A customized version of the below letter was sent to Northwest policymakers on August 16, 2017. It is signed by 47 regional scientists and communicates the benefits of – and the scientists' support for – increased spring and summer spill (water releases over federal dams on the lower Columbia and lower Snake Rivers) to improve survival of out-migrating endangered juvenile salmon and steelhead populations. Spill represents a critical immediate, interim salmon restoration tool available to policymakers and state/federal/tribal managers while the people of the Northwest develop a legally valid, scientifically credible Columbia Snake River Basin Salmon Plan or Biological Opinion over the next several years, as ordered by the U.S. District Court in Portland in 2016.

August 16, 2017

Dear Northwest Policymaker,

In this letter, the undersigned scientists and fishery managers reaffirm the benefits of spill for salmon and steelhead of the Snake/Columbia River Basin, as an essential interim measure awaiting a legally valid, scientifically credible long-term plan. Specifically, we support an immediate increase in spill levels to benefit Snake/Columbia fish, for reasons described more fully below. Increased spill allows more juvenile salmon to pass dams safely via spillways, rather than passing through powerhouses or bypass plumbing. With existing dams in place, spill offers the best potential to improve life cycle survival. This is an essential near-term step for at-risk salmon runs pending the conclusion of the ongoing court-ordered review and development of a new plan, now underway. We support an immediate increase in spill to the highest biologically safe Total Dissolved Gas levels allowed by current environmental regulations; additionally, we also support an adaptive management experiment that expands spring spill levels to 125% of total dissolved gas (TDG), with testable hypotheses and appropriate monitoring of salmon and steelhead responses. Both are fully justified today, from a scientific perspective.

Since a U.S. District Court in Portland ruled earlier this year in favor of expanded spill beginning in 2018, some in the region have questioned the value of spill in reducing the risk to threatened and endangered fish associated with passage through the federal hydro-system. This letter summarizes existing science on the topic and unequivocally supports expanded spill as an effective near-term measure to better protect ESA-listed populations.

Development of the Federal Columbia River Power System (FCRPS) transformed a free-flowing river system into a series of reservoirs and dams, dramatically impacting native salmon and steelhead. The Columbia River salmonid ecosystem, prior to development, was a network of complex interconnected habitats that had been created, periodically altered, and maintained by natural physical processes (ISG 1999; Williams 2006) and passage to and from natal habitats for anadromous fish was unimpeded. Now, the developed Columbia

River ecosystem bears little resemblance to a natural river, and juvenile salmon and steelhead face obstacles of reduced water velocity, dangerously warm water in reservoirs, increased predation, migration delays, mortality, injury and stresses during dam passage. In many cases, additional stresses are introduced by handling and collection of juveniles for transportation. These factors directly and indirectly reduce survival rates during seaward migration and in delayed mortality that occurs in the ocean environment e.g., (Budy et al. 2002, Scheuerell et al. 2009, Van Gaest et al. 2011).

Since FCRPS completion in the 1970s, the abundance and productivity of Snake River salmon – historically almost half of the Columbia basin's entire spring/summer chinook and steelhead run – has declined dramatically. All native anadromous salmonids in the Snake River were listed under the Endangered Species Act (ESA) during the 1990s. The ESA listings were necessary despite a number of "technological fixes" undertaken in prior years to mitigate hydrosystem impacts, including screening of turbine entrances and collecting and transporting juvenile salmon (primarily barging) around dams and through slackwater reservoirs.

The Northwest Power and Conservation Council, in its Fish and Wildlife Program (NPCC 2014) has established a goal of achieving smolt-to-adult survival rates (SARs) of 2% - 6% (4% average) for listed Snake and Columbia River salmon and steelhead. Since the late 1990s SARs have averaged only 0.9% for Snake River wild spring/summer Chinook and 1.6% for Snake River wild steelhead, well short of even the minimum regional goal (McCann et al. 2016). Collecting and transporting (barging) juvenile salmon and steelhead around dams has also failed to compensate for the impacts of the FCRPS (McCann et al. 2016), despite implementing this strategy for decades.

Peer-reviewed literature indicates that life-cycle survival of Snake River spring/summer Chinook salmon and steelhead is related to both freshwater juvenile passage conditions and ocean conditions (Schaller and Petrosky 2007, Petrosky and Schaller 2010, Haeseker et al. 2012, Schaller et al. 2014). These analyses support the NPCC (2014) direction to explore the potential to improve life-cycle survival through new strategies for hydrosystem management and operations, while considering variation in marine conditions (ISAB 2013-1). Independent analyses of long-term (50 year) run-reconstruction and recent (1998-2015) PIT-tag data sets identified similar fresh water passage variables and ocean variables that characterize variation in life-cycle survival. Freshwater passage variables that positively influence survival include high water velocity (low water transit time) and higher spill, which helps smolts avoid dam powerhouses. With existing dams in place, spill offers the best potential to improve life-cycle survival. Only dam removals offer more benefits for salmon.

Fishery biologists widely accept that providing more natural habitat conditions (e.g., a "normative river"; ISG 1999; Williams 2006) is essential to restoring salmon and steelhead in the Snake and Columbia rivers. Factors in restoring more "normative" passage conditions would include reducing the time required

for juveniles to reach saltwater, passing more juveniles over dam spillways, speeding passage through reservoirs, and reducing juvenile collection and transportation (barging).

