# Welcome

*Laura Weatherly, Fisheries & Oceans Canada (DFO) & Jason Hwang, Pacific Salmon Foundation (PSF)*

Laura welcomed participants, noting over 700 registrants from BC, the US Pacific Northwest and beyond. Following a territorial acknowledgement, she noted this is the sixth jointly-hosted knowledge exchange workshop (More info on PSF's Website, where resources and recordings for past workshops can be found). The next workshop in the series will focus on large wood applications in river restoration, on February 13, 2025.

Today's topic was inspired by notable climatic trends towards more extreme weather events, with a focus on characteristics that support greater watershed resilience and tools that improve the ability of watersheds and river systems to absorb such disturbances.

Laura also welcomed the participation of the Washington Governor's Salmon Recovery Officer, Greer Maier, stressing the importance of transboundary collaboration in this work.

Jason provided a brief overview of the PSF mandate, noting that collaboration is key to much of their work. The information being shared today is not meant to be prescriptive, he added, but an opportunity to learn from each other. Following an overview of the workshop agenda and engagement tools, Jason also noted that this event had drawn a record number of registrants, who were invited to submit one-slide summaries of projects they are involved with. Those will be shared during breaks in the agenda. He also shared results of Slido polls offering some more insight on the range of participants, their areas of expertise and where they were joining from.

Greer Maier also spoke briefly about the potential of collaboration on shared learning, described the role of her office and introduced the first speaker.

# The Biophysical Template for River Corridor Resilience

*Ellen Wohl, Colorado State University*

Highlights of this presentation (see PPT for more details):

- Definition of key terms:
    - Resilience as a continuum in time and space.
    - Disturbance: an episodic or continuous extreme event.
    - Disturbance cascade: increased water + sediment inputs and secondary effects.
    - River corridor: important to emphasize that the river changes course and does not exist in isolation.
    - River reach: a stretch with consistent characteristics
- Reach scale influences on resilience: rivers need space and ability to adjust, especially in high gradient streams.
    - Illustration of "string" and "beads" reach morphologies.

- Example: Little Beaver Creek, Colorado
    - Catchment descriptions.
    - History of severe 2020 wildfire followed by 2021 flash floods:
        - More anastomosing seen in bead sections with more spatial heterogeneity — it promoted resilience by attenuating these fluxes.
        - A catchment without such heterogeneity had a major debris flow that killed five people and wiped out fish populations.
    - Massive flood in 2022 inundated the entire flood plain.
        - Beads: Huge response of material moving out into the flood plain.
        - This lateral connectivity is likely to persist, continuing to attenuate downstream fluxes.
        - Also plays a significant role in sediment and OM storage, reduces pollutant and phosphate inputs downstream.
- Anything to protect heterogeneity in selected reaches can enhance system resilience to the disturbance cascade.
    - Beads and strings are established by geology (e.g. glacial history), so you can't change that.
    - But we can affect how they are protected and improve spatial heterogeneity within beads to attenuate downstream fluxes and downstream cascade effects.
    - These principles apply anywhere, to any river network: more spatial heterogeneity, reduced longitudinal connectivity, with enhanced lateral and vertical connectivity.
- Forms of spatial heterogeneity.
- Need to identify what's there, what could be there, along with processes and thresholds for a proportion of the network with high heterogeneity.
    - Then develop management strategies to protect or restore those.
    - Role for field based and remote data collection, conceptual models and numerical/predictive models.

**Discussion**

- We need to reconsider a resilience definition as the ability to respond to threats (as opposed to restoring to a pre-disturbance state).
    - Agree. There are many definitions of resilience. Another definition focusses on the system's absorbing capacity.
- Does it also apply to other characteristics, e.g. low flow/drought?
    - Yes, e.g. a beaver meadow is also a good fire break. Such environments also stand up well during prolonged droughts, and offer resilience to extreme heat and chemical contamination (by helping to avoid downstream contamination).
- Would an entire bead system (vs alternating bead/string) be effective?

