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Why We Need a Free-Flowing Lower Snake River

Explaining the impacts dams have on Snake River salmon and steelhead and why their removal is necessary for wild fish recovery.

How do we bring back Snake River salmon and steelhead?

Look to the science.

Making decisions based on sound science and information is a core principle of Trout Unlimited. With that in mind, we set out to better understand the science behind the decline of Lower Snake salmon and steelhead and what could be done to recover them.

Overwhelmingly, the evidence has led us to conclude that removal of the four lower Snake River dams is the single most important step we can take to recover abundant, fishable and harvestable Snake River salmon and steelhead. Dam removal, however, must be part of a comprehensive recovery plan that includes restoring and protecting habitat, improving hatchery and fishery management, and reducing predation.

We understand that not everyone sees it the way we do. As members of the communities that have been and will be impacted by this challenge, we recognize that all of the Pacific Northwest must benefit from actions designed to help salmon. This is not about sacrifice; it is about saving salmon and steelhead while strengthening the regional economy.

But we are committed — and determined — to seek solutions that work for fish and people while also meeting the needs of the industries and communities that are dependent on the dams.

We have taken a deep dive into the science and data and come out with a clear conclusion: If the four lower Snake River dams are not removed, Snake River wild salmon and steelhead may soon become extinct.

We have compiled the evidence for dam removal and distilled it into an approachable series of questions and answers. We hope you will take some time to dig in, think about it, and then reach out to us, if you have questions, concerns or simply want to be involved in the effort to recover the Snake River's magnificent salmon and steelhead.

Recovery is not theoretical. It is not a distant vision on some yet-seen horizon. It is within our grasp: We can bring back our fish and do so in a way strengthens the regional economy and Columbia Basin communities.

And by working together, we will.



Chris Wood
President and CEO
Trout Unlimited



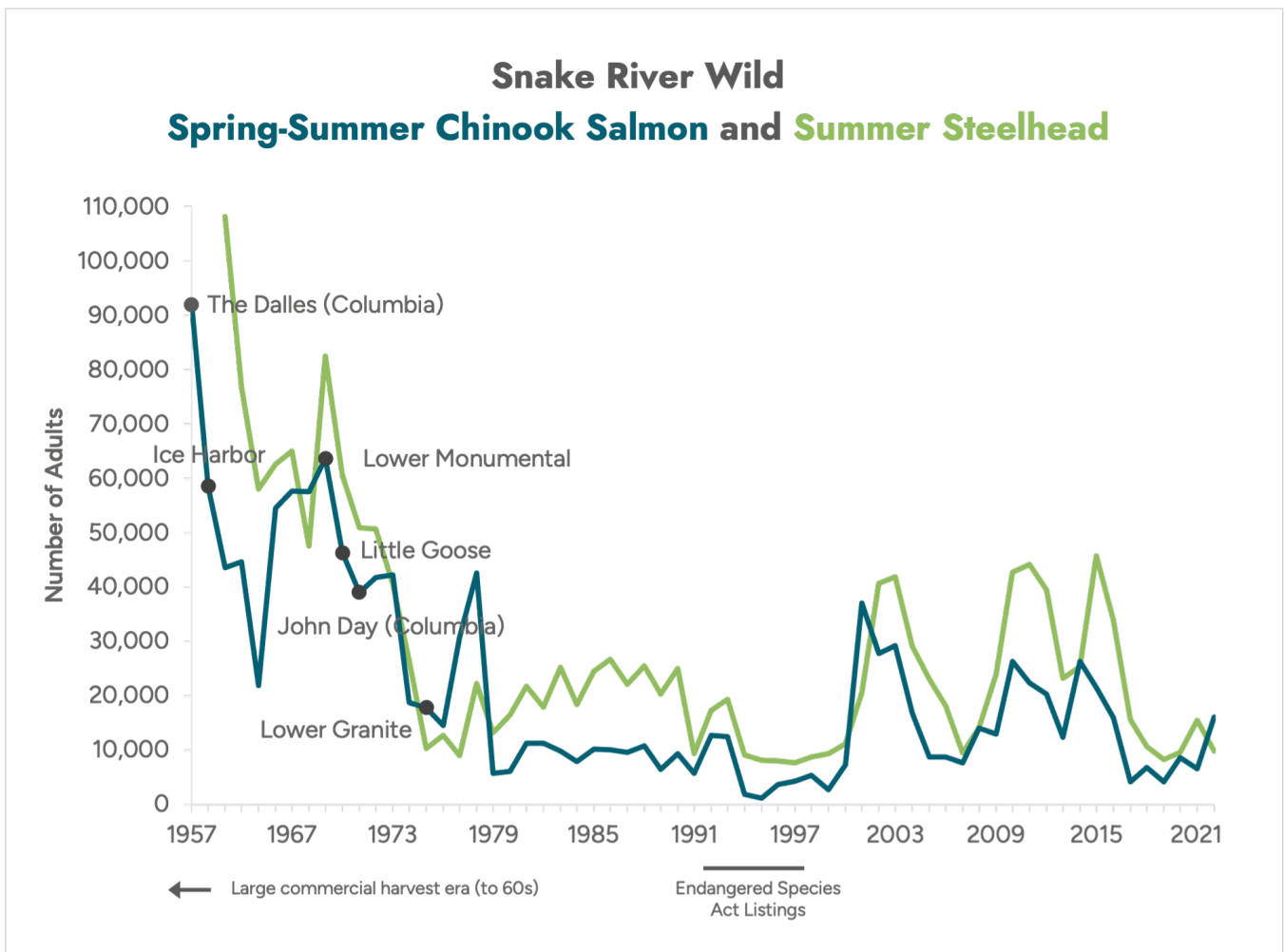
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What is the current state of salmon and steelhead?

As the data clearly reveal, the long-term trends are downward, not improving, and there is no evidence to suggest that we can achieve sustainable, much less abundant and harvestable, populations without major changes in our recovery actions. This is why Snake River Basin steelhead and salmon populations are listed as threatened or endangered under the Endangered Species Act (ESA).

Salmon and steelhead populations fluctuate on an annual basis, sometimes widely so, due to variability in freshwater and ocean conditions. Just as one tracks the performance of a financial portfolio, it is important to focus on long-term trends, not a single annual return.



What does recovery mean, and who decides?

There are different definitions of "recovery." To consider populations recovered and remove them from the ESA requires assurance of an acceptably low risk of extinction.

For Trout Unlimited, recovery means abundant, healthy and harvestable populations of wild salmon and steelhead returning regularly.

But to better quantify what that means, both scientifically and socially, we turn to the Columbia Basin Partnership.

What is the Columbia Basin Partnership?

