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Plot Survey of Dwarf Mistletoe and Comandra Blister Rust Diseases in Lodgepole Pine on the Shoshone National Forest: 2018

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Abstract

In 2018, a plot survey of dwarf mistletoe and comandra blister rust diseases was conducted in lodgepole pine stands on the Shoshone National Forest. Variable-radius plots (n=60) were installed at two-mile intervals along roads to evaluate lodgepole pine for these diseases. Plot survey results estimate 47% of lodgepole pine trees and 70% of the plots near roads were infected with dwarf mistletoe; 35% of the trees and 80% of the plots were infected with comandra blister rust; and 21% of the trees and 60% of the plots had both diseases. Emphasis on suppression work for these two diseases will result in reductions in disease incidences and promote improved forest health.

Introduction

Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) is one of the most important diseases of lodgepole pine (*Pinus contorta*) in the region. It is a parasitic plant that requires water, mineral, and carbon nutrients from its hosts. This stresses host trees causing reductions in both growth and cone/seed production. Seeds are explosively-released and typically fly < 33 ft. Long-distance seed dispersal by birds can occur, but is uncommon. Infections of young host tissues result in stimulation of dormant host buds which causes abnormal-dense clumps of branches called “brooms” or “witches’ brooms.” Other symptoms include branch swellings, host dieback from the top down, and eventual tree mortality. Trees can survive infection for decades. However, in areas with extensive infection, tree mortality can be three to four times higher than in uninfected areas (Hawksworth and Wiens 1996).

Comandra blister rust (*Cronartium comandrae*) is also one of the more important diseases of lodgepole pine in the region. This rust disease requires two hosts to complete its life cycle. The incidence of disease is correlated with the presence of its alternate host; bastard toadflax. Long periods of high humidity in late summer or fall are required for infection of lodgepole pine. Therefore, rust epidemics often follow years with a long-moist late growing season. The disease causes stem deformities, growth reduction, and cankers that girdle branches and/or stems resulting in top-kill and tree mortality. Trees may survive several decades with spiked-tops. However, top-kill can

cause reductions in both growth and cone/seed production. Heavy stand infections can result in high volume losses by affecting tree form, lumber quality, and growth rate.

Plot survey methods were suggested as more accurate than road-side surveys due to ground-level inspections (Blodgett 2015, Harris 2003) since lodgepole pines growing near roads or stand edges can have "stimulation brooms." Stimulation brooms are non-mistletoe brooms that can be confused with brooms induced by dwarf mistletoe and are common in lodgepole pine (Hawksworth 1961, Hawksworth and Johnson 1989). Thus, there may be a tendency to overrate dwarf mistletoe incidence during road-side survey.

We found no past forest-wide survey of these diseases on the Shoshone National Forest (NF). Johnson et al. (1979) assessed growth loss and mortality caused by dwarf mistletoe in the Rocky Mountain Region. Their findings were used to promote dwarf mistletoe suppression work on regional forests. Dwarf mistletoe suppression work has occurred on the Shoshone NF in past years. The objectives of this survey were to evaluate incidence and severity of dwarf mistletoe and comandra blister rust diseases on the Shoshone NF.

Methods

In 2018, plots were evaluated at two-mile intervals along roads near lodgepole pine stands in the Shoshone NF. Plots were installed 2 chains or more into stands perpendicular to roads every 2 miles. Variable-radius plots with 20 basal area factor were used to delineate trees as saplings (dbh < 4 in), poles (4 in ≥ dbh < 9 in), or mature trees (dbh ≥ 9 in). A 1/100 acre, fixed-radius plot at plot center was used to evaluate frequencies of seedlings by species (height ≤ 4.5 feet).

