October 22, 2019

TO: Northwest Policymakers – Governors and Members of Congress
FR: David Cannamela, on behalf of 55 fisheries and natural resource scientists
RE: Science-based solutions are needed to address increasingly lethal water temperatures in the lower Snake River

Dear Northwest Policymaker,

INTRODUCTION:
In recent decades, adult salmon and steelhead migrating upriver to spawning grounds in the Columbia Basin have suffered decreased survival. This is in part due to dangerously warm water in the mainstem Snake and Columbia Rivers, caused by hydro-electric development that created slackwater reservoirs and a changing climate. Excessively high water temperatures, above 20°C/68°F, are now normal for extended periods in July, August, and September.

The four lower Snake River reservoirs have a significant impact on these in-river temperatures. Based on modeling, EPA states that an un-impounded river could, on average, be 3.5°C/6.3°F cooler in late summer and early fall when measured at the site-potential for John Day Dam. EPA modeling also shows that, when considered collectively, the four lower Snake Dams can affect temperatures up to a potential maximum of 6.8°C/12.2°F (EPA, 2003). This water temperature issue remains unmitigated and will worsen as the climate continues to warm. With limited resources in the existing hydrosystem to cool the river, the restoration of the lower Snake River by breaching its four dams is the only action available that can substantially cool mainstem water temperatures on a long-term basis.

KEY FINDINGS:
The Federal Columbia River Power System (FCRPS) reservoirs on the lower Snake River increasingly warm the river above critical levels from July to mid-September, significantly reducing salmon reproduction and survival. This problem was first recognized in the 1990s, and still remains largely unmitigated today. All available information to date about the court-ordered National Environmental Policy Act (NEPA) review now being conducted indicates that federal agencies will propose no plan to adequately address this critical issue.

Cold-water resources to protect migrating salmonids in the existing hydrosystem are extremely limited; there are no additional resources available that can significantly cool the river. Restoring the lower Snake River by removing its four federal dams will significantly reduce mainstem water temperatures on a long-term basis, and is likely the only action that can do so, substantially lowering the risk of extinction for salmon and steelhead here.

DETAIL:
Late summer and early fall water temperatures in the mainstem lower Snake and lower Columbia Rivers have risen to critical levels in recent years, due in large part to the presence of Federal Columbia River Power System (FCRPS) dams and

reservoirs. Reservoir heating is exacerbated today by a warming climate. Historically, construction of FCRPS dams and reservoirs increased slackwater surface area and decreased water velocity compared to a free-flowing river; increased slackwater surface area now serves as a collector of solar energy, and the slow-moving water allows more time for heat to accumulate, compared to free-flowing conditions (Yearsley et al. 2001, EPA 2003, FPC 2015).

The U.S. Environmental Protection Agency (EPA) has modeled impacts of the presence of dams and reservoirs on water temperature to develop a Total Maximum Daily Load (TMDL) for temperature in the Columbia and Snake Rivers. Based on this modeling, EPA stated that an un-impounded river could, on average, be 3.5°C/6.3°F cooler in late summer and early fall when measured at the site-potential for John Day Dam. EPA modeling also showed that, when considered collectively, the four lower Snake Dams could affect temperatures up to a potential maximum of 6.8°C/12.2°F (EPA, 2003). The impact of additional heating in lower Snake River reservoirs is clear, and it can drive water temperatures above 68°F for extended periods in late summer and early fall – dangerous for salmon and steelhead.

In summer 2015, 96% of endangered adult Snake River sockeye salmon died during their upriver migration through the lower Columbia and Snake Rivers, due to the combined effects of very hot air and water temperatures, low flows, and the presence of mainstem dams and their associated reservoirs (FPC 2015). The extreme conditions faced by migrating adult salmon in 2015 will become more frequent as the climate continues to warm.

Although the poor success of the adult migration documented in 2015 for Snake River sockeye is an extreme example, reduced migration success due to high water temperatures has been observed for sockeye in other years, and for other Snake River salmon species generally (Crozier et al. 2014, McCann et al. 2018). These studies indicate that all Snake River salmon species (sockeye, spring/summer Chinook, fall Chinook and steelhead) experience reduced survival at elevated water temperatures above 18°C (64°F), which is, notably, 2°C cooler than the established water quality standard of 20°C (68°F). The proportion of adults of each species or run-type that experience temperatures in excess of 18°C depends on the timing of their upriver migration; steelhead, fall Chinook and sockeye have a greater exposure to high temperatures than adult spring/summer Chinook (McCann et al. 2018), because they migrate later in the summer, when temperatures are hottest. In addition, adults that were transported (barged) as juveniles exhibit impaired homing ability, which results in slower migration speed, lower upstream survival, and higher stray rates.