    - Yes — the Everglades is an example of one giant bead. Historically, beads were much more common on North American river systems.
- Is there guidance on measures of resilience?
    - There is no single metric of resilience, though many have been proposed, including the number of feedback loops. Spatial and temporal heterogeneity are important but there is no consensus yet.
    - Q/A: I can't think of any natural examples where heterogeneity didn't help.
- What actions can agencies take before and after fire or extreme drought events?
    - You can't change beads and strings, but you can remove barriers to the ability of systems to adjust, including bringing beavers back, beaver dam analog construction, or acquiring riparian land when opportunities arise.
- Q/A: I give a "Messy rivers" talk that is generally well received by landowners. People don't want to be vulnerable. It's important to explain technical terms and concepts in relatable language.
- The mass removal of beavers was a disaster. They were not everywhere historically so be aware of the biophysical limitations, but the more we can restore them, the better.

# Salmon Resilience Depends on Maintaining Diversity

*Pete Bisson, US Forest Service (Ret)*

This presentation provided an overview of resilience as it pertains to restoring salmon and habitat. Highlights included (See PPT for details):

- Quote: *"To keep every cog and wheel is the first precaution of intelligent tinkering"* — it's important not to throw away some of the parts.
- The Pacific Northwest was blessed with a variety of natural disturbances over time, the legacy of which lasts for centuries — it's a very dynamic natural landscape.
    - Habitats are diverse and variable across landscapes — due to both natural and anthropogenic disturbances.
- Pacific salmon have very high inter- and intra-specific diversity. They have lots of genetic material with the potential for mutation, which provides genetic capacity for resilience.
    - High natural variation in run size:
        - Pristine Yukon river example with significant run size fluctuations.
        - Bristol Bay: asynchronous rise and fall of individual populations.
    - Life history variation is often under-appreciated: A study of a single fall Chinook system on the Oregon coast found significant variation in life histories.
    - These are ways of spreading risk and important to keep in mind when working on salmon conservation.
- Challenge of restoring populations:
    - In the past, fish were able to respond to extreme natural disturbances.

    - But acceleration of habitat changes such as increased sedimentation, and genetic concentration due to hatchery practices led to systems with reduced carrying capacity, with fish and habitat increasingly disconnected.
- The frequency and severity of disturbance depends on size and location (more frequency downriver).
    - What types of restoration will work in headwaters vs flood plains.
- A holistic approach requires matching habitat restoration to natural disturbance regimes.
    - Early dam removal results are encouraging, with Rainbow trout resuming anadromy (i.e. latent genes can be re-expressed when given opportunity).
    - Road crossing improvements: restore access, avoid choke points.
    - Relax constraints on habitat diversity.
    - Attenuate exaggerated disturbance regimes, especially in urban environments (allow streams to breathe).
    - Restore migration pathways to diverse habitats, e.g. restore access to headwaters.
- Keep every cog and wheel.
    - Don’t write off small populations and unique life histories.
    - Maintain as much habitat diversity as we can.
    - Anticipate future effects of climate change.

**Discussion**

- How does the climate change effect layer over the natural background (disturbance regime). Should we be thinking of it differently?
    - Climate models predict earlier spring runoff and lower summer flows. One way to address that is to identify areas that will be somewhat resilient (e.g. spring-fed streams will be important areas for providing summer refuge). US restoration groups often lack a good inventory of these spring-fed systems that will be naturally resilient.
- Regarding the legacy of early forestry practices, what one change would you recommend?
    - Think very carefully about how you plan timber sales. It’s not good to executive a large number over one area in a short space of time, so disperse them more in space and time and extend some rotations to a longer period of time.
- Q/A: In terms of key ideas learned over the span of a career, the Snake River dam removal was a good example of how there will always be surprises and the importance of approaching restoration with a degree of humility. It’s not usually one single thing we do that will fix the problem.
- Q/A: The three most effective actions to preserve biodiversity:
    - Restoring access: ensure fish have access to all habitat types, even those that formerly didn’t support large populations.
    - Fish need water, so how to keep streams continuously watered, with surface flows wherever possible.

