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THE HONORABLE MICHAEL H. SIMON

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF OREGON

PORTLAND DIVISION

NATIONAL WILDLIFE FEDERATION, et al., Plaintiffs, and STATE OF OREGON, Intervenor-Plaintiff, v. NATIONAL MARINE FISHERIES SERVICE, et al., Defendants.	Case No. 3:01-CV-00640-SI SECOND CORRECTED[1] DECLARATION OF EDWARD BOWLES IN SUPPORT OF OREGON'S MOTION FOR PRELIMINARY INJUNCTION

[1] This Second Corrected Declaration supersedes the Corrected Declaration of Edward Bowles (ECF No. 2393). It is filed for the sole purpose of correcting Figure 1 and Figure 4, which were inadvertently transposed in the previous filing.

I, Edward Bowles, declare:

1. I have previously submitted six declarations in these proceedings, namely: (i) Corrected Declaration of Edward Bowles in Support of State of Oregon's Motion for Injunction, filed January 18, 2017 (ECF No. 2123) (hereafter "Bowles 2017 Spill Injunction Declaration"); (ii) Reply Declaration of Edward Bowles in Support of State of Oregon's Motion for Injunction, filed February 28, 2017 (ECF No. 2165) (hereafter "Bowles 2017 Spill Injunction Reply Declaration") ; (iii) Declaration of Edward Bowles in Support of the State of Oregon's Motion for Summary Judgment, filed September 19, 2008 (ECF No. 1510); (iv) Second Declaration of Edward Bowles in Support of Oregon's Motion for Summary Judgment, filed November 18, 2008 (ECF No. 1592); (v) Amended Declaration of Edward Bowles in Support of the State of Oregon's Motion for Summary Judgment, filed December 1, 2008 (ECF No. 1633); and (vi) Declaration of Edward Bowles in Support of Plaintiffs' Motion for Injunctive Relief, filed November 25, 2008 (ECF No. 1630).

2. My professional experience, education and qualifications are fully set forth in a previous filing. *See* Bowles 2017 Spill Injunction Declaration ¶ 2 (ECF No. 2123). Those facts are incorporated herein by reference, with the following updates. Since my last declaration in 2017, I continued to lead the fish side of Oregon Department of Fish and Wildlife (ODFW) as Fish Division Administrator until October 2020. During that period, I continued providing oversight and direction to the agency's Columbia River fisheries management, research, hatchery, water and conservation programs, including oversight and direction on all aspects related to the Columbia River System (CRS) and the agency's role as a cooperating entity during development of the CRSO EIS. During this time, I also continued as the State of Oregon's lead on the Regional Implementation Oversight Group (RIOG) and as the State's policy and technical lead on the collaborative development and negotiation of the interim Flexible Spill Agreement filed with this court in 2018, which helped secure an interim litigation-free CRS operation until the CRSO EIS was completed in 2020. I retired from ODFW in October 2020, but was retained

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as a temporary part-time employee to continue my leadership role for the State of Oregon on Columbia River salmon recovery. This includes leadership and support on all aspects associated with the CRS and the recently initiated Columbia Basin Collaborative. In large part due to my past and ongoing leadership on Columbia River salmon science and recovery, I was recently presented the 2019 Distinguished Alumni Award from the University of Idaho, and the 2021 Lifetime Achievement Award from the Oregon Chapter of the American Fisheries Society.

3. In this declaration, I address the State's motion for preliminary injunctive relief. Section I discusses the status of listed species and explains why listed fish are currently in a perilous crisis, exacerbated by the increased frequency of poor environmental conditions associated with climate change. Section II explains why the status quo configuration and operation of the CRS will continue to cause irreparable harm to listed fish, and why Oregon's requested relief will reduce irreparable harm in the short-term but—due to the existing configuration and operation of the CRS—is not sufficient to provide a long-term solution. Section III explains why key stop gap measures should focus on increasing life-cycle survival by providing reductions to powerhouse encounters, travel time, and water temperature risks. Oregon's requested injunctive relief with respect to spill is explained in Section IV and with respect to reservoir elevations is explained in Section V.

I. STATUS OF SPECIES: LISTED FISH ARE IMPERILED WITH HEIGHTENED EXTINCTION RISK REQUIRING URGENT ACTION.

4. Previous testimony submitted by the State of Oregon in this case provides extensive background on various population metrics, such as abundance, productivity (recruits/spawner or R/S) and smolt-to-adult return rates (SARs). *See* Decl. of Anthony Nigro in Support of Oregon's Motion for Summary Judgment ¶¶ 12-18, 23 (ECF No. 1986); Amended Declaration of Edward Bowles in Support of the State of Oregon's Motion for Summary Judgment ¶¶ 22-29 (ECF No. 1633). I herein incorporate that previous testimony by reference and provide additional, updated information.

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A. The status of many listed populations has declined even further since issuance of the 2014 BiOp.

5. As of the date of this filing, the most recent NMFS 5-year Review Summary and Evaluation of Snake River Sockeye, Snake River spring-summer Chinook, Snake River fall-run Chinook and Snake River Basin Steelhead is from 2016 ("2016 status review") (NMFS 2016a) [NMFS00322008]. A technical memo prepared in 2015 for the 2016 status review contains more detailed information on the biological status of the species ("2015 technical memo") (NWFSC 2015) [NMFS00333315]. These documents indicate that all populations of Snake River spring-summer Chinook, except one, are either at high risk of extinction or functionally extirpated (2020 BiOp at 104 [ACE001056323], Table 2.2-2). Similarly, the Snake River sockeye salmon Evolutionarily Significant Unit ("ESU") remains at a high risk of extinction (2020 BiOp at 436 [ACE001056655]). The 2021 status review has not yet been released, but there is no evidence to suggest that there has been any substantive improvement in the status of listed fish since the 2016 status review or the 2015 technical memo.

6. Instead, population abundances of several listed salmon and steelhead species have declined dramatically in the intervening years since issuance of the 2014 BiOp and, for those populations that have seen improvements, those improvements have been marginal (NMFS 2016a [NMFS00322008]; NWFSC 2015 [NMFS00333315]; 2020 BiOp; Coordinated Assessments Exchange for Salmon and Steelhead 2021, e.g., 2014 – 2019 priority population data). Several species have recently experienced dramatic declines in abundance of a magnitude not seen since the unprecedented declines of the mid-1990s. Some of these declines were so significant they tripped the "Early Warning Indicator" and "Significant Decline Trigger" of the Adaptive Management Implementation Plan (AMIP) employed in previous BiOps (NOAA 2020; AA 2009; AA and NOAA 2012; 2014 BiOp [NMFS00338212]), which, in 2014, NMFS did not expect would be triggered for the foreseeable future (2014 BiOp at 420 ("[A]t this time 4-year running averages of abundance for each of the monitored species are all well above the Early Warning or Significant Decline abundance triggers identified in the AMIP and are likely to

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remain so for the foreseeable future.") [NMFS00338213]). The AMIP itself explained that "the principle underlying the Significant Decline Trigger is that the observed condition would be a significant deviation from the biological expectations of the 2008 BiOp. If it were to persist despite the AMIP's short and long-term contingency actions, it could call into question the BiOp's No Jeopardy conclusion for one or more species, resulting in the reinitiation of consultation." (AA 2009 at 31).

7. The "Early Warning Indicator" and "Significant Decline Trigger" were purportedly crisis safety nets. In fact, the trigger criteria negated any pretense of "early warning" or safety net by requiring a steep decline and a 4-year running average of very low abundance before anything was triggered. In other words, the damage was already done before any alarm bells were sounded. Nonetheless, when these crisis safety nets were in fact triggered, NMFS' "rapid response" for the CRS was limited to reliance on existing operations associated with the interim Flexible Spill Agreement, a program intended to be "better" for fish than prior operations, but inadequate to provide confidence of population growth and rebuilding necessary to address the low abundance crisis.

8. Equally concerning is that, in the 2020 BiOp, NMFS abandoned the AMIP altogether without noting or explaining that the AMIP abundance thresholds had been triggered, and without replacing it with any rational stop gap measures or any contingency plan to address the urgent population status crisis still evident today.

9. The 2020 BiOp projects that most of the listed salmon and steelhead populations that must migrate past the CRS dams will continue to have dangerously low abundances under the proposed action (*compare, e.g.*, 2020 BiOp Table 2.2-3 (pp. 107 [ACE001056326]) (ICTRT minimum abundance threshold) *with* 2020 BiOp Table 2.2-19b (pp. 228-29 [ACE001056447-8]) (life-cycle model projections of median abundance and QET)).

10. Imperiled species can still have abundances fluctuate up and down coincident with periods of favorable and unfavorable environmental conditions. However, extinction risk is

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heightened with increasing magnitude, frequency, scope (e.g., proportion of populations impacted), and/or duration of these downturns in abundance. Most listed species have experienced several of these downturns since the mid-1990s, with the recent downturn for many populations as perilous as that which precipitated ESA listing. It is self-evident that the CRS BiOps and CRS operations have not ameliorated this pattern of downturns, which is worsening under ongoing climate change.

11. The frequency and magnitude of unfavorable environmental conditions are increasing. NOAA scientists have concluded that "[E]xtreme weather events may become the new normal due to anthropogenic climate change with catastrophic consequences for endangered species." (Crozier et al. 2020 at 1). Climate models consistently show higher temperatures which, in turn, result in less snowpack, earlier snow melt and resulting spring river freshet, and earlier, lower and warmer minimum flows in summer (Crozier et al. 2019 at 11 [NMFS00291866]; Crozier et al. 2020 at 12; Mote et al. 2019; Jacox 2019). Moreover, the impacts of climate change "can act synergistically with other threats, dramatically increasing the impacts of each." (Crozier et al. 2019 at 32 [NMFS00291887]; see also Clifton et. al 2018, and Halofsky et al. 2017).

12. A 2021 publication by NOAA scientists underscores not only the likelihood of climate impacts on the species, but the certainty of extinction if actions are not taken (Crozier et al. 2021 at 9, available at https://www.nature.com/articles/s42003-021-01734-w.pdf (last visited July 12, 2021)). Crozier 2021 explains that "With a warming climate, deterministic declines inevitably lead to extinction unless some ecological, evolutionary, or climatic rescue effect occurs." (*Id.* at 3-4). Crozier et al. 2021 concludes that: "The urgency is greater than ever to identify successful solutions at a large scale and implement known methods for improving survival. Management actions that open new habitat, improve productivity within existing habitat, or reduce mortality through direct or indirect effects in the ocean are desperately

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needed." (*Id.* at 9). Crozier et al. 2021 further explains that "prospects for saving this iconic keystone species . . . are diminishing." (*Id.*).

13. As an example of deteriorating environmental conditions, NMFS' "stop light" summary of various indices of ocean health indicates poor ocean conditions for salmon are generally becoming more frequent over time and can include multiple years of downturns. *See* https://www.fisheries.noaa.gov/west-coast/science-data/ocean-ecosystem-indicators-pacific-salmon-marine-survival-northern (last visited June 21, 2021). Recovery from those poor conditions often falters and is less frequent. Thus, while current ocean conditions have improved somewhat over the extremely poor conditions in the recent past, that improvement is tenuous with no assurance that improvement will continue. NMFS' projections do not anticipate favorable ocean conditions returning soon (2020 BiOp at 118-25 [ACE001056337-44]).

14. Similarly, a substantial reduction in freshwater habitats capable of sustaining salmon and steelhead is likely under most climate change scenarios; this concerning change is already becoming apparent (Wade et al. 2013 [NMFS00348429-40]; Crozier et al. 2019 [NMFS00291856-904). This is largely due to reduced snowpack, earlier snowmelt, and lower flows with higher water temperatures during late spring and summer (Mote et al. 2018). This reality accentuates the vital importance of protecting and enhancing high elevation habitats that will likely retain the most snowpack, and restoring less impeded access for salmon and steelhead to these remaining habitats. The alpine watersheds of northeast Oregon and central Idaho epitomize this dilemma and challenge. Many of these watersheds are high elevation and therefore likely to accumulate and retain the most snowpack. Many of these watersheds include pristine wilderness areas with some of the last and best remaining freshwater habitats for salmon and steelhead. Many of the watersheds outside of wilderness areas have received substantial investments in habitat restoration that may enhance resilience to climate change. If spring-summer Chinook and summer steelhead are to persist in the face of climate change, it is essential for them to have less impeded access to and from these watersheds and their alpine spawning and

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nursery areas. Crozier et al. 2019 concludes that "[a]s demonstrated by recent dam removals and restoration activities that reconnect floodplains, physical and ecological responses can be rapid and can effectively reduce habitat constraints on these systems. Thus, we may be able to provide some relief to the extensive climate change risks highlighted in this vulnerability analysis." (Crozier et al. 2019 at 34 [NMFS00291889] (fns omitted)).

15. The most recent downturn in fish productivity and abundance was associated with several years of poor ocean and freshwater environmental conditions. This downturn was precipitated in part by the extreme conditions in 2015, including the ocean heat wave (aka The Blob) and the extreme interior heat wave in early summer which killed thousands of adult salmon in the impounded sections of the river. At the time of this declaration filing (mid July 2021), the effects of another "unprecedented" interior heat wave during late June 2021 have elevated temperatures in the impounded river beyond critical levels similar to those observed in 2015, creating extreme risk to adults and juveniles in the lower Columbia and Snake rivers.

16. As discussed later in this declaration, the CRS amplifies these thermal risks by dramatically slowing the water, creating a large surface area intensifying solar irradiation, and creating a heat trap for both warm and cool water flowing into the CRS. Emergency actions taken so far in 2021 attempting to mitigate extreme water temperature have amplified risk to fish in other operational areas of the CRS. This includes a reduction of surface passage spill for juveniles (a known biological benefit compared to powerhouse passage) to increase discharge of deeper and cooler water through the turbines at some dams. This will certainly increase the powerhouse encounters for juvenile fish, thus degrading fish passage in an attempt to address lethal surface temperatures. Emergency actions also included an earlier use of cool water from Dworshak Reservoir that will limit availability of cool water later in summer and early fall when it is also needed every year. Due to the large and slow-moving reservoir heat traps in the lower Snake River, cool water benefits from Dworshak will dissipate well before reaching the lower Columbia CRS reservoirs. An additional emergency measure was requested through the

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Regional Forum by some state and tribal salmon managers (that would help mitigate temperature risks without eroding fish passage (i.e., reduced operating range to ensure lower Snake River reservoir elevations were closer to minimum operating pool ("MOP")), but that request was denied by the Corps.

17. Both the 2015 heat wave with its catastrophic effect on already imperiled fish and what is currently unfolding in 2021 accentuate that the existing configuration and operation of the CRS is incapable of responding to, and effectively mitigating, these downturns in environmental conditions, which exacerbate the already adverse impacts of the CRS.

B. An alarming number of populations are currently at or below Quasi Extinction Thresholds.

18. In conservation science, Quasi Extinction Thresholds (QETs) are important criteria generally reflecting tipping points for population collapse, where avoidance of absolute extinction can no longer be assumed or predicted (Reed 2002; McElhany et al. 2000 [NMFS00312602-775]; ISAB 2015-1 [NMFS00305494-751]; Buhle et al. 2018 [USBR000355031-74]). Below QET, uncertainty and extinction risk can amplify and accelerate due to heightened vulnerability of small populations to demographic, genetic and environmental risks. This can result in an extinction vortex, where extinction risk accelerates, resilience deteriorates (i.e., vulnerability to chance and unfavorable conditions increases while the ability to respond positively to favorable conditions decreases), and the likelihood of recovery diminishes (Gilpin and Soule 1986; Simblerloff 1988; Fagan and Holmes 2006). Thus, QET should not be viewed as simply a milestone on a linear path to extinction, but instead as a tipping point for not only accelerated extinction risk, but also heightened likelihood that populations may no longer be able to respond favorably to improved conditions. Because avoiding extinction can no longer be assumed or predicted once below QET, conservation scientists and managers typically use QET, not zero fish, as the "floor" for assessing extinction risk and population viability. For example, the NMFS Technical Recovery Team's criteria for QET generally is population abundance of 50

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adult spawners per year for four consecutive years, which they used to assess extinction risk for population viability analysis when appropriate data were available (ICTRT 2007 [NMFS00304632-892]; ICTRT 2010). The NMFS Technical Recovery Team's criteria for viability generally requires the probability of extinction (i.e, QET) be 5% or less for the next 24, 50 or 100 years (ICTRT 2007 [NMFS00304632-892], 2010; Zabel and Jordan 2020 [NMFS00357923-8083]).

19. Remarkably, I have not been able to find any assessment of the current QET status of listed fish reported in the 2020 BiOp. The 2020 BiOp does assess the probability of reaching QET at some future time under the proposed action, but it does not assess whether, using empirical estimates of spawner abundance, listed fish are already at or near QET presently (2020 BiOp at 223 [ACE001056452]).

20. To fill this void, Nez Perce Tribe scientists modeled current abundance relative to QET(50) (i.e., 50 adult fish for four consecutive years) to assess the number of populations at QET now and, given recent trends, also modeled what this may look like in the next several years (Johnson et al. 2021). The Nez Perce Tribe analysis indicates that 42% of the listed Snake Basin spring/summer Chinook populations already have abundance levels at or below QET(50), and by 2025, 77% of populations are predicted to be at or below QET(50) or to have at least begun the 4-year count for QET(50). *Id.* For listed summer steelhead, 19% of populations are currently at or below QET(50), and by 2025, 44% are predicted to be at or below QET(50) or to have begun the 4-year count. *Id.*

21. ODFW reviewed and concurs with the Nez Perce Tribe analysis, and conducted an additional analysis which, considered together with the Nez Perce Tribe's analysis, adds to the weight-of-evidence that an alarming proportion of listed populations are already at or below QET, and that this extinction crisis is unlikely to ease in the short term.

22. The ODFW analysis complements the Nez Perce Tribe analysis but also incorporates a different analytical framework. ODFW analyzed current status (relative to QET)

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by using the actual adult run sizes estimated for each year; Nez Perce Tribe used a modeling approach to assess current status. ODFW's projections forward relied on variations in the entire time series of prior population abundance patterns observed; the Nez Perce Tribe's projections used recent abundance trends. Lastly, ODFW projections focused on populations at or below QET(50) for four consecutive years; the Nez Perce Tribe included those populations plus other populations that were at least one year into the 4-year count. ODFW's analysis indicates that 29% of the Chinook populations considered are currently at QET and 39% of the populations are predicted to reach the threshold by 2025. Prospects are similarly dire for Snake River steelhead, where 13% of populations are at QET currently, and by 2025, a majority (63%) of populations are predicted to be at QET. ODFW's QET analysis is attached as **Exhibit 1**. Both ODFW and Nez Perce Tribe analyses indicate the dire situation for populations of Snake River spring-summer Chinook and steelhead.

23. Considering the Nez Perce Tribe and ODFW analyses together as weight-of-evidence for current and projected near-term status relative to extinction risk (i.e., QET), somewhere between one quarter to nearly one half of listed Snake River spring-summer Chinook populations are already at QET, and approximately one third to three quarters will likely be at or near QET within the next five years. Also, approximately one sixth to one fifth of listed SR summer steelhead populations are already at QET, with nearly one half to two thirds likely at QET within the next five years.

