
Report RCSC-18-10

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Limber Pine Planting in the Black Hills National Forest

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In the Black Hills of South Dakota, limber pine (*Pinus flexilis*) is a species of local concern (SOLC), consisting of two very-small populations in the Black Elk Wilderness of the Black Hills National Forest and Custer State Park. Recently many of these pines were killed by mountain pine beetle (*Dendroctonus ponderosae*, MPB) and an invasive-exotic pathogen, white pine blister rust (*Cronartium ribicola*, WPBR). Cones were collected from these areas and sent to Bessey Nursery, USDA Forest Service, Halsey, NE. Container grown seedlings were produced from the seed and the seedlings were planted in the Black Hills National Forest.

Successful natural regeneration on the forest is uncertain. The current low regeneration is likely due to: 1) limber pine tree mortality caused by MPB and WPBR resulting in reduced seed (most of the larger trees were killed by MPB); 2) current and future seedling/sapling mortality caused by WPBR (they will never develop into seed-bearing trees); 3) mortality caused by mountain goats and other browsers; 4) the current population consists of mostly seedlings and saplings that produce no or very-few seed; 5) a high percentage of seed consumption by birds, squirrels, etc. (due to the low number of seed); 6) the bare rock substrate which prevents seedling establishment; and 7) many of the existing seedlings/saplings will never develop into seed-bearing trees since they are growing in very-small rock cracks. Therefore, limber pine may not continue in this area.

The goal of the *2017 and 2018 Black Hills National Forest Limber Pine Restoration Project* is to restore this SOLC that has undergone recent mortality due to beetles and an invasive pathogen. The Forest Plan Objectives (FPO) include:

FPO-221: conserve or enhance habitat for R2 sensitive species and SOLC ...

And

FPO-233: collect seeds ... from R2 sensitive and SOLC plants. Retain and/or increase material at a local and willing long-term repository to provide local genetic material for potential propagation and reintroduction efforts in the event existing occurrences are lost. As material is available, reintroduce R2 sensitive or SOLC plants where population occurrences are known to have been lost or in areas where it is determined that specific micro-site conditions for successful introduction efforts likely exist. Initiate the project within 5 years or as seed collection opportunities allow.



On May 4, 2017, 56 two-year-old limber pine seedlings were planted at 4 locations just off trail #2 in the Norbeck Preserve, Black Hills National Forest (**Figure 1**, locations 1 to 4). On May 2, 2018, 220 two-year-old limber pine seedlings were planted at the same and 3 additional planting locations (**Figure 1**, locations 1 to 7). In 2020/2021, 100+ additional seedlings will be planted from seed collected at Custer State Park. This will increase the genetic diversity of the new limber pine population. The Custer State Park seeds were collected on August 23, 2018. The final goal is 376+ planted limber pine.

