer program.</p>
Partnerships	Number of official and unofficial partnerships		<p>The park works closely with several partners on various projects. The Rocky Mountain Conservancy has been our partner and advocate since 1931. They have raised over \$30 million since the mid-1980s to support a variety of projects including educational programs, trails, land acquisition, and the construction of the Fall River Visitor Center.</p> <p>Groups include the Estes Park League of Women Voters, who lobbied Congress to pass a scenic overflight ban at Rocky in order to preserve the natural sounds of the park's wilderness; and the Towns of Grand Lake and Estes Park, and Boulder, Grand and Larimer Counties who have been supportive on a variety of issues including the park's wilderness designation. Others like the Estes Valley Land Trust are working to protect land near and adjacent to the park from incompatible development. The park also has strong working relationships with other federal and state agencies, area universities, and local tourism organizations.</p> <p>In recent years the park has established strong partnerships with protected areas in other countries that share similar resources and issues. The park has a robust Sister Park relationship with Tatra National Park in Poland and Slovakia and also with MonteVerde, Costa Rica.</p>

Resource Brief: Volunteers

In FY 2015, Rocky Mountain National Park had the 10th largest park-based volunteer program in the National Park Service. That year 2,173 volunteers contributed 110,025 hours of service. This is equivalent to over 50 full time equivalent employees, with labor valued at \$2,538,277. Volunteers serve in over 70 different positions in the park, contributing to resource management, interpretation, administration, trails, visitor protection, and facility management. Volunteers staff interpretive sites, assist with searches and rescues, manually control invasive exotic plants, nurse and transplant greenhouse plants, provide visitor information during emergencies, improve and maintain park trails, create and interpret original works of art, and many, many other duties. They are an integral part of protecting park resources while providing outstanding service to visitors.

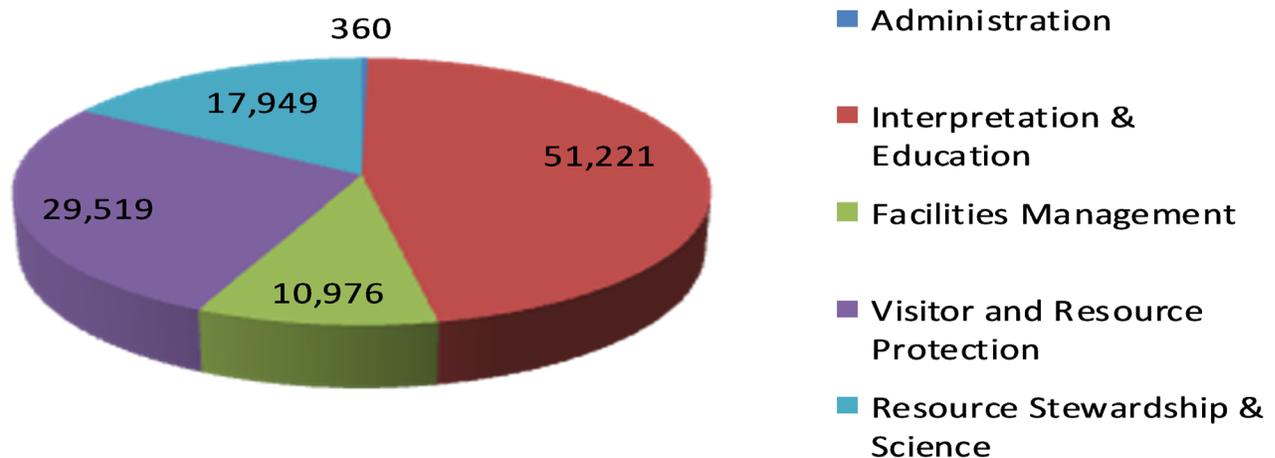


Volunteers at Alpine Visitor Center. NPS Photo.

The trend at the park is for increased volunteerism. FY15 recorded 475 more volunteers than 2011, and total number of hours contributed increased by 5,300. While this represents a positive trend for all the functions that volunteers support, it also means increasing support costs, an increasing need for volunteer housing, and increased workload on the limited staff that provides administrative support to the volunteer program and direct supervision of volunteers. The park employs just one permanent staffer to oversee this complex volunteer program, assisted by 1–2 summer seasonal staff in the east side Volunteer Office. On the west side of the park, where volunteers also serve year-round, there is just one entry-level Volunteer Program Assistant from May–September.

Support costs for this level of volunteerism also pose concerns for long-term sustainability. Housing costs typically run about \$40,000/year for volunteers. Park housing is critical in resort communities where low-cost housing is often difficult or impossible for volunteers to find during the summers. Costs to provide uniforms to volunteers have averaged \$9,800 over the past five years. Other on-going costs include supplies, training, and recognition events and items. Moving into the future the park may be challenged to keep up with rising costs, limited housing, and the administrative/supervisory workload to manage the program.

Volunteer Hours by Division FY15



2.4. Park Infrastructure

Overall Facility Condition Index


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The National Park Service uses a facility condition index (FCI) to indicate the condition of its facilities and infrastructure—the “health” of the assets. The Park Service follows the [Federal Real Property Council’s definition](#) of an asset as any real property owned, leased or otherwise managed by the Federal Government, both within and outside the United States, and improvements on Federal Lands. The FCI is the product of the cost of repairing an asset, such as a building, road, trail, or water system, divided by the cost of replacing it. The lower the FCI number, the better the condition of the asset and the bigger the number, the worse the condition. The condition of park roads, buildings and other infrastructure at each park is determined by regular facility inspections, or condition assessments. These include daily informal observations made during operations, as well as formal yearly inspections and comprehensive inspections roughly every five years. Deficiencies identified from these assessments are documented as work orders in the NPS Facility Management Software System (FMSS) and the cost for each repair determined. Repairs that cannot be completed within the year count against the condition of a structure. The total cost of these deferred repairs divided by the total cost to replace the structure results in the FCI, with values between 0 and 1 (again, the lower the decimal number, the better the condition). The FCI is assigned a condition category of Good, Fair, Poor, or Serious based on industry and NPS standards. The FCI is used in conjunction with several other metrics including the Asset Priority Index (API) to determine the urgency and priority of performing work on one asset versus another. The API considers five criteria: natural and cultural resource preservation, visitor use, park operations, and asset substitutability. For more information about the FCI and other important metrics used in managing park facilities, [Click Here](#).

Deferred Maintenance (DM) projects that require additional funding are identified, formulated, submitted for funding, and prioritized based on FCI, API and many other factors across a variety of funding sources. Annual work plans are developed that account for daily operations as well as deferred and preventative maintenance projects on critical system. For additional information and frequently asked questions about deferred maintenance in the NPS and ROMO, [Click Here](#).

Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
Buildings	454 / 433	0.131 / 0.072		<p>Building assets are on a 5-year comprehensive condition assessment program. The park’s highest priority assets are in the cycle 1 group, and thus are due for assessment in 2016. Park managers expect to identify deferred maintenance that has accumulated since the last inspection.</p> <p>Critical systems have been targeted for preventative maintenance and component renewal projects including roofing, flooring, painting and HVAC systems as represented by the overall improvement in the facility condition index.</p> <p>Not captured in deferred maintenance are issues related to Structural Fire, Accessibility, Security and Sustainability and park managers expect to identify emerging issues regarding compliance in subsequent inspections.</p> <p>Increased visitation in recent years has impacted park operations by expanding the scope and scale and extending shoulder seasons. The park has experienced both a loss of housing units overall within last 5–10 years and an increasing need for both seasonal and permanent units.</p>

Overall Facility Condition Index (continued)

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Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
Campgrounds / Wilderness Camping	122 / 119	0.066 / 0.047		Front country campsites and backcountry campsites are combined in the asset data bases. The park has approximately 586 front country campsites, and approximately 260 backcountry sites. Captured in the “campgrounds” asset inventory includes the campsite parking areas, site signage, tent pad, access trails, food storage locker, picnic table. Main campground roads, comfort stations/buildings, amphitheaters, utility systems (water, wastewater, electric, etc.) are captured elsewhere. Improvements to front country campsites in recent years include comfort station rehab/remodels, vault toilets, accessibility, food storage lockers, signage (informational, interpretational and regulatory), picnic tables, solar rinsing stations and fire rings.
Trails	172 / 169	0.130 / 0.147		Efforts continue to be focused on deferred maintenance (DM) to reduce the park’s FCI; however, the September, 2013 Flood caused significant damage to the trail system and compounded the existing DM. The priority of the park is to immediately address the flood damage to bring the trail system back to pre-flood conditions in the next five years. However, there is still a significant amount of DM to address and as the park focuses on flood recovery efforts; the DM continues to increase due to normal natural processes: heavy spring runoffs and record-setting visitation. This DM has yet to be captured, but ROMO trail assets are on a 5-year comprehensive condition assessment program. Park managers manually adjusted the Condition/Status/Trend symbol to reflect professional assessment of current conditions.
Wastewater Systems	48 / 48	0.287 / 0.176		<p>Wastewater systems are not on a comprehensive condition assessments schedule. Wastewater systems are largely underground assets and thus are challenging and costly to assess completely on a routine basis. However the park has conducted inspections and assessments on an opportunistic basis.</p> <p>ROMO has completed several projects on smaller systems, including rehabilitation of the Green Mountain, Smith Sisters, Tuxedo Park, Tortilla Flats and Kaley Cottage housing area; Grand Lake Entrance Station and Timber Creek and Aspenglen Campground wastewater systems.</p> <p>The data indicates the Trend symbol is correct, but subject matter experts anticipate that future comprehensive condition assessments will identify missing DM, especially on the larger systems, thus this metric is likely to change.</p>

Overall Facility Condition Index (continued)

[web](#) ▶

Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
Water Systems	27 / 27	0.144 / 0.091		<p>Water systems are largely underground assets and thus are challenging and costly to comprehensively assess on a routine basis. However the park has conducted inspections and assessments on an opportunistic basis. Park managers use the age of the system to prioritize component renewal and replacement projects.</p> <p>Based on professional opinion, park managers adjusted the Condition/Status/Trend symbol to more accurately reflect current conditions. Park managers feel that forthcoming comprehensive condition assessments will reveal missing DM.</p> <p>ROMO has completed the first phase of several major distribution rehab projects to improve the main Headquarters East water system. Initial results from operations after phase 1 & 2 indicate success in improving public health and compliance with new and more stringent regulations.</p> <p>ROMO has also completed several improvements to medium and smaller systems including: Aspenglen Campground, Smith Sisters, Bear Lake, Twin Owls and Green Mountain among others.</p>
Unpaved Roads	66 / 65	0.169 / 0.142		<p>These assets are on a 5 year comprehensive condition assessment schedule. Although annual and recurring maintenance efforts continue, the park has struggled to improve the condition of unpaved roads. Due to increased visitation in recent years, it is becoming difficult to keep up with off-road parking, impacts to shoulders, drainage structures/ditch-line maintenance and surface conditions.</p> <p>The park does not feel that the FCI data for this category represents the actual condition that they see locally; therefore the park has modified this rating to reflect their professional view of the condition. The park will be gathering more data on park visitation and use patterns and associated impacts.</p>

Overall Facility Condition Index (continued)

[web](#) ▶

Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
Paved Roads, Parking Areas, Bridges	125 / 125	0.118 / 0.057		<p>Comprehensive condition assessments for all park paved roads are performed by the Federal Highway Administration, Central Federal Lands Division, on a five year cycle and two years for bridges.</p> <p>Impacts to paved roads mirrors that of unpaved roads with increased visitation making it difficult to keep up with off-road parking, impacts to shoulders, drainage structures/ditch-line maintenance and surface conditions.</p> <p>The park is responsible for inspecting, assessing and maintaining all unpaved, secondary and administrative roads, and has a comprehensive condition assessment process in place.</p> <p>Although annual and recurring maintenance efforts continue, the park has struggled to improve the condition of unpaved roads. Due to increased visitation in recent years, it is becoming difficult to keep up with off-road parking, impacts to shoulders, drainage structures/ditch-line maintenance and surface conditions.</p>
All Others	69 / 125	0.084 / 0.043		<p>This category has had the largest number of assets added recently due to changes in business practices. This has added interpretive media, elk enclosures and picnic areas to the asset inventory. "All other" includes fuel systems, Dams (2 inside ROMO), picnic areas, corrals, elk enclosures, electric distribution systems, phone system, Internet/IT/VOIP systems, amphitheaters, interpretive media and wayside exhibits.</p> <p>Park managers manually adjusted the Condition/Status/Trend symbol to more accurately reflect current conditions.</p> <p>Park staff will continue to input and QA/QC data.</p>

Resource Brief: Green Parks Plan

The NPS manages the largest number of constructed assets of any civilian agency in the Federal Government. It operates more than 67,000 structures that account for more than 50 million square feet of constructed space such as visitor centers and historic structures. The [Green Parks Plan](#) (GPP) defines a collective vision and a long-term strategic plan for sustainable management of NPS operations. A critical component of the implementation of the GPP will be informing and engaging parks' staff, visitors, and community partners about climate change and sustainability to broaden opportunities to foster change.

