



Frequently Asked Questions

Year of the Tundra is a Rocky Mountain National Park (RMNP) initiative to highlight the significance and uniqueness of alpine tundra. By celebrating our tundra, we hope to inspire appreciation for the plant and animal species that make the tundra their home, raise awareness of changes affecting the tundra, and encourage visitors to tread lightly on this fragile landscape.



NPS/A. Schonlau

Key Messages

- RMNP's alpine tundra is unique and fragile. Damage to soils and sensitive plant life can take hundreds of years to recover. Damage to cultural resources is irreversible.
- Human impacts, such as trampling, are a primary threat to RMNP's alpine tundra. These can lead to denuding of vegetated areas and soil erosion, which can facilitate the establishment of non-native plants.
- Visitors can help preserve the alpine tundra by staying on paved roads, designated trails, and rocks, avoiding social trails, and obeying area closure signs.
- Impacts from climate change are also a concern to the alpine tundra. Warmer temperatures mean less precipitation falling as snow. Less snowpack in the winter leads to less available water in the summer for alpine species and nearby human communities.

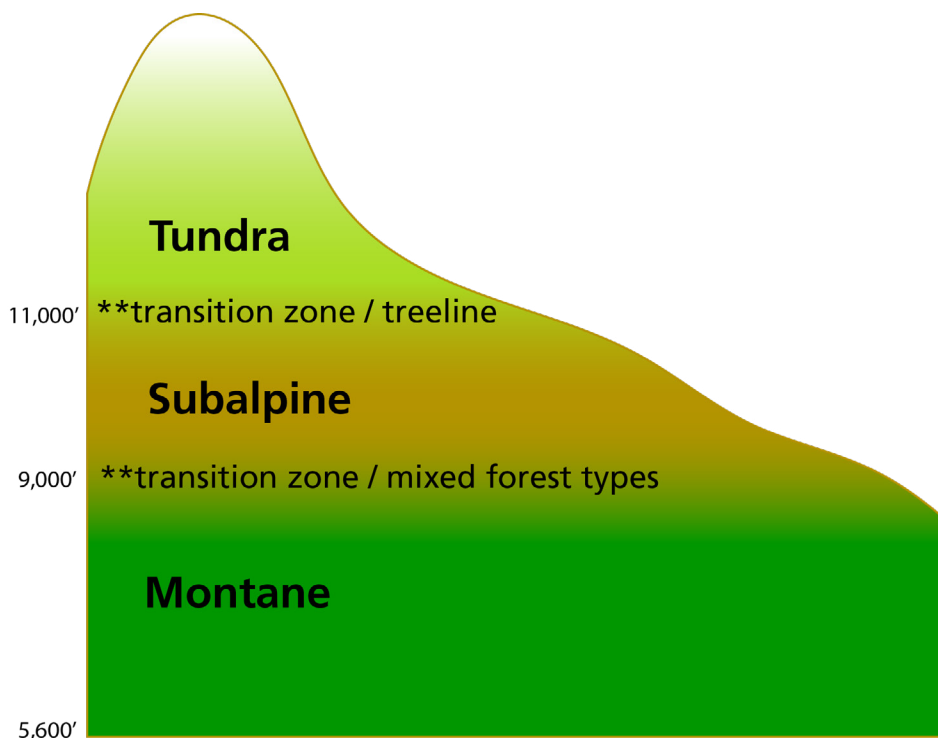
Desired Actions from the Public

- Recognize the importance of the tundra and respect the plants and animals that live there.
- Understand the sensitivity of and threats to long-term sustainability of the alpine tundra.
- Obey park signs and guidance designed to mitigate impacts on the tundra.
- Explore and appreciate the tundra following Leave No Trace principles. Leave plants, rocks, sticks, and archeological artifacts in place.
- Clean boots and gear to avoid introducing and spreading non-native and invasive plants.
- Pack out human waste, especially in high use areas and in and around lakes and streams.
- Consider the human role in climate change and take action at home to reduce their personal impact.

What is tundra, what makes it special, and how much alpine tundra does RMNP have?