    - Don’t give up on diversity of life history types: this has implications for hatchery and fishery management.
- Does the inherent adaptability of salmon reduce concern of losing any one individual population?
    - Salmon have genetic capacity for resilience: if we give them a chance, we will be pleasantly surprised by how well they recover.

# Rewetting the Sponge: Using the Umatilla Tribe’s River Vision to restore resilience in the Tucannon sub-basin

*Kris Fischer, Confederated Tribes of the Umatilla Indian Reservation*

Highlights of this presentation (see PPT for more details):

- Tucannon River overview; explaining the “re-wetting the sponge” concept.
- Umatilla Tribe’s concept of First Foods Management with a River Vision: goals of the Fisheries Habitat Program include restoring highly functioning floodplains that increase First Foods for Native Communities.
- Cluer and Thorne: key takeaways from their work.
- What makes our rivers resilient: a deeper dive.
    - Description of the East-side rivers: a system of channels, roles of riparian vegetarian and large woody debris, importance of narrow channels with frequent overflows.
- Early 19th century changes that reduced resiliency: straightening channels increased velocities, then channels became over-widened and simplified.
    - Consequences included increased stream temperatures, reduced floodplain function or flood plains cut off. Channels became increasingly incised into the floodplain, with increased velocity, and loss of important flood plain functions such as water storage, and more drying out during droughts.
- 2023 project: Landowner agreed to provide 7 acres of land to restore floodplains.
    - Planning included looking at the geomorphic timeline on the Tucannon.
    - Hydraulic models as a tool to demonstrate expected results, i.e. expected reduction in stream velocity (for the property in question and downstream property owners).
    - Habitat suitability index.
    - The above showed how to use physical data to plan such projects.
- Key success criteria: Cottonwood regeneration.
- Implementers workgroup: importance of the landowners’ role in improving access to restore Chinook populations.

- "Moment of Zen" video: First salmon to reach the Upper Klamath spotted in October 2024, months after four dams were removed.

**Discussion**

- Was there any concerns that the work would lead to higher summer temperatures/dewatering?
    - It was definitely a concern. The models helped us explore that and ensure we were doing the right things. There was also robust follow-up monitoring to ensure results were consistent with our predictions. Using LIDAR, we will re-assess after the next 5-year flood event.
- Was the project big enough to change flows downstream?
    - We are tracking that (mostly by tracking vegetation), using biotic metrics to tell us what's going on.
- Q/A: The project spent about $3 million overall over 4 years, part of which went to acquiring trees and costs of earth-moving equipment.
- Q/A: Benefits included increasing water availability for agriculture (this was key to the land exchange). Goals included making irrigation more efficient, in terms of both electricity and water costs.
- Q/A: Re lessons learned, you always ask whether what you did was enough. Monitoring is a big part of being able to learn from such projects to improve the next one.
- Q/A: The first two years focused on main channel work. We re-used remnants of old berms to fill low spots, then added wood to ensure roughness. We moved out into the flood plain in the final year, adding lots of wood, some below and some above ground. One surprise is how quickly the vegetation has come back, due to the sponge being wet again.

# Watershed Connectivity Planning and Restoration Outcomes

*Nick Lapointe, Canadian Wildlife Federation*

Highlights of this presentation (see PPT for more details):

- Importance of partnerships in CWF's work, e.g. offering technical support for local partners.
- Horsefly River example of connectivity planning approach:
    - Began with 2,442 potential barriers, so the challenge was how to triage and prioritize.
    - Thematic plan addressing a tractable conservation issue: this was not intended as a watershed conservation plan, though it can serve as a component of a broader plan, or provide guidance in the absence of a broader plan.
    - Key question: Why is this barrier important?
- Planning process overview: key components.
    - Identified focal species and relevant geographic areas within the watershed, important spawning and rearing habitats on naturally accessible streams. This reduced the list of barriers to 77. Estimated connectivity status as 81%

