

White Pine Blister Rust Confirmed on Limber Pine (*Pinus flexilis*) in Rocky Mountain National Park

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On August 24, 2009, while working in Rocky Mountain National Park (Estes Park, Colorado, USA) on the Conserving Limber Pine Genetic Diversity for Possible Future Restoration at Rocky Mountain National Park project (see Schoettle et al. 2011, 2013, in press), a crew from the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station (RMRS) noticed a small limber pine (*Pinus flexilis*) with a dead top along Highway 36 near the Many Parks Curve (fig. 1). The tree was about 2 m tall and 7 to 10 cm in diameter at breast height (d.b.h., 1.37 m) and occurred at about 3,000 m in elevation. The UTM coordinates for the tree are E445370, N4471762 (WGS84, Z13N). The signs on the main stem were consistent with symptoms caused by the canker fungus *Cronartium ribicola*, which causes white pine blister rust (WPBR). Mature trees and seedlings in the area around the infected tree were surveyed on September 11, 2009. One branch in the upper crown of a mature tree at 3,020 m in elevation resembled WPBR because of the extensive chewing by squirrels (Family Sciuridae). The tree was flagged and its UTM coordinates are E445230, N4471698 (WGS84, Z13N). No other suspected cankers were found. Similar surveys of mature and young trees were conducted at each of 17 research sites within the eastern side of the park and no other suspected WPBR infections were observed.

Ribes inerme, a susceptible alternate host for *C. ribicola*, is present along Hidden Valley Creek in the Beaver Ponds area, suggesting that this area could serve as a source of basidiospores to infect limber pine up slope if the rust were present in the area. No evidence of rust infection of the *Ribes* plants in the Beaver Ponds area was seen during a 2009 inspection.

These observations provided strong evidence for the presence of WPBR in Rocky Mountain National Park. Plans were made to revisit the area in early summer 2010 in an attempt to observe the bright orange aecia that offer a phenotypic identification of the disease.

On June 22, 2010 RMRS and Rocky Mountain National Park employees surveyed the Many Parks Curve and Beaver Ponds areas of the park. Both areas were walked with global positioning system devices and an attempt was made to survey all limber pine within the area for signs or symptoms of WPBR by using binoculars or inspecting smaller trees closely. At Many Parks Curve, two crews of two people each walked parallel to the road for about 1.3 km and surveyed more than 289 limber pine trees and 95 limber pine seedlings (<1.34 m in height) over 2.6 ha (fig. 1). No WPBR infections were found. The limber pine tree above the road in the Many Parks Curve area found in 2009 with a possible canker (fig. 1) had no