24. To reiterate, the magnitude, scope, duration and frequency of severe downturns in population abundance have direct bearing on extinction risk and potential tipping points into extinction vortices. These QET analyses are very alarming for several reasons, including: (1) the magnitude of the current downturn is severe (i.e., at or below quasi-extinction thresholds for many listed populations); (2) it is one of several moderate or severe downturns in the past several decades; (3) the scope is broad (e.g., all listed Snake River spring-summer Chinook populations are down, but approximately one fourth to nearly one half are at or below QET now); and (4) the

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duration is long (i.e., generational downturn is already evident with little indication of favorable environmental conditions in the near term and the prognosis is dire for the future given ongoing climate change). Urgent action is needed to address this extinction crisis.

C. Smolt-to-Adult Returns (SARs) are too low for survival and recovery of listed species.

25. As I explained in previous testimony, *see* 2017 Bowles Spill Injunction Declaration ¶ 24 (ECF No. 2123), for a salmonid population to grow, it is necessary that more adult progeny (recruits) return to spawn than the number of parents that produced them. It is not enough for this to occur sporadically but instead must continue consistently over time. Production of recruits depends on: (1) the number of eggs that survive to become out-migrating juveniles ("smolts") per spawner, which generally occurs in natal freshwater tributaries prior to entry into the CRS; and (2) the survival of those smolts to adulthood (SAR). Most of the mortality that can be attributed to the CRS occurs in the smolt-to-adult stage and is therefore inherent in estimates of SAR. The SAR includes direct and indirect CRS-related mortality during the following smolt-to-adult life stages: juvenile migration through the CRS toward the ocean; residence in the estuary and ocean that can be impacted by delayed effects of stressors associated with the fishes' CRS experience; adult migration through the CRS as fish return to spawn; and, depending on where adults are counted for the SAR estimate, adult migration and holding up to spawning, which may also include pre-spawn mortality related to stressors encountered during the adult's CRS experience.

26. SARs are an important measure of the effects of hydrosystem operations and configuration, as well as other impacts, on life-cycle survival of salmon and steelhead populations. Certainly, SARs include multiple sources of mortality beyond just the CRS; however, the smolt-to-adult stage is critically important for understanding CRS impacts because it includes all sources of mortality (direct and delayed or indirect) associated with the hydrosystem experience. Recognizing this, the Northwest Power and Conservation Council

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("NPCC") Fish and Wildlife Program has set a regional goal of consistently achieving SARs in the 2% to 6% range, averaging 4% (NPCC 2020). A SAR of 2% means that, for every 100 fish that migrate through the CRS as juveniles, two adult fish return. The probability of achieving the mid-range regional SAR goal of 4% is one important aspect of evaluating how changes to CRS spill operations can affect survival (and, as relevant to the present motion, reduce irreparable harm) of federal ESA-listed salmon and steelhead populations.

27. A SAR of 2% is the low point of the range of SARs necessary for populations to maintain their current abundance and avoid further population decline (e.g., most recently demonstrated in McCann et al. 2020). For viable populations at low abundance, this should not be viewed as an average target across a range of environmental conditions, but as the minimum SAR observed during periods of unfavorable environmental conditions. During favorable environmental conditions, this same intrinsic population productivity would result in SARs approaching 6%, and over the range of environmental conditions an average of 4%. At low abundances, maintaining at least an SAR of 2% is critically important because the population cannot afford further declines without heightened extinction risk. This is because SARs that average between 1% and 2% over time are generally associated with a mix of population declines and increases, so there is no certainty of avoiding further decline and heightened extinction risk if SARs are in this range. Listed species impacted by the CRS have exceeded 2% SARs very infrequently and generally were more likely to do so when environmental conditions were favorable. Given the increasing frequency of environmental downturns from climate change, SARs need to consistently exceed 2% SAR in order to avoid further declines.

28. SARs and population status criteria for Snake River salmon and steelhead—populations that must pass eight dams during both their juvenile and adult migration—are particularly dire. In the following paragraphs, I provide an overview of the SARs for wild Snake River spring-summer Chinook and wild Snake River summer Steelhead, two species that are in especially acute crisis.

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29. Snake River spring-summer Chinook:

a. It is well established that SARs for this species are on a declining trend and are currently well below the levels needed for replacement (McCann et al. 2020). The geometric mean SAR for this species during 1964–1969 was 4.3% compared to 1.0% during 1993–1999, 1.1% during 2000-2009, and 0.7% during 2010-2018 (*Id.*). During the available post-listing period (1994-2018) for PIT-tagged wild Snake River spring-summer Chinook, the geometric mean SAR (LGR-to-GRA, jacks included) was 0.75% (*Id.*).

b. Snake River spring-summer Chinook SARs have never met the NPCC 4% average SAR objective during the period 1994-2018 (*Id.*). Annual SARs exceeded the NPCC's minimum SAR objective of 2% in only two of 25 smolt migration years (1999 and 2008) during this period, with both years below the 4% objective (*Id.*) (Figure 1).

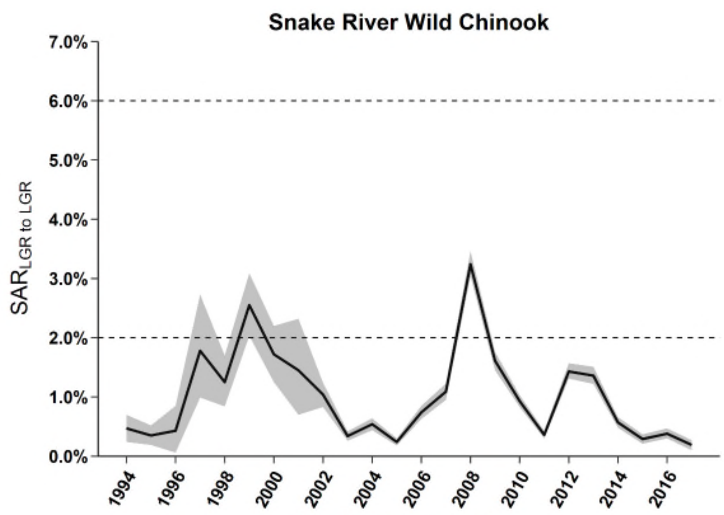

Figure 1 Smolt to adult return rates (LGR-LGR) for Snake River wild spring/summer Chinook salmon, 1994–2017. Shaded region represents 95% confidence bands. Horizontal (dashed) lines indicate the lower and upper NPCC SAR goals. Data are from McCann et al, 2020, Appendix B.

c. A strong positive association has been evident between Recruits to the spawning ground per Spawner ("Rsg/S") and SAR for Snake River spring-summer Chinook populations (Figure 2). Generational declines in abundance (fewer progeny spawners than

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parent spawners; ln Rsg/S < 0) occurred in 71% of Rsg/S estimates (across years and populations) when SARs were less than 1%, but in only 3% of estimates where SARs were greater than 2%. When SARs were between 1% and 2%, generational declines in abundance occurred in 34% of the estimates. At the aggregated scale, SARs less than 1% consistently result in generational declines in abundance (ln Rsg/S < 0) in all four Snake River spring/summer Chinook major population groups (MPGs) (Figure 2 and Figure 3). Conversely, SARs greater than 2% generally resulted in generational increases in abundance in all four MPGs. Although generational declines and increases were mixed when SARs were between 1% and 2%, SARs consistently above 2% are a conservation necessity to avoid further generational declines, or even level status, during periods of critically low abundance such as those occurring now.

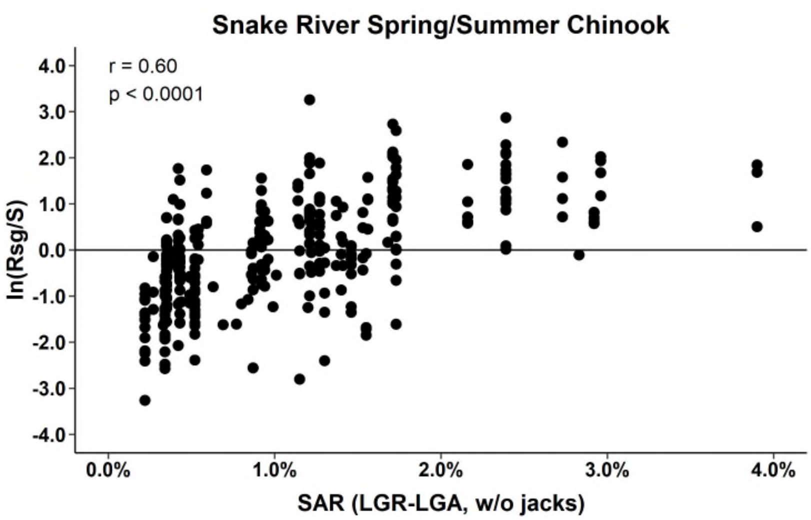

Figure 2 Relation between productivity (ln(Rsg/S)) and SARs for populations of Snake River spring/summer Chinook salmon. Values above zero (equilibrium or replacement) indicate generational increases in abundance, while values below zero indicate generational declines in abundance. SARs are calculated as LGR-LGR without jacks. Data are from McCann et al 2020.

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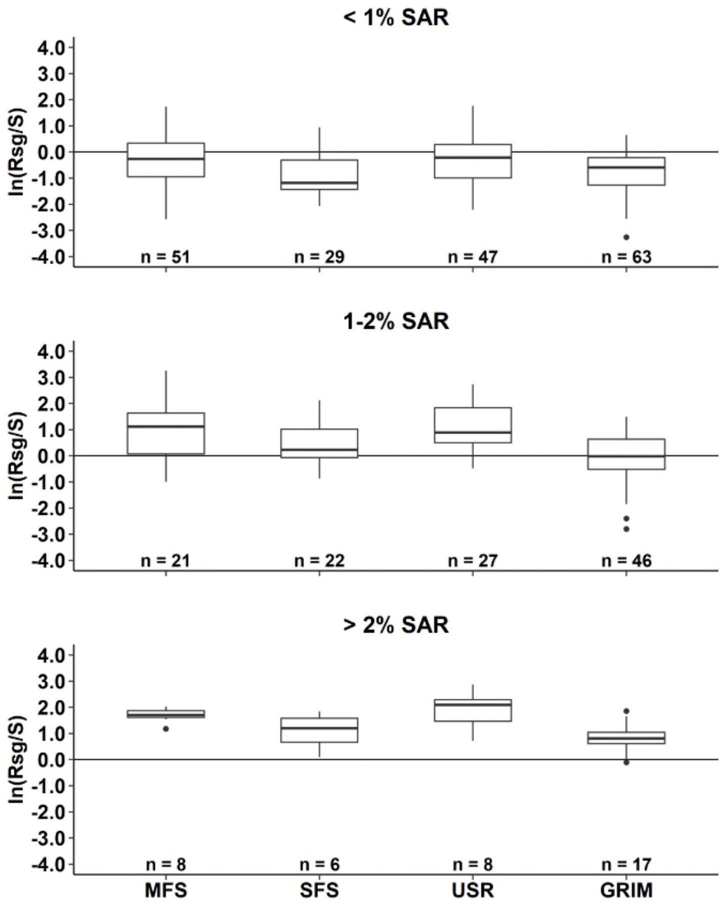

Figure 3 Distribution of estimates of productivity among Snake River spring/summer Chinook Salmon major population groups (MPG) at various levels of SAR. MPGs are: Middle Fork Salmon (MFS), South Fork Salmon (SFS), Upper Salmon (USR) and Grande Ronde/Imnaha (GRIM). Horizontal line indicates replacement; values above the line represent generational increases in abundance whereas values below indicate generational declines. Boxes show 25th percentile, median and 75th percentile of ln(Rsg/S). Whiskers represent 1.5-times the interquartile range or the range of the data. Values beyond 1.5-times the interquartile range are shown as single dots. Data are from McCann et al 2020.

30. <u>Snake River Steelhead</u>:

a. Similar to spring-summer Chinook, SARs for wild Snake River summer steelhead also show a precipitous decline and continued depression. The steelhead geometric mean SAR during 1964–1969 was 7.2% compared to 1.9% during 1990–1999, 2.5% during

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2000–2009, and 1.5% during 2010-2017 (McCann et al. 2020). For the period 1997-2017, roughly since listing, SAR of PIT tagged steelhead had a geometric mean of 1.31% (*Id.*).

b. For the approximate period since listing (1997-2017 migration years), populations have failed to reach even the minimum 2% SAR objective nearly two thirds of the time; and have never reached the 4% average SAR target (Figure 4).

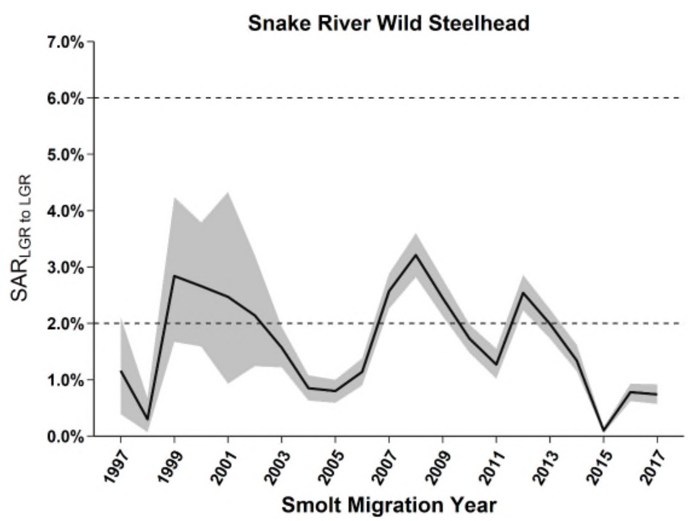

Figure 4 Smolt to adult return rates (LGR-LGR) for Snake River wild steelhead, 1997–2017. Shaded region represents 95% confidence bands. Horizontal (dashed) lines indicate the lower and upper NPCC SAR goals. Data are from McCann et al, 2020; Appendix B).

c. As with spring-summer Chinook, there is a positive association between full life-cycle productivity (Rsg/S) and SAR for Snake River summer steelhead (Figure 5 and Figure 6). Alarmingly, over 80% of life-cycle productivity (Rsg/S) estimates for various Snake River summer steelhead populations over time showed generational declines in abundance (ln Rsg/S < 0). Generational increases in abundance are more likely when SARs exceed 2%, however this threshold is not as certain with steelhead because they have a more complicated life history, including longer freshwater residency, than spring-summer Chinook (McCann et al. 2020). Thus, higher likelihood of avoiding generational decline for steelhead would require

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higher than 2% SAR. When SARs were between 1% and 2%, both generational declines and increases were observed, however declines were more likely due to reasons described above.

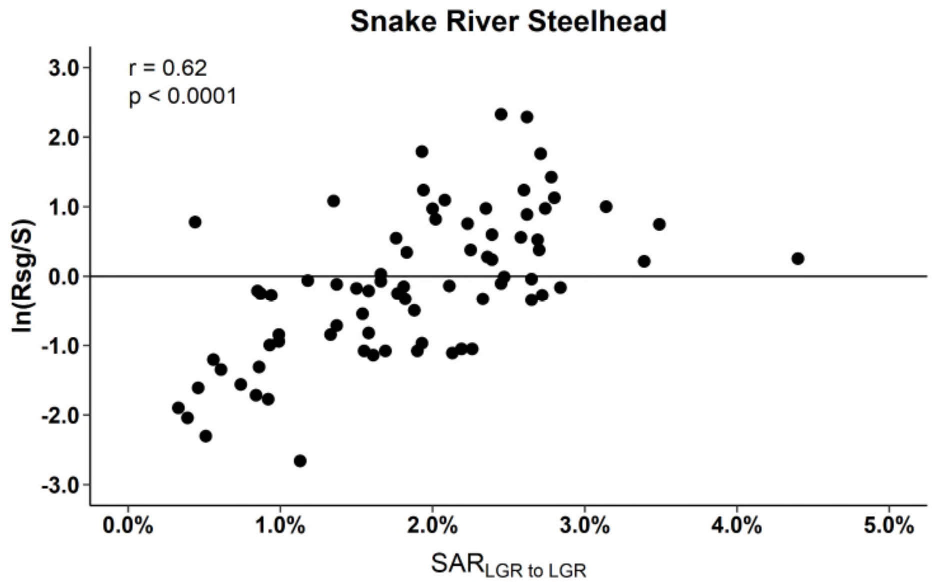

Figure 5. Relation between productivity (ln(Rsg/S)) and SARs for populations of Snake River steelhead. Values above zero (equilibrium or replacement) indicate generational increases in abundance, while values below zero indicate generational declines in abundance. SARs are calculated as LGR-LGR without jacks. Data are from McCann et al. 2020.

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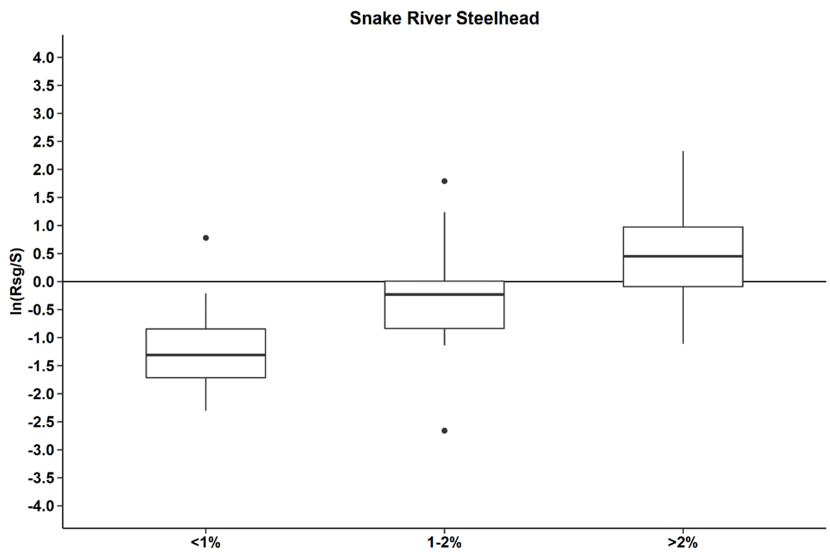

Figure 6. Distribution of estimates of productivity for Snake River steelhead at various levels of SAR. Horizontal line indicates replacement; values above the horizontal line represent generational increases in abundance whereas values below indicate generational declines. Boxes show 25th percentile, median and 75th percentile of ln(Rsg/S). Whiskers represent 1.5-times the interquartile range or the range of the data. Values beyond 1.5-times the interquartile range are shown as single dots. Data are from McCann et al 2020.

D. The weight of scientific evidence is clear that CRS dams and operations are an important factor in the imperiled status of listed fish.

31. It is not scientifically disputed that configuration and operation of the CRS is an important factor in the decline, listing and ongoing imperilment of listed fish (NPCC 2015; Williams et al. 2005 [NMFS00356406-574]; 2020 BiOp; NMFS 2017 [NMFS00324533]).

