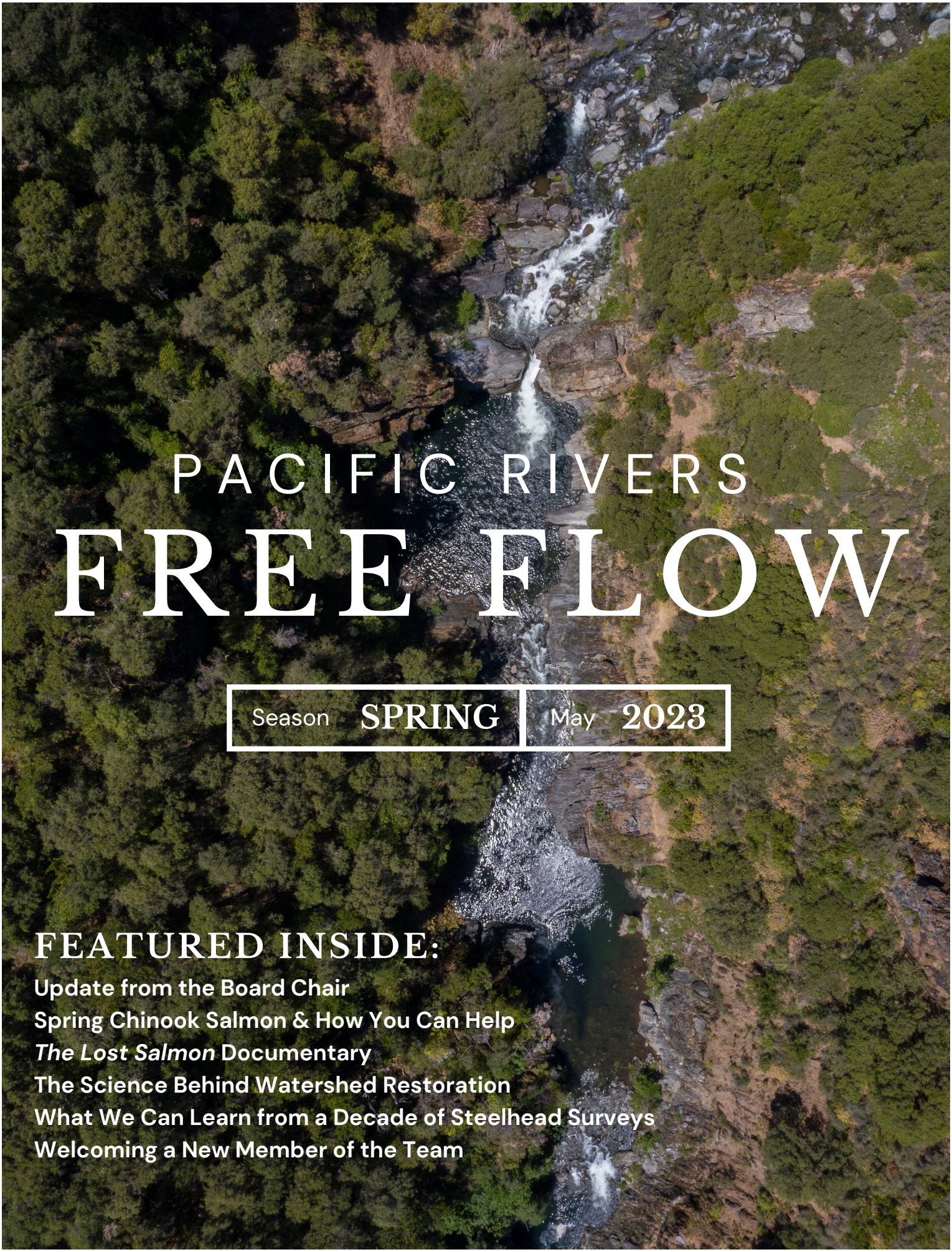


PACIFIC RIVERS

FREE FLOW

Season SPRING | May 2023

FEATURED INSIDE:

BOARD CHAIR UPDATE

Mike Morrison - Board Chair

It gives me great pleasure to have this opportunity to update you on the status of Pacific Rivers' rebuilding and on some of the various projects and initiatives that you are supporting. But first, please accept our heartfelt gratitude for the generous support we received in 2022. The Board and staff are humbled and inspired. The work we do — together — is important and will continue.

Pacific Rivers has always been and remains today a science-driven organization. We strive to ensure that the actions we take, the policies we advocate, and the work we do are solidly based on the best available science. We use science, policy and law to advance river and watershed protection, restoration and stewardship.

And so it is with our decision to submit — with the help of our partners at the Center for Biological Diversity — a Petition pursuant to the Endangered Species Act (ESA) to protect the spring Chinook salmon of the Washington State Coast. We have notified Tribal and Washington State authorities of our intent to file; if it has not been by the time this newsletter is published, the petition will be filed very soon.

Pacific salmon appear to be in danger throughout most of their range, but few if any are more at risk than spring Chinook. Recent genetic research has concluded that spring and later-season run Chinook salmon are genetically distinct from one another and face different challenges to successful spawning. Climate change and human-caused modifications to the environment have presented particular difficulties to spring-run Chinook. Petitions by others for ESA listing of spring Chinook salmon are currently pending for the Northern California and south coast Oregon regions.

Our decision to petition for ESA listing of the spring Chinook of Washington's coastal rivers was carefully considered. We believe firmly that it is the right and necessary course of action to do what we can to save these majestic fish, which are so important to their home watersheds.

You will find a very good discussion of the status and importance of spring Chinook salmon in this issue of Free Flow, authored by Megan Ponder, Vice President of the Pacific Rivers Board, and Don Elder, our strategic advisor.

In this issue we also present the results of the latest in our series of snorkel surveys of juvenile salmonids in the Canton and Steamboat Creek watersheds of the North Umpqua Basin. Fisheries biologist Charley Dewberry, PhD, has been leading a Pacific Rivers effort to assess the health of these populations for several years, with the help of a professional dive crew and students from the Phoenix School in Roseburg, Oregon. This work informs agency management decisions, including in the Frank and Jeanne Moore Wild Steelhead Sanctuary. We are currently exploring ways to develop, in cooperation with partner organizations and agency scientists, a set of management guidelines for the Moore Sanctuary.

Board Treasurer Liz Gilliam also is a contributing author in this issue. Her article on the importance, potential, science and art of stream restoration work is informative and inspiring. It is the first in a series that will highlight outstanding restoration projects around our region that are dramatically improving habitat by returning more natural form and flows to our rivers and streams.

On the nuts and bolts of building a successful organization, we have just taken a big step forward with the hiring of Lindsay Schuelke as Operations Manager. An experienced program manager, event organizer, communicator and fundraiser, Lindsay will accelerate our work on all fronts by coordinating our talented and highly engaged team of Board members, advisors, contractors and partners. She is already spearheading, along with Board member Kate Crump, a series of showings of *The Lost Salmon* at Patagonia stores in Portland, Bend, Seattle and San Francisco. Make sure to check out her scheduling update in this issue. Welcome, Lindsay!

I also want to take this opportunity to thank Shaunna Oteka McCovey (Yurok/Karuk) for her years of service on our Board. A highly respected conservationist, poet and writer, Shaunna is – among many other things – the author of "The Smokehouse Boys", a collection of poems about growing up in river communities near her beloved Klamath, Salmon and Trinity Rivers in Northern California. In addition to her work with Pacific Rivers, Shaunna has worked with numerous tribes, agencies and nonprofit organizations to help protect and restore the rivers of her region. Fortunately for all of us, Shauna has agreed to remain available to share with the Board her wisdom, insights and advice. Thanks, Shaunna!

