READY FOR CHANGE

A framework to promote climate resilience in salmon strongholds

Introduction

The scope and scale of **global climate change** may be overwhelming to salmon advocates and managers. The variety and degree of potential stressors on salmon populations and habitats is daunting.

Summer stream temperatures are already rising across the range of salmon. Warm ocean events are increasing with frequency, affecting aquatic ecosystems worldwide. Scientists predict increased peak flows in winter, changes in the timing of spring snow melt, alterations to tidal wetlands and other riparian ecosystems, proliferation of invasive species, furthering disruptions to aquatic habitats and food webs.

While these threats are real and driven by changes to the global climate system, we can and must make an impact through local and regional action.

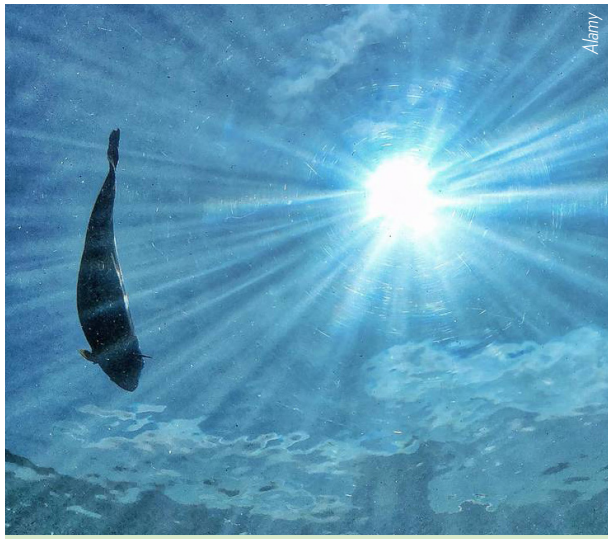
We must focus on high-leverage, immediate actions at a local and regional level to increase the resilience of wild salmon populations and the watersheds on which they rely. To meet this challenge, we must draw together across science/advocacy groups, land managers, fish/wildlife agencies, policy makers, and local restoration partners. The strategies presented here will have a concrete impact and give wild salmon the time they need to adapt to changing conditions.

Resilience-focused habitat and fisheries actions also fit into larger national and international strategies to deal with excess atmospheric carbon and worsening ocean conditions. Improved land management contributes meaningfully to carbon sequestration and the drawdown of global greenhouse gases. Better habitat and fisheries management gives salmon populations the ability to withstand poor ocean survival years – one of the leading climate-related threats to salmon.

Building climate resilience also provides a range of other benefits: creating jobs and strengthening local economies, improving drinking water, and expanding social, cultural, and recreational opportunities.

To ensure that watersheds and fish can keep pace with climate change, WSC is using the resilience framework described below. We offer it as a tool to help formulate an effective regional response to this global challenge and to help communities feeling the worst effects of climate change. Indigenous communities face the loss of key food sources and cultural traditions. Fishing, hunting, and recreation-based communities face job losses, and a strained social fabric.

While each of us must do our part to slow global climate change, we cannot take our focus from what is needed – right now at the local watershed and regional policy levels – to make the greatest difference for wild salmon and those communities who depend on them.



We need focused decision making and work at a regional level to ensure that watersheds and wild salmon can keep pace with climate change.

Our Approach

Resilient Strongholds Anchor Conservation

The heart of WSC's mission is the stronghold approach, a conservation strategy designed to protect the still-thriving cores of wild salmon abundance and diversity around the Pacific Rim. It is critical that we now look at strongholds through the lens of climate resilience.

How will existing salmon strongholds hold up under escalating climate pressure? What characteristics of the watersheds and fish populations must be protected, restored, and reinforced? How do we make sure strong wild populations don't just persist, but thrive?

Maintaining watershed function and healthy wild salmon runs in strongholds is essential in the face of climate change.

Wild Salmon Center's work in strongholds is built on three strategies:

1. Protect and restore salmon watersheds and the processes that create salmon habitat over time;
2. Protect and restore the genetic and life history diversity and abundance of wild salmon;
3. Create and support local conservation organizations that can secure the ecological health of salmon watersheds and their wild salmon.