Last year, federal Judge Michael Simon of the U.S. District Court in Portland ruled that current operation of the FCRPS causes continued irreparable harm to imperiled salmon and steelhead and ordered the federal agencies responsible for managing fish, water, and power in the Columbia Basin to prepare a new analysis that complies with the law and moves wild salmon and steelhead populations toward recovery. The court has given the agencies until 2021 to complete this process. During this interim period, increasing spill at FCRPS dams is critical to the near-term protection and survival of Snake River salmon and steelhead, and other Columbia Basin species.

The groundwork has been laid for increasing spill above the levels allowed by current state water quality standards, and certainly at least to those levels, in recent work by the interagency Comparative Survival Study (CSS) coordinated by the Fish Passage Center. The CSS (2017) took advantage of retrospective analyses of independent data sets relating salmon and steelhead survival rates to freshwater passage conditions and ocean conditions (Petrosky and Schaller 2010, Haeseker et al. 2012, Schaller et al. 2014) and modeled likely responses to alternative future spill scenarios. Key findings include:

- Modeling the effects of increased spill levels (up to 125% Total Dissolved Gas (TDG) predicted the potential for significant improvement in juvenile fish travel times, in-river survival, ocean/marine survival, SARs and life-cycle survival of Snake River spring/summer Chinook and steelhead (CSS 2017).
- Increasing spill for fish passage up to safe limits of 125% TDG has a high probability of increasing SARs and may be capable of meeting regional 2-6% SAR goals. Increased spill is also predicted to lower the probability of extremely low SARs, thus reducing the extinction risk for ESA-listed populations (CSS 2017).
- Historical migration monitoring data indicate that spill for fish passage up to the 125% TDG level does not result in adverse conditions for downstream migration of juvenile salmon and steelhead. Currently, the State of Oregon allows spill to 120% TDG in tailrace monitors, and the State of Washington allows spill to 115% TDG in forebay/120% tailrace monitors (CSS 2017). Efforts are underway to align these standards in time for the 2018 outmigration, with a uniform 120% TDG limit.
- The modeling supports immediate implementation of spill for juvenile passage at the levels currently allowed and indicates that a large-scale adaptive management spring spill experiment across the FCRPS of up to 125% TDG is scientifically warranted. The monitoring structure to support this effort is already in place: current fish marking/tagging levels appear sufficient to monitor the effects of experimental spill management on Snake River spring/summer Chinook and steelhead (CSS 2017).

Regardless of future decisions about dam management, including consideration of dam removal, increased spill holds immediate potential to provide substantial survival benefits for Snake and Columbia River salmon, and to provide important information for future policy and action. Increased spill would benefit all Interior Columbia Basin salmon and steelhead populations, including those in Oregon and Washington State that enter the Columbia mainstem below the Snake River confluence.

The undersigned members of the scientific community support an immediate increase in spill levels as discussed above as a well-documented benefit for the salmon and steelhead of the Snake/Columbia Basin. It is an essential benefit for at-risk salmon runs pending the conclusion of the ongoing court-ordered review and development of a new plan. Therefore, we support immediate increases in spill to the highest biologically safe TDG levels allowed by current environmental regulations, and in an adaptive management experiment, we support expanding spring spill to 125% TDG, with testable hypotheses and appropriate monitoring of salmon and steelhead responses.

Sincerely,

Jack E. Williams, Ph.D.
Doctorate, Fisheries Science, Oregon State University
Senior Scientist, Trout Unlimited
Medford, Oregon

Chris A. Walser, Ph.D.
Doctorate, Biology, Tulane University
Chair, Natural Sciences and Mathematics, The College of Idaho
Caldwell, Idaho

Roger Rosentreter, Ph.D
Doctorate, Ecology, University of Montana
Botanist, Bureau of Land Management, retired
Boise, Idaho

Rick Williams, Ph.D.
Doctorate, Conservation Biology, University of Brigham Young
Research Associate, Department of Biology
The College of Idaho
Caldwell, Idaho

Don W. Chapman, Ph.D.
Doctorate, Fisheries, Oregon State University
Fisheries Biologist for University of Idaho, United Nations, and as independent consultant
McCall, Idaho

Keith A. Johnson, Ph.D.
Doctorate, Pathogenic Microbiology, Oregon State University
Chief of Sockeye fish culture, Idaho Department of Fish and Game, retired
Emmett, Idaho

Helen Neville, Ph.D.
Evolutionary Biology and Ecology, University of Nevada-Reno
Director of Research and Science Partnerships, Trout Unlimited
Boise, Idaho

Jonathan Rosenfield, Ph.D.
Doctorate, Fisheries Sciences, University of New Mexico
Berkeley, California

David C. Burns, Ph.D.
Doctorate, Fisheries Science
Fisheries Scientist Emeritus
McCall, Idaho

Roy Heberger, M.S.
Master of Science, Fisheries/Aquatic Ecology, University of Michigan
U.S. Fish and Wildlife Service, retired
Boise, Idaho

Jim Martin, M.S.
Master of Science, Fisheries, Oregon State University
Chief of Fisheries, Oregon Department of Fish and Wildlife, retired
Mulino, Oregon