We hope you enjoy this issue of Free Flow, and that you learn something useful from its pages. We are looking forward to a busy year of a team effort pursuing projects and initiatives that further our mission of protecting and restoring watershed ecosystems of the West. Please feel free to contact us with ideas, comments, and questions at info@pacificrivers.org.

Thank you,

Mike Morrison

SPRING CHINOOK SALMON: THEIR WATERSHEDS, RIVERS, PEOPLE AND FUTURE

Megan Ponder - Board Vice Chair

Don Elder - Organizational Development Consultant

Pacific salmon are wonders of nature. Chinook salmon are their kings. *Spring* Chinook salmon are wonders of wonders.

"Springers" (as they are commonly called) re-enter freshwater months before other Chinook salmon. They do so exceptionally well prepared for their upstream migrations. With much greater reserves of nutrients in their fatty tissues than fall-run Chinook, they can take advantage of the higher river flows of spring and early summer to reach spawning habitats far upstream. In fact, they reach as far inland as the heart of Idaho's "River of No Return" wilderness, over 800 river miles upstream from the mouth of the Columbia River and over 6,000 feet above sea level. Throughout their range they reach and utilize spawning habitats that are unavailable to fall-run fish. For these feats they have been called "mariners and mountaineers."

Northwest landscapes, rivers, salmon and people

Salmon evolved over eons in the watersheds of the Northwest's dynamic landscapes. Over the last 25 million years their watersheds changed dramatically as the Olympic and Cascade Mountain ranges grew, basalt flows engulfed vast regions of present-day Washington and Oregon, and the northern California Coast Range was uplifted. The watersheds and rivers we know today were created by these and myriad other changes over time.

So too were Pacific salmon, which evolved into today's species of sockeye, pink, coho, chum and Chinook salmon. As they evolved, they also diversified significantly *within* species by adapting to the unique chemical, physical and biological characteristics of each of their home rivers, including their seasonal flows and temperatures. Springers were some of the most magnificent and varied results.

Salmon attracted and sustained some of the first humans in North America. Many early groups thrived along the coast, particularly at the mouths of the Columbia and other great rivers of the Northwest. Some used sites far inland, at least seasonally, at locations springers would regularly reach but few if any other salmon could.

Oregon State archaeologists have recently uncovered projectile points that have been carbon-dated to nearly 16,000 years ago – about 3,000 years earlier than the oldest Clovis points ever yet found in North America. They were found along Idaho's Salmon River, hundreds of miles upstream of the mouth of the Columbia on a prime migration route for springers.[1]

1. Archaeologists Uncover Oldest Known Projectile Points in the Americas: https://phys.org/news/2022-12-archaeologists-uncover-oldest-projectile-americas.html

10,000 years before the first pyramids were built in Egypt, the first people of the Northwest were already salmon people. Over the millennia to come, salmon drove the development of their diets, tribes, cultures, art, traditions, trading and more.

Then, within just the last 250 years, waves of new settlers from Europe and around the world arrived. Salmon drove the rapid development of new communities and economies. The settlers drove most Native peoples from their lands, waters and salmon across the Northwest. With the tools of the new Industrial Age, the settlers also quickly drove massive changes to the region's watersheds, forests and rivers. Salmon, considered an inexhaustible resource, quickly became anything but.

Try to picture the span of time in question as a football field. Imagine the left-hand goal line as 25 million years ago, when the watersheds of rivers of the Pacific Northwest were changing rapidly and salmon were evolving with them. On our imaginary field, the first humans arrive more than 99.9 yards away, on the opposite *two-inch* line. The first Europeans and the Industrial Revolution arrive just *three one-hundredths of one inch* from the goal line.

In other words, in *one-thousandth of one percent* of the time it took today's salmon to evolve in our region, we have brought them from species of prodigious abundance to ones of great concern.

Springers' status today

Today, wild spring Chinook salmon are in particular danger. Their numbers have declined precipitously in recent decades. They are in more trouble than other Chinook runs because the cumulative effects of more than two centuries of habitat degradation and barriers to their migration across their much larger range have taken an even greater toll on them than on fall-run fish.

Some genetically unique populations of spring Chinook salmon have already been lost. In many river basins, remaining runs are now on the brink and could soon also be lost – some perhaps within this decade.

The cultural, dietary, ecological, scientific, educational, and economic value of springers to the Northwest is incalculable. The impact of their possible loss is inconceivable. As Sara Thompson of the Confederated Tribes of Grand Ronde has said, "The loss of spring Chinook would be a tragedy like none other."

Recent genetic research: Findings and implications

For decades, fisheries managers and others have generally assumed that if spring Chinook disappeared, fall Chinook would simply replace them, because they were essentially the same fish. Recent genetic evidence has shown otherwise.

Over the last decade, Dr. Michael Miller and his research team at UC Davis have confirmed that spring Chinook salmon are genetically distinct from fall Chinook salmon. Today we know which unique genetic

attributes created their ability to enter freshwater early and migrate far upstream.

We also know that springers' unique characteristics did not arise independently in each watershed. They are the result of a single genetic mutation millions of years ago that was followed by unique adaptations over immense spans of time to the watersheds they inhabit today.

There is no longer any reasonable basis for an assumption that spring Chinook salmon will magically "re-evolve" in any time frame meaningful to us if we lose them. What took nature eons to create cannot be replaced quickly. We can't be sure it is possible at all.

But some things *are* certain. It is possible to lose springers. We can lose them in specific basins. (We already have.) We can lose them entirely. If we lose them, we will have lost them not just for people living today, but for untold generations to come. *The good news is that we now have a much better understanding of springers, an even stronger case for immediate action to save them, and a very good idea of what those actions must be.*

Urgently needed: ESA protection for spring Chinook salmon

The Endangered Species Act (ESA) can provide protection for a population of a species that constitutes a Distinct Population Segment (DPS) – one that is discrete from other populations of a species and that is significant in relation to the entire species. Springers are a genetically distinct subset of Chinook salmon whose populations are uniquely adapted to specific watersheds. They richly deserve and urgently need protection under the ESA.

Several springer runs have already been listed under the ESA. Petitions for the protection of several more have been submitted in recent years. Recent genetic findings have bolstered scientific support for those petitions.

Pacific Rivers and the Center for Biological Diversity will soon file a new petition for ESA listing of the springers of Washington's coastal rivers: the Chehalis, Quinault, Queets/Clearwater, Hoh and Quillayute. Our petition is the first to focus on these rivers, which are home to some of the most imperiled runs of springers. It is also the first to build its case on the most recent genetic research. Its scientific foundation will solidify the case for action to protect and restore springers, not just on the Washington coast, but across the Northwest.

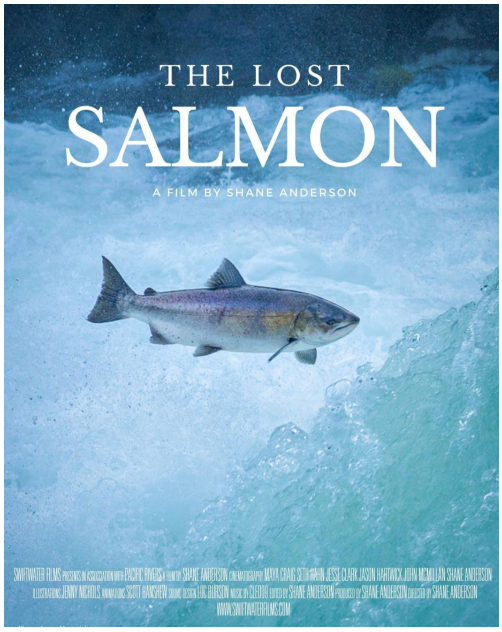
We do not believe it is necessary to list all Chinook salmon under the ESA at this time. While some fall runs are also on the brink, others are currently in decent shape and holding reasonably steady or

even beginning to recover. We do believe that listing of spring Chinook is warranted, imperative, and urgent.

