Impacts and management of western pine beetle in the Sierra Nevada during a period of rapid change

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Introduction

- Sierra Nevada is adapted to frequent, low-severity fires
- Current conditions deviate greatly from historical disturbance regime due to:
  - Fire suppression and exclusion
  - Management practices
- Less resilient forests are more susceptible to severe wildfires, droughts and bark beetle outbreaks
- “Type changes” may occur following severe disturbances

Projects

1. **Changes in Fuel Loads and Snag Longevity Following Severe Drought and Bark Beetle Outbreaks**
2. **Efficacy of Acer Kairomone Blend, Verbenone, and Other Selected Semiochemicals for Protecting Ponderosa Pine Trees from Western Pine Beetle**
3. Effect of Red Turpentine Beetle and Western Pine Beetle on Mortality of Ponderosa Pine Following Prescribed Burns
4. Bonus: Changes in Woody Surface Fuels Following Severe Mountain Pine Beetle Epidemics in Lodgepole Pine Forests in the Intermountain West, U.S.

Changes in Fuel Loads and Snag Longevity Following Severe Drought and Bark Beetle Outbreaks

Monitoring changes in forest structure following a western pine beetle outbreak

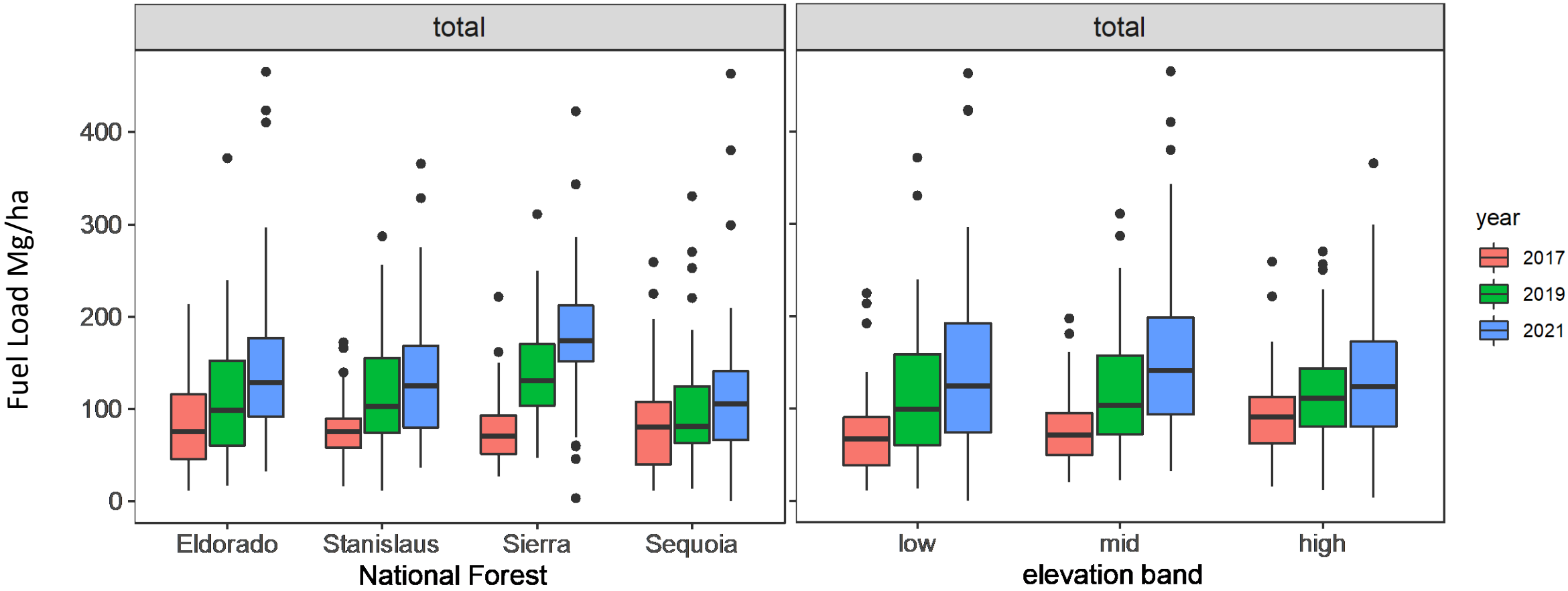
- Severe drought in central and southern Sierra Nevada (2012–2015)
- Followed by western pine beetle (*Dendroctonus brevicomis*) outbreak in ponderosa pine (*Pinus ponderosa*)
- 129 million dead trees in CA (2010 - 2017)