John R. McMillan, M.S.
Master of Science, Fisheries and Wildlife, Oregon State University
Science Director, Trout Unlimited Wild Steelhead Initiative
Port Angeles, Washington

Paul Sankovich, M.S.
Master of Science, Fisheries, University of Idaho
Fisheries Biologist
La Grande, Oregon

Kent Ball, M.S.
Master of Science, Fisheries, University of Wisconsin
Fisheries Biologist, salmon and steelhead research/management, IDFG, retired
Salmon, Idaho

Brian Brooks, M.S.
Master of Science Natural Resources, University of Idaho
Restoration Ecologist
Boise, Idaho

Roger Wolcott, M.S.
Master of Science, Fisheries Biology, University of Washington
U.S. Fish and Wildlife Service/National Marine Fisheries Service, retired
Bend, Oregon

William Goodnight, M.S.
Master of Science, Fisheries, University of Idaho
Fisheries Scientist, Idaho Department of Fish and Game, retired
Boise, Idaho

Gary Gadwa, M.S.
Master of Science, Wildlife and Fisheries Resources, University of Idaho
Wildlife and Fisheries Biologist, Idaho Department of Fish and Game
Stanley, Idaho

David A. Cannamela, M.S.
Master of Science, Aquatic Science, Murray State University/Idaho State University
Fisheries Research Biologist/Fisheries Biologist, Idaho Dept. Fish & Game, retired
Boise, Idaho

Rodney W. Sando, M.S.
Master of Science, Fisheries, University of Idaho
Former Chief of Natural Resources, Minnesota
Former Executive Director, Columbia Basin Fish & Wildlife Authority
Director, Idaho Department of Fish and Game, retired
Woodburn, Oregon

Bill Shake, M.S.
Master of Science, Wildlife Biology, Western Illinois University
Former Assistant Director of Fisheries, USFWS, Portland Regional Office
Special Assistant to the Regional Director on Columbia River salmon, retired
Portland, Oregon

Russ Thurow, M.S.
Master of Science, Fisheries Resources, Univ. of Idaho and Univ. of Wisconsin, Stevens Point
Boise, Idaho

Micah Scholer, M.S.
Master of Science, Natural Resources, Boise State University
Landscape Ecologist
Saint Cloud, Minnesota

Eric Willadsen, M.S.
Master of Science, Natural Resource Management, University of Idaho
Riparian and Rangeland Restoration Ecologist
Boise, Idaho

Bert Bowler. M.S.
Master of Science, Fisheries, University of Idaho
Fisheries Biologist, Snake River Salmon Solutions
Boise, Idaho

Kurt Fesenmyer, M.S.
Master of Science, Environmental Management and Forestry, Duke University
Director, GIS and Conservation Planning, Trout Unlimited
Boise, Idaho

Andre E. Kohler, M.S.
Master's of Science, Stream Ecology, Washington State University
Aquatic Biologist/Salmon River Basin Program Manager
Department of Fish and Wildlife, Shoshone-Bannock Tribes
Fort Hall, Idaho

Scott Bosse, M.S.
Master of Science, Environmental Studies, University of Montana
Bozeman, Montana

Clark Watry, M.S.
Master of Science from University of Idaho
Project Leader – Research Division
Dept. of Fisheries Resource Mgmt., Nez Perce Tribe
Lapwai, Idaho

Andrew Hill, M.S.
Master of Science, Watershed Sciences, Utah State University
Research Biologist
Moscow, Idaho

Amy Goodrich
Master of Science, Ecology, Colorado State University
Natural Resources Specialist
Boise, Idaho

Alison Weber-Stover, M.S.
Master of Science, Ecology, University of California Davis
Senior Ecologist
Berkeley, California

Kerry Overton, M.S.
Master of Science, Fisheries Biology, Idaho State University
Fisheries Biologist
Boise, Idaho

Daniel M. Herrig, M.S.
Master of Science, Fisheries, Oregon State University
Fish Program Manager, retired
Boise, Idaho

Rebecca Fritz, M.S.
Master of Science, Fisheries, Northern Arizona University (expected 2018)
Sandpoint, Idaho

Stephen Pettit, M.S.
Master of Science, Zoology, University of Idaho
Fisheries Research Biologist, Idaho Fish and Game, retired
Lewiston, Idaho

Kimberly A. Apperson, M.S.
Masters of Science, Zoology, University of Idaho
Fisheries Scientist
McCall, Idaho

Richard Howard, M.S.
Master of Science, Wildlife Ecology, Utah State University
Biologist, U.S. Fish and Wildlife, retired
Boise, Idaho

Robert House, B.S.
Bachelor of Science, Fisheries, University of Washington
Meridian, Idaho

Doug Taki, B.S.
Bachelor of Science, Biology, Idaho State University
Fisheries Biologist, Chinook/Sockeye Program Manager, Shoshone-Bannock Tribes, retired
Former Chair, Columbia Basin Fish and Wildlife Authority
Pocatello, Idaho

William D. Horton, B.S.
Bachelor of Science, Fisheries Management
State Fisheries Manager, Idaho Department of Fish and Game, retired
Boise, Idaho

Richard Prange
Bachelor of Science, Natural Resources, Humboldt State University
Bureau of Land Management, U.S. Forest Service, U.S. Bureau of Reclamation, retired
Boise, Idaho

