LOCAL-LEVEL SALMON RECOVERY RECOMMENDATIONS BASED ON THE FINDINGS OF THE

SALISH SEA

MARINE SURVIVAL PROJECT

A toolkit for Salmon Recovery Lead Entities, Local Integrating Organizations, Marine Resource Committees, and project sponsors to incorporate recommendations for marine survival in recovery plans and adaptive management processes.

December 2021

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement PC-01J22301 through the Washington Department of Fish and Wildlife. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency or the Washington Department of Fish and Wildlife, nor does mention of trade names or commercial products constitute enforcement or recommendation for use.

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PURPOSE

This guidance document follows the findings of the Salish Sea Marine Survival Project (SSMSP) and the broad recommendations included in the Full Synthesis Report. The findings point to strategies and actions at both the regional and local levels that can be taken to address the complex issue of low marine survival of Chinook salmon, Coho salmon, and steelhead trout smolts. The regional findings are also being incorporated into the Puget Sound Chinook Salmon Regional Recovery Chapter Update (forthcoming). This guidance document is intended to serve as part of a toolkit for salmon recovery planning processes as plans are developed or updated. This plan can also be considered as a standalone guidance document for considering the issue of marine survival as a criteria for ranking strategies or projects, and/or coordinating with local partners who may already be implementing these recommendations.

BACKGROUND

Since the 1970s, marine survival rates—i.e., the number of fish that survive the migration from river to ocean and return as adults—dropped sharply in the Salish Sea for Chinook salmon, Coho salmon, and steelhead trout. The same species in other regions have not followed this persistent pattern of decline. Researchers and resource managers suspected that the salmonid crisis of the Salish Sea must originate in the unique inland waters of the Strait of Juan de Fuca, Strait of Georgia, and Puget Sound early in their life cycle. For young salmon, the first few months in saltwater are a critical period in determining whether they will survive to maturity. To understand why fewer fish are returning to the Salish Sea as adults, it is important to understand why so few juveniles now survive the early marine survival period as smolts.

In 2014, the Pacific Salmon Foundation in Canada and Long Live the Kings in the United States launched a cross-border, ecosystem-wide research effort. Two hundred scientists from more than 60 organizations in the United States, Canada, and Tribal Nations conducted research on key hypotheses between 2014 and 2019. From these studies, an essential foundation of knowledge emerged about the interrelated dynamics of the Salish Sea ecosystem, and what happens to juvenile salmonids as they encounter it for the first time.

The Salish Sea Marine Survival Project examined 21 hypotheses about the most likely factors influencing juvenile salmonid survival in the Salish Sea. The evidence from more than 90 studies supports the conclusion that many factors are important in marine survival, and that no single change is driving the decline. Complex interrelationships across the ecosystem are contributing to more challenging conditions overall. The Synthesis Committee, made up of the lead U.S. and Canadian scientists, reviewed all the findings to produce the final Synthesis Report and the summary documents.

It is important to note that the findings did not refute any of the underlying principles or strategies currently being advanced to recover salmon and steelhead in the region, namely the importance of preserving population life-history structure and diversity, and the need for aggressive habitat protection and restoration. If anything, this new work reinforced and complimented these approaches.

The Synthesis Report did identify two overarching phenomena behind declining Salish Sea marine survival:

1. **Changes in food supply.** Young salmon, especially Chinook and Coho, need more and larger prey as they grow during the early marine period. Shifting environmental conditions, including weather, water quality, and temperature, appear to be driving changes in both phytoplankton and zooplankton populations at the base of the food web. Climate change is likely an underlying factor behind these changes, but the complexity of these dynamics is not fully understood and is a crucial area for further research. At the same time, populations of forage fish, including herring and eulachon, have also declined in many parts of the Salish Sea, limiting another important food source for salmonids.

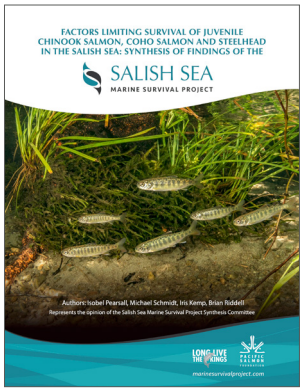

Photo © Eiko Jones

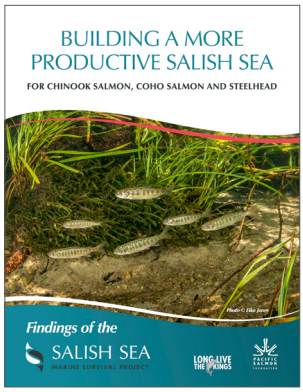
2. **Increases in predators.** Thanks to successful protections for marine mammals introduced on both sides of the border in the 1970s, harbor seal populations have exploded around the Salish Sea. The sheer number of seals means that while salmon and steelhead are a small component of their overall diet, seal predation represents a major proportion of juvenile salmon mortality – between 5 and 60 percent. Human-made changes in the environment contribute to predation "hotspots," such as log booms or migration barriers like the Hood Canal Bridge, where seals have easy access to large numbers of fish. The reduced availability of forage fish, lack of complexity of nearshore habitats, and the consolidated timing of Chinook hatchery releases may also affect the number of salmonids consumed by seals in a given year or location.