32. It is also not scientifically disputed that environmental factors such as poor ocean conditions, drought, reduced snowpack, reduced river flow and elevated water temperatures contribute to the decline and ongoing imperilment of these listed fish, and that the frequency, magnitude and duration of these unfavorable environmental factors are increasing with climate change (Crozier et al. 2019 [NMFS00291856-904]; Crozier et al. 2020). It is also not scientifically disputed that adverse impacts of CRS dams and operations on listed fish can be exacerbated during periods of unfavorable environmental conditions (Crozier et al. 2020; Crozier et al. 2021). As noted in a recent publication, the "eight major hydrosystem dams profoundly

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affect temperatures and flows experienced by salmon in the Columbia Basin. This convergence of pressures may be a harbinger of future biodiversity loss in these unique populations as they respond to climate change." (Crozier et al. 2020 at 2 (fn. omitted)).

33. Therefore, it is informative to tease out, where possible, the relative impacts of the CRS on fish status from the backdrop of these large-scale environmental factors. This can help frame the relative importance of CRS conservation actions and help gauge the success of those actions following implementation.

34. Updated analyses from Petrosky et al. 2020 provide valuable information in this context and continue to strengthen scientific support for the role the CRS plays in the ongoing status and imperilment of listed fish. Petrosky et al. 2020 helps illustrate that listed Snake River spring-summer Chinook (above eight dams) experienced a more dramatic reduction in life-cycle survival coincident with development of the Snake River dams than their downriver counterparts from the John Day River (above three dams), and that this two- to three-fold divergence continues to be evident (Figure 7) (reproduced from Petrosky et al. 2020 [ACE839450–98]).

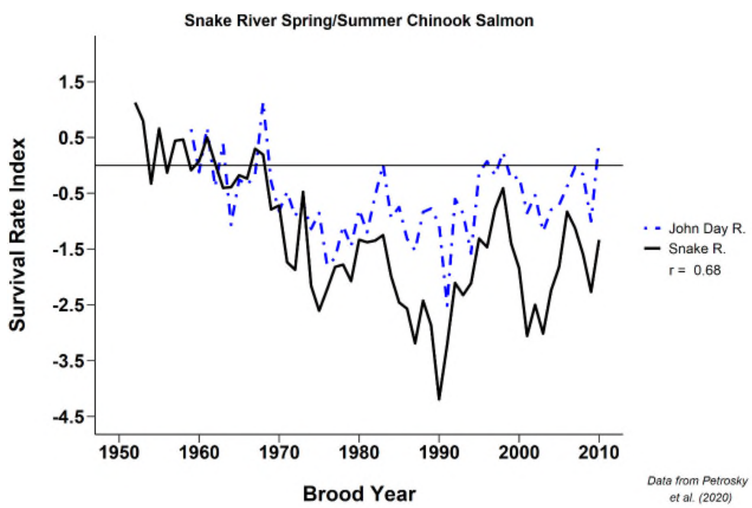

Figure 7. Patterns in survival rate index (SRI) for Snake River (solid line) and John Day River (dashed line) spring/summer Chinook Salmon. SRI values are essentially deviations from predicted recruits and spawners relative to the period preceding completion of the CRS and accounting for density-dependent effects (for a broader definition see Schaller et al. 1999, 2014 [ACE962860–72]; Schaller and Petrosky 2007 [ACE839523–789]). Data are from Petrosky et al. 2020.

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35. Without the John Day comparison, one might erroneously assume the dramatic decline for Snake River fish coincident with completion of Snake River dams was totally due to the dams. However, with the John Day comparison we can assess the relative contribution of the CRS from other large-scale factors common to both Snake River and John Day River populations (e.g., ocean conditions, drought, snowpack). The Snake River populations fluctuate in general synchrony with the John Day populations, likely due to these large-scale factors common to both groups of populations, with both groups experiencing periods of lower life-cycle survival relative to pre-1970s. However, the Snake River populations experience an additional two- to three-fold survival deficit relative to pre-dam survival than is evident for John Day. This two- to three-fold divergence is likely attributable to CRS development and ongoing operations, as there is no evidence of significant differences in migration timing, ocean entry or ocean distribution between the two groups; and tributary habitat conditions are generally better for Snake River populations originating in wilderness areas than for those populations originating in the John Day (Petrosky et al. 2020 [ACE839450–98]). If this divergence gap between Snake River and John Day populations narrowed appreciably, it could be a valuable indication that CRS conservation actions are successfully addressing some of the CRS impacts. Regrettably, the updated analyses in Petrosky et al. 2020 do not show that this divergence gap is narrowing, indicating much more is needed to fully address CRS impacts.

36. The weight of scientific evidence has spurred growing scientific consensus that acknowledges this ongoing disparity between survival of listed fish originating above the Snake River dams and their non-listed counterparts originating below the Snake River dams, and the conservation necessity of addressing those dams (McCann et al., 2020; https://www.orcaconservancy.org/68-scientists-send-letter-to-nw-policymakers-on-snake-river-salmon-and-dams/) (last visited July 7, 2021); https://wildsnakeriversalmon.medium.com/snake-river-salmon-headed-for-extinction-without-drastic-action-e9f0d196eddc (last visited July 7, 2021)). For example, Figure 8 compares SARs for listed Snake River populations (8 dams) with

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non-listed Yakima (4 dams) and John Day (3 dams) populations of spring-summer Chinook. The Snake River SARs are much lower than their counterparts and generally fall outside the 2-6% range necessary for persistence, whereas the Yakima and John Day SARs generally fall within the 2-6% range necessary for persistence (McCann et al. 2020).

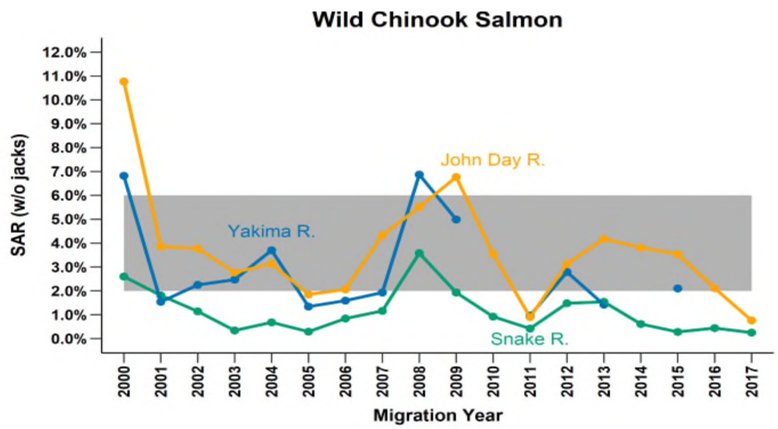

Figure 8. Variation in smolt to adult return rates for John Day, Yakima and Snake river spring/summer Chinook salmon. The shaded region indicates the range of NPCC SAR goals.

E. It is not too late for listed fish but urgent actions are necessary.

37. Populations can often withstand downturns in population abundance, but the frequency, magnitude and duration of these downturns all conspire against the inherent resilience of populations, and their ability to withstand future downturns and respond to improved conditions (McElhany et al. 2000 [NMFS00312602-775]; ICTRT 2007 [NMFS00304632-892], 2010; NMFS 2009 [NMFS00317004]; NMFS 2017 [NMFS00324533]).

38. Fortunately, listed Snake River Chinook and steelhead continue to demonstrate resilience and the capacity to respond favorably when conditions allow, so hopefully they are not yet at the point of no return. For example, the severe downturn in Snake River spring-summer Chinook adult abundance that occurred in the mid-1990s was followed by a brief period in the late 1990s of favorable ocean conditions, snowpack, flow and uncontrolled spill. Both listed and non-listed fish responded favorably to these conditions, with a burst of life-cycle and SAR productivity adequate to exceed replacement levels and provide a rare opportunity for positive

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population growth rates (Figure 9). The magnitude and duration of the current downturn in abundance, productivity, and environmental conditions is alarming, and projections do not indicate a positive change (as discussed above in ¶¶ 18-24 and Exhibit 1). Thus, the amplified extinction risk is real and urgent, requiring immediate additional stop-gap actions to help mitigate the current situation while securing a long-term solution before it is too late.

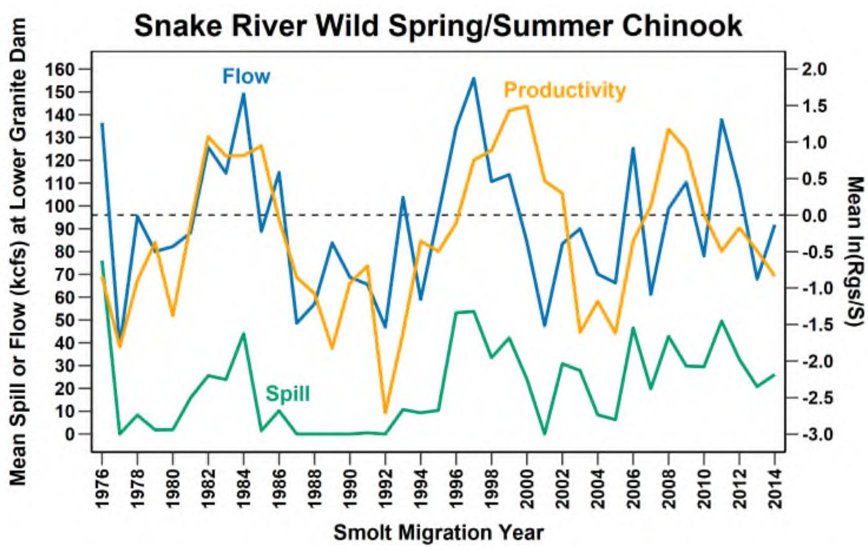

Figure 9. Variation in productivity (ln(Rsg/S)) coincident with inter-annual variability in flow and spill. Values above zero (equilibrium; dashed horizontal line) indicate generational increases in abundance, while values below zero indicate generational declines in abundance.

39. The 2020 BiOp and ROD contain no contingency plan for the current crisis and lacks the urgency needed to prevent additional listed populations from dropping below QET and potentially entering an extinction vortex. The 2020 BiOp and ROD also contain no long-term plan that addresses minimum needs of the fish adequate to avoid further decline and elevated extinction risk.

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II. THE EXISTING CONFIGURATION AND OPERATION OF THE CRS WILL CONTINUE TO CAUSE IRREPARABLE HARM TO LISTED FISH; OREGON'S REQUESTED RELIEF WILL REDUCE IRREPARABLE HARM IN THE SHORT-TERM BUT IS NOT SUFFICIENT TO PROVIDE A LONG-TERM SOLUTION.

40. The proposed action evaluated in the 2020 BiOp and chosen as the Selected Alternative in the ROD represent only minor changes to existing configuration and operation of the CRS that continue to result in irreparable harm to already-imperiled listed fish.

41. At the request of the Action Agencies, the Comparative Survival Study (CSS) analyzed federal operational alternatives for the Columbia River Systems Operations (CRSO) Environmental Impact Statement, using a simulated 80-year water record (McCann et al. 2019 [NMFS374321–5297]). McCann et al. 2019 included analyses of: (1) the No Action Alternative ("NAA") (previous spill operation evaluated in the 2014 BiOp); (2) Multi-Objective Alternative 1 ("MO-1"), which included a "block design" where two different operations—spill to "performance standards levels" and spill to the 115%/120% TDG gas cap—are conducted and evaluated in a single season (3) Multi-Objective Alternative 2 ("MO-2"), a power production focused alternative which included spill to 110% TDG at all eight projects; (4) Multi-Objective Alternative 3 ("MO-3"), which included breach of the Lower Snake River dams ; (5) Multi-Objective Alternative 4 ("MO-4"), which includes spill to the maximum level that meets but does not exceed 125% TDG in the tailrace for 24 hours per day during the spring and summer spill seasons; (6) the Preferred Alternative ("PA") identified in the Draft EIS (spill up to 125% TDG for up to 16 hours a day, then reduced spill for up to 8 hours), which formed the basis for the proposed action evaluated in the 2020 BiOp and was adopted as the Selected Alternative by the Action Agencies; and (7) an additional alternative ("MO-34"), which combined breach of the Lower Snake River dams with maximum spring spill at the Lower Columbia River dams. MO-34 was not one of the alternatives considered in the CRSO EIS.

42. The simulated input data sets provided by the Action Agencies to the CSS reflect best-case scenarios in terms of environmental conditions (e.g., based on a simulated 80-year

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water record, much of which pre-dates the current climate crisis) and operational certainty (e.g., data sets do not account for curtailment of spill for unplanned maintenance). Therefore, the CSS predictions are necessarily biased high, likely overestimating survival benefits. McCann et al. 2019 cautioned that "it is important to carefully consider the lower end of the predicted ranges of biological response metrics, as anticipated consequences of climate change suggest poor river or ocean conditions may occur more frequently, which would mean that the lower end of the predicted ranges is likely to occur more often." Even with the best-case-scenario data sets, McCann et al. 2019 found that the PA "did not meet the regional 4% SAR goal and the lower end of the predicted SAR ranges were well below 1%, indicating greater risk of further population decline. For all fish survival metrics, the PA resulted in only slightly better performance than the NAA." (McCann et al. 2019 at 23 [NMFS00374366]). McCann et al. 2019 predicts that, under the Preferred Alternative, both Chinook and steelhead will experience SARs equal to or less than 2% over 60% of the time (Table 1).

Table 1. Proportion of simulated SARs less than or equal to, or greater than the lower limit (2%) of the NPCC regional SAR goals for Snake River spring/summer Chinook and steelhead for six alternatives proposed in the CRSO EIS and one additional alternative (MO34) analyzed by the Comparative Survival Study (see narrative above for brief descriptions of each MO). Table adapted from McCann et al. 2019. Values effectively represent the probability that for a given alternative, SARs will be above or below the 2% threshold.

	yearling Chinook		steelhead	
Alternative	≤ 2%	> 2%	≤ 2%	> 2%
MO2	0.85	0.15	0.85	0.15
NAA	0.73	0.27	0.73	0.27
MO1	0.71	0.29	0.72	0.28
PA	0.63	0.37	0.65	0.35
MO4	0.53	0.47	0.54	0.46
MO3	0.43	0.57	0.32	0.68
MO34	0.36	0.64	0.25	0.75

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43. Under the Preferred Alternative, which in essence became the Selected Alternative, listed fish will continue to have perpetually low SARs that are, by definition, linked to the return abundances considered and projected in the 2020 BiOp. The ROD and the 2020 BiOp are, at best, leaving already vulnerable populations (many already at or below QET) with too high a risk of further decline and with little opportunity for rebuilding; when considering current and forecasted climate change impacts, the picture looks even worse.

44. Options to meaningfully address the current and projected extinction crisis for listed fish are very limited under existing dam configurations (Table 1). A comprehensive long-term solution must be secured as soon as possible, and the overwhelming weight of scientific evidence is clear that this comprehensive solution must include restoration of the lower Snake River by breaching or removing the lower Snake River dams. This is the only pathway with credible scientific certainty to meet the minimum conservation needs of the fish into the future under climate change. Even though interim options are limited, more can certainly be done to help ease the extinction crisis at hand. Prioritization should be given to interim stop-gap actions that are associated with improved SARs. As such, these must include actions that further reduce powerhouse encounters by juvenile or adult fish, reduce overall juvenile migration travel time and migration delay at dam forebays, and help reduce water temperature risks without elevating risks to fish in other operational areas.

45. In the 2020 BiOp, NMFS embraces the efficacy of spill as a key component of its operation and recognizes it as one of the primary sources of potential survival benefits (e.g., 2020 BiOp at 289-90 [ACE001056508-9]). However, the proposed action limits spill—in time and place—for fiscal reasons. In light of the current extinction crisis, the Corps should be ordered to maximize spill to provide maximum survival benefits. Until there is a comprehensive long-term solution that includes restoration of the lower Snake River, it is imperative that the Corps operate the CRS to maximize benefits to fish, given their crisis status and likelihood of poor environmental conditions.

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III. KEY STOP GAPS SHOULD FOCUS ON INCREASING LIFE-CYCLE SURVIVAL BY PROVIDING ADDITIONAL REDUCTIONS TO POWERHOUSE ENCOUNTERS, TRAVEL TIME, AND WATER TEMPERATURE RISKS.

46. The negative effects of slowed and impeded migration through the impounded CRS are well documented, including impaired smoltification and the physiological transition to allow effective saltwater residence, increased bioenergetic constraints, increased exposure and vulnerability to predation, and increased risk from elevated water temperature as well as the many other stressors associated with dam and reservoir passage, culminating in decreased life-cycle survival (see e.g., CBFWA 1991; NMFS 2000). As the 2020 BiOp states,

> The mainstem dams and reservoirs continue to substantially alter the mainstem migration corridor habitat. The reservoirs have increased the cross-sectional area of the river, reducing water velocity, altering the food web, and creating habitat for native and non-native species that are predators, competitors, or food sources for migrating juvenile Chinook salmon. Travel times of migrating smolts increase as they pass through the reservoirs (compared to a free-flowing river), increasing exposure to both native and nonnative predators (see predation section below). Some juveniles are injured or killed as they pass through the dams (turbines, bypass systems, spillbays, or surface passage routes) (NMFS 2008a).

(2020 BiOp at 140) [ACE001056359].

47. Given the existing impounded system, flow and spill are associated with better fish survival and productivity. Analysis of Snake River spring-summer Chinook recruitment during post hydrosystem development (1977-2002) suggests that population productivity is associated with flow and spill conditions during juvenile migration (Figure 9). Population growth was more likely to be positive (positive ln(Rsg/S)) in those years of highest flow and spill. Conversely, populations were more likely to be in decline (negative ln(Rsg/S)) in those years of lowest flow and spill. Flow and spill appear to work in concert to improve reservoir and dam passage affecting juvenile migration success and subsequent adult returns.

48. In order to prevent listed species from further decline and potentially entering an extinction vortex, the Corps should be ordered to implement all available stop gap measures that

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reduce irreparable harm to the species by further reducing powerhouse encounters, travel time and water temperature risks, all of which are associated with improved SARs.

49. Reducing powerhouse encounters: The main passage routes available to downstream out-migrating salmon and steelhead approaching a hydroelectric project are (a) powerhouse passage or (b) spillway passage, including both traditional and more surface-oriented spillway passage facilitated by weirs. My previous declaration provides extensive background on the benefits of spillway passage for fish and how powerhouse passage negatively affects fish survival (Bowles 2017 Spill Injunction Declaration (ECF No. 2123) at ¶¶ 6-11 (background on CRS spill operations), ¶¶ 12-18 (explaining that spill is a proven tool for improving juvenile survival and adult returns)). I further explained how increased spill would help reduce risk to listed species and buffer environmental uncertainty (*Id.* ¶¶ 24-25 (explaining smolt-to-adult return ratios ("SARs")), ¶¶ 26-28 (explaining that increased SARs are associated with improved productivity (Recruits per spawner ("R/S")), ¶¶ 39-34 (explaining that increased spill reduces the risk of low SARs)). I herein incorporate the above cited paragraphs by reference.