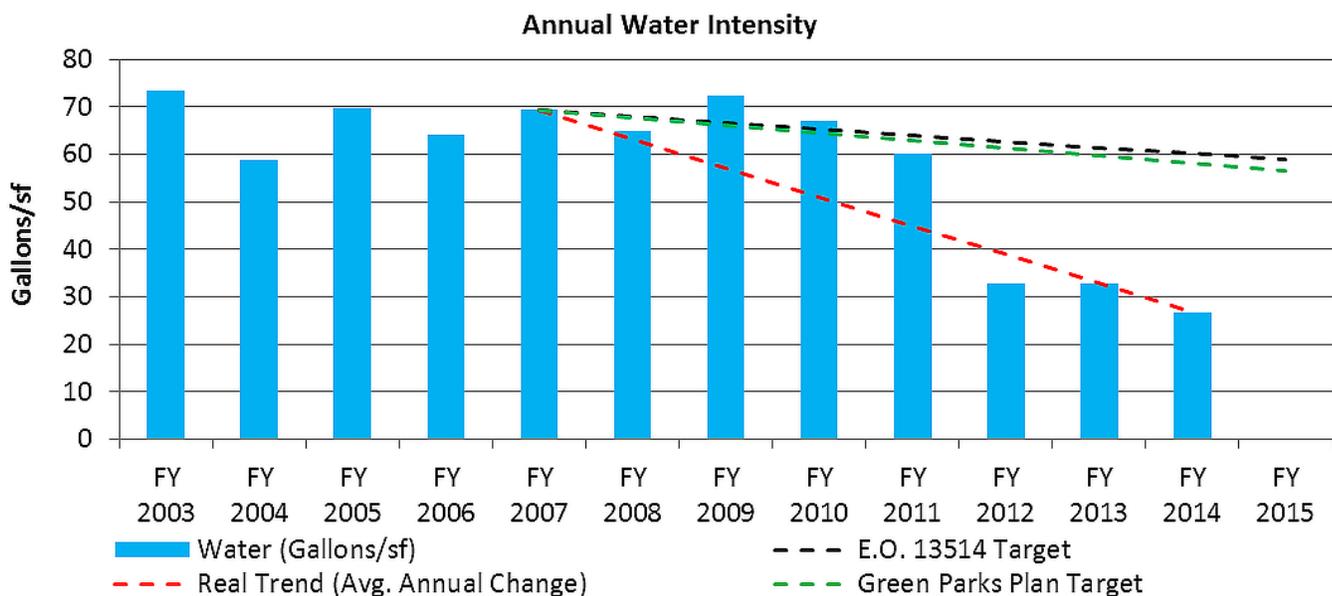
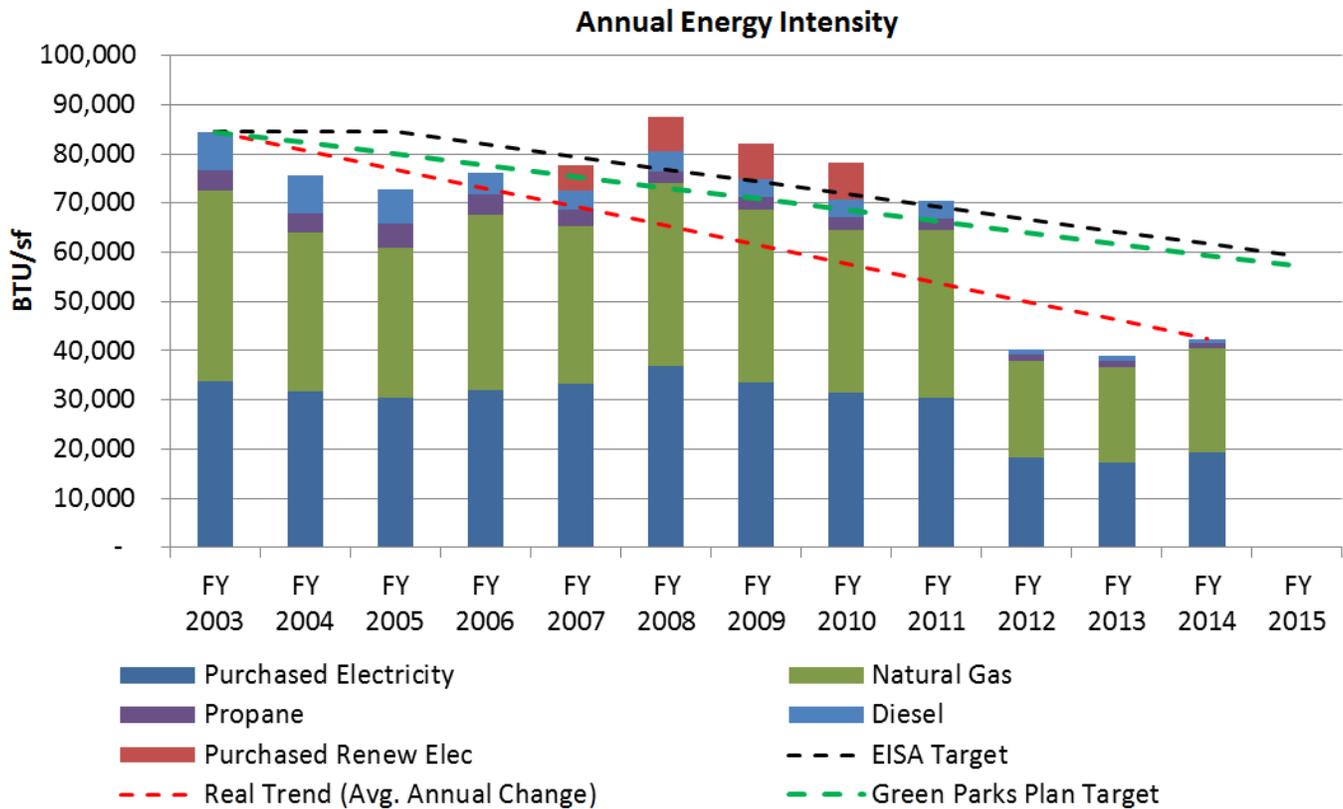
The Vision defined in the GPP plan is, "The NPS will preserve park resources unimpaired for the enjoyment of current and future generations by reducing its environmental impact through sustainable operations, design, decisions, and management at every level of the organization." The plan is based on nine strategic goals that focus on the impact of facilities on the environment and human welfare. Two of those goals are closely aligned with Park Infrastructure as defined in this State of the Park report. Those are:

- Be Energy Smart: The NPS will improve facility energy performance and increase reliance on renewable energy; and
- Be Water Wise: The NPS will improve facility water use efficiency.

One of the performance objectives for Energy is to reduce the Service-wide building energy intensity by 35 percent by 2016 from the 2003 baseline, where energy intensity is energy consumption per square foot of building space. For Water, one of the performance objectives is to reduce potable water use intensity by 30 percent by 2020 from the 2007 baseline.

Resource Brief: Green Parks Plan (continued)

Historical data for energy and water consumption reported by Rocky Mountain National National Park and available in the Energy Data Reporting Tool (EDRT) is shown below. NOTE: Square footage of park housing was not included in intensity calculations for 2003–2011; however, housing was included beginning in 2012, which accounts for the massive reduction shown in the graph beginning that year.



Resource Brief: Green Parks Plan (continued)

Highlights for Rocky Mountain National Park efficiency efforts include:

- Energy Intensity:
 - Installation of approximately 30 high-efficiency / on-demand boilers and heaters in various building including housing and administrative areas.
 - “Right sized” Generators at the Alpine Visitor Center complex, achieving a 50% fuel and emission reduction.
 - Robust recycling program for park operations and projects including recycling:
 - ◊ Household items like mattresses, furniture, appliances and porcelain.
 - ◊ Materials such as metal, wire, wood scrap, (flooring, etc.).
 - ◊ Hard to recycle items like certain plastics, Styrofoam, poly carbonate, etc.
 - ◊ Asphalt, concrete.
 - ◊ Materials for off-site composting.
 - Re-lamping: installation of induction lighting & LED fixtures.
- Strategic housing projects targeting compliance with Structural Fire, Accessibility and Sustainability goals. The ROMO buildings group was one of the first to deploy integrated system and were regionally recognized for their outstanding work.
- Purchasing/procurement—the park buys “green” and “recycled content” building materials and supplies as often as possible.
- Installation of efficient in-floor radiant heat systems.
- Completion of a Sustainability Implementation Plan to guide park greening efforts.
- Completion of an American Society of Heating and Air-Conditioning Engineers (ASHAE) Level Sustainability Assessment of systems using thermal imaging.
- Completion of the Integrated Solid Waste Alternatives Plan (ISWAP).
- ROMO was the first National Park to join the Northern Clean Cities Coalition in 1996.
- ROMO earned a Clean Cities Coalition grant for 2 electric vehicles (Chevy Volts) and 2 charging stations.
- Water Conservation and Reduction:
 - Installation of ultra-low flow fixtures across the park in housing, administrative and public spaces.
 - Installation of jug-fillers—water bottle refilling stations.
 - Installation of on-demand hot water heaters.

Park Carbon Footprint


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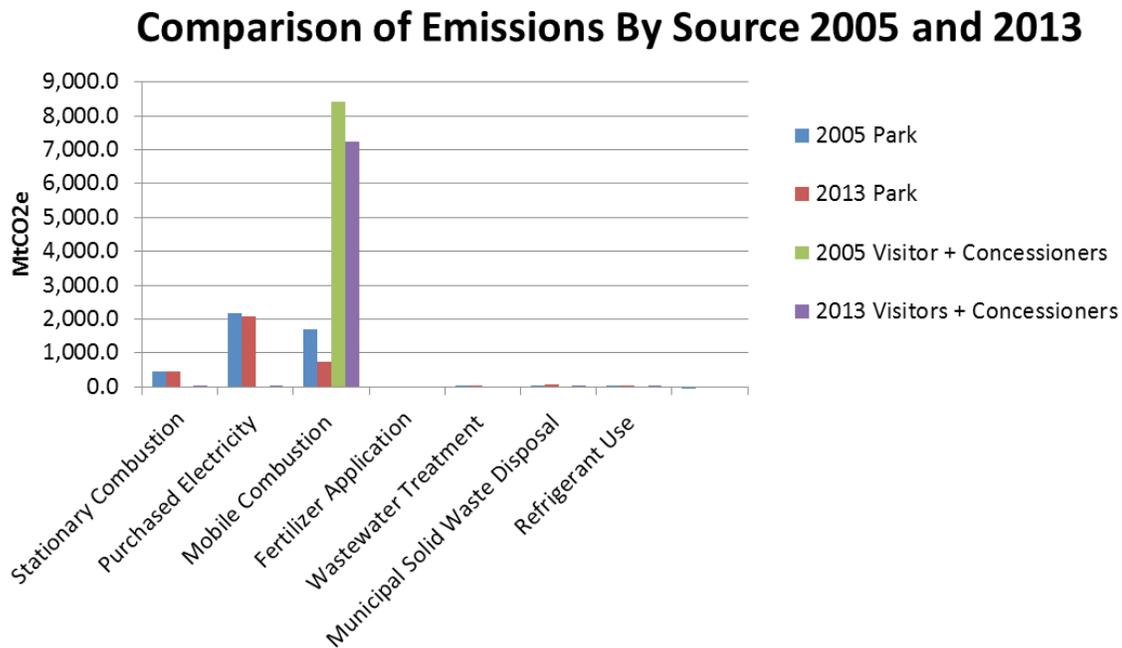
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Greenhouse Gas Emissions	Metric tons of CO ₂ equivalent (MTCO ₂ E)		<p>The goal of ROMO Climate Friendly Parks Action Plan is to reduce the park’s greenhouse gas (GHG) emissions to 17% below 2005 levels by the year 2017 by implementing emission mitigation actions.</p> <p>The park reduced GHG from Park Operations 23.5% from 2005 to 2013: 4,399 metric tons of carbon dioxide equivalent (MTCO₂E) in 2005 to 3,366 MTCO₂E in 2013. ROMO exceeded the Climate Friendly Parks emission reduction goal by 6.5 percent four years before the deadline. Transportation accounted for over 78% of emissions in 2005, and remains the single biggest contributor of GHGs. Data from 2013 show emissions from visitor mobile combustion totaled 6,977.6 MTCO₂E. That reflects a decrease of 1,437.1 MTCO₂E over 2005 levels. The drop in MTCO₂E can be attributed to the increase in shuttle service ridership.</p>

Profile – Park Carbon Footprint

Carbon Footprint is measured by greenhouse gas (GHG) emissions resulting from the combustion of fossil fuels for transportation and energy (e.g., boilers, electricity generation), the decomposition of waste and other organic matter, and the volatilization or release of gases from various other sources (e.g., fertilizers and refrigerants). A decreasing carbon footprint indicates the park is striving to reduce its impact on the climate change through mitigation efforts. In 2005, the baseline GHG emissions set within Rocky Mountain National Park totaled 12,824 metric tons of carbon dioxide equivalent (MTCO₂E). This includes emissions from park and concessioner operations and visitor activities, including vehicle use within the park. To put this in perspective, a typical U.S. single family home produces approximately 12 MTCO₂E per year (U.S. EPA 2011). Thus, the emissions from park operations are roughly equivalent to the emissions from the energy use of 1,170 households each year—or from 29,823 barrels of oil (according to the [EPA Greenhouse Gas Equivalencies Calculator](#)). The largest emission sector for the park is visitor mobile combustion, totaling 8,414.7 MTCO₂E in 2005. Purchased electricity comprises 99 percent of emissions from energy and 17.5 percent of total park emissions. ROMO had the greatest reduction of GHG in mobile combustion. Reduction in GHG of mobile combustion can be attributed to a reduction in driving/idling and an increase of fuel efficient vehicles. 970.1 MTCO₂E was eliminated from park emissions due to changes in the park fleet and employee awareness.

Profile – Park Carbon Footprint (continued)

The chart below compares park emission data from 2005 with 2013:



Current Future Challenges:

- Increased visitation in both sheer number and shoulder season use—especially in the fall, is creating significant competition for recreational opportunities and access to facilities resulting in congestion and impacts along road shoulders, parking areas, and adjacent resources.
- Human waste management in the Back Country—especially in high use areas like the Bear Lake corridor and highly sensitive environments like the alpine tundra.
- Recycling options for the CRD: currently options are limited, but the park is participating in a county-wide recycling and solid waste analysis.