California Tree Mortality Network

- 180 plot network of 0.041-ha plots
  - Plots established in 2016 and 2017
  - At least 10% mortality by stem
  - At least 35% ponderosa pine by basal area
- 5 plots per site
- Four national forests: Eldorado, Stanislaus, Sierra and Sequoia
- Three elevation bands: Low: 914–1218 m, Mid: 1219–1524, High: 1829–2134 m

  *Elevation bands shifted higher on the Sequoia NF

From Fettig et al. 2019 in *Forest Ecology and Management*



Fuel measurements conducted in 2017, 2019, 2021 and 2023 using modified Brown's transects

Efficacy of Acer Kairomone Blend, Verbenone, and Other Selected Semiochemicals for Protecting Ponderosa Pine Trees from Western Pine Beetle

Photo credit: Anders Skjoldjensen

Idaho field site

Field methodology

Experiment 1 – Lindgren-funnel trapping assay

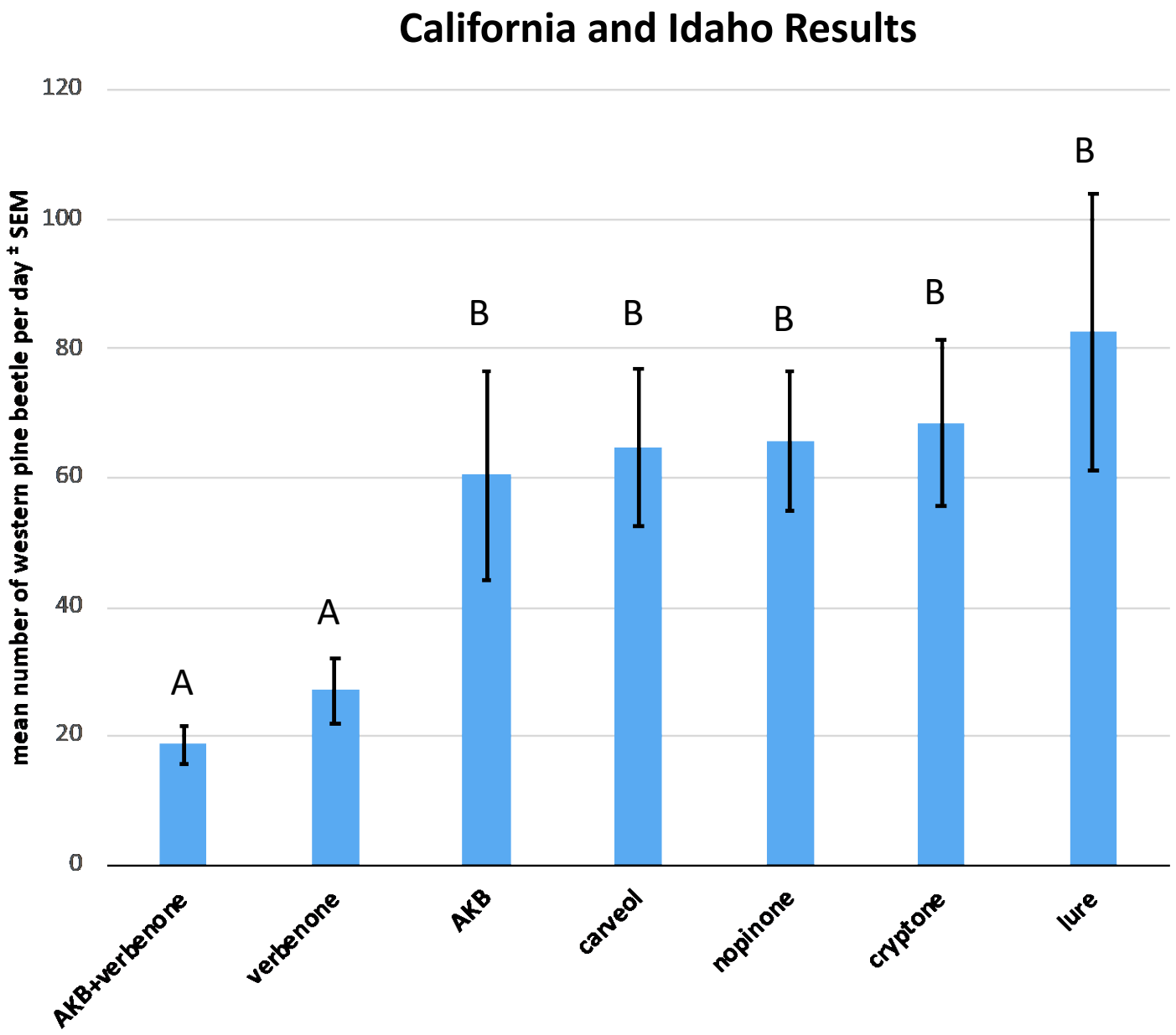
- Two locations:
  - Foresthill, Tahoe National Forest, California
  - Idaho Panhandle National Forests, Coeur d'Alene River Ranger District, Idaho
- Experiments conducted in June 2022 during peak flight period of WPB
- Semiochemicals provided by Synergy Semiochemical Corp., Delta, BC, Canada.