Photo © Ryan Miller

How to use this guidance document:

- Share the supporting reports that describe the findings of the SSMSP with your committees, key staff, and "core team" members who make recommendations and decisions about your adaptive management process. The Salish Sea Marine Survival Project website includes an overview story map; the full Synthesis Report (142 pages) for a technical audience, entitled *Factors Limiting Survival of Juvenile Chinook Salmon, Coho Salmon and Steelhead in the Salish Sea: Synthesis of Findings of the Salish Sea Marine Survival Project*; and a Summary Report (21 pages) for a lay audience, entitled *Building a More Productive Salish Sea for Chinook Salmon, Coho Salmon and Steelhead*.





- Review the full list of strategies and actions organized by issue and level of impact: very high to low.
- Determine the current level of integration in your local area:
  - » Inventory what strategies and actions listed below are already underway or included in a current plan (salmon recovery chapter/strategy, Local Integrating Organization Ecosystem Recovery Plan, Marine Resources Committee plans or other guiding documents).
  - » Determine what strategies and actions are aligned with your current plan but require changes or additional clarity for successful implementation.
  - » Determine what strategies and actions are missing from your current plan.
  - » Discuss with partnering entities to learn who else may be implementing appropriate strategies or actions that can be relied on to continue or expand their work and address a local need.
  - » Discuss with project sponsors, who is poised or interested in implementing new strategies or actions to incorporate the findings as part of an adaptive management strategy.
  - » Determine if gaps or limitations exist in funding, capacity, data, or understanding before the strategies and actions can be integrated or successfully implemented as part of an adaptive management cycle.
- If helpful, use the "starter" results chains at the end of the document to help identify, evaluate, and integrate new strategies in your adaptive management process. Build on the simplified results chains by documenting assumptions and building out details relevant to your local area.

RECOMMENDATIONS

The focus of the guidance document is to present recommended strategies and actions based on the findings of the five years of research. The findings, as expected, demonstrate that juvenile salmonids confront a wide range of interconnected threats on their migration. The key challenge for the Salish Sea Marine Survival Project was to identify which conditions in Puget Sound are driving these species toward extinction. As with any complex ecosystem management approach, issues are overlapping and inter-related. Users of this guidance document are encouraged to stop here and review either the full Synthesis Report (recommended for technical committee members/partner scientists) or the Summary Report (recommended for policy committees or citizen members, or simply those short on time). Both reports are available here.

The two major takeaways of the project are that we must collectively adapt to global changes and fix local impacts. Adapting to global changes is a major undertaking that the salmon recovery and Puget Sound ecosystem recovery community is implementing in a number of ways at various scales. The details are beyond the scope of this guidance document, which focuses on fixing local impacts.

