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State of the Salish Sea: Executive Summary

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EXECUTIVE SUMMARY

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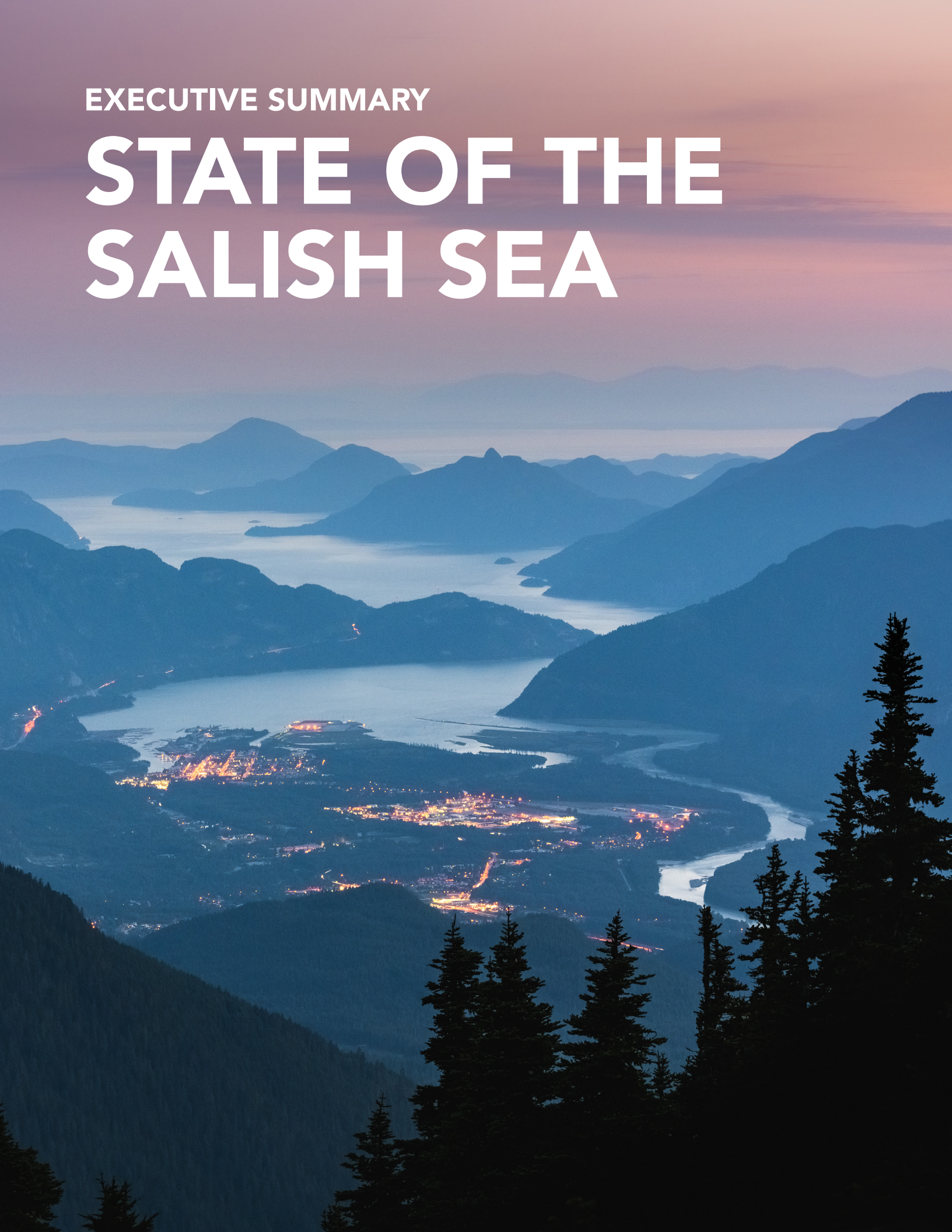


STATE OF THE SALISH SEA

EXECUTIVE SUMMARY

The Salish Sea is a biologically diverse inland international sea that is surrounded by mountainous watersheds of spectacular beauty. For more than 10,000 years, Indigenous peoples have lived along the shores of and cared for the Salish Sea. Today, the region is home to almost nine million people, and that number is rapidly growing.