    - Established SMART goals: to achieve 91% connectivity in 10 years.
    - Prioritized barriers for assessment: selected top 30 barriers for assessment based on the initial goal of reconnecting 57.3 km.
    - Developed an action plan.
    - Field assessment reduced the 77 barriers to 51.
    - Analysis of options: assessment of gains from restoring 5 barriers, 17 barriers, etc.
    - Updated goals as field assessment revised estimates of naturally accessible habitat and presumed barriers.
    - How to address the 13 identified priority barriers.
- CWF-led work to address those barriers:
    - Learned that some of the barriers could be addressed by the BC Ministry of Transportation, or through a novel collaboration with industry (they can replace culverts with bridges during their work, while recouping costs under their stumpage agreements with the Province).
    - Of the original almost 2,500 barriers, 13 were prioritized, 3 have been removed and work on another 6 is in progress.
- Lessons learned:
    - Collaborate to consider all barrier types simultaneously (instead of a Ministry considering only theirs without considering others).
    - Models are useful and can be used anywhere, combined with local knowledge, which saves a lot of time and field work.
    - Prioritizing barriers for field assessment reduced the cost and effort required to understand the system, so we could get to an action plan more quickly.
    - Identify priorities then explore the best ways to address each of them.
- Connectivity models are open source and available for all salmon watersheds in BC. They can provide connectivity status for any watershed, though outputs are greatly improved by including local knowledge. This approach quickly produces a status estimate, priorities for assessment, and context for known barriers.

**Discussion**

- Q/A: Regarding any overlap or conflict between local knowledge and the model, we chose to take a generous approach in modelling, so it was rare that we missed known habitat. Local knowledge benefits include identifying unknown natural barriers and refining/correcting model outputs, so we see the two as complementary.
- Q/A: CWF would not focus on opening previously un-used areas, because of potential consequences to other species, but would support local groups, if that is their priority.
- Given dwindling funding, who will fund such work in future?
    - There is definitely a big discrepancy between the amount being achieved in Washington and Canada. We need to address the gap, but how?

- Q/A: CWF is interested in working on lateral connectivity, with a current focus on how to map such features.

# Panel Discussion

Panelists: Greer, Kris, Laura, Jason, Nick, Ellen and Pete.

Opening thoughts?

- Good to see the connection between these talks in informing an overall approach.
- Good to see an approach broadening from specific sites to whole watersheds.
- Good to see there are lots of definitions of resiliency.
- At the watershed scale, the importance of looking at processes first, then connectivity, then individual projects.

Are you optimistic that the effort be enough to save Pacific salmon stocks?

- Somewhat. I'm optimistic that some efforts are on the right track, but fear that we will lose some populations. Habitat needs to be paired with enhancement and fishery management, especially for mixed stock fisheries.
- There is an argument that optimism is misplaced. If that's true and the future is small remnant runs, what can we do to ensure those can recover?

Where should we go and what should we be thinking about to ensure greater success?

- Restoration has tended to focus on jumping from one hot topic to the next. It's important to look at overall diversifying our restoration approaches.
- Long-term sustainable habitats require looking at the watershed scale. There will be trade-offs between human uses and habitat, but in the absence of a plan that addresses all the factors, we won't get to an approach that balances societal interests sustainably. From a technical planning perspective, that's not so difficult to do (doing it on the East Coast).
- In short, we have to think globally and act locally.
- A great part of working with the Umatilla tribes is their guiding vision of restoring flood plains.

Some streams become inaccessible during drought but if salmon can spawn in neighbouring streams how does this relate to the risks of homogenizing gene flow?

- We can't assume that salmon only move downstream from their natal habitats. They can move in all directions, particularly those that spend a lot of time in freshwater, including upstream and laterally. Fish move for two reasons: food and shelter.

What are the most important unknowns that we need to study?

