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

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Elwha Nearshore: An Overview

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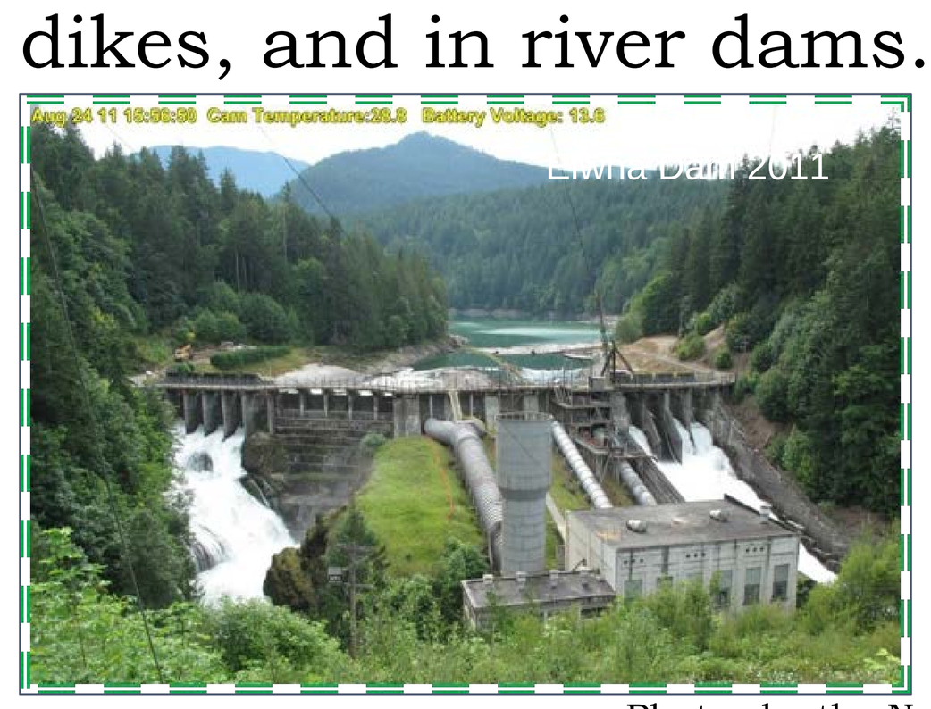
Introduction

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 Lower 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.