Data collected for live trees in plots included species, dbh, and disease rating. The six-level dwarf mistletoe disease rating system was used (Hawksworth 1977). Disease severity ratings for comandra blister rust were: 0 for no infection, 1 for a branch canker, 2 for a stem canker, 3 for a girdling stem canker causing top kill, and 4 for rust-caused mortality. Plot dwarf mistletoe incidences and plot comandra blister rust incidences were calculated as percent of plots with the diseases. Tree dwarf mistletoe incidences and tree comandra blister rust incidences were calculated as percent of trees within plots with the diseases. Frequencies of other damage agents were recorded.

Results and Discussion

We surveyed 60 lodgepole pine plots along 140 miles of roads. Plots contained 727 trees (all sizes); approximately 65% were lodgepole pine (**Table 1**); the average dbh of lodgepole pine in variable-radius plots was 8.8 inches. Lodgepole pine made up 94% of the mature and pole-sized trees; with 1.9% limber pine, 1.6% Engelmann spruce and subalpine fir, and 0.5% whitebark pine.

Table 1. Number of trees by species and size class in 60 variable-radius and fixed-radius plots in the Shoshone National Forest.

Size class[a]	Lodgepole pine	Other conifers	Aspen	Total
Seedlings	115	204	32	360
Saplings	9	0	0	
Pole trees	200	11	0	367
Mature trees	146	10	0	
Total	470	225	32	727

[a] Variable-radius plots with 20 basal area factor were used to delineate trees as saplings (dbh < 4 in), poles (4 in ≥ dbh < 9 in), or mature trees (dbh ≥ 9 in). A 1/100 acre, fixed-radius plot at plot center was used to evaluate seedlings (height ≤ 4.5 feet).

Overall regeneration was low (585 stems per acre; all seedling species). The low regeneration numbers were likely caused by the dense overstory in many of the stands. For seedlings, lodgepole pine made up 33% of the regeneration; with 26% subalpine fir, 22% limber pine, 9% aspen, 5% Engelmann spruce, 3% Douglas-fir, and 2% white bark pine. Lodgepole pine regeneration was observed in 48% of the plots. The large percentage of other conifer seedlings (58%) suggests forest successional changes are occurring on some sites. This could be hastened by reduced seed production due to high levels of dwarf mistletoe and/or comandra blister rust in some stands. The observed disease-caused top-kill can hindered lodgepole pine seed production and viability (Hawksworth and Johnson 1989, Hawksworth 1959).

In trees, the incidences of both dwarf mistletoe and comandra blister rust disease were high, as was the average disease severity ratings of infected trees (**Table 2, Fig. 1 and 2**). Mountain pine beetle was common in mature trees (10% of trees), but other damage agents were infrequent in mature trees: 1.1% for western gall rust and 1.5% for pine engraver beetles (*Ips* sp.). Comandra blister rust disease was never observed in seedlings and dwarf mistletoe was observed in 1% of the lodgepole pine seedlings.

Table 2. Incidence and mean disease ratings for dwarf mistletoe and comandra blister rust in trees[a] in 60 variable-radius plots in the Shoshone National Forest.

Damage agent	Plot incidence	Tree incidence[a]	Mean tree severity rating[b]	Mean infected tree severity rating[b]
Dwarf mistletoe	70%	47%	1.8	3.8
Comandra blister rust	80%	35%	0.7	2.2

[a] Tree incidence is the percentage of infected lodgepole pine.

[b] The six level Hawksworth (1977) system was used to rate dwarf mistletoe infection. Comandra blister rust infections were rated by the most lethal canker on a tree: 1 = branch canker, 2 = stem canker, 3 = girdling stem canker causing top-kill, and 4 = rust-caused mortality; and 0 = no canker.

