

Cold tolerance and seasonal generations of the western pine beetle in California



Erich G. Vallery, USDA Forest Service - SRS-4552, Bugwood.org

Danny Cluck

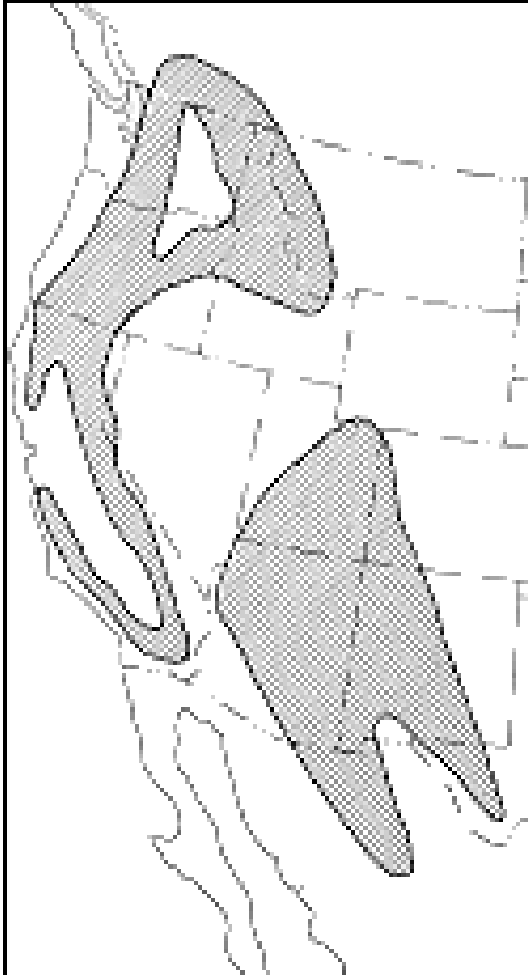
Entomologist

Forest Health Protection

Region 5

Western Pine Beetle

(Dendroctonus brevicomis LeConte)



Hosts: Ponderosa and Coulter pine

- **Two** generations at higher elevations and northern part of the range (June-September)
- **Three** and **sometimes four** at lower elevations and southern part of the range (March-November)

Cold Tolerance

- Western pine beetle larvae begin to develop cold hardiness by late October/early November.
- Laboratory studies found:
 - -7.5°F will kill most larvae in a couple of hours
 - -5°F will kill $>50\%$ of larvae
 - 0°F for an extended time will cause some larval mortality.
- Internal bark temperatures can be up to 8° to 20°F warmer than the ambient air temperature.
- For overwintering larvae to experience lethal temperatures in a tree, ambient air temperatures would have to be substantially lower and sustained (e.g. -15° to -20°F).

From Miller and Keen 1960

Northern California

- Mortality of western pine beetle larvae due to cold temperatures was observed in 1924, 1932, 1933 and 1937 in central Oregon and northeastern California (temps -20°F to -30°F)
- It is likely that several other cold temperature events recorded in northern California since 1937 have resulted in western pine beetle mortality.
- The general consensus of researchers was that anything less than 50% reduction in beetle populations had little to no effect on outbreaks.