Tundra is a biome, or type of environment, which is characterized as treeless, cold, and relatively dry. Across the globe, there are two types of tundra—alpine and arctic. Alpine tundra, the type found in RMNP, occurs at high elevations where temperatures are colder, winters are longer, and growing seasons are shorter. RMNP's tundra starts between 11,000 and 11,500 feet. This transition zone, or ecotone, is where the

forested subalpine zone shifts to the treeless tundra and is often referred to as 'treeline'. Permafrost, an area with a permanently (year-round) frozen subsurface soil layer, is common and widespread in arctic tundra, but patchier within alpine tundra. While models suggest that permafrost was historically prominent throughout RMNP, recent research indicates that areas with permafrost are now very limited^{1,2}. Approximately one-third of RMNP is tundra, making it one of the largest examples of this type of ecosystem protected in the contiguous United States. Large patches of tundra like this are rare in the lower 48 states.



NPS/J. Marino

RMNP's road crew start clearing Trail Ridge Road each year in April. While some areas (Knives Edge, East of Rock Cut, above Forest Canyon) are windswept, other areas (such as Upper Hidden Valley, Rock Cut, and the Lava Cliffs parking area) have high snow drifts. In the spring of 2019, the stretch of road between High Point and Gore Range had drifts as high as 21 feet (6.4 m).

What is it like on RMNP's tundra?

Cold temperatures and strong winds make the tundra a harsh yet spectacular place to be. Summer on the tundra is short; snow is prominent on the landscape into June with a few isolated snow patches remaining through the summer. July is generally the warmest month with an average high temperature of 52°F (11°C). Wind across the tundra is common and can make even a warm, sunny day feel cold. Research conducted in the summer of 1980 documented an average summer (June-August) wind speed of 20.2 mph (32.5 km/h) at the Alpine Visitor Center, with a peak gust of 79 mph (127.1 km/h).³ Afternoon rain and lightning storms are common in summer.

The tundra is a severe place to be in the winter. Winds rip across the mountains, and windy conditions redistribute snow creating highly variable snow depth and snow cover. Wind measurements taken at an alpine site within the park during the winter of 1973-74 recorded monthly peak gusts ranging from 98-122 mph (157.7-196.3 km/h) from December through May.⁴ In the spring of 2019, RMNP's road crew documented snow drifts along Trail Ridge Road as high as 21 feet (6.4 meters) as they worked to open the road for the summer season.

What plants and animals live on the tundra in RMNP?

You have to be tough to live on the tundra! Cold and windy conditions and a short summer season mean that it takes some special adaptations to make a living on the tundra. Plant species are generally low to the ground and can live for years (possibly decades to more than 100 years old!). Each summer, they have a very short window in which to green up, flower, and produce seeds. Forbs (herbaceous flowering plants) and grasses are found wherever there is soil to cling to, and lichens can be found on the surfaces of exposed rocks. Blue alpine forget-me-nots bloom in late May and are one of the first flowers to appear in the alpine. Yellow alpine avens begin flowering in June, but their dark green leaves turn bright red in August, providing brilliant colors throughout the season. Cushion plants, like moss campion with their small star-like purple flowers, resemble mosses with their tightly packed leaves. A long taproot, common to tundra plants, helps them remain anchored in the soil and get nutrients and water. Many plants are covered in tiny hairs to help protect them from the wind. Tundra wildflowers bloom from late May through early August.



©Al Schneider, <http://www.swcoloradowildflowers.com>

Alpine plants have adapted to life on the tundra. Some plants, like this snow willow (*Salix reticulata*), have thick, waxy leaves that help them hold moisture.



NPS/V Pelton

2020 – Year of the Marmot?

2020 is Year of the Rat according to the Chinese zodiac, so why not take this opportunity to celebrate RMNP's largest rodent and tundra dweller—the yellow-bellied marmot! Marmots are a common, vocal, and entertaining sight for human visitors to the tundra. They may also be an indicator of change in the tundra. Earlier spring conditions may bring marmots out of hibernation earlier, before food is readily available. In 2014, a webcam was installed at Rock Cut to provide a citizen science opportunity for schools to document marmot activity in the spring. Although the project is no longer active, it could be revived at a future date. Additionally, marmots are present at Rocky's sister park in Poland and Slovakia, Tatras, which can provide unique insight into how marmots are adapting to change globally.

Animals need to make the most of the summer months to get the food they need for the winter. Some animals, like the yellow-bellied marmot, feed all summer long but then hibernate during the winter months, while others, such as the American pika, gather all the food they need for the winter, store it in hay piles, and stay active in winter below the insulating snow. Other species undergo phenological changes—the white-tailed ptarmigan's plumage turns white and their large feathery feet help them travel on snow. Bighorn sheep are also well adapted for high country living—their hooves are designed for climbing around in the tundra's rocky terrain. Other species, such as RMNP's iconic elk, make forays into the tundra during the summer months to keep cool and feed on forbs, grasses, and alpine willow shrubs.