Mike Kochert, M.S.
Master of Science,
Research Wildlife Biologist, USGS retired
Gooding, Idaho

Ryan Santo, B.S.
Bachelor of Science, Fisheries & Aquaculture,
Data Management Project Leader
McCall, Idaho

James Esch, B.S.
Bachelor of Science, Fisheries, Oregon State University
National Marine Fisheries Service; U.S. Fish and Wildlife Service, retired
Boise, Idaho

Brian Ayers, B.S.
Bachelor of Science, Biology, Fort Lewis College
Fisheries Researcher, Pacific States Marine Fisheries Council
Boise, Idaho

Charles D. Branch
Fisheries Biologist and Hydrology Technician, retired
Coeur d'Alene, Idaho

REFERENCES:

Budy, P., G.P. Thiede, N. Bouwes, C.E. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management 22:35-51.

CSS (Comparative Survival Study Oversight Committee). 2017. Documentation of experimental spill management: models, hypotheses, study design, and response to ISAB. May 8, 2017. 138 p. http://www.fpc.org/documents/CSS/30-17.pdf

Haeseker, S.L., J.A. McCann, J. Tuomikoski and B. Chockley. 2012. Assessing freshwater and marine environmental influences on life-stage-specific survival rates of Snake River spring-summer Chinook salmon and steelhead. Transactions of the American Fisheries Society 141:121-138.
ISAB 2013-1. Review of 2009 Fish and Wildlife Program. Available: http://www.nwcouncil.org/fw/isab/isab2013-1/ (June 2015).

ISG (Independent Scientific Group). 1999. Return to the river: scientific issues in the restoration of salmonid fishes in the Columbia River. Fisheries 24(3):10–19.

McCann, J., B. Chockley, E. Cooper, T. Garrison, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, E. Van Dyke and R. Ehlke. 2016. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and Summer Steelhead. 2016 annual report. BPA Contract # 19960200. Prepared by Comparative Survival Study Oversight Committee and Fish Passage Center. 187 pp. plus appendices. http://www.fpc.org/

NPCC (Northwest Power and Conservation Council). 2014. Columbia River Basin Fish and Wildlife Program. Council Document 2014-12. Available: http://www.nwcouncil.org/fw/program/2014-12/program/ (June 2015).
Petrosky, C.E., and H.A. Schaller. 2010. Influence of river conditions during seaward migration and ocean conditions on survival rates of Snake River Chinook salmon and steelhead. Ecology of Freshwater Fish 10:520-536.

Schaller, H.A., and C.E. Petrosky. 2007. Assessing hydrosystem influence on delayed mortality of Snake River stream-type Chinook salmon. North American Journal of Fisheries Management 27:810-824.

Schaller, H.A., C.E. Petrosky, and E.S. Tinus. 2014. Evaluating river management during seaward migration to recover Columbia River stream-type Chinook salmon considering the variation in marine conditions. Canadian Journal of Fisheries and Aquatic Sciences. 71:259–271.

Scheuerell, M.D., Zabel, R.W., and Sandford, B.P. 2009. Relating juvenile migration timing and survival to adulthood in two species of threatened Pacific salmon (Oncorhynchus spp.). J. Appl. Ecol. 46: 983–990.

Van Gaest, A.L., Dietrich, J.P., Thompson, D.E., Boylen, D.A., Strickland, S.A., Collier, T.K., Loge, F.J., and Arkoosh, M.R. 2011. Survey of pathogens in hatchery Chinook salmon with different out-migration histories through the Snake and Columbia rivers. J. Aquat. Anim. Health, 23: 62–77.

Williams, R.N. (editor). 2006. Return to the river: restoring salmon to the Columbia River. Elsiver Academic Press. London, UK.

Via e-mail and regular mail

August 27, 2018

Governor Jay Inslee
Office of the Governor
P.O. Box 40002
Olympia, WA 98504

Ms. Stephanie Solien, Co-Chair
Mr. Thomas (Les) Purce, Co-Chair
Southern Resident Killer Whale Task Force
c/o Puget Sound Partnership
326 East D St.
Tacoma, WA 98421

Dear Governor Inslee, Co-Chairs Solien and Purce, and Members of the Southern Resident Orca Task Force:

We are writing as salmon scientists with decades of experience and considerable familiarity with the science concerning the protection and restoration of healthy, self-sustaining wild salmon populations in the Columbia and Snake River Basins. We are not marine mammal scientists but we understand that one of the issues before your Task Force is identifying and considering the most effective steps to increase the abundance of Chinook salmon in the ecosystems that support the remaining endangered Southern Resident Killer Whales or Orcas.

We also understand that, in that context, increasing the number of adult Chinook salmon from the Columbia and Snake Rivers is important to the short and long-term future of our remaining orcas. We believe we have the appropriate experience and scientific expertise to recommend two key measures to increase Chinook abundance from the Columbia/Snake system.

