Elwha River's **Return to Nature**

Bill Jones

The removal of two dams from the Elwha River on the Olympic Peninsula between 2011 and 2014 were the largest dam removals in the world at the time. A project of this magnitude and importance should be included in this issue of *LakeLine* with its theme of "Dam Removal." Unfortunately, we could find no one in multiple federal or state agencies, or in universities willing and able to write this article. Therefore, I have prepared the following based upon previously published materials.

Setting

The Elwha River is located in the northern half of Washington's Olympic Peninsula (Figure 1). It is only 45 miles long, from its source high in the Olympic Mountains to its mouth on the Strait of Juan de Fuca, but includes over 100 miles of tributaries. The river flows south to north through old growth forests sustained by 60 to 80 inches of rain per year. About 83 percent of the watershed lies within Olympic National Park (Sadin et al. 2011).

The river historically supported a rich and diverse anadromous (fish that spawn in freshwater but live in saltwater) salmonid population. Prior to hydropower development, the Elwha was one of the few rivers in the lower U.S. that supported all the anadromous salmonids native to the Pacific Northwest: spring and summer-fall run Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), pink (*O. gorbuscha*), and sockeye (*O. nerka*) salmon; summer- and winter-run steelhead (*O. mykiss*); sea-run cutthroat trout (*O. clarkii*), Dolly Varden (*Salvelinus malma*), and bull trout (*S. confluentus*) (Wunderlich et al. 1994). Some chinook salmon exceeded 100 lbs.

Figure 1. Map of the Elwha River watershed on the north side of the Olympic Peninsula. The vast majority of the watershed lies within Olympic National Park. Courtesy of Olympic National Park (from Sadin et al. 2011).

The ancestral territory of the Klallam Indian Nation occupied much of the Olympic Peninsula. The Elwha River was at the heart of Klallam culture and life. For thousands of years, the river was a place of power for the Klallam Indians, as it was the source of their creation story and home to one of their most important spirits, Thunderbird. The river empowered the tribe by providing food, recreation, cultural traditions, and a transportation corridor. A permanent Klallam village was located eight miles from the river's mouth (Sadin et al. 2011).

The Dams

In 1911, a private company began construction of the first of two hydroelectric dams on the Elwha River. The Elwha Dam, completed in 1913, was 105 feet tall and created the 2.5- mile-long Lake Aldwell reservoir; A_o = 325 ac, Z_{max} = 100 ft. (Figure 2). The dam sits 4.9 miles upstream from the mouth of the river. The 210-foot-tall Glines Canyon Dam was completed in 1927 and sits more than eight miles farther upstream at river mile 13.4. It created Lake Mills reservoir; A_o = 490 ac, Z_{max} = 150 ft. (Figure 3; Bureau of Reclamation 2011). There were no fish passages built into the dams. At this time in American history, there was a public fascination with feats of construction and engineering, best exemplified by suspension bridges and hydropower dams that "tamed" the ancient power of rivers, revealing humankind's superiority over nature. City officials, newspaper editors, and community members in Port Angeles and other Olympic Peninsula towns gave the dam construction their enthusiastic support (Sadin et al. 2011).

Originally, the two dams generated about 20 megawatts (MW) of electricity that served numerous residential communities and industries on the Olympic Peninsula. This spurred the growth of the City of Port Angeles. Pulp and paper mills built between 1918 and 1929 gave the city a core industry that became the basis for future economic growth. However, since the 1940s, the Elwha River dams' power has gone to a single customer, the former Crown Zellerbach pulp and paper mill in Port Angeles (Sadin et al. 2011).

This "progress" came at a cost for the Elwha River ecosystem. The river's fisheries produced some 400,000 fish

Figure 2. Aerial photo of Elwha Dam and powerhouse, 1995. Source: U.S. Library of Congress. Photo by Jet Lowe.

Figure 3. Aerial photo of Glines Canyon Dam and Lake Mills, 1995. Source: U.S. Library of Congress. Photo by Jet Lowe.

per year before the dams. But since the dams blocked the passage of anadromous salmonids from their natural and historic spawning areas upstream, the river only produced about 3,000 fish per year in the 4.9 miles of river downstream of the Elwha Dam (National Park Service 2018). With no salmonids spawning in the upper Elwha, an important food source for wildlife and birds was cut off. The dams also blocked the transport of nutrients, sediments, and woody debris downstream. This has caused the eastern edge of the pre-dam Elwha delta to erode, and the barrier beach at Freshwater Bay, at the west of the mouth, to recede and steepen (DOI 1995). The dams also increase water temperatures in the middle and lower reaches of the Elwha River in late summer (Wunderlich et al. 1994). Finally, the dams flooded the historic homelands and cultural sites of the Lower Elwha Klallam tribe (National Park Service 2018).

