US Forest Service
Rocky Mountain Region

Forest Health Protection
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Rapid City Service Center
8221 Mt. Rushmore Rd.
Rapid City, SD 57702

Report RCSC-21-03

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Needle-Blight Disease on Lodgepole Pine in the Bighorn National Forest

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Foliage disease symptoms were reported on lodgepole pines (*Pinus contorta*) on August 28, 2019 by Matt Rathbone (Timber Program Manager, Bighorn National Forest) on the Powder River Ranger District of the Bighorn National Forest (Johnson County, Wyoming) just off Crazy Woman Road. Forest Health Protection did a quick check in September 2019. The site was revisited July 16, 2020 for a quick assessment. On August 27, 2020, a survey was conducted with the objectives to identify the pathogen, assess disease extent, and quantify damage severity.

Methods

To identify the pathogen, needle samples were collected from symptomatic trees (≥3 in DBH), saplings (>4.5 ft tall and <3 in DBH), and seedlings (>0.5 in tall and ≤4.5 ft tall). For the tree size class, needles were collected from larger trees (>6 in DBH). Samples were sent to Jessa Ata (Graduate Student) and Jane Stewart (Assistant Professor), Dept. of Agricultural Biology, Colorado State University, Fort Collins, CO for molecular analysis (ITS with species-specific primers).

The survey consisted of 17 plots (1/20 acre) established along Crazy Woman Road (**Figure 1**) where symptoms were observed. Notes were also taken regarding where symptoms were observed to delineate the disease extent in July and August 2020. Data recorded included latitude, longitude, altitude, tree species, tree size class (tree, sapling, seedling), DBH for trees (regeneration was counted), percentage of live needles present (100% = a full-live crown, 0% = no or a dead crown), and the distribution of symptoms within the crown (if needle loss, dead, or discolored needles were more common in the top, bottom, or evenly distributed in the crown).

Results and Discussion

Pathogen identification. Samples were identified (by Jessa Ata). Based on the August 2020 needle samples, molecular results suggest a *Mycosphaerella* species is the likely pathogen. Red-band needle-blight is common and damaging in WY; caused by *Mycosphaerella* species. However, a *Lophodermium* species was detected in the July 2020 and September 2019 samples. It is unclear if the *Lophodermium* species is a contributing pathogen, an endophyte (growing in live needles without causing disease), or saprophyte (growing in dead needles).

General description of the disease. The disease caused extensive browning and needle loss of lodgepole pines, affecting trees from seedling stage to maturity (**Figure**

2). However, other pines: ponderosa pine (*P. ponderosa*) and limber pine (*P. flexilis*), and other conifer species: Engelman spruce (*Picea engelmannii*), Douglas-fir (Pseudotsuga *menziesii*), and other species in the area were not affected by this disease.

Mycosphaerella pini causes red-band needle-blight (also called Dothistroma needle-blight). The asexual stage of *M. pini is Dothistroma septosporum*. Another related species is *Dothistroma pini* with no sexual stage. Needle-blights cause conifer needles to turn brown and they may shed needles prematurely. Symptoms first appear on older needles in early spring as yellow or tan bands or spots changing to red or brown bands. Needles often discolor from tips first. By mid- to late-spring infected needles become necrotic resulting in red, orange-red, or brown needles. In late summer premature needle shedding can occurs. Fruiting bodies (spore producing structures) form on needle surfaces before or after infected needles are shed.

Healthy lodgepole pine branches typically retain at least 3 or even 4-years of needles (**Figure 3**). Trees were just starting to shed 4th-year needles in other areas of the forest on August 27, 2020. Many of the branches with needle-blight disease had only current-year needles, less than 33% needle retention was common, and many of the retained needles were dead. In recently infected needles, needle tips ranged from brown to tan with green needles bases (**Figure 3**) Many of the older needles had fallen; typical of foliage diseases on lodgepole pine.