FIXING LOCAL IMPACTS

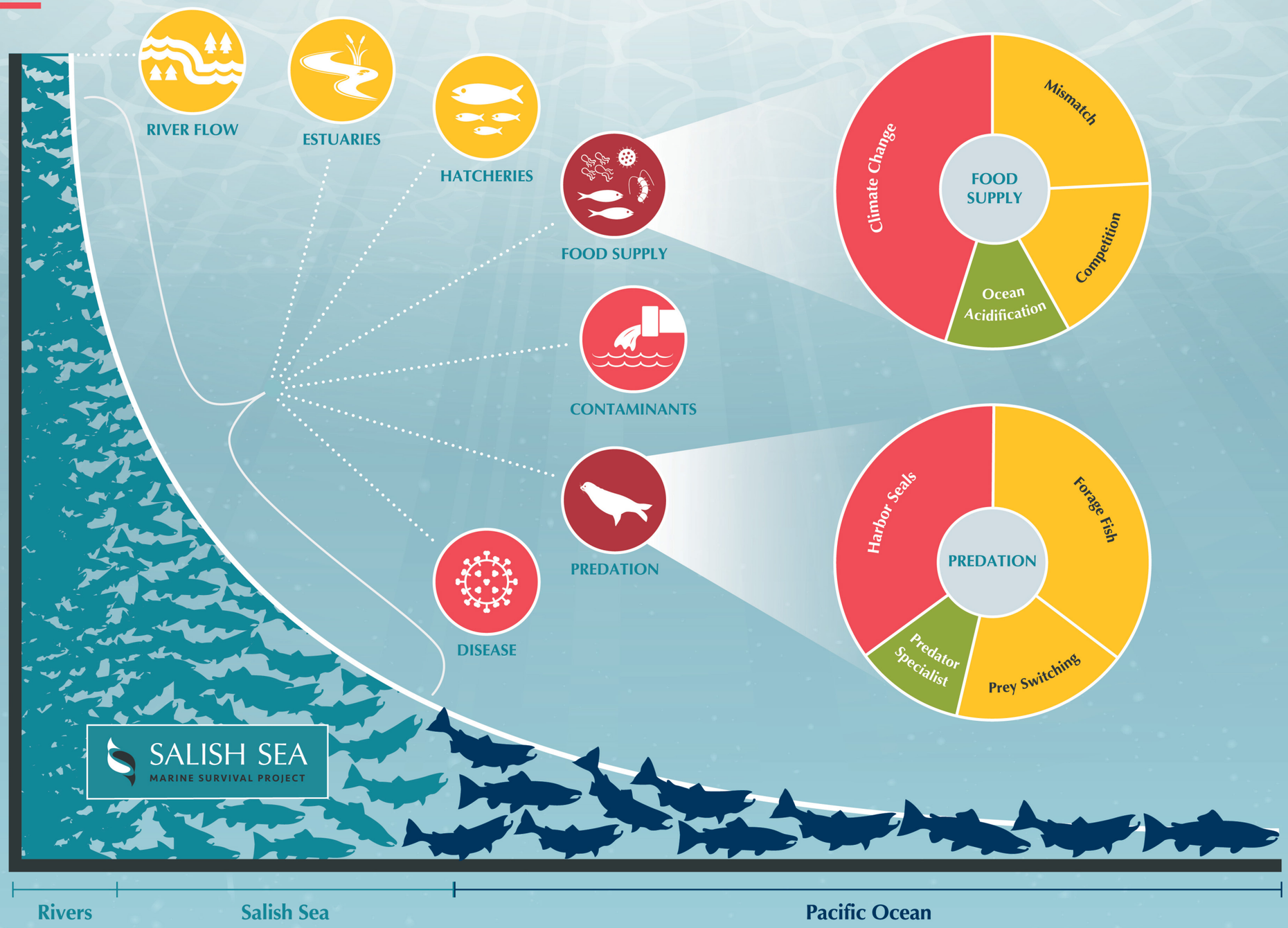
In reports developed for the Salish Sea Marine Survival Project, "local" includes the issues that we can address at the Salish Sea, Puget Sound, watershed, or site scale. The local recommendations that are best addressed at the Salish Sea or Puget Sound-wide scale or those most appropriately addressed by co-managers (WDFW & Tribes) are further detailed in NOAA's ESA Recovery Plan for the Puget Sound Steelhead Distinct Population Segment (2019) or the forthcoming Puget Sound Chinook Salmon Regional Recovery Chapter (Vol. 1) Update. The latter is currently under development by the Puget Sound Partnership (PSP) and recovery partners. PSP utilized the same Salish Sea Marine Survival Project findings, and received input from the SSMSP Coordinating Committee (a body made up of U.S. agency and Tribal scientists and managers that advised Long Live the Kings on the U.S. research and recommendations) in a joint meeting held in May 2021. Some of the regional recommendations are noted throughout for additional context to users of this guidance document. Some details may change as the regional work is finalized.

This guidance document focuses on local impacts that are best addressed at the watershed or project scale. These are organized below by the level of impact: very high (red) to medium (yellow). Regional or Puget Sound-wide strategies are addressed in regional documents, and in some cases included for context in this guidance document.

These were presented and discussed at regional findings workshops hosted by Long Live the Kings in the summer and fall of 2021. Attendees included Salmon Recovery Lead Entity staff and committee members, Local Integrating Organization coordinators, Marine Resource Committee staff (in North Sound), and natural resource staff from Tribal Nations.

Early Marine Survival in the Salish Sea

Impact Levels: Very High · High · Medium · Low



INFOGRAPHIC ILLUSTRATES THE RAPID DECLINE in number of juvenile salmon as they migrate downstream and through the Salish Sea. Impacts shown are those that were assessed as part of the Salish Sea Marine Survival Project. Impact levels were established by the project's lead scientists.

Legend

RIVER FLOW – Low river flows can expose young salmon migrating downstream to higher predation.

HATCHERIES – More hatchery Chinook are released at the same time now versus spread out over the spring as they were in the past. Pulses of hatchery fish can increase predation risk, potentially increase competition for food, or reduce chances of the fish entering the saltwater when prey is plentiful.

CONTAMINANTS – Young Chinook are contaminated with PBDEs or PCBs in many urban watersheds. PCBs continue to accumulate in Chinook that stay in Puget Sound to adult age.

ESTUARIES – Degraded estuaries and nearshore reduce shelter and prey for young salmon, in particular Chinook that use these habitats for some time.

DISEASE – More infectious agents are found in young Chinook and Coho in the Strait of Georgia compared to the open coastline.

FOOD SUPPLY – Zooplankton and forage fish, especially herring, have declined when young salmon need energy-rich food to grow and survive.

CLIMATE CHANGE – More days of sun, less wind, earlier spring river flows, and increasing water temperatures all can affect when, where and how much food is available for young salmon.

