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Climate Change and the Nooksack Adjudication

Whatcom Watch

by Eric Hirst

Adjudication of water rights in the Nooksack River basin will ultimately provide an inventory of water rights. Specifically, a Whatcom County superior court judge will determine who has the right to use water, where, when, for what purpose(s), with what priority date, and how much.(1)

However, this inventory will not relate well to the actual availability of water, either surface waters or groundwater. That is, the amount of *paper* water deemed legal may differ — and differ substantially — from the amount of *wet* water that actually exists in aquifers, creeks, the three forks, tributaries and the mainstem Nooksack River.

Three factors contribute to the gap between water rights and actual flows:

- The most senior claims (held by Lummi Nation and Nooksack Indian Tribe, both instream flow rights and on-reservation rights), are not yet quantified.
- More rights have been issued than water availability would allow; i.e., the basin is over-subscribed.
- Most important is climate change.

This paper addresses two issues related to the effects of climate change on Nooksack basin summer streamflows: (1) past and present effects, and (2) likely future effects.

History

I focus on summer (July, August, September) because that is when flows are lowest, salmon and other wildlife are most likely to need more water than is actually flowing, and human use of water is greatest (primarily agricultural irrigation). Low flows are a problem for wildlife and humans alike. In addition, low flows contribute to elevated water temperatures which, if high enough, can be lethal for fish. And low flows lead to reduced levels of dissolved oxygen, less habitat, and limited access to habitat, all of which are bad for fish.

Over the past 57 years (1967 – 2023), summer streamflow for the Nooksack River at Ferndale, has been declining. Over this period, flows decreased at an average of 0.6 percent per year. However, this adverse trend is accelerating: during the past 15 years (2009 through 2023), flows declined by 3 percent per year.

Similar data for the North, Middle, and South forks, as well as one lower Nooksack tributary (Fishtrap Creek), show similar trends. Overall, summer flows are declining, although erratically and at different rates (Table 1). These declines are worsening over time. Flows during the past 15 years declined much more rapidly — 5 to 10

times as fast — than during earlier years.

#	Flow, cfs		Flow change, %/year	
#	1967–2023	2009–2023	1967–2023	2009–2023
Mainstem Nooksack	2,373	2,110	–0.6%	–3%
North Fork	906	867	–0.4%	–5%
Middle Fork (1992–2023)	385	391	–0.2%	–3%
South Fork (2009–2023)	—	287	—	–5%
Fishtrap Creek (1999-2023)	12.1	11.7	–2.4%	–7%

Table 1.

Table of Nooksack River streamflow changes over time

Causes of Streamflow Declines

Several factors account for these long-term declines in streamflow. These include: higher summer air temperatures (which increase evaporation from surface waters), less summer rainfall, earlier-in-the-season snowmelt, and loss of glacier mass. For example, glaciers in the North Cascades (not just Mt. Baker) have lost almost 40 percent of their mass during the past four decades (Fig. 1.). (2)

The Nooksack Indian Tribe notes, "Some of the glaciers on Mount Baker have receded over 1,000 feet in the last 20 years. This represents a substantial reduction in ice volume. At present rates of glacier melting, several glaciers that feed the Nooksack River watershed may disappear completely. With current trends in the reduction of glaciers
and predictions [of] continued climate change, river flows in the mid- to late summer will be further reduced and temperatures will increase, creating even larger challenges to salmon survival."(3) Ryan Murphy's (WWU) simulation of Mt. Baker glacier dynamics shows that "Glaciers are projected to retreat significantly with smaller glaciers disappearing entirely." (4)

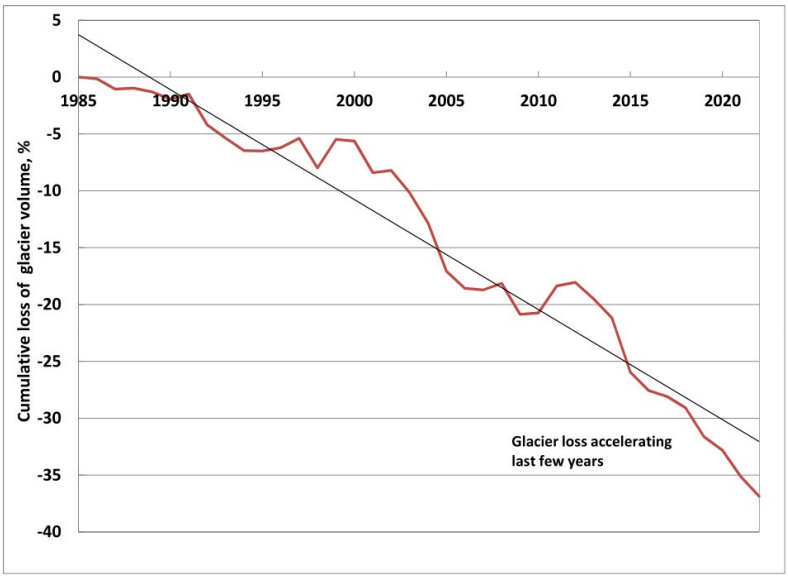

Figure 1. Cumulative loss of glacier volume, percent

Consequences of Declines

The only official estimate of how much water salmon need is the 1985 instream flow rule from the Washington Dept. of Ecology. (5) The rule established minimum flows for 30 reaches within the basin. These minimums are specified for the 1st and 15th of each month, 24 values a year for each reach.

