BROOM RUSTS

State Forester Forum

Introduction

Broom rusts are fungus-caused diseases that result in the formation of witches-brooms in the branches of infected trees. "Witches-broom" is a generic term for a localized proliferation of twigs with short internodes on a branch (Figures 1 & 2). Two broom rusts occur in Idaho. Spruce broom rust, caused by *Chrysomyxa arctostaphyli*, infects Engelmann spruce. Fir broom rust, caused by *Melampsorella caryophyllacearum*, can be found on grand and subalpine fir.

Figure 1. *Witches-broom in spruce. (Photo by Oscar J. Dooling, USDA Forest Service, www.forestryimages.org)*

Figure 2. *Witches-broom in true fir. (Photo by Susan K. Hagle, USDA Forest Service, www.forestryimages.org)*

Disease Recognition

Shoots forming witches-brooms grow upright and produce new needles with yellow to light-green coloration each year, making brooms stand out in the spring and summer against a background of relatively healthy, dark-green foliage (Figures 1 & 2). The fungus-infected needles of a broom are shed during fall and winter, but it is not dead. The shoots of a broom remain alive over winter and, in early spring, new needles grow from the infected shoots. Because the fungus is systemic in the broom's shoots, it grows readily into the new needles. The needles on a broom are shorter

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and thicker than needles on normal branches. In early summer bright-yellow or light-orange tongue-like structures protrude from the needles of a rust broom (Figure 3). These structures produce airborne spores that disperse to infect the alternate hosts.

Figure 3. *Fungus fruiting from infected needles in summer. (Photo by Oscar J. Dooling, USDA Forest Service, www.forestryimages.org)*

The infected branches of fir may have large spindle-shaped or round swellings, while infected branches of spruce are seldom swollen (Figure 4).

Witches-broom can be caused by other diseases as well, most notably dwarf mistletoes on various conifer species and Elytroderma needle cast on ponderosa pine. Therefore, the presence of a broom is not diagnostic of any specific disease. By carefully identifying the host on which the broom is growing, and examining the broom for the characteristics associated with broom rust, this disease can be diagnosed readily.

Figure 4. *Spindle-shaped swelling associated with a witches-broom on true fir. (Photo from USDA Forest Service—Ogden Archives, www.forestryimages.org)*

Rust Biology

Rust fungi have complex life cycles. They produce up to five different types of spores during their life cycle. In addition, many rusts must have an alternate host, a noncommercial plant species, where they spend a portion of their life cycle. The commercial plant, or conifer tree, is the primary host. The simpler rust life cycles have 3-4 spore types and require just one host to complete the cycle.

Aerial dispersal of rust spores varies greatly. In general, for rusts that infect conifers, the spore type that travels from the conifer host to the alternate host is able to go great distances, tens to hundreds of miles, and successfully infect the alternate host. As a result, rust infections on the alternate host can be found great distances from the nearest infected conifer, or in an area where the conifer host is not present. In contrast, the

spore type produced on the alternate host tends to be short-lived due to the effects of drying and sunlight. Therefore, they can only travel relatively short distances to successfully infect the conifer (primary) host. Consequently, infected conifers are found in the vicinity of the infected alternate host(s). Western gall rust is an example of a rust species that requires no alternate host (see Forester Forum No. 13).

Chrysomyxa arctostaphyli, cause of spruce broom rust, has a life cycle that produces four spore types and infects two plants, Engelmann spruce and kinnikinnick. Kinnikinnick, also known as bearberry, is a small, broadleaved, evergreen forest plant. Infection of the conifer host causes gradual formation of a witches-broom, while infection of kinnikinnick causes purple-brown leaf spots. The fungus is systemic and perennial in spruce, meaning that once infection occurs the fungus remains alive from year-to-year in the twigs that form the broom. Infection of kinnikinnick, on the other hand, needs to take place every year, so rust is found on these hosts only where they occur together.

Melampsorella caryophyllacearum, cause of fir broom rust, has a life cycle that produces five spore types and infects *Abies* species and chickweeds. "Chickweed" is the common name for species of either *Stellaria* or *Cerastium*—small, broadleaved, herbaceous plants common in moist, mountain environments. Infection of the *Abies* host, which in Idaho is either grand or subalpine fir, causes a witches-broom while infection of chickweed causes a leaf- or shoot-blight. Infection of fir and the perennial chickweed species is systemic and perennial. Since some chickweeds are perennial, and the fungus overwinters on them before producing the spore that disperses to infect the fir host, the rust can have either a one- or two-year life cycle. Additionally, because the aerially dispersed spore produced from diseased firs can travel long distances to infect chickweed, and as perennial chickweed species do not have to be infected each year, chickweed can be found with rust far outside the range of the fir host. Rust is found on fir, however, only where it occurs with chickweeds due to the short-lived nature of the spore type that disperses from chickweeds to fir.