Semiochemical treatments

1. Western pine beetle (WPB) lure (frontalin, exo-brevicomin, myrcene)
    1. Control treatment
2. Acer kairomone blend (AKB) (linalool, β-caryophyllene, (Z)-3-hexen-1-ol) + WPB lure
    1. Expected to be USEPA registered, repellent to other *Dendroctonus* species
3. Verbenone + WPB lure
    1. WPB antiaggregation pheromone, USEPA registered
4. AKB + verbenone + WPB lure
5. Cryptone + WPB lure
6. Nopinone + WPB lure
7. Carveol + WPB lure

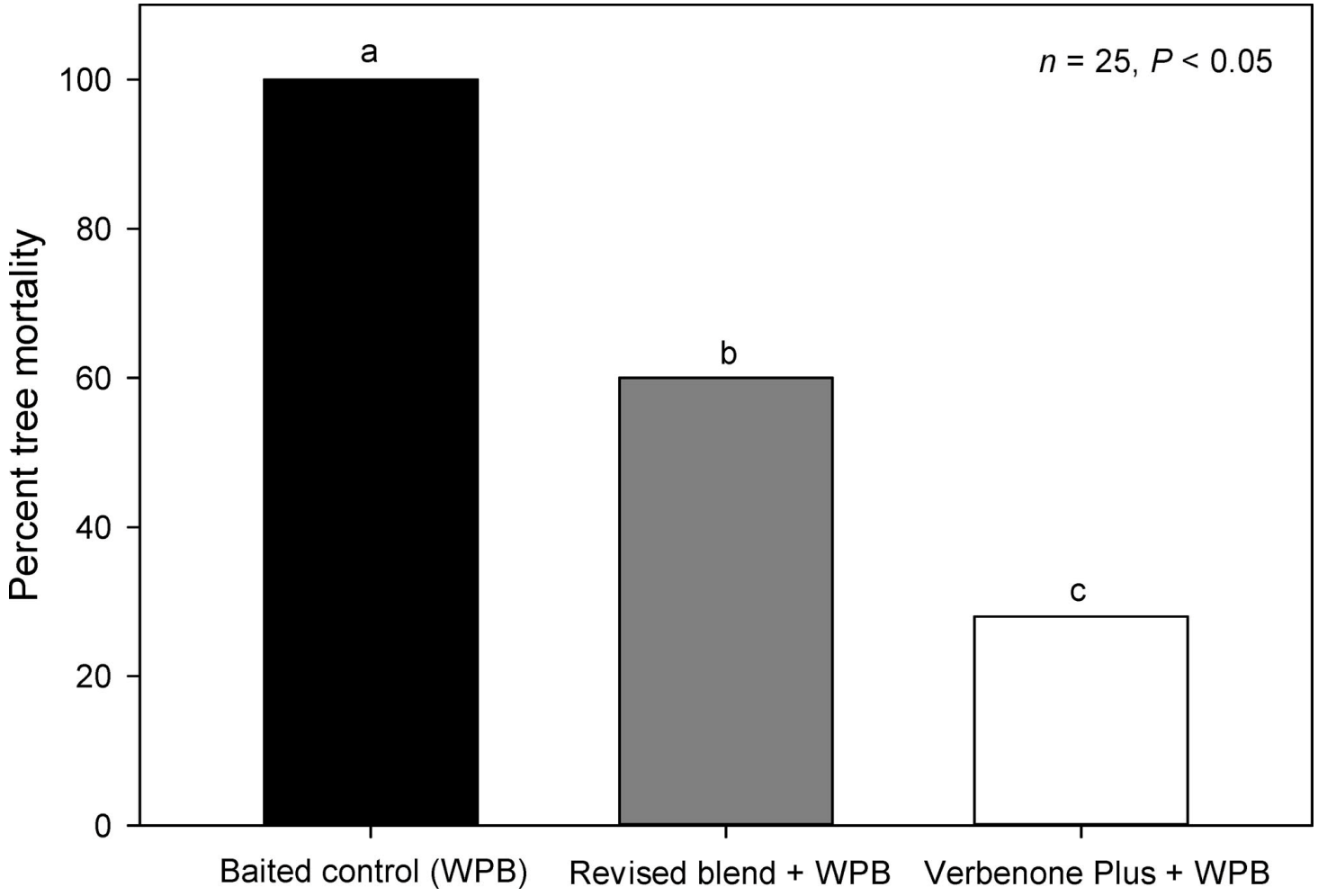
Analyses and Results

- Prior studies show verbenone alone does not protect trees



Repeating experiment

- Repeated August 2023 in California and Idaho
- Including other compounds:
  - Verbenone Plus
    - acetophenone, (E)-2-hexen-1-ol, (Z)-2-hexen-1-ol, and verbenone
    - already shown to protect trees from western pine beetle



From Fettig et al. 2012

Thanks!