Our expanding human footprint brings with it urbanization and ensuing impacts on the seascape as ports become busier, underwater habitats become noisier, natural shorelines give way to hardened infrastructure, and watersheds are converted from native forests to housing developments, industrial parks, and other impervious surfaces. At the same time, global climate change is producing profound impacts on the Salish Sea, as sea level rise threatens low lying areas and as ocean acidification and other changes threaten the intricacies of marine life.

In short, the Salish Sea is under relentless pressure from an accelerating convergence of global and local environmental stressors and the cumulative impacts of 150 years of development and alteration of our watersheds and seascape. Some of these impacts are well understood but many remain unknown or are difficult to predict.

In the years and generations ahead, restoring the Salish Sea and supporting its resilience are both possible—and urgently necessary. As detailed in this report, many stakeholders and programs offer hope in how to lead the way, but an integrated, transboundary ecosystem approach is needed, supported by collaboration across borders, governments, disciplines, and sectors.

The Salish Sea is compromised by the cumulative impacts of global climate change, regional urbanization and a growing population, and intensive human use and abuse across the ecosystem over the last two centuries.

Dr. Kathryn Sobocinski,
State of the Salish Sea Report

The Salish Sea is a dynamic and productive estuary ecosystem.

The Salish Sea is a complex waterbody defined by freshwater and marine water that mix in two primary basins (Puget Sound and Strait of Georgia) and numerous subbasins carved by glacial history. These basins are strongly influenced by their surrounding watersheds, especially the Fraser River. The Salish Sea is also tightly connected to the biophysical dynamics of the Pacific Ocean. Freshwater input gives the Salish Sea its status as an estuary and the immense volume of freshwater from the Fraser River is what drives the physical oceanography of the Salish Sea. Briefly stated, as the relatively warmer, less dense freshwater flows out from the Fraser River onto the surface layers of the Salish Sea, the colder and relatively dense saltwater from the Pacific Ocean is drawn in, creating an oceanographic process known as exchange flow. This large-scale exchange flow in turn drives the fundamental circulation in the Salish Sea.

Similar in function to the circulatory system within our own human bodies, understanding how water within the Salish Sea circulates is important because it distributes the nutrients, oxygen, and other essentials that fuel primary productivity and a very diverse food web. That natural fuel and productivity sustain numerous inter-connected habitats, like eelgrass beds, kelp forests, and sponge and oyster reefs, each of which are described in this report. Those biogenic habitats in turn provide structure and shelter for multitudes of other organisms, including many of importance to humans. Meanwhile, circulation mitigates local impacts of some human harms, such as contaminants, eutrophication, and low dissolved oxygen by continually moving water throughout the system. As climate change disrupts this strong, longstanding, and predictable circulation by altering, for example, the timing and volume of freshwater inputs, the ramifications to the Salish Sea estuarine ecosystem are potentially significant.

"Here in our waters in Puget Sound and into the Salish Sea, we're caught a bit in a vice grip. One arm is rapid climate change—our waters are warming and they're becoming more acidified. At the same time, we're piling on human population. Those two factors act synergistically, and both put a lot of stress on our marine ecosystem."

Dr. Drew Harvell,
Professor of Marine Ecology
at Cornell University and affiliate faculty
at the University of Washington
School of Aquatic and Fishery Sciences

English Bay, Vancouver BC, with Mount Baker
Photo: Kimon Berlin

Local urbanization and global climate change are converging on the Salish Sea with profound impact.

Human impacts are multifaceted and extensive within the Salish Sea. Population growth drives urbanization and development, which in turn triggers structural changes to the landscape and seascape like habitat fragmentation, shoreline armoring, conversion of vegetated areas to impervious surfaces, and profound changes in watershed and wetland hydrology. These gradual but damaging trends also increase nutrient and contaminant loading to the estuarine waters and limit the scope and scale of local fisheries.