MISMATCH – Alterations in climate can change the timing of spring phytoplankton blooms, cascading through the food web so that zooplankton and herring are not available to young salmon in the size and quantities they need when they enter the Salish Sea.

COMPETITION – Competition for food between young salmon or between salmon and herring may occur when food supplies or habitat is limited.

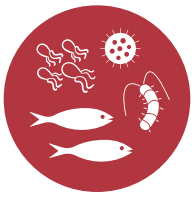
OCEAN ACIDIFICATION AND HARMFUL ALGAE – Ocean acidification and harmful algae pose concerns as climate change continues to affect our waters.

PREDATION / HARBOR SEALS – A massive increase in harbor seal abundance results in high predation rates of young salmon and steelhead.

FORAGE FISH – A primary food source for salmon predators, forage fish like herring are less abundant.

PREY SWITCHING – Prey switching may occur and hatchery fish targeted when they enter the Salish Sea en masse.

PREDATOR SPECIALISTS – At fish migration barriers and other bottlenecks, seals are specializing in eating young steelhead and salmon.



FIXING THE LOCAL FOOD SUPPLY

This is a complex issue, but the recommendations are very much in line with the types of habitat protection and restoration work that is planned and being implemented across much of Puget Sound. The recommended strategies and actions below may provide additional justification for continuing, expanding, or expediting existing work underway in local areas. Six high-level strategies, with more specific sub-strategies and actions, are described below.

LOCAL LEVEL STRATEGIES AND ACTIONS TO FIX LOCAL FOOD SUPPLY

Protect estuary and nearshore habitats, particularly pocket estuaries/embayments and feeder bluffs for salmon, Pacific herring, sandlance, and crab.

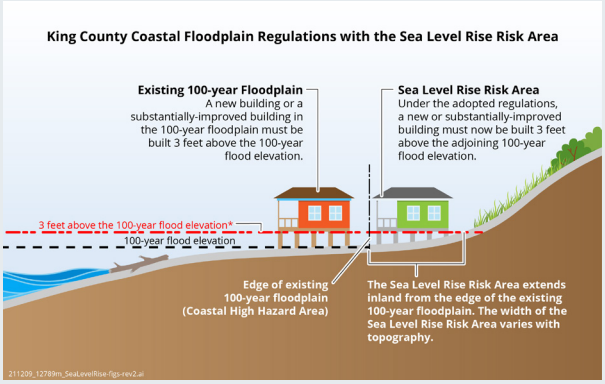
- Track non-compliant or illegal marine shoreline armoring. Note that it can often be politically challenging for local staff to get funding and approvals to conduct this work. While the relevant data are incredibly specific to parcels and individual watersheds, a monitoring program conducted at the regional level will likely be more successful and ongoing.
- Acquire high value habitat.
  - » Identify priority areas under threat of conversion.
  - » Draft an acquisitions strategy for nearshore and estuary parcels to more rapidly access funding when properties become available.
  - » Identify funding sources and position local acquisition projects for grant awards, including aligning these priorities with local programs such as the Conservation Futures Tax Program in each county.
- Increase compliance and enforcement of regulations to protect nearshore habitat and prevent armoring.
- Incorporate coastal squeeze and sea level rise in shoreline regulations.
- Remove shoreline armoring and improve sediment delivery from sources such as feeder bluffs, river and creek discharges, and sediment transport processes to support shoreline habitat formation and function.
- Coordinate with County and City Natural Resource Departments and Public Works/Roads to reduce or remove impacts of roadways on nearshore habitat.
- Follow prioritization frameworks developed locally for habitat protection and restoration.

Regional (Sound-wide) Recommendations to Fix the Local Food Supply:

- Recognize climate and oceanic changes to salmon prey in recovery plans and climate initiatives; develop monitoring and adaptive management responses.
- Continue to assess juvenile Chinook and Coho growth and survival during their first summer; add winter assessments if they appear to experience high mortality.
- Create an Implementation Strategy for Pacific herring as done for other Vital Signs.

The workshop participants recommended that the regional plan include monitoring shoreline armoring as a regional activity due to the challenges of funding and conducting such work at the local level.

- Use adaptive management to update and revise strategies, actions, and locations with the latest science:
    - » Incorporate research and findings presented at the Estuary & Salmon Restoration Program (ESRP) Nearshore Summit (proceedings available Winter 2022).
    - » Track and incorporate findings of Puget Sound Ecosystem Monitoring Program (PSEMP) Nearshore and Forage Fish and Food Webs work groups, ESRP learning projects, and others.



Example of incorporating sea level rise in shoreline regulations: This figure illustrates the boundary and associated building elevation requirements of the King County Sea Level Rise Risk Area, which applies only to **Vashon-Maury Island** in King County.

Support soft-shore initiatives to minimize habitat loss.

