What are the Impacts of the Mega-fires in Colorado on the Mountain Pine Beetle Infestation?

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Background

Warming climate patterns have led to a prevalent mountain pine beetle infestation in the Rocky Mountains. Mountain pine beetles inhabitat a variety of pine species, and once infested, the tree dies and its' needles turn red. Red needles have 10x less moisture than healthy foliage, and therefore ignite quicker than healthy green needles. Controlling infestations is extremely difficult, and controlled burns is one management technique to slow the spread.
Climate change has also caused increasing temperatures and decreased precipitation, leading to dry forests with heightened risk for high intensity fires. As a result, there have been countless mega-fire events across the West coast in 2020, including the Pine Gulch, Cameron Peak, and East Troublesome fires in Colorado, the three largest fires in Colorado history.

Figure 4. Aftermath of a tree after a MPB attacks it. Photo from New York State Dept. of Env. Cons website.

Motivation

The Mountain Pine Beetle population is dramatically affecting pine trees mortality rates and forest health, as are the mega-fires. Although the megafires are detrimental to ecosystem health as a whole, we want to see if they will impact the abundance of the beetle population. This research will help guide management practices of the Mountain Pine Beetle in the future and in other areas and help determine the best controlled burn techniques and severity necessity to slow the spread.

Figure 1. Mountain Pine Beetle. Photo from Mountain Pine Beetle profile on the Government of Canada website.

Hypothesis

We hypothesize that the recent mega-fires in Colorado will have a negative effect on the abundance of Mountain Pine Beetles.

Prediction

We predict that the megafire will help the population concerns of pine beetles. There have been concerns that the mountain pine beetles infestation causes increased incidence/severity of fires, but this evidence is inconclusive, and we want to explore how the severity of the fires have the potential to reduce abundance.

Figure 3. Firefighters watching the Pine Gulch Fire. Photo by Wyoming Hotshots from ABC News.

Study Design: Observational field study

-We will choose three equally sized plots of forest composed of lodgepole and ponderosa pines with previously known infestations of Mountain pine beetles in the area of the 2020 Pine Gulch Fire. We will chose these plots based on burn severity rated by the composite burn index : an area of low severity (.5-1), a medium severity area (1.5-2) and an area with very severe burns (2.5-3) from wildfires.
-We will observe each of these plots over 3 years, randomly sampling from trees using four 100cm^2 bark disks collected with a circular hole-cutting saw on each side of the tree. We will then x-ray these disks and use the negative prints to assess the density of beetles and eggs. We will use this data estimated density and the estimate of the surface area or bark volume of the tree, to estimate of the beetle density within the tree. We will use the data of several trees to estimate the population of the beetles in each plot.
-We will also use basic on tree traps made with nylon screens and collecting bottles to monitor new emergences and we will record if the beetles tend to attack uninjured or injured trees.
-Using scatterplots, field data and observations, we will be able to determine the effects of wildfires and if they have a correlation with the beetle population decline. All necessary permits will be obtained from the U.S Forest Service.

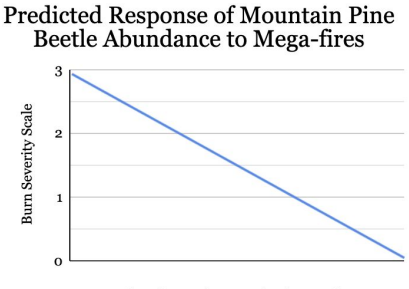

Figure 2. Our predictions on how the high severity of the mega-fires will influence the population of Mountain Pine Beetles.

Intended Analysis

Since our independent variable (severity of burns) and dependent variable (beetle abundance) and are continuous, we will conduct our study design using regression analysis.

This analysis will help in determine the relationship between burn severity and the population of beetles. If the p-value is <0.05, there would be enough statistical evidence to support an alternative hypothesis that there is a relationship between increased burn severity and decline of beetle populations.

As we are only sampling from areas burned by the Pine Gulch Fire, our inferences will be limited to our study area.

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