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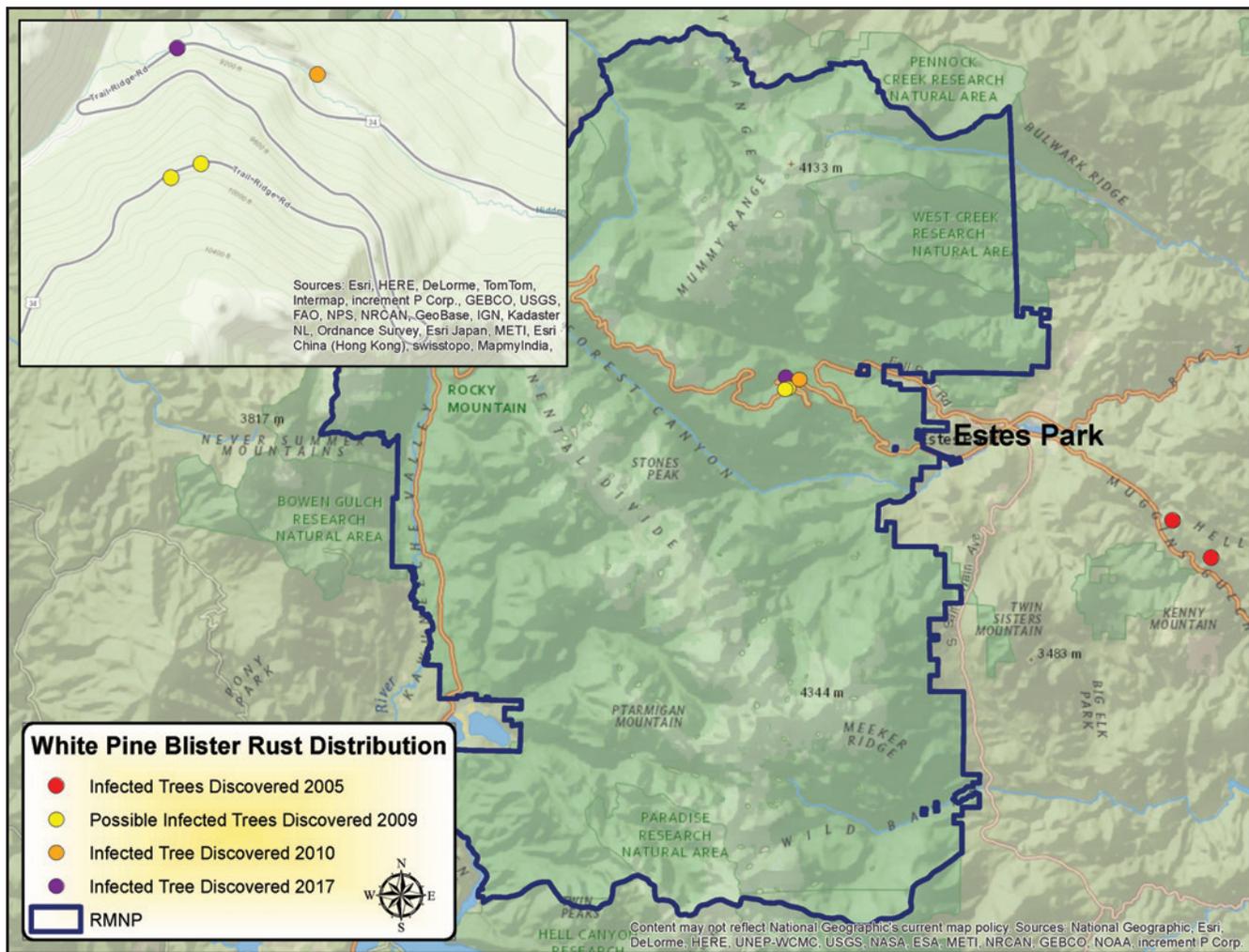


Figure 1—White pine blister rust survey areas of Many Parks Curve and Beaver Ponds in Rocky Mountain National Park. A limber pine possibly infected with *Cronartium ribicola* was found above Trail Ridge Road in Many Parks area in July 2009 and a confirmed white pine blister rust canker found in the Beaver Ponds area in 2010 and another up the road in 2017.

sporulation, suggesting that the infection was successfully removed the previous summer. The second tree found in 2009 with the squirrel chewing also had no evidence of sporulation.

At Beaver Ponds, one crew of three people walked about 1.2 km and surveyed 78 mature limber pine trees and 25 limber pine seedlings (<1.34 m in height) between the creek and the ridgeline over 1.8 ha (fig. 1). One mature limber pine tree was found with a *C. ribicola* sporulating canker (figs. 1 and 2). The tree was tagged with a round metal tag (#4149); the UTM coordinates for the tree are E 445914, N 4472182 (WGS84, Z13N), at an elevation of 2,786 m. The tree is within 200 m of the stream in a riparian area with substantial canopy cover by limber and lodgepole (*P.*

contorta) pines as well as some Engelmann spruce (*Picea engelmannii*). The d.b.h. was 28 cm. The single canker was 25 cm long on a branch about 1.25 m above the ground (fig. 3). Approximately 9 cm of the branch had aecial blisters at both the proximal and distal ends of the canker; the proximal sporulating region was within 20 cm of the main tree bole. The aecial blisters had already ruptured (fig. 4). A small dead twig was present in the center of the canker and a needle on that twig, when alive, was most likely the tissue that was initially infected. With further dissection of the cankered branch, our best estimate is that infection may have occurred 4 to 6 years before 2010. No other cankers were detected in the immediate area or on the infected tree. This is the first confirmed case of WPBR in Rocky Mountain National Park.