Recommendation for an Immediate Measure to Increase Columbia/Snake River Chinook Abundance

First, as many of us have written before, in the short-term, increasing the amount of water voluntarily spilled at the lower Snake and lower Columbia River dams will increase downstream juvenile survival and fitness, and consequently improve adult returns. More specifically, we believe the States of Washington and Oregon should modify their water quality standard waivers at these eight dams to allow total dissolved gas (TDG) levels up to 125% of saturation in the tailrace of each dam (without a forebay TDG limit). The evidence is compelling that the increase in spill that could occur with this level of dissolved gas will benefit salmon survival without any significant adverse impacts either to salmonids or other aquatic biota. Of course, spill at this level would need to be carefully implemented by the relevant fish and dam managers to avoid unintended adverse consequences.

Let us explain the scientific basis for this recommendation, much of which is also described in a letter many scientists sent to Northwest Policy Makers in 2017. A copy of that letter is attached for your reference. Briefly, development of the Federal Columbia River Power System (FCRPS) transformed a free-flowing river into a series of reservoirs and dams, dramatically impacting native salmon and steelhead. (ISG 1999; Williams 2006). The developed Columbia River ecosystem bears little resemblance to a natural river, and juvenile salmon and steelhead face obstacles of reduced water velocity, dangerously warm water in reservoirs, increased predation, migration delays, mortality, injury and stresses during dam passage. In many cases, additional stresses are introduced by handling and collection of juveniles for transportation. These factors directly and indirectly reduce survival rates during seaward migration and increase mortality in later life-cycle phases. (e.g., Budy et al. 2002, Scheuerell et al. 2009, Van Gaest et al. 2011).

The Northwest Power and Conservation Council, in its Fish and Wildlife Program (NPCC 2014) has established a goal of achieving consistent smolt-to-adult return rates (SARs) of 2% to 6% (2% to 4% for survival and above 4% for recovery) to rebuild listed Snake and Columbia River salmon and steelhead. In other words, 2 to 6 of every 100 juvenile salmon that outmigrate past the dams must return as adults. Since the late 1990s SARs have averaged less than 1% for Snake River wild spring/summer Chinook and only 1.6% for Snake River wild steelhead trout. (McCann et al. 2016). Collecting and transporting (barging) juvenile salmon and steelhead around dams has also failed to compensate for the impacts of the FCRPS (McCann et al. 2016), despite implementing this strategy for decades.

Peer-reviewed literature indicates that life-cycle survival of Snake River spring/summer Chinook salmon and steelhead trout is related to both freshwater juvenile passage conditions and ocean conditions (Schaller and Petrosky 2007, Petrosky and Schaller 2010, Haeseker et al. 2012, Schaller et al. 2014). Freshwater passage variables that positively influence survival include high water velocity (low water transit time) and higher spill, which helps smolts avoid dam powerhouses and bypass systems. With all eight existing federal dams in place, spill offers the best potential to improve life-cycle survival. Only removal of the Lower Snake River dams offers greater benefits for salmon. Fishery biologists widely accept that providing more natural habitat conditions (e.g., a "normative river," ISG 1999; Williams 2006) is essential to restoring salmon and steelhead in the Snake and Columbia rivers. Factors in restoring more "normative" passage conditions would include reducing the time required for juveniles to reach saltwater, passing more juveniles over dam spillways, speeding passage through reservoirs, and reducing juvenile collection and transportation (barging). Spill significantly contributes to a "normative river" by reducing the amount of time it takes fish to pass each dam and by reducing the handling and other stresses from dam bypass systems and barging.

The scientific basis for increasing spill above levels allowed by current state water quality standards has been established in recent work by the interagency Comparative Survival Study (CSS) coordinated by the Fish Passage Center. The CSS (2017) took advantage of retrospective analyses of independent data sets which account for both salmon and

steelhead survival rates through freshwater passage conditions and ocean conditions (Petrosky and Schaller 2010, Haeseker et al. 2012, Schaller et al. 2014) and modeled likely responses to alternative future spill scenarios. Key findings include:

- Modeling the effects of increased spill levels (up to 125% TDG on a 24-hour basis) predicts the potential for significant improvement in juvenile fish travel times, in-river survival, ocean/marine survival, SARs and life-cycle survival of Snake River spring/summer Chinook and steelhead trout (CSS 2017).

- Increasing spill for fish passage up to safe limits of 125% TDG has a high probability of increasing SARs to above 2%, and even significantly higher for some runs (within the range of the regional goal of 2-6%). Increased spill is also predicted to lower the probability of extremely low SARs, thus reducing the extinction risk for ESA-listed Chinook populations (CSS 2017) and orcas.

- Historical migration monitoring data demonstrate that spill for fish passage up to the 125% TDG level does not result in adverse conditions for downstream migration of juvenile salmon and steelhead.

The CSS modeling supports immediate implementation of spill for juvenile passage through a large-scale adaptive management spill operation at the eight dams on the lower Snake and lower Columbia Rivers of up to 125% TDG, beginning as soon as possible. The monitoring structure to support this effort is already in place: current fish marking/tagging levels appear sufficient to monitor the effects of experimental spill management on Snake River spring/summer Chinook and steelhead trout (CSS 2017). Regardless of future decisions about dam management, including dam removal, increased spill offers immediate potential to provide substantial survival benefits for Snake and Columbia River Chinook salmon. Spill is, in short, a critical and immediately available measure to increase salmon abundance. We urge the task force to recommend spill to 125% TDG beginning in spring 2019 in its final recommendations to the Governor.