How well have actual streamflows conformed to Ecology's minimums? Fig. 2 shows that, had the rule been in effect during the late 1960s and early 1970s, flows would have been high enough to meet the rule about 55 percent of the summer days. By the late 2010s and early 2020s, however, the rule was met only 25 percent of the time.

Perhaps more important than the number of days during July, August, and September that flows fell below the Ecology minima is the percentage shortfall. During the late 1960s and early 1970s, the deficit was about 15 percent of the Ecology minimum. During the late 2010s and early 2020s, the deficit had increased to about 25 percent. Combining these two factors suggests that summer conditions for salmon in the Nooksack River became two and a half times as adverse at the end of this 57-year period than at the beginning.

Ecology's instream flow rule is based on science that is four decades old. Updating these results would surely require higher minimum flows. Indeed, more recent work, conducted by Utah State University, shows that *optimal* flows for fish are substantially higher than the *minimum* levels set by Ecology two decades earlier. (6) (7) (8)

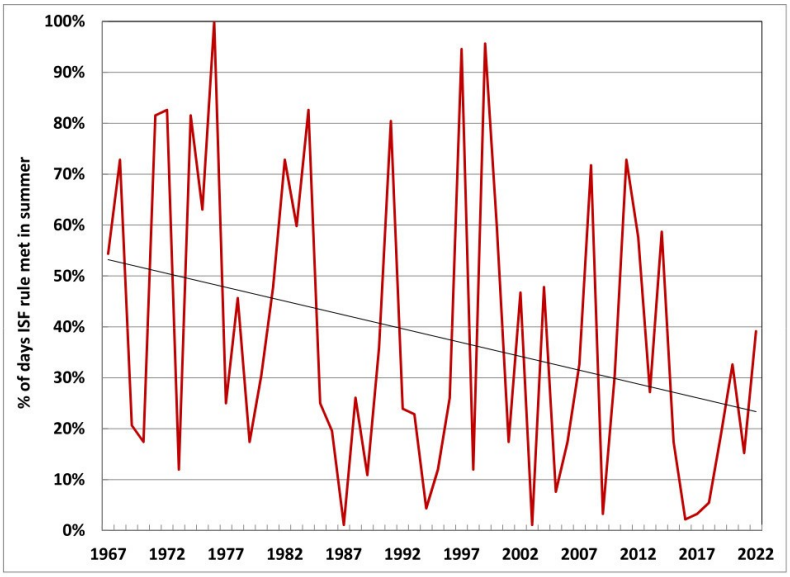

Figure 2. Percent of days ISF rule met in summer

The Future

Murphy modeled the effects of climate change and glacier recession on Nooksack River watershed streamflows for 2050 and 2075.

He developed these projections for the North, Middle, and South forks as well as the mainstem at Cedarville. (9) For 2050, flows are expected to be lower by 33 to 58 percent, depending on scenario and location (Fig. 3). (10)

The Regional Water Supply Planning Project developed projections of future flows for 11 drainages in the Nooksack River watershed. (11) Relative to flows in 2020, summer flows are likely to be lower in 2070 in all drainages, with declines ranging from about 5 percent to almost 70 percent. Flows on the mainstem Nooksack River during the summer months are expected to decline by about 40 percent, ranging from a 6 percent drop in October to a 73 percent drop in July. (12)

According to the *Tribal Climate Tool*, flows in the Nooksack River are expected to be lower than current flows (which are already much lower than historical) by about 20 percent in the 2050s. (13) Analysis from Western Washington University suggests mid-2050s flows lower by 35 to 40 percent throughout the basin. (14)

These projections differ in the details of their estimates of the future effects of climate change on streamflows. However, they all agree that flows during the summer months will be substantially lower than they are today. And today's flows are already much lower than historical flows.

