



WILDFIRE IMPACTS ON SPRING CHINOOK SALMON HABITAT QUALITY IN THE WENATCHEE RIVER SUB-BASIN

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Wildfire disturbances create varying habitat patterns over space and time for fish populations. Spring Chinook Salmon (*Oncorhynchus tshawytscha*) are a wide-ranging salmonid species endemic to the Pacific Northwest, and are listed as threatened or endangered in many portions of their range. The influence of wildfires on aquatic ecosystems and spring Chinook Salmon habitat is not well understood, as stream habitats are linked to the complex landscape around them, and disturbances such as wildfires can affect both forest and watershed characteristics. Spring Chinook Salmon are adapted to natural wildfire disturbance regimes, however, long-term fire suppression has shifted the intensity and frequency of wildfires from historic norms. As such, scientific research has the potential to inform pre- and post-fire forest management planning to consider the potential impacts of wildfire on aquatic systems and salmonid habitats.

In this study, researchers developed models of freshwater habitat for spring Chinook Salmon in pre- and post-fire scenarios in the Wenatchee River sub-basin of central Washington, where a large number of wildfires have occurred in the past 30 years. They predicted changes in in-stream wood, sediment, and water temperature as a result of wildfires and modeled their influence on habitat quality for three life stages (egg/fry, juvenile, and adult) of spring Chinook Salmon. They also compared their model results with the current and historic distribution of spring Chinook Salmon to better understand if decreasing populations are distributed in ways that correlate with fire impacts on habitats.



Spring Chinook salmon. Photo courtesy Michael Humling, US Fish & Wildlife Service



Juvenile Chinook Salmon. Photo courtesy John McMillan

KEY FINDINGS

- At the watershed scale, there is currently less overall high-quality habitat for overwintering juvenile than other life stages of spring Chinook Salmon.
- Across the watershed, wildfire increased the amount of high-quality overwintering juvenile and adult habitat and decreased high-quality egg/fry habitat.
- Fire had the greatest positive effect on habitat for the juvenile life stage and resulted in increased juvenile overwinter habitat quality in all watersheds.
- Spring Chinook Salmon are currently distributed in stream channels that have a consistently positive modeled response to wildfire.

The Northwest Fire Science Consortium is a regional fire science delivery system for disseminating knowledge and tools, and a venue for increasing researcher understanding of the needs of practitioners.



RESULTS

Distribution of high-quality habitat

For the current distribution of spring Chinook Salmon (pre-fire model), the largest amount of high-quality habitat was associated with the egg/fry stage, followed by the adult stage, with the least amount of high-quality habitat currently existing in the watershed for the juvenile overwintering stage. The post-fire model, which projects habitat quality after simulated wildfire intensities and probabilities, showed different impacts on high-quality habitat for each life stage. The post-fire model indicated an overall increase in the amount of quality habitat for juvenile and adult life stages, due primarily to the delivery of large wood to the channel by erosion and debris flows. The increase for juvenile overwintering habitat was the most significant, with a projected increase in high-quality habitat in every watershed in the sub-basin (+73% across the sub-basin). The increase in adult high-quality habitats was consistent but smaller (+8% across the sub-basin). There was a decrease in egg/fry high-quality habitats (-8% across the sub-basin) post-fire, due primarily to inputs of fine sediments and increased water temperature. The combined assessment of habitats across all life stages indicated increases in high-quality habitats from the pre-fire to post-fire conditions.

Comparison of mean habitat quality

Mean habitat quality increased for adult and juvenile overwinter habitat in every watershed in the sub-basin in the post-fire modeled environment, while mean habitat quality for egg/fry decreased post-fire. Areas in the sub-basin that have never been used by spring Chinook Salmon had a lower mean value of habitat quality than channel reaches in the current and historic range, and areas that were used historically but are not currently used by these fishes had lower habitat quality as well. This suggests that the declining populations of spring Chinook Salmon have selected areas with the most positive potential response to wildfire.

MANAGEMENT IMPLICATIONS

Wildfire has the potential to affect all life stages of spring Chinook Salmon. The greatest change in habitat after wildfire in this study was observed in the juvenile overwinter life stage, which increased dramatically post-fire, compared to smaller changes for adult and egg/fry habitat, which showed a much smaller increase and decrease, respectively. This is important because high-quality juvenile overwinter habitat was less extensive in the sub-basin than egg/fry and adult habitat. The potentially

large post-fire increase in this relatively rare high-quality habitat type suggests a shift in fire management from a focus on suppression to a focus on flexible management where wildfire could be allowed to contribute to habitat enhancement for spring Chinook Salmon.

For disturbance adapted aquatic species such as salmonids, periodic events are necessary to maintain a full range of ecosystem conditions. Salmon have evolved adaptive mechanisms that spread the risk of severe environmental disturbances among life stages and cohorts, ensuring long-term population survival from disruptive natural processes. Populations of spring Chinook Salmon have decreased along with suitable habitat in the Wenatchee River sub-basin. Currently, they are located in the portion of the sub-basin that has the greatest potential for enhanced habitat in all life stages after a wildfire disturbance. Thus, promoting natural disturbance processes may be an important option for habitat restoration in this study area. Forest management that considers natural disturbance processes may leverage existing adaptation within native fish populations to enhance their natural resilience.



Wenatchee National Forest. Photo courtesy Autumn Ellison

MORE INFORMATION

This brief is based on the following article :

Rebecca A. Flitcroft, Jeffrey A. Falke, Gordon H. Reeves, Paul F. Hessburg, Kris M. Nyset, and Lee E. Benda. 2016. Wildfire may increase habitat quality for spring Chinook salmon in the Wenatchee River subbasin, WA, USA. *Forest Ecology and Management* 359: 126-140. Available online at: <http://www.sciencedirect.com/science/article/pii/S0378112715005447>

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