Hosts

Spruce broom rust (caused by *Chrysomyxa arctostaphyli*)

Conifer host: Engelmann spruce

Alternate host: Kinnikinnick or bearberry (*Arctostaphylos uva-ursi*)

Fir broom rust (caused by *Melampsorella caryophyllacearum*)

Conifer host: Grand and subalpine fir

Alternate host: Chickweeds (*Stellaria* & *Cerastium* species)

Management

Spruce broom rust is not a concern in forest management, but fir broom rust is very common and damaging in certain areas, such as the mountains south of Twin Falls, Idaho.

Trees with the most severe infections, based on the number of brooms and their proximity to the stem, can be selectively removed during commercial harvest. Trees with rust brooms close to the main trunk should be given higher priority for removal due to potential for associated stem defect.

Large witches-brooms can be pruned from high-value trees in recreation sites and around homes. This will almost certainly increase the vigor of heavily infected trees and decrease any potential hazard from falling brooms. However, trees with

brooms growing close to the stem may have stem decay and thus be more susceptible to stem breakage in high winds.

In areas where broom rust infections are neither a commercial production nor human-hazard concern, they can be left to provide habitat for birds and small mammals, which use large, dense brooms for both resting and nesting habitat.

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Useful links:

Forest Insect and Disease Leaflet

USFS Region 1 Field Guide

USFS R1 Management Guide (Fir)

USFS R1 Management Guide (Spruce)

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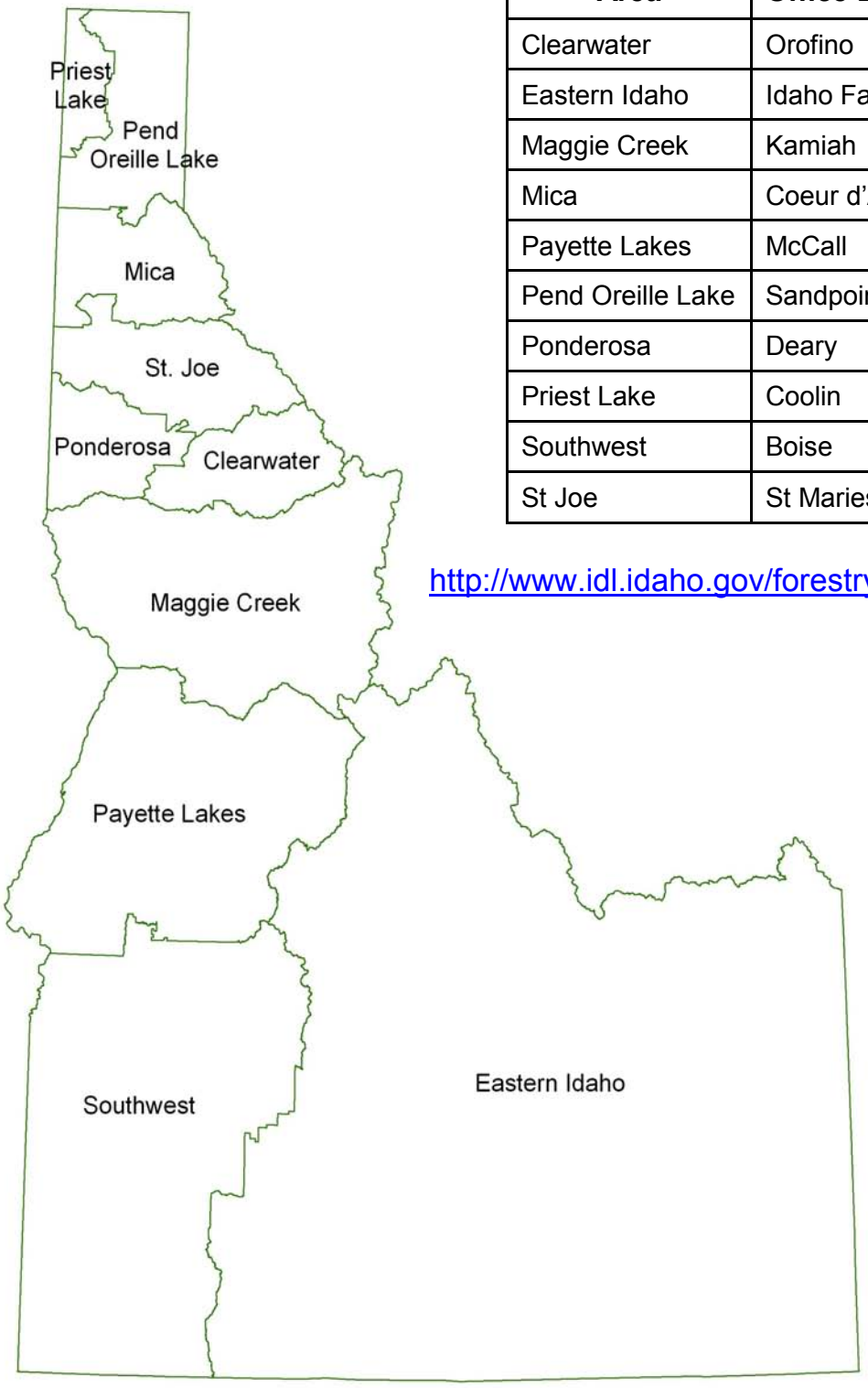

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http://www.idl.idaho.gov/forestry/forest-health/index.html