50. The evidence that positive survival benefits are associated with spillway passage has continued to grow in recent years. For example, PITPH is an index described in Appendix J of the 2015 CSS Annual Report (McCann et al. 2015) which depicts the probability that an average juvenile fish will experience powerhouse passage under specific project operations. CSS analyses use PITPH to characterize the effects of spill. In doing so, CSS has shown that increased spill lowers PITPH (i.e., is associated with fewer powerhouse encounters for migrating fish) and is associated with higher life-cycle survival (McCann et al. 2019 [NMFS374321–5297]). Annual updated analyses by CSS continue to confirm that increased spill is the best available tool for increasing SARs within the existing configuration of the CRS.

51. Federal defendants have already embraced the efficacy of spill by rolling forward the 2019 and 2020 flexible spill operations into their Preferred Alternative, Selected Alternative

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and 2020 BiOp. In light of the ongoing low-abundance extinction crisis, spill operations should be expanded.

52. Travel time and forebay delay: Development of the CRS caused water velocities to dramatically decrease and fish travel times (FTT) to dramatically increase through impounded reaches, which have contributed to the decline of Columbia River anadromous fish runs (NRC 2004). The water travel time (WTT) from Lower Granite to Bonneville was approximately 10 times faster prior to construction and operation of the CRS (Figure 10). Slower FTT is directly associated with slower WTT in the CRS. Fish travel time is a key factor associated with in-river survival and SARs of Snake River spring/summer Chinook and steelhead (Schaller et al. 2007) and is a key variable in NOAA's COMPASS model affecting post-Bonneville SARs of Snake River Chinook and steelhead (Zabel et al. 2008 [NMFS00357911-22]).

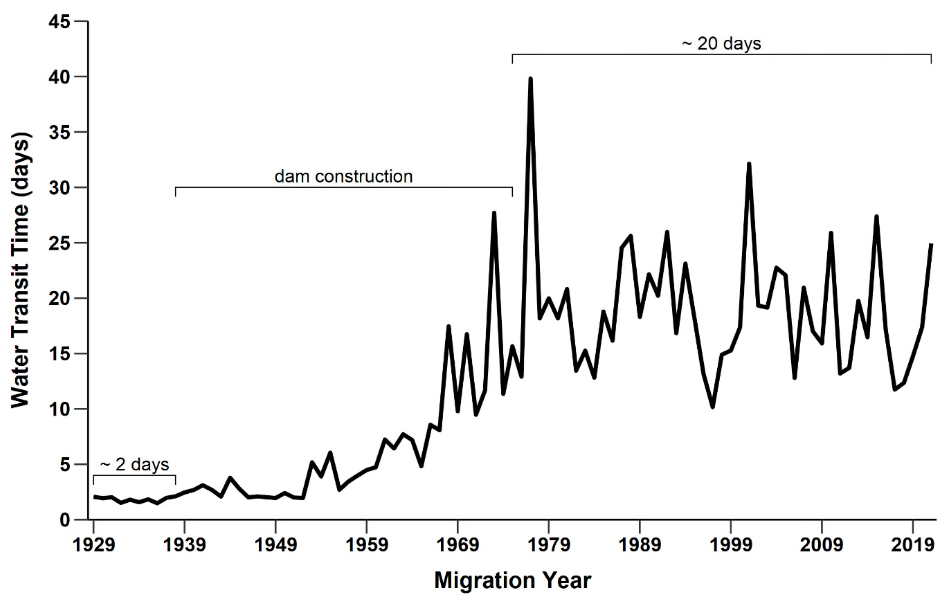

Figure 10 Variation in water transit time from 1929 through 2021. Bracketed regions indicate approximate/mean water transit times before and after completion of the CRS (the period of dam construction is also noted).

53. Forebay delay also contributes to slower overall FTT, but it is less about WTT and more about the proportion of flow hitting a dam that goes through the powerhouse rather

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than the spillways. This is because juvenile fish tend to go where the water goes, and if most of the water is going through the powerhouse located at the base of the dam, these generally surface-oriented fish experience delay in the dam forebay until they reorient and sound deep to the powerhouse orifices. Thus, shifting a larger proportion of the flow to the spillways will not only reduce PITPH, but is also the best available tool for reducing forebay delay and its impact on overall FTT and stress (McCann et al. 2019 [NMFS374321–5297]).

54. Although spill improves SARs and helps reduce forebay delay and overall FTT, it does not help reduce FTT through the main body of mainstem reservoirs. This is because spill does not increase reservoir flows or WTT, nor does it change reservoir configurations. Other actions must be taken to help reduce reservoir WTT.

55. In an impounded system, there are only two ways to increase water velocity: increase flow or decrease the cross-sectional area of the reservoir channel by reducing reservoir elevation. Flow augmentation or manipulating reservoir elevation cannot come close to fully compensating for the lost functional slope of the free-flowing river and the resulting dramatic increase in WTT and FTT. However, the impounded system is already so compromised that these tools can be used to help avoid further degradation and move slightly toward more normative conditions (1995 BiOp [NMFS00321664]; Budy et al. 2002 [NMFS00287129-45]; Williams et al. 2005 [NMFS00356406-574]; Schaller et al. 2007; Schaller et al. 2014 [ACE962860-72]). Difficulty securing additional water to augment flows can be somewhat mitigated by maintaining reservoirs elevations at MOP, as described later in my declaration.

56. Water temperature risk: Water temperature is becoming more and more important in the conservation of listed fish as climate change continues to unfold. As described earlier, the configuration and operation of the CRS contributes directly to elevated water temperature by increasing surface area of water exposed to solar irradiation, dramatically slowing WTT, and creating reservoir heat "traps" not readily dissipated (EPA 2020a [NMFS00293672], 2020b, 2021). The frequency, magnitude and duration of elevated water temperature events have

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increased with climate change and is exacerbated by the CRS (Table 4-1 in EPA 2020a [NMFS00293710], 2020b; Scott 2020).

57. Regrettably, this reality is all too apparent, with devastating impacts on listed fish. For example, as mentioned earlier in this declaration, elevated water temperatures in 2015 resulted in massive fish kills in the lower Columbia River, with thousands of unlisted Columbia River sockeye dying in the impounded sections and over 95% of listed Snake River sockeye succumbing (FPC 2015 [ACE000029297-30211]). The 2020 BiOp acknowledges that "[t]he greatest challenge for migrating SR sockeye salmon adults is the increasing water temperatures as they move upstream through the hydrosystem." (2020 BiOp at 466) [ACE001056685].

58. Observed river temperature exceedances from 2011-2016 demonstrate a stark pattern of summer water temperatures exceeding applicable water quality standards designed to protect salmonids (Table 2).

Table 2: Documented state water quality temperature criteria (68º F, except 56º F in Bonneville Dam tailrace after October 15th) exceedances at lower Columbia River and lower Snake River dam tailraces July-October (EPA 2020a) [NMFS00293672].

	% exceeded July	% exceeded Aug	% exceeded Sept	% exceeded Oct
McNary Dam tailrace	35%	87%	41%	0%
John Day Dam tailrace	52%	97%	57%	0%
The Dalles Dam tailrace	52%	96%	57%	0%
Bonneville Dam tailrace	51%	97%	49%	100%
Lower Granite Dam tailrace	5%	8%	3%	0%
Little Goose Dam tailrace	52%	65%	13%	0%
Lower Monumental Dam tailrace	57%	94%	21%	0%
Ice Harbor Dam tailrace	58%	100%	45%	0%

59. Despite significant efforts, the Corps has not effectively addressed or mitigated elevated water temperature risk in CRS reservoirs and fish ladders. This is partially because very

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little can be done within current dam configurations and operations. Restoration of the lower Snake River via dam breaching or removal is the single most important CRS action that can be taken, which will dramatically reduce heating in the lower Snake River reach, reduce heat loading into the lower Columbia River reservoirs, and help deliver cold water from Dworshak reservoir to the lower Columbia River reservoirs (currently that cold water is dissipated in lower Snake River reservoirs).

60. Until a comprehensive long-term solution that includes restoration of the lower Snake River is secured, there are several actions the Corps can and should take now to help reduce water temperature risk on listed fish. These include additional spill to improve survival, reduce stress and reduce overall FTT; and reduced reservoir elevations to improve WTT, FTT and reduce heating. Care should be taken to avoid operational changes in one part of the CRS that amplify risks to listed fish in other operational areas of the CRS, such as the emergency curtailment of surface passage spill in 2021, unless the CRS temperature emergency is so lethal that no other options are available.

61. Studies have shown that decreasing reservoir elevation will lead to an increase in water velocity and a reduction in WTT (FPC Memo 42-16, June 24, 2016). Although this analysis was for a more substantive drawdown than Oregon is requesting in this motion, it is still indicative of the potential of reduced reservoir elevations to help reduce water temperature risks.

IV. THE STATUS QUO SPILL OPERATION IS EXPRESSLY CONSTRAINED BY THE POWER COST OBJECTIVE; OREGON REQUESTS THAT THE COURT ORDER THE CORPS TO PROVIDE ADDITIONAL SPILL TO REDUCE IRREPARABLE HARM TO THE SPECIES.

62. As I explained in previous testimony, the upper limit on the amount of water that can be voluntarily spilled is constrained by state water quality standards (Bowles 2017 Spill Injunction Declaration ¶ 5 (ECF No. 2123)). Spilling water over a dam increases the level of total dissolved gas (TDG) in the river. Excessive levels of TDG can be deleterious to fish or

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other aquatic life. Oregon and Washington have each adopted water quality standards that provide an upper limit on TDG levels.

63. Oregon's requested relief with respect to spill has three primary components. Oregon asks that the Court: (a) order the Corps to spill the maximum amount of water that can be spilled without exceeding state TDG standards for 24 hours per day during the spring spill period (except as specified below), thus eliminating the "flex spill" operation that allows for reduced spill for 8 hours per day for revenue-generating purposes for BPA; (b) eliminate the late summer transition spill operation which reduces summer spill levels from August 15 to August 31 to save revenue and instead restore the "initial summer spill levels" throughout the entire summer spill season; and (c) from September 1 until the spring spill season, provide the minimum level of spill that allows fish to access surface passage routes.

64. "Gas cap spill" means spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state law, consistent with the Corps' definition in the 2021 Fish Operations Plan (FOP). The 2021 FOP is attached to the Proposed Order as Exhibit 1. Oregon's motion requests that federal defendants use the same spill patterns implemented in 2021 spill operations and calculate spill levels consistent with the methodology articulated in the 2021 FOP.

A. Spring Spill.

65. The Action Agencies' proposed action defines target spill levels for 2021 that are the same as the spill levels negotiated in the interim Flexible Spill Agreement. The Action Agencies do not define target spill levels, nor specify any minimum spill levels or biological performance targets, for the years 2022-2035. The spring spill levels for 2021 are expressly constrained by the power-cost objective identified in the interim Flexible Spill Agreement, i.e., that Bonneville must, at a minimum, be no worse financially compared to the 2018 spring fish passage spill operations ordered by the Court (e.g., CRSO EIS Appendix R, Part 2 [ACE001066383]).

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66. Oregon's request for spring spill asks the Court to remove this revenue-based constraint and maximize spill for fish and therefore remove the 8-hour "flex" spill operation in the spring spill season for each project except as identified in Table 3.

Table 3: Comparison of base operation for spring spill under 2020 BiOp versus Oregon's requested relief for spring spill season.

Project	**Base operation for 2021 spring spill season (2020 BiOp at 56 (Table 1.3-1)) [ACE001056275]**	**Oregon's requested relief for spring spill season**
Lower Granite	125% Gas cap spill for 16 hours per day; 20 kcfs for 8 hours per day from Apr. 3 to June 20.	125% Gas cap spill for 24 hours per day from Apr. 3 through June 20.
Little Goose	125% Gas cap spill for 16 hours per day; 30% spill for 8 hours per day from Apr. 3 to June 20.	Same as 2021 spring spill season.
Lower Monumental	125% Gas cap spill (uniform spill pattern) for 16 hours per day; 125% Gas cap spill (bulk spill pattern) for 8 hours per day from Apr. 3 to June 20.	125% Gas cap spill (uniform spill pattern) for 24 hours per day from Apr. 3 through June 20.
Ice Harbor	125% Gas cap spill for 16 hours per day; 30% spill for 8 hours per day, from Apr. 3 to June 20.	125% Gas cap spill for 24 hours per day from Apr. 3 through June 20.
McNary	125% Gas cap spill for 16 hours per day; 48% spill for 8 hours per day from Apr. 10 to June 15.	125% Gas cap spill for 24 hours per day from Apr. 10 through June 15.
John Day	120% Gas cap spill for 16 hours per day; 32% spill for 8 hours per day from Apr. 10 to June 15.	125% Gas cap spill for 24 hours per day from Apr. 10 through June 15.
The Dalles	40% spill for 24 hours per day from Apr. 10 to June 15.	40% spill up to 125% Gas cap spill (Gas cap fish passage spill restricted to spillbays 1-8) for 24 hours per day from Apr. 10 through June 15.
Bonneville	125% Gas cap spill, not to exceed 150 kcfs for 16 hours per day; 100 kcfs for 8 hours per day from Apr. 10 to June 15.	125% Gas cap spill, not to exceed 150 kcfs for 24 hours per day from Apr. 10 through June 15.

67. As discussed previously, the weight of scientific evidence is clear that spill can benefit survival of listed fish by avoiding powerhouse encounters and reducing forebay delay and overall FTT. The weight of evidence is also clear that potentially deleterious effects of

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elevated TDG causing gas bubble trauma ("GBT") in listed migrating salmon and steelhead can be minimized with spill up to 125% TDG, and that the biological benefits of spill under current dam configurations far outweigh risks (McCann et al. 2019 [NMFS374321–5297]).

68. The major adverse impact on actively migrating salmonids from exposure to excessive TDG levels is GBT. However, as the 2020 BiOp notes:

> Data from all fish sampled in the CRS Gas Bubble Trauma Monitoring Program (1996 to 2019) indicate that signs of GBT were almost non-existent below 120 percent TDG, increased slightly between 121 percent and 125 percent TDG, and then increased in incidence and severity when TDG levels exceeded 125 percent (FPC 2019). The available information in Zabel (2019) and Widener et al. (2020) suggests that the relatively high TDG exposure often exceeding 125 percent during high flow years (e.g., 2006 and 2011) did not reduce smolt survival through the CRS.

(2020 BiOp at 195) [ACE001056414]. In addition, the Oregon and Washington water quality standards that allow for spill up 125% TDG saturation include implementation and biological monitoring requirements to evaluate any concerns regarding impacts to fish from exposure to increased TDG conditions (https://www.oregon.gov/deq/wq/Documents/columbiaUSACEtmdlorder.pdf (last visited June 28, 2021); WAC 173-201A-200(1)(f)(ii)(B)(II)).

69. Federal defendants have embraced spill as one of the primary tools for fish survival in the ROD and 2020 BiOp by operating most dams with spill levels at 125% TDG for two thirds of the day and constrained below 125% TDG for one third of each day. For the spring spill season, Oregon's requested relief simply asks that the power-cost constraint be removed, and for spill benefits to be maximized to help address the low abundance fish crisis. CSS has not explicitly modeled Oregon's requested relief for spring spill. CSS has, however, modeled MO-4 which includes 125% TDG max spill during the spring spill season and is therefore comparable to Oregon's requested relief as it relates to Snake River spring-summer Chinook and steelhead. The CSS analysis for MO-4 indicates that this additional spill could decrease PITPH by approximately 54% and 59%, respectively, and could improve SARs by approximately 27% and

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30%, respectively, compared to modeled results for the Preferred Alternative (McCann et al. 2019 [NMFS374321–5297]).

B. Summer spill.

70. The Flexible Spill Agreement reduced summer spill levels (and the associated fish protections) for the last two weeks in August to meet the power-cost objective—agreed to solely for the purposes of that interim Agreement—that Bonneville must, at a minimum, be no worse financially compared to the 2018 spring spill injunction. *See* Flexible Spill Agreement Attachment Table 1.4 (ECF No. 2298-1 at 20). The summer spill operation in the Selected Alternative and proposed action includes the reductions in spill for the last two weeks in August (2020 BiOp at 58 (Table 1.3-2) [ACE001056277]; 2020 BiOp, at 192 [ACE001056411] ("The Action Agencies propose these late-summer reductions in spill to offset power system impacts caused by higher spring spill.")). These reductions in spill result in significantly lower spill proportion for the last two weeks of August, compared to the rest of the summer spill season and compared to prior years. The Corps should be ordered to reinstate the higher spill levels and remove the late August rollback in spill.

71. The Corps should also be ordered to reinstate higher spill at Ice Harbor and John Day, which were reduced in the interim Flexible Spill Agreement from the 2014 BiOp. Under the 2020 BiOp, the initial summer spill target level at Ice Harbor is 30% spill and at John Day is 35% spill. Under the 2014 BiOp, the target summer spill levels were variable but included the higher spill levels requested for these projects (AA 2014 at 42 (Hydropower Strategy 3—Implement Spill and Juvenile Transportation Improvements at Columbia River and Snake River Dams)). In its motion, Oregon asks the Court to order the Corps to restore the higher end of the spill levels specified for Ice Harbor and John Day in the 2014 BiOp (Table 4).

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Table 4: Summer Spill—comparison of summer spill operation under 2020 BiOp to Oregon's requested relief for summer spill.

Project	**2020 BiOp summer spill operation (2020 BiOp at 57 (Table 1.3-2)) [ACE001056276]**		**Oregon's requested relief for summer spill**
	Initial Summer Spill Operation (24 hours per day)	**Late Summer Transition Spill (Aug. 15 to Aug. 31) (24 hours per day)**	
Lower Granite	18 kcfs from June 21 to Aug. 14	Removable Spillway Weir or 7 kcfs	18 kcfs from June 21 to Aug. 31
Little Goose	30% spill from June 21 to Aug. 14	Adjustable Spillway Weir or 7 kcfs	30% spill from June 21 to Aug. 31
Lower Monumental	17 kcfs from June 21 to Aug. 14	Removable Spillway Weir or 7 kcfs	17 kcfs from June 21 to Aug. 31
Ice Harbor	30% spill from June 21 to Aug. 14	Removable Spillway Weir or 8.5 kcfs	45 kcfs from June 21 to Aug 31
McNary	57% (with no spillway weirs) from June 16 to Aug. 14	20 kcfs	57% spill from June 16 to Aug. 31
John Day	35% spill from June 16 to Aug. 14	20 kcfs	40% spill from June 16 to Aug. 31
The Dalles	40% spill from June 16 to Aug. 14	30% spill	40% spill from June 16 to Aug. 31
Bonneville	95 kcfs from June 16 to Aug. 14	50 kcfs	95 kcfs from June 16 to Aug. 31

72. Juvenile fall Chinook are migrating during the last two weeks of August. As discussed in more detail below, lower numbers of migrants do not negate the importance of protecting the diversity characteristics of listed fish and the rollback of late summer spill, which was implemented for fiscal reasons, should be restored to provide a biological benefit to these fish.