- We don't know how much or where we need to work to restore bead networks. This speaks to the importance of having field-based measurements and feeding those into models, supporting and funding model development.
- Important needs include mapping floodplains and their current condition. Then dig into our ability to prioritize using local knowledge and goal setting.

    - We don't have good tools for working in first-, second- and third-order streams to do that.
- For the Tucannon, we're trying to figure out how much space the river needs to restore natural processes.
- We also need to think about changing climate. If we expect bigger floods/flows, we need to build that into our models.
- Resource managers have an important role to play in providing local knowledge for modelers. But the more you know, the more questions, so how to deal with that, e.g. by using adaptive management. The Horsefly project has kilometres of habitat, but not quality habitat. So given the resources you have, how can you come up with informed plans and take action. Once you get into projects, you do need to get into the details of what's needed to ensure it works.
- There's a great paper from the Rivers Institute in New Brunswick about use of remote sensors. So if LIDAR data are available, or there is potential for that due to recent advances.
- In the Tucannon we started prioritization in 2010 and reprioritized in 2020. We're starting to get to answer how large these projects need to be to detect results. We're counting on the river to do the work, but we're only seeing one-year flows so far. We're trying to act quickly but not too quickly, given that these populations are on the brink.

Where should restoration efforts be focused (the ones on the brink or those that are declining)?

- Draw examples from systems that had historically significant salmon populations, with significant levels of biodiversity. Provide access to sites that were regional nodes for biodiversity.
- For the Tucannon, we're trying to meet the needs of the salmon. It's important to have good communication with the people doing salmon production.

What are effective outreach tools/ways to communicate with landowners, potential stakeholders.

- It depends on how receptive people are to this work. Initially, we had to go out to meet people on the ground and essentially just listen. That set the stage for how we moved forward. Now we have a BBQ, door knocking, plus emails/letters.
- Using language that reaches a broader audience (e.g. Messy Rivers talk).

How to prioritize?

- Focus on accessibility and feasibility, including a focus on public lands. At a smaller scale, focus on the beads, and how to connect the channel and flood plain (re-grading, installing obstructions). Where can you access and get permissions.
- Tributary/confluence areas are hot spots; also estuaries. Areas in the lower reaches that have become disconnected, where we can restore some if not all of the flood plain.

Concluding thoughts?

- I drew a lot of hope from the points relating to genetic plasticity.
- The importance of communication. As we shift our focus downriver where it's all private lands, it's important to start slowly so we can move faster eventually with relationships built on trust.

- Supporting long-term monitoring, which has provided the most useful information on understanding resilience.
- People have been working in the Grand Canyon for more than 30 years and realized they needed to come up with a watershed model of flow and interactions to work effectively.
- We need to move to more intensive and extensive application of tools and models across watersheds.

# Index of Climate Resilience to Guide Salmon Habitat Protection and Restoration on Washington's Coast

*Mara Zimmerman, Coast Salmon Partnership & Foundation*

Highlights of this presentation (see PPT for more details):

- Description of Washington's Pacific Coast.
- Overview of the Coast Salmon Partnership.
- Regional Salmon Plan: Habitat protection and restoration is a key focus and climate change a key consideration
- Climate Adaptation Framework: Informed by best available science and local knowledge. Climate vulnerability is fairly well understood; adaptation strategies just starting to emerge.
- Focus is on four key climate stressors: summer stream temperatures, low flows, winter peak flows and sea level rise/coastal erosion.
- Climate resilience index describes results at the watershed level.
- Definitions: Climate resilience and climate resilient habitat.
- Climate resilience relates to climate exposure, ecological sensitivity and social adaptability.
- Assessment metrics are brought together in a single mathematical calculation to produce an overall resilience score.
- Most scores came from existing data sets. Social adaptability scores were developed via a participatory workgroup process.
- Examples of spatial patterns among metrics, for example for winter peak flows based on exposure, sensitivity and social adaptability, plus the combined score for all three factors.
- Application: Results beg the question of "What now?"
    - An online interactive tool, user guide and watershed report cards are made available to support planning.
- Overview of information in the Watershed Report Cards and example for the Lower Clearwater River, showing how to the information can help identify priorities for action, including by identifying factors or metrics which can contribute the most to improving resilience if their values can be improved.
    - Based on this information, the report card provides recommendations for priority actions in the watershed.