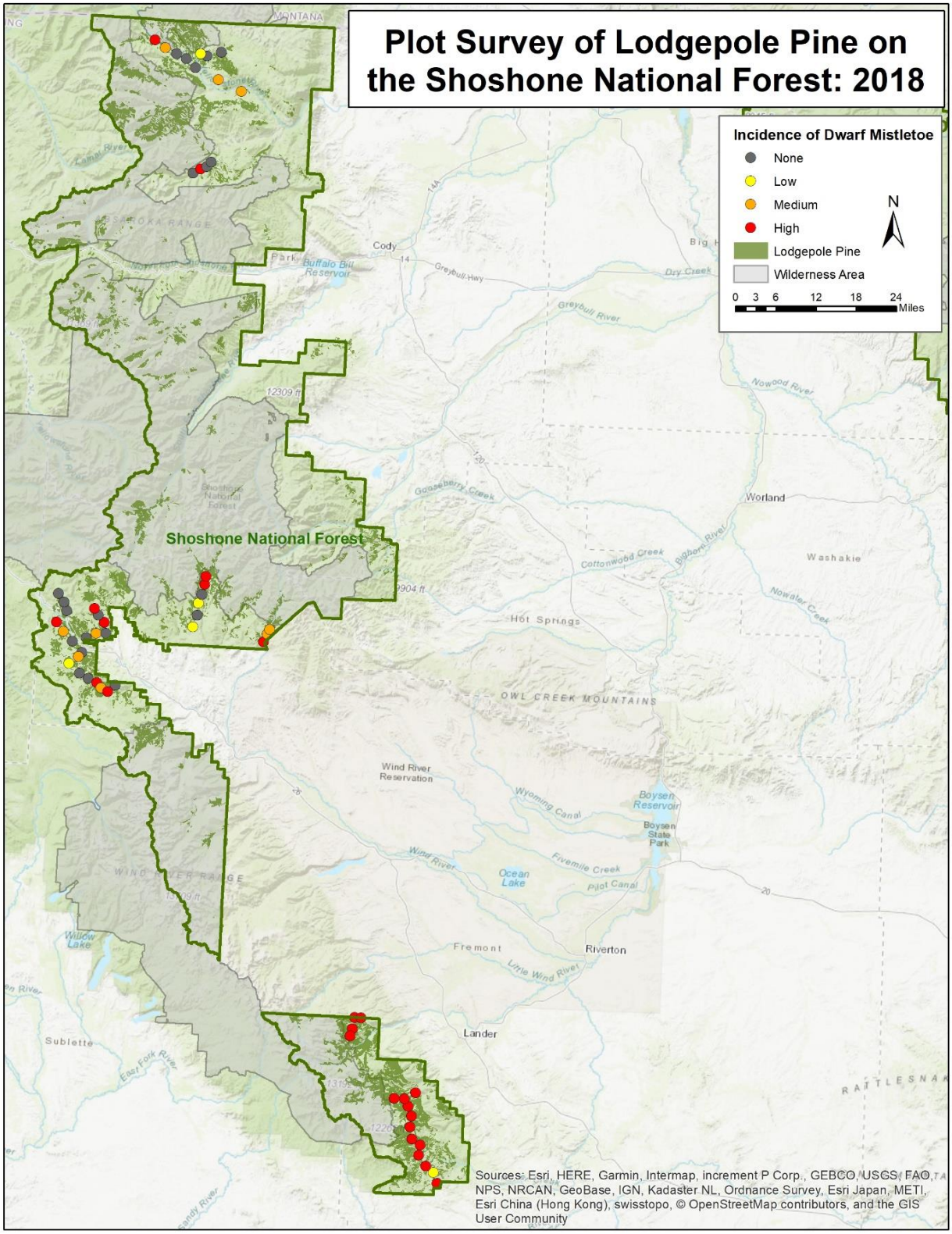

Figure 1. Incidence of dwarf mistletoe in lodgepole pine on the Shoshone National Forest. Plots were installed at 2-mile intervals along 140 miles of roads in 2018.