We need look no further than coho salmon for an ESA success story. Since Oregon's coastal coho were listed as threatened under the ESA 1998, coho runs have rebounded impressively and are now on the road to recovery.[2] What we have done in the last quarter century for coho we must now do for spring Chinook.

New spring Chinook documentary: *The Lost Salmon*

Last fall we celebrated the release of *The Lost Salmon*, a full-length documentary film that makes a beautiful and compelling case for protecting and restoring springers. It was written and produced by filmmaker Shane Anderson, who has produced several important films with Pacific Rivers in recent years. All, including *The Lost Salmon*, are available on our website.[3]



The Lost Salmon chronicles Shane's two-year journey across Washington, Oregon, California and Idaho to document some of the last genuinely wild springers, the historic and ongoing causes of their declining numbers, and their profound relationship to the people and places of the Pacific Northwest. The film follows the recent genetic research and concludes with an inspiring account of a springer stronghold today that shows what's possible if we give springers a chance elsewhere.

The Lost Salmon aired last fall on regional PBS affiliates and is now streaming nationwide on PBS.[4] We encourage everyone to watch this film to gain a better appreciation of the wonders of spring Chinook and the need for their increased protection.

Shane dedicated *The Lost Salmon* to "the loving memory of Jon Kurtz," Pacific Rivers' beloved long-time board member who left us much too soon last year.

The path to recovery for springers

The needed actions to protect and restore spring Chinook runs are many. They vary by region and river, but there are some clear themes. We need to:

- Reconnect rivers and streams to their floodplains to improve water quality, flows, riparian vegetation and spawning habitat. (See article on floodplain reconnection by Pacific Rivers Board member Liz Gilliam in this issue of *Free Flow*.)
- Better mimic the natural quantity and timing of flows that springers need in many rivers.
- Improve fish passage around many dams and other barriers that have been created over the last two centuries.
- Remove dams that are particularly harmful, such as the four on the lower Snake River.
- Prevent the construction of new dams, such as one currently being considered for Washington's Chehalis River.

2. See Oregon Coast Salmon Recovery Is Within Our Reach at https://www.oregonlive.com/opinion/2022/12/opinion-oregon-coast-salmon-recovery-is-within-our-reach.html
3. https://www.pacificrivers.org/storytelling.html
4. https://www.pbs.org/video/the-lost-salmon-8hjf4t/

Most of all, we need to protect and restore watersheds, not just for the sake of spring Chinook salmon, but for all fish, wildlife, and people. We need to provide the highest levels of protection for the healthiest remaining watersheds, and we need to accelerate work to improve the health of watersheds that have been degraded by deforestation and other damaging land uses. That is our mission.

All this *can* be done over time. The question is whether enough of it can be done quickly enough to save springers. Doing so will require leadership, commitment, partnerships, teamwork, focus, persistence, monitoring, and funding. We need to utilize every tool at our disposal to save spring Chinook.

To be clear: The Endangered Species Act is not a panacea for springers. It *is*, however, a key to a bigger toolbox. It's time to turn the key.

A time for decision and action

In the Northwest, we have no more important or urgent conservation challenge than saving spring Chinook salmon. Honoring Indigenous people, cultures and treaties demands it. The ecological health of our watersheds demands it. Saving orcas and other species demands it. Our regional identity, quality of life, health, economy, and prospects for sustainability all demand it.

But simply preserving the status quo won't get the job done. Timid, incremental measures won't either: there is simply not enough time left for us to depend on a little more of what already has proven not nearly enough. As a region, we must scale up our efforts an order of magnitude to give springers a fighting chance. Right now.

Doing our part is a top priority for Pacific Rivers. Here's how you can help:

1. Watch *The Lost Salmon*, the new documentary by Shane Anderson, streaming on PBS in 2023 at https://www.pbs.org/show/lost-salmon/ and on the Pacific Rivers website at https://www.pacificrivers.org/storytelling.html.
2. Write the following officials of the National Marine Fisheries Service to call for Endangered Species Act protections for all imperiled populations of spring-run Chinook salmon: Janet Coit, Assistant Administrator for Fisheries, janet.coit@noaa.gov; Jennifer Quan, NOAA Regional Administrator for West Coast Fisheries, jennifer.quan@noaa.gov.
3. Host a viewing party of *The Lost Salmon* or share a copy of this article and discuss with family and friends.
4. Call or write your governor and members of Congress to urge new protections for springers at the federal, state and/or local levels.
5. Join Pacific Rivers at www.pacificrivers.org.
6. Look for timely alerts for specific additional actions the months ahead.

THE LOST SALMON IS RUNNING AND MAKING WAVES

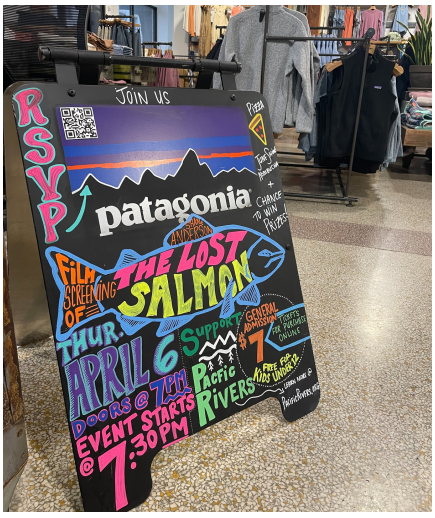
Lindsay Schuelke - Operations Manager

Over the past several months, Pacific Rivers has had the pleasure and privilege of showcasing Shane Anderson's newest documentary, *The Lost Salmon*. Communities across the west are experiencing this striking film highlighting salmon science and stories in arguably the most thorough documentary overview of the issues created to date. Of particular note, we learn more about the beloved and genetically unique spring Chinook salmon.

It is not surprising that the topic of spring Chinook salmon continues to bring people together. The film originally aired on PBS last fall. Since then, many organizations have been gearing up and hosting screening events in Montana, Idaho, Washington, Oregon, California - and more!

It was featured in the Wild and Scenic Film Festival and the Klamath Independent Film Festival, as well as at the 40th Annual Salmonid Restoration Conference. Other hosting organizations include Patagonia, The North Umpqua Foundation, Meaningful Movies Project, Idaho Wildlife Federation, Idaho Guides & Outfitters Association, Wild Salmon Center, Idaho Rivers United, Idaho Conservation League, RE Sources, and Endangered Species Coalition, among others. Pacific Rivers has been directly supported by the Maybelle Clark Macdonald Fund to host screening events and continue other outreach efforts. We are deeply thankful for each and every group and individual sharing this film in their communities.

Watching *The Lost Salmon* instills a sense of awe, and of urgency - and thousands of people have had the chance to watch the film so far. There is much-needed momentum around these events - and there will be more to look out for this year! Please contact us if you would like more information or to help host a screening event near you.



FLOODPLAIN RECONNECTION: A KEY COMPONENT OF WATERSHED RESTORATION

Liz Gilliam - Board Treasurer

Floodplains are among the most biodiverse, productive, and threatened lands on the planet. They provide many functions that support fish and wildlife and protect communities. Unfortunately, connected floodplains and healthy meadows have become scarce throughout the country. As a result, the benefits they used to provide free of charge are all-too-rarely enjoyed today.

