Presentation Title:
"Thermal Benefits of Restoration"

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Abstract:
"In the Pacific West, summer water temperatures in 99% of streams have increased by ≈0.1°C/decade since the mid-1960s. Global climate change models agree that stream temperatures will continue to increase in the foreseeable future. Much of the Pacific West now exhibits thermal impairment of waterbodies, and temperature-sensitive taxa such as Pacific salmonids already encounter thermal barriers that impede migrations, forcing range contractions. These impacts are not limited to salmonids, but rather extend to include additional important fishes such as herring and lamprey. Currently, temperature mitigation efforts focus on maintaining or restoring riparian buffers to augment stream shading and reduce accretion of additional thermal load. While effective at buffering streams from warming effects of solar radiation, shading does little to cool water that is already warm. Roads, urban development, and agricultural uses can logistically limit practical riparian buffer widths and function. Moreover, imperiled fish stocks may not be able to wait the decades necessary for the functional benefits of riparian plantings to be realized. As a result, there is a compelling need for techniques that effectively promote in-stream cooling. One mechanism proposed to cool stream water is forcing the water to infiltrate the channel bed and interact with hyporheic substrate. During summer months, ground temperatures underneath the stream bed are substantially cooler than stream water temperatures. When warm stream water is forced into interstitial spaces between stream bed substrate, this water interacts with particles that are cooler than the water itself. Rate of water cooling depends on the temperature differential between the water and hyporheic substrate, as well as the spatiotemporal dynamics of this water-substrate interaction. Spatially longer hyporheic path lengths and temporally longer residence times are generally associated with cooler upwelling zones. When they promote deep downwelling, habitat structures show demonstrable temperature-moderating effects. If accomplished on a sufficiently large spatial scale, techniques making use of such structures have the capacity to lower in-stream water temperatures downstream of the placement. We hypothesize that thermal impairments can be addressed by local increases in exchange between surface and subsurface waters. Consequently, we analyzed series of temperature data associated with different types of restoration projects, and undertook a synoptic review of published data to determine differences in temperature above, below, and through reaches that received restoration treatments. Findings from this study could inform management of temperature problems in salmonid streams in places where competing interests such as agricultural land uses, and physical constraints like roads might preclude conventional responses to temperature issues."