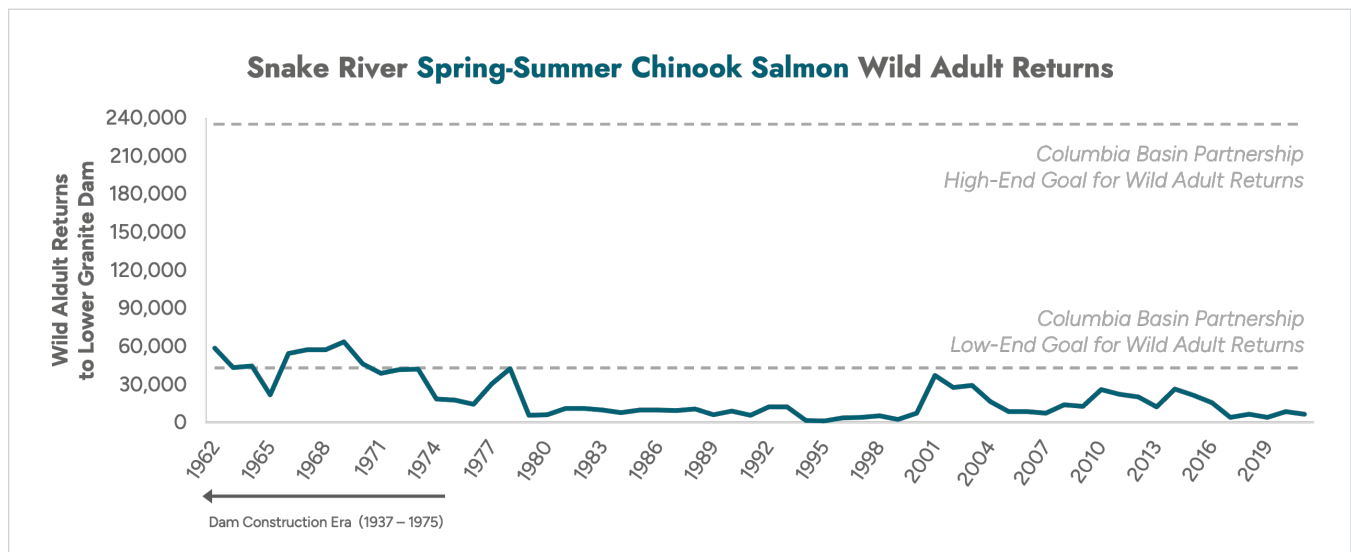
The Partnership is a diverse group of 31 Columbia Basin stakeholders and sovereigns, including representatives of the four Columbia Basin states, tribes, ports, public power entities, irrigators, commercial and recreational fishers and conservationists. It was the Partnership which unanimously defined "recovery" to mean "healthy and harvestable" naturally reproducing populations of salmon and steelhead.

How many fish do we need?

The Partnership created a range of goals — low, medium and high. To achieve the cultural and economic stability provided by healthy salmon and steelhead stocks, many more naturally produced fish are needed to meet recovery goals — roughly five times the number needed to lift ESA protections. Still, these goals are a modest percentage of historical numbers.

How are these different from the goals agencies set?

The way salmon and steelhead are managed by NOAA Fisheries sets a much lower bar. NOAA abides by the Endangered Species Act (ESA), which requires only that risk of extinction be sufficiently low over a 100-year timeframe. The Partnership's definition of recovery takes a broader approach and considers both the health of the fish and the strong desire of people to fish for salmon and steelhead, which fuels rural economies and meets treaty obligations to Native American tribes.



MANY POINTS *of* IMPACT

The four lower Snake River dams and the reservoirs they create harm fish in numerous ways.

1

The dams kill juvenile fish as they pass over, around, and through each structure on their migration to the Pacific.

3

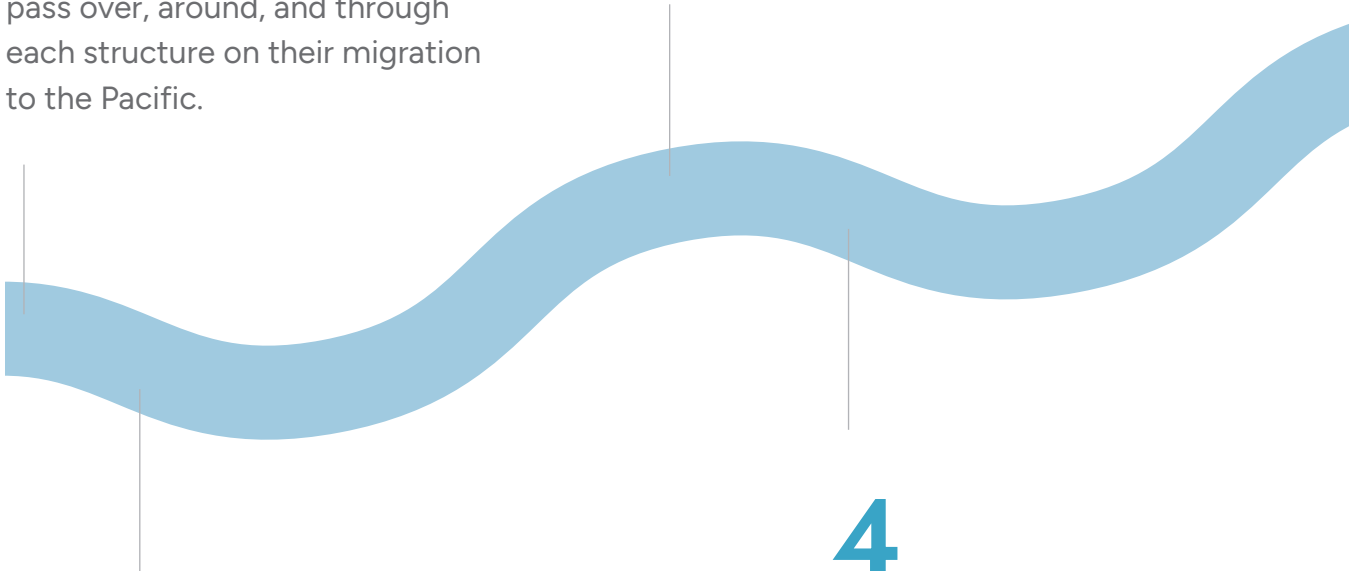
The dams cause sustained high water temperatures in reservoirs during the summer and early fall that weaken or kill migrating fish.

2

The dams inundate 140 miles of river habitat and create slow moving reservoirs.

4

The dams cause juvenile fish to expend much more energy to migrate to the Pacific because the fish must actively swim through reservoirs instead of migrating passively with the river current.



5

The dams alter the food supply for juvenile fish by inundating river habitat that produces food.

7

Reservoirs behind the dams provide habitat for both invasive and native predatory fish and make juvenile fish easy targets for predatory birds.

8

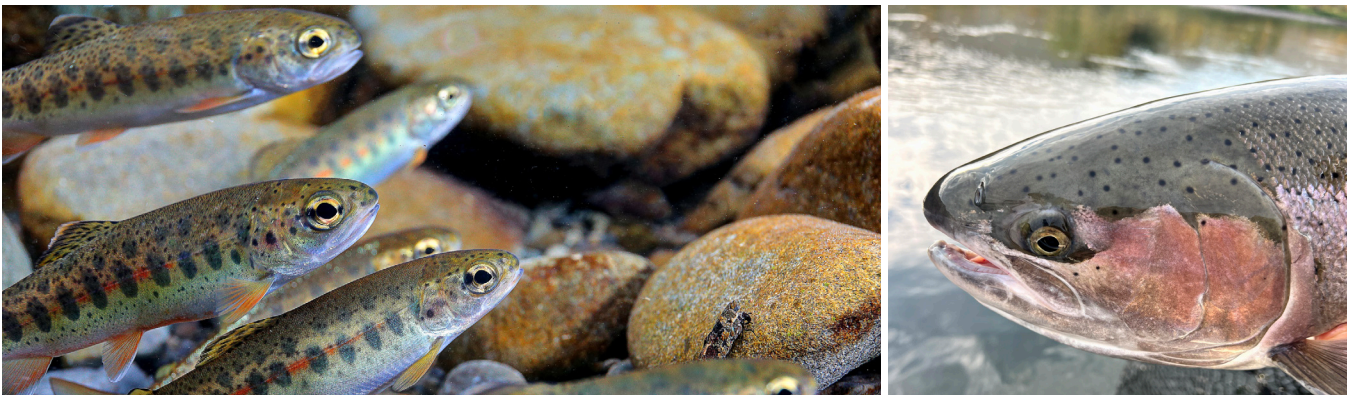
The dams kill adult fish returning to their spawning grounds.

6

The dams increase, on average 10x, the amount of time it takes juvenile salmon to reach the ocean; this increases their exposure to heat and predators and causes a mismatch between timing of ocean entry and the process of smoltification.