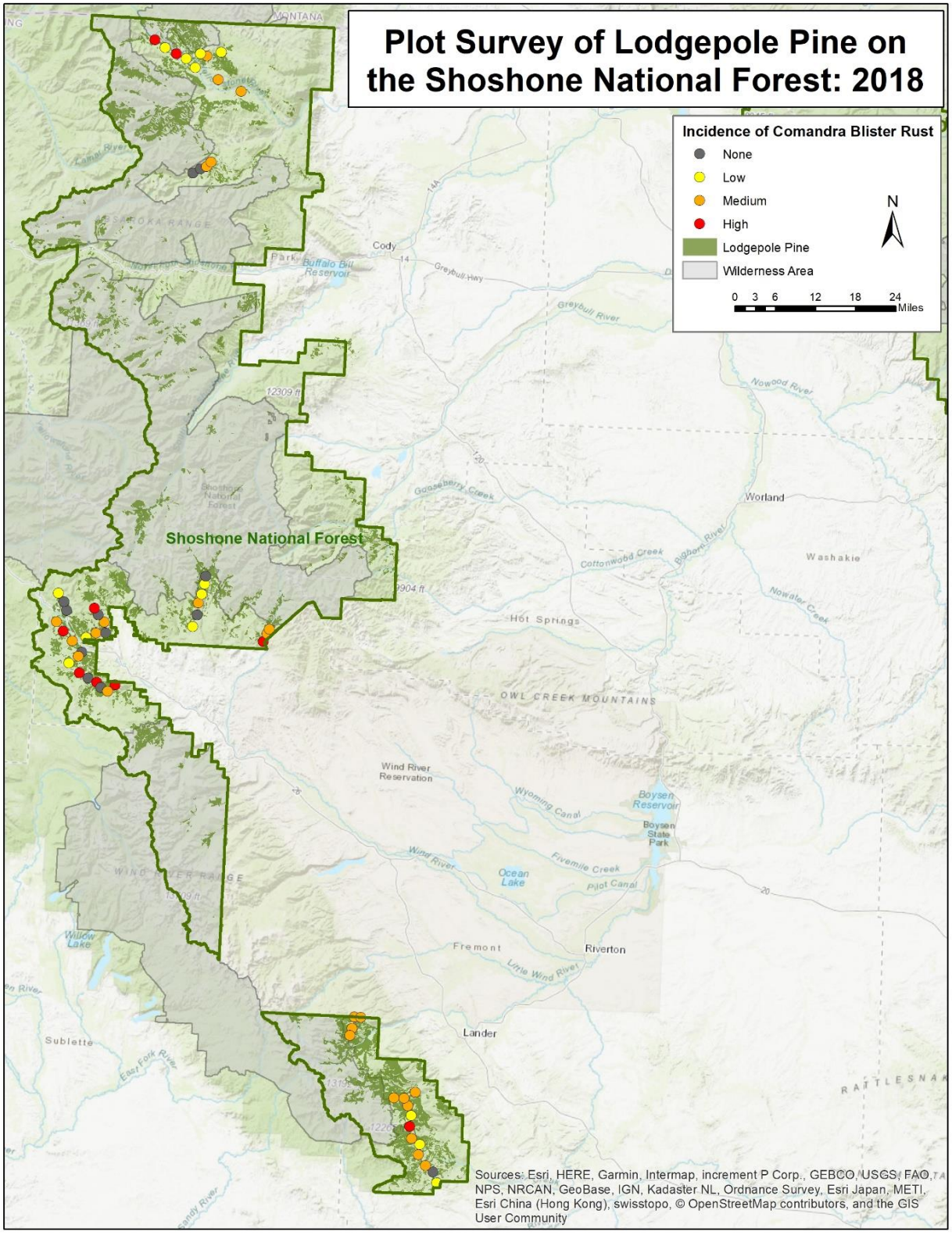

Figure 2. Incidence of comandra blister rust disease in lodgepole pine on the Shoshone National Forest. Plots were installed at 2-mile intervals along 140 miles of roads in 2018.

At least one of the two diseases occurred in 90% of the plots (**Fig. 3**). In lodgepole pine trees (variable-radius plots), 59% were infected with either dwarf mistletoe, comandra blister rust, or both diseases (**Fig. 3**). Thirty-six percent of the lodgepole pine trees had a high dwarf mistletoe infection rating (≥ 3 infection rating). Twenty-three percent of the trees had comandra blister rust stem canker (≥ 2 infection rating); and 9% had a high infection ratings for both diseases.