2.5. Wilderness Character and Stewardship

The Wilderness Act of 1964 requires the NPS to maintain Wilderness character, including the qualities of being “...untrammelled by man...undeveloped...natural,” and allowing for “...solitude or primitive and unconfined recreation.” A summary of wilderness character for the park is summarized below.

Overall Wilderness Character  web ▶			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wilderness Character Qualities	Natural		Wilderness ecological systems are substantially free from the effects of modern civilization. The park’s wilderness wetlands are generally in “reference” (good) condition. The park has a small number of formally listed threatened and endangered species but faces challenges from a general loss of large carnivores. Landscape connectivity is currently in good condition but warrants future concern from regional population growth and obstructions to wildlife corridors. Visibility warrants moderate concern. Nitrogen deposition in the high altitude ecosystems of the park is a serious concern.
	Undeveloped		Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation. The total number of administrative structures in the park has largely remained the same over the last five years although some research installations have been removed. Administrative mechanized use hours have remained generally unchanged, but the park is increasing the use of traditional tools and skills to provide wilderness appropriate alternatives. New safety protocols during fire suppression operations have led to increased aviation use and increased impacts in Wilderness areas.
	Untrammelled		Wilderness is essentially unhindered and free from modern human control or manipulation. Human impacts both in and outside the park are leading to the need for increasing management interventions to restore and preserve the natural qualities of wilderness character. The acreage being treated for exotic plants management is an example of this trend. The increase in visitation has led to an increase in human caused impacts including fire ignitions, human waste issues, etc.
	Solitude or Primitive and Unconfined Recreation Opportunity		Wilderness is essentially unhindered and free from modern human control or manipulation. A current rapid increase in wilderness visitation and a projected steady increase in regional population levels are leading to a decline in opportunities for solitude and unconfined recreation. Increasing human-caused sound and night lighting are impacting these qualities. Increasing demand will likely lead to the increasing need for active management of visitor wilderness use. Opportunities for solitude can still be found for wilderness users in a variety of locations.
	Other Features and Values		492 archeological sites are known in the park wilderness area but this only represents a 10% survey of the area. Additionally, there are 161 historic structures. We currently have no systematic monitoring of impacts to cultural resources in Wilderness. Cultural resources, many undocumented, are vulnerable to loss from natural processes and human activity.

Wilderness Stewardship


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Stewardship to Preserve Wilderness Character	Key Information		Key information is included in 2013 Rocky Mountain National Park Foundation Document and Rocky Mountain National Park Geographic Information System Database.
	Management Operations		Wilderness character considerations are consistently included in Rocky Mountain National Park planning and review processes.
	Status of Plans		2001 Backcountry/Wilderness Management Plan in force, but needs updating. Wilderness Character Monitoring Plan is in preparation.
	Completed Training		Key staff has attended Carhart wilderness training.

Resource Brief: Wilderness Designation for Rocky Mountain National Park

In 1964, Congress designated Rocky Mountain National Park as a wilderness study area. In 1974, President Nixon recommended to Congress 239,835 acres for immediate designation and 5,169 acres for potential designation as wilderness in the park. Congress had not enacted legislation to implement the wilderness recommendation until 2009.

Per National Park Service policy, all parklands that have been formally recommended for wilderness are managed to preserve wilderness resources and character until the legislative process of wilderness designation has been completed. Therefore, since the recommendation in 1974, park managers have been managing the park as wilderness.

The endorsement of the gateway communities of Estes Park and Grand Lake, and the three Colorado counties that encompass the park (Larimer, Grand, and Boulder) was crucial to successfully achieving wilderness designation for Rocky Mountain National Park. In May 2007, S.1380 and H.R.2334, legislation to designate as wilderness certain land within Rocky Mountain National Park and to adjust the boundaries of the Indian Peaks Wilderness and the Arapaho National Recreation Area of the Arapaho National Forest, were introduced by Senator Ken Salazar, with Senator Wayne Allard as cosponsor, and by Representative Mark Udall, with Representatives Marilyn Musgrave, Ed Perlmutter and John Salazar as cosponsors. The proposed legislation included approximately 249,339 acres within Rocky Mountain National Park in the National Wilderness Preservation System.

On January 15, 2009, S. 22, the Omnibus Public Land Management Act of 2009, was passed by the Senate. Title I, Subtitle N of the bill contains the provisions of the amended version of S. 1380 approved by the Senate Energy and Natural Resources Committee in May 2008. The provisions of S. 22 were amended into H.R. 146, which passed the Senate on March 19, 2009 and the House on March 25, 2009. The President signed the bill into law (PL 111-11) on March 30, 2009.

In May of 2009, the park held a large event—attended by many dignitaries, stakeholders, and park staff to celebrate the passing of the Act and the official designation of the Wilderness.



Left to Right: Fmr. Senator Mark Udall, Fmr. Secretary of the Interior Ken Salazar, Fmr. Grand Lake Mayor Judy Burke, Senator Michael Bennet, Fmr. Congresswoman Betsy Markey.



Former Secretary of the Interior, Ken Salazar poses with Rocky Mountain National Park Rangers to celebrate the designation of the Rocky Mountain National Park Wilderness. NPS Photo.

Resource Brief: Wilderness 50th Anniversary Special Events

On September 3, 1964 President Lyndon B. Johnson signed into law the Wilderness Act. This historic bill established the National Wilderness Preservation System (NWPS) and set aside an initial 9.1 million acres of wildlands for the use and benefit of the American people. In the 50 years since, and as a result of America's support for wilderness, Congress has added over 100 million acres to this unique land preservation system. The 1964 Wilderness Act defines "Wilderness" as areas where the earth and its communities of life are left unchanged by people, where the primary forces of nature are in control, and where people themselves are visitors who do not remain.

In 2014, our Park celebrated "50 Years of Wilderness" with a wide variety of educational events, projects, programs, and products to raise awareness of wilderness during the anniversary year. The event tied in park rangers, volunteers, park visitors, community groups, and individuals to present and participate in special Wilderness Explorer Junior Ranger programs, a speaker series, film series, quilting contest, poetry contest, integrating the Wilderness theme into interpretive programming in our walks, talks, trailhead information, publications, exhibits, and outreach programs in local schools. There were magazine and newsletter articles, articles in the park and local newspapers, radio and TV interviews. The City of Estes Park proclaimed September 2014 as Wilderness Appreciation Month, and encouraged all citizens of Estes Park to celebrate 50 years of the Wilderness Act and appreciate all the ways the protected wilderness area surrounding our community enhances our way of life. The celebration culminated in a Walk for Wilderness with lots of family activities, demonstrations, and exhibitors, including Leave No Trace and traditional skill teams. By adding these interpretive offerings and events to the park programs for 2014, we were able to raise awareness of wilderness and its values in over 5,600 participants!



Park visitors enjoy a "Walk for Wilderness" during the 50 Years of Wilderness Celebration. NPS Photo.

Resource Brief: Primitive Tools Use at Rocky Mountain National Park

As a National Park we strive to fulfill the mission of the National Park Service while also meeting the unique needs of Rocky Mountain National Park's ecosystem. As stewards we find ourselves on all sides of the decision-making process. We are continually spanning the past and the present; balancing the challenges of the current times and the past history of the area. Wilderness stewardship, safety, efficiency, risk management, changing leadership, and project completion are just some of the common challenges of our everyday workplace as land managers.

In 2008, a large scale mountain pine beetle infestation became visible throughout the landscape and the challenge of addressing this change came to the front of the queue for all work groups. We were tasked with incorporating primitive tool use into the mitigation process and all wilderness project work. Primitive tools can be difficult to obtain and change the process of how tasks are completed.

Crosscut saws are not readily available and incorporating them into daily operations with a standardized training program was the next step for us. Time was spent drafting a Crosscut Saw Use Policy, which was signed as a Pilot Program in 2011 at the park level. Hours were spent in the field adjusting policy needs, bringing in regional trainers from the USFS and trying to follow a standard that was long established in U.S. Forest Service in order to create a practical program. The final product was a Park-based Crosscut Use Policy that closely mimicked the standards of the USFS. The



A park ranger uses traditional crosscut saw skills to remove hazard trees. NPS Photo.



Park Ranger Tara Vessella leads the Crosscut Saw Training Program at Rocky Mountain National Park. NPS Photo.

Resource Brief: Primitive Tools Use (continued)

crosscut saw has become a primary tool for wilderness projects at Rocky and it has proven to be the tool of choice for new sawyers. We have made contributions to the development of an online training course, which helps train new employees on standardized use of crosscut saws and axes throughout the land management agencies. The tool continues to maintain forward movement. Additionally this process of evaluating how we complete work projects in wilderness, prompted additional use of axes, increased use in a variety of primitive hand tools and the added eight llamas to our pack stock family to ensure our foot print on the land is lighter. Small pieces of the past continue to reestablish themselves in the current time within Rocky Mountain National Park.

If crosscut saws worked for wilderness back in the 19th and 20th centuries, why can't they work for us in the 21st century? Now is just as good a time as ever to introduce a bit of the past into a changing workplace. Rocky Mountain National Park continues to utilize crosscut saws in daily felling and bucking operation throughout wilderness project work. Training and maintaining tools also continues, while pushing forward and reaching out to other parks in hope to see a primitive tool stewardship find its way back into the agency.

Chapter 3. Summary of Key Stewardship Activities and Accomplishments

Activities and Accomplishments

The list below provides examples of stewardship activities and accomplishments by park staff and partners to maintain or improve the condition of priority park resources and values for this and future generations:

Natural Resources

- Air quality – ROMO, the Colorado Department of Public Health and the Environment (CDPHE) and the Environmental Protection Agency (EPA) are collaboratively working to implement the August 2007 Nitrogen Deposition Reduction Plan (NDRP). Since that time, the agencies have also been working with agricultural stakeholders to better understand the sources and mechanisms of nitrogen transport and deposition on fragile alpine tundra ecosystems. Recent accomplishments have been testing implementation of a voluntary early warning system of predicted upslope weather events that allows agricultural producers to conduct best management practices that reduce the transport of atmospheric nitrogen and ammonia compounds to alpine tundra in the park.
- Elk management – Over the past 2 decades the park has made great strides toward managing elk populations and beginning to restore degraded habitat. The winter population size meets the objectives of the [Elk and Vegetation Management Plan](#) and steady progress is being made toward meeting objectives for vegetation conditions.
- Exotic Vegetation Treatment and Restoration – Despite efforts to reduce the abundance, distribution, and number of exotic plant species in the park, invasive plants such as cheatgrass and Canada thistle continue to spread, even in previously undisturbed habitats. New exotic, invasive plant species are also being discovered, particularly in lower elevation habitats where more human disturbance occurs. Over the last few years, exotic plant management crews have treated thousands of acres of exotic plant infestations each year. Recent conditions and discovery of new exotic plants have prompted the need for the park to develop an Environmental Assessment on a proposed new exotic management plan that can eradicate exotic plant infestations and prevent their spread throughout the park.
- Grand Ditch – On May 30, 2003, the Grand Ditch, a trans-basin water diversion canal in the northwest corner of the park, breached its bank. The breach caused a 48,000 cubic yard mud and rock slide that damaged about 22 acres and 1.5 miles of riparian, upland, and wetland habitat in the Lulu Creek and the headwaters of the Colorado River. After completing an Environmental Impact Statement in 2013, the NPS began stabilization of the hillslope immediately below the canal in 2016.
- Fire management – ROMO has experienced more wildfire (as measured by acres burned) in the last 6 years than in the previous century. The largest of these fires, the Fern Lake fire of 2012, was just less than 3,500 acres. A previously completed hazardous fuels reduction project allowed firefighters to safely engage the Fern Lake fire, preventing it from leaving the park and burning onto developed private property. The park completed a new Fire Management Plan in 2012. In addition, the park recently hosted an interagency workshop to discuss wildfire response in mountain pine beetle impacted dead tree stands in the southern Rocky Mountains.
- Science-based management – The park has moved toward science based natural resource management through the development of the Continental Divide Research Learning Center, a broad program of research on park ecosystems, and implementation of long-term Vital Signs monitoring across the park. These programs aim to provide credible scientific data and analysis in a form that is most useful for protecting and restoring ecological integrity of park ecosystems.

- Black bear program – Research in the mid-2000s indicated that the black bear population in ROMO was becoming more food-conditioned and habituated to human-use areas. In response, the park has increased and improved bear-resistant facilities and increased education of both staff and visitors. Since 2012, 174 food storage lockers have been installed in campgrounds with an additional 85 awaiting installation in 2016. All dumpsters and trash cans have been retrofitted with latches and clips to prevent access by bears. Educational signs have been added to the park including: high visibility signs with a bear message at the five campgrounds and the Wild Basin area, 29 bear-specific signs posted at trailheads, >230 bear message stickers added to dumpsters and trash cans, and >200 bear message stickers added to food storage lockers. Two short educational videos regarding use of food storage lockers were filmed and placed on the park website. A bear technician has been hired from 2012 to the present during the summer months to respond to bear incidents, conduct trash roves and provide emergency emptying or maintenance to prevent bears getting trash, conduct educational roves in campgrounds and other high use areas, assist with staff training, serve as a clearinghouse for bear information and summarize bear data. The park has also been a key participant in the multi-agency Estes Valley Bear Education Task Force.
- Ongoing boreal toad restoration efforts – Beginning in 2004, over 20 historic sites have been evaluated for their reintroduction potential for boreal toads. The Red Mountain site was selected as the most promising and nearly 40,000 tadpoles have been released into the site from 2007 to 2015. The reintroduction has been a success in attaining survival through metamorphosis and over the first winter with many yearlings returning to the site. In addition, much has been learned regarding the optimum tadpole stage for reintroduction. Natural breeding has not been observed to date.
- The Cutthroat Trout – Over the last decade, the natural distribution of cutthroat trout subspecies throughout Colorado has become better understood. The park has funded research to understand where genetically distinct lineages occur both in ROMO and throughout the State. Based on this emerging information, ROMO staff is assisting in the process to draft a Recovery Outline for the Greenback cutthroat trout. This document will guide proposed fisheries management actions in the park that support recovery of this subspecies.
- Forestry program – More than 90% of the forested acres within ROMO have been impacted by bark beetles, resulting in stands of dead trees and a serious threat to the safety of visitors and employees. Visitors, employees, and infrastructure are protected through actions guided by the Standards and Protocols for Frontcountry Hazard Tree Management (2011). This document provides a systematic approach for detecting, mitigating, and disposing of hazard trees, protects high-value trees in developed high-use areas, and minimizes the cost and potential resource damage associated with hazard tree management.
- Limber pine plan – In response to the threats facing limber pine, ROMO developed the Limber Pine Conservation Strategy in 2015 to conserve limber pine genetic diversity in the park and ensure the future health of the species.