Smoltification is the physiological change juvenile salmon and steelhead undergo to prepare for a saltwater environment

How do the Lower Snake River dams harm wild salmon and steelhead and how are those impacts measured?



The dams harm and kill salmon and steelhead in various ways, only some of which can be quantified. Those in support of maintaining the dams often cite precise statistics regarding the high percentage of juvenile fish (smolts) that survive as they pass each dam (from top to bottom of one physical structure, measured as a "performance metric" for the structure). But physical passage over a dam is just one of the many points of impact for salmon and steelhead.

Data also show that while smolts may initially survive the journey from one dam to another or even through a series of dams, the *cumulative* impacts on survival of passing eight dams are significant (about 50% mortality through the last dam). Further, data related to downstream migration mortality don't represent the full effect.

Studies establish that some fish still die even after they have "successfully" passed through the hydro-system because of the stressful experience of passing the dams and migrating through the reservoirs.

This is referred to as "delayed mortality" and it occurs at some point below Bonneville dam, the last dam fish must pass on their way to the ocean.

The amount of delayed mortality experienced by salmon and steelhead has been a hotly debated topic for decades because it is difficult to measure considering all the variables affecting mortality after fish exit the hydrosystem. But the fact that it is difficult to quantify does not negate its potentially significant impact.

Recent estimates of latent mortality used by NOAA in the Columbia Basin Partnership process range between 9 and 67 percent.

For fish that survive passage through the dams and reservoirs, the experience also exerts significant stress on returning adults, which ultimately reduces the number of offspring they produce. Some returning females never spawn, and others produce far fewer eggs. As is the case with delayed mortality, it is not possible to quantify this harm, but that does not diminish the fact that it exists and contributes to depressed wild salmon and steelhead populations.

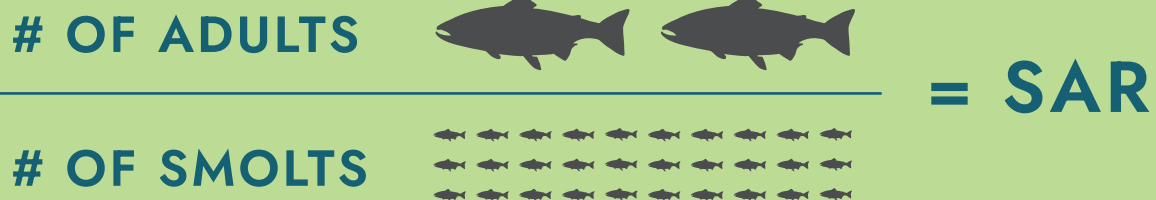
The combined impact of these factors shows us the four lower Snake River dams and the reservoirs behind them take a heavy toll on Snake River salmon and steelhead. The mortality that can be quantified is substantial. But when the harm caused by the dams and reservoirs that cannot be quantified is added to the equation, it becomes clear that breaching the four lower Snake River dams would vastly improve the abundance and productivity of wild Snake River salmon and steelhead.



The four lower Snake River dams and the reservoirs behind them take a heavy toll on Snake River salmon and steelhead.

What is the smolt-to-adult return ratio and why is it important?

The smolt-to-adult return ratio (SAR) is the percentage of smolts from a given cohort that survive and return as adults:

$$\frac{\text{\# OF ADULTS}}{\text{\# OF SMOLTS}} = \text{SAR}$$


2%

SAR needed for Snake River adult salmon and steelhead to replace themselves and simply avoid extinction

For example, if 100 steelhead smolts pass Lower Granite dam on their downstream migration and 2 adult steelhead from that group return and survive to pass Lower Granite on their way to spawn, the SAR to Lower Granite would be 2% (adults/smolts).

4–6%

SAR needed to rebuild Snake River salmon and steelhead populations

SAR is an important metric because it is the only metric that captures (most of) the cumulative impacts of the hydro system on salmon and steelhead, telling us how sustainable the returns of adults are over time. This is critical because even if high quality habitats produce a lot of smolts, the population will only be sustained if those smolts can make it out to the ocean and survive to return and spawn as adults.

For Snake River stocks, SAR is often calculated by dividing the number of returning adult salmon or steelhead that pass the uppermost lower Snake River dam, Lower Granite, on their way to spawn, by the total number of smolts (juvenile salmon or steelhead) that previously passed Lower Granite dam earlier as they were migrating to the ocean.

A downward TREND

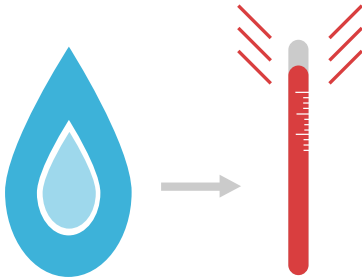
Salmon and steelhead have survived the swim to sea for millennia, but dams have made that journey more deadly.



As fish migrate to and from the ocean, countless obstacles will kill a percentage of the population. While some causes are natural, many, such as high water temperatures in reservoirs and increased predators, are caused or exacerbated by the presence of dams.

DAMS

Physically crossing dams kills fish.



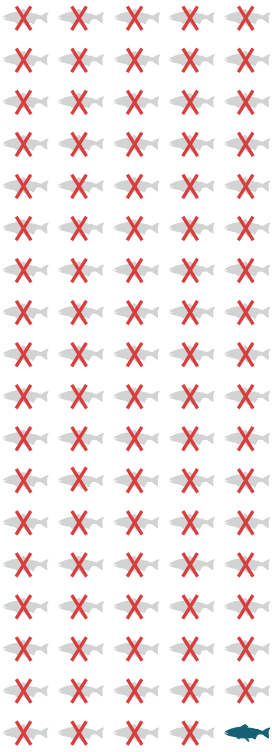
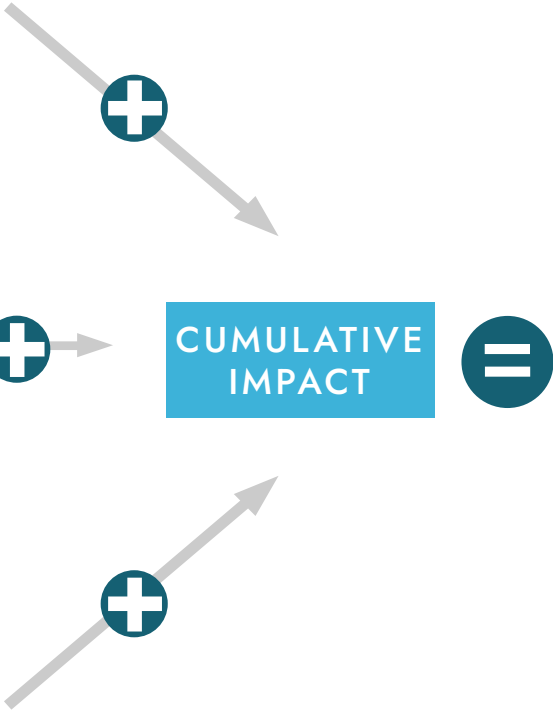
HOT RESERVOIR TEMPS

Reservoirs created by dams heat up and kill more fish.