NPS/A Schonlau

RMNP has three year-round Rocky Mountain bighorn sheep subherds, two comprise the west side herd and one is part of a larger herd on the east side. These herds spend the summers at high elevation above treeline, but venture to lower elevations in winter and spring to access mineral licks. RMNP's bighorn sheep are highly sensitive to human disturbance and disease.

How have humans used the tundra in the past?

Rocky Mountain National Park contains rare and exceptional glimpses into the earliest connections between people and the Rocky Mountain environment. The area encompassed by the park has been used by Native Americans continuously for over 10,000 years. The high elevation alpine tundra provides important and nutritious plant and animal species that remain critical to the survival and lifeway of affiliated Native Americans. Mountains, and high places in particular, have been important to Native Americans since time immemorial. The Ute Trail represents one of the earliest evidences of human travel over the mountains—the start of a continuum of human visitation that continues today.

Routes across the Continental Divide at Forest Canyon Pass (Ute Trail, Fall River Road, Trail Ridge Road) and their associated structures (Lake Irene mess hall, for example) provide an exceptional example of transportation and engineering through the years across what would become our nation's highest continuous paved highway. Tourism, starting in the early 1900s, brought a new wave of human interest and experiences of the tundra. Construction of Old Fall River Road between 1913 and 1920, provided tundra access to the new burgeoning tourism industry. Trail Ridge Road, completed in 1932, opened opportunities for tourists to explore the tundra and play in the persistent snow fields. Listed on the National Register of Historic Places, the Beatrice Willard Alpine Tundra Research Plots represent one of the United States' first efforts to incorporate science into long-term management. Data collected from these plots continues to influence the experience of visitors today. Today, Trail Ridge Road, scenic viewsheds, and historic alpine trails continue to attract visitors to this unique environment.



A car caravan transports visitors up Fall River Road, June 1923.

NPS/RMNP museum collection

What is the best way for visitors to explore and experience the tundra?

Scenic drives along Trail Ridge Road and Old Fall River Road are a great first step in seeing RMNP's alpine tundra. Paved pull-offs and formal trails give access to spectacular mountain vistas, opportunities to view wildlife, and a chance to get up close to the short, hardy vegetation that covers the ground. Interpretive exhibits at the Alpine Visitor Center, located along Trail Ridge Road at 11,796 feet, provides insight into plants and animals that make the tundra home. For the intrepid visitor, multi-day hikes and wilderness camping can provide an intimate tundra experience.

Trail Ridge Road is only open seasonally, generally from Memorial Day weekend until mid-October, and is closed to vehicular traffic in the winter. Visitors can still access the road by foot, ski, and snowshoe, in the winter months.



Tundra travel, anytime of year, requires a unique set of safety considerations. Changes in daily temperatures and strong winds mean that warm clothes and layers can make the difference between a comfortable or miserable visit. The thin air at high elevation can make it hard to catch your breath and can also lead to altitude sickness for some visitors. Thinner air and high elevations also mean that UV radiation is stronger. RMNP recommends that visitors get an early start for recreation above treeline to avoid the summer's typical afternoon lightning storms.

NPS/R Williams

What are the main threats to RMNP's tundra?

Human visitors to RMNP can negatively impact the alpine tundra. Vegetation trampling and social trailing can hinder vegetation growth and lead to soil erosion, as can driving and parking vehicles on unpaved roadsides. Non-native plant species can then take advantage of denuded areas and may outcompete native plants that wildlife depends on. It can take hundreds of years for the alpine tundra to recover from seemingly minor impacts.

Human impacts to the alpine tundra extend beyond visitors. Airborne pollutants from industry and development, as well as natural events, can come into the park through rain and snow. Recent algal blooms in alpine lakes are likely a result of nitrogen deposition interacting with warmer water temperatures. If nitrogen deposition increases, it may lead to a shift in alpine plant communities, including fewer wildflowers. Air quality presents a unique challenge in mitigating risks, as pollutants can come from hundreds and thousands of miles outside RMNP.



NPS/A Schonlau

Social trailing results in unnecessary vegetation trampling and soil erosion. It can take hundreds of years for these areas to recover.



