Elwha River restoration: evolution of habitats and nearshore ecosystems during large-scale dam removal project

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I. Sediment Processes – Historic/Pre-Dams

Located northwest of Seattle, Washington on the Olympic Peninsula, the Elwha River nearshore extends from the western edge of Freshwater Bay east to the tip of Ediz Hook, and encompasses five distinct geomorphic landforms: lower river, estuary, embayed shoreline, feeder bluffs, and spit. Extending from the area of tidal influence, including the riparian zone, out to 30 meters Mean Low Water (MLLW) depth, the Elwha nearshore provides migration corridor, rearing, and spawning habitat for federal and state listed species including the following: bull trout, chinook salmon, coho salmon, steelhead, eulachon, longfin smelt, surf smelt, and Pacific sand lance.

The Elwha nearshore has been severely degraded due to significant sediment starvation, in order, from shoreline armoring, lower river dikes, and in river dams.

II. Sediment Processes – Post-Dam Construction

About 160,000 m³ of fine and coarse sediment per year were delivered to the mouth of the Elwha River (Randle et al. 1996). Sediment from the river and feeder bluffs were transported eastward by wind and waves to replenish beach substrate and contribute to the formation and maintenance of Ediz Hook (Schwartz 1972, 1994).

Shoreline armoring and diking have been documented to inhibit deposition of sediment and large woody debris (LWD) along the Elwha nearshore (Rich et al. 2014, Lee et al. 2018). Removal of shoreline armoring and dikes has shown fast improvement in sediment deposition and restoration to forage fish spawning grounds (Lee et al. 2018).

III. Sediment Processes – During Dam Removal

Major changes in the area of the shoreline and delta occurred during dam removal. From 2013 to 2014, the total area increased by about 26 ha or 64 acres (Shaffer et al. 2017).

By 2015 about 3.5 million m³ of sediment had been deposited at the delta (Warrick et al. 2015). After restoration is complete, annual sediment delivery is expected to be restored to 160,000 m³/year (BOR 1996).

IV. Sediment Processes – Post-Dam Removal

Prior to dam removals, 91% of salmon species used only 15% of Elwha estuary habitat (Shaffer et al 2009). Monthly beach seineing continue in Elwha nearshore. Historic estuary is now lower river side channel, and new estuary habitat is being formed with sediment delivery to the river mouth.

Anthropogenic Factors

Species richness has not changed significantly since dam removal has begun. However, fish have been quick to occupy new estuary habitat created by the delta growth. It is notable that bull trout, eulachon, and redside shiner have been documented for the first time ever in the estuary since dam removal began.

Lower River and Estuary Study

As a result of human alterations, the Elwha nearshore was starved of sediment. Removing the dams has provided large amounts of sediment to the nearshore, creating new estuary habitat for various species of fish and softening newly restored beaches. Nearshore ecosystem restoration is limited by the remaining habitat impediments including armoring and lower river dikes. It is important to continue efforts to understand, restore, and protect these important and evolving nearshore landforms and habitats.

Acknowledgements and Citations

\[\text{References}\]

- Shaffer, J.A., M. Beirne, T. Ritchie, R. Paradis, D. Barry, and P. Crain. 2009. Fish habitat use response to anthropogenic induced changes of various species of fish and softening newly restored beaches. Nearshore ecosystem restoration is limited by the remaining habitat impediments including armoring and lower river dikes. It is important to continue efforts to understand, restore, and protect these important and evolving nearshore landforms and habitats.