- Coordination, collaboration and next steps: Unique position enables provision of guidance to key groups who can undertake the proposed actions.
- Climate resilience index is designed to be refined as new data becomes available.
- Next steps: Climate resilience lens prompts us to think about restoration actions and land use together.
    - These tools can be used to develop and evaluate projects, prioritize and coordinate outreach strategies, refine watershed scale restoration strategies, and identify species-specific vulnerabilities.

**Discussion**

- How will climate change affect the northern systems?
    - Impacts there are expected mainly due to changes to glacial melt and snow levels — so worse impacts are expected in pristine systems in Olympic National Park.
- How much updating is needed for the report cards?
    - Climate projections are the most dynamic factor now, so we set up the report cards to be easily updated as new information comes in.
- Q/A: It's a fairly low-budget. It was developed as a grad student project, with many partners contributing to ongoing development, and with help of a facilitator (under $100K total cost).
- How might the index vary for different species of salmon?
    - We developed species-specific coefficients and implemented those for watersheds where those species were known to exist.
- Q/A: The variability across sub-basins was interesting and they were certainly varied. The social factor was consistent across basins and related to land use.

# Watershed Restoration and Resilience in the Context of Natural Resource Management

*Rachel Benbrook, Washington Department of Natural Resources*

Highlights of this presentation (see PPT for more details):

- Background: Establishment and mandate of Washington's Department of Natural Resources, and the trust mandate to manage ~3 million acres of State Trust lands under a mandate defined in statute.
- Acknowledgement of ancestral tribal lands, the important role of tribes as partners and their treaty rights to fish.
- Role in salmon recovery:
    - Forestry management, regulation/forest practices, work to promote forest resilience.
    - Management of aquatic resources, science and monitoring, aquatic restoration program and watershed resilience program.
- Despite years of work and $1 billion spent, salmon are still dying, raising the question of whether the Department could do more.

    - This led to the 2022 Pilot Snohomish Watershed Resilience Action Plan.
    - Five overall goals, measurable outcomes and 115 implementation actions. Value noted of having such an accountability framework when working on the ground.
- Key take-aways:
    - Value of having a watershed scale plan, but also the importance of being place-based. Viewing the watershed as a series of inter-connected places, and using a place-based lens to reduce complexity.
    - Significant up-front investment in relationship building.
    - Think like a watershed: group areas into headwaters, tributaries, estuaries and apply a sub-basin scale; finding what already exists, what's worked before.
- Watershed Resilience Program:
    - Current watersheds: Original Snohomish pilot; now also working on Puyallup and Nisqually.
    - Purpose: Provision of in-house salmon and watershed expertise, resource for externals; support for partners on the ground. Also leveraging local, state and federal funding, and inspiring cross-program and inter-agency collaboration.
- Key takeaway #3: Sometimes thinking big is better: some issues demand the watershed scale (e.g. strategic invasive control), refugia, beavers.
    - Three buckets of work: Expand existing programs, pilot new initiatives, and support work undertaken by our partners. We're using sub-basins as incubators for projects, then amplifying those once you work out the kinks to accelerate the impacts.
    - Examples of projects: Eelgrass and kelp protection zones, large wood supply initiative, forest landowner fish passage initiative, watershed expansion and beaver restoration/process based restoration on State lands.
- Key Takeaway #4: Get boots on the ground. Desktop exercises are useful for preliminary prioritization but there's only so much you can do from a desk.
    - Also the importance of investing in relationships.
    - Building a pipeline of projects but thinking about them holistically.
- Challenges: These are multi-use lands, so how to balance competing needs?
    - The problems are big when you're working at the watershed scale, so how to make them manageable?
    - Capacity limitations; accessing remote spaces.
    - The Department is trying to play catch up re freshwater habitat systems.
- Opportunities: Potential for large-scale projects; supporting access to restoration resources, filling data gaps, bridging the gap between planning and implementation.
- Overview of early successes so far.
- Watershed moment: The Department's shift from managing land to managing ecosystems.