Today there is a groundswell of effort to bring back those benefits through dozens of river restoration projects across our region. Their ecological, economic, scientific, and educational promise is profound and inspiring.

In the next few issues of Free Flow, we will discuss various dimensions of **river restoration**: the art and science of managing rivers and their watersheds to **reinstate natural processes** and **restore biodiversity**, providing benefits to people and wildlife. We will also illustrate important principles of restoration through case studies of projects.

Landscape Legacies

The management of water in our nation's waterways has long been a focus of land stewards. During early colonization and through to today, a primary goal of 'improving the land' has been to move water off of it as quickly and efficiently as possible. This typically meant draining fields and floodplains through the use of canals, ditches, piping and tiling of agricultural lands, straightening of channels, the eradication of beaver, and so on. Vast floodplains and wetland complexes, widely seen as "wasted" property, were eliminated. Legacy effects from this are pervasive today.

One of the "jobs" of a healthy river system is sediment transport – the process of moving and depositing sands, gravels and clays down and across the system, including on floodplains. Rivers deprived of flows needed to overflow their banks periodically and banks that allow those flows actually to reach their floodplains can't do that job properly. Today, the over- and under-abundance of sediment (and water) on floodplains causes millions of dollars in damages annually. These water and sediment supplies are fundamental issues: Expensive and widespread problems occur annually along rivers in the PNW – rain-on-snow events in the colder months, drought and water quality issues during the dry summers. These issues may be a result of weather variability year to year, but also can be at least partially attributed to the manipulation of the landscape by humans. They affect all of us.

These issues are not just centered along waterways. Landscape impacts have affected the natural geomorphic, ecologic and water quality processes basin-wide and in turn have impacted the conditions that support healthy riparian and aquatic habitats.

Deer Creek, tributary to Mckenzie River, OR. Photo courtesy of Willamette National Forest.

Watershed restoration requires that we understand the bigger picture and how the impacts, landscape-wide, can be addressed for better and sustainable conditions in rivers and streams for their inhabitants, both fish and people, who rely on them.

SCIENCE!

Watershed restoration is based on a strong scientific foundation that has been developed over many decades.

Let's talk about a few key concepts that are important for all of us to appreciate in the context of how rivers function and evolve. These are the importance of geology, hydrology and biology in the development and maintenance of river systems. How well these concepts are understood (in the context of the project location) and incorporated into project planning can make or break a project's success in the long term.

The importance of sediment and water. *Lane's Balance* is a conceptual model that depicts the balance between water, sediment, and topographic dynamics on the influence of a waterway (aka river, stream, etc.). Notably, Lane's balance can be used to guide the fit between the type of issue a channel is experiencing and the appropriate types of mitigation measures. Although Lane's balance is neither quantitative nor temporal, it serves as a useful starting point for further analysis and complements communication between stakeholders.

Riparian Zones, the lands adjacent to rivers and streams, are critical for maintaining the health of aquatic ecosystems, providing wildlife habitat, reducing erosion, and filtering pollutants. Scientists have studied the characteristics of riparian zones, including the composition of vegetation, soil structure, and hydrology, to better appreciate their role in river health and develop restoration strategies that can improve their function.

An excellent article by Castro and Thorne (2018) puts into context the importance of geology, hydrology and biology in their 'Stream Evolution Triangle' (See Figure 1).

An interesting film called 'RiverWebs' by Freshwater Illustrated (the full film from Freshwater Illustrated can be found online, link here: https://www.freshwatersillustrated.org/riverwebs) highlights the importance of inputs from the riparian to stream fishes, and the cascading top-down effects they produce in stream food webs. It's eye-opening in portraying the connection between the terrestrial and aquatic ecosystems, and the incredible importance of healthy riparian corridors.

Biological Processes: The plants and even animals within the watershed can affect the form and

function of rivers. Humans, of course(!) are an example. So are beavers. And fish and freshwater mussels, and riparian vegetation. These all have very large roles, and require more space to present than this newsletter has room for, but you can catch the interesting stories here:

Freshwater mussels' role in the river system: https://www.xerces.org/blog/merit-of-mussels

The Stream Evolution Triangle: https://www.researchgate.net/publication/332021685_The_stream_evolution_triangle_Integrating_geology_hydrology_and_biology

Beavers: An article in the Fall edition of Free Flow will highlight the work of beavers in rivers and their role in watershed restoration efforts. Let's just say here that we are Beaver Believers. Beavers are a keystone species and ecosystem engineers. Through their normal day-to-day behaviors, beavers create uniquely disturbance-resistant landscapes and ecosystems that enhance biodiversity, improve water quality, reduce damage from wildfire, drought, and flood, and more. These ecosystem services provide economic benefits on the order of $69,000 per square kilometer, per year (Jordan and Fairfax 2022). Where conditions allow, projects focused on recruiting, supporting, and at times relocating beavers are being implemented across the country and in Europe. They provide a low-cost but widely beneficial solution to degraded streams where the space and community allow.

The Evolution of Restoration - River Form and Function

River shapes and styles may be shallow and wide, or deep and narrow. Gravel-bedded or sandy. They may feature wide wetland complexes on the flanks, or steep, cascading bedrock channels that efficiently convey water and sediment downstream (See Figure 1). These 'River Styles' are dictated by 'driving factors' such as the local climate, geology, and biology of the watershed. All interconnected and exerting influence on the shape and function of the river.

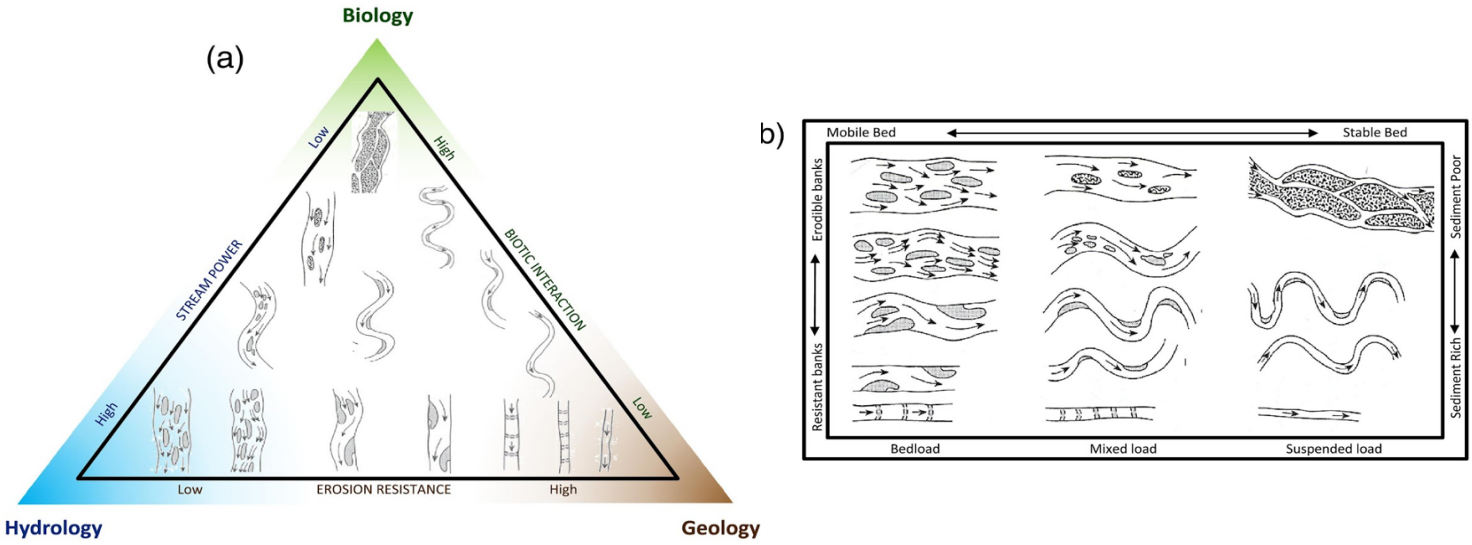


Figure 1A and 1B: The Stream Evolution Triangle (Castro and Thorne 2019): (a) Stream evolution triangle with the planform patterns defined by Schumm (1955) used to illustrate typical morphologies that might be expected in different river styles within the triangle. The stream evolution triangle represents the relative influences of geology (erosion resistance), hydrology (stream power), and biology (biotic interaction); (b) channel patterns after Schumm (1955), adapted from Knighton (1984).

