

Coastal Beaver, Chinook, Coho, Chum Salmon, and Trout Response to Nearshore Changes Resulting from Diking and Large-Scale Dam Removals: Synergistic Ecosystem Engineering and Restoration in the Coastal Zone

Anne Shaffer^{1,2}, **Dave Parks**¹, **Katrina Campbell**¹, **Anna Moragne**¹, **Bligh Hueske**^{1,2}, **Pamela Adams**¹, **Jenise M. Bauman**²

¹Coastal Watershed Institute (CWI) PO Box 266, Washington 98362, Port Angeles, USA

²Western Washington University, College of the Environment, 516 High St, WA 98225, Bellingham, USA

In this paper we assess long-term trends and habitat changes to understand the relationships between coastal beaver (*Castor canadensis*), salmon, shoreline alterations, large-scale dam removals and nearshore ecological restoration. From this work we conclude that the removal of two large-scale dams in the Elwha River has benefited beaver use of the coastal zone through water quality changes that allow beaver to re-establish high-quality zones and the expansion of riparian zones that provide extensive new food resources to beaver. However, the lower river hydrodynamic processes continue to be disrupted by a 200-meter earthen dike installed by local government and landowners for flood protection in the Elwha coastal zone in the 1960's. The dike acts as a driver of lower river geomorphology and has resulted in the formation of a large and persistent lateral bar along the lower river channel. Associated disrupted hydrodynamics are causing a critical coastal zone of the un-impounded lower river side channels to fill in. This channel habitat has decreased by 23%, with an annual average shrinkage rate of 13%, from pre-dam removal size, resulting in a decrease in both quality and quantity of nursery function for juvenile wild fish in a coastal zone that was historically documented to be the highest functioning for endangered juvenile salmon and trout. Inversely, physical changes including improved water quality in the adjacent impounded west side channel and continued expansion of riparian vegetation along the west delta lateral bar benefitted coastal beaver that recolonized the west delta after dam removals. The newly colonized coastal beaver may provide ecological engineering services to offset side channel loss as well as promote continued fish access. However, recreational use was found to negatively impact beaver use of the area. We therefore recommend a series of additional ecosystem restoration actions that incorporate beaver as an ecosystem restoration component of the coastal zone. These actions include a public outreach program to encourage passive recreation measures to prevent negative impacts to beaver, and legacy, ecosystem scale restoration projects that reconnect the hydrodynamics of the west delta to complete Elwha ecosystem restoration. Together, these steps, if implemented, will result in a synergistic ecosystem restoration throughout the watershed to the benefit of the coastal ecosystem, including both beaver and salmon, as intended by the large-scale dam removal project.

Contact Information: Anne Shaffer Coastal Watershed Institute Phone: 360-461-0799, Email: anne.shaffer@coastalwatershedinstitute.org