Several things might look similar to this needle-blight disease including other needle-blight diseases and needlecast diseases. The normal loss of the 4th year needles occurs every fall but may be more pronounced some years (such as in 2020). Other symptoms that might be confused with needle-blight diseases includes salt-stress which is common along highways in the Bighorn National Forest. Winter desiccation has also been common in recent years.

Survey results (disease extent and damage severity). The mean plot location was latitude 44.169814, longitude -106.89707, and altitude 7,390 ft. Approximately 123 acres of lodgepole pine were affected (**Figure 1**). Approximately 36 acres were severely affected ("disease center"). Symptoms were present in all plots but were more pronounced within the disease center where less than one-year of needle retention was common. Disease severity clearly decreased away from the disease center (target-like pattern). Trees outside the surveyed area had no or very-minor needle-blight symptoms. This target-like pattern suggests the disease started within the disease center.

For the tree size class, lodgepole pine made up 96% of the composition with an average lodgepole pine DBH of 8.8 inches and 222 lodgepole pines per acre. For saplings, lodgepole pine made up 61% of the composition with 47 lodgepole pine per acre. For seedlings, lodgepole pine made up 32% of the composition with 140 lodgepole pine per acre. For the tree size class, plots had similar composition (**Figure**

4) within and outside the disease center. For regeneration (saplings and seedlings) lodgepole pine composition was lower at the disease center than outside the disease center.

Needle-blight symptoms were common in all size classes but were more severe in regeneration (**Figure 5**). For trees, the mean percentage of crown present was 55% (40% at the disease center, 80% outside the disease center). For saplings, the mean percentage of crown present was 46% (36% at the disease center, 77% outside the disease center). For seedlings, the mean percentage of crown present was 32% (23% at the disease center, 51% outside the disease center). Plots in the disease center had more disease and less lodgepole pine regeneration. This suggests the disease is causing mortality in lodgepole pine regeneration.

For many foliage diseases including red-band needle-blight, symptoms are more prevalent in the lower crown. However, in this area, symptoms were mostly evenly distributed throughout the crown in all tree size classes (**Figure 6**). Symptoms were evenly distributed in the crown in 89% of the trees, 89% of the saplings, and 99% of the seedlings.

We hope to isolate the pathogen in pure culture to test for pathogenicity. If this can be accomplished, we plan to confirm the pathogen caused the observed damage using Koch's postulates with molecularly confirmed isolates.

Management Recommendations

Disease control for most foliage diseases is often unnecessary in non-commercial forest situations. Damage can vary from year-to-year from severe and widespread to no apparent disease the next year. Growth losses are usually temporary and large-tree mortality seldom occurs from needle-blight diseases. Mortality is more common in regeneration. However, these diseases can stress trees resulting in growth loss and can make trees more susceptible to other diseases and some insects. The high incidence of this disease maybe be due to unusually wet weather in 2019, combined with the valley-stream location. High humidity is required for infection.

Needle-blight diseases tend to be more common in dense stands, since dense stands often have high humidity. Needle-blight diseases can also flourish when conifers are in drought stressed conditions, which can occur in crowded stands. Therefore, stand thinning might reduce impacts from this disease. Favoring non-host species during thinning would further reduce losses from this disease. Thinning would speed drying of needles, thus reducing infections. Intra- and inter-species competition for water would also be reduced from thinning. However, thinning is not recommended for disease control unless needle-blight diseases are severe for consecutive years (3+ years).

Fungicide applications would not be practical. Such applications are only used for high-valued ornamentals.