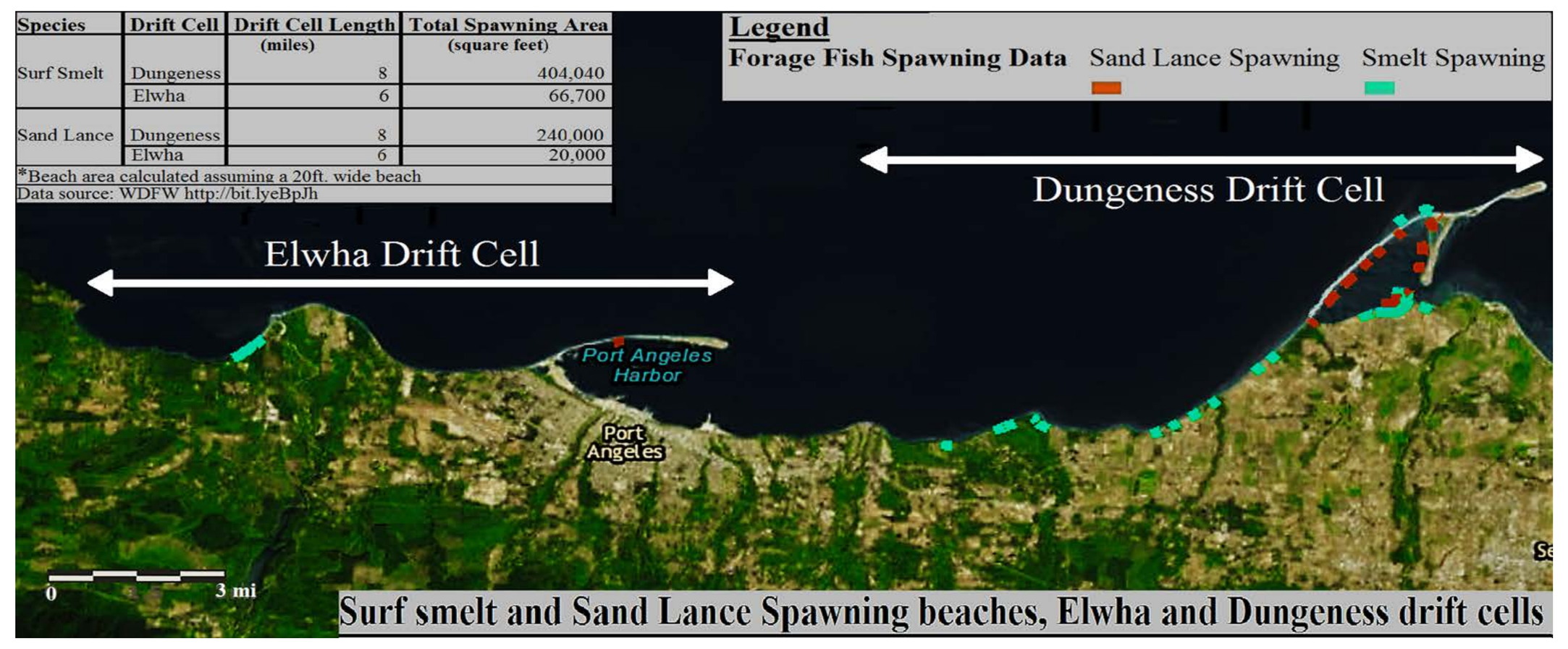


Photos by the National Park Service

Elwha Drift Cell

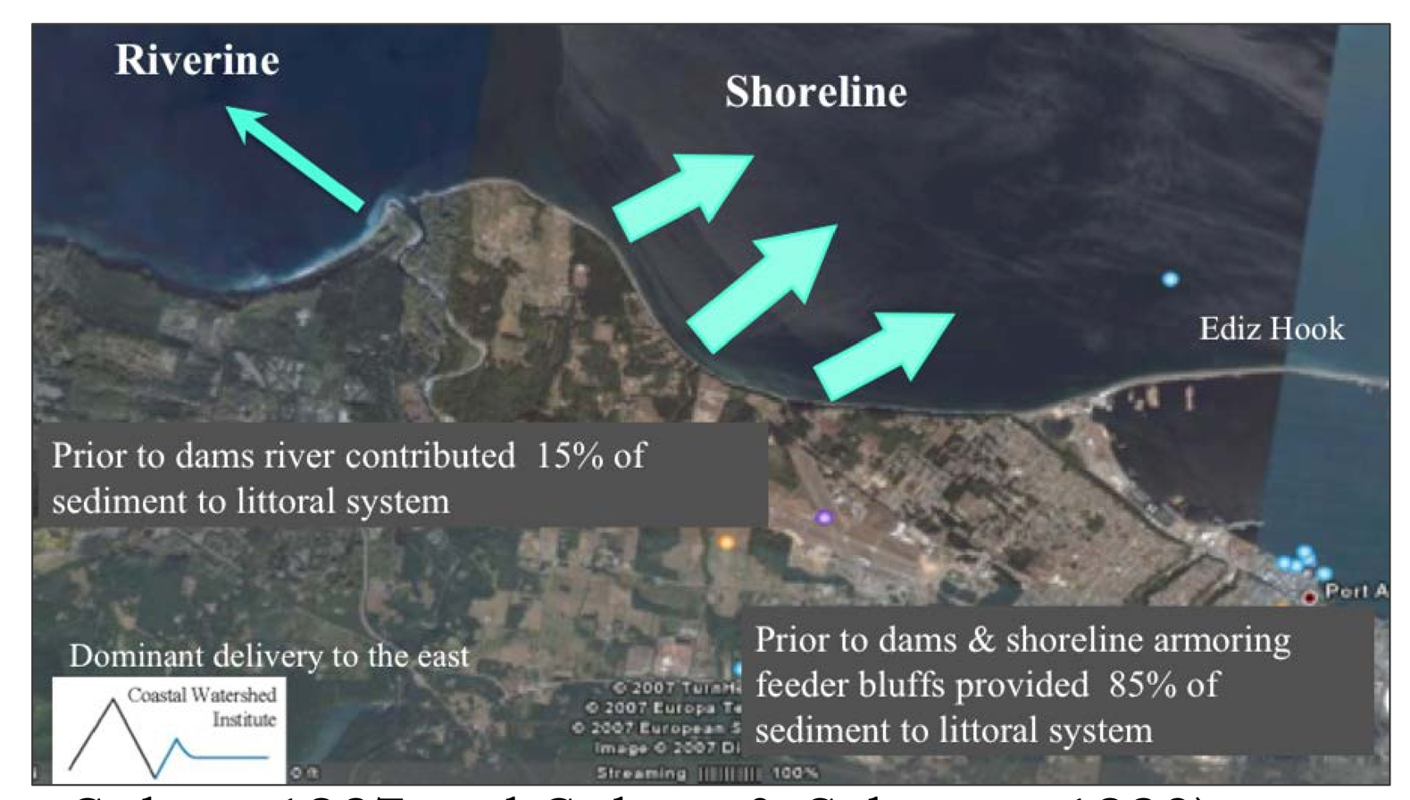
Habitats	Length	Area
Lower river	0.5 km	
Estuary (pre-dam removal)		88.96 acres
Embayed shoreline	7 km	
Feeder bluffs	6 km	
Spit	5 km	
Total Shoreline	18.5km	