C. Fall-Winter Spill Season.

73. The 2020 BiOp's Incidental Take Statement ("ITS") requires the Action Agencies to "implement offseason surface spill as a means of providing safe and effective downstream passage for adult steelhead that overshoot and then migrate back downstream through McNary Dam and the Snake River dams during months when there is no scheduled spill for juvenile passage." (2020 BiOp at 1399) [ACE001057618]. Specifically, the ITS requires the Action

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Agencies to provide "surface-oriented spill" from October 1 to November 15 and March 1 to March 30, at the four Lower Snake River projects and McNary Dam, at least three times each week on non-consecutive days. On selected days, spill will be provided for 4 hours each morning (generally between 5 a.m. and 11 a.m.) through a spillway weir at each of the five dams. 2020 BiOp at 1399-1400 [ACE001057618-9]. "Surface-oriented spill" corresponds to the minimum amount of spill that will allow adult steelhead to access surface passage routes.

74. As an additional conservation measure, Oregon asks that the Court order the Corps to provide surface-oriented spill 24 hours per day, seven days per week from September 1 through the start of the spring spill period at all eight dams. Table 5, below, compares the fall/winter spill operations under the 2020 BiOp with Oregon's requested relief:

Table 5: Fall/Winter—comparison of 2020 BiOp spill levels to Oregon's requested relief.

Project	**2020 BiOp status quo operation** (2020 BiOp at 1399-1400) [ACE001057618-9]	**Oregon's request relief for 24 hours per day/7 days per week**
Lower Granite	Oct. 1 to Nov. 15 and March 1 to March 30, at least three times each week on non-consecutive days; on selected days, surface-oriented spill will be provided for 4 hours each morning (generally between 5 a.m. and 11 a.m.) through a spillway weir at each of the five dams.	September 1 through April 2, Surface-oriented spill (Full operation of Bay 1 RSW)
Little Goose	Oct. 1 to Nov. 15 and March 1 to March 30, at least three times each week on non-consecutive days; on selected days, surface-oriented spill will be provided for 4 hours each morning (generally between 5 a.m. and 11 a.m.) through a spillway weir at each of the five dams.	September 1 through April 2, Surface-oriented spill (Maximum operation of Bay 1 ASW high crest)
Lower Monumental	Oct. 1 to Nov. 15 and March 1 to March 30, at least three times each week on non-consecutive days; on selected days, surface-oriented spill will be provided for 4 hours each	September 1 through April 2, Surface-oriented spill (Full operation of Bay 8 RSW)

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	morning (generally between 5 a.m. and 11 a.m.) through a spillway weir at each of the five dams.	
Ice Harbor	Oct. 1 to Nov. 15 and March 1 to March 30, at least three times each week on non-consecutive days; on selected days, surface-oriented spill will be provided for 4 hours each morning (generally between 5 a.m. and 11 a.m.) through a spillway weir at each of the five dams.	September 1 through April 2, Surface-oriented spill (Full operation of Bay 2 RSW)
McNary	Oct. 1 to Nov. 15 and March 1 to March 30, at least three times each week on non-consecutive days; on selected days, surface-oriented spill will be provided for 4 hours each morning (generally between 5 a.m. and 11 a.m.) through a spillway weir at each of the five dams.	September 1 through April 9, Surface-oriented spill (Full operation of TSWs in Bay 19 and Bay 20)
John Day	0 kcfs from TSWs Sep. 1 through April 9. Approximately 1.6 kcfs Adult attraction Bay 2 Sep. 1 through Nov 30.*	September 1 through April 9, Surface-oriented spill (Full operation of TSWs in Bay 18 and Bay 19)
The Dalles	TDA ITS from Oct 1 through Dec 15 & Mar 1 through Apr 9. 0 kcfs spillway Sep. 1 through April 9.*	September 1 through April 9, Surface-oriented spill (Open ITS End Gate and OPEN Sluice gates 1-1, 1-2, 1-3 & 18-1, 18-2, 18-3)
Bonneville	None planned but Bonneville Powerhouse 2 Corner Collector ("B2CC") prioritized for unplanned Spill Sep. 1 until Kelt Trigger met March 1 through April 9. PH1 ITS Dec. 1 through the end of February for steelhead kelt passage. Approx. 2.3 kcfs Bay 1 & 18 for adult attraction Sep. 1 to April 9.*	September 1 through April 9, Surface-oriented spill (B2CC, PH1 ITS) Approx. 2.3 kcfs Bay 1 & 18 for adult attraction Sep. 1 to April 9.*

***** These spill operations are defined in the 2021 Fish Passage Plan (FPP), available at FPP21_Final_06-29-21.pdf (crohms.org) (last visited July 8, 2021).

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75. Although federal management actions that address migration in the impounded lower Snake River and lower Columbia River have focused primarily on spring and summer migratory periods (spring and summer spill seasons), it is well documented that juvenile and adult salmon and steelhead move among habitats in the impounded mainstem year-round (Connor et al. 2011; Tiffan et al. 2012; Richin and Skalski 2018 [NMFS00335277]). Currently, for much of the year, turbines are the only available passage routes for these species. In addition, there is emerging evidence that the overall outmigration timing for juvenile spring-summer Chinook and steelhead is shifting earlier (i.e., before the start of the spring spill season). Currently, there is no surface passage route available for these fish. Thus, as described more fully below, the purpose of Oregon's requested relief for fall-winter spill is to provide a non-powerhouse downstream passage route for (a) listed adult steelhead that overshoot their natal tributaries or migrate downriver after spawning, (b) listed juvenile fish (primarily fall chinook) residing and moving in the impounded reaches outside of the spring and summer migration periods, and (c) listed juvenile fish (can be from all types of salmon and steelhead) that begin their migration to the ocean before the start of the spring spill season in early April.

76. Oregon's requested relief for fall-winter spill is particularly important for species diversity. Diversity is one of the recognized Viable Salmonid Population ("VSP") benchmarks for assessing the status of salmon and steelhead, together with population abundance, population growth or productivity, and spatial structure (McElhany et al. 2000 [NMFS00312602-775]). Diversity refers to the distribution of traits within and among populations that contribute to species persistence and adaptability. Because salmon and steelhead exhibit unique traits within and among populations, sustaining variation (diversity) is important to both population and ESU/DPS viability. Diversity provides a means for addressing highly variable environmental conditions. Similarly, diversity protects species from short term changes to their physical environment (spatial) and timing or phases of their life cycle (temporal). Additionally, diversity helps ensure populations maintain the breadth of characteristics needed to survive and adapt to

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long-term environmental change. For these reasons, conserving adaptive diversity has been at the center of NMFS' VSP management strategy (Waples 2007; McElhany et al. 2000 [NMFS00312602-775]). As examples, diversity in life-cycle characteristics can improve resilience to climate change impacts already occurring, such as earlier spring freshets from earlier snowmelt (e.g., earlier migrating smolts may have adaptive advantage), and warmer and lower flows during summer (e.g., earlier returning adults and earlier migrating juveniles may have adaptive advantage, or, for fall Chinook, earlier and later migrating juveniles may have adaptive advantage). Such adverse and changing conditions have been observed in recent years and are expected to continue in future climate change scenarios. Thus, because of their importance to species diversity, failure to protect the diverse and unique life-cycle characteristics of species may have a disproportionate impact on ultimate species viability and resilience.

Adult steelhead overshoot and kelt movement.

77. Existing CRS operations, which provide limited downstream surface passage for listed adult steelhead overshooting their natal stream or listed steelhead kelts migrating downriver after spawning, should be expanded to help protect listed steelhead during this period of critically low abundance and elevated extinction risk.

78. Although Pacific salmon die after spawning (semelparous) other listed species like steelhead are able to spawn multiple times (iteroparous). This steelhead life history trait is well documented and is considered an import trait to sustain their persistence (2020 BiOp; Hatch et al. 2018 [NMFS00302120-299]; Keefer and Caudill 2013; Keefer et al. 2016 [NMFS00309323-576]). The term "kelts" refers to those steelhead that have survived spawning and may return the following year to spawn again. As such, these kelts can be important to population productivity, particularly during periods of low abundance like we are experiencing now. Ensuring these kelts are provided a non-powerhouse route of downriver passage at each dam can improve their survival and likelihood of contributing as spawners the following year.

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79. In addition to kelt movement, surface-oriented downriver passage is also critically important for "overshoots." Listed adult steelhead, as indicated through PIT tag monitoring, often migrate one or more dams beyond their natal tributary before ultimately traveling back downstream to their stream of origin for spawning.

80. The 2020 BiOp describes this life history characteristic with respect to McNary and the Lower Snake River dams:

> Relatively large numbers of adult steelhead (e.g., MCR steelhead from the John Day, Umatilla, and Walla Walla River MPGs; and SRB steelhead from the Tucannon River population) overshoot McNary and the lower Snake River dams and then volitionally migrate downstream through the dams to reach their natal streams in the fall and spring. To return to natal streams, these fish often have no passage options other than turbines and screened bypass systems once spill operations for juvenile migrants have ended. This behavior has been repeatedly documented and is identified as part of the hydrosystem threat in the Snake River spring-summer Chinook and steelhead recovery plan. (NMFS 2017 pp. 140, 144, 236-37). Recent observations in Ham et al. 2019, and detections at the newly operated Lower Granite Dam Removable Spillway Weir (RSW) PIT system suggest that overshoot adult steelhead can pass rapidly once a surface passage route is provided.

(2020 BiOp at 1399) [ACE001057618]. Additionally, Colotelo et al 2013 and 2014 identified steelhead used surface weirs in greater proportions and survived at higher rates compared to powerhouse route passage [NFMS00290583] [NMFS00290961].

81. Overshoot for adult steelhead also occurs at other projects in the Columbia River (e.g., NMFS 2016b, p. 51). For example, Faber et al. 2018 examined a pattern of low survival rates for the Fifteenmile Creek steelhead population, which enter Fifteenmile Creek at its confluence with the lower Columbia River in the tailrace of The Dalles Dam. The Fifteenmile Creek population was present in the mainstem upstream of Bonneville Dam from late July 2016 to early May 2017 and overwintered in the mainstem upstream of The Dalles Dam (Faber et al. 2018). The majority of the Fifteenmile Creek adult steelhead detected ascending Bonneville Dam were subsequently detected ascending The Dalles Dam in summer and fall, prior to returning downstream to enter Fifteenmile Creek and spawn the following spring. Low survival

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rates of these adults between Bonneville and Fifteenmile Creek were viewed as an indication of a high pre-spawn mortality at least partially caused by difficulty descending The Dalles Dam (Faber et al. 2018).

82. Overshoot is a considerable threat to 80% (8 out of 10) of Oregon's extant Middle Columbia summer steelhead populations, especially wild-only populations. The Fifteenmile Creek and John Day River populations exhibit the highest upstream dam overshoot rates and the lowest mean return success rates; impacts that likely constrain the recovery potential of these six, wild-only Oregon Middle Columbia summer steelhead populations, their associated MPGs, and the DPS (ODFW 2019). To put finer points on the level of impact, approximately 78 percent of wild adult Fifteenmile Creek steelhead overshoot above The Dalles Dam (Faber et al. 2014; Ruzycki et al. 2015; Pierson, Faber, and Ruzycki 2017; ODFW 2019). The Fifteenmile Creek population must meet or exceed viable status (low extinction risk) to contribute to Cascades Eastern Slope Tributaries MPG viability (NMFS 2009 [NMFS00317004]). Approximately 53% of wild John Day adult steelhead overshoot above McNary Dam (Carmichael et al. 2012; Ruzycki and Tattam 2014; Ruzycki et al. 2015; Bare et al. 2017; Richins 2017; ODFW 2019). The five John Day populations comprise the only wholly-wild MPG in the Middle Columbia Steelhead DPS, a necessary contributing MPG for DPS ESA-delisting viability status (low to very low extinction risk status; NMFS 2009 [NMFS00317004]). Additionally, approximately 44% of wild Umatilla River steelhead (Richins 2017; Hanson 2018) and 37% of Walla Walla River wild steelhead overshoot above McNary and Snake River dams (Richins 2017); the Umatilla River population must meet/exceed viable status to contribute to Umatilla/Walla Walla Rivers MPG viability (NMFS 2009 [NMFS00317004]). The effects of overshooting Middle Columbia steelhead on Snake River steelhead DPS populations is unknown (NMFS 2017 [NMFS00324533]).

83. Expanding the surface-oriented spill operation consistent with Oregon's request will provide benefits to adult steelhead. Spillway passage is the safest and most effective route

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to pass adult steelhead back downstream (2020 BiOp at 906 (citing Colotelo et al. 2013)) [ACE001057125]. As the 2020 BiOp reports, "Colotelo et al. (2013) also found that the survival rate of adult steelhead kelts through spillways and surface weirs was high (>95 percent) and survival through turbine units was lowest (<80 percent), indicating that overshoots survive at a higher rate when spill protection is provided when they migrate back downstream." (2020 BiOp at 906) [ACE001057125].

84. Fall-back related mortality occurs year-round; it is not limited to the narrow window selected by NMFS for its offseason spill operation. As the 2020 BiOp states, many Middle Columbia River steelhead overshoots "do not attempt to migrate back downstream through McNary Dam until after the prescribed spill has ended in August, and a smaller portion do not attempt downstream migration until after the juvenile bypass system has shut down in mid-November." (2020 BiOp at 906) [ACE001057125]. Research also shows that overshoot-related fallback mortality occurs year-round and overshoot-related winter fallback mortality may be relatively high at dams closest to home tributaries (Keefer et al. 2008 [NMFS00309041-54]; 2020 BiOp at 906) [ACE001057125].

85. The federal agencies have been analyzing the issue of adult overshoot of steelhead since the 1990s (Boggs et al. 2004) [NMFS00283192]. Consistent with the operation in the ITS, these evaluations have provided adult steelhead with only intermittent access to spillway passage for brief hourly operational periods during intermittent days of a week or month. However, the available data shows that adult steelhead are attempting to pass the mainstem dams more regularly (e.g., daily, not just three times per week on alternate days) and during any hour of the day (Colotelo et al. 2013 and 2014 [NMFS00290583-735], [NMFS00290961-1086]).

Benefits for juvenile fish.

86. Listed summer steelhead have the most diverse juvenile life history characteristics of any listed species impacted by the CRS. These fish are present in freshwater habitat, including the mainstem, for one to several years after emerging. In part due to their diverse life

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history characteristics, Snake River juvenile steelhead can be in mainstem habitat year-round (Busby et al. 1996 [NMFS00287760-8034]).

87. Snake River fall Chinook also have unique life history characteristics. Unlike many anadromous species that spawn and rear in tributaries, Snake River fall Chinook spawn and rear in the mainstem Snake River and lower mainstem of major tributaries. It is well documented that subyearling fall Chinook are present in, and moving among and between, mainstem critical habitats within the CRS year-round (Connor et al. 2011; Tiffan et al. 2012). Although there is annual variation, timing of subyearling dispersal into lower Snake River habitat has been evident September through March. The Lower Granite Dam juvenile bypass system (JBS) is typically shutdown in late November, eliminating data on juvenile movement (2021 Fish Passage Plan p. LWG-15 Available FPP - LWG (crohms.org)).

88. Listed species with juveniles overwintering and dispersing through mainstem impounded habitats prior to outmigration will benefit from continuous surface passage operations.

Protecting the early and late components of juvenile migration.

89. Juvenile outmigration timing is generally characterized by a somewhat bell-shaped curve with "tails" on both sides of the main migration period. Voluntary spring spill has traditionally begun in early April, informed at least in part on prior observed run timing of the majority of outmigrating smolts. It is becoming more apparent, however, that (1) this timing fails to provide spill for the early tail of the run, which is key for species diversity and resilience to climate change, and (2) the overall run timing appears to be shifting earlier as a result of earlier snowpack melt due to climate change, increasing the proportion of fish that must pass the dams without the benefit of voluntary spill.

90. In 2017, the Court granted Oregon's motion to require the Action Agencies to operate the juvenile bypass and related Passive Integrated Transponder ("PIT") tag detection system beginning March 1 of each year beginning in 2018 (ECF No. 2190). In my declaration

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that year, I testified that early monitoring, which required operating the juvenile bypass system, would provide a biological benefit by providing an alternative to turbine passage for outmigrating fish during the pre-spill period and that the early and late tails of a run are particularly important for species diversity (2017 Bowles Injunction Decl. ¶¶ 46-51).

91. The data collected as a result of the Court-ordered earlier PIT tag monitoring shows that fish are moving past the dams during this earlier period (e.g., FPC Memo 56-20, Dec. 30, 2020). Although the number of daily observations of fish passing in the earlier part of March has been relatively low, it is very important to protect even these few fish when, as now, the population total abundances are extremely low. These early tails of the run are also important for species diversity. And the early component of the run may be increasingly important for resilience to climate change. Oregon's request for expanded surface-oriented spill will provide a survival benefit to the fish in this early component of the run by providing them with a spillway passage route, thereby reducing irreparable harm to the fish.

Minimize impacts from zero flow operations.

92. Another benefit of Oregon's request with respect to surface-oriented spill is that it will help mitigate for a zero flow operation implemented by the Corps that is detrimental to fish in order to benefit power. Completely shutting off flows in all or portions of the lower Snake and lower Columbia rivers is never good for listed fish. However, this has been an operational allowance for the CRS in prior BiOps during winter months, as long as these operations did not start prior to December 1 and considered fish abundance criteria. Even this limited fish consideration was rolled back in the ROD and 2020 BiOp, which now allows complete shutoff of nighttime flows in the Snake River as needed to benefit power starting as early as Oct 15. This earlier extension also removed the requirement to consider fish abundance criteria (2020 BiOp at 63) [ACE001056282]. Oregon's requested relief would limit the Corps from completely shutting off all flow because at least some limited surface-oriented spill would be required year-round.

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V. OPERATING MAINSTEM RESERVOIRS AT MINIMUM OPERATING POOL (MOP) WITH A ONE-FOOT OPERATING RANGE WILL REDUCE IRREPARABLE HARM TO FISH.

93. As I discussed in a 2008 Declaration, flow augmentation, spill, and partial reservoir drawdown are the best hope for moderating the effects of the dams on in-river migrants (Declaration of Edward Bowles in Support of Plaintiffs' Motion for Injunctive Relief ¶¶ 7-15 (ECF No. 1630)). Partial drawdown of reservoirs to improve water velocity and fish travel time is a key component of the strategy to improve survival of smolts through the lower Snake and Columbia rivers (NMFS 2000; Williams et al. 2005 [NMFS00356406-574]). Oregon is not requesting a partial drawdown below MOP in this Preliminary Injunction motion, but rather is asking that the Court order the Corps to maintain reservoir elevations at MOP with a restricted operating range as further specified below.

94. Oregon's requested injunctive relief with respect to reservoir elevations falls into two main categories: (a) reinstatement of prior MOP operating ranges that were better for fish (but were rolled back in the 2020 BiOp) in the lower Snake River reservoirs, for implementation in 2022, and (b) development of a plan in 2022 to implement MOP operations with a one-foot operating range in the lower Columbia River reservoirs beginning in 2023 that are better for fish than the status quo.