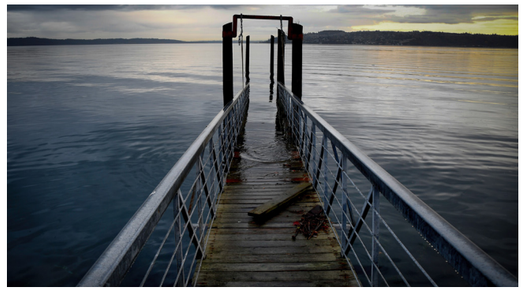
While the causes of climate change are global and primarily from greenhouse gas emissions, impacts of climate change manifest locally and are already becoming physically and biologically evident in the Salish Sea. As described in this report, that evidence includes documented, measurable warming of the atmosphere and oceans, changes in global and regional precipitation patterns, and rising mean sea level—all effects contributing to known changes within the Salish Sea ecosystem. Increased seawater temperatures and ocean acidification are currently stressing biota, and accelerating rates of both point to potentially significant ecosystem changes ahead.

Fortunately, scientists and managers continue to compile data and analyze trends that collectively help us better understand some of the predicted near-term effects of global climate change, aided by global- and regional-scale models. Regional accuracy of such models and their predictions is improving, but our understanding of how Salish Sea organisms, ecosystem processes, and interactions are affected by global climate change is less certain, especially looking ahead into the future. When the effects of global change in our oceans are combined with the increasing disruption from local urbanization, the Salish Sea estuarine ecosystem will continue to degrade. Forecasting and planning related to these changes is a challenge for the coming decades.

Cumulative effects impair systems and species.

Salmon and orcas are emblematic of the beauty of the Salish Sea and, along with numerous lesser-known species, signal to us that cumulative troubles are mounting in our ecosystem over time and space. Theory and observation suggest an eventual tipping point, and scientists and managers are rushing to understand if and how the Salish Sea has the capacity to recover from short-term disruptions alongside ongoing chronic stress. Much more work is needed to unravel the repercussions of cumulative and relentless stress on the Salish Sea ecosystem, including its resident salmon, orcas, and hundreds of other aquatic species.

Orcas provide a case study for how one species is faring under the cumulative effects of human activities. The Southern Resident population—salmon eating orcas found in the Salish Sea in the summer months—are challenged by at least three main threats: scarce food, contaminants, and marine noise. Chinook salmon are their primary food source and also the species most in decline throughout the region. Contaminants in the fish they eat are taken up and stored in their bodies impeding their ability to reproduce and fight disease. Orcas are also increasingly forced to hunt in a fog of noise, which can affect their ability to capture the food they need to successfully reproduce. As a top predator, orcas rely on a functional ecosystem—at all levels—for survival, but face an increasingly inhospitable habitat.



Water level above a dock during Tacoma King Tide
Photo: Ryan Dicks via MyCoast

OPPORTUNITIES FOR IMPROVING ASSESSMENT AND UNDERSTANDING OF THE SALISH SEA: OVERVIEW

BUILD HABITS AND SUPPORT FOR COLLABORATING ACROSS DISCIPLINES AND BORDER

Establish a Salish Sea Science Panel

Convene scientists from Indigenous Nations, Washington, and British Columbia to re-prioritize formal collaboration and develop large-scale actionable science needs, priorities, and methods. Maintaining the strength and priority of science in the Salish Sea is essential for identifying emerging concerns and creating actionable solutions.

Advance Data Collection and Monitoring Using Novel Tools

Leverage creative partnerships and new technologies to collect data over long time periods and larger spatial scales to better understand changes from climate change and local human impacts.

Use Models as Integrative Tools

Ongoing modeling work throughout the Salish Sea is bringing together data, computing power, and technical expertise to better understand oceanographic and ecosystem processes. Modeling tools should incorporate the multiple simultaneous and cumulative impacts on the Salish Sea from climate change, urbanization, and more. To become truly powerful and integrative, models must incorporate the transboundary, social-ecological system at multiple levels of spatial and temporal complexity.

Create a Transboundary Salish Sea Data and Information Repository

Develop strategies for integrated data management, including efforts to harmonize data across the border and across disciplines, jurisdictions, and agencies. Long-term collection and curation of Salish Sea-wide data, information, and stories will support shared efforts toward transboundary science, policy, and education.

