

# Limber Pines of the Cathedral Spires

## A Unique Tree



**John Ball**, Professor, SDSU Extension Forestry Specialist and South Dakota Department of Agriculture and Natural Resources Forest Health Specialist

**Julie Leidholt**, Instructor, Department of Geography and Geospatial Sciences, South Dakota State University

**Amanda Morrison**, Forest Planner, South Dakota Department of Agriculture and Natural Resources

**Brandon Prehn**, Custer State Park Forester, South Dakota Game, Fish & Parks

July 2025

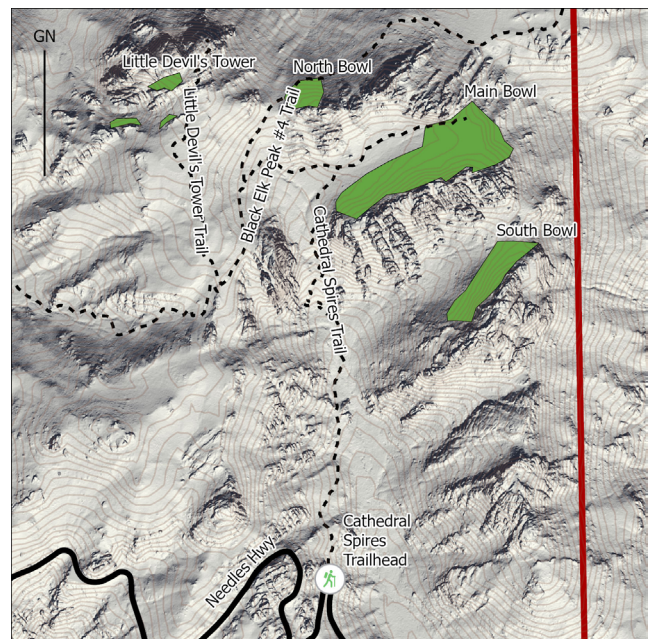
There is more to see along the Cathedral Spires trail in Custer State Park than the impressive, towering rock formations (Figure 1). Almost hidden among the ponderosa pine (*Pinus ponderosa*) trees along the slopes are limber pines (*Pinus flexilis*). The Cathedral Spires are a unique weathered granite formation, but they are also home to the rare, disjunct relict stands of limber pines. Together, they received a 1976 National Natural Landmark designation as the Cathedral Spires and Limber Pine Natural Area.



**Figure 1.** Many of the limber pines are along the Cathedral Spires trail.

There are four small limber pine stands scattered over about six acres of the Cathedral Spires-Little Devil's Tower area (Figure 2). These are one of three populations isolated from the contiguous range of limber pine which lines the Rocky Mountains from

Alberta to Arizona. The other two outliers are in western Nebraska and North Dakota.



**Figure 2.** Map of limber pine locations (green) in Custer State Park.

The North Dakota stand is believed to be of human origin, most likely as "pine nuts," edible seeds, brought by Native Americans from the Bighorns. The limber pines in South Dakota and Nebraska are native stands that reside as glacial refugia, relicts from the last glacial maximum.

The South Dakota limber pines are a genetically diverse population, with higher genetic diversity than the two other outlier populations. The limber pines in the Cathedral Spires are also essential in maintaining the diversity of wildlife in the Black Hills. The Clark’s nutcracker (*Nucifraga columbiana*), which feeds on the large, edible seeds in the cones, is found nowhere else in South Dakota.

The conservation of the Cathedral Spires limber pines is critical for maintaining the genetic diversity of the limber pine species and the ecological diversity of the Black Hills ecoregion. This bulletin covers the history of this unique species; its status and threats are also discussed.

### History of limber pine in the Black Hills

The first report of limber pine in the Black Hills was in 1914 by Professor Dilwyn Rogers, a biology professor at Augustana College in Sioux Falls, South Dakota. The report did not provide any details other than noting there was a small population of limber pines in the Cathedral Spires that were dying and would soon disappear.

Another survey was conducted more than a half century later by John Thilenius with the USDA Forest Service Experiment Station in Rapid City. He described the limber pines as scattered over a six-acre area on north-facing slopes in the Cathedral Spires. The largest tree was 17.9 inches DBH<sup>1</sup>. Many of the mature trees had dead tops. The mean age of the 32 trees he cored was 102 years. These trees had a mean diameter of 8.7 inches.

<sup>1</sup> DBH: Diameter of a tree at 4.5 feet above the ground. All diameters mentioned in this bulletin were taken at 4.5 feet above the ground on the trunks.

### Status

Despite the unique status of these trees, little had been done in the past fifty years to further investigate the number, size, and condition of the limber pines. Starting in 2020, another survey began through a collaboration between the South Dakota Department of Agriculture and Natural Resources and Game, Fish & Parks. Students and faculty from South Dakota State University were also instrumental in locating and collecting data (Figure 3). The objective was to update and expand the past surveys. Students and staff walked through the entire Cathedral Spires-Little Devil’s Tower area to locate every limber pine within Custer State Park. The location of each limber pine, from seedling to mature tree, was recorded using geographic information and global positioning systems along information on each tree’s age, size, and health (Figures 4-7) (Table 1).