We have begun to consider each of these strategies within a 'resilience framework' that can help us determine priorities and actions in specific strongholds through the lens of a changing climate.

This framework also defines a set of terms to ensure consistency in local and regional resilience planning and policy.

Resilient strongholds anchor our fight to conserve wild Pacific salmon across their range.

A Framework for Resilience

Understanding Local Risks and Opportunities

Climate change planning in salmon conservation often starts and ends with a discussion of the anticipated **exposure** of watersheds and fish populations to changing climatic conditions.

To ensure policymaking is strategic and on-the-ground actions are effective, WSC considers two additional criteria when evaluating the resilience of species and watersheds: first, **sensitivity** to anticipated changes, and, second, **adaptability** of resident and anadromous fish populations. We define these three criteria as exposure, sensitivity and adaptability.

If we are to maintain healthy salmon populations and watersheds into the next century, every management and policy discussion must apply these filters to understand and effectively respond to climate change. By understanding exposure, sensitivity, and adaptability, we can ask, "What characteristics of a watershed and fish populations can best ensure resilience in the face of ongoing climate change?" By answering that question, we can foster the long-term resilience of wild salmonid populations.

What characteristics of watersheds and fish populations can best ensure resilience in the face of ongoing climate change?

EXPOSURE The physical, chemical, biological, and other changes occurring in a selected geography due to broader shifts in climate.*

This is the lens through which we typically consider climate change – the regional maps with the red and yellow lines that project how the local environment will change over time. These exposure maps often use "downscaled" models that apply broad climate projections to make local predictions for individual regions or watersheds. These models can project future changes in temperature, precipitation, snowpack and other variables, at the watershed scale.

* We use the above definition in the context of wild salmon. The U.S Climate Resilience Toolkit defines exposure as "the presence of people, assets, and ecosystems in places where they could be adversely affected by hazards."

SENSITIVITY The unique characteristics of watersheds and species that determine the impacts of exposure to climate changes.

Local watershed conditions will respond to climate change differently. Land use and development in salmon ecosystems greatly affects their sensitivity to change. For example, water temperatures in streams with well-shaded, **forested buffers** will likely rise less than in those with denuded streamsides. Similarly, peak flows in winter are better absorbed and minimized in watersheds with **connected floodplains**, and **healthy riparian forests.** Likewise, the impacts of climate change will differ across species and locally adapted populations depending on their life histories, habitats, and the climate conditions they have experienced during their **evolutionary history**.

ADAPTABILITY The capacity of wild populations to change in ways that allow them to survive – and even thrive – in changing conditions.

Salmon have proved to be remarkably adaptable animals over the last 18 million years, surviving global warming periods and ice ages. This adaptability is driven by both genetic diversity across populations, and the diversity of survival strategies – also known as life histories – found within a salmon population. **Restoring life history and population diversity** increases the likelihood that populations can adapt to changes in their watersheds, limiting the severity of climate impacts and reducing extinction risk.

Turning to Action: Watershed Action Priorities

Reducing Climate Sensitivity

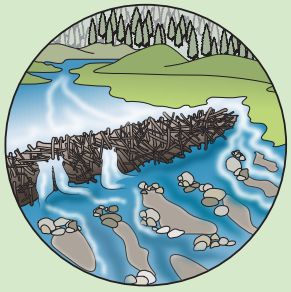
Using our climate resilience framework, we are evaluating our programs and clarifying the issues we take on, so we can be confident that our work is bolstering the resilience of strongholds to climate change and increasing the adaptability of healthy populations. We are working with local partners to focus on short- and long-term local and regional actions that can be initiated now to ensure our watersheds and our fish are ready for change. Waples et al. explain that "the conservation of natural processes is crucial to the resilience of both habitats and species."[1]

Proactive conservation is the best way to protect intact natural processes in relatively unaltered places such as Bristol Bay, Alaska, and Kamchatka in the Russian Far East. Here, long term protection of ecosystem function is essential to limit **watershed sensitivity** over time. Where formal protection (e.g designation of a protected area) is not possible, forward-looking and precautionary watershed management must be applied. Land managers need to understand and protect interconnected processes that support healthy rivers, moving beyond the view that a watershed is simply a sum of its component habitats.