Cultural Resources

- In 2015, the Continental Divide Research Learning Center (CDRLC) funded a 3-year Ice Patch Archeology Project at ROMO spearheaded by Dr. Jason LaBelle at Colorado State University (CSU). The project goal is to survey ice patches previously identified by Craig Lee (2010) and document and analyze fragile paleobiological and/or cultural resources recently exposed in receding ice patches.
- The ROMO historic preservation crew is one of few in the NPS that provide historic window preservation and restoration services for the National Park Service.
- The historic preservation crew at ROMO has been involved in the NPS Preservation and Skills Training (PAST) program for over 10 years. The PAST Program provides opportunities for NPS employees to learn traditional trade skills.
- The historic preservation crew provides training opportunities to youth in historic preservation through the Rocky Mountain Conservancy (RMC) Youth Corps. This provides hands-on learning with experts.
- The park hosted a 3-day Mission 66-Era Resources Work Group in September 2015. Participants included the NPS Intermountain Region Cultural Resources, Colorado State Historic Preservation Office, Public Lands History Center (PLHC) at Colorado State University (CSU), and ROMO Facilities Management and Cultural Resources staff. This resulted in a better understanding of significant NPS Mission 66-Era historical resources located within the park and provided guidance for managing the resources for the future.
- Archives Initiative successfully identified federal records for inclusion into the Museum Archives, and paid for processing and finding aid creation. The federal records are accessed almost daily by park staff and partner institutions such as Colorado State University Public Lands History Center graduate students and professors.

- The Collection Condition Survey initiated in 2014 was completed and published in 2015. Identification of problem conditions and facilities helped orient the new Museum Curator. A schedule and budget for improvement was provided. Implementation of the improvements began before the CCS was published. A ten-year implementation plan will improve storage and environmental conditions. Staffing and space concerns continue to plague the museum program.
- The Research Permit and Reporting System permittees generate scientific interest and researchers produce reports and voucher specimens. They continue to reveal information to staff and the public through publication, presentations and training sessions. The backlog of scientific specimens and associated materials was tackled in 2015 by the museum staff. The ongoing need for dedicated staff to track specimens and issue loans and conduct inventories in non-federal repositories is great.

Visitor Experience

- In FY 2015, Rocky Mountain National Park had the 10th largest park-based volunteer program in the National Park Service. That year 2,173 volunteers contributed 110,025 hours of service. This is equivalent to over 50 full time equivalent employees, with labor valued at \$2,538,277.
- The park's Junior Ranger program continues to grow. Since the development of a Junior Ranger Headquarters, 5,000–7,000 kids experience an activity each year. In comparison, prior to 2011 only about 2,000 visitors participated in ranger-led youth programs. In that same time period the Junior Ranger booklet program has grown from 30,000 books per year to 45,000 books per year.
- Search and Rescue program has saved many lives over the years with many successful missions. The program received the Department of the Interior Unit Award for a 2014 incident response.
- RMC has been our partner and advocate since 1931, raising over \$30 million since the 1980s in support of varied projects, such as educational programs, land acquisition, and trails.
- The park's digital presence has grown tremendously and is now one of the largest in the National Park Service. In 2015, our website and social media platforms hosted over 7.5 million virtual visitors, bringing Rocky to new audiences around the world.
- From September 4, 2014, through September 4, 2015, Rocky Mountain National Park, celebrated the park's 100th Anniversary. The goal of the Centennial Celebration was to **Honor the Past, Celebrate the Present and Inspire the Future**. Over 200 events highlighted the park's Centennial Celebration year, emphasizing what has made Rocky beloved to so many over the past 100 years.
- Wildland fire crew's response to several fires saved lives and property.
- The park has been working with the Town of Estes Park, the Colorado Department of Transportation, the Federal Highway Administration, and the Estes Valley Recreation and Park District to enhance multi-modal options for accessing the park and improving mobility within the community. Projects include the development of intercept parking lots in Estes Park, enhancing shuttle bus service, and developing a multiuse trail system.
- Within the last two years, the park and its partners have successfully acquired three private inholding parcels containing a total of 56 acres. The most significant acquisition is the 39.5-acre Cascade Cottages, which is the largest remaining private resort in the park. Acquisition of the three parcels will expand designated wilderness in the park by over 24 acres.
- Thanks to the dedicated work of concerned citizens, led by the League of Women Voters of Estes Park, Congress enacted a permanent ban on commercial air tours over Rocky Mountain National Park in October 1998. Rocky is the only national park in the western U.S. that has such a ban.
- In 2013 the park's shuttle bus fleet underwent a "Greening" of the fleet. Eight of the 10 full sized shuttle buses were converted to clean diesel technology with the installation of diesel particulate filters (DPF). These DPF units remove just about all of the solid particulate materials and a large quantity of toxic emissions associated with standard diesel engines meeting the EPA's clean diesel standard. The remaining two shuttles have been replaced by hybrid buses; these buses have increased fuel efficiency while emitting less pollutants and noise. With these changes the fleet is expected to see at least an 11% increase in fuel efficiency.
- Starting in 2011 the park began using Variable Message Signs both in and outside of the park. The signs have been used in a variety of ways; to promote the use of park shuttle system within and from the Town of Estes Park, to provide real time traffic/parking conditions and the status of Trail Ridge Road. The use of these signs have enhanced visitors' experiences in the park and influenced traffic patterns to alleviate congestion.

Park Infrastructure

- Over the last 10 years, the park has put a priority focus on the rehabilitation of two main roadways in the park, Trail Ridge Road and Bear Lake Road. These projects involved the assistance of the Federal Highways program for funding, design, and project management. In all, the park was able to reconstruct 77.4 miles of paved roads along with several retaining and drainage structures; returning these assets to a new condition.
- On September 12th, 2013 Rocky Mountain National Park received a record amount of rainfall. Accumulations ranged from 2 inches to over 18 inches throughout the Front Range of Colorado. For most of these locations, the annual average rainfall amount is approximately 20 inches. Average September precipitation east of the Continental Divide is below 2 inches. Damage in the park was wide-spread on the east side of the continental divide. Repairs are ongoing. Most of the stabilizing projects were completed in FY14 as were projects for: mold abatement and structural repairs to buildings and housing, shoulder stabilization and culvert repairs to roads, Emergency Relief for Federally Owned Roads (ERFO), repairing or replacing damaged boilers, and small emergency fixes throughout the park. A few projects continued into FY15 including: the replacement of housing quarters Q-0699, the reconstruction of several backcountry trail bridges, and the reconstruction of some washed out trails, and the repair of the historic Old Fall River Road.
- In 2015 a 350-foot section of Trail Ridge Road above switchback #3 that had become undermined was stabilized.
- The Holzwarth parking lot was paved in 2014 and all sections of associated road and parking lots were slurry sealed in 2015.
- The Timber Creek Campground’s main road, 4 loops, and 100 parking sites were recently resealed.
- The Grand Lake Entrance station was newly constructed in 2008 and 2009.
- The park completed rehabilitation of the main water system for the Colorado River District (west unit) of the park including the treatment, storage, and water distribution systems. This included 3,700 feet of new fill and distribution lines, installation of 13 service taps, tank cleaning and recoating, and treatment process enhancements to remove manganese. This also included completion of a new laundry facility for park employees and volunteers.
- Sustainable trail construction in the sub-alpine and alpine tundra is an ongoing challenge. Trails face exposure to extreme weather patterns, high winds and erodible soils, with high visitor use causing severe erosion. Because of this, the trails program has been focused on high quality construction with 100–200 year life cycle in mind. This is especially true of the constructed rip-rap style of rock work that involves constructing a tread surface using flat laid stone. This style of trail work can best be seen above Granite Pass on the Longs Peak Trail, which held strong against the 2013 Flood where other structures failed. The result has been a very sustainable trail that is expected to remain in service for decades and longer. In most cases this type of construction can maintain a trail’s historic integrity of a “smooth grade.”
- Over the last 10 years, the park has replaced and constructed 13 new roadside vault toilets using the most up-to-date and sanitary building materials.
- Wood picnic tables have been replaced with concrete ones parkwide, increasing accessibility and durability.

Wilderness Character and Stewardship

- ROMO, joined by our gateway communities, the Colorado Governor and our congressional delegation, celebrated formal designation of the majority of the park as wilderness in 2009.
- The park hosted a variety of special programs to celebrate the 50th anniversary of the Wilderness Act in 2014.
- The park received two NPS Intermountain Region wilderness awards in 2014. Dave Pettebone, the Wilderness Program Manager at the time, was awarded the “Wilderness Champion” award and the Resources Stewardship Division was awarded the “Leader in Wilderness Stewardship” award.
- The ROMO backcountry office plays an important role in wilderness education, resource protection and preventative search and rescue.
- Park staff has developed an innovative program to provide training and encourage the utilization of a variety of traditional tools and skills to maintain wilderness character including the use of cross cut saws, axes, hand tools and pack stock (including llamas).
- Wilderness themes are incorporated into many park interpretive programs to increase visitor appreciation and stewardship.

- Park research activities are consistently negotiated and reviewed to minimize impacts to wilderness character while optimizing information to inform wilderness management. Novel research methods such as GPS site marking, fecal sampling of wildlife species for genetic analysis, and the use of photography to “mark and recapture” boreal toads have been utilized by researchers and park staff to minimize impacts to wilderness character.
- In the last two years, 534 lbs. of research equipment has been removed from the Loch Vale area of the park. In addition, 25 ground water wells and 87 pieces of rebar were removed from other park locations.
- Wilderness character is consistently integrated into park planning processes and everyday decision making.
- The park has instituted the use of bear canisters to reduce human-bear conflicts while reducing administrative structures in wilderness.
- The park demonstrated restraint in pursuing wilderness facility repairs following the 2013 Flood (not replacing some lost trail bridges, abandoning unsustainable campsites and trail sections).
- Wilderness character considerations were integrated into fire management decisions during the Cow Creek, Fern Lake, and Big Meadows Fires.
- Protecting and improving wilderness character has played a significant role in planning for restoration of the area impacted by the 2003 Grand Ditch Breach.
- Prescribed fire and fuels treatments are planned or have been conducted to increase options for restoring natural fire regimes.

Chapter 4. Key Issues and Challenges for Consideration in Management Planning

The park's Foundation Document was completed in 2013, which identified challenges and opportunities for current and future management planning. These are still relevant today, and include the park's highest priorities of visitation, climate change, and relevancy to future generations:

- Day use visitation within the park has increased 32% since 2014, and 40% since 2012. The park received its highest annual visitation in 2016, with more than 4.5 million visitors. Rocky is the fourth most visited national park in the system, resulting in natural and cultural resource degradation, crowding, congestion, and a diminished visitor experience. In addition, budgets and staffing have not kept up with the visitation increase, resulting in operational capacity and safety deficiencies.
- Climate change is the largest environmental issue in our human history, in terms of both scale and scope, and our capacity to address this is not keeping pace with the burgeoning threat to park resources.
- Relevancy of the park to future generations continues to be a challenge, and while we have made some progress exposing new and diverse visitors to the park, it has been difficult determining how to retain them as future stewards and integrating diversity within the workforce.

In addition, workforce engagement has become an important issue for management and leadership in the National Park Service. As we move forward, we will be looking to make new, positive strides to improve workforce engagement, empower staff, improve communications across all levels, and ensure accountability and recognition.

Day Use Visitation

Over the last four years visitation has increased 40%, to more than 4.5 million visitors per year. This has resulted in congestion, resource damage, significant safety issues and diminished visitor experience—including long lines of traffic on highways 34 and 36 leading up to Estes Park, long lines at entrance gates and at shuttle stops; overwhelmed rest room facilities and backcountry sites; crowded trailheads and social trailing. Park operational capacity has declined over the last six years: staff, both employees and volunteers, have consistently been overwhelmed. Visitation has significantly increased in each month of the year. The top six visitation days in 2016 were in September and October, representing a shift from our normal July expectations. The park can no longer manage as a summer western park with “shoulder seasons” and needs to look at a year-round model of operation.

This “new norm” of visitation is likely due to a number of factors, including lower oil prices, the park's Centennial in 2015, the NPS Centennial in 2016, and perhaps most significant—the dramatic increase in the front range population growth. Rocky has consistently been largely influenced by local and regional repeat visitation. This suggests that even when oil prices rise again, visitation will continue to be high. Moreover, a 2002 transportation report projected more than 5 million visitors in 2020. Although the models that inform the projection are not perfect, it would be a mistake to ignore them given their relative accuracy. Observations of issues related to the dramatic increase in visitation include but are not limited to:

- Flat and eroded ONPS budgets have left little flexibility to adapt, particularly as soft funding carries constraints on the types of projects and staff that can be hired.
- Continually-evolving hiring constraints are an obstacle to hiring and retaining the types of positions and lengths of appointments that are needed for a park that no longer has seasonal visitation with shoulder seasons.
- Fee funds do contribute toward issue resolution; however, business rules constrain the flexibility needed to 1) address fee collection program needs (the front line of visitor engagement and revenue generation), 2) acquire much-needed ranger staff, and 3) address resource impacts.
- Employee morale and fatigue are at the forefront of issues to be addressed as operational capacity is out of alignment with visitation, and the recent significant increase of reporting across all program functions consumes significant time.
- Visitor and staff safety has been compromised through frequent traffic congestion issues and increased crime.
- Illegal campfires more than doubled in 2015 (The Fern Lake Fire of 2012 was caused by an illegal campfire causing evacuations, loss of a structure, and cost more than \$6 million).
- Back country and front country resources have significant and increasing impacts.