The cankered branch was removed. Annual inspections in early summer have been made in this area and no additional infections have been identified (C. Cleaver, Colorado State University, and A. Schoettle, personal communication, 2015). *Cronartium ribicola* was detected, however, on *R. inermis* in the area in fall 2015 (K. Burns, personal communication, 2015). Because WPBR is difficult to identify in the early stages of an outbreak, it is possible there are more infected trees in the area.

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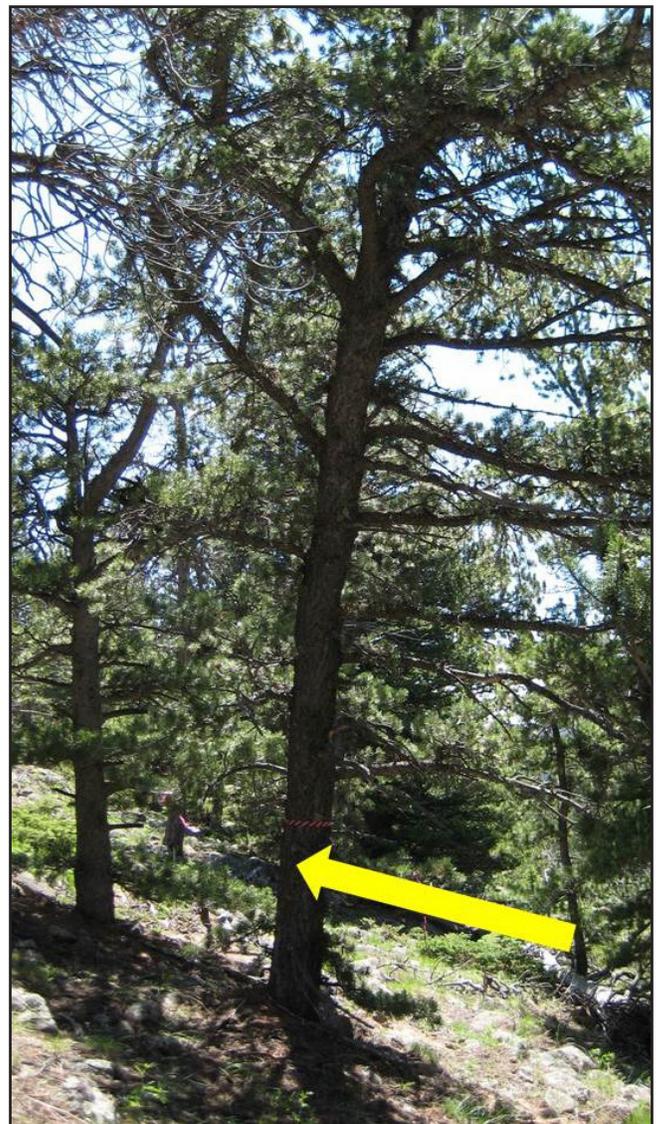


Figure 2—The limber pine tree found infected with white pine blister rust in the Beaver Ponds area of the Rocky Mountain National Park. The cankered branch is the lowest branch on the left (yellow arrow).



Figure 3—The distal end of the canker with the aecia is on the left and the proximal end of the canker, also with aecia, is on the right. Overall canker length is 25 cm. The tree bole is to the right.



Figure 4—Proximal sporulating end of the canker (ruler included for scale). Note that the aecial blisters have already ruptured and begun releasing the orange aeciospores.