- Extensive shoreline armoring in the Elwha drift cell significantly limits available spawning habitat of forage fish.
- The Elwha drift cell supports surf smelt spawning along less than 11% of its beaches compared to 47% along the comparative and intact Dungeness drift cell. Less than 3% of the Elwha drift cell supports sand lance spawning, compared to 28 percent of the Dungeness drift cell beaches.



I. Sediment Processes – Historic/Pre-Dams

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).



(Galster 1987 and Galster & Schwartz 1990)

II. Sediment Processes – Post-Dam Construction

- About 21 million m³ of sediment had been locked behind two Elwha dams (Shaffer et al. 2017).
- After dam construction and shoreline armoring, sediment volumes were reduced to approximately 15% of historical volumes (Parks 2015).

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).

IV. Sediment Processes – Post-Dam Removal

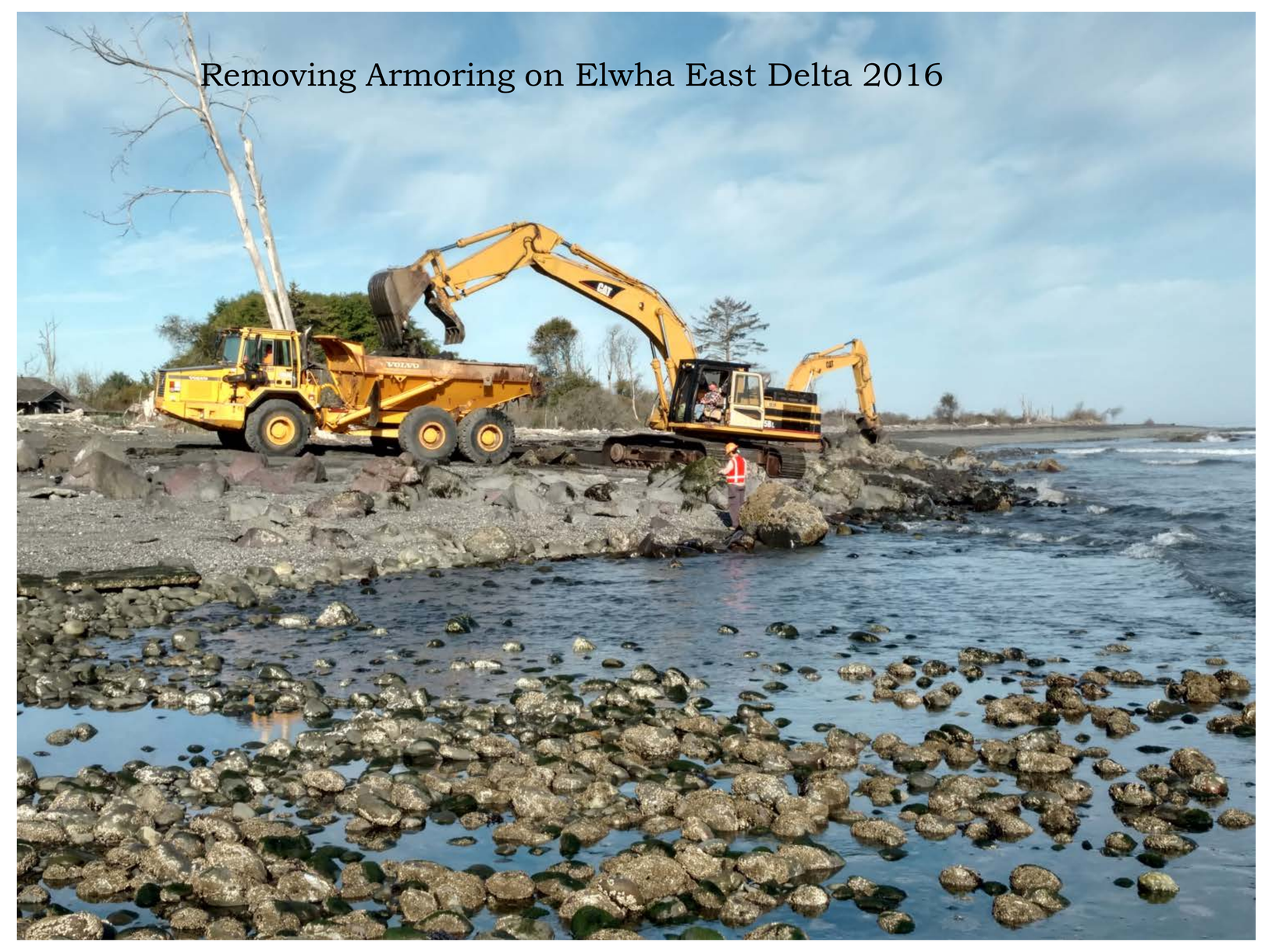
By 2015 about 3.5 million m³ of sediment had been deposited at the delta (Warrick et al. 2015). After restoration is complete, annual sediment delivery is expected to be restored to 160,000 m³/year (BOR 1996).

What's not restored with dam removal?

- Altered shoreline armoring along Elwha feeder bluffs and Ediz Hook
- Lower river diking, including blocking of west estuary by west levee.