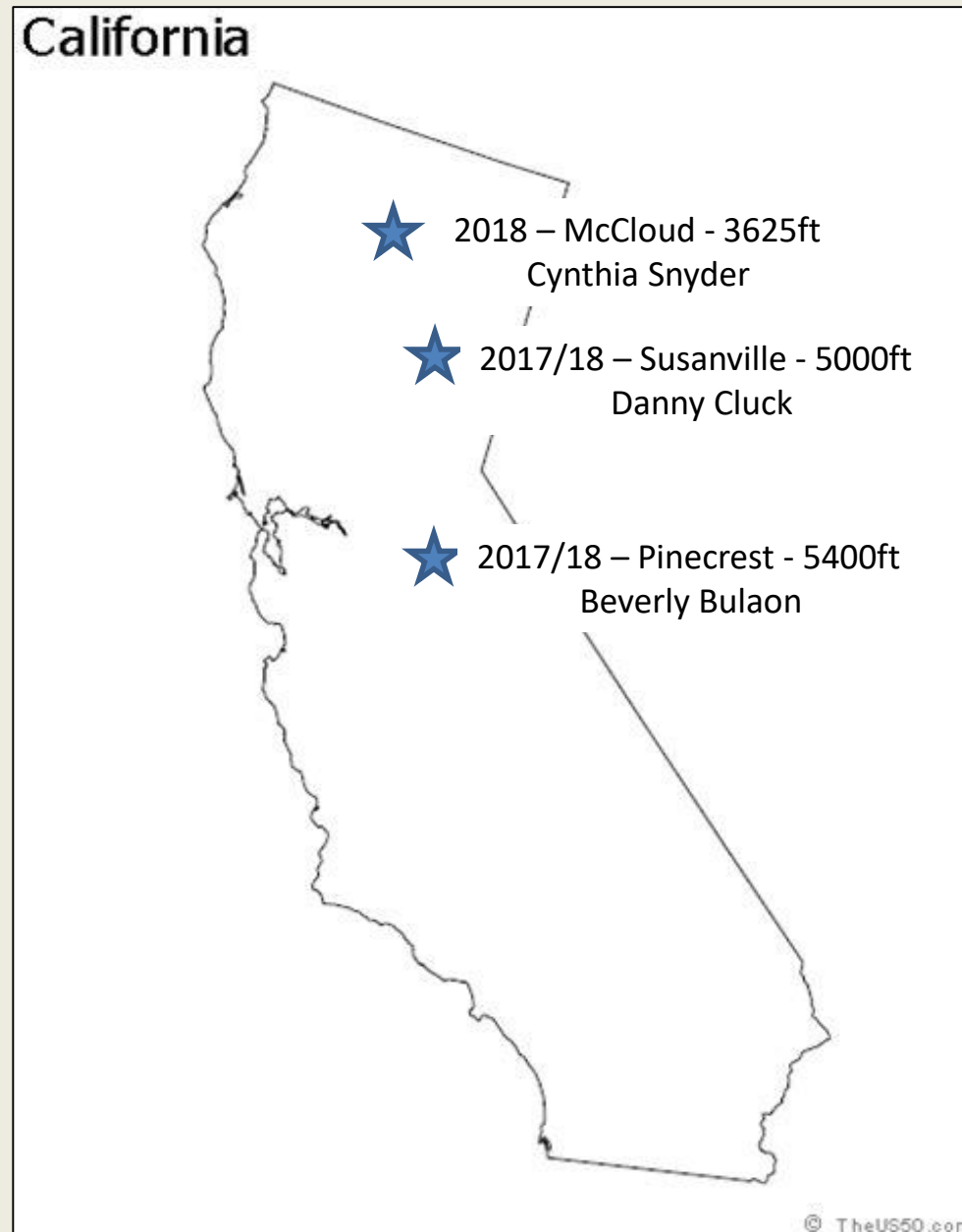
From Miller and Keen 1960

South Sierra and Southern California

- Only one record of western pine beetle mortality due to cold temperatures is known to exist for the west slope of the Sierra Nevada.
- Larval mortality was estimated at 15% on a single tree near Bass Lake, CA after the record cold temperatures of January 1937 (-21°F at Wawana, CA).
- The same survey also found no abnormal mortality of forest insect broods in southern California
- Weather records suggest that winter mortality events would have been rare to non-existent in most locations within this region (nearly all cold temp records -6°F or warmer).