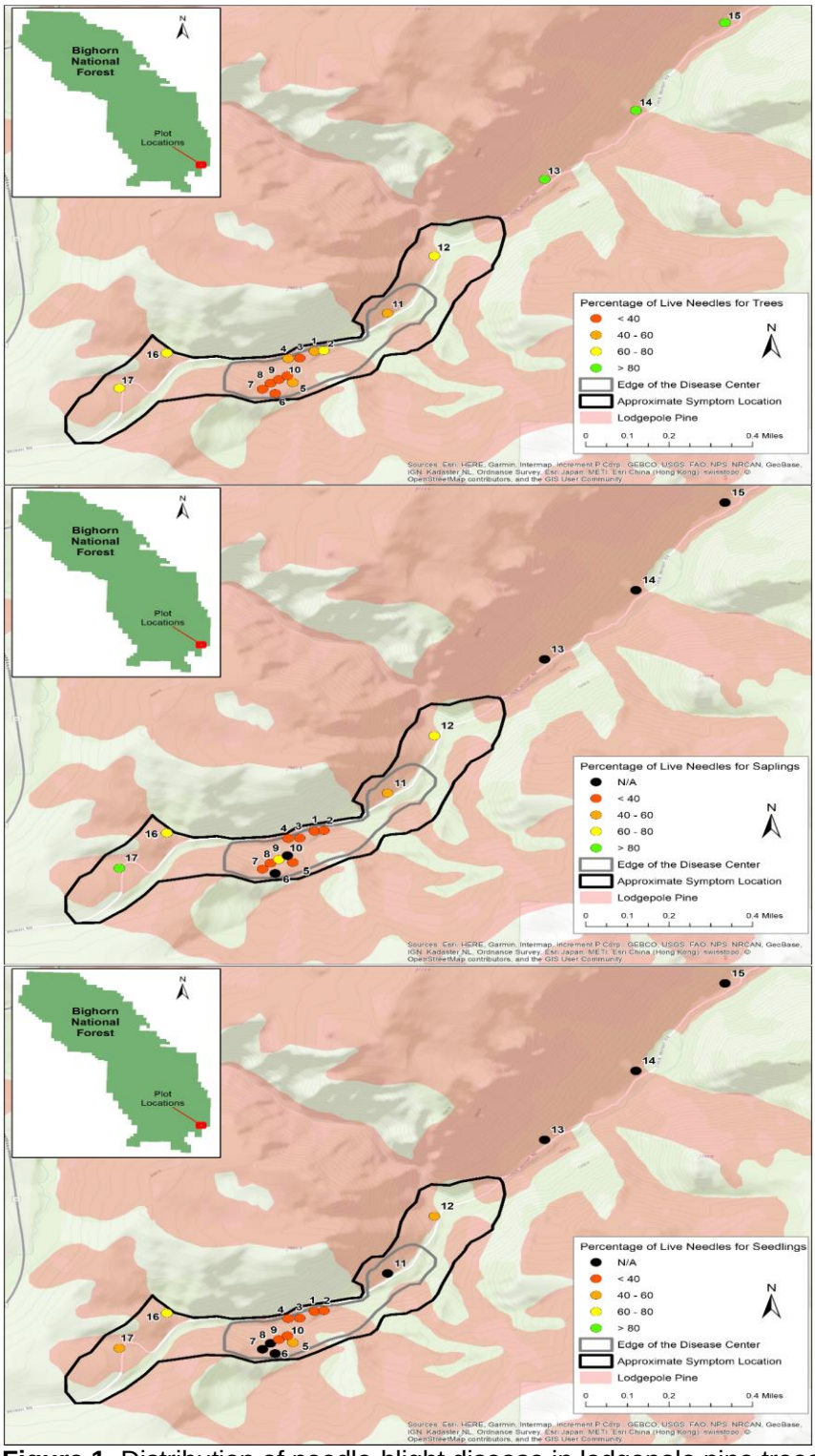

Figure 1. Distribution of needle-blight disease in lodgepole pine trees, saplings, and seedlings in the Bighorn National Forest, Wyoming. Symptoms were observed inside the black polygon. The gray polygons indicate where symptoms were most pronounced (disease center). N/A = no lodgepole pine regeneration was observed in the plot.

Figure 2. Symptoms of needle-blight disease in lodgepole pine trees (**left**), a sapling (**middle**), and a seedling (**right**) in the Bighorn National Forest.