A few decades ago, restoration focused largely on channel-based and form-based methods to add needed habitat elements to degraded stream channels. Projects typically focused on 're-meandering' straightened streams. You can imagine that picture-perfect river: single-threaded with deep pools, abundant gravels, meandering on its way downstream. These are the locations of happy fish, and happy anglers, and, as it was thought at the time, should be the template that is strived for to have thriving fish populations. These conditions were constructed to maximize the project's benefits to salmonids. And often referred to as "field of dreams," channels were engineered using a structure-oriented approach focused on creating that idealized form.

Much was learned from the successes and failures of these projects. We now know that many different shapes, sizes and types of river styles and habitats should persist due to those driving factors of climate, geology, hydrology and topography. And rivers are dynamic, not locked in place. There is no one-size-fits-all. In many cases, the projects were not successful past the next channel-resetting flood because the localized conditions would not sustain those idealized forms naturally.

> ***"No man ever steps in the same river twice, for it's not the same river and he's not the same man."***
>
> **- Heraclitus**

There is increasing appreciation of the importance of incorporating climate change considerations and resiliency into restoration planning. Climate change may be accounted for in restoration in multiple ways: recognition that recent stream flow may not be representative of future flows (e.g., for determining channel capacity), increased emphasis on creating thermal refugia, and emphasis on restoration methods that will be resilient to or mitigate climate change.

Science in Action – Floodplain Reconnection Project Example(s)

What is it? Definition: *Floodplain Reconnection is a valley scale, process based (hydrologic, geologic, and biologic) approach that aims to reestablish depositional environments to maximize longitudinal, lateral and vertical connectivity of the river with the floodplain and facilitate development of dynamic, self-formed and self-sustaining wetland-stream complexes*. Let's break that down.

The philosophy of floodplain reconnection is to work with natural processes to rehabilitate a modified and incised or aggrading channel and restore the water connection to its floodplain. Good floodplain reconnection projects operate at a scale that is big enough to address the constraints on the river, while being technically and economically attainable. The focus beyond the stream channel and onto the valley and floodplain more appropriately incorporates the broader landscape in the project, delivering a more resilient mosaic of habitats than just in-channel restoration.

These projects remove constraints on the channel, for example removing levees or dams, lowering banks that have disconnected the channel from the floodplain, or removing roads that impinge on the natural channel corridor; they bring water out of ditches and onto the floodplain. There are many terms and versions of this approach: process-based restoration, Stage Zero, Valley Reset – but these terms relate to creating the space to allow a river to be messy. The approach has been equated to pressing 'Ctrl-Alt-Delete' to clear an intractable computer problem.

Floodplain reconnection can also be achieved by filling in a degraded channel mechanically – which is sometimes termed a 'valley floor reset'. In larger rivers, constrictions on the channel are removed and the valley floor is brought closer to the elevation of the channel. The removal of constraining features such as levees and embankments often supply the sediment needed to fill the incised channel.

Practitioners initially implemented Valley Reset projects on very low risk restorations of small, incised streams draining wet meadows on the arid east side of Oregon. In areas that are less degraded, floodplain reconnection can often be achieved simply by installing inexpensive features that encourage water out of the channel onto the floodplain. These often mimic permeable beaver dams (aka Beaver dam analogs [BDA's] and low-tech process-based restoration [LTPBR] features). In some instances, floodplain reconnection can be achieved by lowering channel banks or removing impinging roadways. Many good reconnection projects mix and match these kinds of approaches.

Figure 2: Restoration of a wet meadow in Eastern Oregon. Left: pre-restoration (July 2013); Right: one-year post-restoration. Red oval indicates the same tree stump, as a point of reference. Photo credits: Paul Powers.

Restoration approaches evolved as practitioners gained experience and confidence, up-scaling projects to larger rivers. Many projects in varying regions, climates and land-use settings are now underway, from small headwaters meadow streams to major lowland rivers and estuaries, in wet and arid climates, across the US, Europe and beyond.

The South Fork McKenzie River project required identifying the topography and slope of the river-floodplain system before it was impacted by human activities. This is termed defining the 'Geomorphic Grade Line' (Powers et al., 2018). Earthworks were then undertaken that created localized lowering of the floodplain and using material from removed berms to in-fill the existing single-thread channel. Large woody material placement and pioneer planting of trees across

Figure 3: Pre and Post-construction aerial photos of Deer Creek, a tributary to the Mckenzie River, Oregon.

the floodplain created flow deflectors that spread flows and dissipated the erosive forces of the increased floodplain flow. Natural geomorphic processes then took over, developing a fully connected, stream-wetland-floodplain system, resulting in the creation of multi-thread channels. For smaller streams and ditches, the same process is undertaken, and the land is allowed to become saturated, creating wetland and marsh habitat.

Figure 4: Restoration of the South Fork McKenzie River by the US Forest Service. Left: de-watered channel pre-restoration; Right: immediately post-restoration (2018). Photo credits: Kate Meyer and Johan Hogervorst.

The Landscape (and Fish) Response

Large wood, complex channel systems, low slopes and low flow velocities cause sediment to be deposited across restored reaches. This has multiple benefits including supplying many different species with nutrients required for growth and habitat creation, slowing flood flows, recharging shallow groundwater, and moderating water temperatures throughout the year. It also reduces turbidity downstream and the over-concentration of sediment where it is undesirable for fish and people. During big floods, healthy floodplains benefit communities by slowing and spreading dangerous flood waters that would otherwise flood riverside communities, harming people and property. Healthy floodplains are nature's flood protection.

Let's describe some floodplain restoration benefits in more detail. The benefits are many!

INCREASED HABITAT FOR WILDLIFE: Recharging groundwater levels will grow more riparian vegetation that will eventually shade and cool down the stream in the process. Similar to the story of restoring wolves to Yellowstone, re-wetting floodplains provides benefits for fish, but also wildlife, waterfowl, birds, insects, etc.

INCREASED HABITAT FOR FISH, ALL LIFE STAGES: Stream conditions that maintain a dynamic and resilient set of fluvial and riparian processes benefit an array of aquatic and terrestrial biota.

GRAVEL RETENTION: Reduced stream power and abundant large wood encourage gravels and fine sediment to accumulate –– creating abundant spawning habitat for native fish. Before, a narrower channel with fast-flowing water would have transported those gravels and fines downstream, limiting fish spawning habitat.

HABITAT DIVERSITY: Good restoration projects recreate a diversity of habitats across the valley bottom. Side channels with slow-moving water and plenty of cover are excellent rearing habitat for juvenile salmon and trout.