In disturbed watersheds, restoration will be undertaken, but it should be underscored that not all restoration promotes resilience. A survey of scientific literature in 2012 found that reconnecting floodplains to their river, restoring natural stream flow regimes, and restoring incised (deeply cut) channels are the actions most likely to buffer against stream flow and temperature changes while increasing habitat diversity and population resilience.[2]


Ryan Peterson

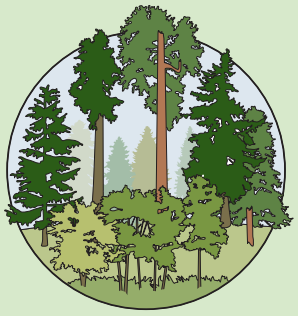
Land-use decision makers need to prioritize the following strategies for reducing watershed sensitivity:

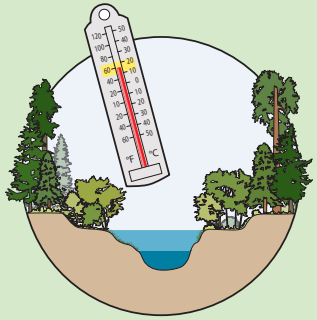

Protect cold water flows and cold-water refuge areas


Restore and increase flows in tributaries


Protect off-channel, wetland, and estuary habitats


Restore incised channels, and reconnect rivers and streams with their floodplains


Protect healthy vegetated stream corridors and upland forests


Restore stream corridors that have the greatest potential to lower water temperatures

Illustrations by Elizabeth Morales

Turning to Action: Fisheries Action Priorities

Managing Fisheries to Protect Adaptability

Ensuring salmon and steelhead populations can adapt is best accomplished by maintaining healthy, abundant populations, and by protecting and restoring their genetic and life history diversity.

With a changing climate, salmon returns have become increasingly variable, with strong returns in some years and unexpected run failures in others. Tracking and quickly responding to this interannual variability is essential if fishery management aims to protect the abundance and diversity that allow the species to adapt to changing watershed conditions, as they have for eons.


Scott Carlson


B. Deral


Ben Knight

These actions need to be implemented now, to promote diversity:

- **Establish escapement targets** that conserve genetic and life history diversity to sustain and rebuild wild salmon abundance.
- **Transition to terminal and selective fisheries** from high-risk mixed-stock fisheries to avoid overharvest of small populations and endangered stocks.
- **Manage fisheries with in-season data** to reduce harvest impacts during years of low returns and to allow fisheries when they are warranted.
- **Manage fisheries to protect genetic diversity**.
- **Implement precautionary harvest management** backed by rigorous monitoring of adult escapement and juvenile production to adaptively manage wild salmon populations.
- **Stop the expansion and negative impacts of fish hatcheries.** Where they exist, manage hatchery programs to minimize the impacts of domestication and artificial selection on locally adapted wild salmon stocks, and to also minimize bycatch of wild stocks in pursuit of returning hatchery fish.

Policy and management decisions that do not meet these standards need to be reevaluated to ensure they are not undermining adaptation and resilience in wild salmon populations. With rapid changes to watersheds already underway, we must not make it harder for wild salmon to adapt in the future.


Alamy

Healthy Salmon Ecosystems Sequester Carbon

Protecting and restoring critical salmon ecosystem functions also mitigates climate change by sequestering carbon.

Land management is a key strategy in mitigating climate change. A 2018 study led by the Nature Conservancy estimated that improvements in land management could absorb up to a fifth of the United States' annual emissions – the equivalent to taking all cars and trucks off the road. [3]

Building salmon resilience at the local and regional level has significant climate benefits for the world.

In salmon country, **freshwater wetlands** and coastal estuaries sequester carbon and other greenhouse gases. When these areas are drained and degraded, they not only wipe out important juvenile salmon habitat but also release significant amounts of carbon dioxide and methane into the atmosphere and reduce the ability of wetlands to sequester additional carbon.