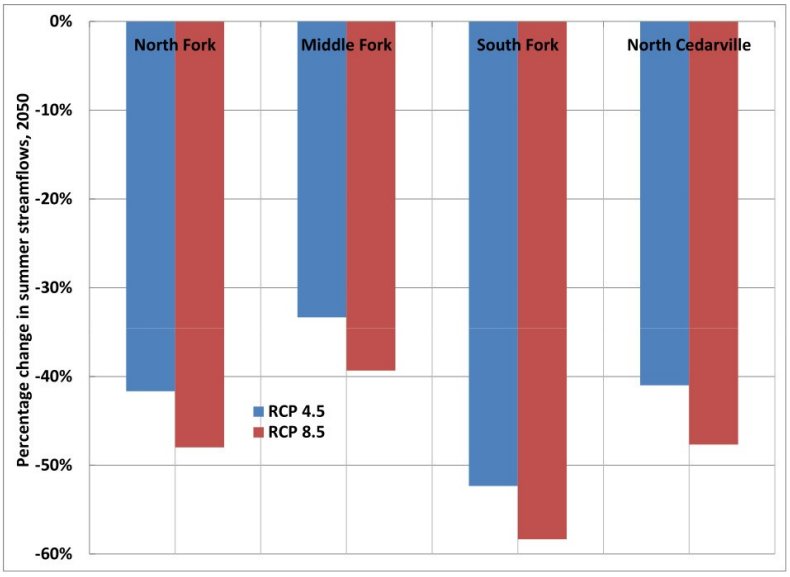

Figure 3. percentage change in summer streamflow, 2050

Conclusion

" Instream flow is the water flow within a river or stream required to maintain a healthy ecosystem, support wildlife, and sustain recreational and cultural activities. This is particularly vital to salmon who begin swimming back to their spawning grounds in late summer — when water levels can be fatally low." (15)

Historical data and projections show clearly that summer streamflows throughout the Nooksack River basin have been declining for years and will continue to do so in the future.

These historical and near-certain future declines in water supply have major implications for the Nooksack

adjudication. Unless Ecology and the superior court judge explicitly account for climate change in assigning water rights to the tribes, farmers, rural homeowners, and water utilities, some entities will hold paper rights that bear little relationship to the amounts of water actually available. What happens then?

Obtaining a legal water right through the adjudication process does not mean one will be allowed to use that water during the low-flow summer months, because real water will be apportioned to rights' holders based on the priority date of those rights.

The oldest rights will get water first, and, if there is not enough water, the newer water rights will be turned off. The most senior rights surely belong to the tribes; thus, others may be required to curtail summer water use unless we develop substantial new water-use efficiency, water storage, and water supply resources. The Tribes' objective to restore the Nooksack River habitat for anadromous fish recovery and the objective of water diverters to maximize economic benefit conflict. The changing climate is certain to aggravate that conflict.

Endnotes

1. The adjudication will encompass all of Water Resource Inventory Area 1 (essentially all of Whatcom County), not just the Nooksack watershed. This paper deals only with the Nooksack basin.

2. M. Pelto, "Disastrous Year for North Cascade Glacier Mass Balance (Snow/Ice Economy)," American Geophysical Union, Blogosphere, Aug. 20, 2015. Also personal communication with M. Pelto, Nichols College, Sept. 15, 2023.

3. Environmental Studies Program, University of Oregon, Tribal Climate Change Profile: Nooksack Indian Tribe, July 2014.

4. R.D Murphy, Modeling the Effects of Forecasted Climate Change and Glacier Recession on Late Summer Streamflow in the Upper Nooksack River Basin, Western Washington University, Feb. 2016.

5. Washington Dept. of Ecology, Instream Resources Protection Program—Nooksack Water Resource Inventory Area (WRIA) 1, Chapter 173-501 WAC, June 9, 1988.

6. C. Bandaragoda and J. Greenberg, Data Integration of WRIA 1 Hydraulic, Fish Habitat, and Hydrology Models, WRIA 1 Joint Board, June 2013.

7. E. Hirst, What Does the Nooksack Instream Flow Rule Mean?, April 2018.

8. The federal Endangered Species Act might also come into play here, given that several local species are listed.

9. R.D Murphy, Modeling the Effects of Forecasted Climate Change and Glacier Recession on Late Summer Streamflow in the Upper Nooksack River Basin, Western Washington University, Feb. 2016.

10. RCP 4.5 is a moderate scenario in which emissions peak around 2040 and then decline. RCP 8.5 is a business-as-usual scenario in which emissions continue to rise throughout this century.

11. RH2 Engineering, Regional (WRIA1) Water Supply Plan, Phase 2, January 2023.

12. These results are relative to actual flows from 2017 through 2023.

13. https://climate.northwestknowledge.net/NWTOOLBOX/tribalProjections.php

14. E.A. Paul, Modeling 21st Century Peak Flows in the Nooksack River Basin in Northwestern Washington State Using Dynamically-Downscaled Global Climate Model Projections, Western Washington University, March 2023.

15. I. Simonelli, "Nooksack Basin residents prepare to define, defend water rights," *Cascadia Daily News*, Apr. 4, 2024.

Eric Hirst has a Ph.D. in engineering from Stanford University, worked at Oak Ridge National Laboratory for 30 years as a policy analyst on energy efficiency and the structure of the electricity industry. He spent the last eight years of his career as a consultant.

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2. https://www.psp.wa.gov/
3. https://pugetsoundkeeper.org/
4. https://www.snocomrc.org/
5. https://www.whatcomcountymrc.org/
6. https://wdfw.wa.gov/species-habitats/science/marine-toxics/tbios

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