EMBRACE MULTIPLE WAYS OF KNOWING AND CONNECTING TO THE SALISH SEA

Apply Social-Ecological Systems Science

Invest in initiatives that address human well-being and cultivate a strong sense-of-place within Salish Sea communities. Understanding the complex relationships between people and their environment can stimulate wise management decisions and development actions for ecosystem restoration and protection, as well as economic sustainability.

Recognize Indigenous Knowledge Systems

Recognize traditional ecological knowledge in assessing, managing, and restoring the state of the Salish Sea and its ecosystem functions. Through co-management, creating ethical space for collaboration, and working together as equal partners, we can better ensure the future health and wellness of the Salish Sea.

Build Knowledge, Relationships, and Connection through Place-Based Learning

Invest in more intentional Salish Sea-wide place-based education, including support for Indigenous communities to build capacity for ecological and cultural restoration. Education initiatives can increase appreciation of the Salish Sea, creating stronger ties with the lands and waters around us.

STRENGTHEN THE SCIENCE-TO-MANAGEMENT BRIDGE

Enable Practitioners to Bridge Science and Community Investment

The Salish Sea benefits from many local- and regional-scale organizations that operate at the interface of science and practice, bringing additional participants into actionable science. Foster community science initiatives by promoting local involvement in data collection, restoration, and priority-setting to elevate calls to action within the Salish Sea.

Use Adaptive Management Tools to Strengthen Planning

Use adaptive management strategies to address cumulative impacts associated with climate change and human development in the Salish Sea. The iterative nature of adaptive management allows for simultaneously confronting complexity and uncertainty while also being proactive and responsive at local and regional scales.

Build Sustained and Regenerative Ecosystem Functions to Improve Resilience

Build resilience, especially at the land-sea ecotone where human infrastructure will exacerbate problems associated with rising sea level. Positive, protective, restorative, and regenerative actions are increasingly necessary as the population grows and threats from climate change alter ecosystem processes.

Ecosystem decline has outpaced restoration and protection. Structural changes are needed to be truly effective in supporting a thriving ecosystem.

Over time, government agencies and others around the Salish Sea have implemented numerous management programs, policies, and regulations to protect the ecosystem. Transboundary governance agreements have been signed and initiatives launched. Yet, as the 2010 Coast Salish Gathering Treatise asks, "Would the Salish Sea be in the state [it's] in if, in fact, these agreements were doing what they intended to do?" Indeed, layers of laws, treaties, regulations, and jurisdictions make for a complicated and even fragmented approach to Salish Sea governance, exacerbating challenges from global climate change to local lack of enforcement and funding. The cost of business as usual is high, especially as we anticipate further declines and unknown repercussions for the region.

Looking ahead, there is hope through more action and ecosystem-scale collaboration.

Not since The Shared Waters Report in 1994 has there been a holistic assessment of the Salish Sea as an integrated ecosystem. More than 25 years later, a fresh snapshot is timely—and necessary. The regional population has grown by over two million people since the publication of The Shared Waters Report, and new threats are recognized in the form of climate change, warming waters, sea level rise, ocean acidification, microplastics, and more. Perhaps of greatest concern is the cumulative impacts of these persisting, continuing, and emerging threats intersecting within the seascape during more than 150 years of anthropogenic change.

Righting the course to a more functional and sustainable Salish Sea requires a strong scientific foundation. It also requires a renewed and clear commitment to strategic planning, systemic changes in governance, large-scale investment, and significant shifts in our economic systems, collective values, and changing relationships to our lands and waters. Now is the time to shift thought and policy paradigms from treating the environment as a resource to instead build systems of relationships and responsiveness that are based in science and incorporate the interconnected system of humans and environments. As illustrated by several encouraging examples in this report from all around the region, we know that much can be achieved through well-coordinated restoration, mitigation, and protection measures.

An aerial look at the Nooksack River delta looking out to the Strait of Juan de Fuca. Photo: Frank James, M.D.

The State of the Salish Sea Report

With the help of dozens of contributors from around the region, this report is an effort to synthesize and characterize the most pervasive problems and state of the ecosystem. For the benefit of all readers, irrespective of current role or interest in the Salish Sea, we end the report with a spectrum of specific needs and associated opportunities for how governments, organizations, and individuals can work together to meet the needs of science and science-driven management for the Salish Sea — as well as questions to open substantive dialogue and prompt collective action across the seascape.