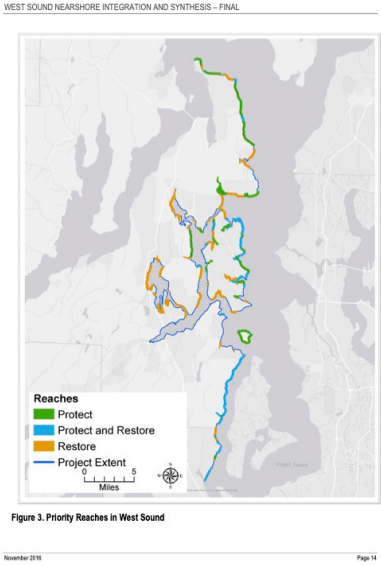
- Create incentives for nearshore landowners to protect non-armored beaches.
- Provide tools and incentives for nearshore landowners to restore habitat using soft-shore approaches and moving at-risk infrastructure that is threatened by erosion or sea level rise.
- Educate the public on how to steward the nearshore and maintain and restore native marine riparian vegetation.

Fund, design, and promote large-scale, process-based nearshore and estuary restoration projects.

- Include climate projections in restoration design.
- Increase function by coordinating among multiple entities, stringing together projects, and developing a project sequence or prioritization that maximizes beneficial functions.
- Increase connectivity between estuary, eelgrass, and kelp (see also in estuary strategy).

Enhance nearshore habitat where process-based restoration is not feasible.

- Nourish beaches using material of appropriate grain size for interim forage fish spawning habitat enhancement.
- Plant trees and shrubs on armored shorelines to shade forage fish spawning sites and increase egg survival.
- Supplement spawning substrate for forage fish using traditional ecological knowledge and innovative solutions.

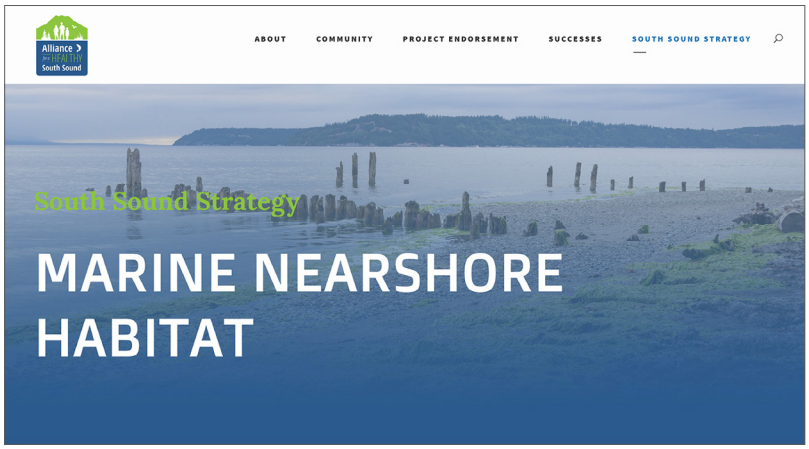


One example of a local prioritization is the West Sound Nearshore Integration and Synthesis of Chinook Salmon Recovery Priorities.

Restore seagrasses and kelps.

Follow findings from the 2021 report on eelgrass restoration technique and outcomes for the U.S. West Coast, noting that site selection is the most important factor for project success (see resources section for link).

- Remove overwater structures, pilings, mooring buoys, and marine debris.
- Consider kelp protection and restoration as an important approach to ensuring that larval crab and other zooplankton have marine habitat structure and function to increase the diversity of food sources available to juvenile salmon, in areas where kelp is, or historically was, naturally occurring and known to support juvenile salmonids.



*Alliance for a Healthy South Sound uses WDFW's forage fish data to track progress and adaptively manage their work (see **resources** section for link).*

Assess, recover, protect, and maintain diversity in Pacific herring populations.

- Follow recommendations of the *Assessment and Management of Pacific Herring in the Salish Sea* report (see resources section for link) until a regional Implementation Strategy is developed.
- Track local research and monitoring of herring and adaptively manage based on local data.
- Recover Cherry Point herring stock.

Improve marine water quality.

- Follow recommendations in Puget Sound Partnership's Marine Water Quality Implementation Strategy.
- Adaptively manage with latest data and monitoring.
- Utilize tools and resources available from Puget Sound Partnership and the WA Department of Ecology (e.g., Eyes Over Puget Sound website).

SHORE FRIENDLY

Shore Friendly is an incentive program for private landowners of marine shorelines in Puget Sound. Shore Friendly programs are active in each county. For more information, see the Shore Friendly website: **www.shorefriendly.org**.

A 2021 feasibility study looked at demand and options for a residential shoreline revolving loan program for homeowners as a new incentive of Shore Friendly.

Nisqually Indian Tribe and LLTK adapted traditional methods to create supplemental spawning substrate for herring by deploying evergreen boughs at traditional herring spawning locations.