**Figure 3.** Measuring a young limber pine near Little Devil’s Tower.

**Table 1.** Size and condition of the limber pines in the Cathedral Spires-Little Devil’s Tower area of Custer State Park.

Size	Healthy	Declining	Dying	Recently Dead	Old Dead
Seedling	60	4	0	0	-
Sapling	11	8	0	3	-
3.1-6.0	34	11	8	7	1
6.1 to 9.0	19	8	3	3	2
9.1 to 12.0	6	1	5	5	4
12.1-15.0	1	3	2	4	3
Healthy: less than 5% canopy with dead branches. Declining: 6 to 50% of the canopy with dieback of branches. Dying: more than 50% of the canopy with dieback of branches. Recently dead: within the past 5 years, fine twigs and bark are still attached. Old dead: dead longer than 5 years, fine twigs and bark shed from tree.					





**Figure 4.** A seedling limber pine in the North Bowl



**Figure 5.** A sapling limber pine near Little Devil's Tower.



**Figure 6.** A mature limber pine along the Cathedral Spires in the Main Bowl.



**Figure 7.** A mature limber pine near Little Devil's Tower.



Between 2020 and 2025, 185 limber pines were found in the Cathedral Spires-Little Devil's Tower of Custer State Park (Table 2). These trees are distributed across four isolated populations. Three populations within the Cathedral Spires area have been designated as Main Bowl, North Bowl, and South Bowl. The fourth population is south of Little Devil's Tower.

The highest concentration of limber pines occurs along the north-facing slopes of the Main Bowl, where 137 limber pines have been documented. These trees are located along the Cathedral Spires trail between the fork with the connecting trail to Black Elk Trail #4 and its terminus.

Four of these trees are located on the west side of the Cathedral Spires trail near the trail end. The largest recorded limber pine is one of these trees. It has a diameter of 14.4 inches and is more than one hundred-years-old. The remaining 133 trees are east of the trail, distributed along the base of the Spires. Seedlings and saplings predominately occupy the lower slopes and more open areas, while the mature trees are concentrated closer to the base of the rock formation.

The Main Bowl also supports the highest density of limber pine seedlings, a trend attributed to the loss of the ponderosa pine overstory ten years ago. Limber pine is not shade tolerant and exhibits limited regeneration under denser canopies. Increased sunlight following the removal of the ponderosa pine overstory has facilitated new seedling establishment. Sapling numbers remain comparatively low, likely a reflection of earlier unfavorable conditions for germination and early growth.

Along the slope is the oldest limber pine recorded during the survey. It is 194 years old and 8.8 inches in diameter. There are another twelve trees along this slope that are more than a century old. There may be older trees, but the center of many mature limber pines is hollow, so their age is unknown.

There are 20 limber pines along the north-facing slopes of the South Bowl. These trees are well off the Cathedral Spires trail and are difficult to reach. The larger pines are found growing about 50 to 100 feet away from the base of the rock face while the seedlings and sapling are found growing nearer the base. The largest tree along the South Bowl is 9.5 inches in diameter and 90 years old.

There are 13 limber pines along the north-facing slopes of the North Bowl. These trees are along the Black Elk trail #4 about 1,500 feet north of the where this trail meets the connecting trail to the Cathedral Spires. One of the trees is 13.5 inches in diameter. Its age could not be determined due to the center of the trunk being hollow.

The Little Devil's Tower limber pines are scattered along the south side of the Little Devil's Tower Spur trail. The trees begin appearing about 1,200 feet from the cutoff with Black Elk Trail #4 and end just south of where the trail begins its steep ascent to the top of Little Devil's Tower. The area contains 14 limber pines. These are the easiest limber trees to identify and locate in Custer State Park as there are fewer ponderosa pines in the vicinity compared to the other stands. The second oldest limber pine found in Custer State Park is 190 years old, 10.4 inches in diameter, and is found here.

### Threats to the limber pines in the Black Hills

The largest population of limber pines in South Dakota is in the Cathedral Spires area of Custer State Park. There is a much smaller population of about 24 trees, mostly seedlings and saplings near Black Elk peak. There were more mature trees near Black Elk in the 2000s, but these were killed during the mountain pine beetle (*Dendroctonus ponderosae*) epidemic that occurred in the Black Hills between 1997 and 2016. This highlights the uniqueness of the limber pine in Custer State Park and the importance of an initiative-

**Table 2.** Diameter distribution of limber pines in the Cathedral Spires-Little Devil's Tower area of Custer State Park by site.