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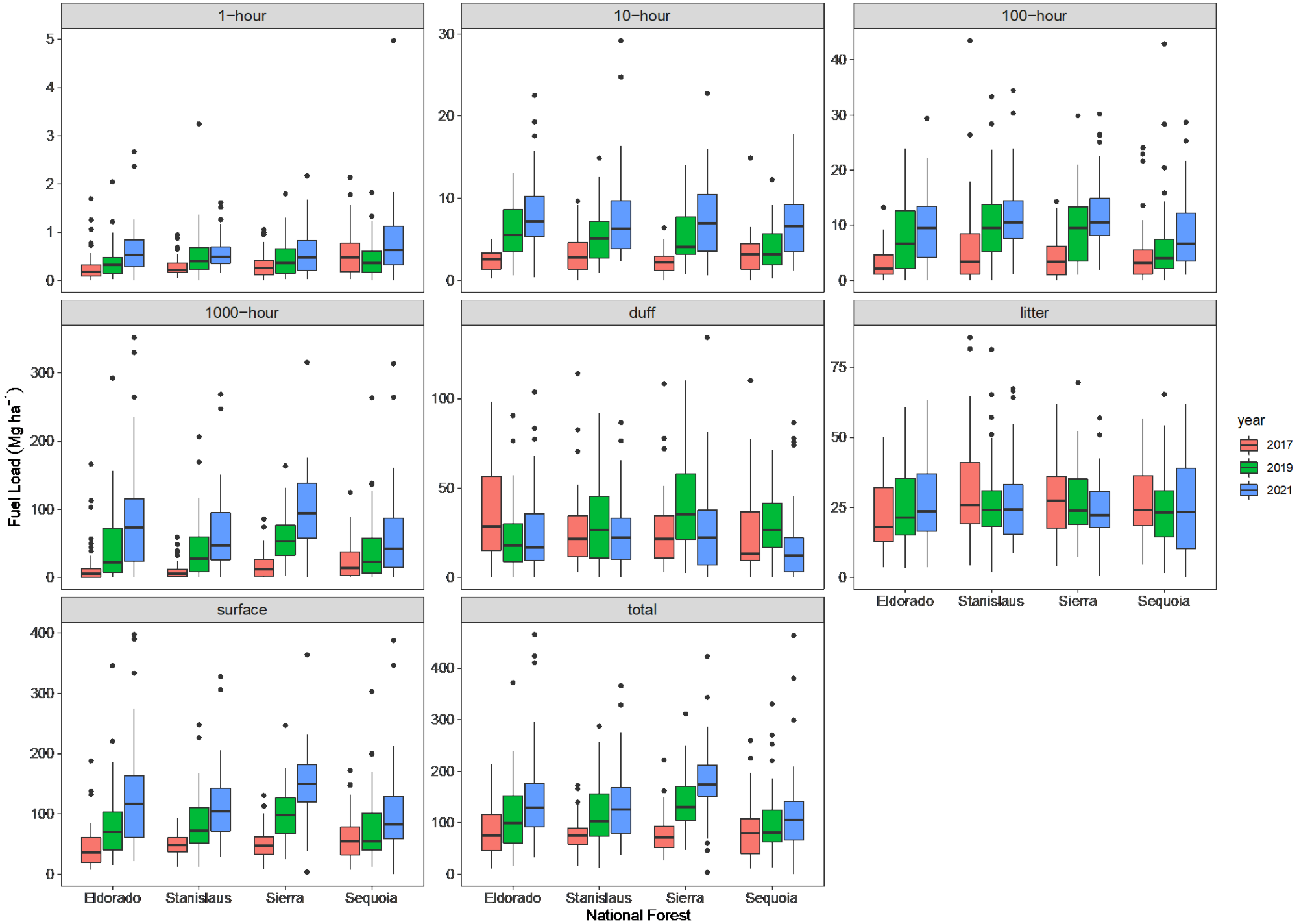
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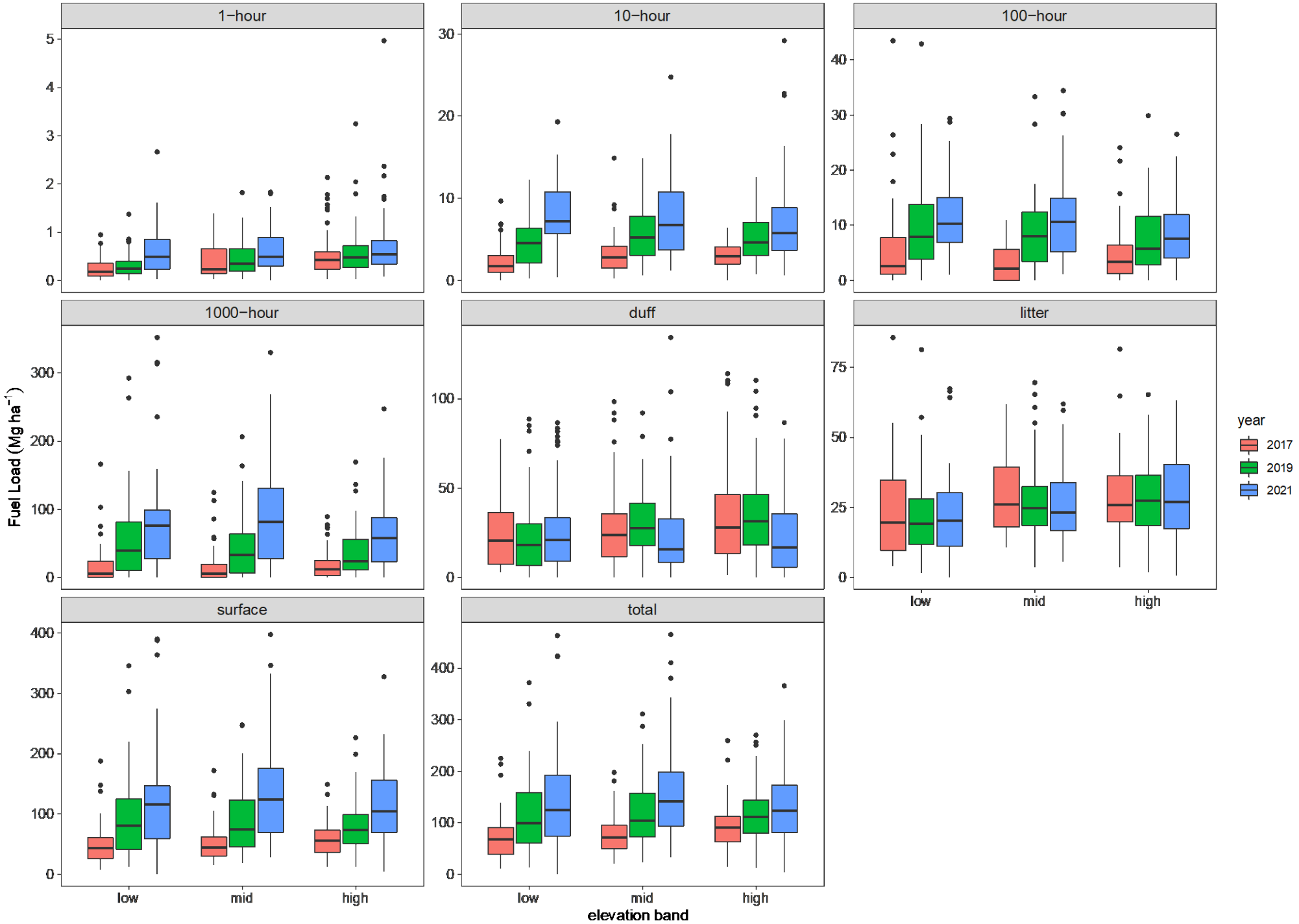
