**Fire Injury and Bark Beetle and Wood Borer Response**

When one walks out into a severely burned area of pine forest several months after a mid-season wildfire, there is usually very little evidence of beetle activity. Careful examination of fire-killed trees reveals little evidence of boring dust from bark beetles and often very little sound from wood borers gouging at the wood in the stems. These beetles are dependent upon the living tissues of the phloem and cambium for their nutrition during all of their feeding stages in the case of bark beetles and during their early developmental stages in the case of woodborers.

The heat from the fire injures these living tissues, rendering them unsuitable as a food resource for the beetles. Without high quality living tissues these fire-killed trees provide very little in the way of suitable habitat for bark beetles and woodborers. Because fire damage can be somewhat patchy around the stems of fire-killed trees, some wood borers may find some suitable tissue available in otherwise severely burned trees.

From a forest entomologist’s point of view, the fire-killed, blackened trees are not a significant source of habitat for bark beetles to utilize for reproduction. On the other hand, fire-injured trees may be exploited by bark beetles and wood borers.

Research outside of the Front Range indicates that bark beetles may be associated with fire-injured trees. These reports indicate that beetles are often successful in attacking and colonizing fire-injured trees.

**Bark Beetles that Respond to Fire Injury of Ponderosa Pine**

**Red Turpentine Beetle (*Dendroctonus* *valens*):** The red turpentine beetle is associated with fire-injured ponderosa pine throughout the range of this tree. The beetles produce conspicuous and large masses of pitch where they bore into the tree. In general, attacks by the red turpentine beetle are not fatal to trees unless other more aggressive beetles also are involved.

**Pine Engraver (*Ips* *pini)* and related species of *Ips*:** The pine engraver is the one species of bark beetle that is always of concern following fires. Of all the bark beetles that attack ponderosa pine, this species has the greatest potential to develop into an outbreak following wildfire or prescribed fire. In general, one may see this insect killing fire-injured trees for one to two years following a wildfire. The pine engraver was observed killing small numbers of fire-injured ponderosa pine on portions of the Hayman fire in the Platte River canyon for two years following the fire but quickly subsided without further losses.

The most significant pine engraver outbreak following wildfire along the Front Range developed following the TA25 fire on the western side of Fort Carson, at the south side of Colorado Springs. Following the fire, I examined the burned area with Fort Carson forestry staff. Across most of the burn area the ponderosa pine and piñon pine were completely blackened and killed. Along the northern and northwestern boundary of the burned area the fire burned in a more variable pattern and caused considerably more fire injury.

Pine engravers got started in the fire-injured trees in this area and within three years the beetles had increased to such an extent that they were attacking and killing ponderosa pines with limited fire-injury and were beginning to spread into adjacent undamaged ponderosa pines. The pine engraver is very difficult to get under control when it reaches this level of outbreak, especially during the severe drought conditions that set in at the time.

**Root and Root Collar Bark Beetles (species in the genera*, Hylastes* and *Hylurgops*):** Bark beetles in the genus *Hylastes* and *Hylurgops* are associated with the larger woody roots of ponderosa pine. These bark beetles do not kill trees and are not considered to be important in the death of fire-injured ponderosa pine.

**Western Pine Beetle (*Dendroctonus* *bervicomis*):** This bark beetle is not found along the Front Range but it does occur in southwest Colorado and may be associated with fire-injured ponderosa pine in this area. The western pine beetle has been associated with fire-injured ponderosa pine in California, Oregon, and Washington.

**Mountain Pine Beetle (*Dendroctonus* *ponderosae*):** The mountain pine beetle does not exhibit a strong association with fire injury in ponderosa pine. This bark beetle may be more commonly found attacking fire-injured and uninjured ponderosa pine trees in the High Park fire area due to the current epidemic in Larimer County.

**Bark Beetles that Respond to Fire Injury in Lodgepole Pine**

In the study by Ryan and Amman (1996) 61% of fire-injured lodgepole pines were attacked by one or more species of bark beetles or wood borers. The majority of the dying trees had more than 75% basal girdling.

**Mountain Pine Beetle (*D.* *ponderosae*):** The mountain pine beetle will utilize moderately injured lodgepole pine to a limited extent (2% of available fire-injured trees and 23% of the favored moderately injured trees) at low population densities and will utilize moderately injured and uninjured lodgepole pine during epidemics (Powell et al. 2012). Ryan and Amman (1994, 1996) found mountain pine beetle in eight fire-injured lodgepole pine trees in their study.

**Pine Engraver (*I.* *pini)*:** Pine engraver association with fire-injured lodgepole pine is more or less similar that observed for ponderosa pine, mentioned above. In general, this species of bark beetle can be considered important in the death of fire-injured lodgepole pine. Also, it is an important competitor of the mountain pine beetle in fire-injured trees. In the study of Ryan and Amman (1994, 1996), the majority of fire-injured lodgepole pines killed by bark beetles were killed by the pine engraver.