Site	Seedling	Sapling	3.0 to 6.0 inches	6.1 to 9.0 inches	9.1 to 12.0 inches	12.1 to 15.0 inches
Main bowl	53	13	35	21	10	5
South bowl	4	2	8	5	1	0
North bowl	5	1	2	3	1	1
Little Devil's tower	2	3	7	1	1	0
Seedling: less than 4.5 feet tall Saplings: taller than 4.5 feet but less than 3.0 inches in diameter. All diameters measured at 4.5 feet above the ground.						



taking conservation strategy to address the threats to their survival.

Most trees less than 9 inches in diameter in the Cathedral Spires-Little Devil's Tower area were rated as healthy in the survey. The trees greater than 9 inches in diameter were mostly declining, dying or dead. Two of the dead trees had been killed by mountain pine beetle back in the early 2010s. The decline of the saplings and trees less than 6 inches in diameter is mostly due to infection by white pine blister rust. The cause of the decline or death of the other limber pines is unknown.

#### White pine blister rust

White pine blister rust is a disease caused by the fungus *Cronartium ribicola*. It is the greatest threat to limber pines in the Interior West. The fungal disease originated in Asia and affects all North American five-needled pines including limber pine. Infections from this disease are often fatal to limber pines. White pine blister rust was first found in the limber pines at the Cathedral Spires in 1992. Approximately 25% of the limber pines 3 inches in diameter or greater have branch or stem cankers from the disease (Figure 8).



**Figure 8.** White pine blister rust canker on limber pine near Cathedral Spires.

There were several young trees that had already died from the disease when the survey started in 2020. Sanitation pruning – when infected branches are pruned out before the disease reaches the trunk – has been conducted every spring to slow the spread of the disease in the remaining trees. The infection is mostly found in saplings and mature trees less than 6 inches in diameter.

#### Mountain pine beetle

Limber pine is a preferred host of the mountain pine beetle, along with ponderosa pine. This insect was responsible for the loss of more than 16 million ponderosa pines in the Black Hills between 1996 and 2016. About half of the ponderosa pines in the Cathedral Spires area were killed by the beetle between 2006 and 2014.

The limber pines in the Cathedral Spires-Little Devil's Tower area were protected from the beetle by bark applications of insecticides from 2006 to 2014. Verbenone patches – a pheromone to repel attacking beetles – were placed on the trunks of trees larger than 4 inches in diameter during this same period (Figure 9). Only a few limber pines were lost to mountain pine beetles but unfortunately the large tree (>17" DBH) identified by Rogers and Thilenius was one of them.



**Figure 9.** Verbenone pouch on limber pine.

#### Climate

The changing climate may also contribute to the decline of trees and reduce seedling recruitment (defined as seedling germination, survival and growth). The past twenty-five years have experienced slight warmer mean July temperatures – the warmest month – than the previous three decades (1971-2000). This same period has also been slightly drier during the critical three

months – April, May, and June – for tree growth and pine seed germination. Warmer summer temperatures combined with lower precipitation can induce stress in the trees, making them more vulnerable to insects and pathogens.

The limber pines along the slopes and trails of Cathedral Spires and Little Devil's Tower are a unique feature of this landscape, one found nowhere else in the Black Hills. Take a moment during your hikes to look at the pines along the way, you might just come across a limber pine. But take only pictures, not needles or cones, as we want to conserve this special plant of the Black Hills flora.

### How to separate limber pine from ponderosa pine

There are two pine species in the Cathedral Spires, ponderosa pine (*Pinus ponderosa*) and limber pine. There is one other evergreen tree species in the Spires, the white spruce (*Picea glauca*). The spruce can be easily separated from the pines as spruce has single needles rather than needles in fascicles (bundles).

Ponderosa pine has needles in fascicles of 2s and 3s. The needles are about 7 inches long and yellow green to gray green (Figure 10). Limber pine has needles in fascicles of 5. The needles are about 2.5 inches long and dark green. Limber pine needles are clustered at the end of branches (Figure 11).



**Figure 10.** Ponderosa pine foliage



**Figure 11.** Limber pine foliage

The cones for ponderosa pine are 3 to 6 inches long, ovoid, with scales having a small prickly (umbo) at their tips. Limber pine produces cones about 3 to 10 inches long, cylindrical, with scales thicken at the tips. The seeds are large and often wingless. The seeds are rarely seen as birds and rodents quickly take them (Figure 12).



**Figure 12.** Limber pine (left) and ponderosa pine (right) cones

### Acknowledgement

We appreciate the financial support for this project by Neiman Enterprises, Inc, Hulett, WY



**SOUTH DAKOTA STATE  
UNIVERSITY EXTENSION**

**SOUTH DAKOTA STATE UNIVERSITY®**  
**AGRONOMY, HORTICULTURE AND PLANT SCIENCE DEPARTMENT**

SDSU Extension is an equal opportunity provider and employer in accordance with the nondiscrimination policies of South Dakota State University, the South Dakota Board of Regents and the United States Department of Agriculture.

Learn more at [extension.sdstate.edu](https://extension.sdstate.edu).

© 2025, South Dakota Board of Regents

P-00346