MORE PREDATORS

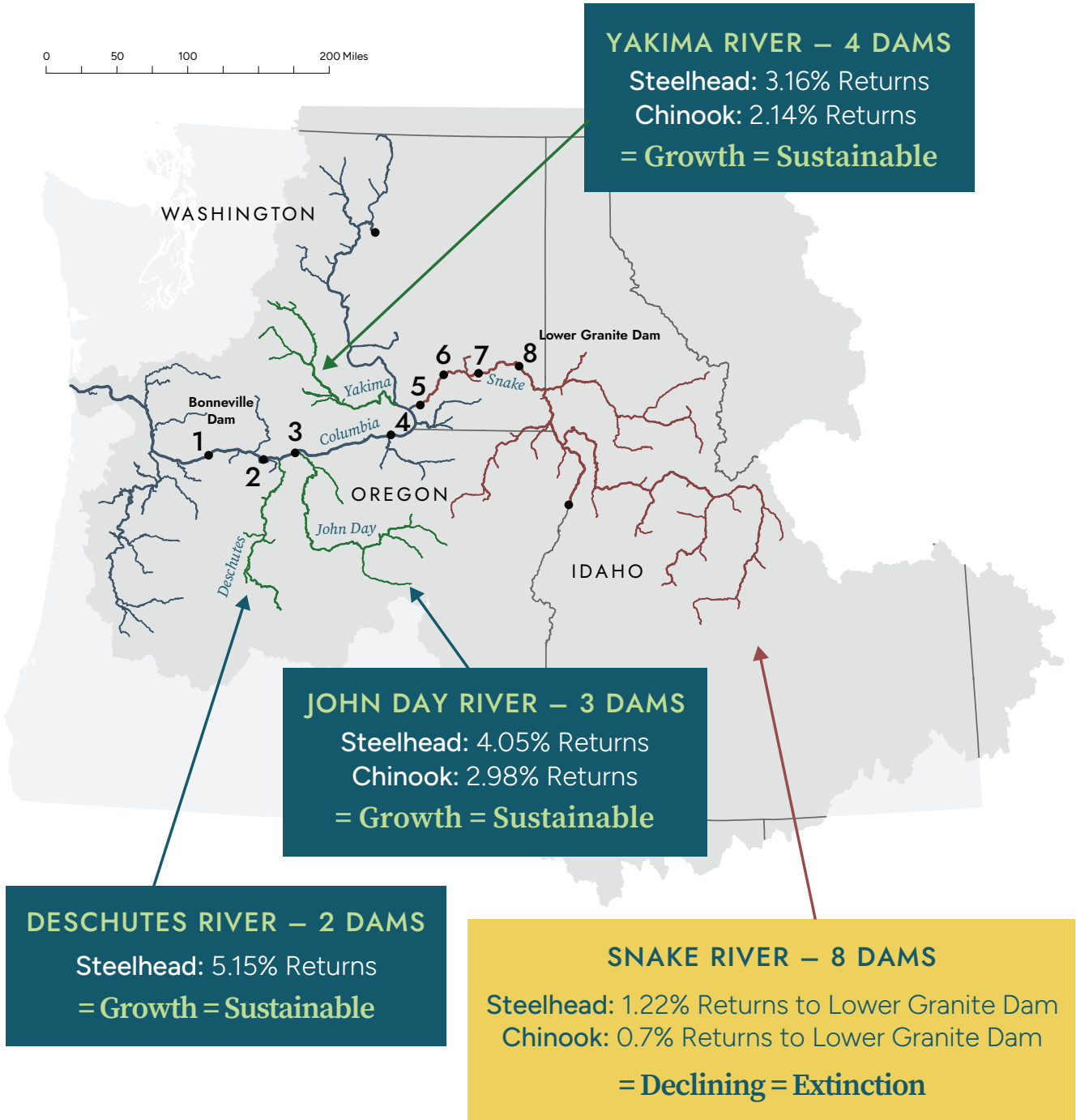
Predators aided by dam-caused conditions kill more fish.



TREND TOWARD EXTINCTION

2022 Wild Steelhead & Wild Chinook Salmon Smolt-to-Adult Returns in the Columbia River Basin

0 50 100 200 Miles



● Dams (with dam count between Pacific and Snake Basin)

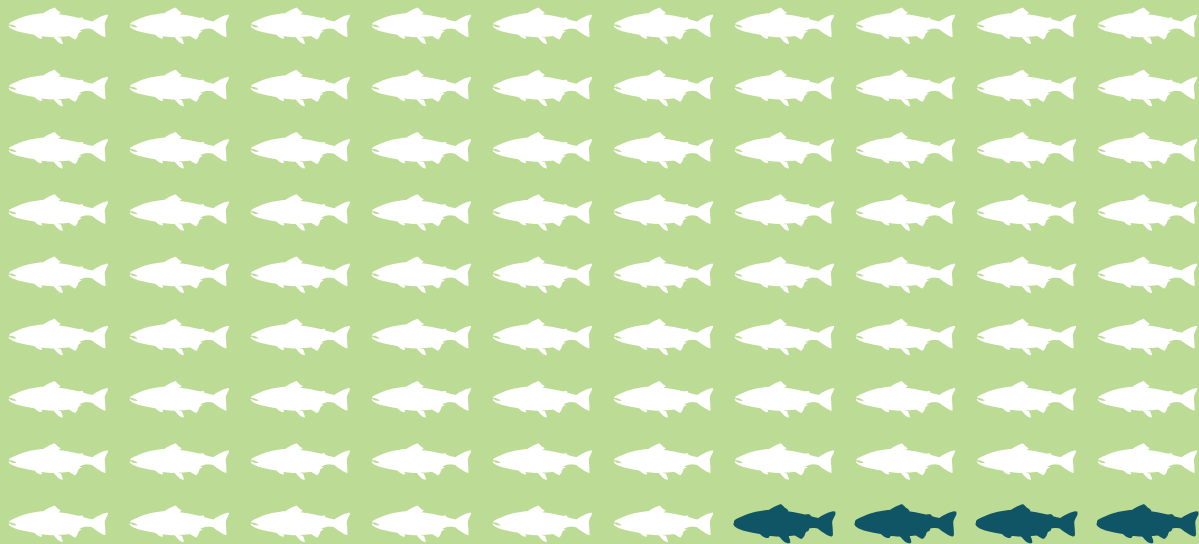
Current salmon/steelhead distribution

SAR data source:
Fish Passage Center
2022 Comparative Survival Study

A PATH TO EXTINCTION

Recovery Needs

Of these **100 SMOLTS**, we need at least **4 ADULT FISH** to survive the hydro system and return to spawn.



This will recover **HEALTHY & HARVESTABLE POPULATIONS** in the Snake River basin.

But in the last 25 years, the Snake River Basin has not even averaged **2 ADULTS**, a return rate that will lead to extinction.

Is it possible to recover salmon and steelhead without removing the dams?



The short answer is no. Rebuilding salmon and steelhead populations will require increasing the smolt-to-adult ratio, or SAR.

However, in the past 25 years, salmon and steelhead SARs have failed to reach the minimum-required 2 percent average despite restrictions and closures of modern fisheries, and massive investments in Snake River Basin habitat restoration and juvenile fish passage systems at the lower Snake River dams.

While many actions like habitat restoration and increased spill over dams have been taken, and billions of dollars have been spent, populations have not rebounded.

The science on the need for and benefit of breach is clear. According to NOAA, to reduce mortality from the hydro system, breach of the Snake River dams must be a "centerpiece action" for recovery.

Will breaching the dams solve the problem?

For some context, in the mid-1960s, before the last three Snake River dams were completed (Ice Harbor was in place as were the Columbia dams), SARs for Snake River spring/summer Chinook salmon ranged from 3.5–6.5 percent (average 4 percent from 1964–1968). And today downstream populations that pass fewer dams (3–4) are returning at sustainable rates.

