



Five-Needle Pine Monitoring Database for the Rocky Mountains



Scientists throughout the Rocky Mountains have been monitoring five-needle pines for many years to understand the current status of and threats to these charismatic and ecologically important species. This resource brief introduces a new database that integrates various datasets into a single tool that resource managers and researchers can use to improve analysis and conservation of five-needle pines.

Importance of Five-Needle Pines

Often growing in dramatic, contorted shapes, five-needle pine species are high-elevation trees with bundles of five needles, including whitebark pine (*Pinus albicaulis*), limber pine (*P. flexilis*), and bristlecone pine (*P. aristata*). They are ecologically valuable for their role in capturing and slowing snowmelt to mediate erosion and in providing forage to bears and Clark's nutcrackers. Aesthetically, they are prized for the artistic dimension their twisted shapes add to the already breathtaking vistas at high elevations in places like Great Sand Dunes National Park and Preserve, Glacier National Park, and Rocky Mountain National Park.

Five-needle pines are threatened by the interaction of climate change with two stressors: an invasive pathogen that causes white pine blister rust, *Cronartium ribicola*, and the mountain pine beetle, *Dendroctonus ponderosae*. For example, white pine blister rust has contributed to high mortality of whitebark pine populations in the Northern Rockies and is a factor in listing the species as protected under the federal Species at Risk Act in Canada, as endangered in Alberta under The Wildlife Act, and as a candidate species for listing under the Endangered Species Act in the United States. These threats have led to conservation concern for five-needle pine species across the Rocky Mountains.

Database Objectives and Scope

Monitoring data collected by the National Park Service Rocky Mountain Inventory and Monitoring Network (ROMN), USDA Forest Service, and partner organizations are currently unavailable in a format conducive to comparison and analysis. These data span the last 13 years and include lands in Colorado, Wyoming, and Montana in the United States and in British Columbia and Alberta in Canada (Table 1, next page). In order to combine these diverse datasets into one source that allows for comparison and syntheses across larger geographic scales, the NPS funded the creation of the Five-Needle Pine Monitoring Database. This relational database, accessed through the SQL programming language, is currently housed on an NPS server.

Summary queries draw from all datasets and include many metrics useful in analysis and reporting, such as:

- Percent of living trees infected by white pine blister rust for each site
- Forest stand composition and density; regeneration
- Tree status (including mortality and declining health)
- Mountain pine beetle infestation by species, location, and year
- Summary metrics for individual trees

Potential Analyses

By combining datasets spanning the Rocky Mountains, analyses can be geographically expanded to potentially reveal larger scale patterns or trends. For example, Figure 1 shows the percentage of live limber pine, bristlecone pine, and whitebark pine tree populations that were infected with blister rust at time of sampling from southern Colorado up through Canada. With repeated measurements, we can explore trends in rust infection across the landscape. This dataset also helps address other questions, such as the status of forest regeneration or changing stand composition in the Rocky Mountains.

Future Directions

- Future data from ongoing USDA Forest Service or National Park Service monitoring can be included in the database. Field crews are collecting data from approximately 80 pre-existing sites in the Colorado, Wyoming, and Montana Rocky Mountains in 2016. These measurements, repeated 10 years after the initial survey, will be added in 2016–2017.
- The USDA Forest Service is developing the “Hi5” database that will summarize data from any source in the West. Users will be able to view summary statistics and spatial locations of plots, make queries to refine the data output, and facilitate the addition of data. When Hi5 is fully functional, a database tool can be created that uploads and summarizes contents of the Five-Needle Pine Monitoring Database into the Hi5 database.
- There may also be opportunities to collaborate with other entities collecting data on five-needle pine health, such as the National Park Service Greater Yellowstone Inventory and Monitoring Network.

