Wildfire effects on Sin Nombre hantavirus prevalence and *Peromyscus maniculatus* abundance in the Northern Sierra Nevada

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Introduction

The frequency and impact of wildfires are increasing globally due to climate change. Land use change through wildfire and human landscape alteration can potentiate pathogen transmission and spillover. Hantaviruses are found globally and predominantly hosted by rodents. *Sin Nombre orthohantavirus* (SNV; Order: *Bunyavirales*, family: *Hantaviridae*) is maintained throughout North America by *Peromyscus maniculatus* rodents (deer mice) and can cause hantavirus cardiopulmonary syndrome (HPS) in humans, with case fatality ratio of 35-40%. Climate change has also been linked to an increased prevalence of human hantavirus infections, but less is known regarding wildfire effects on SNV prevalence in deer mice. To better understand potential links between wildfire and SNV prevalence in deer mice, we conducted longitudinal surveillance of deer mice in Red Clover Valley at wildfire impacted and unburned control sites from August 2020 to June 2022. This includes two seasons of sampling data prior to the Dixie fire of 2021.

Objectives

1. Determine impact of wildfire on overall abundance of *P. maniculatus* at select sites
2. Determine impact of fire on in SNV prevalence in *P. maniculatus*

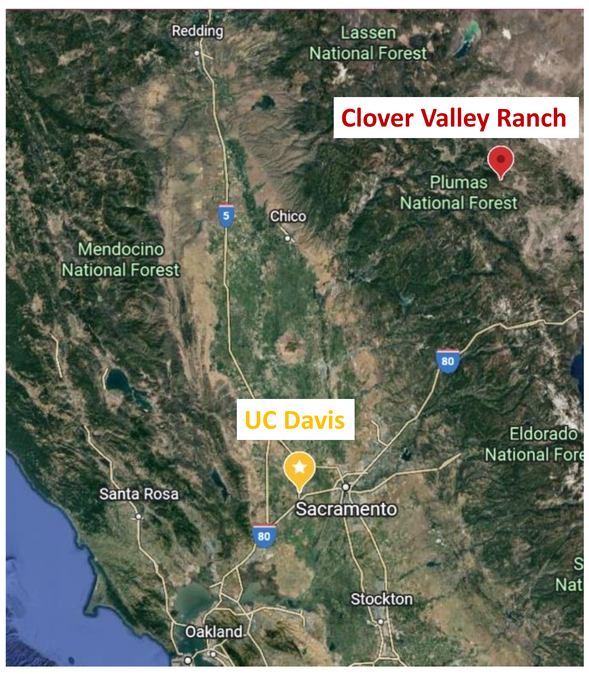

Figure 1: Map of California adapted from GoogleEarth with a pinpoint on Clover Valley Ranch, and star on UC Davis campus location.

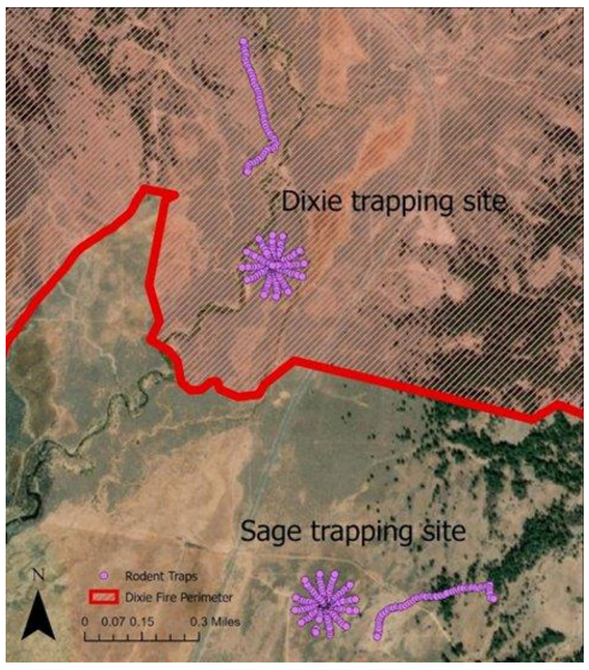

Figure 2: Map of two trapping sites. Red hashmarks represent the Dixie fire perimeters and purple dots represent individual traps at each site.

Hypothesis

We hypothesize that an initial decrease of *P. maniculatus* abundance and prevalence will be observed at burned sites in the first 3 months following wildfire. Then after 12 months at burned sites, we expect to observe greater rodent abundance, and equivalent or greater SNV prevalence compared to pre-fire levels.