Figure 3. From left to right: healthy lodgepole pine trees, saplings, and a seedling from an uninfected area of the Bighorn National Forest; and an uninfected branch and branch with needle-blight disease. Healthy lodgepole pine branches have at least 3-years of green needles.

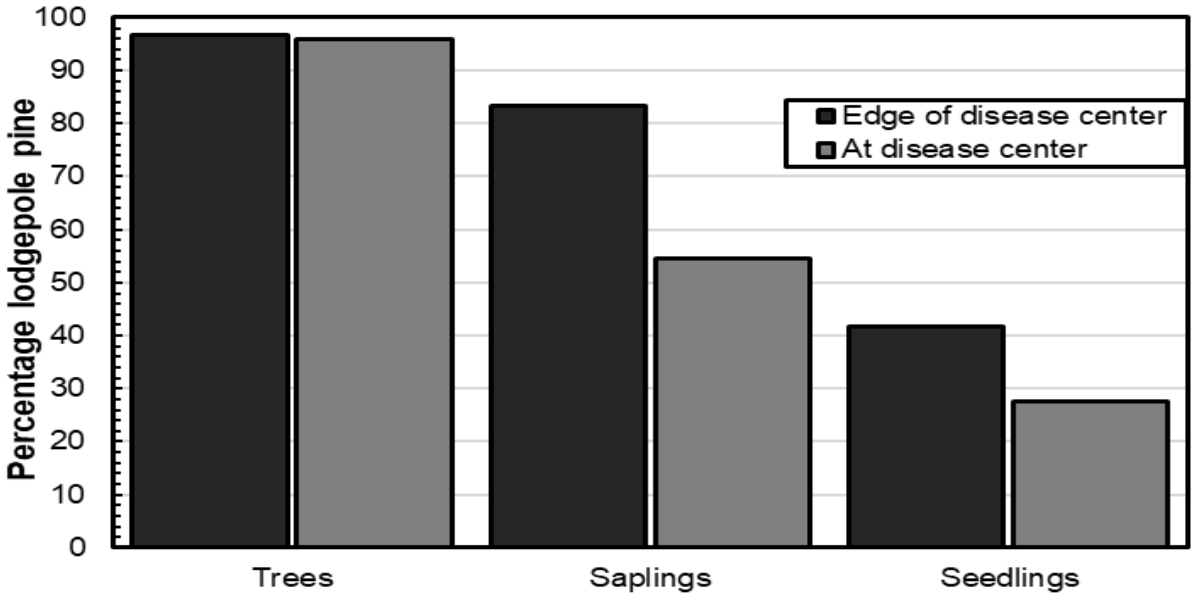

Figure 4. Mean percentage of lodgepole pine composition in stands by tree size class and proximity to the disease center for the needle-blight disease survey of lodgepole pine in the Bighorn National Forest.