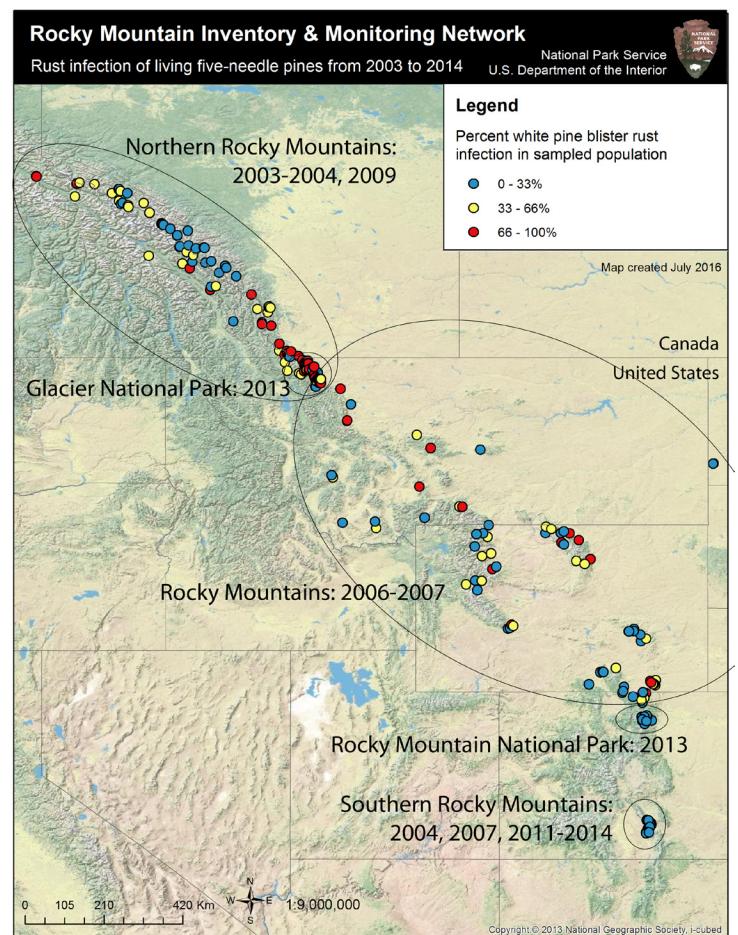


Figure 1. Proportion of sampled live five-needle pine populations infected by the invasive pathogen that causes white pine blister rust (*Cronartium ribicola*). Blue, yellow, and red indicate infection of <33%, 33-66%, and >66% of the sampled population, respectively. Species include whitebark pine (*Pinus albicaulis*), limber pine (*P. flexilis*), and bristlecone pine (*P. aristata*). Data were collected by various organizations 2003–2014. Data are provisional, pending peer review.

Table 1. Monitoring data integrated into the SQL database, from sources including USDA Forest Service (USFS), National Park Service’s Rocky Mountain Inventory and Monitoring Network (ROMN), Montana State University (MSU), Glacier National Park, and other Canadian sources.

Location (state)	Year	No. of sites	Sources
Southern Rocky Mountains (CO)	2004	28	USFS
Southern Rocky Mountains (CO)	2007	14 (revisits)	USFS
Southern Rocky Mountains (CO)	2011-2014	26 (revisits)	USFS, ROMN, MSU
Rocky Mountains (CO, WY, MT)	2006-2007	83	USFS
Rocky Mountain National Park (CO)	2013	10	USFS, ROMN, MSU
Glacier National Park (MT)	2013	12	USFS, ROMN, MSU
Northern Rocky Mountains (MT, Alberta, British Columbia)	2003-2004	181	Glacier National Park and other Canadian sources
Northern Rocky Mountains (MT, Alberta, British Columbia)	2009	4 (revisits)	Glacier National Park and other Canadian sources

More Information

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About ROMN

The Rocky Mountain Network is one of 32 vital signs monitoring networks across the National Park Service. It monitors status and trends in upland vegetation and soils, wetlands, streams, alpine vegetation, and other systems at six parks throughout Montana and Colorado.