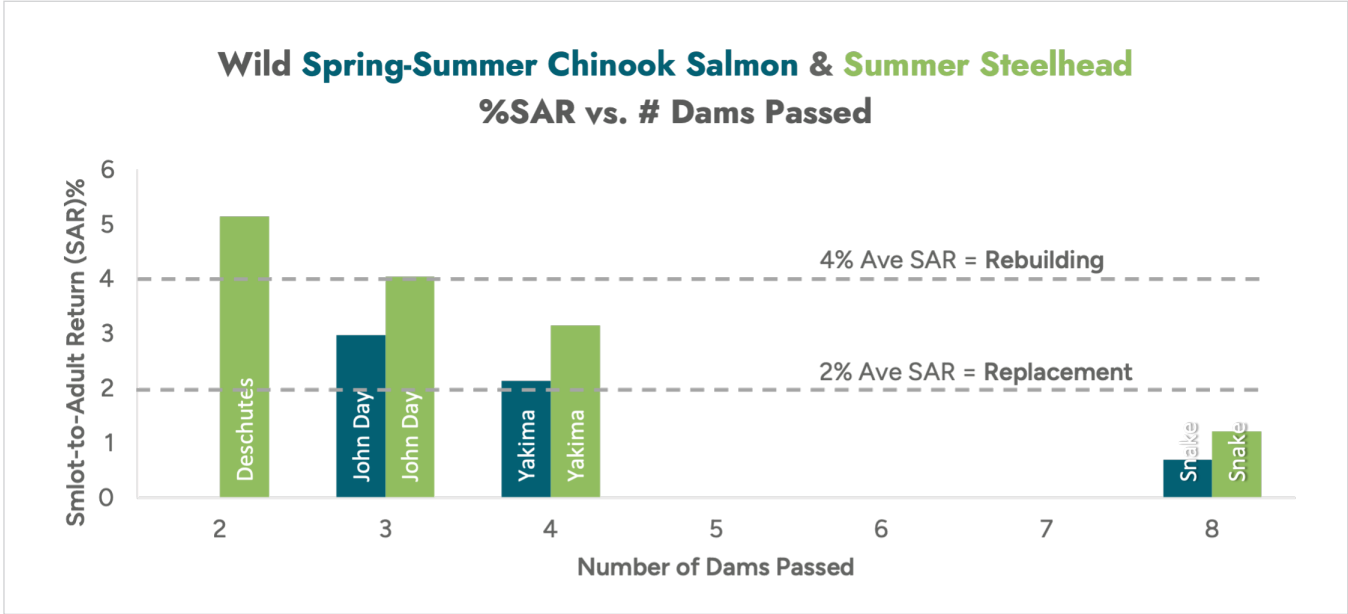
In contrast, the average SAR for wild Snake River sock-eye and fall Chinook salmon is currently 0.7 and they have exceeded 2 percent in only two of 26 years; Snake River sockeye and fall Chinook salmon are generally below 2 percent. Snake River steelhead have hit 2 percent in 4 of the last 22 years (years of data available varies by species), but their mean SAR is still well below 2 percent. This represents a trajectory toward extinction because not enough smolts are surviving to return and spawn as adults.

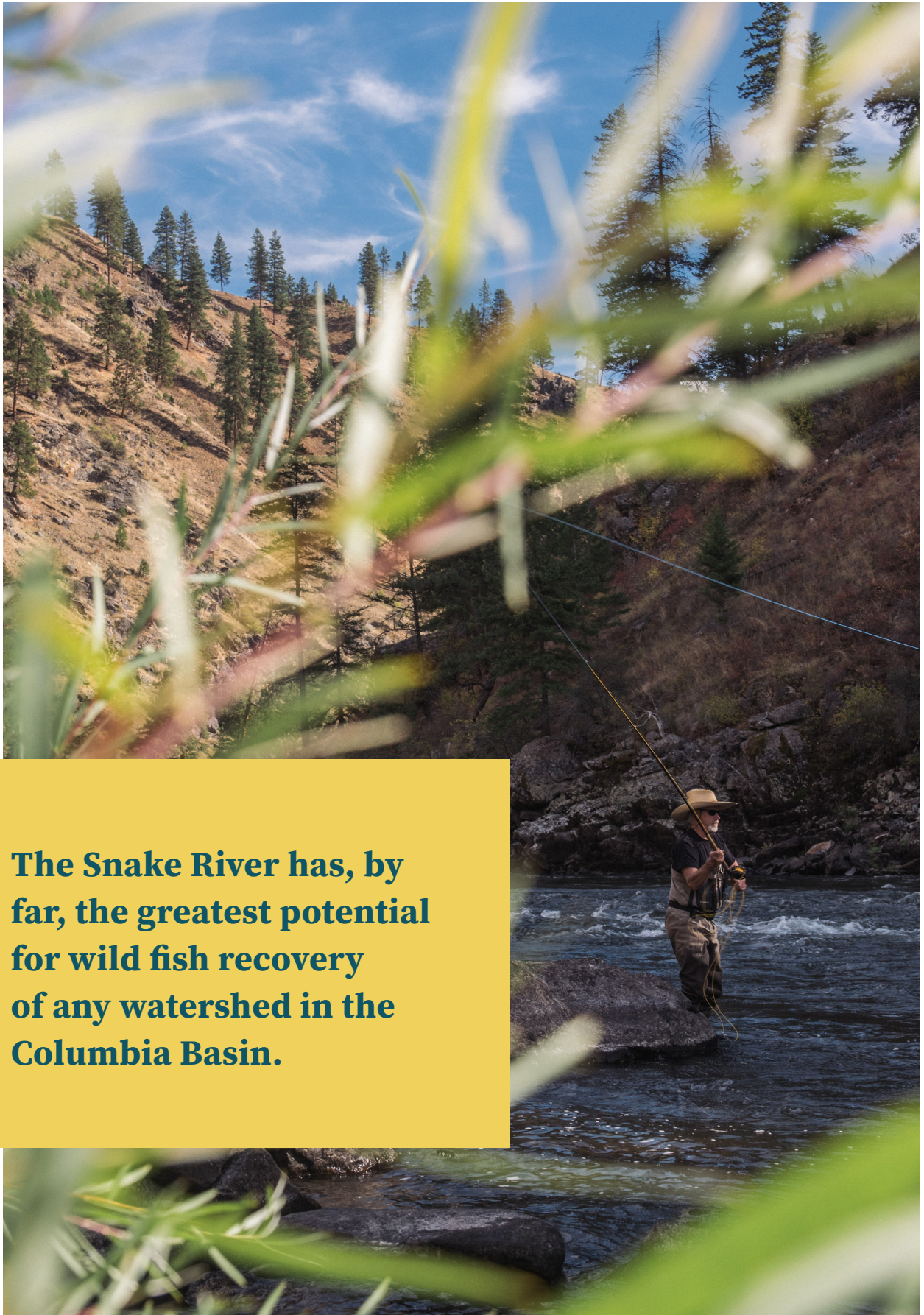
Restoring a free-flowing lower Snake River, when coupled with complementary actions such as predator control, habitat restoration and spill, is the only meaningful action left in our toolkit to avoid extinction and recover Snake River salmon and steelhead to healthy and harvestable levels.

An ongoing, long-term study called the **Comparative Survival Study**, conducted by biologists from OR, WA and ID, the U.S. Fish and Wildlife Service and Tribes estimates that Snake River dam breaching in concert with maximum flow at downstream dams could **increase SARs up to four times the Biological Opinion baseline**.

The graph below shows the average SAR in the context of how many dams the fish must pass. Populations with fewer dams to navigate, such as the Deschutes and the John Day, typically have much higher SARs.

John Day & Deschutes SARs are measured at Bonneville dam, Yakima at McNary dam, and Snake River at Lower Granite dam.





The Snake River has, by far, the greatest potential for wild fish recovery of any watershed in the Columbia Basin.

Why is the Snake River Basin the right place to make this kind of investment?

The Snake River has, by far, the greatest potential for wild fish recovery of any watershed in the Columbia Basin.

Historically it produced about 40 percent of the spring/summer Chinook salmon and 55 percent of the summer steelhead in the Columbia system. Annual run estimates prior to the 1850s exceed two-million fish for all Snake River stocks.

Even with significant areas of the Snake River blocked by impassable dams (Hells Canyon Complex and Dworshak) it still has tens of thousands of miles of high-quality salmon and steelhead habitat in the Clearwater, Salmon, Grand Ronde and Imnaha sub-basins.