Methods

Non-Lethal Rodent Sampling: Two sites (burned and unburned) within the Clover Valley Ranch were chosen. At each site and time point a fixed GPS-referenced pattern of live-capture Sherman traps were placed in standard web and linear transect arrangements. Each web contained 148 traps in a circular pattern (12 linear lines emanating from a central point, 12 traps per line, 100m radius; 4 additional traps at central point). Transects ran up elevation and contained 52 traps placed every 10 meters apart. Traps were baited in the evening (between 6 and 8 pm; oats, peanut butter, and bacon) and left open over night. Traps were checked at dawn and captured rodents were processed following standard field BSL-3 practices appropriate for hantavirus surveillance on site. Standard morphometric data, oral and urogenital swabs, fecal samples, and blood specimens were collected and placed directly into virucidal lysis buffers. Prior to release at the specific site of capture, a unique ID tag was placed on the right ear of each rodent. During each sampling month, traps were placed at each site for two consecutive nights.

Sin Nombre virus Testing: Inactivated specimens were transported to the One Health Institute Laboratory in liquid nitrogen. Total nucleic acids (RNA and DNA) was extracted (DuoPrime, Kingfisher) and SNV genome was detected utilizing a pan-SNV RT-qPCR detection assay (ABI 7500 system, *Bagamian et al., 2012*). Positive controls included purified SNV RNA and short cDNA oligos containing the targeted region of the SNV genome. Specimen quality and nucleic acid extraction fidelity was determined by pan-eukaryotic 18s rRNA assays. Results were analyzed and depicted using GraphPad-PRISM 9.

Figure 3: *Peromyscus maniculatus* (deer mouse). Source: E. Preston

Figure 4: Collecting oral specimen. Source: E. Preston

Figure 5: Collecting urogenital specimen. Source: E. Preston

Results

- 383 small mammals (5 species) were sampled from August 2020 to June 2022. Of these, 317 were *P. maniculatus* (85.2%)
- SNV RNA was detected from the oral and urogenital swabs of 24 and 7 *P. maniculatus* rodents, respectively.

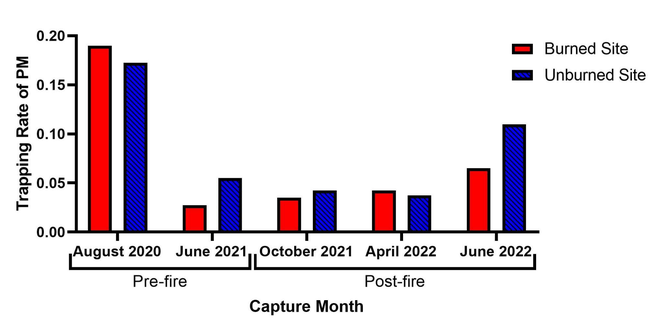

Figure 6: *Peromyscus maniculatus* trap rate compared between burned and unburned sites over time. There is no statistically significant difference between sites and fire exposure using one-way ANOVA.

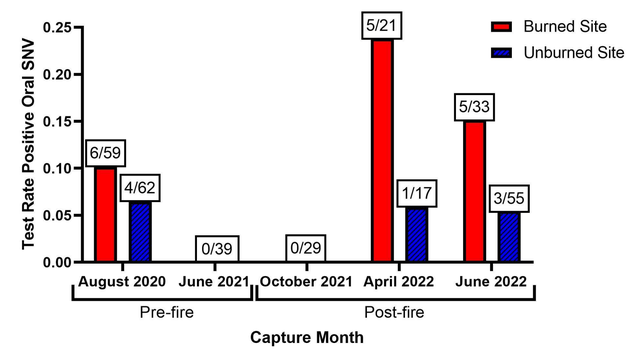

Figure 7: Prevalence and counts of SNV positivity in *P. maniculatus (*oral swabs) sampled at burned and unburned control sites over time.

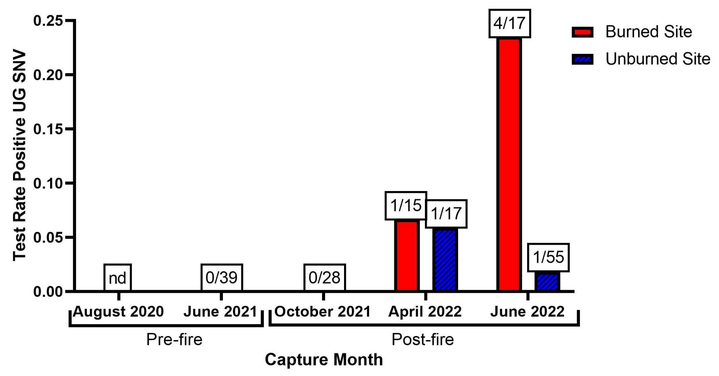

Figure 8: Prevalence and counts of SNV positivity in *P. maniculatus (*urogenital swabs) sampled at burned and unburned control sites over time.

Conclusion & Discussion

- Higher prevalence of SNV in oral and UG swabs collected from the burned site compared to non-burned control site. At this time no significant association has been determined.
- More rapid recovery of rodent abundance at non-burned control site in June 2022
- Additional rodent sampling in August and November may allow for more robust statistical analyses of these trends
- Analyses are impacted by seasonality differences in rain/snow fall and other climatic variables, and overall small sample size to date.
- Additional primary sampling data and analyses of virus diversity, rodent population density, trapline differences (web vs. transect), and additional mathematical modeling are pending.

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