

WILD SALMON RESPONSE TO NATURAL DISTURBANCE PROCESSES

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Dynamic landscapes are shaped by a variety of natural processes and disturbances operating across multiple temporal and spatial scales. Persistence of species in these dynamic environments is also a matter of scale: how do species dispersal and reproductive rates merge with the scales of disturbance? Across the Pacific Northwest, salmon populations have evolved with a complex set of natural disturbance patterns and processes creating and altering their essential habitats. In most watersheds, human activities have changed the disturbance regimes and compromised our ability to examine both the natural processes and salmon population responses. In this study, we evaluated wild Chinook salmon responses to natural disturbance processes in the Middle Fork Salmon River (MFSR), Idaho. The MFSR is a large wilderness basin where natural processes function relatively unimpeded by human activities. During the last 20 years, a series of fires have burned large portions of the MFSR basin. Those fires, followed by intense thunderstorms over some burned areas, have resulted in large debris flows that have altered salmon habitats within both the mainstem MFSR and several major tributaries. Over this same 20 year period, we have annually surveyed and geo-referenced the location of all Chinook salmon redds (spawning nests) across the entire MFSR basin. In this paper, we describe the mechanisms of debris flow creation and sediment routing, illustrate temporal and spatial responses of spawning Chinook salmon to natural patterns of habitat disturbance in the basin, assess the importance of salmon dispersal and habitat connectivity, and addresses how a changing climate may alter natural landscape dynamics. In particular, warming temperatures are expected to increase fire frequency and subsequent debris flows in the basin, while increased rain-on-snow events may cause more frequent avalanches, both of which input wood and sediment to the stream network. Field observations are coupled with sediment routing models to explore the consequences of these dynamic processes on salmon habitat over space and time. Inspection of larger-scale stream and basin morphology shows that these processes have been acting on this landscape for millennia and have had long-term effects on channel gradient, stream width, and associated salmon habitats. Consequently, the disturbance processes are not new, geomorphically or biologically, but rather their frequency and spatial extent are being altered by climate change. Although salmon have evolved with these disturbance processes, a key question is whether adaptation of native species can keep pace with rates of climate change and associated disturbance regimes.

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