

Fire: A Vaccine for the Forest

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Key Findings:

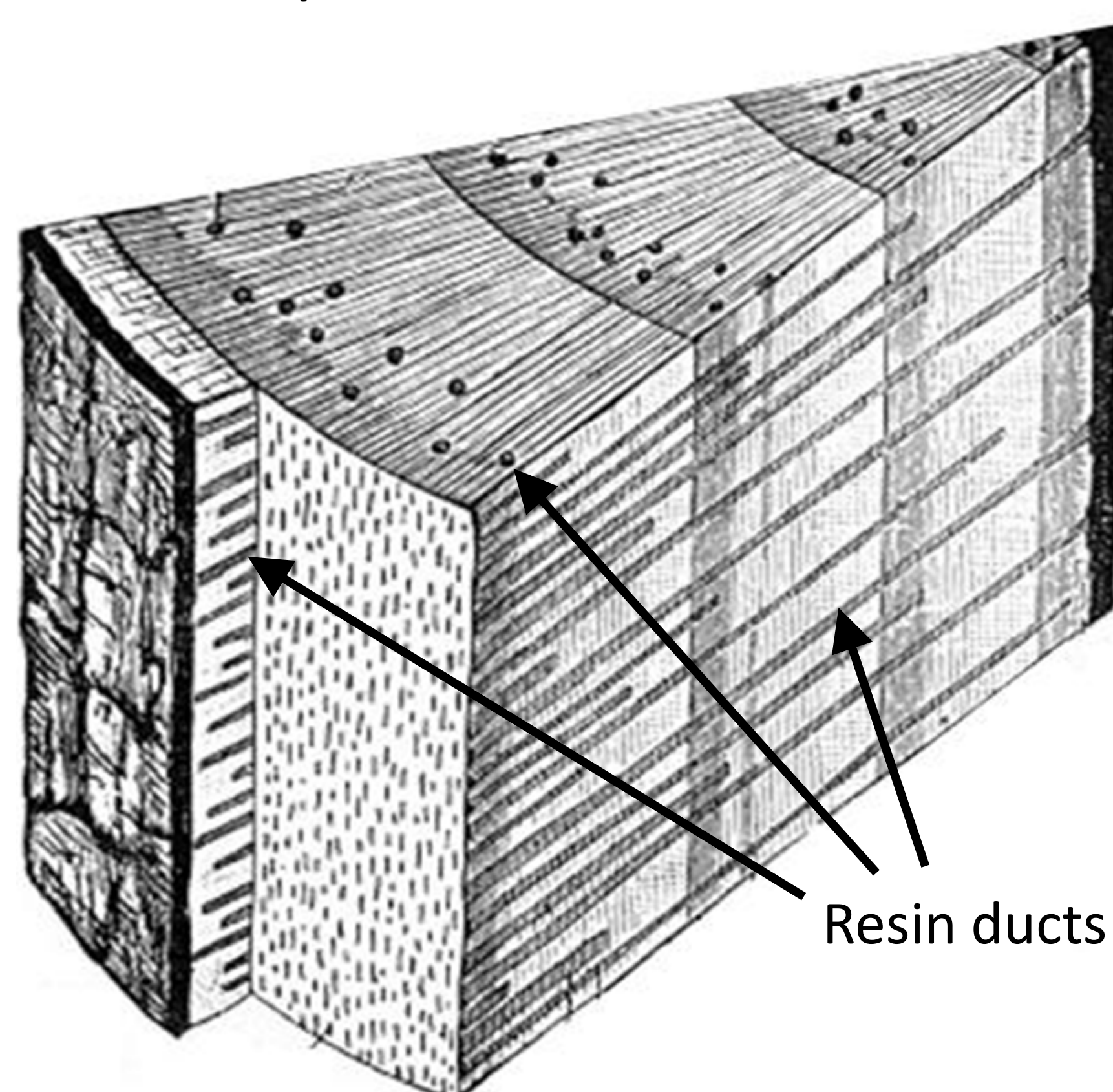
- Low-severity fire increases resin ducts.
- Fire exclusion reduces resin ducts.

