Removal of Lower Snake River Dams for Salmon Growth

River restoration has become a topic that has garnered interest not only with conservationists but also the general public. Large scale river restorations in the form of dam removal have sparked debates on the efficiency of such projects and the short term negative effects it may have. The Snake River is the largest tributary to the Columbia River with 1,078 miles stretching through Washington, Oregon, Idaho, and Wyoming. Between the 1960s and 1970s, the Army Corps of Engineers built four dams on the river in southeast Washington in a bid to provide affordable and clean energy to the region. These four dams: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite caused much discussion. Concern for the creation of the dam and its impact on the ecosystem has been present since the 1960s and has continued to gain traction, with residents, tribal members, and scientists alike rallying for the removal of these dams as a way to replenish dwindling salmon populations and restore the river's ecosystem. Since the 1990s, four species of Columbia Basin salmon and steelhead have been placed under the Endangered Species Act and the decline of salmon populations became a key talking point in Pacific Northwest restoration.

Supporters of the dams' main argument is that removal will not only cost the state a hefty price but also will eliminate a clean energy source that aids in Washington's goal of net zero emissions by 2050[1]. The four dams have a capacity to hold 3,500 megawatts of energy and provide around 2,300 megawatts of energy to the region while producing an average of 900 megawatts zero-carbon energy every year[2]. Harnessing flowing water to create electricity is one of the oldest renewable forms of clean energy, with the first hydroelectric power plant being constructed in 1882 in Wisconsin[3]. As of 2018, over 41% of all renewable energy in the United States coming from hydroelectric sources[4]. Washington state has a higher use of hydroelectric power compared to other states, with 67% of total net generated electricity coming from hydropower in 2022, generating between one third and one fourth of all

[1] Fragiacomo, *Why Give a Dam About the Snake River*
[2] Olson, et al. *BPA Lower Snake River Dams Power Replacement Study,* 14.
[3] Nunez, *Hydropower Explained*
[4] Somani, et al. *Hydropower Value Study: Current Status and Future Opportunities*, 8.

hydroelectric power in the nation[5]. Removal of these dams raises concern for how to replace this form of energy and provide reliable energy sources to the areas affected by the removal.

Salmon Populations

The Columbia Basin used to be an interconnected network of waterways where salmon populations flourished. Historically between 10-16 million salmon and steelhead adults returned annually to spawn, with the year 1850 having a grand estimate of 16 million returning. These once large populations have been shrinking and within the past 25 years salmon and steelhead estimates have dropped to 660,000 annually[6]. The cause for such a decline is a range of factors from overfishing to pollution, but one large cause impeding salmon and similar species from spawning and increasing stock size is the use of dams. The construction of four dams along the lower Snake River directly interferes with migration to spawning grounds for many species and lowers their survival chances. At one point, the Snake River Basin supported almost fifty percent of Chinook salmon and steelhead in the Columbia River Basin, but as of now the salmon and steelhead populations are around 1-2% of their historic levels[7]. In 1950, an estimate of 130,000 adult salmon and steelhead returned to Snake River, but that number has plummeted below 10,000 as of 2017[8]. The decline in anadromous fish is a cause of concern. Fish species that inhabit the river could possibly disappear if no action is taken, with all four stocks of salmon and steelhead inhabiting the river at risk of extinction [9]. According to American Rivers, which puts out a yearly list of the most endangered rivers in the United States, the Snake River was listed as the fourth most endangered river in 2023[10]. Removal of the dam is thought to give almost twice the probability of recovering Chinook salmon stocks compared to increasing improvements to the current dams[11]. Survival rates of yearling Chinook and steelhead in the Columbia River Basin are also found to be higher when migrating through four or fewer dams[12].

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[5] U.S. EIA, *Washington Energy Analysis*
[6] Us Government Accountability Office, *Columbia River Basin Salmon and Steelhead*
[7] American Fisheries Society, *"Statement of the American Fisheries Society (AFS)..."*
[8] Helmer, *In the Columbia–Snake River Basin, Salmon Are Losing Their Way*
[9] Save our Wild Salmon Coalition, *Restoring the Lower Snake River*
[10] American Rivers, *Most Endangered Rivers 2023*
[11] Marmorek, *PATH Final Report for Fiscal Year 1998*
[12] Storch et al. "*A review of potential conservation and fisheries benefits of breaching four…"*

Cost Concerns and Power Replacement

Concerns about the cost of dam removal is a large factor in the debate surrounding the restoration process. Replacing services provided by the dams could cost an estimated $10.3 billion to $31.3 billion[13]. Although there is worry about power replacement costs, findings on the cost to public power customers to replace the power source lost from the dams would be considerably insignificant, with only an increase of $1 per month or less. The amount of energy the dams generate for the region is also considerably small. The dams energy represents only 4% of the regional load, and in the winter and summer when river flow is low and energy demand is high the dams only provide around 2% of regional energy[14]. A report by the NW Energy Coalition shows that balanced alternatives such as solar, wind, energy-efficiency, and storage could replace the power the four dams provide to the region at levels equal or better than the current system. Implementing balanced alternative energy sources is also predicted to raise greenhouse emissions by less than 1% but has the possibility to reduce regional emissions below the predicted amount[15].