Recommendation for a Permanent Measure to Increase Columbia/Snake River Chinook Abundance

Our second recommendation to you is the most effective measure we know of to permanently increase the sustained abundance of Chinook salmon from the Snake and Columbia Rivers: removing the four federal dams on the lower Snake River and restoring the ecological health of that river corridor. The Snake River Basin now supports 70% of the habitat available for recovery of spring/summer Chinook and steelhead trout in the entire Columbia River watershed. Removing these dams will take some time and careful planning, but a decision to undertake this restoration must be made as soon as possible for dam removal to occur in a timeframe that will make a difference for orcas. The efficacy of dam removal is supported by both considerable scientific analysis and, at least anecdotally, by experience with the removal of large and small dams on other salmon streams.

As with spill, compelling currently available scientific information regarding the benefits of removing the four lower Snake River dams is described in the CSS 2017 analysis and report. This report summarizes historical smolt-to-adult return rates for wild spring/summer Chinook and steelhead trout (above 8 dams) which have averaged only 0.8% and 1.6%, respectively, since the mid-1990s. This is far below the Power Council's goal of 4% average SAR with a range of 2%-6%. For comparison purposes, SARs of wild spring Chinook from the John Day River (now above 3 dams) and Yakima River (above 4 dams) have averaged 4.0% and 2.4%, respectively, since 2000. SARs of wild steelhead trout from the Deschutes River (above 2 dams), John Day River (above 3 dams) and Yakima River (above 4 dams) have averaged 7.5%, 5.3% and 4.6%, respectively, since 2000. Life-cycle survival (from spawner to adult return to the Columbia River) of Snake River spring/summer Chinook has declined to only about 13% of the life-cycle survival prior to FCRPS completion. This decline was much more severe than for John Day spring Chinook (above 3 dams), which declined to 46% of life-cycle survival prior to FCRPS completion.

The CSS's integrated, empirical, life-cycle model for spring/summer Chinook salmon populations from the Snake basin, developed by Dr. Robert Lessard, builds upon and incorporates results from several empirical statistical models, integrating decades of data on tributary adult spawners, tributary smolts, in-river survival estimates, ocean survival estimates, smolt-to-adult return estimates, and harvest estimates in order to predict the relative survival and recovery benefits of different management actions in the tributaries and in the FCRPS. The modeled scenarios include increased voluntary spill as discussed above, and also examine lower Snake River dam removal combined with various levels of voluntary spill at lower Columbia River dams. The results of this modelling show:

- Up to four times as many salmon would return if the four lower Snake River dams were breached and spill at the four lower Columbia River dams was increased to 125% TDG. Figure 2.10 in the 2017 CSS Annual Report projects SARs for Snake River Spring/Summer Chinook under Lower Snake River dam removal and 125% TDG spill at the lower Columbia River dams could be as high as 6% or more (a 148% increase).

- Dam removal with lower levels of spill at the remaining projects would result in lower, but still significant, increases in salmon abundance while allowing increased flexibility for power generation at the remaining dams. For example, breaching the four Lower Snake River dams and holding spill at the much lower levels allowed by the 2014 BiOp could produce up to two and a half times as many salmon which, while lower than dam removal with spill at 125% TDG, would still be a very significant survival increase.

- In this modeling exercise, harvest rates increase according to the *U.S. v. Oregon* harvest management framework as return abundance increases. There also are a number of potential benefits from dam removal that this model does not incorporate, including reduced water temperatures in a free-flowing lower Snake River and decreased predation rates (as compared to reservoir predation) in a free-flowing river.

To be clear, the CSS 2017 Annual Report is not the only analysis to identify the benefits for salmon survival of removing the four lower Snake River dams. As long ago as 1996, many salmon scientists, including a number of those on this letter, produced a report, *Return to the River*, that recommended a goal of restoring more normative river conditions in the Snake and Columbia as the most effective way to ensure the survival and recovery of salmon and steelhead populations in these rivers and their tributaries. Among the recommendations in this report was that removal of the four lower Snake River dams would be the most significant step available to improve the circumstances of these species.

Similarly, NOAA Fisheries in its 2000 Biological Opinion for FCRPS operations recognized that removal of the four lower Snake River dams had the greatest potential to improve survival of Snake River salmon, including spring/summer and fall Chinook. As NOAA stated then: "breaching the four lower Snake River dams would provide more certainty of long-term survival and recovery than would other measures." 2000 BiOp at 9-5. The U.S. Fish and Wildlife Service reached the same conclusion in a report to the U.S. Army Corps of Engineers in 2002, stating that: "the USFWS concludes that the benefits to fish and wildlife from the Dam Breaching alternative exceed the benefits provided by the other alternatives," 2002 Corps EIS, App. M at M11-1 ("all available science (synthesized in Budy, 2001) appears to suggest that dam breaching has the greatest biological potential for recovering Snake River salmon and steelhead" *Id*., App. M, at M10-1).

Nonetheless, at that time (and since) the federal agencies involved in operating these dams have chosen to take other approaches to restoring Columbia and Snake River salmon, approaches that consistently have been rejected by the courts as legally inadequate. We too believe these past efforts demonstrate that the focus on nursery habitat restoration and other measures short of dam removal cannot deliver sufficient survival benefits for salmon and steelhead, and that Lower Snake dam removal remains the most effective and available action to increase Snake River salmon abundance in the long-term. It is not a stand-alone action for salmon recovery, but it is the single largest step we can take to increase salmon abundance for orcas at critical times of the year. For that reason, we recommend that your Task Force include this measure in its recommendations to the Governor.