Similarly, protecting and **restoring healthy forests** is central to the task of protecting salmon populations in a changing climate. Research has shown that keeping forests intact provides major benefits in carbon sequestration,[4] while conversion of forest lands for agriculture, and development is the largest source of emissions around the globe.

A 2019 Oregon State University study identified coastal forests in Oregon and Washington as some of the most important in the Lower 48 for mitigating climate change.[5] These forests, including the Tillamook Rainforest and the rainforests on Olympic Peninsula are also home to some of the last, best salmon and steelhead runs south of Canada.

Although they cover just three percent of the world's land surface, **peatlands** are the most effective land type for storing carbon. They harbor more carbon than all other land types combined. [6]

In the Russian Far East province of **Khabarovsk**, Wild Salmon Center and Russian partners are working to protect several hundred thousand acres of boreal peatlands – home to salmon and the endangered mega-trout, Siberian taimen.

Alaska's **Bristol Bay** region, home to world's largest run of sockeye salmon, is also a massive tract of largely undeveloped wetlands and peatlands the size of Wisconsin. As a coalition of Alaska Native communities, tourism and fishing businesses defend the region from hard rock mining proposals, they are also keeping intact a massive carbon sink.

Building salmon resilience at the local and regional level has significant climate change benefits for the world. And it will be a an essential part of the American drive for net-zero emissions.

Land management is a key strategy for mitigating climate change.

Freshwater wetlands, coastal estuaries, and boreal peatlands all sequester carbon and other greenhouse gases.

The Way Forward

With the climate already changing rapidly, there is an urgent need to develop tools and approaches to watershed conservation and recovery that can promote resilience in the face of these ongoing changes.

Taking a stronghold approach to conservation protects intact systems and populations. Applying a climate resilience framework to management ensures that decisions protect and rebuild resilience, instead of continuing to erode it. The goal is to protect key processes and characteristics of watersheds and fish populations to ensure long-term resilience.

Climate adaptation planning described in the framework above should not be viewed as just a stand-alone planning process. Rather, it should be viewed as an exercise that can – and should – be integrated into all species management and land use decision-making.

We believe that greater watershed and species resilience can be accomplished. But this requires a shared understanding and commitment across the salmon conservation and management spectrum, from those in the field to those in state capitols.

The faster that decision-makers and conservation practitioners adopt forward-looking approaches that build and support climate resilience, the sooner we will begin to see the benefits, in both communities and ecosystems.

Going forward, we must integrate an adaptive framework in all regional species and watershed planning as well as in our local watershed-based planning.

Endnotes

1 Waples, R. S., T. Beechie, and G. R. Pess 2009. Evolutionary history, habitat disturbance regimes, and anthropogenic changes: What do these mean for resilience of Pacific salmon populations? Ecology and Society 14(1): 3. [online] URL: http://www.ecologyandsociety.org/vol14/iss1/art3/

2 Beechie, T.J., Imaki, H., Greene, J., Wade, A., Wu, H., Press, G., Roni, P., Kimball, J., Stanford, J., Kiffney, P., Mantua, N.J. 2013. Restoring salmon habitat for a changing climate. River Research and Applications, 29: 939-960. doi: 10.1002/rra.2590

3 Fargione, Joseph et. al SCIENCE ADVANCES14 NOV 2018 :EAAT1869 Natural climate solutions for the United States https://advances.sciencemag.org/content/4/11/eaat1869

4 Domke, Grant M.; Walters, Brian F.; Nowak, David J.; Smith, James, E.; Ogle, Stephen M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/FS-RU-227.

5 Polly C. Buotte, Beverly E. Law, William J. Ripple, Logan T. Berner. Carbon sequestration and biodiversity co-benefits of preserving forests in the western USA. Ecological Applications, 2019; DOI: 10.1002/ea

6 Project Drawdown: https://drawdown.org/solutions/peatland-protection-and-rewetting

Erin McKittrick

This report produced by:

Wild Salmon Center
721 NW 9th Ave, Suite 300
Portland, OR 97209
503.222.1804

wildsalmoncenter.org

The Mission of the Wild Salmon Center is to promote the conservation and sustainable use of wild salmon ecosystems across the Pacific Rim.