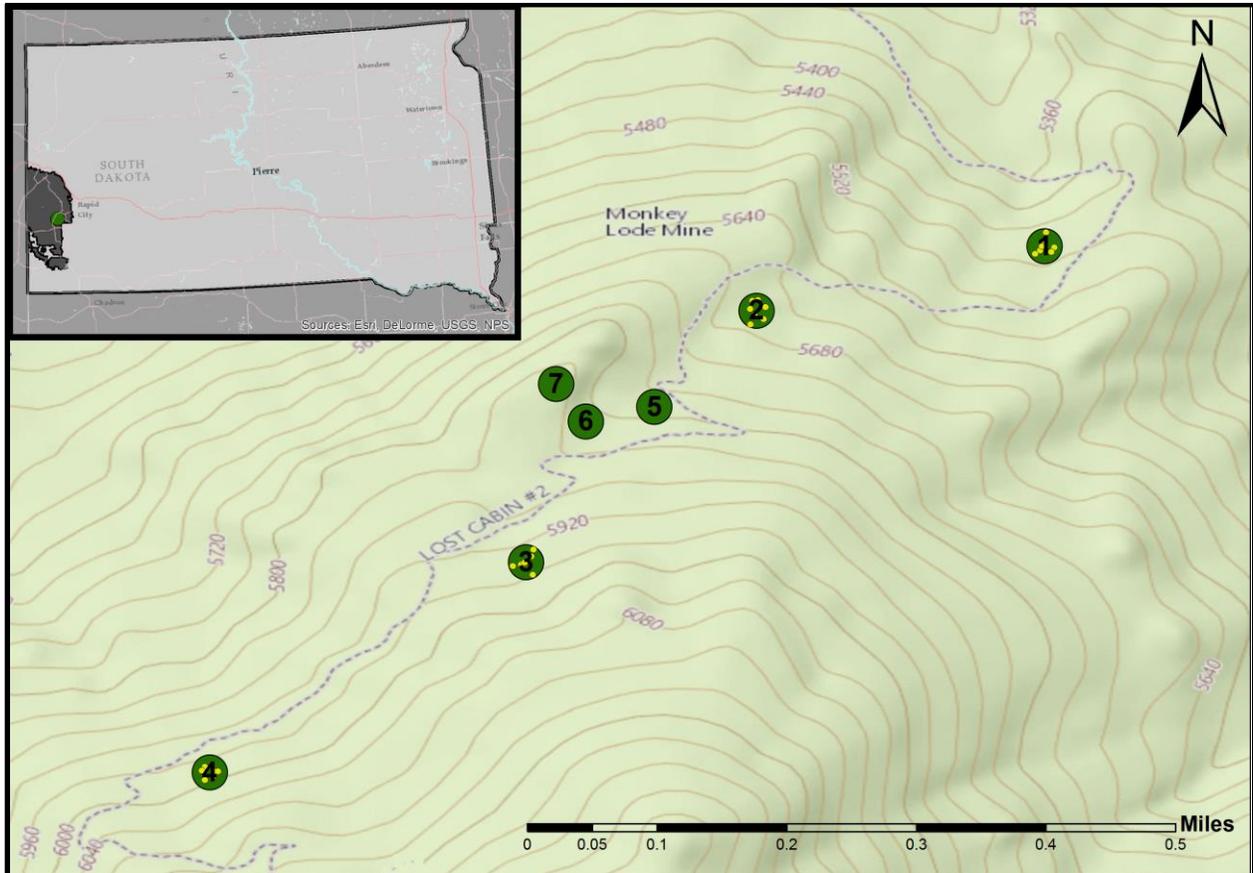


Figure 1. Limber pine planting locations in the Black Hills National Forest. Seedlings were planted at locations 1 to 4 in 2017; and at all 7 locations in 2018. These seedlings are being monitored at stakes (yellow dots), with a few additional non-staked trees at location 7.

Several USDA Forest Service employees and volunteers assisted with the plantings in 2017 including: Cheryl Mayer, Kelly Warnke, Steve Hirtzel, Brad Phillips, and Ken Marchand (Black Hills National Forest); Jim Blodgett (Region 2 Forest Health); Jordan Purintun and Shelly Deisch (South Dakota Department of Game, Fish, and Parks); and Keith Burden (private volunteer). In 2018 tree planters included: Cheryl Mayer, Steve Hirtzel, Jim Blodgett, Jordan Purintun, Keith Burden, and Marcus Warnke (South Dakota Department of Agriculture, Forest Health) (**Figure 2**).



Figure 2. Some of the USDA Forest Service employees and volunteers who assisted with limber pine planting in the Black Hills National Forest.

Planting sites were selected near the original limber pine population. At this time the Forest chose not to reintroduce this SOLC into the original population since the site is in a designated wilderness. Areas chosen had extensive ponderosa pine (*Pinus ponderosa*) mortality from MPB (*i.e.*, reduced competing tree vegetation and an open overstory canopy), sufficient soil to support young transplants, a northerly aspect to retain moisture, and were close to a trail (ease of access). Most of the dead ponderosa pine have fallen. Small groups of 3 or 4 seedlings were planted on the north or north-west side of stumps, logs, or rocks (*i.e.*, "nurse" objects) to protect the seedlings¹. Small live woody regeneration (mostly ponderosa pine) was removed within 12 ft of plantings