We hope you find these two recommendations useful in the important work you and the Task Force are doing to address threats facing Southern Resident Killer Whales. **If you have questions regarding these recommendations or require additional information, please feel free to contact David Montgomery 206-618-9220, or Dave Cannamela 208-890-1319.**

Sincerely,

David R. Montgomery, Ph.D.
Dept of Earth & Space Sciences, University of Washington
Author: *King of Fish: The Thousand-Year run of Salmon* and numerous papers and articles on geomorphology, salmon, and human influences on salmon runs.
Seattle, Washington

Rick Williams, Ph.D.
Doctorate, Conservation Biology, University of Brigham Young
Research Associate, Department of Biology
The College of Idaho
Caldwell, Idaho

Jack A. Stanford, Ph.D.
Doctorate, Limnology, University of Utah
Emeritus Professor of Ecology, Univ of MT Flathead Lake Biological Station
Polson, Montana

David C. Burns, Ph.D.
Doctorate, Fisheries Science
Fisheries Scientist Emeritus
McCall, Idaho

Jack E. Williams, Ph.D.
Doctorate, Fisheries Science, Oregon State University
Senior Scientist, Trout Unlimited
Medford, Oregon

Melissa Evans, Ph.D.
Research Biologist
Fish and Wildlife Dept., Shoshone-Bannock Tribes
Fort Hall, Idaho

Don W. Chapman, Ph.D.
Doctorate, Fisheries, Oregon State University
Fisheries Biologist for University of Idaho, UN, and as independent consultant
McCall, Idaho

Keith A. Johnson, Ph.D.
Doctorate, Pathogenic Microbiology, Oregon State University
Chief of Sockeye fish culture, Idaho Department of Fish and Game, retired
Emmett, Idaho

Chris A. Walser, Ph.D.
Doctorate, Biology, Tulane University
Chair, Natural Sciences and Mathematics, The College of Idaho
Caldwell, Idaho

Nick Gayeski, Ph.D.
Doctorate, Systems Ecology, University of Montana
Decades of research on historic salmon abundance, current habitat, ESA plans
Aquatic Ecologist, Wild Fish Conservancy
Duvall, Washington

Jonathan Rosenfield, Ph.D.
Doctorate, Evolution, Ecology, and Animal Behavior, University of New Mexico
Lead Scientist, The Bay Institute
Berkeley, California

Daniel B. Matlock, Ph.D.
Doctorate, Zoology, Oregon State University
Professor Emeritus, Biology, Seattle University
Freeland, Washington

James Lichatowich, M.S.
Master of Science, Oregon State University, Fisheries Science
45 years in salmon research and management
Author: *Salmon without Rivers, a History of the Pacific Salmon Crisis,* and *People and Place - a Biologist's Search for Salmon Recovery*
Columbia City, Oregon

Rodney W. Sando, M.S.
Master of Science, Fisheries, University of Idaho
Former Chief of Natural Resources, Minnesota
Former Executive Director, Columbia Basin Fish & Wildlife Authority
Director, Idaho Department of Fish and Game, retired
Woodburn, Oregon

Bill Shake, M.S.
Master of Science, Wildlife Biology, Western Illinois University
Former Assistant Director of Fisheries, USFWS, Portland Regional Office
Special Assistant to the Regional Director on Columbia River salmon, retired
Portland, Oregon

Jim Martin, M.S.
Master of Science, Fisheries, Oregon State University
Former Chief of Fisheries, Oregon Department of Fish and Wildlife, retired
Mulino, Oregon

Roy Heberger, M.S.
Master of Science, Fisheries/Aquatic Ecology, University of Michigan
U.S. Fish and Wildlife Service, retired
Boise, Idaho

David A. Cannamela, M.S.
Master of Science, Aquatic Science, Murray State University/Idaho State University
Fisheries Research Biologist/Fisheries Biologist, Idaho Dept. Fish & Game -retired
Boise, Idaho

Andre E. Kohler, M.S.
Master of Science, Stream Ecology, Washington State University
Aquatic Biologist/Salmon River Basin Program Manager
Department of Fish and Wildlife, Shoshone-Bannock Tribes
Fort Hall, Idaho

Stephen Pettit, M.S.
Master of Science, Zoology, University of Idaho
Fisheries Research Biologist, Idaho Fish and Game, retired
Lewiston, Idaho

Anthony DeGange, M.S.
Master of Science, University of South Florida
Chief, Ecological and Geographical Research, USGS Alaska Science Ctr, retired.
Anchorage, Alaska

John Heimer, M.S.
Master of Science, Biology/Fisheries, University of Idaho
Fishery Biologist, 33 years, Idaho Dept of Fish and Game – retired
Boise, Idaho

Gary Gadwa, M.S.
Master of Science, Wildlife and Fisheries Resources, University of Idaho
Wildlife and Fisheries Biologist, Idaho Department of Fish and Game - retired
Stanley, Idaho

Daniel M. Herrig, M.S.
Master of Science, Fisheries, Oregon State University
Fish Program Manager, USFWS - retired
Boise, Idaho