NPS/A Schonlau

The white-tailed ptarmigan population along Trail Ridge Road has been monitored almost continually since 1966. The population declined by 66% between the mid-1970s and 2000. Ongoing studies by researchers at the US Geological Survey and Colorado State University are investigating changes in breeding phenology and habitat use to learn more.

Climate change is another concern to long-term preservation of RMNP's alpine tundra. Warmer average temperatures mean less precipitation in the form of snow, earlier seasonal melting of snow and ice, more evaporation of water during the growing season, and thawing of soils. These all result in drier conditions that can lead to desiccation of sensitive plant species and loss of habitat for wildlife. Earlier snow melt and less snow also means less water later in the summer season which may lead to future water shortages—a concern for neighboring human

communities. Although not an issue currently, drier conditions and changing vegetation may lead to spread of fire across the tundra in the future.

Changes in seasonal snow can lead to changes in phenology (the timing of biological events). For example, RMNP's white-tailed ptarmigan initiate nesting an average of 12 days earlier than they did in the 1960s.⁵ Chicks feed on insects, and if hatching begins to happen before insects are available, RMNP's ptarmigan populations could be in jeopardy. Earlier springs could also mean that plants flower before or after pollinators are present. This and other mismatches in phenology can have cascading effects on plant and wildlife populations.

What kind of research is happening in the tundra at RMNP?

There are several research projects at RMNP that are specific to the alpine tundra and species that rely on this environment.

The Global Observation Research Initiative in Alpine Environments (GLORIA) is an international program for long-term monitoring of alpine vegetation and soils across the globe. The NPS' Inventory and Monitoring Program's Rocky Mountain Network (ROMN) established [GLORIA monitoring in RMNP](#) in 2009. Field crews visit the sites every five years to identify vascular plant species and evaluate non-native species, human disturbance, and herbivore activity. Soil temperature loggers, buried just under the ground, take measurements year-round and provide insight on snow melt timing.

Since 2015, Dr. Sarah Schliemann from Metropolitan State University of Denver, has been investigating the release of carbon dioxide from alpine soils, also known as 'soil respiration'. Carbon dioxide is released when soil organic matter decomposes. Results reveal that both soil moisture and soil temperature, in combination, influence the rate of soil respiration.⁶ Drying conditions may mitigate carbon release from the alpine. Further study will investigate the chemical characteristics of carbon found in RMNP's alpine soils, and the relationship between soil moisture and snowpack.



Students from Metropolitan State University of Denver collect soil samples as part of the soil respiration study. Alpine soils are recognized as carbon sinks, storing carbon in the form of organic materials; however, changing conditions may mean faster decomposition and greater release of stored carbon as carbon dioxide, a heat-trapping (or greenhouse) gas.

Courtesy of S Schliemann

In 2010, the NPS collaborated on the [Pikas in Peril Project](#), which investigated how expected changes in climate would affect the [American pika](#), an animal that needs access to cool microclimates and is recognized as an indicator species of the ecological effects of climate change. Using simulation models, the project estimated that by 2099 pikas would be limited to 20% of their present range in RMNP.⁷ A key investigator in that project at RMNP was Dr. Chris Ray of University of Colorado-Boulder. Dr. Ray continues to study pika in and around RMNP and works with the [Front Range Pika Project](#) to engage citizen scientists in gathering data on the presence of pika within appropriate habitat throughout the park.



NPS/A Schonlau

Although heat stress is a concern for long term survival of pika in the U.S., recent studies have identified a decrease in snowpack as the greatest threat to pikas in RMNP, as a lack of snow reduces their ability to insulate from extreme cold.

There are several other recent and current research projects happening within RMNP's alpine tundra, including long-term monitoring of [white-tailed ptarmigan](#), visitor use studies, long-term monitoring of nitrogen deposition and its impacts on alpine lakes, and paleoecological and archeological investigations of retreating ice fields. RMNP is mindful of research needs within the alpine environment and works with academic and agency partners to answer management-relevant research questions.

What is the park doing to help protect the tundra?

RMNP is working to protect the tundra in a number of ways. Public education through visitor contacts in visitor centers, the wilderness office, and in the field, give visitors information on the sensitive tundra environment and empowers them to make decisions that minimize their impacts. The Tundra Guardians, a group of dedicated volunteers, regularly interact with visitors at high use areas along Trail Ridge Road providing information about the park and its resources. In an effort to improve air quality, RMNP works with federal and state agencies on policy development and voluntary best management practices. RMNP also continues to work with researchers to learn more about changes to the tundra environment to inform management decisions related to the continued preservation of the tundra and species that inhabit it.