**Discussion**

- Comment on the effectiveness of stream buffers.
    - There are different rules for those on State and private lands (State rules are more protective). The adaptive management team does ongoing monitoring, and there is also experimental work on the effectiveness of different types of buffers.
- Comment on the importance of old growth/legacy forests.
    - The program's focus is on freshwater aquatic systems.
- Q/A: Note the value of past work done by other groups and having sub-basin strategies, having that foundational work that can help us prioritize projects.
- With a small team of six, is all the work done in-house or do you rely on external expertise?
    - We're still a growing team and are working to build it, but we expect to rely on external consultants as well. There are also great opportunities for partnerships with academia and the research community and we are very interested in connecting with work/expertise on headwaters.

# Tsecmenulecwem-kt: Deadman Recovery & Resiliency Initiative

*Devin Halcrow, Skeetchestn Natural Resources Corp*

Highlights of this presentation (see PPT for more details):

- Background: Description of the area and severe impacts of the 2021 Sparks Lake Wildfire.
- Overview of restoration planning, overall goal of establishing a monitoring and adaptive management plan.
- Results of restoration planning: list of ongoing restoration activities.
- How wildfire affects hydrology.
- Burned area emergency response catalogue:
- Activities:
    - Mulch strip application: overview of target area, goals, trials and challenges.
    - Reforestation: 10.5 million trees by 2031; underplanting in severely damaged areas.
    - Guidelines for wildfire salvage harvesting.
- How to evaluate long-term effectiveness: focus on water quality over the long term.

# Black Cottonwood restoration in the Lower Deadman

*Brenley Yuan, DFO*

Highlights of this presentation (see PPT for more details):

- Goal was to pilot techniques for restoring vegetation in this very hot, arid area.
- Cottonwood riparian ecosystems in BC's Southern Interior have been reduced to fragments due to land conversion and disruption of natural flood processes.

    - Very little shade left in the Lower Deadman, loss of sponginess in middle reaches, significant wildfire damage in the upper river.
    - Cottonwood are trying to re-establish but challenges include scoring and erosion.
- Worked with Okanagan Nation Alliance (ONA) staff to design a process-based approach similar to what they did in the Okanagan, plus solar drip irrigation for areas not suitable for process based restoration.
- Process-based design considerations: requirements for cottonwoods, for salmonids and measures to slow continued incision.
- Riffle and floodplain construction: just completed — need to monitor over the next decade.
- Solar drip irrigation: Drip lines linked to solar-powered pump and timer (specs to be shared via DFO library).
    - Initial results positive after one irrigation season.
- Next steps: Long-term monitoring and expansion to other sites.

**Discussion**

- Re the Cottonwood irrigation pilot, it will be interesting to see how they do over time.
- Q/A: Replanting has included a variety of species, including non-commercial species like Aspen. In the riparian zone, species include Red Osier Dogwood, Cottonwood and Willow.
- Q/A: Pilot has not considered use of bio-char to date but could certainly include that in future experimentation plans.
- Re costs, lessons of the drip system, costs were about $2,500 for the system, plus ~$2,000 for the big tank. Much of that is re-usable. Issue/fixes included gravity feeding and animal management (horses trampling plants).
- Sampling design for sediment tracing was assisted by UNBC.