From Miller and Keen 1960 and Salman 1937

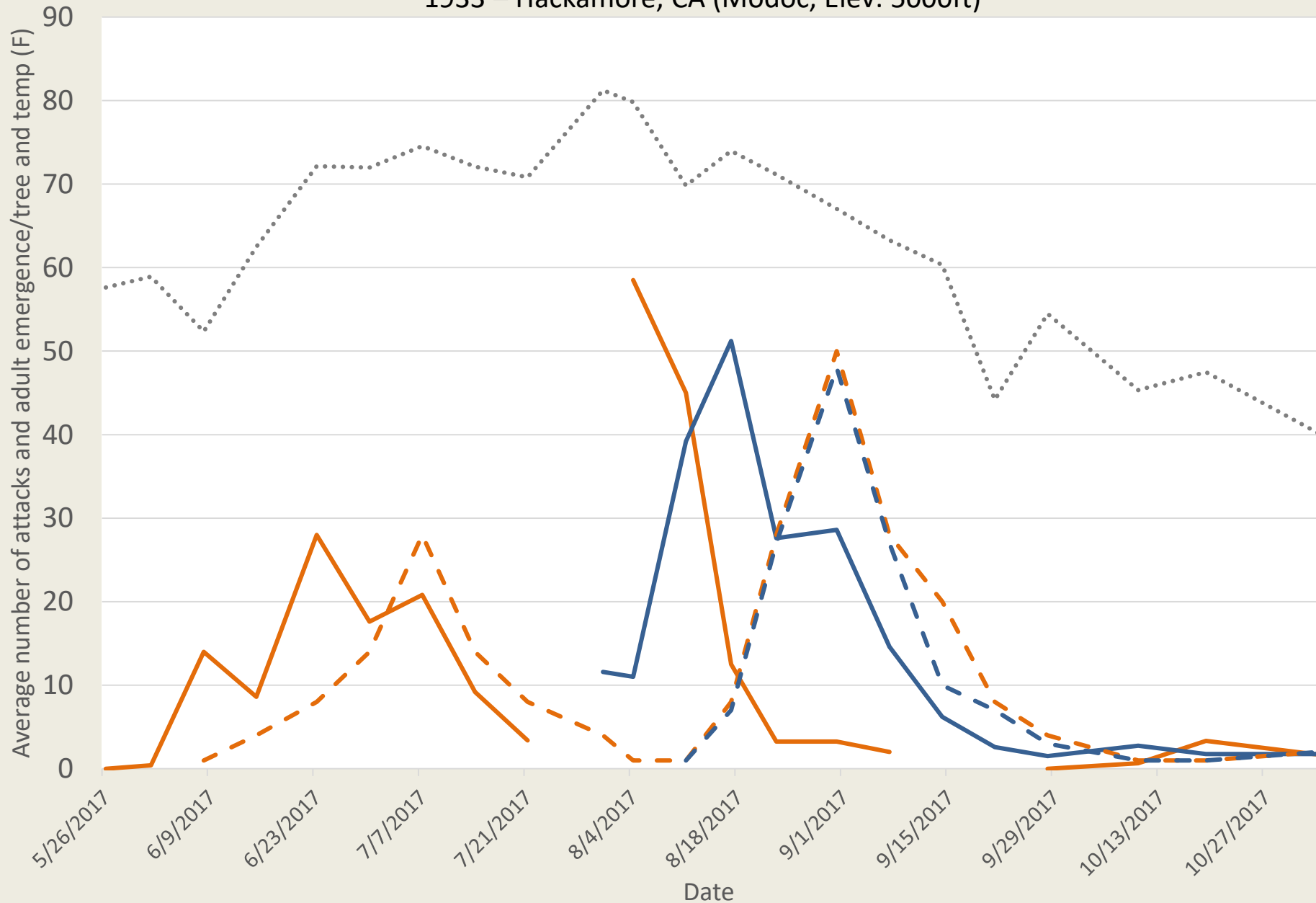
Western Pine Beetle Seasonal Generations Monitoring





