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Conditions in White Spruce Stands in the PAR Project area

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INTRODUCTION

White spruce (also referred to locally as Black Hills spruce) is common in the northern coniferous forests of Canada, the Great Lakes region, and the northeastern US. It occurs in the Black Hills as an outlier population removed from the general range. White spruce in the Black Hills is more abundant in the northern hills on north facing slopes and stream bottoms, but can be found scattered throughout most of the forest.

Spruce covers about 51,000 acres in the Black Hills representing a small percentage of forest cover (Walters et al. 2013). Most of the spruce is in large diameter classes. While limited in extent, it is still a valuable part of the forest contributing to timber products, wildlife habitat, and overall forest diversity. It is a shade tolerant species and new seedlings can be found underneath existing stands of spruce and other species. It is a relatively slow growing, long lived species in the Black Hills.

The most frequent damaging agents to spruce are bark beetles and root diseases. Bark beetles, either spruce beetle (*Dendroctonus rufipennis*) or spruce engraver beetles (*Ips* spp.), have killed trees in large numbers across other parts of white spruce's range. Root diseases, such as *Armillaria* (*A. solidipes* and *A. sinapina*), are commonly found in spruce and can lead to tree decline and death. White spruce in the Black Hills is relatively susceptible to internal decay caused by red ring rot (*Porodaedalea pini*).

Recent aerial and ground surveys have detected low level, scattered spruce mortality in the Black Hills.

METHODS

A total of 14 white spruce stands were sampled in 2020 (Figure 1). In each stand a series of three 1/20th acre plots were installed along a transect line through the stand. In each plot all trees larger than three inches diameter breast height (DBH) were counted. Measurements included species, DBH, status (live or recently dead), and any damage agents. Recently dead were considered to be trees that still maintained small branches and twigs and were estimated to have died in the past 4-5 years. Additionally, regeneration was counted for the entire plot noting total number of each species present and any damage agents present on the seedlings. At each stand, root inspections were made to determine if *Armillaria* was present in the stand. Also, all spruce were sounded using a hatchet to detect decay.