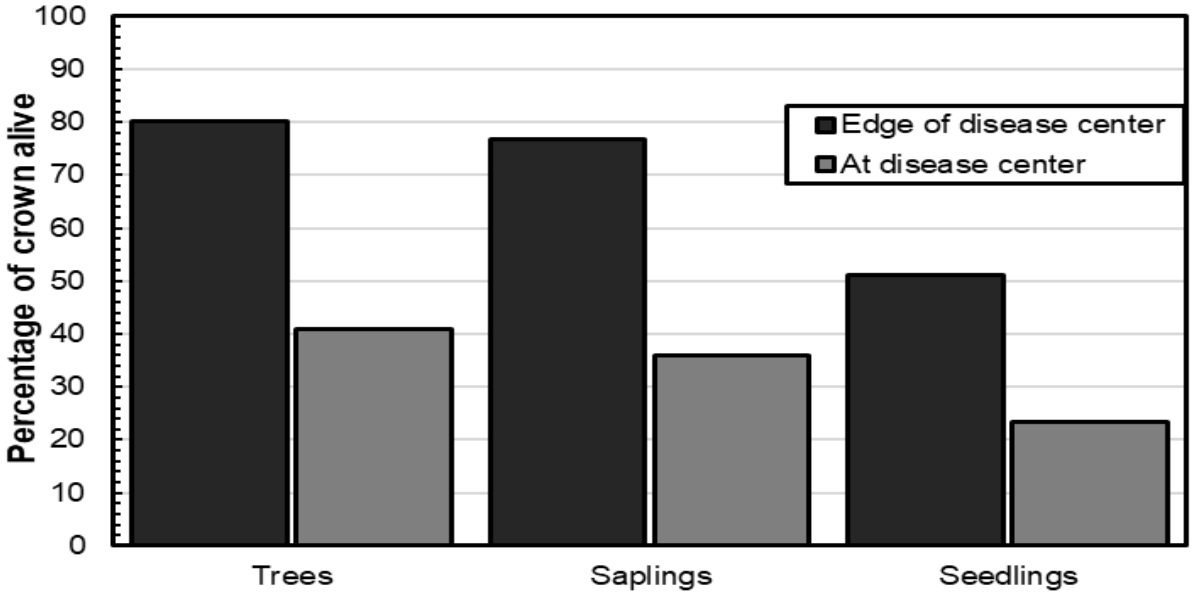

Figure 5. Mean percentage of the crown alive by tree size class and proximity to the disease center for the needle-blight disease survey of lodgepole pine in the Bighorn National Forest. 100% of the crown alive would indicate no observed disease.

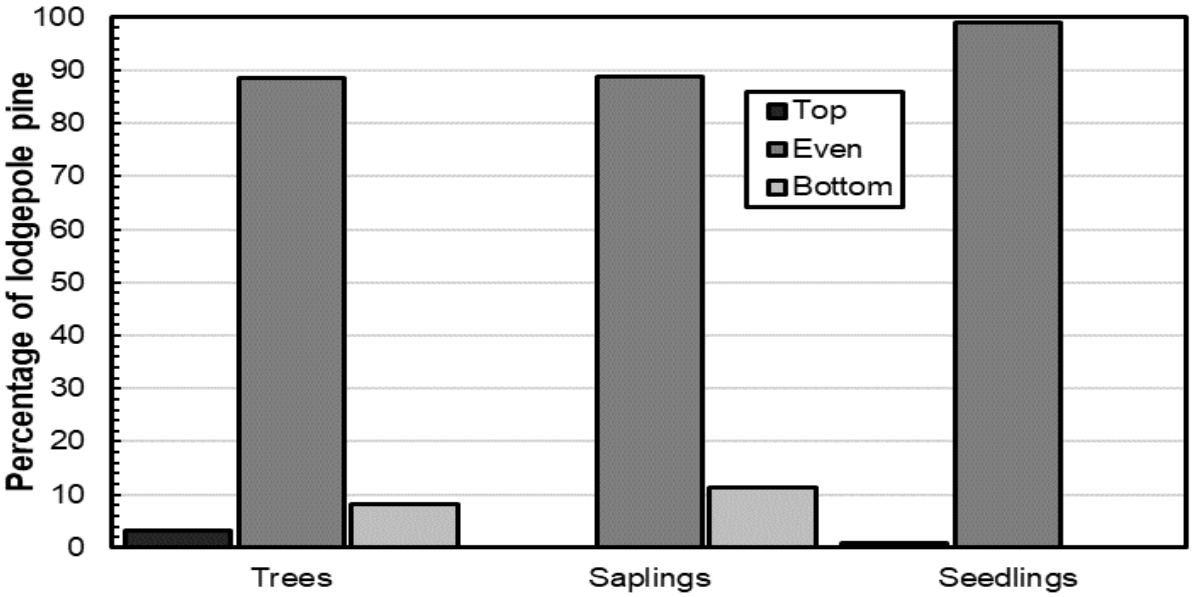

Figure 6. Mean percentage of lodgepole pine with symptoms in the upper or lower crown, or evenly distributed in the crown by tree size class for the needle-blight disease survey of lodgepole pine in the Bighorn National Forest.