- Wilderness character is being compromised, including the proliferation of social trails, an increase in human waste, and degraded wilderness experiences.
- Emerging recreational demand is increasing for wilderness-based recreation, commercial services, and novel recreational activities such as geocaching and intensive bouldering in remote areas.
- Emerging technology challenges our capacity to respond, such as the use of unmanned aerial vehicles and the rapid dissemination of off-trail hiking information on social media.
- Visitor complaints were significant during 2015. They have improved since implementation of short term congestion measures during the summer of 2016.
- Property damage and vandalism increased significantly.

During the past decade, the park addressed several significant issues that helped buffer the immediate increase in visitation including:

- Investment of more than 66 million Federal Lands Highway Program dollars into a road system that is now largely in a maintenance cycle.
- Investment of approximately 66 million Federal Lands Recreation Enhancement Act dollars (gate fees) into projects of infrastructure and wildlife habitat which park visitors experience every day.
- Investment of hundreds of thousands of dollars, with diverse academic collaboration, in social science investigations focused on visitor experience and impacts in our most visited parts of the park.
- Investment in operational leadership training for all staff to provide foundational tools for assessing risk and being safe during times of change.
- Management of park finances to retain as much flexibility as possible for adaptation to management needs.

These measures have assisted the park in addressing the increasing visitation, but additional short term and long term strategies and actions are needed to move the park to the next step.

In October 2015, the park leadership team embarked upon a deliberative process to address these issues. During the summer of 2016, park staff restricted vehicle access in two specific areas, the Bear Lake Road corridor and the Wild Basin area, when parking areas filled and heavy congestion warranted. These short term restrictions were put in place during most weekends from late June through September of 2016. As a result, traffic congestion, safety, and staff morale improved, and fewer visitor complaints were received. These short term restrictions will continue for the foreseeable future, in conjunction with other actions such as removing illegal roadside parking.

For the long term, addressing day use will require a thoughtful and community-engaged planning process. To set the foundation for this planning effort, in early 2016 the leadership team began engaging the local communities about visitor use management issues and challenges. In the fall of 2016, an IMR transportation planner was detailed at Rocky to research visitor use management planning efforts and strategies being conducted by other parks with similar overcrowding issues, and to develop a draft strategy for creating a short term Bear Lake Corridor Action Plan, as well as a framework and funding strategy for a longer term park-wide strategy.

Climate Change

Rocky Mountain NP celebrated the 100th birthday of its designation in 2015. During this time, the park experienced more large fires in the last five years than in the previous ninety-five years combined. The Fern Lake Fire, a human-caused fire that began in October 2012, endured during the driest November on record in more than one hundred years, burning through winter and over snow. Because of large expanses of beetle-killed forests (a phenomenon related to climate change), indirect firefighting tactics were needed as a primary firefighting approach to mitigate risks to firefighters.

Less than one year later, in September 2013, the park experienced one of the largest rain events in its history, resulting in floods that erased roads and infrastructure from the park to the Front Range of Colorado. The area became part of a national disaster area, and recovery continues today. Geologists stated that the last time the soils of this region were this saturated was during postglacial melting thousands of years ago.

We can expect more of these extreme events as a consequence of climate change, even though the precise link to climate change is less certain. While it is impossible to predict when and where extreme weather events will occur, the park has the capacity to better prepare for these events and to work under the assumption that they will occur more regularly. Fire managers now recognize that fires can and

do occur in any season in Rocky Mountain NP. As infrastructure was repaired and replaced after the 2013 flood, larger, more flood-resistant designs were chosen.

Beyond extreme weather events, Rocky recognizes many other significant ecological responses to longer-term patterns of climate change, such as the continental impacts of the mountain pine beetle to forests. The recent outbreak of pine bark beetles is unprecedented in its size and severity. At Rocky, over 90% of the pine forests have been impacted to some degree. Drought, a decrease in severe winter low temperatures, and longer growing seasons are all contributing factors. Currently a second beetle outbreak, of spruce bark beetles, is severely impacting the subalpine spruce forests of the park. Non-native invasive plants are also appearing at increasing elevations in the park. Cheatgrass, which was limited to the lowest elevations of the park twenty years ago, is now spreading to areas above 9,500' in elevation, moving more than two thousand feet in elevation in just ten years.

To better understand these and many other impacts of climate change on the park (e.g., hydrology—earlier spring melt, earlier peak flow; temperature impacts on the American pika), we work with numerous partners, particularly universities, to cultivate research within the park, resulting in dozens of projects each year. We have engaged on a pathway toward biodiversity discovery and understanding through sponsoring BioBlitz events, supporting biodiversity research, and partnering with universities and non-governmental organizations, such as the E.O. Wilson Foundation and Discover Life in America, to support graduate student engagement in the park. The park's Continental Divide Research Learning Center (RLC) engages in a variety of information and education processes to transfer knowledge, build science literacy, and anticipate concerns or information gaps among staff and stakeholders. Park resource staff participates in directed workshops on science topics, and attend a weekly series focused on professional development activities. In addition, the RLC sponsors a scientific dialogue at the park through the park's Biennial Research Conference.

How the park communicates science within the park, integrates it with our collective culture, and communicates it with the public matters more than ever. Among the park's biggest challenges for responding to climate change is communicating the impact of climate change on a personal level, telling the story in biologically and culturally meaningful ways in order to increase understanding and support from the public.

Relevancy

The National Park Service cannot achieve its mission unless we reflect the face of the nation, which means we must do a much better job to attract diverse staff, visitors, and advocates. We must work within a framework of trust, respect, and inclusion that is responsive to, and a valued part of, contemporary American society. The NPS Office of Relevancy, Diversity, and Inclusion (RDI) defines the importance of this effort as:

- Relevancy is achieved when all Americans are able to establish a personal connection to the National Park Service parks and programs and find meaning and value in the mission of the National Park Service.
- Diversity represents the practice of actively incorporating people of different backgrounds, perspectives, thoughts and beliefs throughout the organization to ensure that NPS is advantaged by the best thinking possible. Diversity is not limited to race, ethnicity, gender, sexual orientation, age or physical ability, but rather represents the wide range of visible and invisible differences and similarities that make each of us unique.
- Inclusion is the practice of intentionally building a culture that is flexible, values diverse ideas, and embraces the meaningful participation of all.

Although Rocky is only 1.5 hours from the major metropolitan area of Denver, visitors and park supporters are not diverse or reflective of the national population. The park is engaging with underserved audiences and youth through various initiatives and partners, including youth programs and student work programs, but there is a long way to go and a current lack of capacity to adequately address this issue. Similarly, the diversity of park staff has improved, but more progress needs to be made. Improving the diversity of park staff will increase national park advocacy amongst more user groups, and provide a welcome and familiar face that will help attract more diverse visitation.

Rocky's high elevation ecosystems, designated wilderness, and more than 350 miles of trails within close proximity to the urban area of Denver provide a variety of recreational and educational experiences as well as challenges and opportunities for balancing urban communities and wilderness. This interface provides an outstanding venue for outreach and partnerships with more diverse audiences, and an improved understanding and advocacy for the NPS. Our efforts to make these connections will help us be more responsive and engaging as a modern 21st-century agency.

The park's overall goal in this respect is to ensure Rocky is relevant to future generations, both for the benefit and enjoyment of society itself, as well as for the protection and advocacy of our parks and places.

Workforce Engagement

Rocky is looking to make new, positive strides to improve workforce engagement, empower staff, improve communications across all levels, and ensure accountability and recognition. Servicewide, Employee Viewpoint Survey results have been declining each year, highlighting the need to place a high priority on improving the workplace environment. Focusing on staff engagement and development is the right thing to do, and long overdue. We have engaged in dialogue with the staff at listening sessions and all employee meetings and trainings, and we have conducted surveys to better understand what the park staff believes the park is doing right, what could be improved, and how. As a result, we are committed to engaging the staff more to provide interdisciplinary input on park goals, issues and challenges; improving communication across all levels of the park, creating a culture of inclusiveness and respect, and providing more training opportunities, with a greater focus on building great supervisors. These efforts will be a work in progress and continually evolving.

The Way Forward

The recent addition of more than a million annual visitors, lack of capacity to protect park resources and provide for positive visitor experiences, the challenges of integrating science into management and communicating climate change threats, the hurdles to ensuring that our staff and visitors reflect the face of the nation for both the park and society's sake, and the necessity to continually engage and support staff in positive work environments, are all very real challenges. We must find a path forward to ensure the enduring sustainability of the park for the future. Investment in relationships with staff, partners, community, and the public is critical. We need to open our minds and expand our thinking by collaborating with diverse groups of staff, partners, communities and stakeholders to share perspectives for framing the issues and developing the possibilities. We must place a greater emphasis on communication, at all levels within the park and externally, to increase understanding and support. We need to be politically and fiscally savvy, and create solid business cases that will increase the likelihood of financial support and advocacy for the park. We need to use adaptive management and be flexible to changing times and situations.

Rocky is an incredible park supported by a highly dedicated, skilled, and passionate workforce. We are surrounded by supportive communities and adoring national and international advocates. We are optimistic about the future, and look forward to continuing our important work ahead.

References

See the [State of the Park Report for the Park website](#) for a more complete list of references to documents and data sets upon which the assessments in this State of the Park report are based. References for several of the key documents cited in this report are as follows:

- [Agee, J. K., and C. N. Skinner. 2005.](#) Basic principles of forest fuel reduction treatments. *Forest Ecology and Management* 211:83–96. Journal Article - (Code: 2237566).
- Armstrong, D. M. 1987. *Rocky Mountain mammals: a handbook of mammals of Rocky Mountain National Park and vicinity.* Colorado Associated University Press in association with Rocky Mountain Nature Association. Boulder, Colorado. Published Report - (Code: 108600).
- Atkins, D. F. 1964. *Historic Sites and Buildings Survey, Rocky Mountain National Park.* Unpublished.
- Baker, C., et al. 2007. *Rocky Mountain National Park Collection Management Report.*
- Baker, B. W. 2006. Efficacy of Tail-Mounted Transmitters for Beaver. *Wildlife Society Bulletin.* 34(1):218–222. Journal Article - (Code: 2237915).
- Baker, B. W., and B. S. Cade. 1995. Predicting biomass of beaver food from willow stem diameters. *Journal of Range Management.* 48(4):322–326. Journal Article - (Code: 2237913).
- Baker, B. W., and E. P. Hill. 2003. Beaver (*Castor Canadensis*). Pages 288–310. In Feldhamer, G. A. and Others (ed.). *Wild Mammals of North America: Biology, Management, and Conservation.* Johns Hopkins University Press. Baltimore, Maryland. Book Chapter - (Code: 2237914).
- Baker, B. W., D. C. S. Mitchell, H. C. Ducharme, T. R. Stanley, and H. R. Peinetti. 2004. Why aren't there more beaver in Rocky Mountain National Park?. Pages 85–90 *in* *Wildlife and Riparian Areas. Proceedings of the Colorado Riparian Association 17th Annual Conference, October 13–15, 2004, Estes Park, Colorado.*
- Baker, D. L., and N. T. Hobbs. 1982. Composition and quality of elk summer diets in Colorado. *Journal of Wildlife Management* 46(3):694–703. Journal Article - (Code: 26428).
- Baker, W. L., J. A. Munroe, A. E. Hessel. 1997. The effects of elk on aspen in the winter range in Rocky Mountain National Park. *Ecography.* 20(2):155–165. Journal Article - (Code: 617290).
- [Baldwin, R. A., and L. C. Bender. 2007.](#) Population demographics, habitat utilization, critical habitats, and condition of black bears in Rocky Mountain National Park. Final report for Rocky Mountain National Park, Estes Park, Colorado, USA. Park files. Rocky Mountain National Park, Colorado. Unpublished Report - (Code: 2168795).
- Baron, J. 1992. *Biogeochemistry of a subalpine ecosystem—Loch Vale Watershed.* New York, Springer Verlag, *Ecological Studies Analysis and Synthesis* 90, 247 p. Book - (Code: 2082287).
- Baron, J. S. 2006. Hindcasting nitrogen deposition to determine an ecological critical load. *Ecological Applications.* 16(2):433–439. Journal Article - (Code: 648399).
- [Baron, J. S., C. T. Driscoll, J. L. Stoddard, and E. E. Richer. 2011.](#) Empirical Critical Loads of Atmospheric Nitrogen Deposition for Nutrient Enrichment and Acidification of Sensitive US Lakes. *BioScience.* 61(8):602–613. Journal Article - (Code: 2207967).
- Baron, J. S., H. M. Rueth, A. M. Wolfe, K. R. Nydick, E. J. Allstott, J. T. Minear, and B. Moraska. 2000. Ecosystem Responses to Nitrogen Deposition in the Colorado Front Range. *Ecosystems.* 3(4):352–368. Journal Article - (Code: 171496).
- Bear, G. D. 1989. Seasonal distribution and population characteristics of elk in Estes Valley, Colorado. *Colorado Division of Wildlife Special Report* 65, R–S—65–89.
- Bender, B., and D. K. Senge. 2015. *Rocky Mountain National Park Collection Condition Survey.*
- [Binkley, D., D. M. Kashian, S. Boyden, M. W. Kaye, J. B. Bradford, M. A. Arthur, P. J. Fornwalt, and M. G. Ryan. 2006.](#) Patterns of growth dominance in forests of the Rocky Mountains, USA. *Forest Ecology and Management.* 236(2–3):193–201. Journal Article - (Code: 661191).