VEGETATION RECOVERY: Reconnecting floodplains helps an abundance of diverse native plants emerge from existing seed banks without the need for extensive planting. Species like willow and cottonwood that colonize rapidly in disturbed areas that are regularly inundated with water will thrive. The vegetation that colonizes these reaches provides more shade than that along incised channels, protecting the stream from increased air and water temperatures.

INCREASE IN BEAVER ACTIVITY: An increase in beaver activity and the construction of beaver dams is often observed throughout project areas. Beavers are very important ecosystem engineers and will maintain a well-connected valley bottom for many years to come.

SELF-SUSTAINING RESILIENCE: Projects that allow channels to fluctuate with sediment input, water levels and vegetation growth tend to be more resilient and long-lasting than those that don't. The depositional nature of the reconnected floodplains allows for log jams to recruit wood from upstream, thus reducing the risk of less appropriate log jams downstream in higher risk areas.

Figure 5: Beaver Dam Analag (BDA) in Bridge Creek. Photo courtesy of Utah State University.

CLIMATE CHANGE RESILIENCE: These projects combat the drought periods that are expected to increase with climate change by storing water and releasing it much more slowly. This provides the ability to recharge aquifers during high flows, which in turn makes the whole region more resistant to drought. The consistently wet vegetated area can also act as a fire break during wildland fires that occur with droughts (Randall, 2018; Jordan and Fairfax, 2022). The ponded water on the floodplain slowly seeps into the soil, keeping it wet and plants green. When wildfires come through, the wetlands are too wet to burn. You can't start a campfire with soggy sticks, as Dr Emily Fairfax states on her web site devoted to being a beaver believer (also see Fairfax and Whittle 2020; https://emilyfairfaxscience.com/research/firebeavers/).

Fisheries Responses

Within even a few weeks following project installation fish have been observed to inhabit the floodplain. On the Mckenzie River, for example, biologists in 2017 observed spring Chinook salmon spawning in Deer Creek after construction was completed - the first documented spawning since 1993! Several spawned-out salmon carcasses were found in log jams – an important step for supporting a productive food web as salmon carcasses provide rich marine-derived nutrients to the freshwater ecosystem. The photo in Figure 6 is from a study of salmon juveniles in California and clearly shows that fish reared on the floodplain have much higher growth rates (Jefferies et al., 2008). The study explicitly states that

juveniles are often pushed out of the limited floodplain zones that do exist due to limited channel complexity during high flows. Therefore, floodplains not only provide better rearing habitat for wild fish but refuges and multiple slower flow paths to reduce mortality during flood flows as well.

In many locations, restoration of a river to its pre-disturbance condition may not be feasible due to anthropogenic changes and constraints. But where a river or stream can be fully reconnected to its floodplain, this may represent the most sustainable, resilient future, with the greatest ecological uplift.

Figure 6: Photograph from Jefferies et al., 2008 displaying the difference in size of juvenile fish raised in the channel (left) and on the floodplain (right) as a result of more nutrients, shelter and favorable conditions.

How to find out more and get involved:

Watershed Councils in Oregon and Salmon Enhancement Groups in Washington are working on beneficial projects across the region. Call them, join volunteer activities and help get the word out about their good work!

Other Resources:

Stage Zero Information Hub (https://stagezeroriverrestoration.com/index.html) - A wealth of resources helping restoration practitioners properly determine pre-disturbance (i.e. "natural" conditions) and then design projects with those conditions as their goal.

American Rivers Information Page (https://www.americanrivers.org/threats-solutions/restoring-damaged-rivers/benefits-of-restoring-floodplains/) - Why we need to restore floodplains and how we can best do so.

Naturally Resilient Communities (https://nrcsolutions.org) - An information filled website from a collaboration between many entities, including the Nature Conservancy, American Society of Civil Engineers, and others.

Natural channel and floodplain restoration (http://www.habitat.noaa.gov/restoration/techniques/srrestoration.html) - USDA NRCS website "about using a combination of fluvial geomorphology, hydraulics, hydrology, and aquatic biologic attributes to accomplish natural channel restoration."

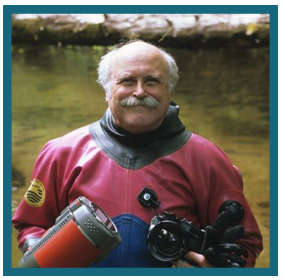
Streams and rivers restoration (http://www.habitat.noaa.gov/restoration/techniques/srrestoration.html) – NOAA Habitat Conservation/Restoration Center provides information about assessments, planning, permitting, design, cost and techniques.

NOAA's Community-based Restoration Program (https://www.fisheries.noaa.gov/grant/coastal-and-marine-habitat-restoration-grants) – Includes information about grants and lists previous recipients and links to many of those projects.

Reconnecting Rivers to Floodplains (PDF) (http://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2016/06/17194413/ReconnectingFloodplains_WP_Final.pdf) – Produced by American Rivers, this report highlights how floodplain functions are lost through floodplain disconnection and modification and provides a framework from which to consider process-based floodplain restoration using the four attributes of functional floodplains: connectivity, variable flow, spatial scale, and habitat.

The online, interactive Floodplain Prioritization Tool (http://www.freshwaternetwork.org) is designed to help decision makers prioritize floodplain conservation and restoration investments in the Mississippi River Basin and assess tradeoffs related to water quality, wildlife habitat, flood risk reduction and other goals.

RESULTS AND LESSONS FROM A DECADE OF STEELHEAD SURVEYS IN STEAMBOAT AND CANTON CREEKS



Charley Dewberry - Restoration Ecologist

For the last decade, Pacific Rivers has spear-headed juvenile steelhead surveys in Steamboat basin (Steamboat and Canton Creeks) of the North Umpqua River, which give us a snapshot of the abundance and distribution of the juvenile steelhead and help us understand how the fish are adapted to the basin. Recently, two new developments have made the surveys more valuable.

One was the creation of Frank and Jeanne Moore Wild Steelhead Sanctuary, which includes all the Steamboat Basin except Canton Creek. Our surveys are providing a snapshot of how steelhead are using the sanctuary today.

The other development is recent genetic work on the steelhead in the North Umpqua basin, concluding that all the steelhead in both Canton and Steamboat are summer steelhead. No other tributary of the North Umpqua has predominantly summer fish. Steelhead have two basic life-histories, winter steelhead and summer steelhead. Winter fish are the more prevalent. The rarer summer fish spend all summer in the river and tributaries. The North Umpqua has gained an international reputation for flyfishing for these summer run fish. Canton and Steamboat Creeks are the two most important tributaries in the North Umpqua supporting the summer steelhead.

Student from the Phoenix School conduct in-stream counts of juvenile salmonids. Courtesy of Audrey Squires.

We have been doing the surveys in the sanctuary in Steamboat Creek for four years now (2019-2022). Unfortunately, in 2020 and 2021, we could not dive the whole basin because of wildfires. It is also very difficult to evaluate these surveys after only a couple of years of work.

However, we have been surveying Canton Creek for 11 years with a number of partners: Phoenix school, Bureau of Land Management (BLM), and Cow Creek Tribe. For ten of the years the Phoenix School students participated in the dive counts. Each student crew was supervised by one of our experienced divers and their counts verified. The surveys are conducted by a team of at least two divers. One crew member is tallying the stream into

habitat types: riffles, pools, and glides. We dive every fifth pool, eighth glide, and tenth riffle. When a habitat is snorkeled, we divide the steelhead into their three age groups: age-0, age-1, and age-2. Steelhead spend at least two years in the streams before they go to the ocean.