Why this is important:

- Trees that produce more and larger resin ducts are more likely to survive bark beetle attacks.
- Ducts remain functional for years, so this increase in ducts after fire results in a long-term increase in defense.
- Excluding low-severity, frequent fire may make forests more susceptible to bark beetles.

Background

- Trees use resin as defense against bark beetle attacks.
- Resin is toxic to the beetles and acts as a physical barrier.
- Resin is produced and stored in resin ducts.



Drawing of pine tree showing connected network of horizontal and vertical resin ducts.



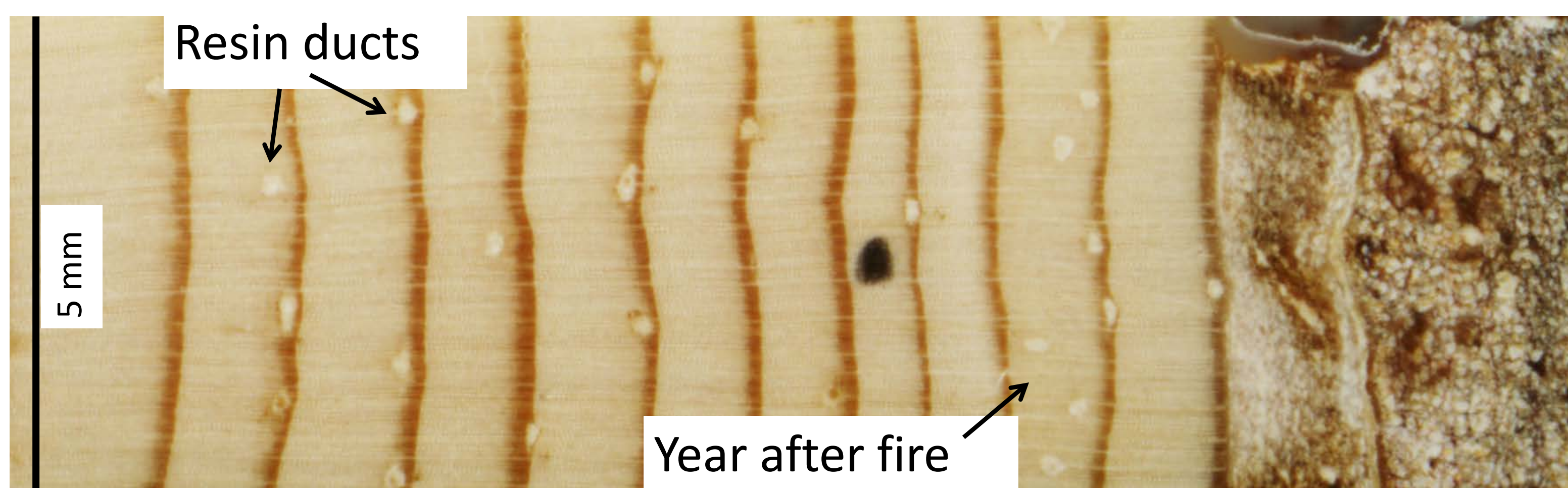
When beetles bore into a tree, ducts are severed and resin begin to flow out of the tree to try to stop the attack.

Methods

Study 1: Compare resin ducts between successfully and unsuccessfully attacked trees to determine if resin ducts are a good indicator of defense.

Study 2: Compare resin ducts before and after low-severity wildfire to determine if fire increases ducts.