- Blett, T., and G. Eckert. 2013. Restoration of nitrogen-impacted park systems through removal of invasive plant species: general guidelines for NPS plants and projects. National Park Service, Lakewood Colorado. Unpublished Report - (Code: 2224770).
- Bobbink, R., K. Hicks, J. Galloway, T. Spranger, R. Alkemade, M. Ashmore, M. Bustamante, S. Cinderby, E. Davidson, F. Dentener, and others. 2010. Global assessment of nitrogen deposition effects on terrestrial plant diversity: a synthesis. *Ecological Applications* 20(1):30–59. Journal Article - (Code: 2222944).
- Braun, C. E., D. R. Stevens, K. M. Giesen, and C. P. Melcher. 1991. Elk, white-tailed ptarmigan and willow relationships: a management dilemma in Rocky Mountain National Park. In *Transactions of the North American Wildlife and Natural Resources Conference* (Vol. 56, pp. 74–85). Conference Proceeding Paper - (Code: 2237569).
- Braun, C. E., K. Martin, and L. A. Robb. 1993. White-tailed ptarmigan (*Lagopus leucura*). In: Poole, A. (ed.) *The Birds of North America*. Cornell Lab of Ornithology, Ithaca, NY. Retrieved from the Birds of North America. <http://bna.birds.cornell.edu/bna/species/068>. Book Chapter - (Code: 2237570).
- [Brett, J. A. 2003](#). Ethnographic Assessment and Documentation of Rocky Mountain National Park. Denver, CO. Published Report - (Code: 2194976).
- Bromberg, J. E., S. Kumar, C. S. Brown, and T. J. Stohlgren. 2011. Distributional changes and range predictions of downy brome (*Bromus tectorum*) in Rocky Mountain National Park. *Invasive Plant Science and Management*. 4(2):173–182. Journal Article - (Code: 2237917).
- Buechling, A., and W. L. Baker. 2004. A fire history from tree rings in a high elevation forest of Rocky Mountain National Park. *Canadian Journal of Forest Research* 34:1259–1273. Journal Article - (Code: 2167524).
- Burchett, T. 2012. Rocky Mountain National Park Scope of Collections Statement. Unpublished.
- [Butler, W. B. 2006](#). Mining in Rocky Mountain National Park. Estes Park, CO. Published Report - (Code: 2195022).
- [CDPHE] Colorado Department of Public Health and Environment. 2011. Implementation guidance for determining sediment deposition impacts to aquatic life in streams and rivers Policy 98-1. Colorado Department of Public Health and Environment Water Quality Control Commission, Denver, Colorado.
- Carter, M. A. 1998. Yellow-billed Cuckoo. In Kingery, H. E. (ed.). *Colorado breeding bird atlas*. Colorado Bird Atlas Partnership and Colorado Division of Wildlife. Denver, Colorado. Book Chapter - (Code: 2237918).
- Clow, D. W. 2010. Changes in the Timing of Snowmelt and Streamflow in Colorado: A Response to Recent Warming. *Journal of Climate*. 23(9):2293–2306. Journal Article - (Code: 2193687).
- Colorado State Forest Service. 2015. Colorado Wildfire Risk Assessment Summary Report: Rocky Mountain National Park.
- Connor, J. 1993. Neotropical Migrant Bird Survey for Rocky Mountain National Park. Rocky Mountain National Park Resource Management Series. Report #17. Published Report - (Code: 2237919).
- Cooper, D. J., J. Dickens, and E. Gage. 2003. Constraints on, and Opportunities for, Riparian Willow Establishment, Rocky Mountain National Park, Colorado. Unpublished Report - (Code: 552677).
- [D'Antonio, A. L. 2010](#). Recreation Resource Impacts in the Bear Lake Road Corridor of Rocky Mountain National Park, Colorado. An Assessment of Resources Conditions and Visitor Perceptions. Utah State University, Logan, Utah 2010. Thesis - (Code: 2181879).
- D'Antonio, A. L., et al. 2015. An Assessment of Informal Trails and Visitor-created Sites in Rocky Mountain National Park, Colorado. Utah State University, Logan, Utah.
- Driscoll, C. C., J. G. Driscoll, C. Hazekamp, J. B. Mitton, and J. D. Wehausen. 2015. A tale of two markers: Population genetics of Colorado Rocky Mountain bighorn sheep estimated from microsatellite and mitochondrial data. *The Journal of Wildlife Management*. 79(5):819–831. Journal Article - (Code: 2237592).
- Dungan, J. D. 2007. Activity patterns, foraging ecology, and summer range carrying capacity of moose in Rocky Mountain National Park, Colorado. University of Idaho. Thesis - (Code: 2237920).
- Duriscoe, D. M. 2013. Measuring anthropogenic sky glow using a natural sky brightness model. *Publications of the Astronomical Society of the Pacific*. 125(933):1370–1382. Journal Article - (Code: 2209429).

- [Eagles-Smith, C. A., J. J. Willacker, and C. M. Flanagan Pritz. 2014.](#) Mercury in fishes from 21 national parks in the Western United States—Inter and intra-park variation in concentrations and ecological risk: U.S. Geological Survey Open-File Report 2014-1051. Published Report - (Code: 2208703).
- Ehle, D. S., and W. L. Baker. 2003. Disturbance and Stand Dynamics in Ponderosa Pine Forests in Rocky Mountain National Park, USA. *Ecological Monographs*. 73(4):543–566. Journal Article - (Code: 563610).
- Esser, S. M. 2015. Topography, disturbance, and climate: subalpine forest change 1972–2013, Rocky Mountain National Park, USA. M.S. thesis. Colorado State University, Fort Collins, Colorado. Thesis - (Code: 2222310).
- [Federal Aviation Administration. 2010.](#) FAA Aerospace Forecast Fiscal Years 2010–2030. U.S. Department of Transportation Federal Aviation Policy and Plans, Washington D.C. Published Report - (Code: 2206282).
- [Federal Highway Administration. 2013.](#) Traffic volume trends: May 2013. Traffic volume trends. Federal Highway Administration. Published Report - (Code: 2215216).
- [Flanagan Pritz, C. M., J. E. Schrlau, S. L. Massey Simonich, and T. F. Blett. 2014.](#) Contaminants of Emerging Concern in Fish from Western U.S. and Alaskan National Parks – Spatial Distribution and Health Thresholds. *Journal of American Water Resources Association* 50 (2): 309–323. Journal Article - (Code: 2210538).
- [Franke, M. A., T. Johnson, I. Ashton, and B. Bobowski. 2015.](#) Natural resource vital signs at Rocky Mountain National Park. *Natural Resource Report*. NPS/ROMO/NRR—2015/946. National Park Service. Fort Collins, Colorado. Published Report - (Code: 2221612).
- Giersch, J. J., S. Jordan, G. Luikart, L. A. Jones, F. R. Hauer, and C. C. Muhlfeld. 2015. Climate-induced range contraction of a rare alpine aquatic invertebrate. *Freshwater Science*. 34(1):53–65. Journal Article - (Code: 2218124).
- [Gonzalez, P. 2012.](#) Climate Change Trends and Impacts for Planning at Rocky Mountain National Park. National Park Service Climate Change Response Program. Washington, DC. Unpublished Report - (Code: 2217747).
- Gross, J. E., M. C. Kneeland, D. M. Swift, and B. A. Wunder. 2000. Scientific assessment of the potential effect of mountain goats on the ecosystems of Rocky Mountain National Park. Final report for Rocky Mountain National Park, Estes Park, Colorado, USA. Park files. Rocky Mountain National Park, Colorado. Published Report - (Code: 171534).
- Gysel, L. W. 1960. An ecological study of the winter range of elk and mule deer in the Rocky Mountain National Park. *Journal of Forestry*. 58(9):696–703. Journal Article - (Code: 2237921).
- Hobbs, N. T., D. L. Baker, J. E. Ellis, and D. M. Swift. 1981. Composition and Quality of Elk Winter Diets in Colorado. *The Journal of Wildlife Management*. 45(1):156–171. Journal Article - (Code: 2237922).
- Hoffman, M. J., A. G. Fountain, and J. M. Achuff. 2007. 20th-century variations in area of cirque glaciers and glacierets, Rocky Mountain National Park, Rocky Mountains, Colorado, USA. *Annals of Glaciology*. 46(1):349–354. Journal Article - (Code: 651047).
- [IPCC] Intergovernmental Panel on Climate Change. 2007. Climate change 2007: Synthesis report. Published Report - (Code: 2182361).
- [Isaak, D. J., C. H. Luce, B. E. Rieman, D. E. Nagel, E. E. Peterson, D. L. Horan, S. Parkes, and G. L. Chandler. 2010.](#) Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network. *Ecological Applications*. 20(5):1350–1371. Journal Article - (Code: 2237597).
- Jeffress, M. R., T. J. Rodhouse, C. Ray, S. Wolff, and C. W. Epps. 2013. The idiosyncrasies of place: geographic variation in the climate-distribution relationships of the American pika. *Ecological Applications*. 23(4):864–878. Journal Article - (Code: 2192553).
- Kaczynski, K. M., D. J. Cooper, and W. R. Jacobi. 2014. Interactions of sapsuckers and *Cytospora* canker can facilitate decline of riparian willows. *Botany*. 92:485–493. Journal Article - (Code: 2225083).
- Kaliski, K. et al. 2010. Noise assessment of transportation alternatives in the Bear Lake corridor of Rocky Mountain National Park. Unpublished report.
- [Ketz, A. C., T. L. Johnson, R. J. Monello, and N. T. Hobbs. 2016.](#) Informing management with monitoring data: the value of Bayesian forecasting. *Ecosphere*. 7(11):1–15. Journal Article - (Code: 2237485).

- [Kohut, R., C. Flanagan, E. Porter, and J. Cheatham. 2012.](#) Foliar Ozone Injury on Cutleaf Coneflower at Rocky Mountain National Park, Colorado. *Western North American Naturalist*. 72(1): 32–42. Journal Article - (Code: 2187617).
- [Kohut, R. J. 2004.](#) Ozone risk assessment for Rocky Mountain Network. National Park Service. Fort Collins, Colorado. Published Report - (Code: 2181542).
- [Kohut, R. J. 2007.](#) Ozone risk assessment for Vital Signs Monitoring Networks, Appalachian National Scenic Trail, and Natchez Trace National Scenic Trail. NPS/NRPC/ARD/NRTR—2007/001. National Park Service, Fort Collins, Colorado. Published Report - (Code: 643892).
- [Kunkel, K. E., L. E. Stevens, S. E. Stevens, L. Sun, E. Janssen, D. Wuebbles, K. T. Redmond, and J. G. Dobson. 2013.](#) Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 6. Climate of the Northwest U.S. National Oceanic and Atmospheric Administration Technical Report NESDIS 142–6, Washington, DC. Published Report - (Code: 2198275).
- [Lafrancois, T. 2005.](#) A survey of the impacts of fish introduction and removal on zooplankton of alpine lakes in Rocky Mountain National Park, USA. Final report for Rocky Mountain National Park, Estes Park, Colorado, USA. Park files. Rocky Mountain National Park, Colorado. Published Report - (Code: 642415).
- [Landers, D. H., S. M. Simonich, D. A. Jaffe, L. H. Geiser, D. H. Campbell, A. R. Schwindt, C. B. Schreck, M. L. Kent, W. D. Hafner, H. E. Taylor, and others. 2008.](#) The Fate, Transport, and Ecological Impacts of Airborne Contaminants in Western National Parks (USA). Western airborne contaminants assessment project final report: Volume 1. EPA/600/R-07/138. U.S. Environmental Protection Agency, Office of Research and Development, NHEERL, Western Ecology Division, Corvallis, Oregon. Published Report - (Code: 660829).
- [Landers, D. H., S. M. Simonich, D. A. Jaffe, L. H. Geiser, D. H. Campbell, A. R. Schwindt, C. B. Schreck, M. L. Kent, W. D. Hafner, H. E. Taylor, and others. 2010.](#) The Western Airborne Contaminant Assessment Project (WACAP): An Interdisciplinary Evaluation of the Impacts of Airborne Contaminants in Western U.S. National Parks. *Environmental Science and Technology*. 44(13):855–859. Journal Article - (Code: 2171893).
- Larkins, K. F. 1997. Patterns of elk movement and distribution in and adjacent to the eastern boundary of Rocky Mountain National Park. University of Northern Colorado, Greeley, Colorado. Thesis - (Code: 172985).
- [Lord, M. L., D. Germanoski, and N. E. Allmendinger. 2009.](#) Fluvial geomorphology: Monitoring stream systems in response to a changing environment, in Young, R., and Norby, L., *Geological Monitoring: Boulder, Colorado*, Geological Society of America, p. 69–103, doi: 10.1130/2009.monitoring(04). Book Chapter - (Code: 2237601).
- [Lukas, J., J. Barsugli, N. Doesken, I. Rangwala, and K. Wolter. 2014.](#) Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation. A Report for the Colorado Water Conservation Board, Western Water Assessment, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado Boulder. Published Report - (Code: 2237923).
- [Mast, M. A. 2007.](#) Assessment of historical water-quality data for National Park units in the Rocky Mountain Network, Colorado and Montana, through 2004: U.S. Geological Survey Scientific Investigations Report 2007–5147. Published Report - (Code: 651209).
- [McBeth, S. 2007.](#) Native American Oral History and Cultural Interpretation in Rocky Mountain National Park. University of Northern Colorado, Greeley, Colorado. Unpublished Report - (Code: 2185819).
- [McWethy, D. B., S. T. Gray, P. E. Higuera, J. S. Littell, G. T. Pederson, A. J. Ray, and C. Whitlock. 2010.](#) Climate and terrestrial ecosystem change in the U.S. Rocky Mountains and Upper Columbia Basin: Historic and future perspectives for resource management. Natural Resource Report NPS/GRYN/NRR—2010/260. National Park Service, Fort Collins, Colorado. Published Report - (Code: 2165825).
- Mennitt, D., K. Sherrill, and K. Fristrup. 2014. A geospatial model of ambient sound pressure levels in the contiguous United States. *Journal of the Acoustical Society of America*. 135(5):2746–2764. Journal Article - (Code: 2218195).
- Metcalf, J. L., S. L. Lovell, C. M. Kennedy, K. B. Rogers, D. McDonald, J. Epp, K. Keepers, A. Cooper, J. J. Austin, and A. P. Martin. 2012. Historical stocking data and 19th century DNA reveal human-induced changes to native diversity and distribution of cutthroat trout. *Molecular Ecology*. 21:5194–5207. Journal Article - (Code: 2195786).
- [Monahan, W. B., and N. A. Fisichelli. 2014.](#) Climate exposure of US National Parks in a new era of change. *Plos One*. 9(7):e101302. Journal Article - (Code: 2211579).