Temperature tolerance or intolerance in salmon and steelhead (and fish generally) has been well documented in the scientific literature, and local adaptation can play a role in thermal limits for different populations of the same species. Effects of high temperature on adult salmon migration include direct mortality, migration delay, and may also include depletion of energy reserves through delay and increased respiration, reduced gamete viability, and increased rates of disease (e.g., McCullough et al. 2001). It is well established that water at higher temperature carries less dissolved oxygen, while cooler water carries more and benefits all salmon species.

In the Snake/Columbia mainstem, impounded by FCRPS dams, fish ladders often expose adult salmon to elevated temperatures due to the warm surface water used to provide ladder flows (Keefer and Caudill 2015). High water temperatures can result in fish repeatedly entering and exiting these ladders, reducing survival rates. Ladders that have a high temperature gradient from warm surface waters in the forebay to cooler tailwaters can also delay migration of adult salmon through the ladders, reducing survival. The migration delays typically result in delayed migration to spawning grounds, increased total thermal exposure, and decreased migration success (Caudill et al. 2013, Keefer and Caudill 2015).

Elevated water temperature in the Columbia and Snake Rivers is a long-recognized problem that to date remains largely unmitigated (NMFS 1995; EPA 2001, FPC 2015). The inability to meet a temperature water quality standard of 20°C (68°F) in summer and the issue of elevated fish ladder temperatures are long-standing problems, both recognized in the 1995 FCRPS Biological Opinion (NMFS 1995). In general, the temperature exceedance problem has been more severe in the Snake River than in the Columbia River (FPC 2015). In 2015, temperatures exceeded the 20°C standard for 35% to 46% of the April-August passage season at all FCRPS projects except Lower Granite Dam (LGR; FPC 2015).

Current FCRPS strategies to cool overheated mainstem water in the Snake River rely primarily on the release of cold water from Dworshak Reservoir (on the North Fork Clearwater River) to help cool a portion of the lower Snake River from July into September, to protect migrating juvenile and adult salmonids. Dworshak's cold water releases have generally kept temperatures from exceeding the 20°C standard to Lower Granite Dam's tailwater, but the 20°C standard is routinely exceeded downstream (http://www.fpc.org). Cold water volumes from Dworshak are limited and must be used judiciously during the July-September period. Efforts to cool the adult fish ladders with auxiliary pumps at Lower Granite and Little Goose Dams have shown some potential to reduce migration delay at those dams (FPC 2015), but do not mitigate the larger problem of warm summer water temperatures in the entire lower Snake River and in the lower Columbia.

Climate change is exacerbating existing elevated temperature problems, and the severe problems faced in 2015 will increase in frequency. Snake River sockeye have been identified as extremely vulnerable to climate change due in part to their long migration through exceptionally warm reaches of the Snake River (Crozier et al. 2019). Data from recent years confirm that current strategies to cool the mainstem are insufficient, and the alternatives currently under evaluation by the Federal Action Agencies in the NEPA review process appear to inadequately address this problem. (http://crso.info).

Schultz and Johnson (2017) used the EPA temperature model (RBM-10) to simulate water temperatures in the lower Snake River throughout the summer of 2015, assuming that its four dams and reservoirs in eastern Washington did not exist; the simulations also assumed that cold water releases as in 2015 from Dworshak would continue. Their simulations indicated that a free-flowing lower Snake River would have remained cool enough for salmon to migrate successfully in 2015 (i.e., met the 20°C standard, except for brief periods after which temperatures quickly returned to a safe level), despite that summer's record-breaking air/water temperatures and low flows. For comparison, most parts of the impounded lower Snake River during July and August of 2015 were dangerously warm, becoming lethal for salmon and steelhead. Although not evaluated specifically, the modeled temperatures at Ice Harbor Dam suggest that the cooling effect of dam removal (with cold water releases from Dworshak) would have extended downstream at least to the confluence of the lower Snake and Columbia rivers. Shultz and Johnson (2017) concluded that "a free-flowing Lower Snake River could remain viable salmon habitat—at least from a water temperature perspective—despite some degree of climate change."

In the current NEPA review process, in which FCRPS alternatives are being studied by federal Action Agencies to restore ESA-listed salmon populations, strategies to reduce overall mainstem water temperatures do not appear to be sufficiently addressed. This serious flaw, if uncorrected, will mean that hot mainstem water will remain unmitigated and salmon and steelhead losses will continue and worsen over time, especially for Snake River stocks.