A. Restrict operating range at Lower Snake River reservoirs to one-foot to ensure elevations remain closer to MOP.

95. In the recent past, the Corps utilized a one-foot operating range above minimum operating pool ("MOP") at the lower Snake River projects for fish protections, consistent with prior Biological Opinions (e.g., 2008 BiOp Hydro strategy 1 Action No. 5; Water Management Plans 2001-present, available at http://pweb.crohms.org/tmt/documents/wmp/ (last visited July 5, 2021)). The 2020 BiOp allows the Corps to increase the operating range above MOP to benefit economic sectors at the expense of these prior fish protections (2020 BiOp at 58-59 (Table 1.3-3 n.2 and 3)) [ACE001056277]. The 2021 FOP implements the in-season adjustments that allow

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for "an expanded forebay operating range (Expanded MOP), raised minimum forebay elevation (Raised MOP), or a variable forebay operating range (Variable MOP)." These operating ranges allow for up to 4.5 feet above MOP, depending on flows. Allowing these increased operating ranges has a detrimental impact on fish and, in light of the current fish crisis, should at least be restored to the one-foot operating range above MOP.

96. The Fish Passage Center (FPC) recently studied the effects of operational changes in the Lower Snake River on juvenile Chinook and steelhead travel times (FPC Memo 34-21, Apr. 29, 2021). The FPC's model showed that forebay elevations under the 2020 BiOp would result in higher water transit time (WTT) in the Lower Granite Dam pool in 2021 relative to elevations maintained within the one-foot operating range (i.e., in this case, held constant at 733.8 feet) (*Id.* at 1). As discussed above, under the 2020 BiOp and the 2021 FOP, the forebay operating range at Lower Granite Dam is higher than past years and variable (*Id.* at 4). These increases in forebay elevation will affect reservoir volume, and consequently, WTT in the pool (*Id*.). The largest increases in WTT were associated with the lowest flows, with WTT increasing approximately 0.4 days at 30 Kcfs (*Id*.). Forebay elevation increases under the 2020 BiOp were predicted to result in increases in fish travel time (FTT) of up to 0.5 days from Snake River Trap through the Lower Granite reservoir to Lower Granite Dam at low flows (30-40 Kcfs) (*Id.* at 2). Conversely, incremental increases in flows in the Lower Snake River were predicted to decrease FTT from the Snake River Trap to Ice Harbor Dam from nearly 2 days to about 0.5 days, depending on flows and the time of year (*Id*. at 2). Improvements in FTT of 0.1 up to 0.3 days (depending on species and flows) are anticipated when the Lower Granite Dam forebay is held constant at 733.8' rather than the elevations allowed in the 2020 BiOp and implemented in the 2021 FOP (*Id*. at 2). The FPC's study indicated that for both yearling Chinook and steelhead, there would be a predicted increase in FTT if the forebay elevations in the 2020 BiOp were implemented, with the largest impacts predicted during the lowest flows (*Id*. at 5). The FPC modeling also showed that changes to forebay elevations or flows would impact early migrants

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more than late season migrants because early season migrants tend to migrate more slowly (*Id.* at 2, 7).

B. Operate Lower Columbia River reservoirs elevations at MOP with a one-foot operating range.

97. Oregon's requested relief requires the Corps to prepare an implementation plan by September 1, 2022 to operate John Day, The Dalles, McNary, and Bonneville at MOP with a one-foot operating range from March 1 to June 15, beginning in 2023. This implementation plan is an opportunity for the Corps to identify potential impacts to affected interests and mitigation options. The delay in implementation until spring 2023 will allow some opportunity for those affected sectors to make adjustments.

98. The lower Columbia River reservoirs have not been required to operate at MOP in any of the prior BiOps and have not generally had a biologically-constrained operating range, resulting in allowed normal operating elevations up to 6.5-feet above MOP depending on the project (2020 BiOp at 59, Table 1.3-3) [ACE001056278].

99. John Day reservoir is the largest and longest reservoir in the lower Columbia River and has long been recognized as a significant source of mortality for in-river migrants (NMFS 1995 BiOp [NMFS00321664]; CBFWA 1991). The 1995 BiOp required the Corps "to continue planning, design, and construction to continuously operate John Day pool near MOP by March 1996." (NMFS 1995 BiOp [NMFS00321783]). That planning was focused on reductions from minimum irrigation pool ("MIP" at 262.0 feet above mean sea level) to MOP (257.0 feet above mean sea level) for additional fish protections but the reductions were never implemented. Maintaining John Day pool at MIP, as opposed to MOP, is done to accommodate pumped water withdrawals that failed to develop adequate infrastructure (e.g., pipe length and pump strength) for operation at MOP, and not for fish protections.

100. More recently, the John Day Reservoir elevation is held between 264.5 and 266.5 feet from April 10 to June 1 under the 2020 BiOp and 2021 FOP. The proffered rationale for this

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elevation is to deter Caspian terns from nesting in the Blalock Islands Complex during this period (2020 BiOp at 58) [ACE001056277]. While the stated reason for these elevated reservoir levels at John Day is to prevent predation by terns, there are many other ways to deter terns that do not involve compromising fish travel times and survival. Habitat alteration, such as planting vegetation to discourage terns from nesting, hazing, and oiling tern eggs to prevent hatching, are viable options that will reduce tern predation while avoiding any detriment to fish. Operating John Day Reservoir at MOP with a one-foot operating range is well justified, given the long-recognized adverse impacts of the reservoir on fish and the availability of other alternatives to address avian predation and water pumping needs.

101. Flow objectives for the lower Columbia River are rarely met. Operating the LCR reservoirs at MOP with a one-foot operating range will slightly increase the likelihood of meeting the velocity equivalents of the flow objectives established for LCR, improving associated FTT and survival, and help ameliorate temperature risks. A recent comparison by the FPC of FTT through the John Day Reservoir based on various forebay elevations and flows at John Day Dam predicted substantial decreases of FTT when operated at MOP when compared to full pool or MIP; similar to Lower Granite, the most significant gains were at low flows and decreased as flows increased (FPC Memo 57-20, Appendix A). Reductions in yearling Chinook FTT associated with MOP elevations ranged from 0.5 to 2 days (depending on flow) when compared to full pool and 0.2 to 0.9 days when compared to MIP (FPC Memo 57-20, Appendix A). Similar gains are predicted for steelhead (0.4 to 1.6 days when comparing MOP to full pool and 0.2 to 0.7 when comparing MOP to MIP) (FPC Memo 57-20 Appendix A).

102. These analyses indicate that important additional fish protections can be gained for juvenile outmigrants during the spring if lower Columbia River reservoirs are operating at MOP with a one-foot operating range during that timeframe.

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VI. CONCLUSION.

102. The existing configuration of the CRS limits options to provide urgent conservation actions necessary to help address CRS impacts on listed fish in the face of ongoing climate change and the current low abundance extinction crisis. A long-term comprehensive solution that includes restoring a free-flowing lower Snake River and conservation spill at other mainstem dams is the only option with acceptably high certainty to meet the biological needs of listed fish. This comprehensive solution is urgently needed to address the current extinction crisis and provide a pathway to recovery moving forward.

103. In the interim, and despite configuration limitations, there are certainly additional conservation actions that can be taken in the CRS to help address CRS impacts and reduce extinction risk. This is the basis for Oregon's requested relief, which includes: additional spill to reduce powerhouse encounters of juvenile and adult listed fish, reduce forebay delay and associated FTT of juveniles and reduce zero flow operations; and reestablishment or establishment of MOP operations to reduce FTT and river warming. All these actions can be implemented within existing dam configurations and can provide at least some urgently needed conservation benefits until a long-term comprehensive solution is secured.

I declare under penalty of perjury that the foregoing is true and correct.

EXECUTED on August 19, 2021.

s/ Edward Bowles
EDWARD BOWLES

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Exhibit 1. ODFW analyses of population status relative to QET

The purpose of this analysis is to assess the status of listed populations of Snake River spring-summer Chinook and summer steelhead relative to Quasi-Extinction Thresholds (QET) defined as adult population abundance at or below 50 fish for four consecutive years. The analysis assessed current status and projected status through 2025.

Analytical Approach

Current status relative to QET was simply assessed by determining whether the empirically-based adult spawner abundance estimates for each population in the past several years showed at least four consecutive years with 50 or fewer fish. To project status relative to QET through 2025, the empirically-based adult abundance dynamics (i.e., patterns) observed during the past were modeled to predict adult abundance in the near-future. To characterize these patterns of variation in natural-origin spawner abundance over time for Snake River spring-summer Chinook salmon and steelhead and, ultimately, to generate predictions, ODFW fit a common class of time series model (autoregressive integrated moving average; ARIMA) to population-specific time series of natural origin-spawner abundance (including jacks; $NOSA_{ij}$). The "behavior" of a typical ARIMA model without exogenous regressors (e.g., environmental or operational covariates) is dicated by three parameters: an autoregressive term (p), a differencing term (d) and a moving average term (q). The d term essentially transforms the original time series (here, $NOSA_{ij}$) to ensure stationarity. In this application, ODFW assumed trends inherent in the time series varied with time and therefore, d was held constant (d = 2) for all models[1]. Other parameters (p and q) were allowed to vary in the fitting routine between 0 and 10 to generate a suite of candidate models for each population where parameter sets represented all combinations of: d = 2, p = {1, 2…9, 10} or q = {1, 2…9, 10}. After fitting, all estimable models were compared based on the akaike information criterion adjusted for small sample sizes (AIC_c) and the model(s) with the lowest AIC_c value was used to generate predictions through the year 2025.

Based on the empirical time series and modeled projections, ODFW considered two questions. First, what proportion of populations exhibited spawner abundance $\leq$ 50 fish for at least the last four years of the empirical time series (i.e., current QET status)? Second, what proportion of populations are predicted to reach spawner abundance $\leq$ 50 fish in at least the last four years of the empirical and predicted time series (i.e., prospective QET status)? This approach effectively assumes that patterns in the historical time series will be reflected in the future. With climate change already exacting deleterious tolls on populations, ODFW understands this likely is an optimistic view of the prospects for these species (i.e., adverse conditions these species are likely to encounter in the future have not necessarily been experienced in the past; Crozier et al. 2020).

[1] Because the differencing term essentially transforms the original times series, it would be inappropriate/potentially misleading to compare models with different values of d.

Output

Snake River spring/summer Chinook salmon

Based on the data and given the approach (i.e., using the entire empirical time series to generate predictions) and the definition of QET adopted, **29%** of listed Snake River spring/summer Chinook populations are currently at QET while **39%** of populations are predicted to be at or below QET by 2025 (Figures 1.1–1.8).

Snake River summer steelhead

Based on the data and given the approach (i.e., using the entire empirical time series to generate predictions) and the definition of QET adopted, **13%** of listed Snake River summer steelhead populations are currently at QET while **63%** of populations are predicted to be at or below QET by 2025 (Figures 2.1–2.4).