- [Monahan, W. B., T. Cook, F. Melton, J. Connor, and B. Bobowski. 2013.](#) Forecasting Distributional Responses of Limber Pine to Climate Change at Management-Relevant Scales in Rocky Mountain National Park. *Plos One*. 8(12):e83163. Journal Article - (Code: 2207990).
- Monello, R. J., J. G. Powers, N. Thompson Hobbs, T. R. Spraker, M. K. Watry, and M. A. Wild. 2014. Survival and population growth of a free-ranging elk population with a long history of exposure to chronic wasting disease. *The Journal of Wildlife Management*. 78(2):214–223. Journal Article - (Code: 2237924).
- [Moore, C. M., J. M. White, F. Turina. 2013.](#) Recommended Indicators of Night Sky Quality for NPS State of the Parks Reports. National Park Service, Fort Collins, Colorado. Protocol Development Summary - (Code: 2198592).
- [Mueggler, W. F. 1985.](#) Vegetation associations. Pages 45–55. In DeByle, N. V., and Winokur, R. P. (ed.). *Aspen: Ecology and Management in the Western United States*. U.S. Department of Agriculture, Forest Service. Fort Collins, Colorado. U.S. Department of Agriculture (USDA), Forest Service General Technical Report. RM-119. Published Report Section - (Code: 2237925).
- [Musselman, L. K. 1971.](#) Rocky Mountain National Park Administrative History 1915–1965. National Park Service. Published Report - (Code: 2195035).
- [NADP-TDEP] National Atmospheric Deposition Program. 2014. Total Deposition Maps, v2014.02. <http://nadp.sws.uiuc.edu/committees/tdep/tdepmaps>. November 3, 2014. Web Site - (Code: 2222176).
- [NPS] National Park Service. 2007. Rocky Mountain National Park, Elk and Vegetation Management Plan and Environmental Impact Statement. National Park Service. Plan - (Code: 2237926).
- [NPS] National Park Service. 2013a. Acoustical Study of FAA RNAV Procedure in Rocky Mountain National Report. Accessible online <https://irma.nps.gov/rprs/IAR/Profile/100097>.
- [NPS] National Park Service. 2013b. Hydrographic & impairment statistics. Available at <http://www.nature.nps.gov/water/HIS/index.cfm> (accessed August 2013).
- [\[NPS\] National Park Service. 2013c.](#) Rocky Mountain National Park Investigator’s Annual Report for ROMO-2012-SCI-0012.
- [NPS] National Park Service. 2016. NPSpecies, Information of Species in National Parks. Rocky Mountain National Park (ROMO). IRMA Portal version. National Park Service. Accessed January 28, 2016. Available at <https://irma.nps.gov/NPSpecies/Reports/Systemwide/Ozone-Sensitive%20Species%20in%20a%20Park>.
- [NPS-ARD] National Park Service, Air Resources Division. 2016. Air Quality Conditions & Trends by NPS Units: Rocky Mountain NP, 2014 End Year. National Park Service. Denver, CO. Accessed March 4, 2016. <http://www.nature.nps.gov/air/data/products/parks/index.cfm>.
- Naiman, R. J., C. A. Johnston, and J. C. Kelley. 1988. Alteration of North American Streams by Beaver. *BioScience*. 38(11):753–762. Journal Article - (Code: 7209).
- [Newman, P., S. Lawson, and C. Monz. 2010.](#) Integrated Approach to Transportation and Visitor Use Management at Rocky Mountain National Park. National Park Service. Unpublished Report - (Code: 2238347)
- Olmstead, C. E. 1979. The ecology of aspen with reference to utilization by large herbivores in Rocky Mountain National Park. Pages 89–97. In Boyce MS and Hayden-Wing LD. *North American elk: ecology, behavior, and management*. University of Wyoming Press. Laramie, Wyoming. Book Chapter - (Code: 620028).
- [Packard, F. M. 1947.](#) A Study of the Deer and Elk Herds of Rocky Mountain National Park, Colorado. *Journal of Mammalogy*. 28(1):4–12. Journal Article - (Code: 2237927).
- [Pardo, L. D., M. J. Robin-Abbott, and C. T. Driscoll, eds. 2011.](#) Assessment of nitrogen deposition effects and empirical critical loads of nitrogen for ecoregions of the United States. Gen. Tech. Rep. NRS-80. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. Published Report - (Code: 2222177).
- Patterson, B., G. Levandoski, P. McLaughlin, P. Opler, S. Chaini, Z. Chen, C. Johnson, and J. Wu. 2015. Species Diversity in the Park. National Park Service, Rocky Mountain National Park, Colorado.
- Peet, R. K. 1981. Forest vegetation of the Colorado Front Range: composition and dynamics. *Vegetatio*. 45(1):3–75. Journal Article - (Code: 2237618).

- Peet, R. K. 1988. Forests of the Rocky Mountains. Pages 63–102 in M. G. Barbour and W. D. Billings, editors. North American Terrestrial Vegetation. Cambridge University Press, New York, NY. Book Chapter - (Code: 620046).
- Peinetti, H. R. 2000. Riparian willow dynamics and their interaction with environmental and biological factors in the elk winter range of Rocky Mountain National Park (Colorado) - a multiscale analysis. PhD. dissertation. Colorado State University, Ft. Collins. Thesis - (Code: 2237929).
- Peinetti, H. R., M. Kahlkan, and M. B. Coughenour. 2002. Long-term changes in willow spatial distribution in Rocky Mountain National Park. *Landscape Ecology*. 17(4):341–354. Journal Article - (Code: 2238348)
- Romme, W. H., and D. H. Knight. 1981. Fire frequency and subalpine forest succession along a topographic gradient in Wyoming. *Ecology*. 62(2):319–326. Journal Article - (Code: 549737).
- [Romme, W. H., T. T. Veblen, M. R. Kaufmann, R. Sherriff, and C. M. Regan. 2003.](#) Part 1: Historical (Pre-1860) and Current (1860 – 2002) Fire Regimes. Pages 181–195. In Graham, R. T. (ed.). Hayman Fire Case Study. Ogden, Utah. U.S. Department of Agriculture (USDA), Forest Service General Technical Report. RMRS-GTR-114. Published Report Section - (Code: 2237628).
- [Scherer, R., I. Leinwand, B. R. Noon, and D. M. Theobald. 2010.](#) Extent of suitable beaver habitat. In: A Natural Resource Condition Assessment for Rocky Mountain National Park. Natural Resource Report NPS/NRPC/WRD/NRR—2010/228. National Park Service, Fort Collins, Colorado. Published Report Section - (Code: 2237635).
- [Scherer, R. D., B. Baldwin, J. Connor, and B. R. Noon. 2011.](#) Occupancy of beaver (*Castor canadensis*) in Rocky Mountain National Park: The second field season. Unpublished report to Rocky Mountain National Park. Unpublished Report - (Code: 2182084).
- Schoenecker, K. A., M. K. Watry, L. E. Ellison, M. K. Schwartz, and G. Luikart. 2015. Estimating bighorn sheep (*Ovis canadensis*) abundance using noninvasive sampling at a mineral lick within a national park wilderness area. *Western North American Naturalist*. 75(2):181–191. Journal Article - (Code: 2237639).
- Schoettle, A. W., J. Connor, J. Mack, P. Pineda Bovin, J. Beck, G. M. Baker, R. A. Sniezko, and K. S. Burns. 2014. Establishing the science foundation to sustain high-elevation, five-needle pine forests threatened by novel interacting stresses in four western national parks. *George Wright Forum*. 30:3(302–312).
- [Schreck, C. B., and M. Kent. 2013.](#) Extent of Endocrine Disruption in Fish of Western and Alaskan National Parks. NPS-OSU Task Agreement J8W07080024. NPS Final Report. Unpublished Report - (Code: 2195337).
- Schutte, M. 2015. Geomorphic Response of Fall River to the 2013 Flood, Thesis, University of Colorado Boulder. Thesis - (Code: 2237645).
- Schwalm, D., C. W. Epps, T. J. Rodhouse, W. B. Monahan, J. A. Castillo, C. Ray, and M. R. Jeffress. 2016. Habitat availability and gene flow influence diverging local population trajectories under scenarios of climate change: a place-based approach. *Global Change Biology*. 22(4):1572–1584. Journal Article - (Code: 2233847).
- Schweiger, E. W., and others. 2016. Stream ecological integrity at Rocky Mountain National Park, 2014–2016 Stream Monitoring Report. Unpublished.
- Schweiger, E. W., E. Gage, K. Driver, D. Cooper, L. O’Gan, and M. Britten. 2015. Rocky Mountain Network wetland ecological integrity monitoring protocol: Narrative, version 1.0. Natural Resource Report NPS/ROMN/NRR—2015/991. National Park Service, Fort Collins, Colorado. Published Report - (Code: 2222993).
- Sharp, P. J., and R. Moss. 1981. A comparison of the responses of captive willow ptarmigan (*Lagopus Lagopus Lagopus*), red grouse (*Lagopus Lagopus scoticus*), and hybrids to increasing daylengths with observations on the modifying effects of nutrition and crowding in red grouse. *General and Comparative Endocrinology*. 45:181–188. Journal Article - (Code: 2237647).
- Sibold, J. S., T. T. Veblen, and M. E. Gonzalez. 2006. Spatial and temporal variation in historic fire regimes in subalpine forests across the Colorado Front Range in Rocky Mountain National Park. *Journal of Biogeography*. 33(4):631–647. Journal Article - (Code: 642413).
- Simonson, S. E., P. A. Opler, T. J. Stohlgren, and G. W. Chong. 2001. Rapid assessment of butterfly diversity in a montane landscape. *Biodiversity and Conservation*. 10(8):1369–1386. Journal Article - (Code: 2237930).
- Singer, F. J., and L. C. Zeigenfuss. 2002. Ecological Evaluation of the Abundance and Effects of Elk Herbivory in Rocky Mountain National Park, Colorado, 1994-1999. U.S. Geological Survey (USGS) Open-File Report. 02-208. Fort Collins, Colorado. Published Report - (Code: 2207296).