About 46 percent of the Snake Basin's historic spawning and rearing habitat for spring and summer Chinook Salmon and summer steelhead remains accessible.

More broadly, within the current, native distribution of salmon and steelhead on the West Coast (CA, OR, WA, and ID), the 30,000 miles of stream habitat in the Snake River Basin represents:

20% of the total amount of accessible stream habitat

40% of the current coldwater habitat

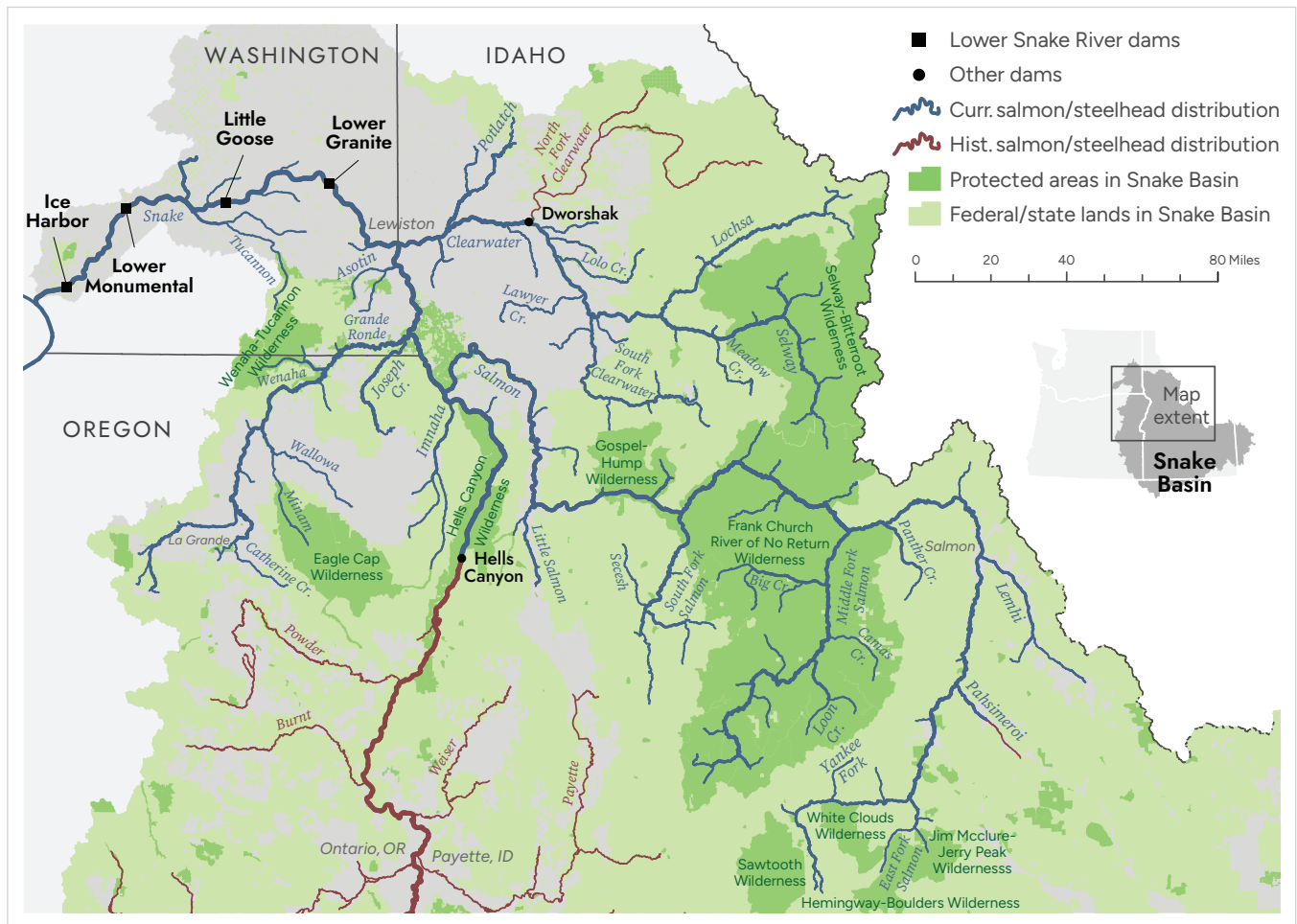
45% of the predicted coldwater habitat in 2080

40% of protected public lands with wilderness qualities

Mile-for-mile, the Snake River basin contains the coldest, most undisturbed stream habitats in the Lower 48.

The bottom line is that if we are going to make major investments in wild fish recovery in the Columbia Basin, the Snake is the place to put our money.

The Snake River Basin represents the coldest most undisturbed habitat in the Lower 48.



45%

of the predicted
coldwater habitat
in 2080



40%

of the current
coldwater
habitat

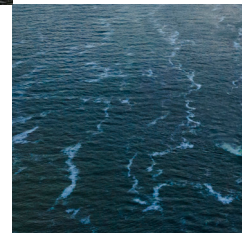


40%

of protected
public lands
with wilderness
qualities

20%

total amount of accessible
stream and habitat
in the current, native
distribution of West Coast
salmon and steelhead



Can we recover Snake River salmon and steelhead by improving habitat?

If habitat were the limiting factor for Snake River salmon, we would expect fish in Idaho wilderness to be relatively abundant.

Idaho has the largest, connected federally managed Wilderness in the lower 48, much of it protecting rivers in the Snake River Basin. If habitat were the limiting factor for Snake River salmon, we would expect fish in Idaho wilderness to be relatively abundant.

Instead, return patterns in the Middle Fork Salmon River, anchored in the Frank Church Wilderness of No Return, mirror those in the rest of the basin. Despite this basin having one of the highest estimates of productivity recorded for spring/summer Chinook salmon, these fish continue to straddle extinction and suffer a large recovery gap — in wilderness.

Since 1995, redd (salmon and steelhead nests) counts in the Middle Fork Salmon River have averaged just 3 percent of estimates from the 1950s and '60s, and the National Marine Fisheries Service explicitly recognizes that “natal habitat actions in the [Middle Fork Salmon River] basin will not produce the increases in survival needed ... to achieve viability.”

That is not to say that habitat restoration would not be helpful in the Snake River Basin. Watersheds like the Lemhi, Pahsimeroi, and Yankee Fork have been altered by mining and agriculture. Large partnerships are working to improve these habitats and much progress has already been made, but despite millions of dollars invested in habitat restoration adult fish are not increasing because of the toll the dams continue to take on survival.

It is also telling that 50 years ago when habitat in rivers including the Lemhi was more degraded than it is today, more adult salmon and steelhead were present.



For example, from 1960–62, when habitat was severely degraded, inaccessible or totally absent due to dewatering, redd counts in the Lemhi averaged 1,588 — in 2019 only 81 redds were observed.

The evidence is overwhelming that restoring habitat, while needed to improve the productive potential of parts of the Snake River basin, will not recover wild salmon and steelhead. The key to restoring healthy, harvestable/fishable salmon and steelhead is greatly increasing the number of adult fish that return to Snake River basin.



The key to restoring healthy, harvestable/fishable salmon and steelhead is greatly increasing the number of adult fish that return to Snake River basin.

What role does climate change play in the debate over removing the four Lower Snake dams?

The data show conclusively that the Pacific Northwest's climate is warming. The Snake River basin will experience hotter temperatures in the summer, which will make water conditions in the lower Snake River more problematic than they are at present.

High water temperatures under current conditions can already take a devastating toll. In 2015, 96 percent of Snake River sockeye returning to spawn succumbed to high water temperatures in the Columbia and Snake.

Dams increase water temperature in the Snake to lethally high levels.

The reservoirs warm during the summer months and create a block of slow-moving hot water that does not cool until fall air temperatures drop. In contrast, though a free-flowing river will also occasionally warm to unhealthy levels, it will cool again at night when air temperature drops. This does not happen with the reservoirs because they retain their heat through the night.