The science presented herein is intended to inform, illuminate, and ultimately ignite deep discussion and meaningful action, from grassroots efforts to large-scale collective and governmental investments. Addressing centuries of degradation, swelling human population, and global climate change requires vision and solutions for the future that are innovative, adapt easily to local needs, and spark change in our collective values and relationships with the Salish Sea.

Regeneration of the Salish Sea will require multi-faceted and collaborative approaches that support greater understanding through education and science, plus sufficient political will, public support, and systemic changes. Fundamental alteration of human–environment relationships, coupled with new and ambitious goals, are needed to change the arc of anthropogenic impacts.

We ask readers to consider your roles, responsibilities, and opportunities for caring for our shared waters in the days, years, and generations ahead. Will we choose to work together to make these commitments and investments toward a future of resilience and connection across the Salish Sea?

A CALL TO ACTION

Ginny Broadhurst, Natalie Baloy, and Kathryn Sobocinski

What is the state of the Salish Sea? As this report documents, the Salish Sea is compromised by the cumulative impacts of global climate change, regional urbanization and a growing population, and intensive human use and abuse across the ecosystem over the last two centuries. While biological response varies throughout this diverse ecosystem —owing to biophysical drivers like geology and oceanography, and gradients of human impacts—caring for our shared waters in more holistic, multi-jurisdictional, and multi-disciplinary ways is sorely needed to be responsive to current and emerging threats.

Over time, government agencies and others around the Salish Sea have implemented numerous management programs, policies, and regulations to protect the ecosystem. Transboundary governance agreements have been signed and initiatives launched. Yet, as the Coast Salish Gathering Treatise asks, "Would the Salish Sea be in the state [it's] in if, in fact, these agreements were doing what they intended to do?" (2010:6).

Ecosystem decline has outpaced restoration and protection (Treaty Indian Tribes of Western Washington 2011; State of the Sound 2019). Layers of laws, treaties, regulations, and jurisdictions make for a complicated and even fragmented approach to Salish Sea governance (Clauson & Trautman 2015), exacerbating challenges from global climate change to local lack of enforcement and funding. The cost of business as usual is high—staggering—especially as we anticipate further declines and unknown repercussions for the region (Kehoe et al. 2021).

It is clear that structural changes are needed if we are to be truly effective in supporting a thriving ecosystem. Righting the course to a more functional and sustainable Salish Sea requires strategic planning, systemic changes in governance, large-scale investment, and significant shifts in our economic systems, collective values, and relationships to lands and waters (Treaty Rights at Risk 2011; Poe et al. 2016; Caillon et al. 2017; Kehoe et al. 2021).

> *"In the past 150 years, since the nation states of Canada and U.S. made their claims to our territory, we have seen the thriving Salish Sea of our Ancestors impacted by pollution, development and environmental mismanagement."*
>
> Coast Salish Gathering Treatise 2010

It is unlikely that we will fully reverse the legacies of urbanization and industrial impacts to the Salish Sea, but it is possible to improve conditions from what they are today. Much can be achieved through well-coordinated restoration, mitigation, and protection measures to restore ecosystem function and create greater resilience to the future impacts we know are coming. In some cases, the ecosystem will rebound on its own once harms are removed, but action is imperative.

We end this report with a series of questions to invite dialogue and ignite action. While the science documented in this report is sound, science alone is not a solution. Enhanced collaboration is needed but is also not the only answer. Many voices beyond our own will be needed to respond meaningfully to the challenges presented in this report. Our questions acknowledge the limitations of this project, and invite dynamic and diverse responses across disciplines, sectors, communities, cultures, and borders. We ask readers to consider your roles, responsibilities, and opportunities for caring for our shared waters in the days, years, and generations ahead.

Can we create and commit to shared goals to recover the Salish Sea? Can agencies, people, and organizations acknowledge the Salish Sea as a shared ecosystem to shape their work ahead?

Can we liberate ourselves from a pollution-based economy in support of a healthy Salish Sea and connected watersheds for all beings who call this place home?

How will we collectively prioritize restoration and stronger protection of the Salish Sea through shared governance, shared ingenuity, and shared responsibility to act?