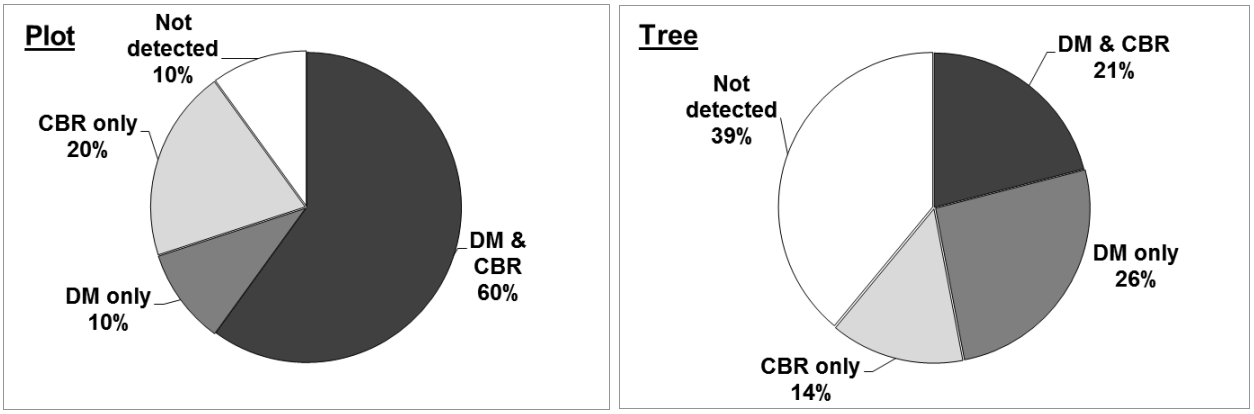

Figure 3. Frequencies of dwarf mistletoe (DM) and comandra blister rust (CBR) infection in plots and in lodgepole pine trees (sapling to mature trees) in 60 variable-radius plots along Shoshone National Forest roads in 2018.

Summary and Recommendations

- Dwarf mistletoes levels are high and comandra blister rust levels are moderate in the forest.

- Some lodgepole pine stands are shifting to subalpine fir, limber pine, and/or other species. This might be due to forest succession and/or reduced lodgepole pine seed production resulting from dwarf mistletoe and/or comandra blister rust.

- Several stands are reaching levels where the only management option is stand replacement to improve forest health. These heavily infected mature stands have reduced vigor and volume growth. Stand replacement could result in healthier residual stands.

- Although mean per tree dwarf mistletoe and comandra blister rust disease severity ratings were low, plot incidences are high for these diseases. The mean tree

severity ratings of infected trees are also high. This indicates several stands (not all) in the forest would benefit from disease management.

- Options for comandra blister rust management could include removal of infected trees during partial cuts and selecting disease-free trees as leave trees during seed cuts.

- Silvicultural controls to reduce incidence and severity of dwarf mistletoe include:
  - clear large areas during regeneration cuts or by fire, to reduce new infections from stand edges,
  - select disease-free trees as leave trees during seed cuts, and promptly remove or kill all infected seed-trees after regeneration is established,
  - use stand borders adjacent to treated areas that are dwarf mistletoe free,
  - establish buffer strips around infection centers or around sanitized patches, and promptly remove or kill infected trees along the edge (to create a 52 foot barrier) once regeneration is established,
  - remove or kill infected trees during partial cuts,
  - prune infected trees when possible (*e.g.*, in campgrounds, picnic areas, etc.),
  - favor or encourage non-host species that are adapted to the site,
  - monitor treatments to identify and remove infected trees that were missed or had latent infections.

- Dwarf mistletoe and comandra blister rust suppression work will promote healthier forest stands. Forest Health Protection staff can assist with planning and funding suppression projects for these diseases.

References

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