Title: A Longitudinal Analysis of Coastal Cutthroat Trout (Oncorhynchus clarkii clarkii) and *Oncorhynchus mykiss* Following Severe Wildfire in Oregon Cascades Headwaters.

Like many regions around the world, wildfire regimes in the Pacific Northwest region of North America have been disrupted over the past century and a half due to the cessation of indigenous burning and a broad policy of fire suppression. As wildfire increases in frequency and severity in forested watersheds across the western US and around the world, there is increasing concern about the effects of severe wildfire on fish communities and water quality. It is important to recognize as fire regimes continue to shift in the Pacific Northwest, most of these fires are occurring in regenerating forested watersheds with a legacy of forest management. Salmonid fish are an ecologically, culturally, and economically important taxa, they help structure headwater stream food webs, and are highly sensitive to environmental changes. Thus, they have become a well-studied species for assessing impacts of land-use changes. To understand and parse out ecological effects of fire disturbances on salmonids in headwater systems, it is important to contextualize responses relative to the historic impacts of forest management. Given that fire occurs at the landscape scale and creates a mosaic of disturbance, exploring the effects of fire in a small stream section may only describe one of multiple potential effects. Therefore, assessing salmonid responses to wildfire benefits from assessing a larger section of stream from small headwaters down. Further, the response of habitat quality and resource availability varies across large spatial and temporal scales and studies do not often address questions about context or how focal fish populations in study streams compare to those across a broader regional context. Our study focused on the response of native salmonid populations to wildfire in the Hinkle Creek catchment in western Oregon at two spatial scales. Previous long-term research from this system documented the effects of contemporary timber harvest on fish and invertebrates, which provides a rare opportunity to contextualize effects of wildfire on stream apex predators. We repeated longitudinal fish and habitat surveys to draw comparisons among fish responses to different forest disturbances. We also established four intensive reaches to estimate fish biomass and density in comparison to regional and historical estimates from other studies. In 2020, the Archie Creek fire burned more than 53,000 ha of land in the Western Cascades, resulting in more than 75% canopy cover loss in over 70% of the Hinkle Creek watershed.

We assessed biomass and density of Coastal cutthroat trout (CCT) and *O. mykiss* in all pool habitats along the mainstem of the South Fork Hinkle Creek among three distinct pre-fire harvest periods (pre-harvest monitoring, post-headwater harvest, and post-mainstem harvests) and after severe wildfire. Our results generally showed that salmonid biomass and density increased after forest management disturbance and severe wildfire. We found that estimated mean biomass of CCT in pools in the post-fire period was between 154–290% (12.77 g/m^2) greater and density in pools was between 90–149% (0.45 $fish/m^2$) greater compared to estimates from the pre-fire periods. Similarly, post-fire estimated mean salmonid biomass in pools was between 110–321% (13.60 g/m^2) greater and density in pools (0.75 $fish/m^2$) was between 30-165% (0.75 $fish/m^2$) greater than the pre-fire periods.

We also estimated the potential range of variation for total biomass and total density along the mainstem from the pre-fire period using bootstrapping to run 2,000 cumulative distributions. We found that observed post-fire total CCT biomass and density were greater than 100% and 81–92% of the bootstrapped distributions, respectively. Observed post-fire total salmonid biomass and density were greater than 91–92% and 45–73% of the pre-fire bootstrapped distributions, respectively. Further, we found that after fire, cumulative functions showed faster cumulation of biomass and density in the upper portions of the mainstem for cutthroat and total salmonids. This follows a pattern of downstream increases in stream temperature along the mainstem of the South Fork with cooler temperatures in the upper reaches.

To further understand Coastal cutthroat trout (CCT) response to wildfire, we estimated cutthroat trout biomass from 11 multi-pass surveys in Hinkle Creek from 2021–2022, and we conducted a literature review to contextualize these estimates to the range of variation in cutthroat populations in a core part of their range. With the literature review, we gathered 113 biomass estimates from 27 other sites west of the Cascade Crest in Oregon and Washington, 3 of which came from recently burned watersheds. We found that in three of the five sites in Hinkle Creek fish biomass was more than one standard deviation above the regional mean and in two of the sites CCT biomass values exceeded all other estimates from the literature review. However, not all sites had higher biomass. Of the 11 estimates in Hinkle Creek (across 5 sites) CCT biomass ranges encompassed nearly the full range of biomass estimates from the literature review. This shows that native salmonids of the Pacific Northwest do not only persist after varying degrees of forest disturbance, but overall salmonid production may increase.

This study demonstrates a wide range of variation in headwater trout populations at temporal and spatial scales. In this study, Coastal cutthroat trout and O. mykiss show potential resilience and an adaptive capacity to disturbances such as wildfire and logging. Our results suggest that trout populations are not currently vulnerable to these disturbances, but a holistic approach to continued monitoring and research is necessary to fully understand the long-term impacts and adaptive capacity of trout populations to successive disturbances.