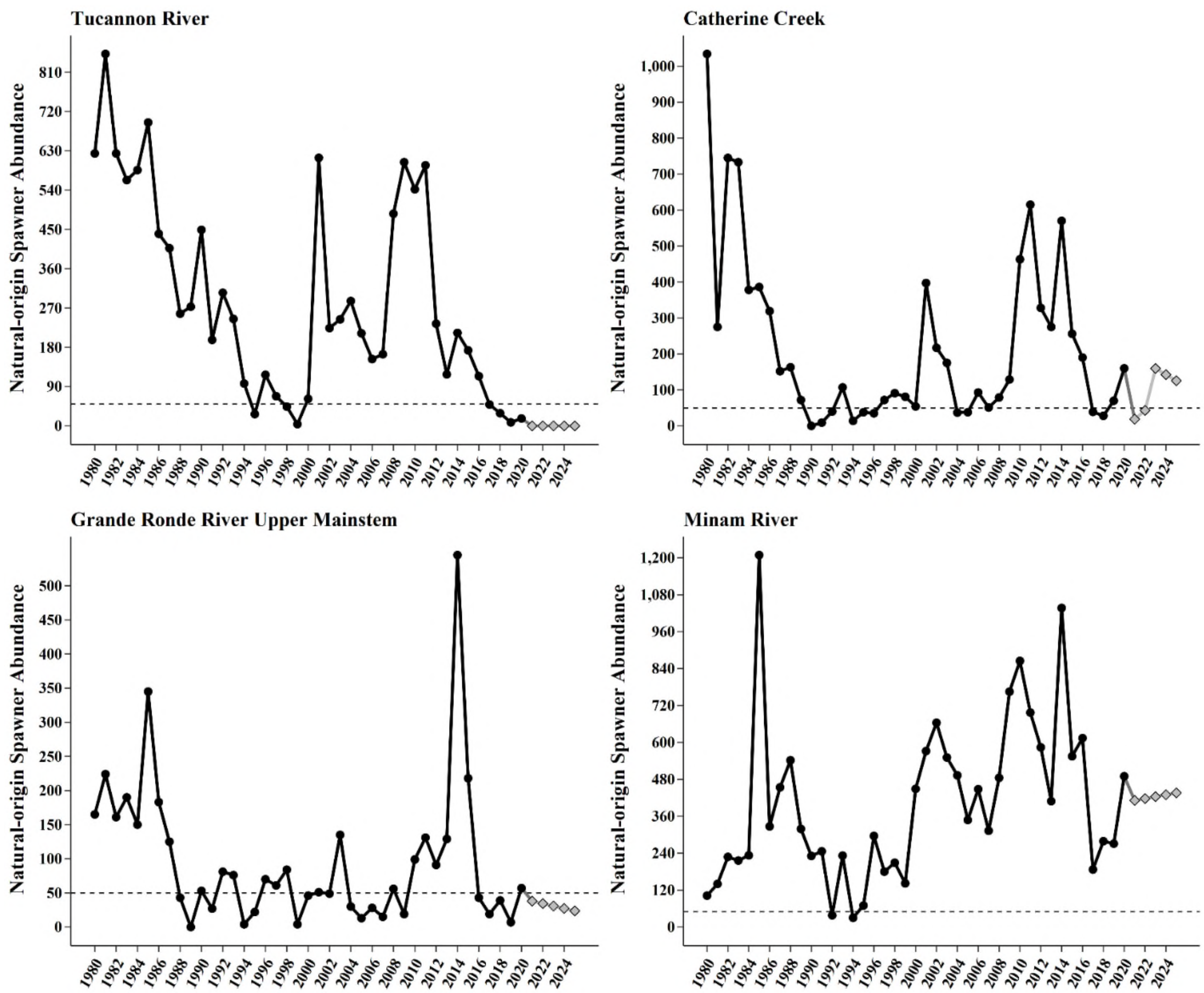

Figure 1.1. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

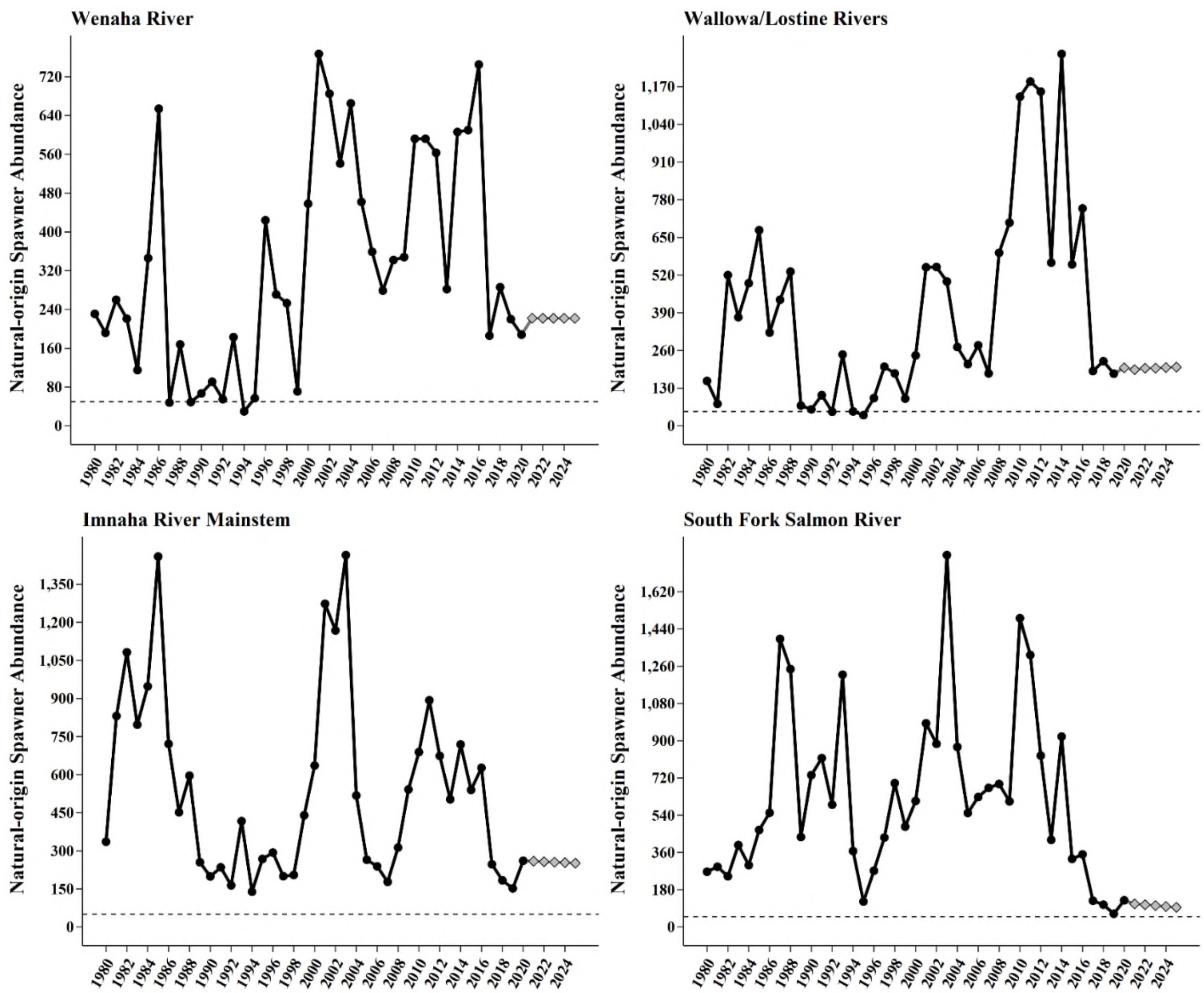

Figure 1.2. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

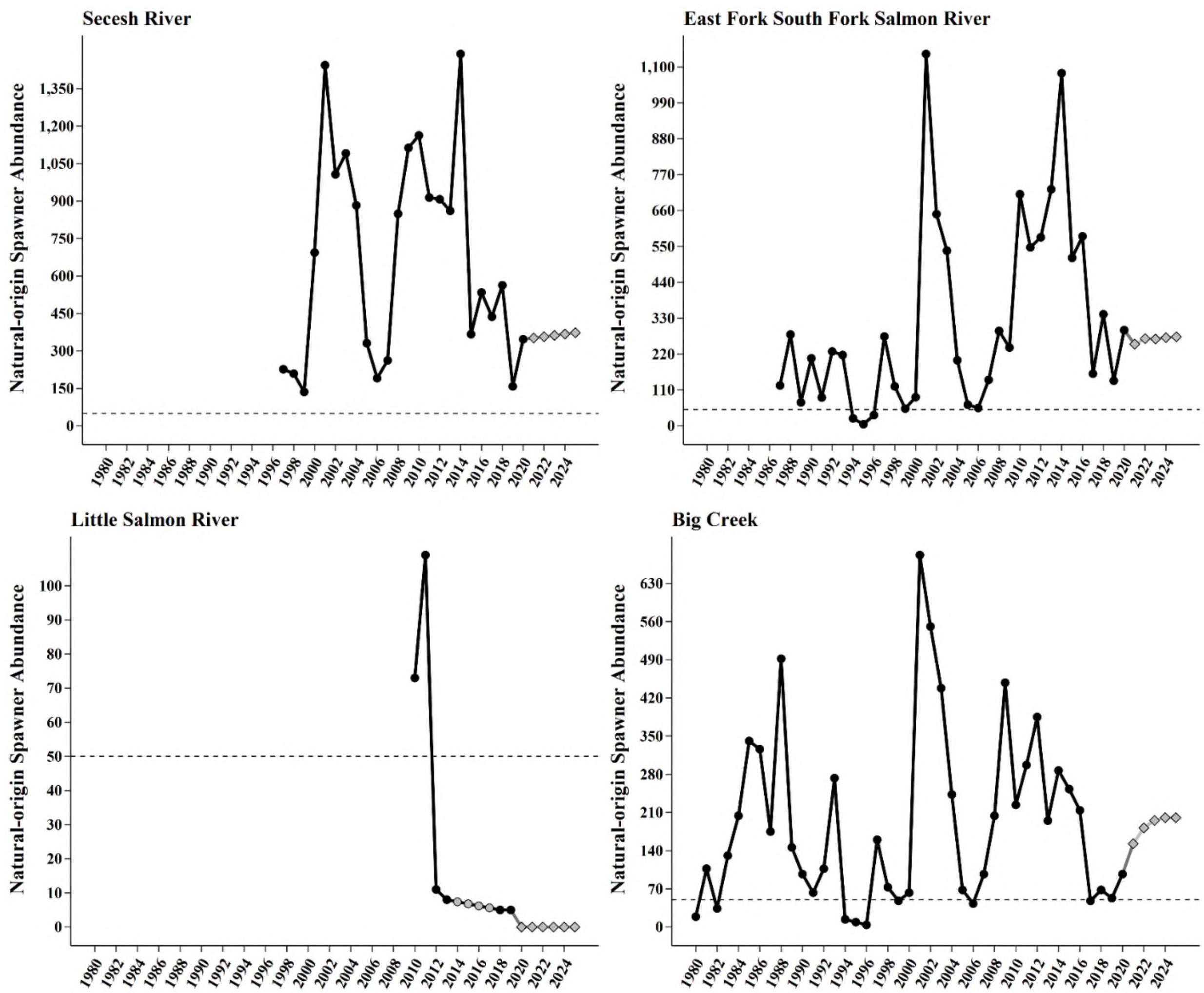

Figure 1.3. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

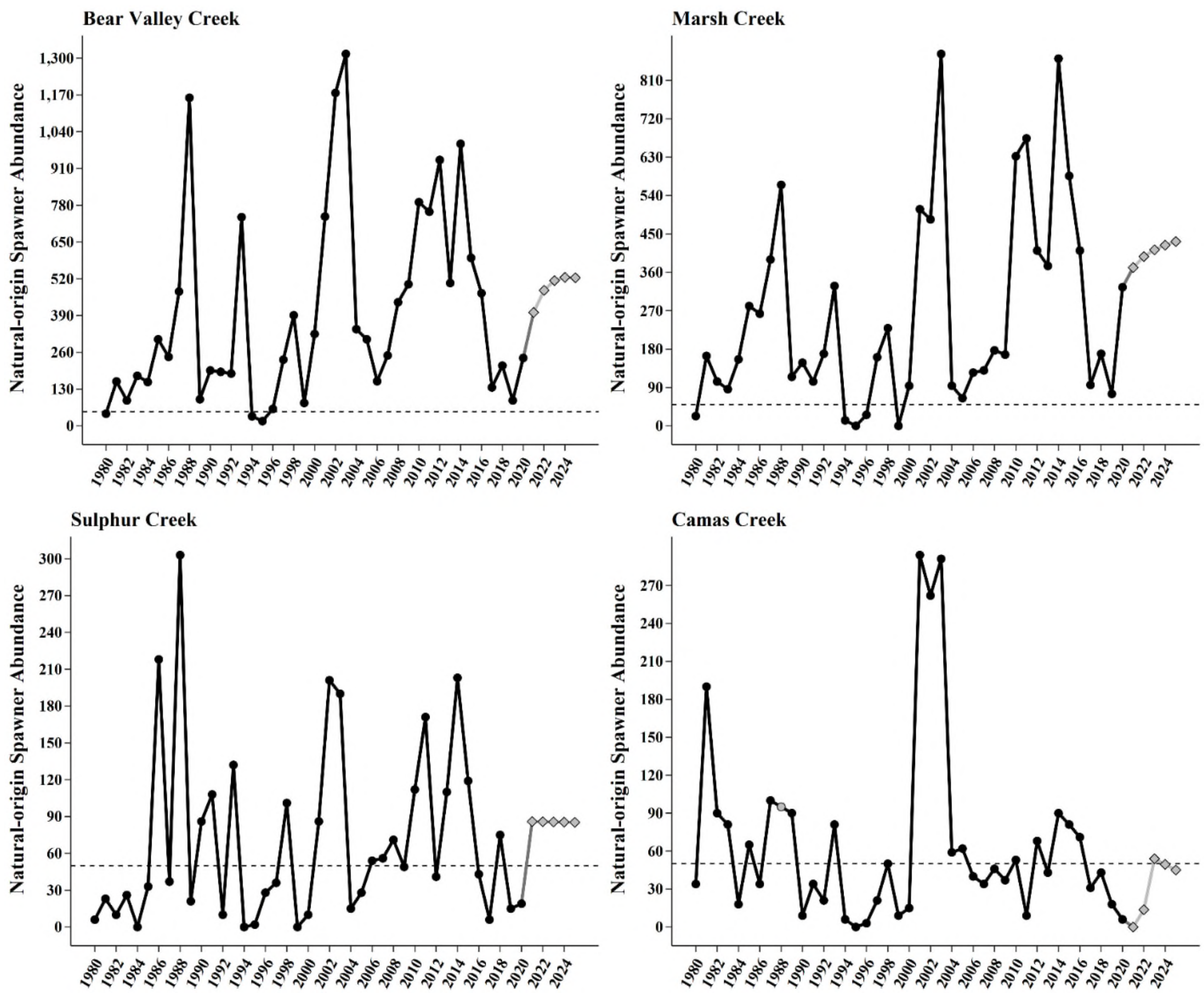

Figure 1.4. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see “Approach”). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

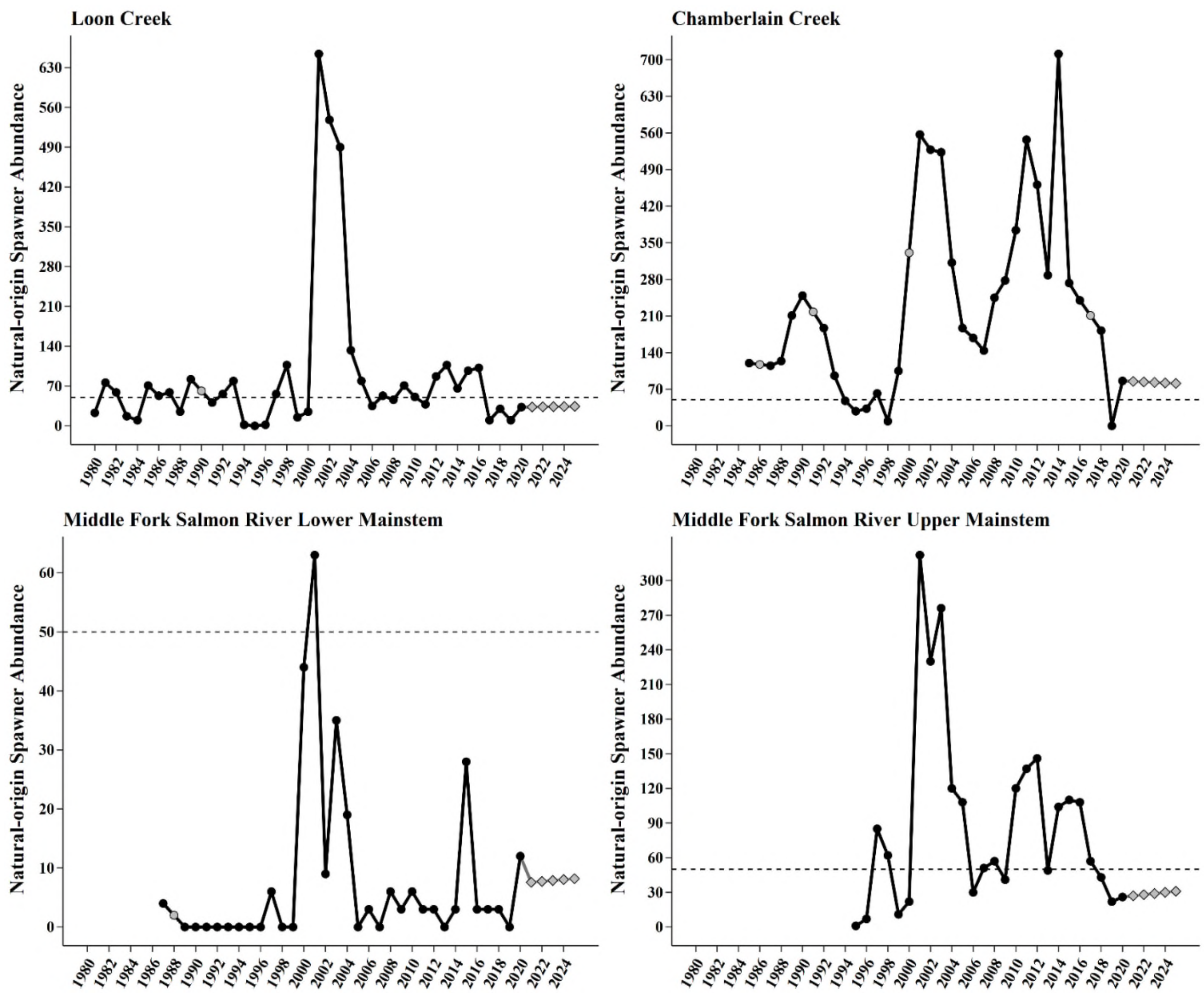

Figure 1.5. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

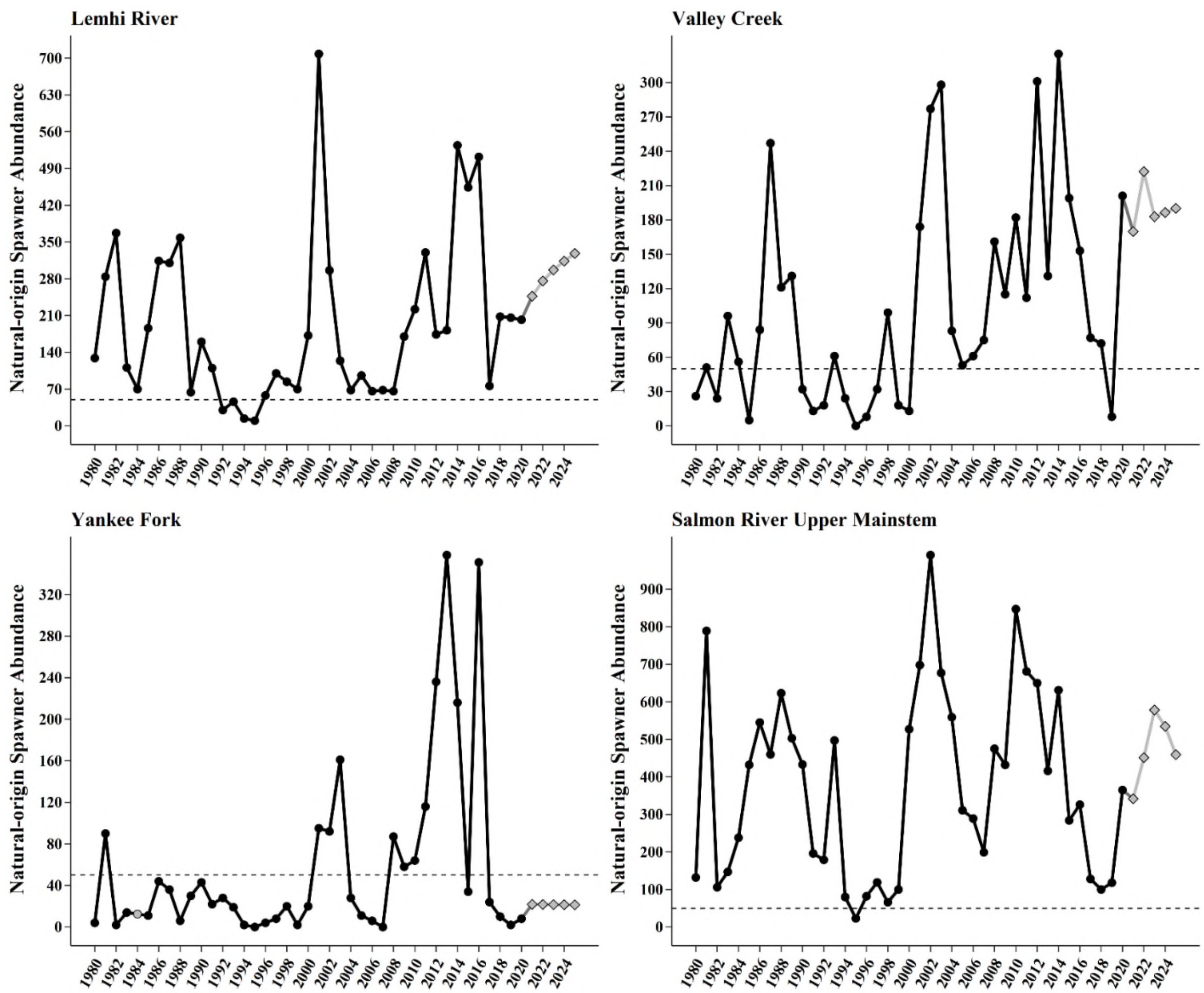

Figure 1.6. Time series of estimated natural-origin spawner abundance (NOSA$_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see “Approach”). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