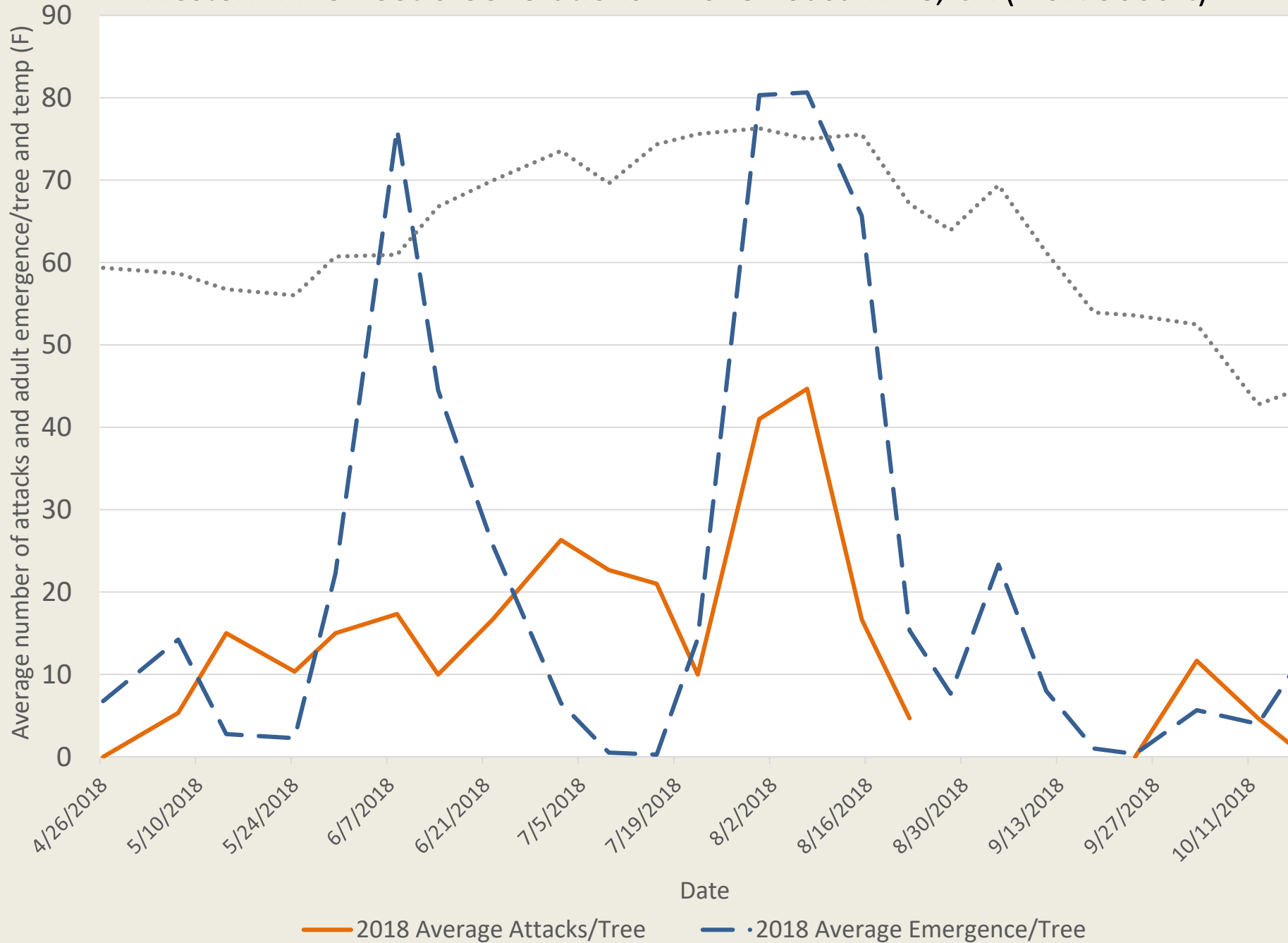


Western Pine Beetle Generations - 2017 - Susanville, CA (Elev: 5000ft) and
1933 - Hackamore, CA (Modoc, Elev: 5000ft)