¹ Casper, A. M. A., Jacobi, W. R., Schoettle, A. W., Burns, K. S. 2016. Restoration planting options for limber pine (*Pinus flexilis* James) in the Southern Rocky Mountains. *J. Torrey Bot. Soc.* 143: 21-37.

to reduce competition for light and water. In 2017, ponderosa pine bark was placed around seedlings to inhibit competing vegetation and each seedling was given 1 to 1.5 liters of water after planting. In 2018, given the number of seedlings planted, bark placement and watering were not done. Vexar tubes (*i.e.*, animal protectors) were staked around all seedlings, except at location 7, to protect them from herbivory.

For long-term monitoring, 26 groups of four seedlings were planted in cardinal directions around an orange plastic stake (1.5 to 2 feet out from the stakes); year and GPS location were recorded at each stake (**Figure 3**). Stakes were approximately 12 to 25 yards apart. Long-term monitoring will be conducted each spring and will include assessments of mortality, cause of mortality, damages, and occasionally height or diameter measurements.

All seedlings were planted around stakes in 2017 (14 of the 26 four-seedling groups). The seedlings planted around stakes in 2018 (12 of the 26 four-seedling groups) will be monitored as representative of the 2018 planting. In addition to the seedlings planted around stakes in 2018, 9 to 24 additional seedlings were planted at locations 1 to 4. More seedlings were planted at locations 1 and 3 given the larger, favorable planting areas. These additional seedlings were planted in groups of 3, with no center stake, and GPS locations were not recorded (*i.e.*, not included with the monitoring trees). These seedlings were otherwise planted/treated the same, including the removal of surrounding vegetation. Approximately 40 seedlings were planted at each of the newer 2018 locations (location 5, 6, and 7). Locations 5 and 6 are similar to the other planting sites. However, location 7 is on a rocky ridge top with less soil where stakes and vexar tubes could not be installed. The staked seedlings are not representative for location 7. Therefore, GPS locations were recorded for 5 of the three-seedling groups at location 7 for long-term monitoring. This results in a total of 119 of the 276 planted seedlings for long-term monitoring.



Figure 3. Examples of limber pine planted in the Black Hills National Forest. From left to right: a group of 4 seedlings with animal protectors around an orange plastic stake and bark to inhibit competing vegetation, a group of 4 seedlings with animal protectors but no bark, a single seedling with animal protector, and a single seedling with the animal protector removed.

In 2017, seedlings from four known mother trees (T#) were planted. They included 23 seedlings from T2, 1 seedling from T3, 19 seedlings from T4, and 13 seedlings from T10². Trees were planted in magnetic cardinal directions to identify mother trees (14 stakes; all 56 seedlings). In 2017, stakes were labelled A, B, or C and the following patterns were used (**Figure 4**). Extra seedlings from T2 (13) and T4 (6) were planted at the random (R) cardinal directions. In 2018, 63 of the 220 seedlings were selected for monitoring. These seedlings were grown from a bulk seed collection (*i.e.*, the specific mother tree was unknown). Therefore, a random (R) design (like the "C Stake" pattern in Figure 3) was used for all stakes, but stakes were labeled with "D" to differentiate year.



Figure 4. Planting patterns used in 2017 in the Black Hills National Forest.

On June 27, 2018 seedlings were examined for mortality, cause of mortality, and other damages. All seedlings planted in 2018 were healthy. Mortality and damage were observed on seedlings planted in 2017. For seedlings planted in 2017 survival was high (98%). However, minor amounts of mortality resulting from "damping-off" disease (2 seedlings) and rodent damage (1 seedling) occurred. One seedling was heavily browsed but still alive, and one seedling had about 25% needle mortality. Seven of the animal protectors were slanted or out of the ground. It's unclear if this was caused by wind or animals, but only the one seedling was browsed. Protectors were repositioned. The large pieces of ponderosa pine bark used in 2017 inhibited competing vegetation.

² Blodgett, J. T. 2014. Harney Peak Limber Pine-2014. USDA For. Serv., Rocky Mountain Region, For. Health Mgt., Rpt. RCSC-03-15.