In some cases, trail and area closures are instituted to allow for resource protection and tundra rehabilitation. In 2019, RMNP removed the paved “Trail to Nowhere” east of Rock Cut, because of the high intensity and extent of trampling that was occurring in adjacent areas. The park revegetated the trail using native tundra plants grown in the park’s greenhouse. The park has designated six Tundra Closure Areas to restrict use and protect the alpine tundra in high traffic areas. Within these areas, off-trail hiking is prohibited within 100 yards of trails and parking lots.



NPS/J Bromberg

During the summer of 2019, RMNP’s vegetation crew restored the former ‘Trail to Nowhere’. The asphalt was removed, rare native plants in the area were salvaged, top soil was added to the site, and a variety of tundra species were planted. The plants were propagated in the park’s greenhouse during the winter and spring of 2019.

The Tundra Closure Areas are:

1. Forest Canyon Overlook - Adjacent to the parking lot and trail on the south side of Trail Ridge Road.
2. Rock Cut - Adjacent to the parking areas on both north and south sides of Trail Ridge Road and along the Tundra Communities Trail corridor. Alpine View Trail is closed for restoration.
3. Gore Range Overlook - Adjacent to and below the parking area on the south side of Trail Ridge Road.
4. Alpine Visitor Center - Adjacent to the parking area and Alpine Ridge Trail.
5. Tundra Communities Trail - All areas on either side of the Tundra Communities Trail and it’s terminus at Toll Memorial.
6. Lava Cliffs - Areas on the north side of Trail Ridge Road adjacent to the parking lot and areas accessing the summit of Lava Cliffs.



How can visitors help protect our tundra ecosystem?

Everyone has a role to play in protecting RMNP's alpine tundra. Understanding the unique and fragile tundra environment, and the impact that people can have on it, are a first step to minimizing visitor impacts to this sensitive resource. Road-based visitors can avoid parking on unpaved shoulders along the roadside. Visitors that explore Trail Ridge Road's pull-offs and short trails can be active participants in tundra protection by staying on hardened trail surfaces, obeying area closure signs, and not creating or using social trails. Backcountry visitors should follow [Leave No Trace](#) principles when exploring the wilderness and pack out all trash, including human waste. Visitors can also take the Rocky Pledge: www.nps.gov/romo/planyourvisit/rockypledge.htm

Energetic visitors and local area residents can also support science and research by becoming citizen scientists through the Front Range Pika Project (FRPP). Data collected through this project is used by the park to evaluate the status of the American pika, an important indicator species of tundra health.

Ultimately, everyone can do their part to protect RMNP's alpine tundra, both while in the park and at home.



Courtesy of M Malloy

Front Range Pika Project volunteer citizen scientists collect field data on pika occupancy in 72 plots within RMNP's alpine areas.

References

- ¹Janke, J. R. 2005. The occurrence of alpine permafrost in the Front Range of Colorado. *Geomorphology* 67:375-389.
- ²Ashton, I. W., J. Visty, E. W. Schweiger, J. R. Janke, and B. Bobowski (editor). 2013. State of the alpine report for Rocky Mountain National Park: 2010 Summary Report. Natural Resource Data Series NPS/ROMN/NRDS—2013/535. National Park Service, Fort Collins, Colorado.
- ³Glidden DE. 1981. Summer Wind Studies Near the Alpine Visitors' Center, Rocky Mountain National Park. Rocky Mountain Nature Association. Estes Park, CO. <https://irma.nps.gov/DataStore/Reference/Profile/2237704>
- ⁴Glidden DE. 1982. Winter Wind Studies in Rocky Mountain National Park. Rocky Mountain Nature Association. Estes Park, Colorado. <https://irma.nps.gov/DataStore/Reference/Profile/2244125>
- ⁵Wann. GT, CL Aldridge, and CE Braun. 2016. Effects of Seasonal Weather on Breeding Phenology and Reproductive Success of Alpine Ptarmigan in Colorado. *PloS ONE* 11(7):eo158913.
- ⁶Schliemann, S. and J. Janke. 2020. Soil Characteristics, Carbon Storage, and Tundra Persistence in a Changing Climate. Report to Rocky Mountain National Park. Denver Metropolitan University, Denver, CO.
- ⁷National Park Service. 2016. Pikas in Peril Research Project: Rocky Mountain National Park – Summary and Results. <https://irma.nps.gov/DataStore/Reference/Profile/2225575>