TABLE 1: RANGE & LONG-TERM AVERAGE OF STEELHEAD FROM CANTON CREEK (2011-2022)

Age	Range	Long-term Average
0	7,000 to 40,000	26,000
1	1,460 to 5,000	2,700
2	268 to 950	786

Rather than provide figures presenting all of the survey results for the period, I will present a summary and highlight the major points of interest from the last four years. Let us start with a summary of age-0 steelhead from the Canton Creek over the last eleven years. Age-0 steelhead have ranged between 7,000 and 40,000 individuals annually (Table 1). The eleven-year average is around 26,000 fish. In years when there are fewer fish, the center of their distribution is in Pass and Upper Canton Creeks. In years when they are abundant, their center of distribution is lower in the basin in the main-stem of Canton Creek.

TABLE 2: POPULATION ESTIMATE OF STEELHEAD FROM CANTON CREEK (2019-2022)

Age	2019	2020	2021	2022
0	7,302	38,885	16,215	9,986
1	2,213	1,934	1,993	4,239
2	733	902	434	2,425

Now let us look at the results of the surveys for the last four years in Canton Creek (Table 2). Only one year in the last four were the age-0 steelhead over the average of 26,000 fish. In 2021, Upper Canton Creek could not be surveyed because it was closed due to wildfires. However, it is unlikely that the unsurveyed section would have raised the total to the average. In 2019, there were only 7,302 age-0 fish estimated to be in the basin. This is the lowest estimate for the entire 11 years of survey. In 2019, both the mainstem of Canton and Upper Canton had only 24% of the long-term average estimated number of fish, while Pass Creek had 40% of the long-term average estimated number of fish. This suggests that the age-0 fish in Pass Creek did better than other reaches of stream in the basin during 2019.

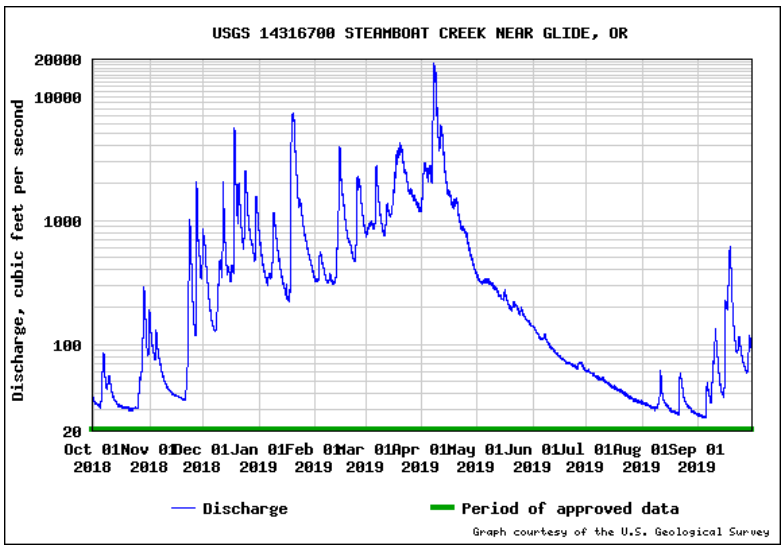


Figure 1.

Why were the age-0 steelhead estimates so low in 2019? In April 2019, there was a storm which caused a peak flow of 18,000 cubic feet per second (cfs) (Figure 1). By contrast, most annual peak flows in the last decade have been less than half that, around 8,000 cfs. The 2019 storm flows scoured out steelhead redds (nests) and the eggs were destroyed. Remember, there were more age-0 steelhead in Pass Creek than in the other reaches.

The second lowest year was 2022, which was also the second lowest year of the eleven years of the surveys. All reaches of Canton Creek were well below average. In fact, Pass Creek had

only 30% of the long-term average -- lower than the other sections. Pass Creek did not buffer the fish during this event, but it did buffer them from the 2019 event. What caused these low numbers? Starting in early March, there was a series of nine storms which did not end until mid-June that raised flows to 1,000 to 4,000 cfs (Figure 2). These series of high flows scoured eggs out of redds and destroyed the juvenile salmon which were just emerging from the gravel.

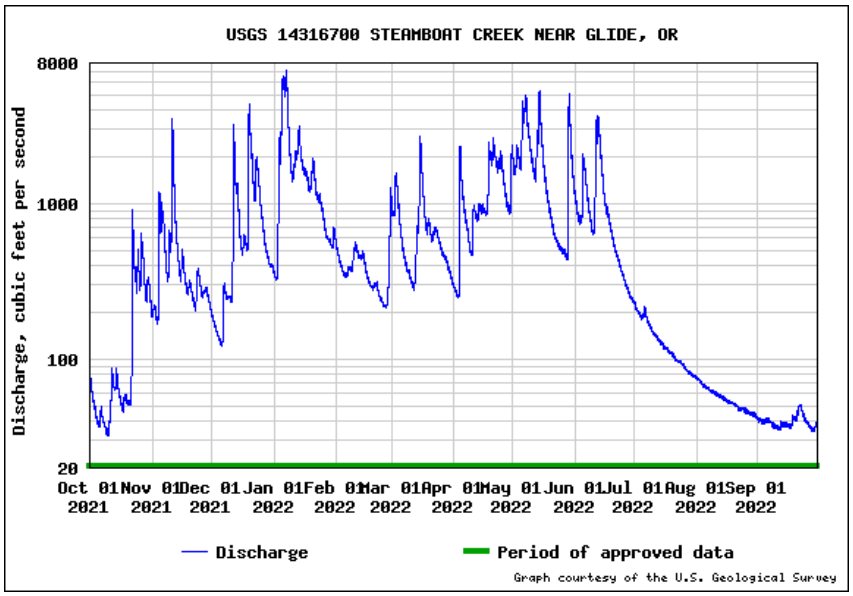


Figure 2.

High flow events are not the only cause of low counts of age-0 steelhead. In two of the eleven years of surveys, summer droughts with high stream temperatures caused a great deal of mortality of juvenile steelhead in the mainstem of Canton Creek.

Now let us return to the four years of Steamboat surveys (Table 3). We would expect similar trends to those of Canton Creek. Many of the reaches, mainstem and tributary, where we were able to survey all four years, showed the same trends. Curiously, Cedar Creek, which we have surveyed three years, has had a similar number of age-0 steelhead in each of the three years. It will be very interesting to see how many age-0 fish are in it during the coming year.

We will now move to age-1 steelhead, beginning with Canton Creek. The number of age-1 has ranged from 1,460 to 5,000, with an average of 2,700 fish (Table 2). Over the last four years, the estimated number of age-1 steelhead has been under the average in three of the four years. In 2022, it was twice the long-term average and the second highest estimate in the long-term survey. The lowest number of age-1 steelhead also did not occur in 2019. The peak flow event that devastated the age-0 steelhead did not appear to dramatically affect the age-1 steelhead. The series of nine storms in 2022 that devastated the age-0 fish appears to have benefited the age-1 fish. It ensured that the summer flows were high and there would be less likelihood of high summer stream temperatures. So, age-1 steelhead are affected quite differently than age-0 steelhead during the same year.