ADDRESSING PREDATION

The increase in predators, particularly harbor seals, is a complex issue to largely be addressed by the co-managers. The Chinook Salmon Regional Recovery Chapter Update (forthcoming) will include the importance of addressing this issue at the appropriate scale. The Washington Department of Fish and Wildlife (WDFW) and Tribes are conducting additional research to improve data on the population size and better define and identify hotspots. Local implementer engagement may be appropriate and necessary where hotspots are known and possible solutions are identified. Two well known hotspots are the Hood Canal Bridge and Ballard Locks.

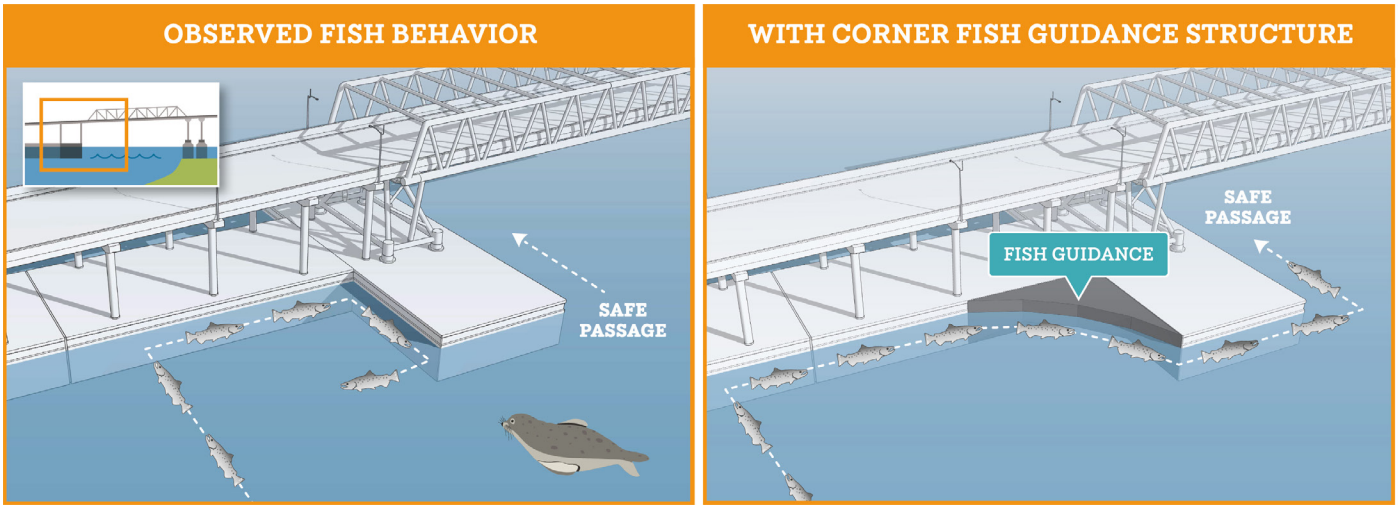
The findings of the Salish Sea Marine Survival Project show that removal of over 50 percent of the seal population may be necessary to see an increase in salmonid survival. This is not seen as a viable strategy for many reasons; therefore, the strategies below are recommended in addition to putting a major emphasis on increasing the food supply (forage fish) to act as buffer prey.

Predation and food supply are inter-related. Regional strategies to address predation can include supporting life-history variability through habitat restoration*, population management and experimenting with various hatchery rearing and releasing strategies.

**Lead entities who are implementing a wide variety of habitat protection, restoration, and enhancement actions are already using the strategies to encourage life-history variability. Diversity of habitats is necessary to support diversity of life-histories. This should be considered and communicated as project sponsors draft proposals, Lead Entity groups develop scoring criteria, and recovery chapters are updated.*

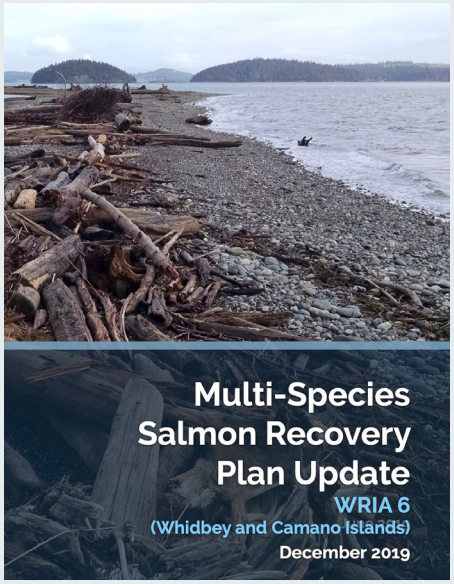
LOCAL LEVEL STRATEGIES TO ADDRESS PREDATION AT HOTSPOTS

- Facilitate fish passage at migration barriers (see graphic below).
- Utilize and test predator deterrents (such as acoustic devices).
- Obstruct/remove log booms and other haul-outs.
- Prevent low streamflows (to deter avian and other upstream predators).
- Recover forage fish (see the above strategy).



