

Restoration of Cold Water Refugia in the Columbia River Estuary

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During the past century, a combination of factors has degraded Columbia River water quality, including its thermal regime. Adult and juvenile salmonids migrate through the mainstem Columbia River (including the Columbia River estuary) during periods when temperatures average 18-22°C and reach as high as 24°C. The effects of these temperatures include physiological stress and higher susceptibility to predation. Data are available detailing the characteristics and use of thermal refugia by adult salmon and steelhead above Bonneville Dam; however, very limited data exist regarding use of thermal refugia in the Columbia River below Bonneville Dam. Despite this data gap, available evidence suggests that thermal refugia may provide important benefits to outmigrating juvenile salmon. This is particularly true for subyearling Chinook, whose migration timing coincides with the period of warmest mainstem Columbia River temperatures. This reliance has important implications for salmon recovery, particularly in the face of climate change (warmer air temperatures and changes in precipitation patterns), which is anticipated to increase mainstem temperatures above already stressful levels. The anticipated benefits (and potential future reliance) of thermal refugia to subyearling Chinook also presents a new habitat enhancement strategy for salmon recovery projects in the Columbia River estuary. We present an overview of the need for, and potential benefits of, thermal refugia; a summary of site characteristics that are anticipated to provide thermal refugia; a summary of remaining uncertainties associated with the ability of individual sites to provide thermal refugia; and a case study of a recently completed project that provides examples of habitat enhancement techniques that are anticipated to protect and restore thermal refugia.