**Pityogenes bark beetles (*Pityogenes* *knectheli*):** *Pityogenes* *knechteli* is associated with fire-injured lodgepole pine. This bark beetle engraves the sapwood, like the pine engraver, but produces galleries that assume a star-shaped pattern. This species, plus perhaps other species in the genus, is an important competitor of the mountain pine beetle in fire-injured trees. Ryan and Amman (1996) reported this bark beetle in fire-injured lodgepole pine but did not specifically mention it as responsible for tree mortality.

A twig beetle, *Pityophthorus* *confertus*, was reported to kill eighteen fire-injured lodgepole pine trees in the study by Ryan and Amman (1996). The red turpentine beetle, *Dendroctonus* *valens*, was associated with the death of one fire-injured lodgepole pine in their study.

**Bark Beetles that Respond to Fire Injury in Douglas-fir**

**Douglas-fir Beetle (*Dendroctonus* *pseudotsugae*):** The Douglas-fir beetle is regularly associated with fire-injured Douglas-fir. This bark beetle was observed in fire-injured trees that died following the Hayman fire. In the study by Hood and Bentz (2007) the Douglas-fir beetle was responsible for an estimated 25% post-fire mortality and 71% of Douglas-fir trees examined in the Yellowstone fires were attacked by this bark beetle (Ryan and Amman 1994, 1996). The Douglas-fir beetle preferred fire-injured trees with more than 50% basal girdling, ample uninjured phloem, and less than 75% crown scorch (Ryan and Amman 1994, 1996).

Ryan and Amman (1994, 1996) indicated that other bark beetles associated with Douglas-fir were of minor importance in the Greater Yellowstone Area fires.

**Douglas-fir Pole Beetle (*Pseudohylesinus* *nebulosus*):** Mortality of small diameter fire-injured trees was associated with this bark beetle in the study by Ryan and Amman (1996).

**Wood Borers (Buprestidae and Cerambycidae):** Wood borers were reported attacking and killing 23% of fire-injured Douglas-fir that died in the Greater Yellowstone Area fires (Ryan and Amman 1994, 1996).

**Bark Beetles that Respond to Fire Injury in Spruce**

**Spruce Beetle (*Dendroctonus* *rufipennis*):** The spruce beetle will utilize fire-injured spruce trees for breeding. However, the bark and phloem of the favored lower-bole portion of fire injured trees is often fully consumed by the fire, so suitable habitat may be limited for this species. Following the Yellowstone fires in1988, 94% of Engelmann spruce trees were infested with spruce beetle (Ryan and Amman 1994, 1996).

**Spruce Ips (several species of *Ips*):** A number of species of spruce Ips are associated with Engelmann and Colorado blue spruce. These species can take advantage of fire-injured spruce trees. Ryan and Amman (1996) reported *Ips* *pilifrons* responsible for some Engelmann spruce mortality in their study but did not provide any figures related to their importance.

**Bark Beetles that Respond to Fire Injury in Subalpine Fir and White Fir**

**Engravers (species of *Scolytus*):** For subalpine fir, engravers have not been associated with fire-injured this tree species, although it is likely that the engraver beetles that utilize fire-injured trees would be the same species evident in trees dying from subalpine fir decline. The fir engraver, *Scolytus* *ventrails*, is often associated with fire-injured white fir.

**Western balsam bark beetle (*Dryocoetes* *confusus*):** This species has not been mentioned associated with fire-injured subalpine fir.

**Wood Borers (Cerambycidae and Buprestidae):** Wood boring insects have been associated with post-fire mortality of subalpine fir following the Yellowstone fires (Ryan and Amman 1996).

**Bark Beetles that Respond to Fire Injury in Rocky Mountain Bristlecone Pine and Limber Pine**

**Limber Pine Engraver (*Ips* *woodi*):** The limber pine engraver, *Ips* *woodi*, was observed to breed in fire-injured Rocky Mountain bristlecone pine. Following the Snyder Creek fire in northeastern South Park in 2011, the limber pine engraver was collected from under the bark of fire-injured Rocky Mountain bristlecone pine. This species is more commonly observed in dying limber pines. I have no first-hand observations of this bark beetle attacking fire-injured limber pine, although it is highly likely.

***Pityophthorus* bark beetles (various *Pityophthorus* species):** The *Pityophthorus* bark beetles, often called twig beetles, are very small and are most frequently associated with small twigs and branches of conifers. A number of species utilize Rocky Mountain bristlecone pine and several of these are common in fire-injured Rocky Mountain bristlecone pine. In the Snyder Creek burn area, *P*. *confertus* *confertus* and *P*. *murrayanae* *murrayanae* were the most frequently encountered bark beetles utilizing the main stems of fire-injured Rocky Mountain bristlecone pines. *Pityophthorus* species are commonly observed in limber pine but I have no first-hand observations of this bark beetle in fire-injured limber pine.

**Bark Beetles that Respond to Fire Injury in Piñon Pine**

**Piñon Ips (*Ips* *confusus*):** I have no first-hand observations associating the piñon ips bark beetle with fire-injured piñon pine. Given the propensity of Ips bark beetles to exploit fire-injured conifers, I suspect that this insect would utilize fire-injured piñon pine.

***Pityophthorus* bark beetles (species of *Pityophthorus*):** I have no first-hand observations associating these bark beetles with fire-injured piñon pine.