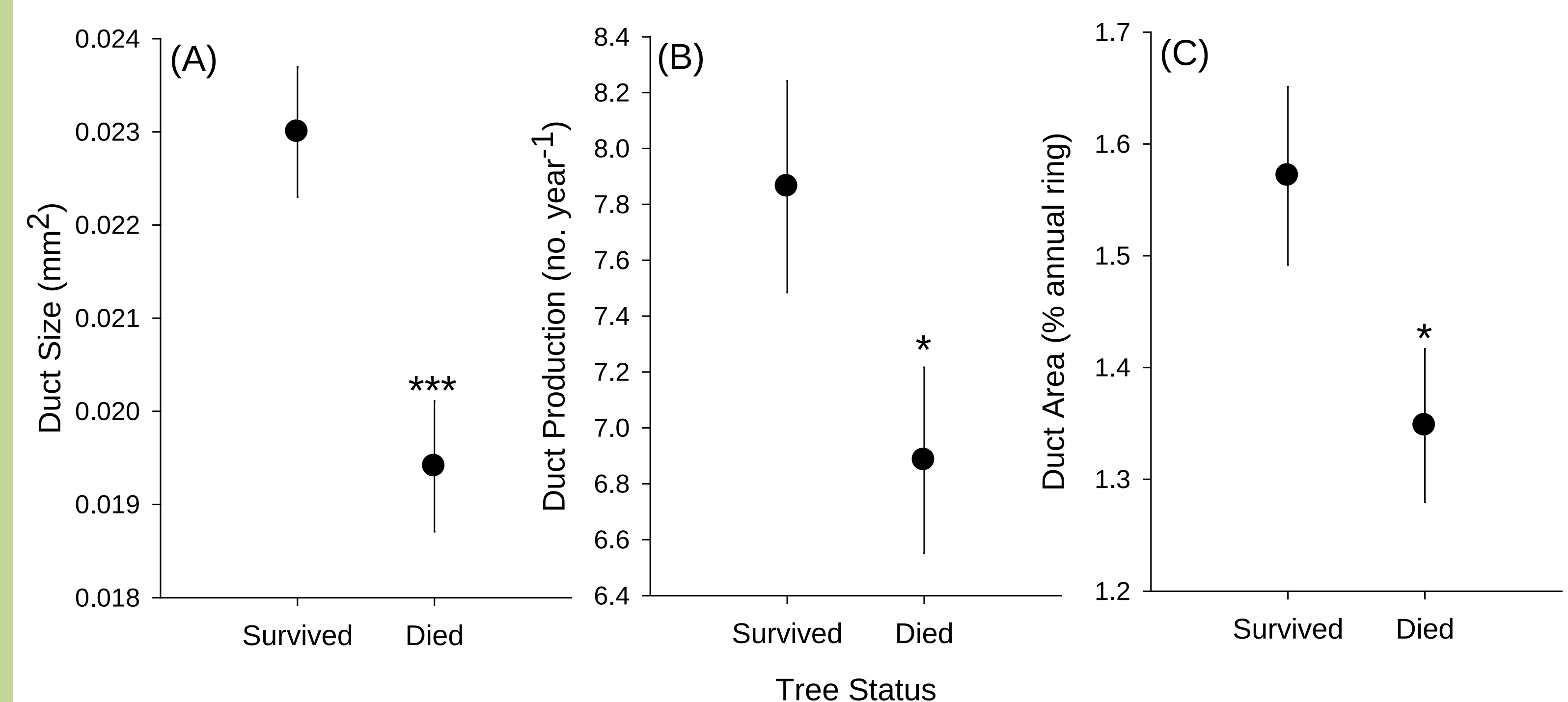
Study 3: Compare resin ducts before and after fire exclusion to determine if removing low-severity, frequent fire causes a reduction in ducts.



Cross-section of a tree core. The large, pale circles mostly in the darker bands of latewood are resin ducts. The large dot is a pencil mark indicating the ring produced in 2010.