How will we recognize Indigenous sovereignty and laws, and support Coast Salish involvement and representation at all decision-making tables?

How and when will we fully apply science, Indigenous knowledge, and multiple ways of knowing in making critical policy decisions?

How can we sustain and deepen existing practices while also building new habits and systems to connect people with each other and to the Salish Sea?

We encourage you to add your own questions and answers to this list for debate and action in organizations, institutions, and communities across the Salish Sea.

As a convenor of many voices in the Salish Sea, the Salish Sea Institute recognizes the need to gather and promote diverse ideas to build solutions collectively and collaboratively. Through curriculum, collaborations, and convenings, we look forward to stimulating dialogue, connection, and collective action for restoring and protecting the Salish Sea.

This report synthesized science to help us all better understand the Salish Sea as an interconnected and shared ecosystem facing many unrelenting threats. In light of this realization, how will we collectively move forward together?

Our hope is that the science presented here serves to inform, illuminate, and ultimately ignite deep discussion and meaningful action, from grassroots efforts to large-scale collective and governmental investments. Addressing centuries of degradation, swelling human population, and global climate change requires vision and solutions for the future that are innovative, adapt easily to local needs, and spark change in our collective values and relationships with the Salish Sea.

Regeneration of the Salish Sea will require multi-faceted and collaborative approaches that support greater understanding through education and science, plus sufficient political will, public support, and systemic changes. Fundamental alteration of human–environment relationships, coupled with new and ambitious goals, are needed to change the arc of anthropogenic impacts (Diaz et al. 2020). Will we choose to work together to make these commitments and investments toward a future of resilience and connection across the Salish Sea?

"Science gives us knowing, but caring comes from someplace else."

Robin Wall Kimmerer

STATE OF THE SALISH SEA: FULL REPORT

Sobocinski, K.L. (2021). *State of the Salish Sea*. G. Broadhurst and N.J.K. Baloy (Contributing Eds.). Salish Sea Institute, Western Washington University. tinyurl.com/StateoftheSalishSea

This is a timely report that shares how much has changed in the Salish Sea, and how much is at risk if we do not change course. Our legacies will be defined by the next few years, and I'm hopeful that people will take action for future generations.

Mindy Roberts, Puget Sound Program Director for Washington Environmental Council and co-author of *We Are Puget Sound: Discovering and Recovering the Salish Sea*

This is an exceptional and unique report. It represents a landmark effort to understand how the Salish Sea social-ecological system works, what is causing it to change, and what we can do about it. The report will be essential reading for scientists, marine managers, industry and civic leaders, and everyone interested in the health of the marine environment of this place that we call home.

Ian Perry, Emeritus Scientist with Fisheries and Oceans Canada

Thorough and credible, the State of the Salish Sea report is a long-overdue, evidence-based assessment of the condition of the Salish Sea ecosystem. Perhaps the greatest accomplishment is that Dr. Sobocinski's team captured the wakening of scientists, managers, and citizens to the fact that the Georgia and Juan de Fuca Straits and Puget Sound comprise one integrated ecosystem.

Ronald Thom, Past President of the Washington State Academy of Sciences and Staff Scientist Emeritus of the Coastal and Estuarine Research Laboratory at Pacific Northwest National Laboratory

The health and sustainability of the Salish Sea is intertwined into the Coast Salish People's lives, bloodlines and culture. We are the caretakers of this great place we have called home since time immemorial. Thus the Coast Salish are the first scientists of the Salish Sea, as our cultural laws and traditional knowledge are found in each of our songs, names, stories, and teachings all come from the land, water, air and resources. We are honored to be part of the State of the Salish Sea project with Western Washington University's Salish Sea Institute, and we honor the partnership and respect in which our Coast Salish People have been treated as the First People of the Salish Sea.

Patti Gobin, Tulalip Tribes
Ray Harris (Shulqwilum), First Nation Summit Co-Chair
Debra Lekanoff, Coast Salish Gathering Coordinator
Chief Dalton Silver, Sumas Nation

Front cover: Squamish and Howe Sound from Brohm Ridge
Photo: Yuri Choufour

Back cover: Aerial view of Seattle, Puget Sound, and the Olympic range
Photo: iStock

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