Elwha River:

Impact of ongoing Glacier Retreat

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North Cascade Glacier Climate Project: Since 1984

The 70 km long Elwha River in Olympic National Park was once of the most productive salmon rivers in the Pacific Northwest. At the headwaters of this stream are two named glaciers Carrie and Fairchild, and four unnamed glaciers, which play an important part in the hydrology of the watershed. The glaciers have retreated considerably since the building of the dams, rapidly since 1980. The result is a significant reduction in late summer glacier runoff than when the stream last flowed naturally. The construction of Elwha Dam (1913) and Glines Canyon Dam (1927) devastated the Elwha River's salmon runs. Dismantling the Elwha and Glines Canyon dams over the next two years will allow the river to flow freely for the first time in nearly 100 years. The river will run from its headwater glaciers to the sea. Dams alter streamflow by withholding water and then releasing the water to generate power during peak demand periods. This leads to unnatural flows, which interrupt natural variations that are critical to the fish and wildlife species. Besides dam removal recent climate change is altering the seasonal flow of the Elwha River. The loss of glacier area has and will lead to ongoing significant changes in summer streamflow in the Elwha River. In the Elwha River from 1950-2006 summer streamflow declined by 25%, spring streamflow by 17%, and winter streamflow increased by 6%. Part of this change is due to the loss of glacier extent in the watershed.

Glaciers act as natural reservoirs storing water in a frozen state instead of behind a dam. Glaciers modify streamflow releasing the most runoff during the warmest, driest periods, summer, when all other sources of water are at a minimum. Annual glacier runoff is highest in warm, dry summers and lowest during wet, cool summers. The amount of glacier runoff is the product of surface area and ablation rate. The North Cascade Glacier Climate Project began annual monitoring program of North Cascade glaciers in 1984. This program has also examined the change in glacier volume and extent in the Bailey Range and on Anderson Glacier in the Olympic Mountains. Mass balance is observed annually on ten glaciers. Olympic glaciers have provided 135 million m^3 of runoff each summer in the past, but today this contribution is declining as glacier area available for melting declines. The glacier retreat in the Olympics is not just in the Elwha watershed since 1990 Hoh Glacier has retreated 450 meters, Blue Glacier 270 meters, and Humes Glacier 120 m. In 1992 we examined Anderson Glacier its area was 0.38 square kilometers, down from 1.15 square kilometers a century before. Ten years later the glacier had diminished to 0.30 square kilometers, but had thinned even more, leaving it poised for a spectacular change, over the next five years. Large outcrops of rock have appeared beginning in 2003 and further exposed in 2005 and 2009 in the middle of the glacier, indicating this glacier will not last long.

In the Elwha watershed glacier extent has declined from 2.8 km^2 in 1980, to 2.6 km^2 in 1990, to 2.1 km^2 in 2008. The consequent glacier runoff has declined by 750,000-850,000 ft^3/day in the summer since 1980. The resultant annual hydrograph for the Elwha River is not the same as it was before dam construction. In particular late summer and fall salmon runs will experience less runoff due in part to declining glacier runoff. Streamflow in the Elwha River has declined 25% during July-Sept. for the 1950-2006 period. The mean summer flow from 1950-1991 was 1034 cfs. From 1992-2009 only two summers had mean streamflow above 1034 cfs. The decline in glacier size is not the principal cause of the summer streamflow decline, but it reduces the low flow mitigating ability of the glaciers. In both basins winter runoff has increased due to more winter rain events at intermediate elevations, summer runoff declines are altering the hydrographs of the river, continued glacier retreat will further reduce runoff from July-September. We will continue to examine glacier change in the basin, and look forward to providing data to the Elwha restoration community.

Figure 1: Carrie Glacier early July 2006 with considerable snow remaining, which is typical of Olympic glaciers at the start of the main glacier melt season.

Figure 2: Carrie Glacier from above in September 2006 with little snowpack remaining and many annual layers exposed. This indicates the lack of a large persistent accumulation zone on the glacier in recent years.

