The Effectiveness of Vegetation Management Practices for Mitigating the Impacts of Insects on Forest Ecosystems: *A Science Synthesis*

Executive Summary

Introduction

Phytophagous (plant eating) insects are major components of forest ecosystems. Some forest insects periodically become so abundant that they threaten ecological, economic, social or aesthetic values. Recent epidemics of native forest insects are exceeding historical records. During the last decade, we have witnessed unprecedented levels of tree mortality in spruce in Alaska, lodgepole pine in Canada and the Rockies, southern pines in the Appalachians, pinyon and juniper in the Southwest, and ponderosa pine in Arizona and California.

A team of seven experts from federal, state, and university research programs prepared a knowledge synthesis (drawing from over 480 scientific publications) to review the effectiveness of vegetation management practices for mitigating the impacts of insects on forest ecosystems. This executive summary presents the key findings of the peer-reviewed knowledge synthesis.

Key Findings

- There is extensive literature examining the effect of forest thinning and other vegetation management practices on tree and stand susceptibility to insect infestations.
- Recent epidemics of some native forest insects have exceeded historical records. Changes in forest structure and composition have led to increased competition among trees for water, nutrients and growing space, which then leads to reduced tree vigor and compromises the ability of trees to resist attacks from bark beetles and other forest insects.
- Efforts to avoid catastrophic insect outbreaks focus on returning the forest landscape to a healthier, more resilient condition that is better able to survive natural disturbances, such as fires and hurricanes.
- A variety of vegetation management practices, such as thinning, prescribed burning, selective cutting (with or without tree removal) of insect-infested trees, and others, are available to address these conditions. Even a course of *no action* is not without consequence.
- Management to reduce stand or landscape-level susceptibility to bark beetles must address factors related to tree density.
- Native tree-killing bark beetles are a natural component of forest ecosystems. Eradication is neither possible nor desirable and periodic bark beetle outbreaks will occur as long as susceptible forests and favorable climatic conditions exist.
- The scientific literature generally supports the effectiveness of thinning in preventing and/or reducing tree mortality caused by bark beetles in both the southern and western U.S. Some studies do not show differences between thinning treatments, and others are largely descriptive in nature.
- Thinning of forest stands affects the vigor of residual trees and the physical environment within the stands.
- Thinning causes changes in forest microclimate (temperature, air movement, etc.), which influence the fitness of bark beetles, their predators, and

competitors. These changes may also disrupt the movement of pheromones (the chemical signals used by beetles to attract mates and attack and colonize host trees) and negatively affect the ability of tree-killing bark beetles to mass attack susceptible trees.

- Thinning treatments also redistribute growing space to desirable trees, encourage tree regeneration, create early cash flows, set back forest succession, and reduce risks associated with fire and diseases.
- Certain bark beetles are attracted to the logs, limbs, and branches which remain after a thinning has been conducted. However, published guidelines exist which can help land managers reduce the amount of bark beetle activity in forested areas that have undergone a thinning treatment.
- The relationships described above between tree and stand density and insect outbreaks are consistent across a variety of insect-tree systems. However, caution must be used when extrapolating data from one bark beetle system, or one region, to another.

- Forested landscapes that lack diversity in insect host tree species and/ or tree ages promote the creation of large contiguous areas susceptible to insect outbreaks.
- Climate change may alter patterns and magnitudes of insect outbreaks through effects on insect development and survival, tree physiology and resistance, and associated organisms.
- Information on some forest cover types and common bark beetle species is underrepresented or lacking. Additional research is needed to address knowledge gaps.

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