Bert Bowler. M.S.
Master of Science, Fisheries, University of Idaho
Former Anadromous Fish Manager, Idaho Dept of Fish and Game, retired
Fisheries Biologist, Snake River Salmon Solutions
Boise, Idaho

Roger Wolcott, M.S.
Master of Science, Fisheries Biology, University of Washington
U.S. Fish and Wildlife Service/National Marine Fisheries Service, retired
Bend, Oregon

Kerry Overton, M.S.
Master of Science, Fisheries Biology, Idaho State University
Fisheries Biologist
Boise, Idaho

Kimberly A. Apperson, M.S.
Master of Science, Zoology, University of Idaho
Fisheries Scientist
McCall, Idaho

Leonard P. Corin, B.S., M.A.
Bachelor of Science, Wildlife Conservation, Cornell University
M.A. Biology, Northern Michigan University
Deputy Ass't Regional Director, Fisheries and Ecological Svcs, USFWS (Retired)
Oak Harbor, Washington

William D. Horton, B.S.
Bachelor of Science, Fisheries Management
State Fisheries Manager, Idaho Department of Fish and Game, retired
Boise, Idaho

James Esch, B.S.
Bachelor of Science, Fisheries, Oregon State University
National Marine Fisheries Service; U.S. Fish and Wildlife Service, retired
Boise, Idaho

Charles D. Branch, B.S.
Bachelor of Science, Univ of Montana, Biology/Aquatics
Fisheries Biologist and Hydrology Technician - Wyoming, Idaho, Alaska, retired
Coeur d'Alene, Idaho

Bill McMillan
Field fisheries biologist, Wild Fish Conservancy
Consultant – WDFW, Seattle Public Utilities, NOAA toxicology
Concrete, Washington

CC:
Members of the United States Senate and House of Representatives in Washington State, Oregon and Idaho
Oregon Governor Kate Brown
Idaho Governor Butch Otter

References

Budy, P., G.P. Thiede, N. Bouwes, C.E. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management 22:35-51.

CSS (Comparative Survival Study Oversight Committee). 2017. Documentation of experimental spill management: models, hypotheses, study design, and response to ISAB. May 8, 2017. 138 p. http://www.fpc.org/documents/CSS/30-17.pdf

Haeseker, S.L., J.A. McCann, J. Tuomikoski and B. Chockley. 2012. Assessing freshwater and marine environmental influences on life-stage-specific survival rates of Snake River spring-summer Chinook salmon and steelhead. Transactions of the American Fisheries Society 141:121-138.
ISAB 2013-1. Review of 2009 Fish and Wildlife Program. Available: http://www.nwcouncil.org/fw/isab/isab2013-1/ (June 2015).

ISG (Independent Scientific Group). 1999. Return to the river: scientific issues in the restoration of salmonid fishes in the Columbia River. Fisheries 24(3):10–19.

Williams, R., P. Bisson, D. Bottom, L. Calvin, C. Coutant, M. Erho, C. Frissell, J. Lichatowich, W. Liss, W. McConnaha, P. Mundy, J. Stanford, and R. Whitney. 1999. Scientific issues in the restoration of salmonid fishers in the Columbia River. *Fisheries*, 24:3 10-19.

McCann, J., B. Chockley, E. Cooper, T. Garrison, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, E. Van Dyke and R. Ehlke. 2016. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and Summer Steelhead. 2016 annual report. BPA Contract # 19960200. Prepared by Comparative Survival Study Oversight Committee and Fish Passage Center. 187 pp. plus appendices. http://www.fpc.org/

NPCC (Northwest Power and Conservation Council). 2014. Columbia River Basin Fish and Wildlife Program. Council Document 2014-12. Available: http://www.nwcouncil.org/fw/program/2014-12/program/ (June 2015).

Petrosky, C.E., and H.A. Schaller. 2010. Influence of river conditions during seaward migration and ocean conditions on survival rates of Snake River Chinook salmon and steelhead. Ecology of Freshwater Fish 10:520-536.

Schaller, H.A., and C.E. Petrosky. 2007. Assessing hydrosystem influence on delayed mortality of Snake River stream-type Chinook salmon. North American Journal of Fisheries Management 27:810-824.

Schaller, H.A., C.E. Petrosky, and E.S. Tinus. 2014. Evaluating river management during seaward migration to recover Columbia River stream-type Chinook

salmon considering the variation in marine conditions. Canadian Journal of Fisheries and Aquatic Sciences. 71:259–271.

Scheuerell, M.D., Zabel, R.W., and Sandford, B.P. 2009. Relating juvenile migration timing and survival to adulthood in two species of threatened Pacific salmon (Oncorhynchus spp.). J. Appl. Ecol. 46: 983–990.

Van Gaest, A.L., Dietrich, J.P., Thompson, D.E., Boylen, D.A., Strickland, S.A., Collier, T.K., Loge, F.J., and Arkoosh, M.R. 2011. Survey of pathogens in hatchery Chinook salmon with different out-migration histories through the Snake and Columbia rivers. J. Aquat. Anim. Health, 23: 62–77.

Williams, R.N. (editor). 2006. Return to the River: Restoring Salmon to the Columbia River. Elsiver Academic Press. London, UK.