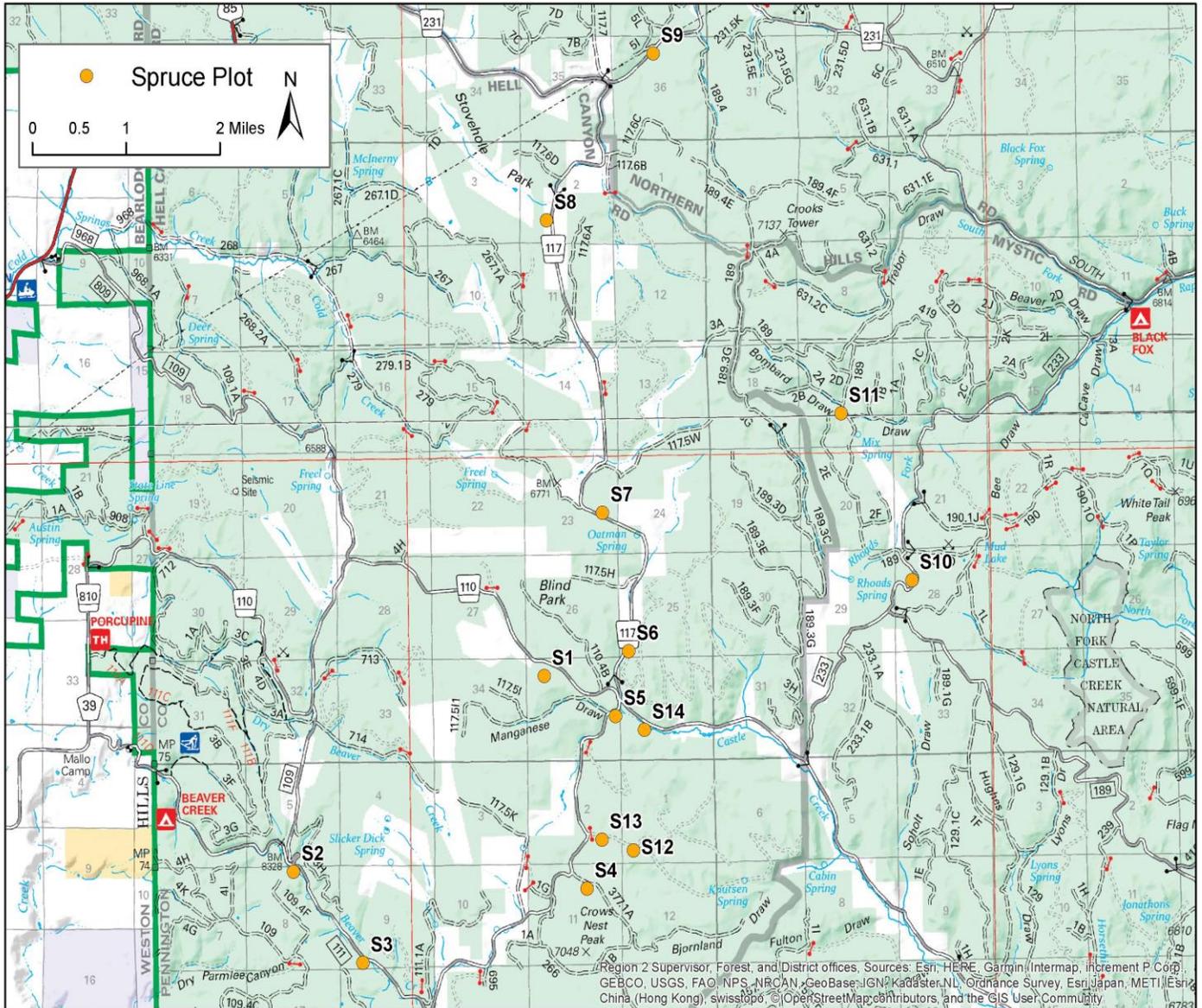


Figure 1. Location of spruce stands sampled.



Figure 2. Declining spruce stand.



Figure 3. *Armillaria* fan on spruce.



Figure 4. Spruce attacked by bark beetles.

RESULTS

Nearly 500 spruce were sampled over 14 stands. Overall spruce mortality was low with 95% alive and 5% found to be recently dead (killed within the last 4-5 years). Only two stands had slightly elevated mortality rates greater than 3%/year. Average mortality across all stands was 1%, or very low and in line with normal “endemic” type mortality. Stands seven and 10 each had about 3% mortality per year noted (Figure 2). Spruce mortality ranged from 0-3.3% across all stands. Most stands were dominated by white spruce (95% of all trees sampled), followed by ponderosa pine (4%), and aspen (1%).

The average DBH of live spruce trees was 11.5 inches and the average of dead spruce was 10.7 inches. Of the recently killed trees almost all had evidence of either *Ips* spp. (96%) or *Armillaria* root rot (100%), and frequently both (Figures 3 and 4). Evidence of spruce beetle was only found in one recently killed tree. All of the stands contained *Armillaria* infection. About 25% of mature spruce had some level of internal decay, with a range across stands of 12% to 60%.

Regeneration was abundant across all areas, averaging about 600 seedlings/saplings per acre. Regeneration was largely composed of spruce (97%), followed by ponderosa pine (2%), and aspen (1%). There was no noticeable death or decline in the regeneration.

CONCLUSIONS

White spruce in the project area appears to be in good health with very little recent mortality. We considered trees killed in the past 4 to 5 years as recent mortality and of all spruce sampled only 5% were determined to have been killed in this timeframe. This results in about 1% mortality per year, or something in the realm of natural or expected mortality levels. There did not appear to be any damage agents causing mortality outside of relatively low, expected levels. Generally, there were no groups or pockets of mortality, but more single, scattered trees. Most of the recently dead trees had both evidence of *Ips* spp. and *Armillaria* root rot present. Again, in both instances, neither seemed to be creating localized, higher levels of mortality. Perhaps the most damaging agent is red ring rot (or potentially other decay organisms) as around 25% of mature trees sounded had some level of internal decay. These decays can cause tree failures as they become more extensive over time.

Since mortality was so low, there was no real indication that tree size or stand density played any part in tree mortality. The damage agents found appeared to be acting as natural stand thinning agents, behaving more as secondary invaders, killing single trees scattered around the landscape.

Regeneration in these stands was dominated by spruce and was generally plentiful. There did not appear to be any insect or disease concerns that were reducing or killing the regeneration.

LITERATURE CITED

Forests of the Black Hills National Forest. 2011. Walters, Brian F., Woodall, Christopher W., Piva, Ronald J., Hatfield, Mark A., Domke, Grant M., Haugen, David E. 2013. Resource Bull. NRS-83. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 36 p.