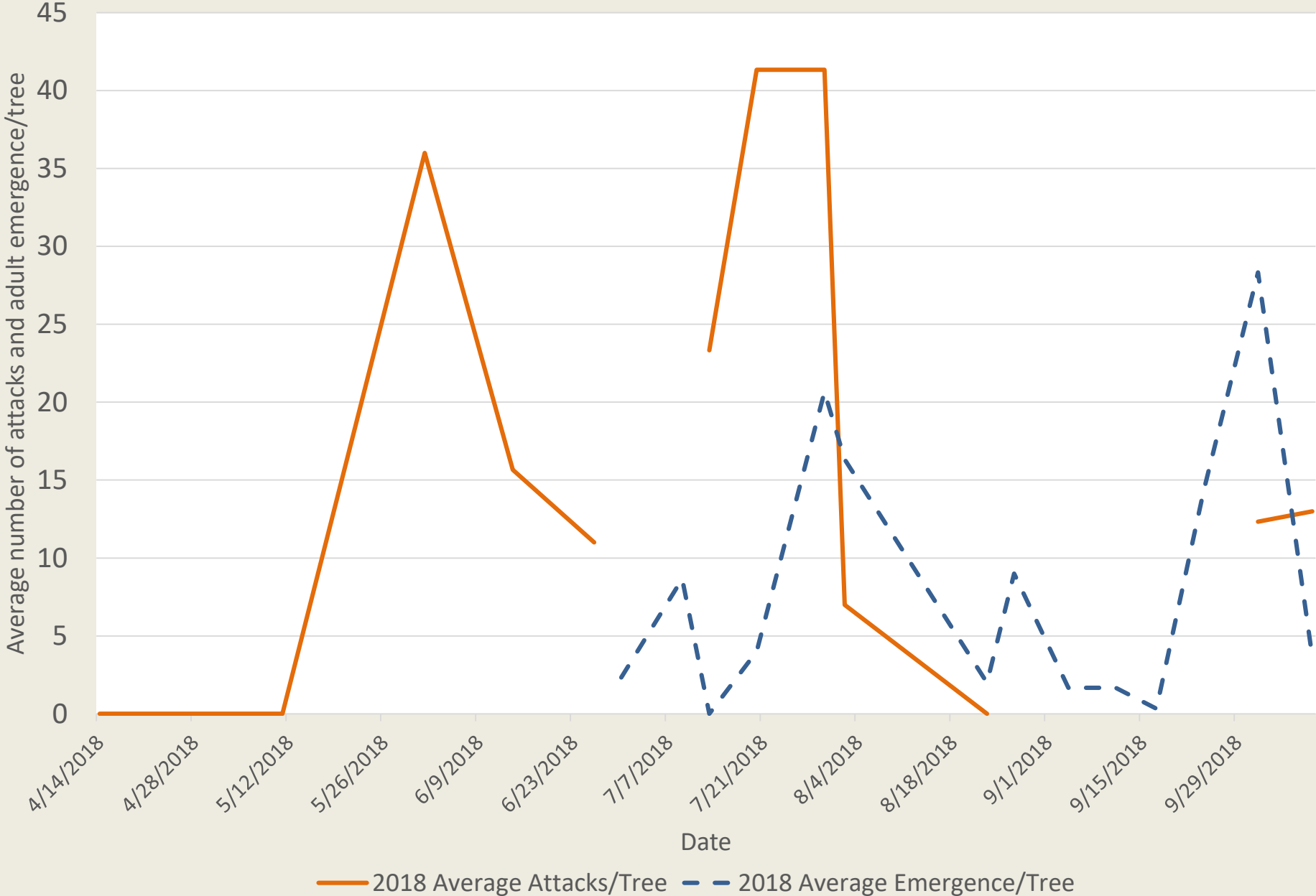


— 2017 Average Attacks/Tree
 — 2017 Average Emergence/Tree
 - - - 1933 Average Attacks/Tree
- - - 1933 Average Emergence/Tree
 ····· 2017 Average Temperature (F)