Anthropogenic Factors

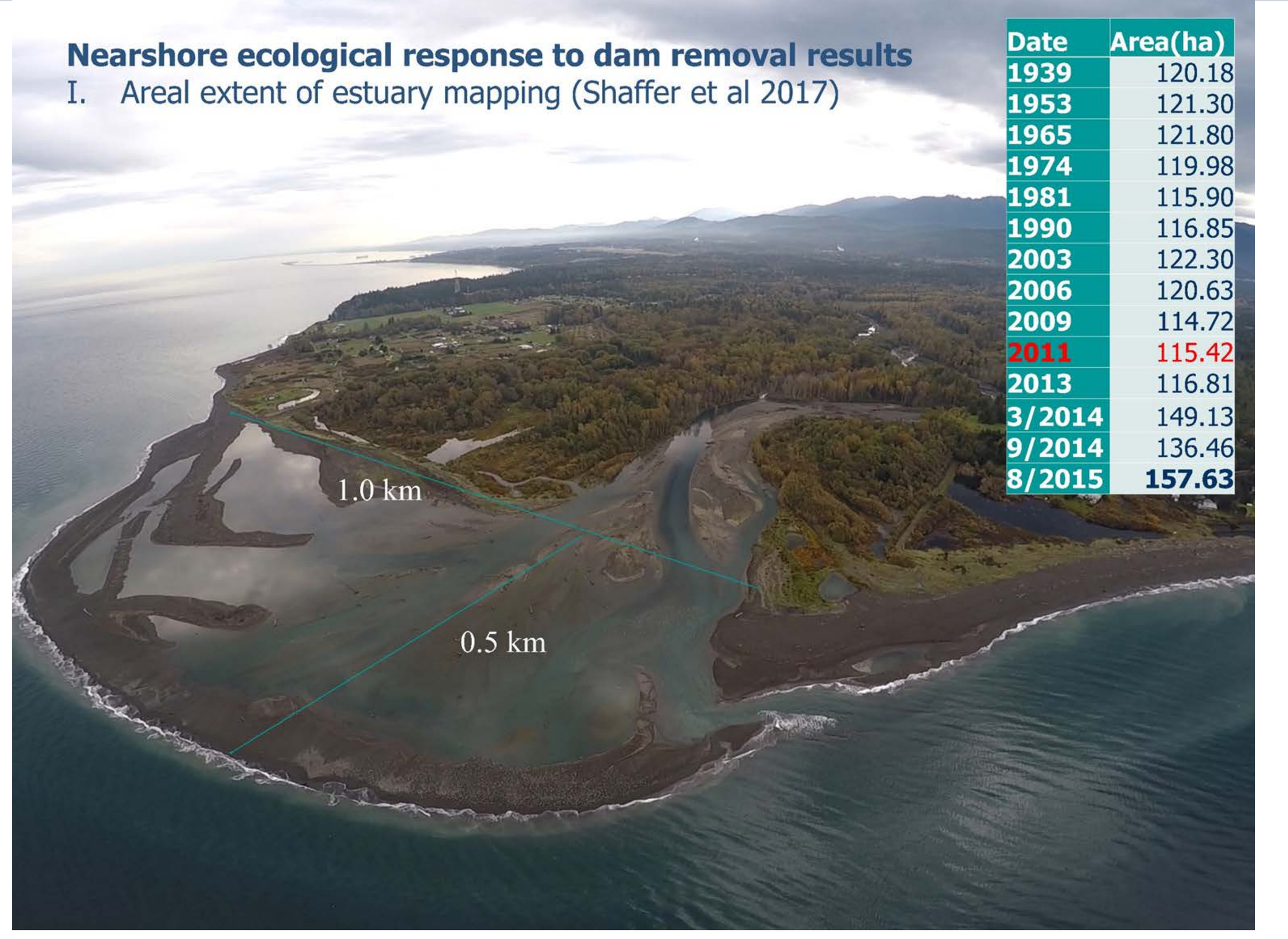
Shoreline armoring and diking have been documented to inhibit deposition of sediment and large woody debris (LWD) along the Elwha nearshore (Rich et al. 2014, Lee et al. 2018). Removal of shoreline armoring and dikes has shown fast improvement in sediment deposition and restoration to forage fish spawning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



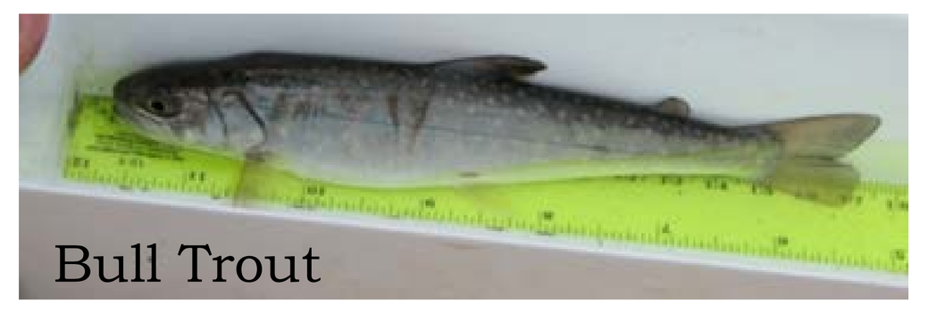
Lower River and Estuary Study

Prior to dam removals, 91% of salmon species used only 15% of Elwha estuary habitat (Shaffer et al 2009). Monthly beach seining 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.

Delta Growth Post-Dam Removal



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.



Synopsis

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

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