Facilitating Steelhead Passage at Hood Canal Bridge. Source: Long Live the Kings

Local recovery plans/chapters and ecosystem recovery plans should note the importance of predation as a regional threat to be addressed at the appropriate scale and call on the right players to fulfill that role. The WRIA 6 Multi-Species Salmon Recovery Plan Update provides a good example of a plan that highlights the issue but puts the role of assessing and managing predators on the region (see resources section for link).



(*) These actions were identified in the 2005 Salmon Recovery Plan. However, since then, strategies and efforts to address predation have been determined to fall outside of local Lead Entity control and should be enacted upon at the regional level by entities like the Puget Sound Partnership, NOAA, WDFW and other co-managers.

Objective 3: Quantify and evaluate impacts of predation by marine mammals and other wildlife on salmonid and forage fish populations (e.g. Orca, Sea Lion, Harbor Seal, Heron, Cormorants, Mergansers, Humans, etc.)	Action 2.3.1 - Encourage the state and federal agencies to determine if it would be appropriate for NOAA Fisheries to transfer management oversight of pinnipeds to the WA Department of Fish and Wildlife	N/A*
	Action 2.3.2 - Assist a study of predation (seals, sea lions, and other wildlife) in WRIA 6 on salmonids and forage fish (by species/stock) and collaborate with neighboring watershed groups on projects specific to their stocks	N/A*
	Action 2.3.3 - Assist with WDFW to identify realistic levels of predation on salmon and forage fish	N/A*
	Action 2.3.4 - Collaborate with WDFW to identify sustainable predator population levels and methods to achieve these levels	N/A*
	Action 2.3.5 - Compare the impacts on salmon caused by predation versus the impacts caused by habitat loss/degradation	N/A*

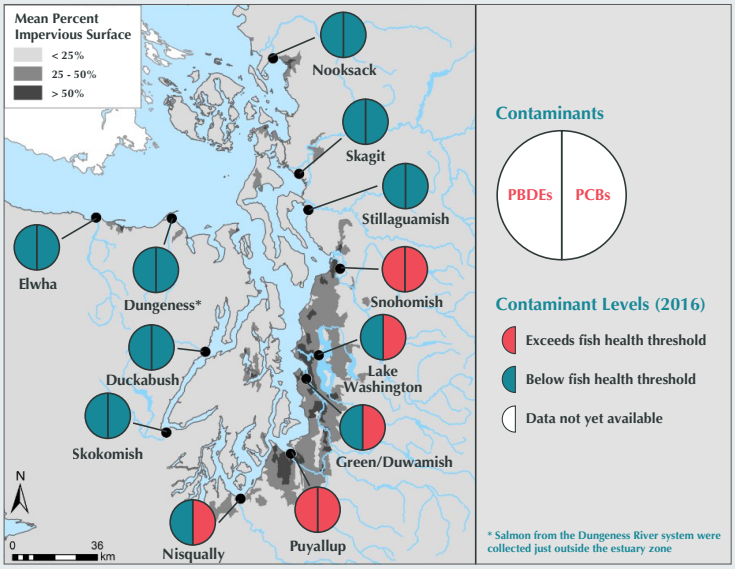
During the regional findings workshops, questions arose about how hotspots are defined and identified. A paper by WDFW and partners will be published soon to help answer these questions. All new publications and technical reports will be posted on the Salish Sea Marine Survival Project website.

STRATEGICALLY ADDRESS CONTAMINANTS

Contaminants are ranked as a high priority issue for increasing marine survival of salmonids. This is a broad category that includes some regulated and unregulated compounds. Others are just beginning to be discovered or understood. The contaminant signature differs by geography throughout Puget Sound. The regional approach to contaminants as they relate to early marine survival include: reducing contaminant burdens where impacts are greatest; determining the PCB pathways in the Puget Sound food web; focusing larger-scale remediation efforts on PCB hotspots for Chinook residing in Puget Sound; and assessing contaminants of emerging concern (CECs) and supporting actions to reduce Urban Runoff Mortality Syndrome (URMS).

LOCAL LEVEL STRATEGIES TO REDUCE CONTAMINANTS

- In areas identified as contaminant hotspots, engage with existing or planned remediation, clean-ups, natural resource damage assessments, or other processes to ensure that salmon recovery is being considered.
- In areas where marine survival is known to be tied to contaminants, like flame retardants (PBDEs) in the Snohomish Estuary, engage in identifying, funding and testing solutions and/or mitigating exposure of smolts.



Symbols on this map indicate sites where contaminants in juvenile Chinook salmon exceed (red) or remain below (green) adverse health effects thresholds. Source: PSP 2021: https://vitalsigns.pugetsoundinfo.wa.gov/VitalSignIndicator/Detail/49

INCREASE THE PACE OF ESTUARY RESTORATION

While estuary restoration is a medium priority for increasing marine survival, this is well aligned with work underway in natal estuaries around Puget Sound. Creating habitat for fish that migrate to the estuary as fry, especially in urbanized estuaries, is important for increasing the survival of those populations. Restoring habitat for all outmigrating salmonids to remain in estuaries longer and grow larger before entering marine waters is important for increasing overall survival. All estuaries are important for providing rearing habitat and a place for Chinook and Coho smolts to grow before entering marine waters.

