

# What is Killing the Trees?

## Mystery on the Markagunt Plateau

*As you meander through the evergreen forests on the Markagunt Plateau, it may seem as if a great mystery is unraveling before your eyes. Thousands of dead and dying trees dot the hillsides. Upon closer inspection, you will notice it is primarily the Engelmann Spruce that are*

*dying. What is killing them? Unraveling this mystery was a job left to Entomologists, or scientists who study insects. By setting up study plots, they were able to extricate answers from amidst the debris. Pitch tubes, frass and gallery engravings were just a few clues that led to the culprit ...*



**The Spruce Bark Beetle** (*Dendroctonus rufipennis*)

*Low-level, or endemic, populations of this native beetle roost in trees killed by old age, drought, windfall, logging or other disturbance. Spruce Bark Beetles also often infest live trees. If there are only a few attackers, healthy trees can keep insects from boring into vital parts by flooding holes with gooey sap. When trees are too weak or devoid of moisture to “pitch-out” a beetle, the insects begin carving into living tissue under the bark.*

### 1. Pitch Tubes



**Pitch Tubes** - Healthy trees can exude enough resinous pitch to keep insects from boring into vital parts by flooding holes with gooey sap. In time, that defensive pitch hardens into tubes.

### 2. Frass



**Frass** - If a tree is too weak or devoid of moisture to “pitch-out” insects, you will find tiny piles of sawdust, called frass. These piles indicate a beetle's successful entry past the tree's protective bark.

### 3. Gallery Engravings



**Gallery Engravings** - Removing a small section of bark will likely reveal galleries carved in the inner bark and possibly various life stages (larvae, pupae, or adults) of the beetles.

### How Big is the Problem?

Billions of trees died during a 1990 beetle epidemic, making it the largest in North American history. Not all of those tree deaths occurred here however. In Alaska alone, 3.2 million acres of forest were impacted by this beetle. Other attacks harmed southern Utah, Wyoming and Colorado.



Dead Engelmann Spruce Forest

# Beetles, the Forest and Climate are Intertwined

*Should we blame the industrious beetle for all this damage, or look deeper to understand the underlying circumstances that weakened the trees?*

## Beetles Cannot Take All the Blame

Many scientists believe that these epidemics are a natural and direct result of the combined effects of changing forest health, climate and the beetle's natural life-cycle. These three elements combine to create conditions that favor beetle outbreaks and harm trees.



Spruce Bark Beetles engraving bark & laying eggs.

## Changing Forests

- Long-term **drought** can weaken trees in a widespread geographical areas.
- **Wildland fire suppression** has lead to unnaturally dense forests, forcing trees to compete for limited resources.
- Historically clear-cut forests resulted in the regrowth of **tree-stands with little variety in age**.
- Weakened tree stands are knocked down during strong winds, **creating large areas of downed logs perfect for nesting beetles**.

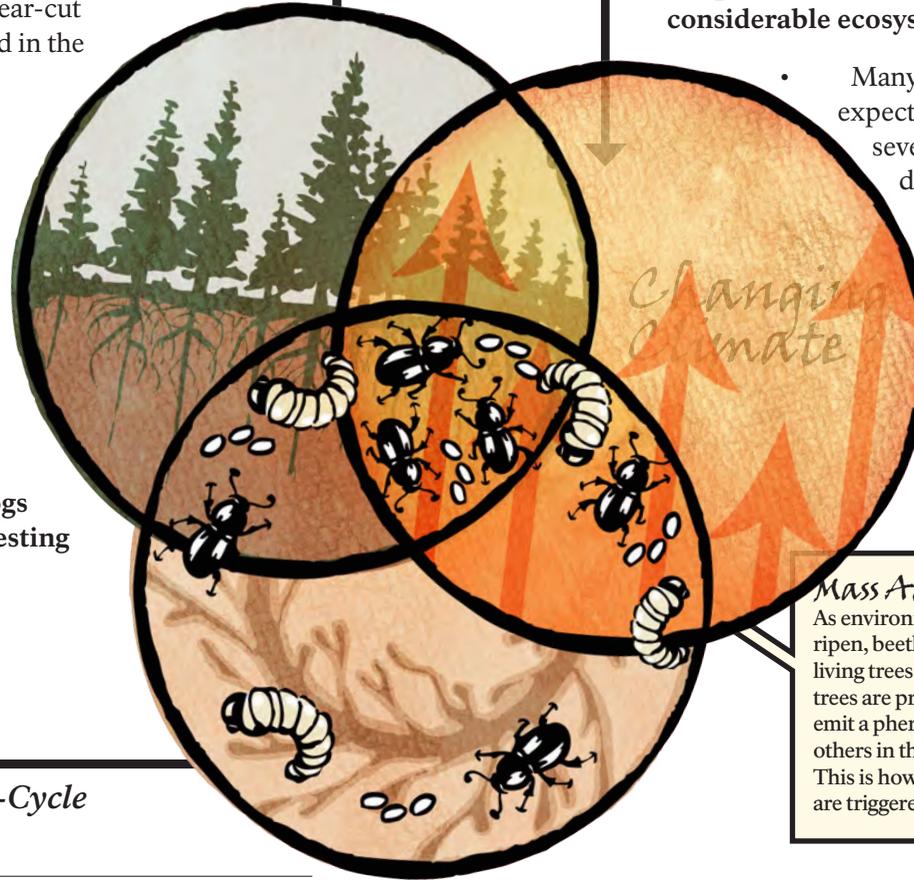
## Changing Life-Cycle of the Beetle

Most beetles enter a period of dormancy driven by endocrine signals and environmental cues, called **diapause**.

The purpose of diapaus is to keep the insects in sync with food availability and to enable them to survive extremes in temperature. It also helps them to synchronize their life cycle to the environment around them. The changing climate impacts

## Changing Climate

- In the next century, global temperatures are expected to rise between 1.8 and 4.0 degrees Celsius. **On high elevation sites like the Markagunt Plateau, these temperatures will likely create a considerable ecosystem change.**
- Many scientists are expecting continually severe periods of drought in the West. This could impact a variety forest types, including Engelmann Spruce.



**Mass Attack**  
As environmental conditions ripen, beetle begin attacking living trees. If many weak trees are present, beetles emit a pheromone that alert others in the area to swarm. This is how large outbreaks are triggered.

when diapaus is triggered. Above average summer temperatures can halt this pre-pupal resting period of Spruce Bark Beetles.

Rather than “snoozing” through part of summer, warmer temperatures can induce Spruce Beetles to grow and reproduce at a more rapid rate, **potentially doubling their population and their impact on the forest.**



Forest regrowth under dead Engelmann Spruce trees.

## Natural Cycles

The National Park Service recognizes that natural processes are an important aspect of any forest ecosystem. **Insects, like fire, trigger renewal and nutrient recycling in forests that can no longer support themselves under given circumstances.**

*As Aristotle once said, “Nature does nothing uselessly.” When Spruce Beetles show up in vast numbers there are usually very sound reasons for their arrival.*