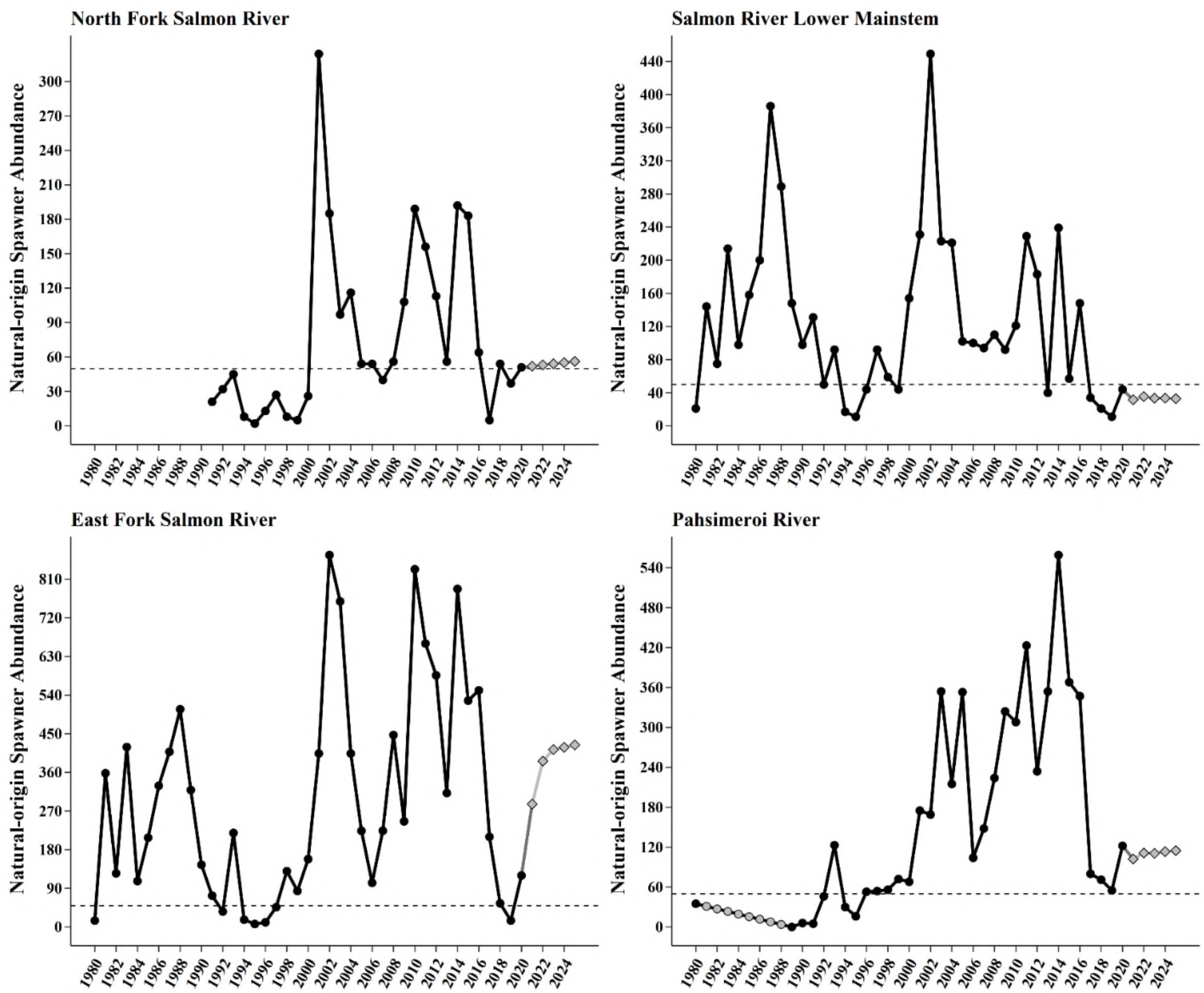

Figure 1.7. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

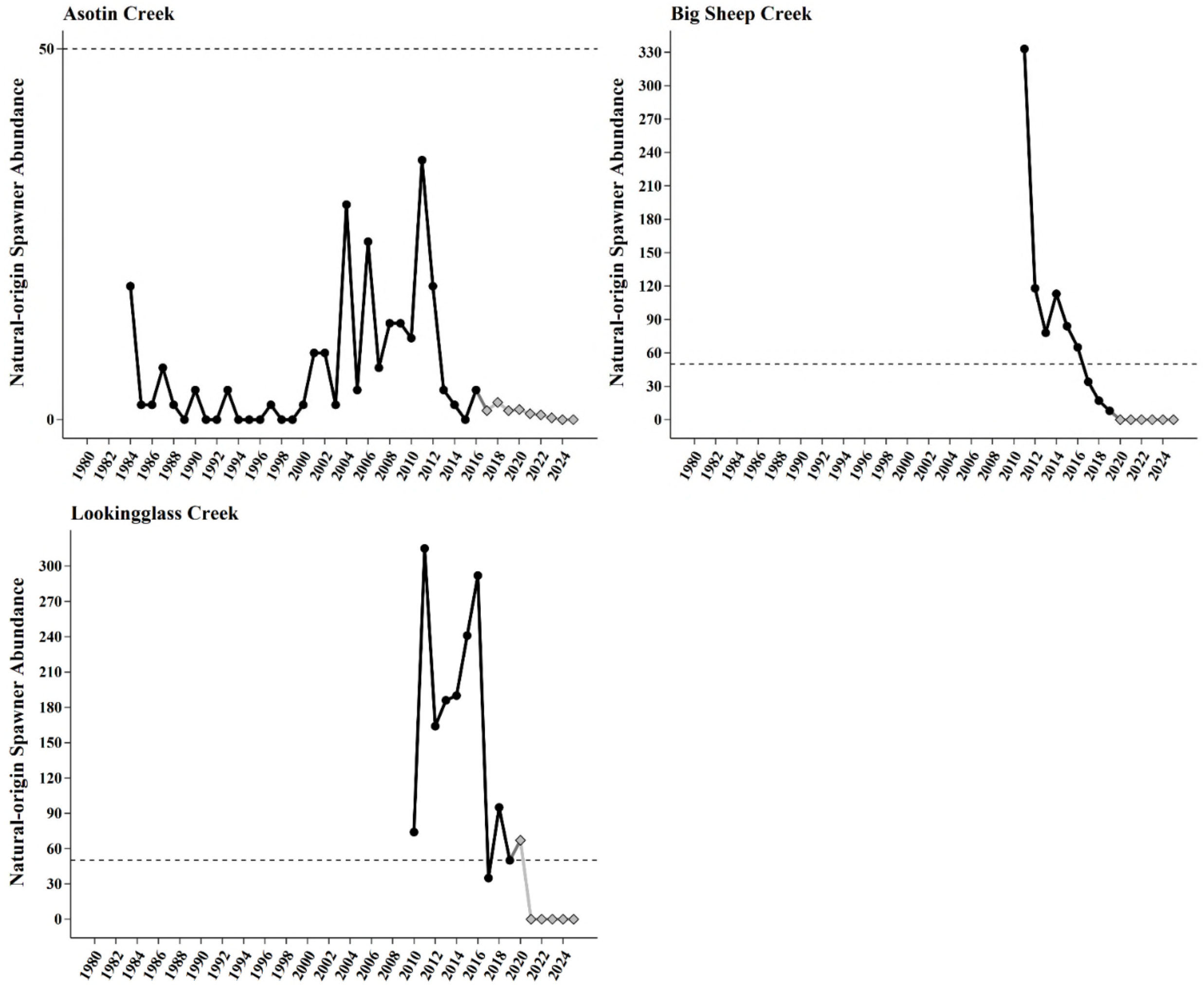

Figure 1.8. Time series of estimated natural-origin spawner abundance (NOSA$_{ij}$; circles) and projections (gray diamonds) for populations of Snake River spring/summer Chinook salmon. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see “Approach”). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

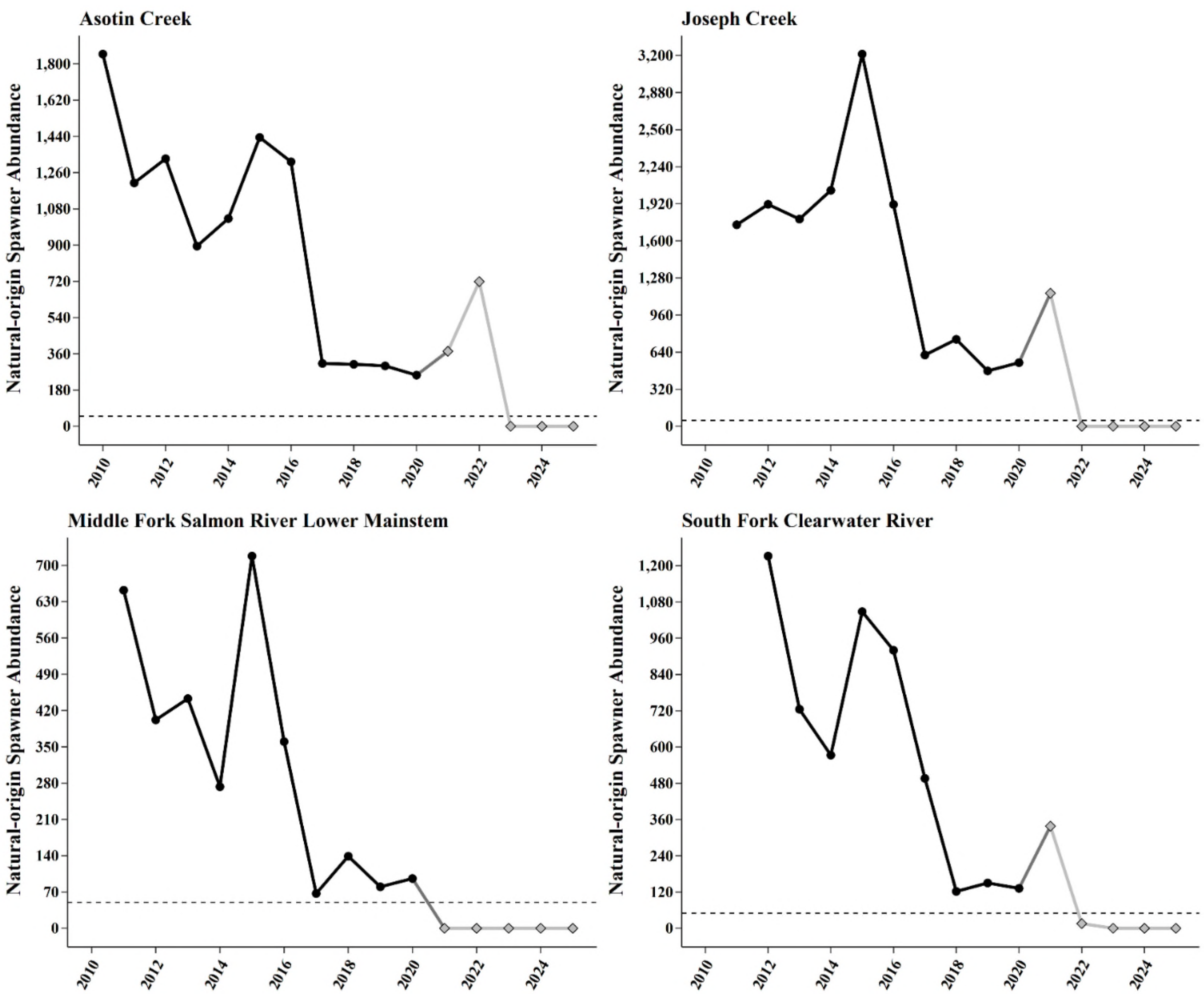

Figure 2.1. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River summer steelhead. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

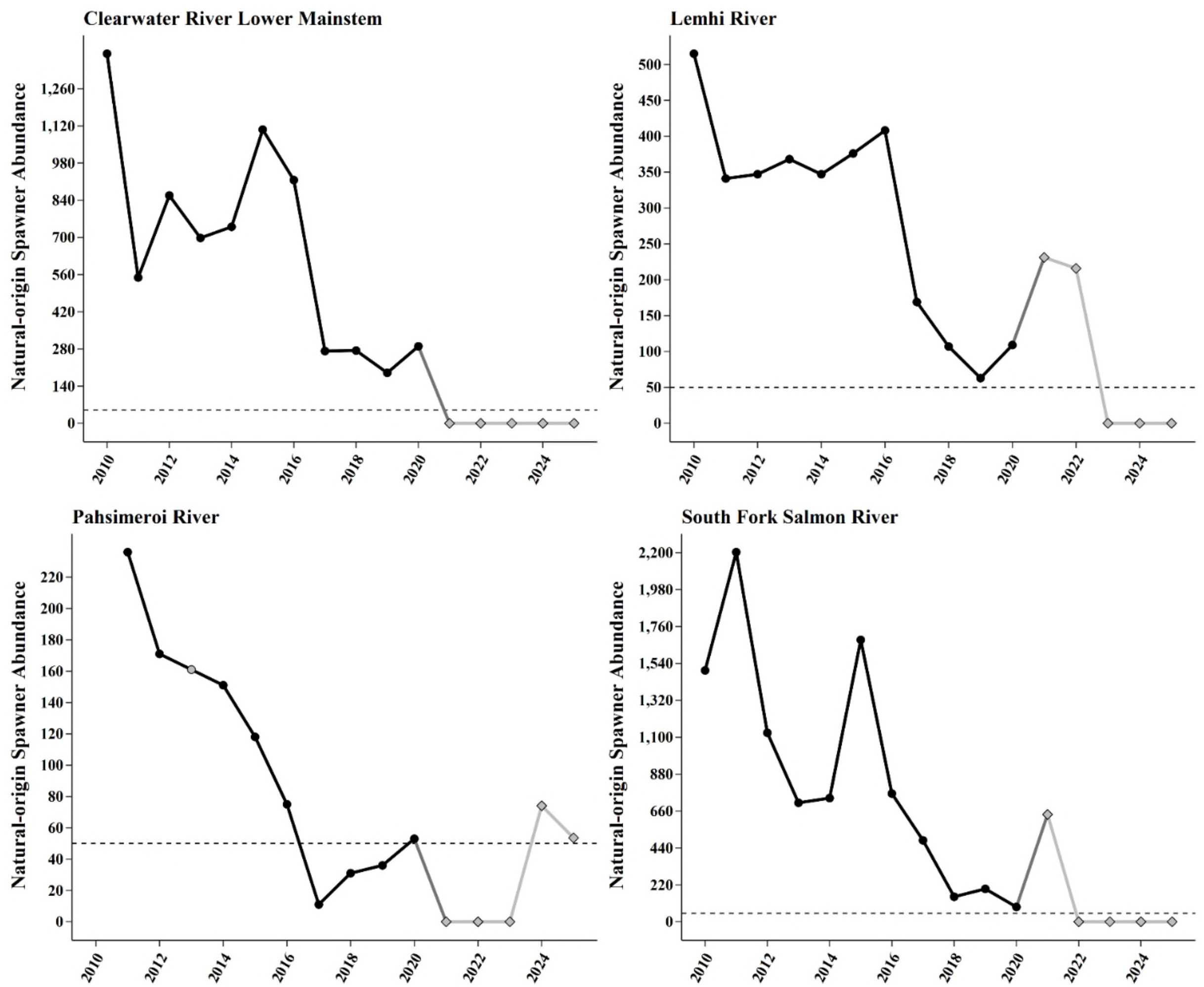

Figure 2.2. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River summer steelhead. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

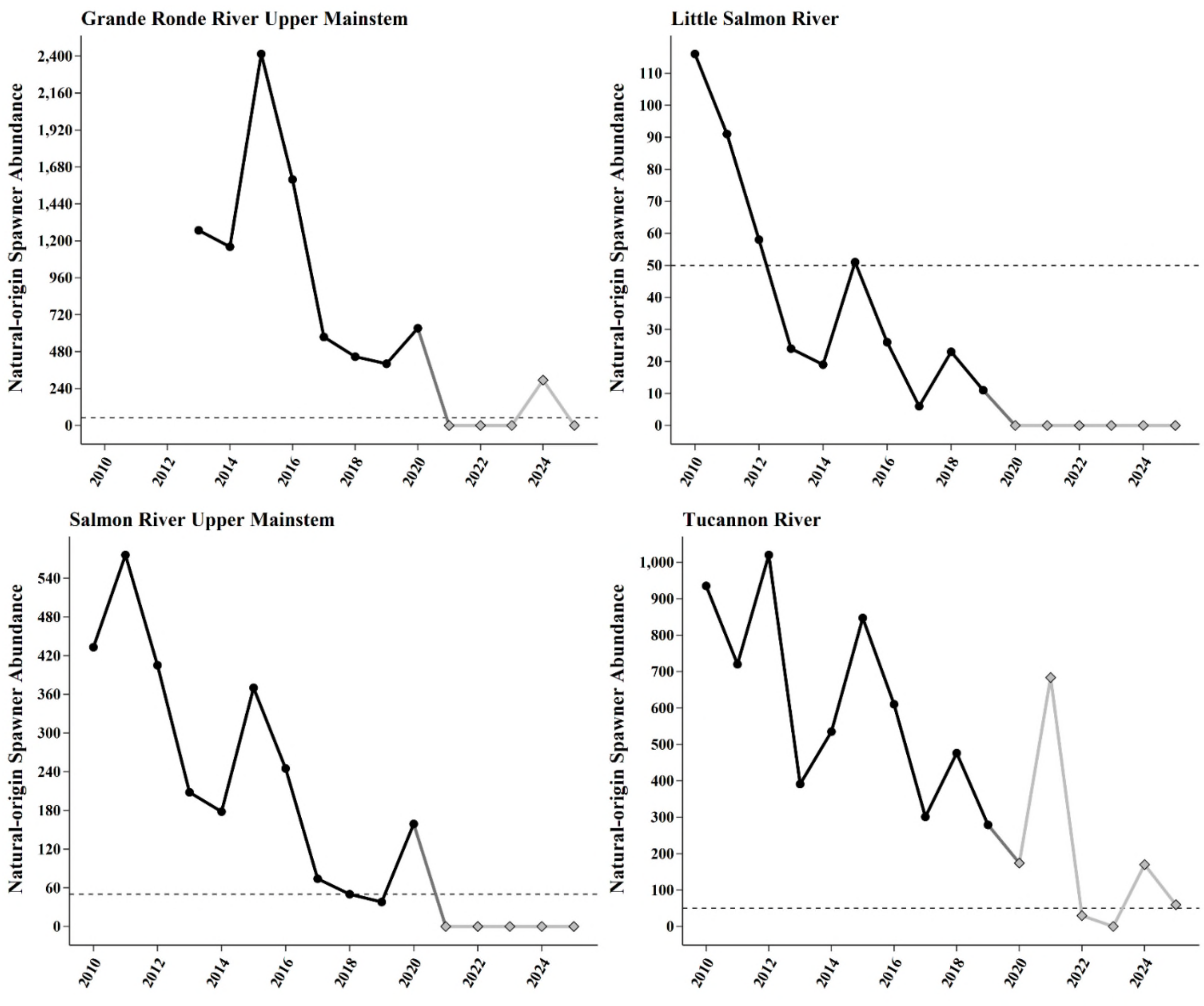

Figure 2.3. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River summer steelhead. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).

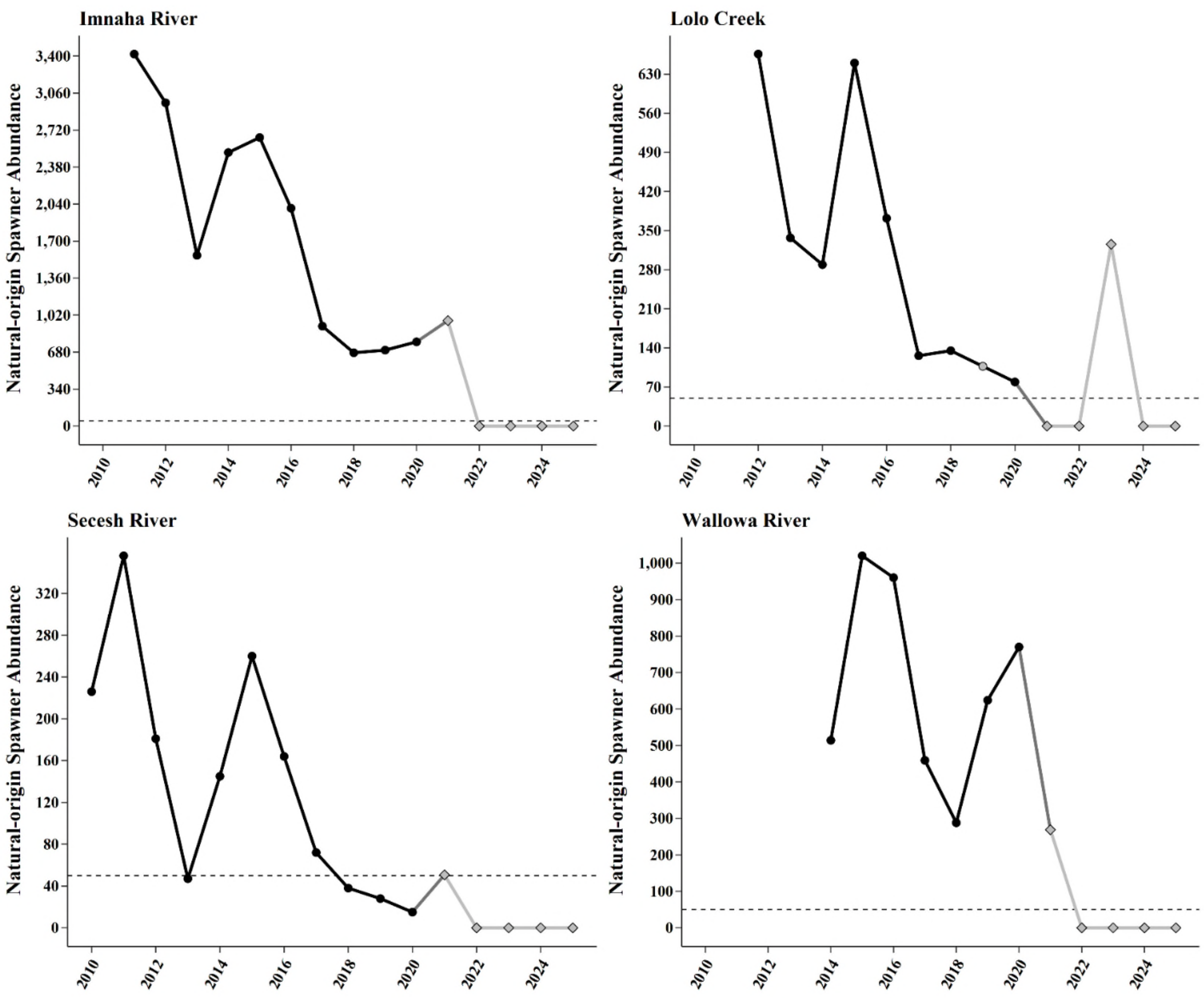

Figure 2.4. Time series of estimated natural-origin spawner abundance ($NOSA_{ij}$; circles) and projections (gray diamonds) for populations of Snake River summer steelhead. Projections are based on constrained autoregressive integrated moving average (ARIMA) models fit to the empirical time series. ARIMA parameters are from the best-supported model (see "Approach"). Where present, gray circles represent interpolated values based on ARIMA fits. The dashed horizontal line represents the threshold at which quasi-extinction threshold (QET) was assessed (i.e., < 50 spawners).