litter
surface
total
Fuel Load (Mg ha^{-1})
Eldorado
Stanislaus
Sierra
Sequoia
National Forest
year
2017
2019
2021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Fuel Load (Mg ha^{-1})
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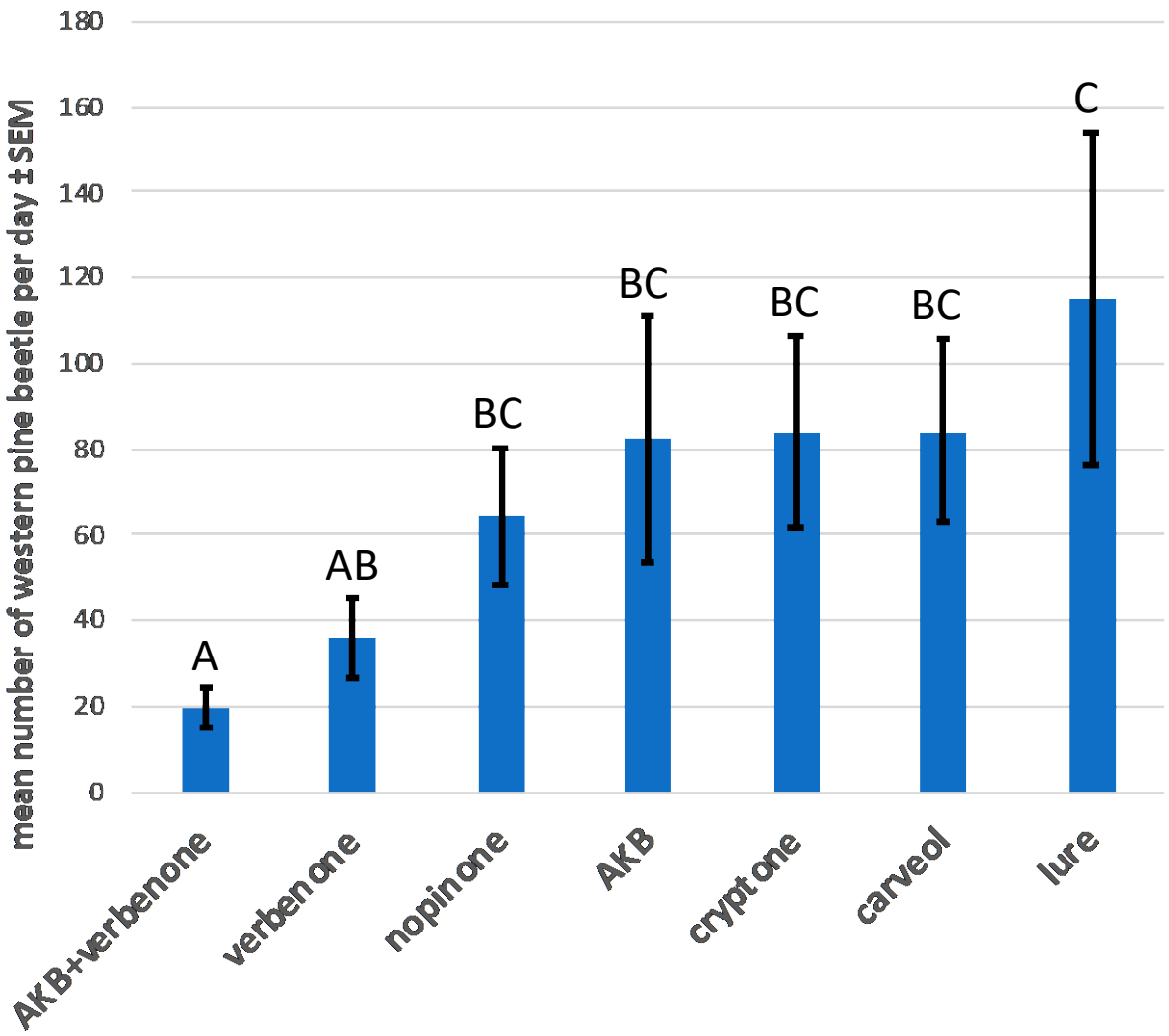
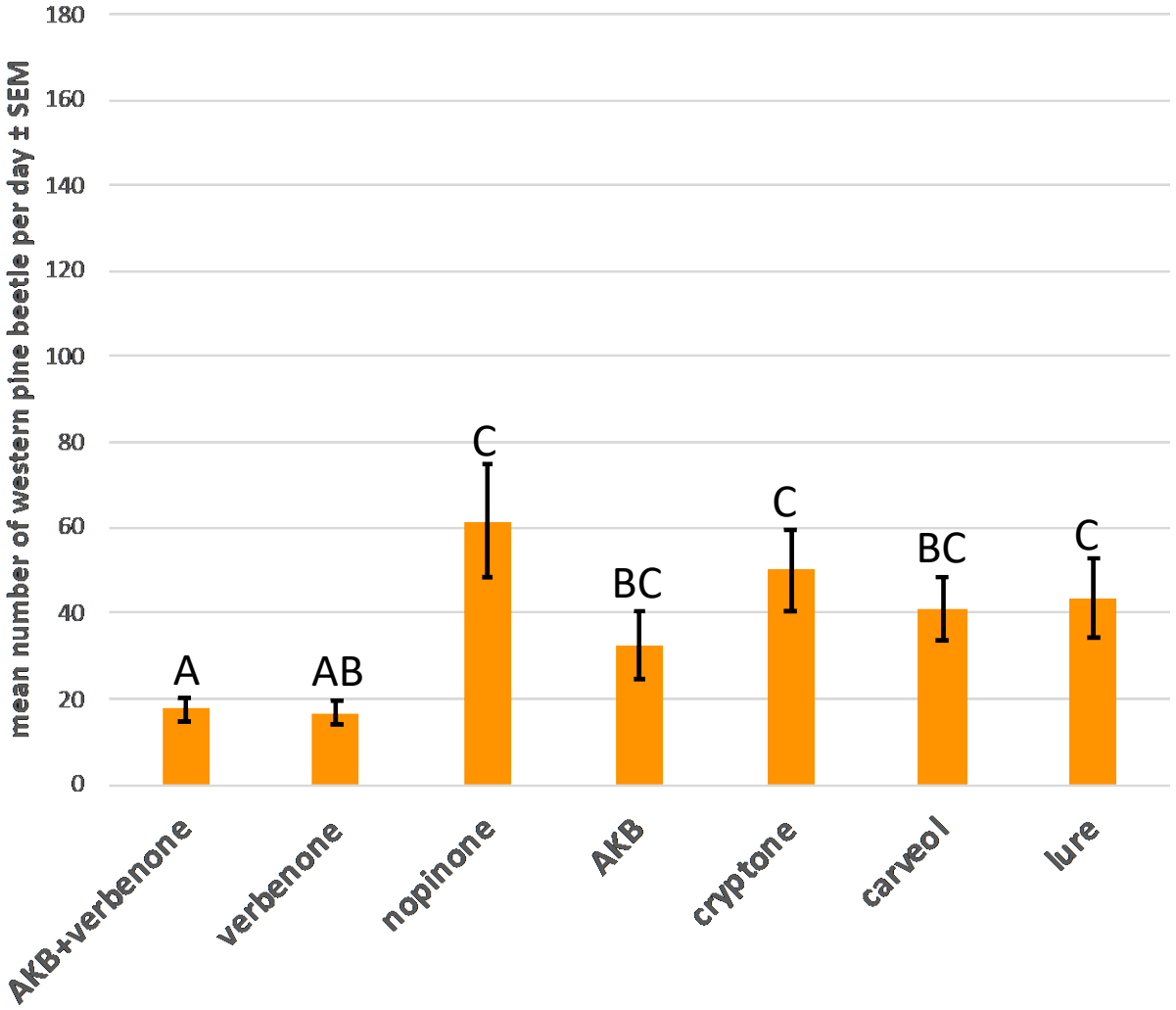
year
2017
2019
2021

California Results



Trap location is not significant and excluded from final model.

Idaho Results



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