Another key thermal difference between reservoirs and rivers is that in unstratified reservoirs like those in the lower Snake, water temperature

is uniform so there are no cold-water refuges for fish to use. In contrast, dynamic rivers have different water temperatures in different locations, which provide refuges for migrating salmon and steelhead to use as "stepping stones" on their migratory journey.

In October 2019, scientists sent a letter to Pacific Northwest elected leaders informing them that restoring a free-flowing lower Snake River is the only known option for substantially cooling the lower Snake and enabling salmon and steelhead to migrate through it safely. They cited modeling by the Environmental Protection Agency that shows that removing the four lower Snake River dams would reduce Snake River water temperatures by 6.3 degrees F, on average, during the summer and early fall.

As discussed in the scientists' letter, cold-water releases from Dworshak dam on the North Fork Clearwater are currently used to cool water temperatures in the lower Snake. The beneficial impact of those cold-water releases is limited to the area around the upper-most dam, Lower Granite.

CLIMATE CHANGE *at a* GLANCE



HABITAT CHANGES

The Snake Basin
currently contains

20%

of the stream habitat
accessible to salmon and
steelhead on the West Coast



But by 2080, the Snake River
Basin is forecast to contain

45%

of the coldest, most
climate-resilient stream
habitats on the West Coast

WATER CONDITIONS

96%

of Snake River sockeye returning
to spawn succumbed to high water
temperatures in the Snake and
Columbia in 2015

Aren't ocean conditions the primary cause of the decline?



Ocean conditions are certainly a major driver of salmon and steelhead abundance, and always have been.

Conditions that salmon and steelhead experience in the Pacific can change dramatically, based on natural global ocean-atmospheric interactions (like the Pacific Decadal Oscillation or El Niño Southern Oscillation) that create blocks of years (multiple years to decades) that are alternately warmer or colder.

Ocean temperatures are also warming due to climate change. Conditions become particularly

difficult for salmon when general ocean warming coincides with warm-water phases of the oscillations mentioned earlier. As one example, in 2014 an extreme (high) anomaly in surface temperatures, colloquially referred to as “the Blob,” set up and spanned from California to southern Alaska for several years.

Yet, even with a greater frequency of adverse ocean conditions, there will continue to be years when ocean conditions are favorable to salmon and steelhead. When positive conditions exist, we need to enable salmon and steelhead to take advantage of them.

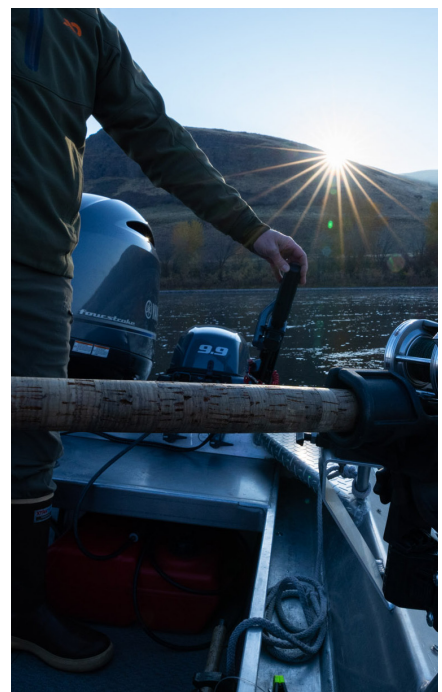
How do we do that? By increasing their abundance, productivity and diversity. It is these attributes that have allowed salmon and steelhead to withstand extreme environmental conditions throughout their evolutionary history. This history included four glacial cycles during which ocean conditions vacillated dramatically, and a period when the ocean was 115 meters below our current sea level.

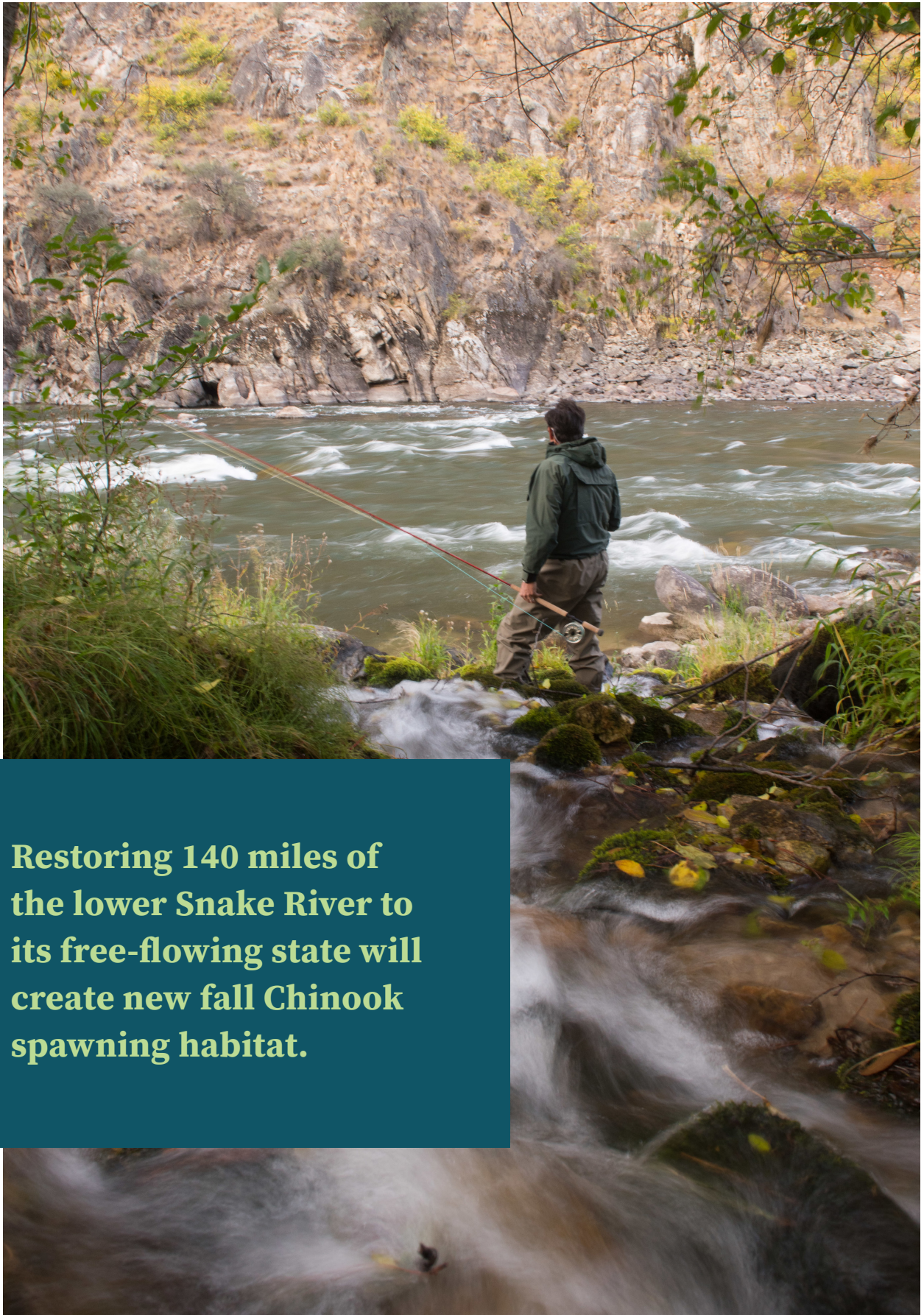
Not only did salmon and steelhead endure these extreme conditions, but it is this dynamic landscape that has sculpted their main means of persistence: diverse life histories. Just as a financial portfolio spreads risk for us, their different migratory and reproductive life history strategies spread risk for them. The different strategies mean that not all of a given population or stock is in one place at one time — some are in the ocean, some are in freshwater, all at different ages.