TABLE 3: AGE-0 SALMONID POPULATION ESTIMATES FROM SECTIONS OF THE MAINSTEM STEAMBOAT CREEK & TRIBUTARIES (2019-2022)

Stream Reach	2019	2020	2021	2022
Mainstem:				
Mouth- Little Falls	60			294
Steelhead to Singe	134			
Little Falls to Steelhead				498
Steelhead to Big Bend		9508		2203
Big Bend-Cedar	179	2555		1620
Cedar- Little Rock	760	8897	8433	1450
Little Rock- Horse Heaven	1896	4921	9001	900
H.H. - Headwaters	240	4549	2950	481
Tributaries:				
Big Bend Creek	362	2843		
Buster		185	206	21
Cedar	2,864	2410		2581
City Creek	1,278	1919	6498	171
E.Fork Steamboat	26	572	374	
Horse Heaven Creek	1,281	5771	5503	231
Little Rock Creek	3,968	14685	9915	399
Reynolds	639	198		
Singe Creek	171	156		
Steelhead Creek	921	525		127
E.Fork Headwaters	19			

There is one more trend that is important to understand about steelhead. In the Western Cascade Mountains, the number of age-0 fish has almost no correlation to the number of age-1 steelhead we see in the next year. In other words, the number of age-0 steelhead in a year has virtually no effect on the number of age-1 steelhead observed the following year. The correlation that we see in Canton Creek from age-0 to age-1 is about 0.07. Zero means no relationship. One means a perfect relationship. This correlation is close to the no relationship, and typical for steelhead. Also, notice that the long term average number of age-0 steelhead is estimated to be 26,000 fish and the long-term estimated number of age-1 steelhead is 2,700 fish. That is a survival rate from age-0 to age 1 of slightly more than 10%. Turning now to Steamboat Creek, the trend in higher than average estimates for age-1 fish in 2022 appears to hold (Table 4). No other trends stand out.

TABLE 4: AGE-1 SALMONID POPULATION ESTIMATES FROM SECTIONS OF THE MAINSTEM STEAMBOAT CREEK AND TRIBUTARIES (2019- 2022)

Stream Reach	2019	2020	2021	2022
Mainstem:				
Mouth- Little Falls	117			143
Little Falls to Steelhead				1119
Steelhead to Big Bend		163		1919
Big Bend to Cedar	132	131		424
Cedar- Little Rock	91	284	380	1187
Little Rock- Horse Heaven	336	151	277	466
H.H. - Headwaters	183	203	238	251
Tributaries:				
Big Bend Creek	114	308		
Buster		19	8	36
Cedar	893	135		198
City Creek	125	282	244	396
E.Fork Steamboat	12	6	42	
Horse Heaven Creek	116	243	377	108
Little Rock Creek	166	312	530	930
Reynolds	241	142		
Singe Creek	85	87		
Steelhead Creek	363	215		158
E.Fork Headwaters	13			

Now we will turn to age-2 steelhead. Their range has been from 52 to 2,425 fish, and the long-term average number of fish is estimated to be 786 (Table 2). This is a survival rate from the long-term average age-1 steelhead of about 30%, much higher than that of the age-0 to age-1 steelhead. It was also the case that the number of age-1 steelhead observed the previous year does not correlate well with the number of age-2 fish that we see the following year. The correlation is 0.18, which is low. In the last four years, the age-2 steelhead in Canton Creek have had a greater than the long-term average estimated population in two years. One of those years was 2022, which had the highest estimate of all eleven years. The age-2 steelhead appeared to benefit greatly from the series of spring storms, like the age-1 fish. The lowest estimated number of age-2 steelhead occurred in 2021, the year when we could not dive Upper Canton because of wildfires, but it is unlikely there were a high number of age-2 steelhead in that reach. Turning to Steamboat Creek, the main stem counts were also very high in 2022, as we would expect (Table 5). No other trends stood out.

TABLE 5: AGE-2 SALMONID POPULATION ESTIMATES FROM SECTIONS OF THE MAINSTEM STEAMBOATCREEK & TRIBUTARIES (2019-2022)

Stream Reach	2019	2020	2021	2022
Mainstem:				
Mouth to Little Falls	177			279
Little Falls to Steelhead				373
Steelhead to Big Bend		341		998
Big Bend to Cedar	44	11		343
Cedar- Little Rock	8	105	38	428
Little Rock- Horse Heaven	58	174	6	127
H.H. - Headwaters	0	16	16	56
Tributaries:				
Big Bend Creek	164	45		
Buster		5	0	0
Cedar	115	118		80
City Creek	15	35	40	100
E.Fork Steamboat	0	0	11	
Horse Heaven Creek	24	76	17	5
Little Rock Creek	24	12	84	246
Reynolds	47	16		
Singe Creek	76	21		
Steelhead Creek	64	63		138
E.Fork Headwaters	0			

The surveys are limited to the steelhead that stay in the Steamboat basin, but we know that

steelhead of all ages migrate out of Steamboat Creek down into the North Umpqua River. We have no idea what happens to those fish. So, the surveys are giving us information about the fish that stay in the basin, but that is not the whole story.

Even though these surveys do not provide the whole story about the summer steelhead in Steamboat Creek, they provide us with a snapshot of the abundance and distribution of juvenile steelhead of the juveniles rearing in Steamboat basin. Without this information we do not have any idea of the trends in juvenile summer steelhead estimates, how the fish are distributed in the basin, and how they are responding to natural and man-made events. These surveys are essential to understanding the trajectory of summer steelhead in the Steamboat basin.

In two of the last four years, high water in the spring has decimated age-0 steelhead, but that does not mean that these year classes will necessarily send a low number of steelhead juveniles to the ocean. The year class strength is usually determined by the survival of age-1 or age-2 steelhead. Also, the spring storms that decimated the age-0 steelhead were beneficial to the age-1 and age-2 steelhead, because it created higher than average streamflow in the summer which both provides more and better habitat and keeps stream temperatures lower during the summer months.

Student from the Phoenix School conduct in-stream counts of juvenile salmonids. Courtesy of Audrey Squires.

WELCOME, LINDSAY!

We are delighted to welcome Lindsay Schuelke as the newest member of our team! Since last fall she has been assisting Pacific Rivers part-time on a variety of projects, including organizing Pacific Rivers' screenings of *The Lost Salmon* and assisting other groups with theirs. In April she joined our team full time as Operations Manager. In her new role, she will work closely with our Board of Directors, volunteers and project managers to advance our conservation work and our continuing organizational development.

Lindsay brings a wide variety of skills as well as significant experience with conservation, environmental and social justice groups. She has worked with The Nature Conservancy as Fundraising Coordinator, SOLVE as Partnership Manager, and Forth as Program Manager. Since moving to Oregon from her native Wisconsin in 2015, Lindsay has loved exploring the Northwest, learning about its natural wonders, and finding ways to get involved in Northwest conservation. She currently serves on the Board of Directors of the Greater Hells Canyon Council and as a volunteer for the Forest Park Conservancy.

Lindsay's dedication to our mission, enthusiasm for our work, intelligence, experience, creativity, and can-do attitude are all wonderful contributions to our team. We joyously welcome her to Pacific Rivers and hope that you will too! She can be reached at lindsay@pacificrivers.org.

THANK YOU FOR YOUR SUPPORT!

We want to thank our many, many supporters for giving us the motivation, ammunition, and yes, funding, to tackle these challenging issues. We could not do it without our contractors, scientists, policymakers, friends and family to be eyes-wide-open and motivating change.

OUR MISSION

The mission of Pacific Rivers is to protect and restore the watershed ecosystems of the West to ensure river health, biodiversity and clean water for present and future generations.

OUR VISION

A future where healthy communities have access to clean, cool drinking water free from chemicals, and people can play in rivers and streams. A future where watersheds that store carbon are resilient to warming temperatures and other effects of climate change and are home to abundant populations of fish and aquatic wildlife.

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