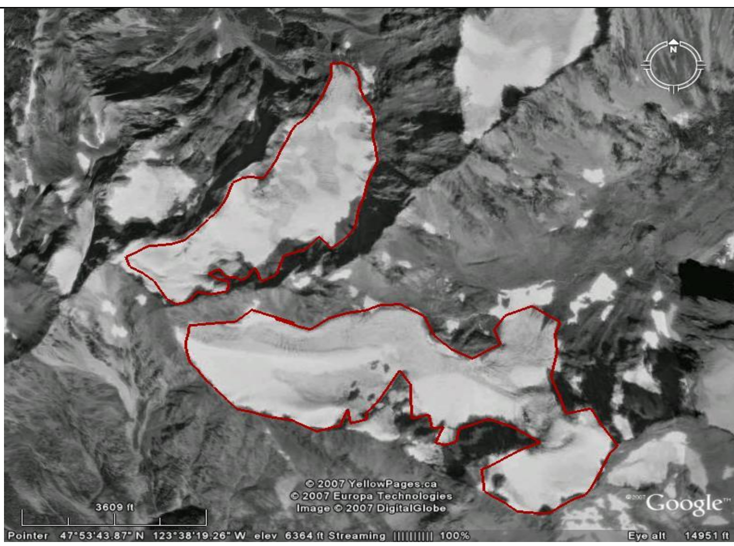

Figure 3. In red superimposed on the images is the 1966 map outline of the Elwha River glaciers, above is the 1990 USGS aerial photograph indicating minor retreat since 1965.

Figure 4: at right is a 2006 satellite image indicating considerable retreat from 1965. This process has continued with 2009 being a particularly negative year for the glaciers.

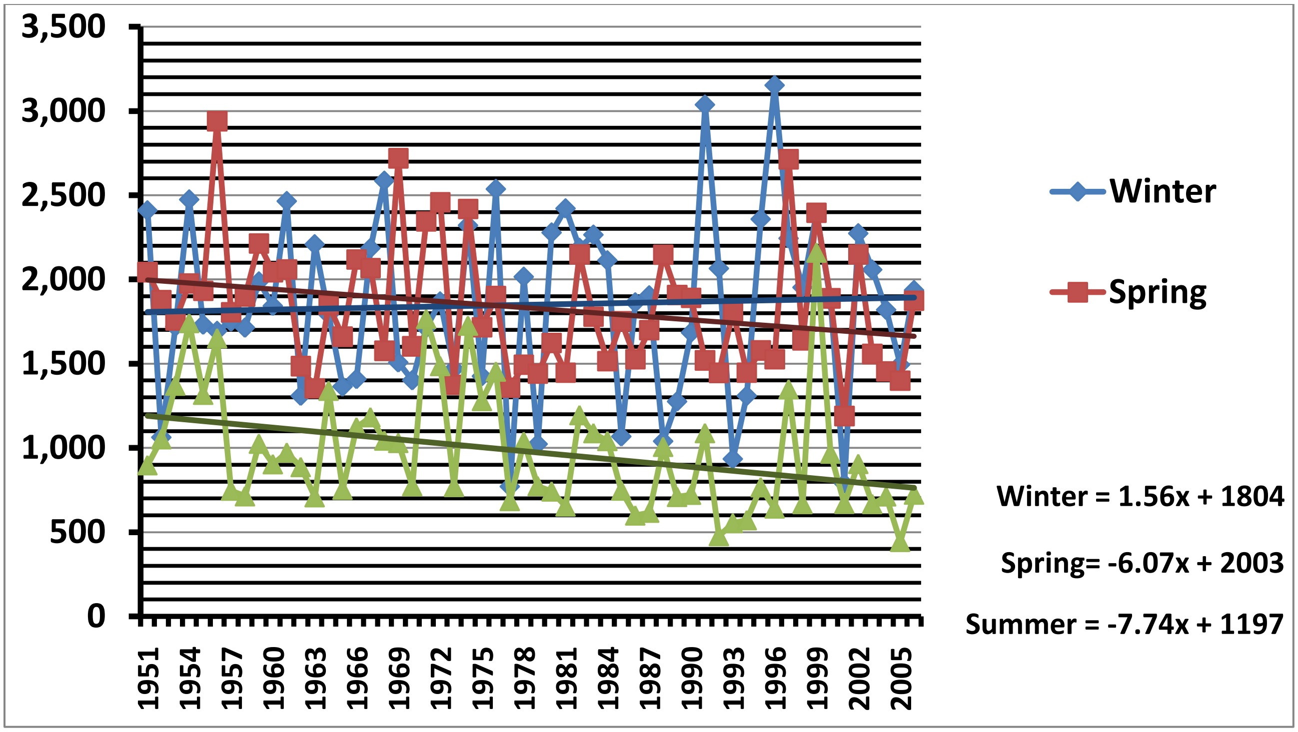

Figure 3. Annual mean discharge seasonally for the Elwha River at the USGS gaging station. Winter=November-March, Spring =April-June, Summer=July-September. Sumer has the most substantial change.