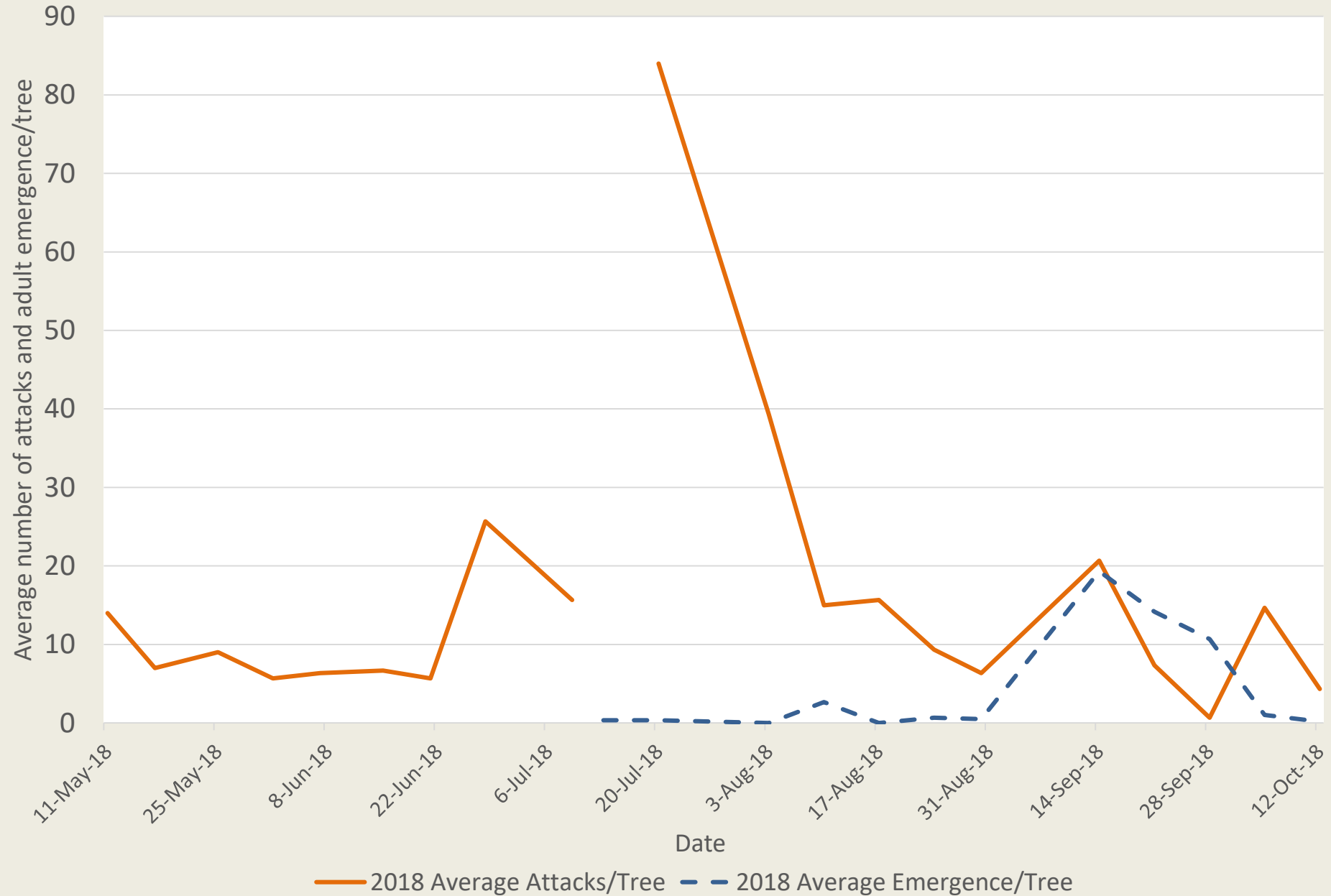
Western Pine Beetle Generations - 2018 - Susanville, CA (Elev: 5000ft)



Western Pine Beetle Generations - 2018 - Pinecrest, CA (Elev: 5,400ft)



Western Pine Beetle Generations - 2018 - McCloud, CA (Elev: 3,625ft)



Conclusions from 1920s and 1930s research

- Year to year variation in temperature can influence the rate of life stage development but likely results in no more than one extra partial generation.
- The level of tree mortality in any particular region or year seems to have little direct relation to the number of beetle generations produced annually.

From Miller and Keen 1960

Take Home Messages

- Cold winters have likely never controlled western pine beetle populations in California, especially on the west slope of the Sierra Nevada and Southern California.
- Recent warmer and drier conditions do not appear to be increasing the number western pine beetle seasonal generations at this time.

Thank you!

Acknowledgments:

Beverly Bulaon, Entomologist, R5 FHP

Cynthia Snyder, Entomologist, R5 FHP

Barbara Bentz, Research Entomologist, RMRS

Jim Vandygriff, Research Entomologist, RMRS

Sheri Smith, Regional Entomologist, R5 FHP

Bill Woodruff, Plant Pathologist, R5 FHP

Tyanna Blaschak, Hydrologist, Lassen NF