The overall cost to maintain the dams is also found to be increasing. According to the NW Energy Coalition, the annual cost to maintain the four dams has exceeded the U.S. Army Corps of Engineers 2002 estimate of $56 million and has risen to an estimated cost of $269 million annually. Given this information the cost to maintain the dams is over $2 billion every decade with a projection of over $13 billion spent on maintenance over the next five decades. Previous attempts to recover salmon through fish ladders and other methods in the Snake River has cost an estimated $17 billion[16]. These efforts have not shown any great increase in the salmon population over time and are an example of why adding fish ladders to these dams may not be as effective as hoped. The cost of maintenance and improvements to the lower Snake River dams shows that a large amount of money is already being put into these areas. If the dams were to stay in place, large sums of money could be lost in adding methods to increase salmon stock which has shown to be ineffective.

Comparing Results with Elwha Dam Removal

[13] Washington Governor's Office, *Lower Snake River Dams: Benefit Replacement Report*
[14] Weiss, *Restoring wild salmon Power system costs and benefits of lower Snake River dam removal*
[15] NW Energy Coalition, *The Lower Snake River Dams Power Replacement Study*
[16] Associated Press, "*Electricity, irrigation could be replaced if Snake River dams are breached…"*

The most famous example of recent successful dam removal also comes from Washington State, with the Elwha and Glines Canyon dam removal project. The upper and lower Elwha watershed was disconnected for 94 years, reducing anadromous fish habitat by 90% with remaining salmon populations greatly decreased[17]. Before the dams were constructed around 400,000 salmon returned to the area annually and after construction the estimate was lowered to 4,000[18]. These dams altered the ecosystem in the area and flooded the historic homelands of the Lower Elwha Klallam Tribe. In 1992 Congress passed the Elwha River Ecosystem and Fisheries Restoration Act and approved the dams removal. After much planning in late 2011 the largest dam removal in United States history began in hopes of restoring the once thriving ecosystem.

One concern for the dam removals was the large accumulation of sediment stored behind the dams: around 24 million cubic yards was held behind the two dams[19]. Sediment is vital to shaping a river's habitat and helps combat erosion. Years of lack of sediment transportation five miles downstream to the Strait of Juan de Fuca created degraded habitats along this area, causing a decline in the salmon run. Sand also disappeared from the beaches creating a lack of suitable environment for bivalves and shortened shorelines, with coastal erosion on reservations ranging from 125' to 500'. To restore sediment flow scientists concluded that slowly lowering the water from the reservoirs and letting the river naturally carry the sediment was the proper way to ensure the sediment made it to the Strait of Juan de Fuca. As of a decade later 14 million tons of this once trapped sediment has settled in the coast and ocean with an additional 8 million tons of sediment settling along the river, reports Save our Wild Salmon Coalition. This redistribution of sediment aids in restoring the coastlines and previously eroded riverbeds to what they once were, in turn creating habitat for various species including salmonids.

The process of restoring salmon in the area takes time, but results were showing just five years after restoration. An estimated 7,600 Chinook salmon returned to their spawning grounds in 2019, the highest numbers seen since the late 1980s[20]. The process of removing the dams is also showing improved

[17] Pess et al. "*Biological Impacts of the Elwha River Dams and Potential Salmonid…"*
[18] Save Our Wild Salmon Coalition, *Dam Removal Success Stories 2021*
[19] Hair, *A Trip to the Elwha: Part 4, The Challenge of the Sediment*
[20] Breda, *Tribe to fish for salmon on Elwha River a decade after dams fell*

environmental conditions and increased native riparian zones. Before the dam removal native riparian species richness was 41% lower below the dam, but only 6 years after removal the native riparian species richness increased 31% between the two dams[21]. Riparian buffers around rivers are extremely important to a diverse river ecosystem, not only do they prevent contaminants from entering the river and improve water quality; but they also reduce shore erosion and provide large woody debris which is used by fish species to rest and hide from predators[22].

Conclusion

The removal of the lower Snake River dams should be conducted in order to restore the endangered salmon and steelhead stocks. Removing the dams would reinstate water and nutrient flows as well as create habitat for spawning salmon[23]. Without proper intervention the National Marine Fisheries Service estimates a 55-100% extinction probability of stock groups over the next 100 years[24]. The race against extinction shows that it is of utmost importance to approve and begin river restoration by removing the dams. Despite difficulties in cost and replacement of energy from the hydroelectric dams, the dams themselves do not provide a significant amount of energy to the region and can be replaced with other forms of clean renewable energy with minimal energy cost increases to consumers in the area.

Sediment disruption would be observed after dam removal but with proper protocol this sediment redistribution could be conducted similarly to the Elwha dam removal and done over a period of time to prevent large accumulations of sediment from causing a substantial amount of damage to the environment. Using the Elwha dam removal as reference for removal of the lower Snake River dams does not give a definite prediction of restoring salmon stock, but gives insight into how river restoration is happening in real time in Washington state. Elwha has shown that reconnecting the paths salmon and other species use by removing the obstacle of a dam does increase the amount of salmon spawning annually and restore the environment around the area. Removal of the dams is key to preventing once-thriving stocks from disappearing over time and restoring the habitat around the Snake River.

[21] Brown et al. *Does large dam removal restore downstream riparian vegetation diversity?...*
[22] Parkyn, *Review of Riparian Buffer Zone Effectiveness*
[23] Wai, *Narratives Surrounding Dam Removal Along the Lower Snake River*
[24] Budy et al. *Evidence Linking Delayed Mortality of Snake River Salmon to Their…*

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