Pine Beetles, Fire, and Global Warming
By Mike Dubrasich, Western Institute for Study of the Environment, Jul 8, 2012

The 2012 fire season in Colorado has been particularly severe. The Waldo Canyon Fire proximate to Colorado Springs is the most destructive in state history, with 18,247 acres burned, 346 homes lost, and two deaths. The High Park Fire near Fort Collins is the second largest in state history, burning 87,284 acres and 259 homes. The Little Sand Fire northwest of Pagosa Springs has burned 24,900 acres in the San Juan National Forest. The Pine Ridge Fire east of Grand Junction burned 13,920 acres. In total 350 fires have burned this year in Colorado; many are as yet uncontained.

Questions arise as to causes. Some have speculated that global warming is a factor. Others point out the pine beetle infestation that has reportedly killed half the state's lodgepole pines across 1.5 million acres, and blame Colorado's fires on that.

But do those speculations have merit? Some facts are in order.

Pine beetle outbreaks have many causes, but warm winter temperatures are not to blame, despite frequent media claims.

Average winter temperatures in Colorado have been below freezing in every year on record since record keeping began in 1895. From 1992-2011 winter temperatures declined -0.78 deg F per decade. In January 2011 the average temperature was 23.4 deg F, one-tenth of a degree below the 1901-2011 January average and 2 deg F below the 1901-2011 winter average.

In fact, winter temperatures in Colorado have not changed significantly over the last 115 years, and they have fallen slightly over the last 20 years, the very period of beetle infestations.

Pine beetles (Dendroctonus spp.) occur wherever pine trees occur, in North America from 66° N in Canada to 12° N in Nicaragua. They are capable of surviving and thriving at a wide range of temperatures, as is evident from their wide latitudinal range. In southerly regions winter temperatures are never very cold, and in northerly regions cold winter temperatures are the rule.

The principal causes of bark beetle outbreaks are:

* Natural population cycles. Insect populations follow regular cycles. Why this happens is not fully understood, but rise and fall over decadal periods has been noted in numerous insect populations. (Some investigators have noted correlations with sunspot cycles, but correlation is not causation etc.)

* Food availability. Widely spaced, healthy, well-watered pine trees are resistant to bark beetle attack and subsequent fungal infection. There are anti-fungal terpenes and other compounds in pine sap, and abundant sap can coat and smother boring beetles. Conversely, when pines are closely spaced they compete for soil moisture. Individual trees in pine thickets are moisture stressed and cannot defend themselves. Pine thickets are thus ready food sources for bark beetles.

The standard silvicultural remedy for pine beetles is thinning. Widely spaced trees with full crowns are the goal. Depending on initial conditions (stem density and age of the trees) it may take a decade or more for trees to respond to thinning and develop resistance. There are numerous examples of thinned pine stands exhibiting resistance--the practice can and has been successful.

* Fire. Pine beetles invade burned stands within days after the fire. I have heard the faint chirping (stridulation) of pine beetles in burned stands; it is quite eerie. Burned trees are often singed of needles

but still alive. Beetles invade and mortality ensues, as much from fungus as from the fire. Unburned trees adjacent and within the burn zone are also invaded and infected.

Burned pine forests thus become beetle infestation centers. The beetles lay eggs and invade adjacent stands the following year, often in massive outbreaks--even healthy trees can succumb if the outbreak is sufficiently ample.

Pine beetles do kill pine trees. The beetles carry fungi in special anatomical sacs. When they bore under the bark and into the cambium layer of trees, they inoculate the trees and lay eggs. The larvae feed on the fungi (which have the enzymes to digest lignin). The fungi (typically the blue stain fungus, Grosmannia clavigera) are what actually kill the tree. The mycelia plug the water transport vessels in the cambium and the tree dies of drought.

But perhaps counter intuitively, beetle-killed pine trees are not especially fire-prone. Fires are a principal cause of pine beetle outbreaks, but outbreaks are not a principal cause of fires.

The needles of beetle-invaded, fungi-infected trees first turn red and then drop, usually with a year or two at most. The needle drop removes fine fuels from the canopy, leaving only courser fuels, which become courser over time as small and then larger twigs and branches fall.

Fire propagation through forest canopies requires abundant fine fuels (and continuity of those fuels). Without needles aloft, canopy fires do not propagate and fires instead "go to ground". Fires may spread quite readily at ground level where brush and dead needles provide a fine fuel source, but ground fires are typically slower to propagate than canopy fires. Hence beetle-killed forests present somewhat less fire hazard than green forests.

Fuels are biological, however, and biomass growth occurs even after bark beetle outbreaks. Fine fuels continue to grow at ground level as brush or new tree seedlings. The fire hazard returns in as little as 5 years.

The recent fires in Colorado were very aggressive and spread rapidly even though they were not canopy fires. Abundant ground-level fuels, fine and course, and the unbroken continuity of those fuels are the reasons those fires were so difficult to contain and did so much damage.

Much of Colorado's beetle infestation followed the Hayman Fire of 2002. In Central Oregon beetle outbreaks can be directly attributed to individual fires. Ditto in California and British Columbia.

That is one reason (there are many) why the Federal policies of reduced forest management and Let It Burn have been so incredibly destructive. Over the last 20 years more than 100 million acres of our public and private forests have been incinerated, and as a direct result, more millions of acres of unburned forests have been lost to beetles. Federal forests with abundant, unbroken fuel loadings are a preventable disaster realized.

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