The two Elwha River hydroelectric plants operated with little regulation for 50 years until the Federal Power Act required the owner to license the Elwha Dam and relicense the Glines Canyon Dam with the Federal Energy Regulatory Commission (FERC) in the 1970s. Challenges to the legitimacy and safety of the dams began soon thereafter, and led the Lower Elwha Klallam Tribe and several environmental organizations in the mid-1980s to call for the removal of the Elwha River dams (Sadin et al. 2011). The licensing process by the FERC became extremely contentious and drawn out for a variety of reasons, in particular, over the inability to design fish and wildlife mitigation measures capable of meeting federal, state, and tribal resource goals (Wunderlich et al. 1994). Removal of both dams emerged as an alternative. Since costly legal challenges could delay the federal licensing or removal by a decade, Congress offered legislation to solve the problem. On October 26, 1992, President George H.W. Bush signed the Elwha River Ecosystem and Fisheries Restoration Act into law. The act authorized federal purchase of the two dams on the Elwha from the timber companies that owned them and authorized the Secretary of the Interior to develop a report to identify the alternative that would result in "full restoration" of the Elwha River ecosystem and native anadromous fisheries (Wunderlich et al. 1994).

Dam Removal

The National Park Service had the lead in preparing an environmental impact statement (EIS) (DOI 1005). Five options were reviewed: (1) removal of both dams, (2) dam retention with fish passages installed on both, (3) removal of Elwha Dam, (4) removal of Glines Canyon Dam, and (5) no action. The EIS determined that the only way to insure full restoration was to remove both dams.

Removal work on the Glines Canyon Dam began September 15, 2011 and at Elwha Dam on September 19, 2011. Different demolition methods were used at the two dams because of their unique structural requirements. You can view videos documenting the dam demolition and river basin restoration at: https://www.nps.gov/olym/learn/nature/elwha-ecosystem-restoration.htm. It took just six months to remove the Elwha Dam (Figures 4 and 5).

The larger Glines Canyon Dam wasn't completely removed until 2014. With some 20 million cubic yards of sediment trapped behind the Glines Canyon Dam, one-half of which was fine sediment that could suffocate downstream fish and their eggs if released at once, contractors had to be more careful. They employed a notch-and-release method where for every 15 ft. of dam removed, they paused two weeks before proceeding. The river did the work in removing the sediments gradually (National Park Service 2018).

Results of Dam Removal

The $26.9 million dam removal contract was part of a $324.7 million total restoration cost. This included purchase of the two dams and hydroelectric plants, construction of two water treatment plants to protect local water supplies, construction of flood protection facilities, and a new, larger fish hatchery for the Lower Elwha Klallam tribe (National Park Service 2018). A project of this magnitude had many cooperating partners, including the National Park Service, Bureau of Reclamation, U.S. EPA, U.S. Fish & Wildlife Service, U.S. Geological Survey, NOAA, Washington State Department of Fish & Wildlife, and the Lower Elwha Klallam tribe.

The ecosystem benefits of dam removal far outweighed the few detriments. On the detriment side, the two reservoirs were water supplies and recreational resources to flat-water boaters and anglers, as well as winter habitat for trumpeter swan (DOI 1995). These benefits were lost with the dam removals. The higher water levels in the river resulting from sediment accumulation caused floodwaters to rise higher than normal, causing two campgrounds and a road to be washed out.

Millions of cubic yards of sediments trapped behind the dams washed downstream, rebuilding riverbanks and gravel bars in and around the river's mouth, creating 70 acres of new beach and riverside estuary habitat for Dungeness crabs, sand lance, surf smelt, clams, and other species (Nijhuis 2014) (Figure 6). The Lower Elwha Klallam tribe once again has access to their historic homelands inundated by the dam impoundments.

Within a week of the last blast at Glines Canyon Dam, fisheries biologists confirmed that two radio-tagged bull trout had migrated through Glines Canyon and were upstream of former Lake Mills in Rica Canyon. A snorkel survey confirmed that naturally migrating Chinook had spawned above Glines Canyon Dam for the first time in over 100 years.

Dam removal is finished, but this is just the beginning of Elwha River Restoration.

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Figure 4. Elwha Dam early in the deconstruction process. Water has been diverted to the spillway on the right to lower the Lake Aldwell. Source: Creative Commons. Photo by Ben Cody.

Figure 5. After removal of Elwha Dam with river back in its original channel. Source: Creative Commons. Photo by Zandcee.

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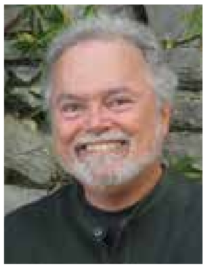

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Figure 6. Elwha River delta in July 2015 showing development of significant bars and beaches. Source: Creative Commons. Photo by Ian Miller.