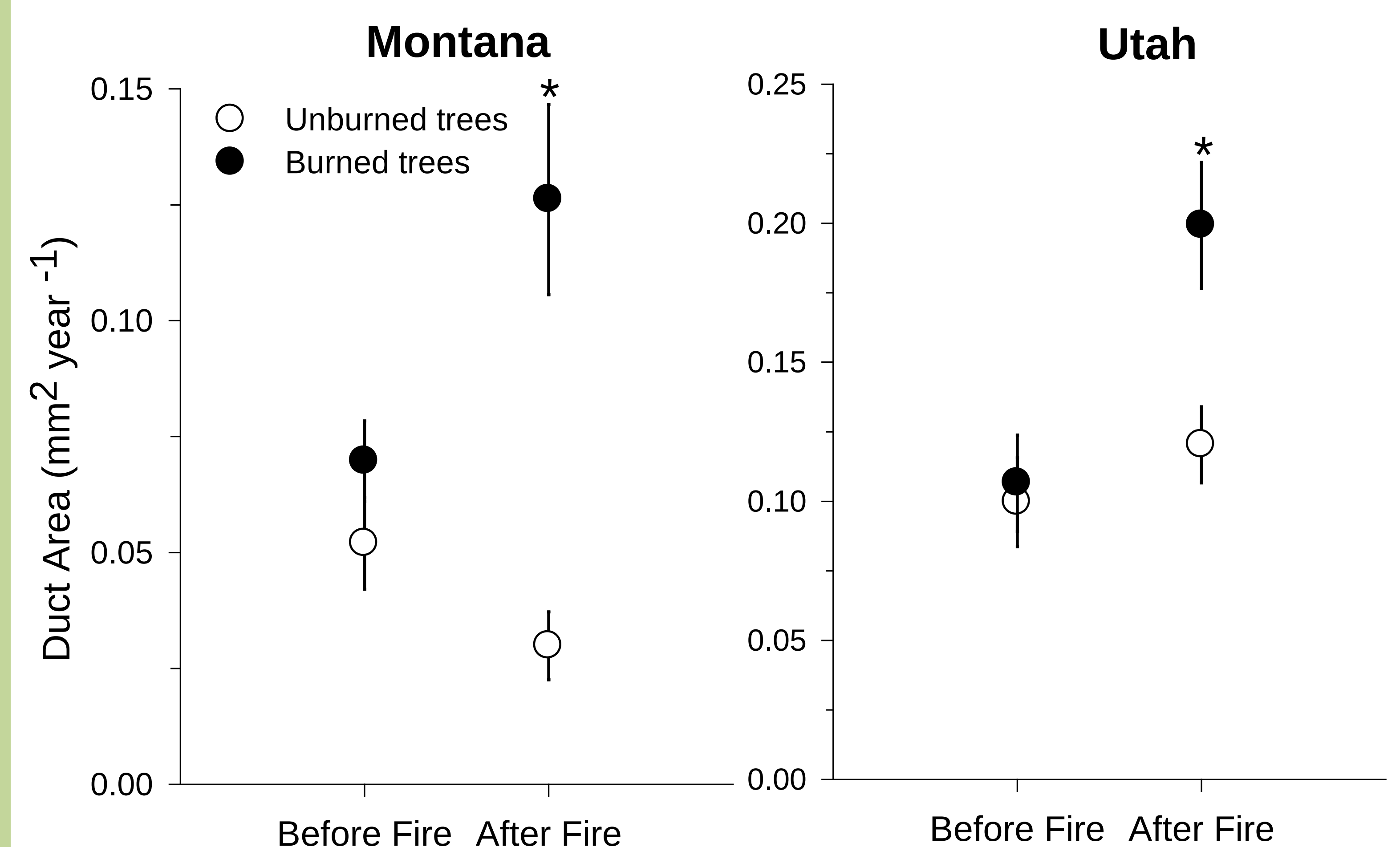
Results

Study 1: Resin ducts are a good measure of defense against beetles.