The option of breaching lower Snake River dams, combined with existing or modified cold water releases, has enormous potential to alleviate the very serious problem of elevated summer temperatures in the lower Snake River, and increase the survival rate from out-migrating smolts to returning adults (smolt-to-adult return; SAR) for all salmon species (Marmorek et al. 1998, Peters and Marmorek 2001, McCann et al. 2017). It would also significantly increase available spawning and rearing habitat for imperiled Snake River Fall Chinook.

No other action or actions can significantly lower summer water temperatures in the lower Snake River on a long-term basis, while also providing additional cooling in the lower Columbia.

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REFERENCES:

Caudill CC, Keefer ML, Clabough TS, Naughton GP, Burke BJ, Peery CA. 2013. Indirect effects of impoundment on migrating fish: Temperature gradients in fish ladders slow dam passage by adult Chinook Salmon and steelhead. PloS One. 8(12):1–13.

Crozier LG, Burke BJ, Sandford BP, Axel GA, Sanderson BL. 2014. Passage and survival of adult Snake River sockeye salmon within and upstream from the Federal Columbia River Power System. Report to Walla Walla District, U.S. Army Corps of Engineers. Northwest Fisheries Science Center.

Crozier LG, McClure MM, Beechie T, Bograd SJ, Boughton DA, Carr M, et al. (2019) Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. PLoS ONE 14(7): e0217711. https://doi.org/10.1371/journal.pone.0217711

EPA (Environmental Protection Agency). 2003. Columbia/Snake Rivers Preliminary Draft Temperature TMDL. July 2003.

FPC (Fish Passage Center). 2015. Requested data summaries and actions regarding sockeye adult fish passage and water temperature issues in the Columbia and Snake rivers. Memo 159-15. October 28, 2015.

Keefer ML and C.C. Caudill. 2015. Estimating thermal exposure of adult summer steelhead and fall Chinook salmon migrating in a warm impounded river. Ecology of Freshwater Fish. https://doi.org 10.1111/eff.12238

Marmorek, D.R., Peters, C.N., and Parnell, I. (Editors). 1998. PATH final report for fiscal year 1998. Compiled and edited by ESSA Technologies, Ltd., Vancouver, BC. Bonneville Power Administration, Portland, Oregon. 263 pp. Available from http://www.essa.com/documents/1998_Final_Report.pdf

McCann, J., B. Chockley, E. Cooper, B. Hsu, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, E. Van Dyke, A. Storch and D. Rawding. 2017. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead and Sockeye. 2017 annual report. BPA Contract # 19960200. Prepared by Comparative Survival Study Oversight Committee and Fish Passage Center. 230 pp. plus appendices. (http://fpc.org/)

McCann, J., B. Chockley, E. Cooper, B. Hsu, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, A. Storch and D. Rawding. 2018. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead and Sockeye. 2018 annual report. BPA Contract # 19960200. Prepared by Comparative Survival Study Oversight Committee and Fish Passage Center. 234 pp. plus appendices. (http://fpc.org/)

McCullough D, Spalding S, Sturdevant D, Hicks M. 2001. EPA Issue Paper 5: Summary of technical literature examining the physiological effects of temperature on salmonids. EPA-910-D-01-005.

NMFS (National Marine Fisheries Service). 1995. Endangered Species Act Section 7(a)(2) Biological Opinion on the Re-initiation of consultation on the 1994–1998 Operation of the Federal Columbia River Power System. NMFS, Northwest Region, Portland, Oregon. March, 1995.

Peters, C.N., and Marmorek, D.R. 2001. Application of decision analysis to evaluate recovery actions for threatened Snake River spring and summer Chinook Salmon (Oncorhynchus tshawytscha). Canadian Journal of Fisheries and Aquatic Sciences 58: 2431–2446. doi:10.1139/f01-173.

Schultz, M and M. Johnson. 2017. Computer modeling shows that Lower Snake River dams caused dangerously hot water for salmon in 2015. White Paper prepared for Columbia Riverkeeper. https://www.wildsalmon.org/factsheets-and-reports/

Yearsley, J.D. 2003. Developing a Temperature Total Maximum Daily Load for the Columbia and Snake Rivers: Simulation Methods. Final report 910-R-03-003 by the U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Yearsley, J., D. Karna, S. Peene and B. Watson. 2001. Application of a 1-D heat budget model to the Columbia River system. Final report 901-R-01-001 by the U.S. Environmental Protection Agency, Region 10, Seattle, Washington.