For example, Chinook salmon are known to have 18 distinct life histories and steelhead an incredible 38. This portfolio of life histories buffers the population as a whole from environmental impacts that may be particularly bad in any single year, season, river, or creek. It is what allows them to persist through modern floods, fires, landslides, volcanic eruptions and changing ocean conditions.

No doubt they will respond to take advantage of a free-flowing Snake River as ocean conditions cycle through to more productive conditions.

Not only did salmon and steelhead endure these extreme conditions, but it is this dynamic landscape that has sculpted their main means of persistence: diverse life histories.





Restoring 140 miles of the lower Snake River to its free-flowing state will create new fall Chinook spawning habitat.

Are there other benefits to restoring a free-flowing river?

Restoring spawning habitat would be a major benefit to breaching the four lower Snake River dams, primarily for fall Chinook salmon.

Historically, fall Chinook spawned extensively in the mainstem Snake River above Hells Canyon. That spawning habitat was lost when the three-dam Hells Canyon Complex was built by Idaho Power in the 1960s, creating an impassable fish barrier.

Consequently, the spawning habitat currently available to fall Chinook salmon is quite limited.

Restoring 140 miles of the lower Snake River to its free-flowing state will create new fall Chinook salmon spawning habitat, increasing the potential for wild fall Chinook production.

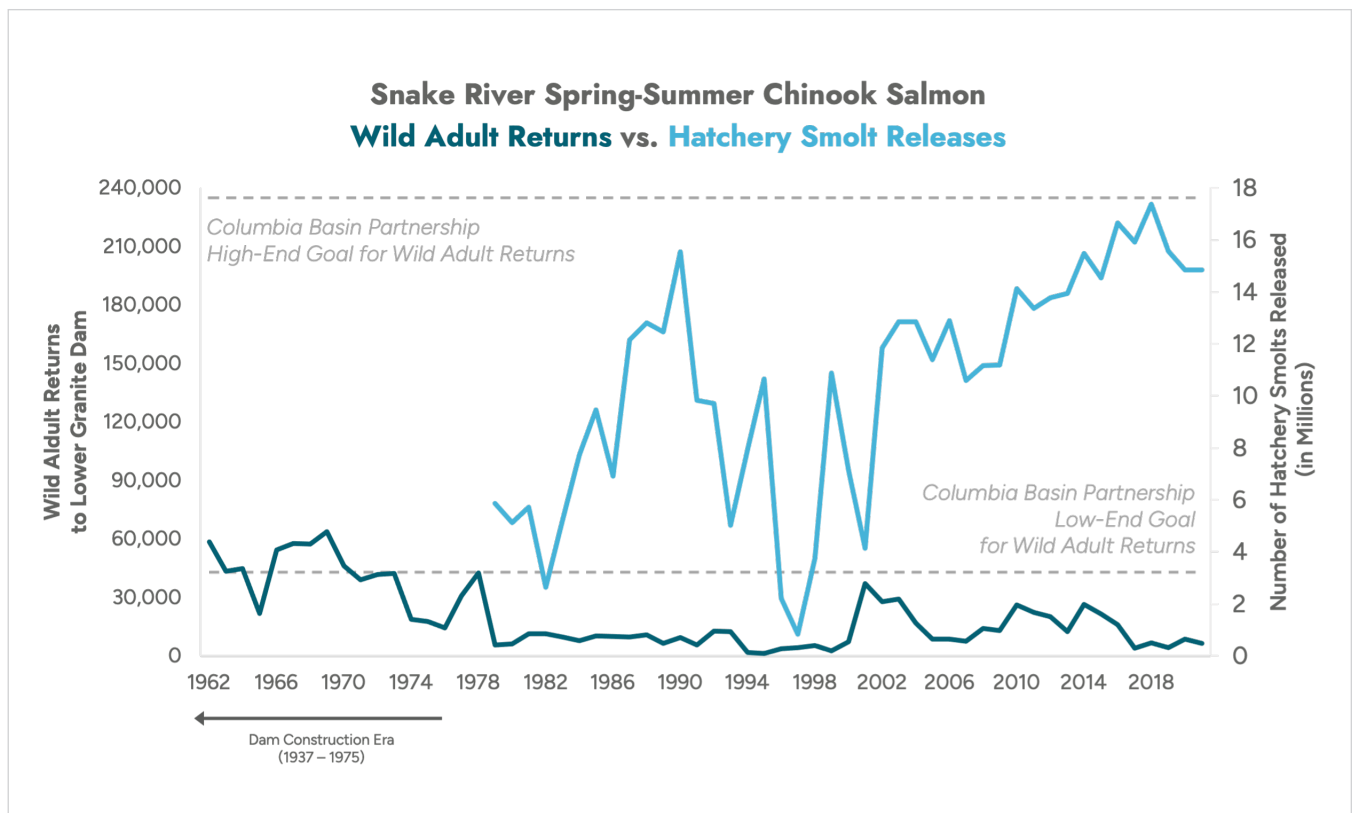
In particular, the habitat currently inundated by Lower Granite and Little Goose dams, the two dams furthest upriver, likely fostered important diversity in spawn timing.

Restored spawning habitat is a major additional benefit of dam breaching beyond improvement in migration survival.

Why can't we just release more hatchery fish to solve the problem?

The widespread use of traditional hatchery programs has actually contributed to the overall decline of wild populations.

When the dams were built it was thought that hatcheries would "mitigate" for lost natural production of wild salmon and steelhead caused by the hydro-system. Since then, our scientific understanding of what hatcheries can and can't do has grown by leaps and bounds. Today, we now know definitively that hatcheries can't substitute for wild salmon and steelhead.



The figure shows that, despite dumping over 16 million smolts into the Snake (light blue line), wild returns of Spring/Summer Chinook have continued to decline precipitously (dark blue line).

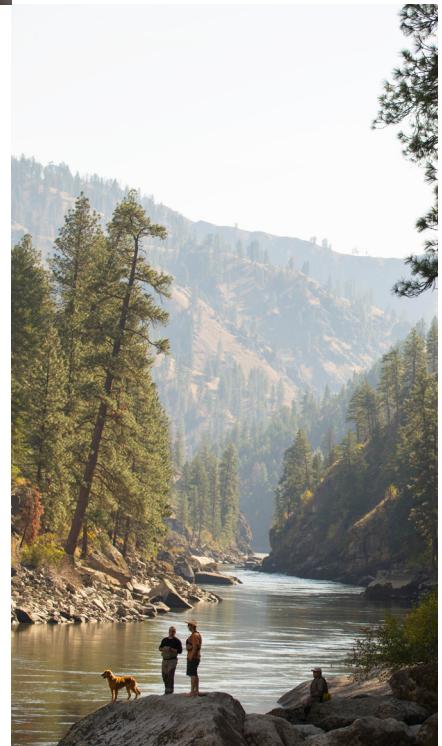


The Congressionally-established Hatchery Scientific Review Group stated this reality in no uncertain terms in 2015 in a report to Congress:

“...the traditional mitigation policy of replacing wild populations with hatchery fish is not consistent with today’s conservation goals, environmental values, and prevailing science. Hatcheries cannot replace lost habitat and the natural populations that rely on it. It is now clear that the widespread use of traditional hatchery programs has actually contributed to the overall decline of wild populations.”

If hatchery fish were the answer to the loss of wild salmon and steelhead in the Snake River basin, we would not have a problem today.

Though hatcheries have been essential in preventing Snake River sockeye from going extinct and have provided harvest and fishing opportunity that could not have been sustained on depressed wild salmon and steelhead populations, wild salmon and steelhead continue to decline despite massive releases of hatchery fish.



Hatcheries cannot replace lost habitat and the natural populations that rely on it.



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