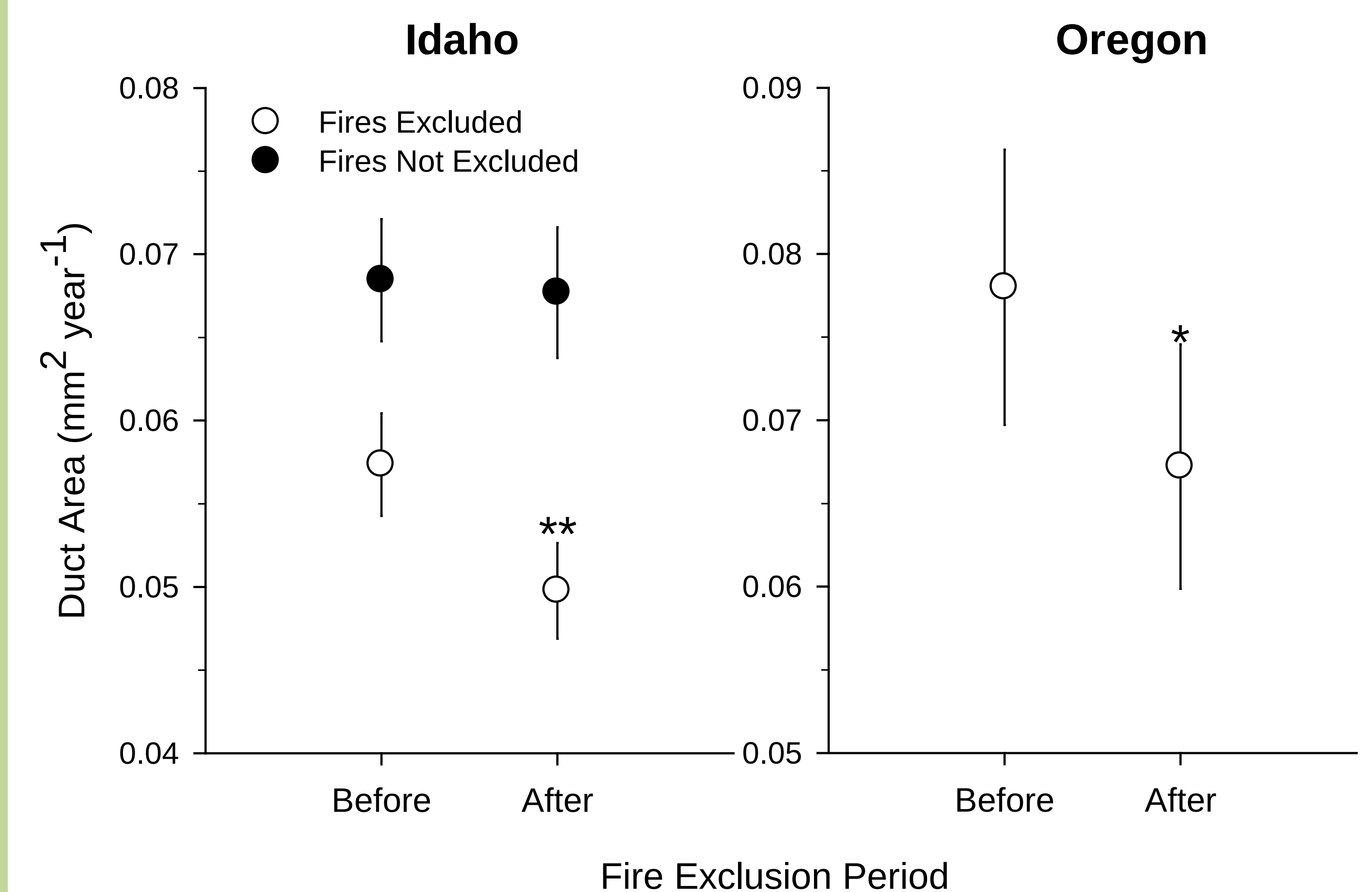
Trees that survive bark beetle attack produced (A) bigger ducts, (B) more ducts, and (C) invested more energy into defense compared to trees that died from attack. * $P \leq 0.05$; *** $P \leq 0.001$. Hood et al. In Review. *Ecology*.

Study 2: Low-severity increases resin ducts.



Total resin duct area increased after one low-severity fire in burned trees, but did not change in trees outside the fire perimeter. * $P \leq 0.05$.

Study 3: Trees in areas where frequent, low-severity fires have been excluded have fewer resin ducts.



Total resin duct area decreased after fire exclusion in areas with historically frequent, low-severity fires, but not in an area that continued to burn several times in the 1900s. * $P \leq 0.05$; ** $P \leq 0.01$.

Management Implications

Low-severity fire increases defenses against bark beetles and may make forests more resistant to beetles.