# Final Panel

- Advice for other First Nations: The key to being so effective so quickly in the Deadman was the longstanding existing relationships with governments and consultants. Also note importance of the central office to coordinating, linking projects in the territory.
- How is adaptive management integrated at various scales?
    - For Washington it’s just starting. There is increased understanding of the need to protect our remaining salmon runs, which speaks to the importance of monitoring and adaptive management, although there is no formal program yet in place.
    - Restoration is a young science and we’re still learning so much, so it’s important to share lessons learned. Funders also more aware and focussing more on the importance of funding ongoing monitoring, maintenance and adaptation. We need to balance getting stuff done and learning from it.
    - Agree that funders are more open to the importance of ongoing monitoring and evaluation. Unlike consultants, the Skeetchestn people are not going anywhere so we have an interest in ensuring positive long-term outcomes.

    - Partnering with community groups that have a long-term commitment to the place is helpful. Monitoring is super important, especially when we're trying new things or learning how to adapt methods for different locations.
    - We're trying to learn how to leverage tools like remote sensors to understand changes at the landscape or watershed scale, as well as reach assessments. This must be directly tied to a collaborative group and discussing how best to use the information in making decisions over time.
- What role does restoring river processes have in ensuring that riparian plantings thrive?
    - Both are important, but don't under-estimate the impacts of a dense monoculture of invasive plants. we're thinking about bringing projects to places where we have the jurisdiction to make a difference.
    - They are all interconnected — restoring river flows and establishing vegetation. There are many processes that are all interconnected, including steam flows and river processes.
    - It's also about recruitment of vegetation if it's been lost, so you may have to recreate that, including mimicking disturbances.
- What are water license requirements for such projects?
    - We needed a short-term water use license from the Province and landowner support. It was a fairly simple process, but we needed to explain how much water we needed and why.
- Do practitioners feel supported by universities and resource centres? How can we improve?
    - Because it's so new, often the researchers are the practitioners.
    - It feels a little opaque sometimes. It could be clearer who to approach in academia and how, and how to have those conversations. There are lots of opportunities for collaboration but when you're focused in getting projects off the ground, it gets missed.
    - There are lots of great publications. The gap is around how to translate between theory and application, for people who are busy trying to get projects off the ground.
    - Each watershed is different in terms of how much academics are engaged. I'd like to see more funding for capacity building and tools to translating research into practice.
    - This suggests opportunity for a workshop that brings researchers and practitioners together.
- Given 115 proposed actions, how do you prioritize what's most useful?
    - Typically, you pick the lowest hanging fruit first. For us it was important to demonstrate our effectiveness to legislators to build momentum. We're also focusing on things that were clearly our role, and where we could show up and add the most value, like tackling invasive species on our State lands. Some projects were further from our mandate, so those were examples where we could support others to do them.

    - That was the intent of our sensitivity analysis: identifying which factors have the biggest influence on climate resilience to help groups see where to focus for the greatest impact.
- Closing thoughts:
    - One thing that stood out was how all this comes together, leaning in to our individual expertise and responsibilities and authorities. Also Devin's comment that they were ready because of pre-existing relationships and the underlying theme of the importance of relationships and everyone bringing their own valuable contribution.
    - I'm always struck by the similarities of the issues, despite the very different river systems and ecologies. It's good to feel like we're all cogs in a big machine trying to improve and move the planet forward.
    - It's great to see other projects and learn from them, including how to break down watersheds and manage piece by piece, and how to scale up/down. It will be different for everyone, but if people are willing to work together, things will happen.
    - As a practitioner, I appreciated learning about new tools and would like to be able to follow their development and implementation over time if there was a way to do so.
    - It was very informative, with hopeful messages on the importance of setting the table and having people step up and take on the required roles. Also of systems thinking, monitoring and adaptive management. There are great opportunities for collaboration, and for including other human values (other wildlife, flood protection). We need to communicate the importance of this work to all those other areas.

Co-hosts thanked everyone, noting that all workshop materials and recordings would be made available, along with past workshop materials already on the PSF Website. Organizers will email participants with a follow-up workshop survey. Participants were also reminded to save the date for the next workshop in the series on February 25, 2025.

*Adjourned: 3:36 pm*