- [Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005.](#) Changes toward earlier streamflow timing across Western North America. *Journal of Climate*. 18:1136–1155. Journal Article - (Code: 2237931).
- Stoddard, J. L., D. V. Peck, A. R. Olsen, D. P. Larsen, J. Van Sickle, C. P. Hawkins, R. M. Hughes, T. R. Whittier, G. A. Lomnický, A. T. Herlihy, P. R. Kaufman, S. A. Peterson, P. L. Ringold, S. G. Paulsen, and R. Blair. 2005. Environmental Monitoring and Assessment Program (EMAP) western streams and rivers statistical summary. EPA 620/R-05/006. U.S. Environmental Protection Agency. Washington, DC. Published Report - (Code: 2237660).
- [Sullivan, T. J., G. T. McPherson, T. C. McDonnell, S. D. Mackey, and D. Moore. 2011a.](#) Evaluation of the sensitivity of inventory and monitoring national parks to acidification effects from atmospheric sulfur and nitrogen deposition: main report. Natural Resource Report NPS/NRPC/ARD/NRR—2011/349. National Park Service, Denver, Colorado. Published Report - (Code: 2170555).
- [Sullivan, T. J., T. C. McDonnell, G. T. McPherson, S. D. Mackey, and D. Moore. 2011b.](#) Evaluation of the sensitivity of inventory and monitoring national parks to acidification effects from atmospheric sulfur and nitrogen deposition: Rocky Mountain Network (ROMN). Natural Resource Report NPS/NRPC/ARD/NRR—2011/372. National Park Service, Denver, Colorado. Published Report - (Code: 2170600).
- [Sullivan, T. J., T. C. McDonnell, G. T. McPherson, S. D. Mackey, and D. Moore. 2011c.](#) Evaluation of the sensitivity of inventory and monitoring national parks to nutrient enrichment effects from atmospheric nitrogen deposition: main report. Natural Resource Report NPS/NRPC/ARD/NRR—2011/313. National Park Service, Denver, Colorado. Published Report - (Code: 2168692).
- [Sullivan, T. J., S. D. Mackey, T. C. McDonnell, G. T. McPherson, and D. Moore. 2011d.](#) Evaluation of the sensitivity of inventory and monitoring national parks to nutrient enrichment effects from atmospheric nitrogen deposition: Rocky Mountain Network (ROMN). Natural Resource Report. NPS/NRPC/ARD/NRR—2011/324. National Park Service, Natural Resource Program Center. Denver, Colorado. Published Report - (Code: 2168730).
- Suzuki, K., H. Suzuki, D. Binkley, and T. Stohlgren. 1999. Aspen regeneration in the Colorado Front Range: differences at local and landscape scales. *Landscape Ecology*. 14(3):231–237. Journal Article - (Code: 552025).
- Szewczyk, T. 2016. Local perspective on mountain biodiversity: ant biodiversity in the park and along the elevational gradient from Loveland to Sundance peak. Presentation for the Rocky Mountain National Park Biodiversity Workshop. February 9, 2016. Rocky Mountain National Park, Colorado.
- [Theobald, D. M., J. S. Baron, P. Newman, B. Noon, J. B. Norman, III, I. Leinwand, S. E. Linn, R. Scherer, K. E. Williams, and M. Hartman. 2010.](#) A natural resource condition assessment for Rocky Mountain National Park. Natural Resource Report NPS/NRPC/WRD/NRR—2010/228. National Park Service, Fort Collins, Colorado. Published Report - (Code: 2124892).
- [Turchi, G. M., P. L. Kennedy, D. Urban, and D. Hein. 1995.](#) Bird species richness in relation to isolation of aspen habitats. *The Wilson Bulletin*. 107(3):463–474. Journal Article - (Code: 2237932).
- [USGS] U. S. Geological Survey. 2015. Predicted surface water methylmercury concentrations in National Park Service Inventory and Monitoring Program Parks. U.S. Geological Survey. Wisconsin Water Science Center, Middleton, WI. Accessed November 2, 2015. Web Site - (Code: 2222182) Available at: <http://wi.water.usgs.gov/mercury/NPSHgMap.html>.
- U.S. Census Bureau. 2010. 2010 Census Urban and Rural Classification. Retrieved January 5, 2015 from <http://www2.census.gov/geo/tiger/TIGER2010/UA/2010>.
- U.S. Census Bureau. 2014. Metropolitan Population Estimates. Retrieved January 5, 2015 from <http://www.census.gov/population/metro/data/index.html>.
- Visser, M. E., and C. Both. 2005. Shifts in phenology due to global climate change: the need for a yardstick. *Proceedings of the Royal Society* 272(1581):2561–2569. Journal Article - (Code: 2237663).
- Wang, G., N. T. Hobbs, K. M. Giesen, H. Galbraith, D. S. Ojima, and C. E. Braun. 2002. Relationships between climate and population dynamics of white-tailed ptarmigan *Lagopus leucurus* in Rocky Mountain National Park, Colorado, USA. *Climate Research*. 23(1):81–87. Journal Article - (Code: 2237665).
- Wann, G. T., C. L. Aldridge, and C. E. Braun. 2014. Estimates of annual survival, growth, and recruitment of a white-tailed ptarmigan population in Colorado over 43 years. *Population Ecology*. 56(4):555–567. Journal Article - (Code: 2237666).
- Wann, G. T., C. L. Aldridge, and C. E. Braun. In preparation. Estimating demographic rates from long-term data for alpine ptarmigan at Rocky Mountain National Park.

- [Wann, G. T., C. L. Aldridge, and C. E. Braun. 2016.](#) Effects of Seasonal Weather on Breeding Phenology and Reproductive Success of Alpine Ptarmigan in Colorado. PLoS ONE. 11(7):e0158913. Journal Article - (Code: 2244427).
- Weisberg, P. J., and M. B. Coughenour. 2003. Model-based assessment of aspen responses to elk herbivory in Rocky Mountain National Park, U.S.A. Environmental Management. 32(1):152–169. Journal Article - (Code: 2237934).
- Wohl, E., and D. Cadol. 2011. Neighborhood matters: patterns and controls on wood distribution in old-growth forest streams of the Colorado Front Range, USA. Geomorphology. 125(1):132–146. Journal Article - (Code: 2237668).
- Wohl, E., and J. R. Goode. 2008. Wood dynamics in headwater streams of the Colorado Rocky Mountains. Water Resources Research. 44(9). Journal Article - (Code: 2237667).
- Wolfe, A. P., A. C. Van Gorp, and J. S. Baron. 2003. Recent ecological and biogeochemical changes in alpine lakes of Rocky Mountain National Park (Colorado, USA): a response to anthropogenic nitrogen deposition. Geobiology. 1(2):153–168. Journal Article - (Code: 568384)
- [Zeigenfuss, L., D. Binkley, and G. Tuskan. 2008.](#) Aspen Ecology in Rocky Mountain National Park: Age Distribution, Genetics, and the Effects of Elk Herbivory. U.S. Geological Survey (USGS) Open-File Report. 2008–1337. Published Report - (Code: 2185844).
- Zeigenfuss, L. C. F. J. Singer, S. A. Williams, and T. L. Johnson. 2002. Influences of Herbivory and Water on Willow in Elk Winter Range. The Journal of Wildlife Management. 66(3):788–795. Journal Article - (Code: 2237935).
- [Zeigenfuss, L. C. 2006.](#) Alpine Plant Community Trends on Elk Summer Range of Rocky Mountain National Park, Colorado: An Analysis of Existing Data. U.S. Geological Survey (USGS) Open-File Report. 2006–1122. U.S. Geological Survey. Published Report - (Code: 2237674).
- [Zeigenfuss, L. C., and T. L. Johnson. 2015.](#) Monitoring of vegetation response to elk population and habitat management in Rocky Mountain National Park, 2008–14. U.S. Geological Survey (USGS) Open-File Report. 2015-1216. U.S. Geological Survey. Reston, Virginia. Published Report - (Code: 2237936).

See Also:

[Collection of Natural Resource-Related References](#)

[Collection of Cultural Resource-Related References](#)

[Collection of Visitor Experience-Related References](#)

Glossary

See the [State of the Parks home page](#) for a link to a complete glossary of terms used in State of the Park reports. Definitions of key terms used in this report are as follows:

Key Term	Definition
Americans with Disabilities Act (ADA) and American Barriers Act (ABA)	Laws enacted by the federal government that include provisions to remove barriers that limit a disabled person's ability to engage in normal daily activity in the physical, public environment.
Archeological Sites Management Information System (ASMIS)	The National Park Service's standardized database for the basic registration and management of park prehistoric and historical archeological resources. ASMIS site records contain data on condition, threats and disturbances, site location, date of site discovery and documentation, description, proposed treatments, and management actions for known park archeological sites. It serves as a tool to support improved archeological resources preservation, protection, planning, and decision-making by parks, centers, regional offices, and the national program offices.
Baseline Documentation	Baseline documentation records the physical condition of a structure, object, or landscape at a specific point in time. A baseline provides a starting point against which future changes can be measured.
Carbon Footprint	Carbon footprint is generally defined as the total set of greenhouse gas emissions caused by an organization, event, product, or person.
Climate Friendly Park	The NPS Climate Friendly Park designation requires meeting three milestones: completing an application; completing a comprehensive greenhouse gas (GHG) inventory; and completing a Climate Action Plan, which is the actions, policies, programs, and measures a park will put into place to reduce its GHG emissions.
Cultural Landscapes Inventory (CLI)	A Cultural Landscapes Inventory describes historically significant landscapes within a park. The inventory identifies and documents each landscape's location, size, physical development, condition, characteristics, and features, as well as other information useful to park management.
Cultural Landscape Report (CLR)	A Cultural Landscape Report is the principal treatment document for cultural landscapes and the primary tool for long-term management of those landscapes. It guides management and treatment decisions about a landscape's physical attributes, biotic systems, and use when that use contributes to historical significance.
Curation	National parks are the stewards of numerous types of objects, field notes, publications, maps, artifacts, photographs, and more. The assemblage of these materials comprises a museum collection. Curation is the process of managing, preserving, and safeguarding a collection according to professional museum and archival practices.
Facility Condition Index (FCI)	FCI is the cost of repairing an asset (e.g., a building, road, bridge, or trail) divided by the cost of replacing it. The lower the FCI number, the better the condition of the resource.
Foundation Document	A park Foundation Document summarizes a park's purpose, significance, resources and values, primary interpretive themes, and special mandates. The document identifies a park's unique characteristics and what is most important about a park. The Foundation Document is fundamental to guiding park management and is an important component of a park's General Management Plan.
Fundamental and Other Important Resources and Values	Fundamental resources and values are the particular systems, processes, experiences, scenery, sounds, and other features that are key to achieving the park's purposes and maintaining its significance. Other important resources and values are those attributes that are determined to be particularly important to park management and planning, although they are not central to the park's purpose and significance. These priority resources are identified in the Park Foundation Document and/or General Management Plan. The short-cut name that will be used for this will be Priority Resources.
General Management Plan (GMP)	A General Management Plan is a strategic planning document that outlines the future management of a National Park Service site for the next 15 to 20 years. The plan will set the basic philosophy and broad guidance for management decisions that affect the park's resources and the visitor's experience.

Key Term	Definition
Green Parks Plan (GPP)	The Green Parks Plan defines a collective vision and a long-term strategic plan for sustainable management of NPS operations. A critical component of the implementation of the GPP will be informing and engaging park staff, visitors, and community partners about climate change and sustainability to broaden opportunities to foster change.
Historic Integrity	Historic Integrity is the assemblage of physical values of a site, building, structure, or object and is a key element in assessing historical value and significance. The assessment of integrity is required to determine the eligibility of a property for listing in the National Register.
Historic Resource Study (HRS)	The historic resource study is the primary document used to identify and manage the historic resources in a park. It is the basis for understanding their significance and interrelationships, a point of departure for development of interpretive plans, and the framework within which additional research should be initiated.
Historic Structures Report (HSR)	The historic structure report is the primary guide to treatment and use of a historic structure and may also be used in managing a prehistoric structure.
Indicator of Condition	A selected subset of components or elements of a Priority Resource that are particularly “information rich” and that represent or “indicate” the overall condition of the Priority Resource. There may be one or several Indicators of Condition for a particular Priority Resource.
Integrated Resource Management Applications (IRMA)	The NPS-wide repository for documents, publications, and data sets that are related to NPS natural and cultural resources.
Interpretation	Interpretation is the explanation of the major features and significance of a park to visitors. Interpretation can include field trips, presentations, exhibits, and publications, as well as informal conversations with park visitors. A key feature of successful interpretation is allowing a person to form his or her own personal connection with the meaning and significance inherent in a resource.
Invasive Species	Invasive species are non-indigenous (or non-native) plants or animals that can spread widely and cause harm to an area, habitat, or bioregion. Invasive species can dominate a region or habitat, out-compete native or beneficial species, and threaten biological diversity.
List of Classified Structures (LCS)	LCS is an inventory system that records and tracks the condition of the approximately 27,000 historic structures listed in the National Register of Historic Places that are the responsibility of NPS.
Museum Collection	NPS is the steward of the largest network of museums in the United States. NPS museum collections document American, tribal, and ethnic histories; park cultural and natural resources; park histories; and other aspects of human experience. Collections are managed by professionally-trained NPS staff, who ensure long-term maintenance of collections in specialized facilities.
National Register of Historic Places (NRHP)	The National Register of Historic Places is the official list of the Nation’s historic properties worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service’s National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America’s historic and archeological resources. Listing in the National Register of Historic Places provides formal recognition of a property’s historical, architectural, or archeological significance based on national standards used by every state. The National Register is a public, searchable database about the places.
Native American Graves Protection and Repatriation Act (NAGPRA)	A federal law passed in 1990. NAGPRA provides a process for museums and federal agencies to return certain Native American cultural items (e.g., human remains, funerary objects, sacred objects, objects of cultural patrimony) to lineal descendants and culturally-affiliated Indian tribes and Native Hawaiian organizations.
Natural Resource Condition Assessment (NRCA)	A synthesis of existing scientific data and knowledge, from multiple sources, that helps answer the question: what are current conditions of important park natural resources? NRCAs provide a mix of new insights and useful scientific data about current park resource conditions and factors influencing those conditions. NRCAs have practical value to park managers and help them conduct formal planning and develop strategies on how to best protect or restore park resources.

Key Term	Definition
Priority Resource or Value	This term refers to the Fundamental and Other Important Resources and Values of a park. These can include natural, cultural, and historic resources as well as opportunities for learning, discovery, and enjoyment. Priority Resources or Values include features that have been identified in park Foundation Documents, as well as other park assets or values that have been developed or recognized over the course of park operations. Priority Resources or Values warrant primary consideration during park planning and management because they are critical to a park’s purpose and significance.
Project Management Information System (PMIS)	A servicewide intranet application within the National Park Service to manage information about requests for project funding. It enables parks and NPS offices to submit project proposals to be reviewed, approved, and prioritized at park units, regional directorates, and the Washington Office.
Resource Management	The term “resources” in NPS encompasses the many natural, cultural, historical, or sociological features and assets associated with parks. Resource management includes the knowledge, understanding, and long-term stewardship and preservation of these resources.
Rocky Mountain Network (ROMN)	One of 32 Inventory and Monitoring (I&M) Networks established as part of the NPS Inventory and Monitoring Program . The Rocky Mountain Network provides scientific data and expertise for natural resources in six parks located in Colorado and Montana.
Specific Measure of Condition	One or more specific measurements used to quantify or qualitatively evaluate the condition of an Indicator at a particular place and time. There may be one or more Specific Measures of Condition for each Indicator of Condition.
Volunteers In Parks Program (VIP)	The Volunteers In Parks Program was authorized by Public Law 91–357 enacted 1970. The primary purpose of the VIP program is to provide a vehicle through which the National Park Service can accept and utilize voluntary help and services from the public. The major objective of the program is to utilize this voluntary help in such a way that is mutually beneficial to the National Park Service and the volunteer. Volunteers are accepted from the public without regard to race, creed, religion, age, sex, sexual orientation, national origin, or disability.
Wilderness	A designation applied to certain federal lands set aside for preservation and protection in their natural condition, in accordance with the Wilderness Act of 1964 .