LOCAL LEVEL STRATEGIES AND ACTIONS TO RESTORE ESTUARIES

- Step up efforts to restore estuary habitat in urbanized and urbanizing estuaries to create rearing habitat, particularly for fry migrants.
- Ensure availability of shallow water edge habitat.
- Connect marsh, eelgrass, and kelp habitats (also included in fix food supply strategies above).
- Reduce presence of overwater structures in estuaries.
- Prioritize projects for acquisition and restoration.
- Model future sea level rise and build projections into target-setting, project prioritization, and project design.
- Utilize the results of the Salish Sea Marine Survival Project to elevate the priority and further justify estuary restoration as part of a recovery strategy.
- Consider more than just tidal wetland extent and incorporate the latest fish use data (local and regional), as estuary conditions are monitored and future projects are planned.

INCORPORATE WATER QUANTITY IN RECOVERY CHAPTERS

There are many reasons for plan updates and new recovery plans to incorporate streamflow. The forthcoming Puget Sound Chinook Salmon Regional Recovery Chapter Update addresses the topic, which was left out of the original plan. This is a medium priority as it relates to increasing marine survival, but the recommendations below align with others related to managing water quantities and instream flows for fish. The research findings point to considering streamflow not just within a freshwater context, but in how the timing and volume of flow from rivers can influence the food web. In addition, low flow in freshwater can lead to increased predation by avian predators at barriers or in dewatered reaches, reducing the survival of smolts migrating downstream. Most of the recently updated Chinook recovery chapters incorporate flow as a key issue for overall recovery.

LOCAL LEVEL STRATEGIES TO ADDRESS LOW FLOW

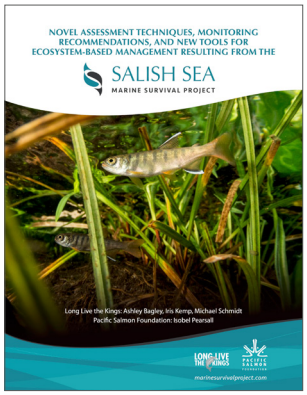
- When setting or managing for flow in a watershed or subwatershed, consider impacts on the marine food web and instream predation of salmonids.
- Incorporate dam management and Federal Energy Regulatory Commission (FERC) relicensing in recovery plans.
- Develop capital projects that protect and restore water instream; push for regulatory reform and policies that protect instream water for fish.

MAINTAIN, FUND, AND IMPROVE MONITORING PROGRAMS

Within the local and regional recovery plans, it is important to incorporate or note the need for both regional and local monitoring efforts to continue to build on the findings and test recommendations of the Salish Sea Marine Survival Project. In particular, monitoring related to the following topics is of primary importance for furthering our understanding and adequately addressing early marine survival:

- Oceanography
- Zooplankton
- Juvenile salmonids and herring
- Seal and sea lion demographics and diets

See the Novel Assessment Techniques, Monitoring Recommendations, and New Tools for Ecosystem-Based Management Report on the Salish Sea Marine Survival Project website for more details.



Other Resources, Examples, and Useful Links:

Alliance for a Healthy South Sound. South Sound Strategy – Nearshore Marine Habitat and **Nearshore/Marine Mapping Tool**. Available at: South Sound Strategy: Marine Nearshore Habitat – Alliance for a Healthy South Sound & AHSS - South Sound Strategy - Interactive Mapping Tool (squaxin.us).

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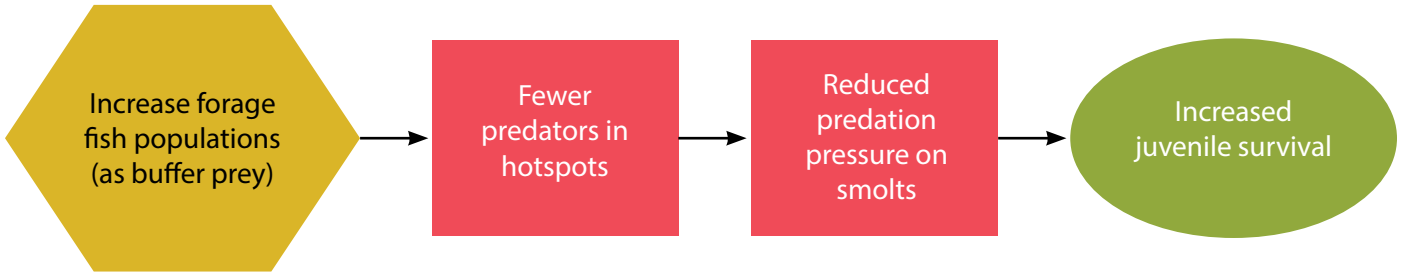
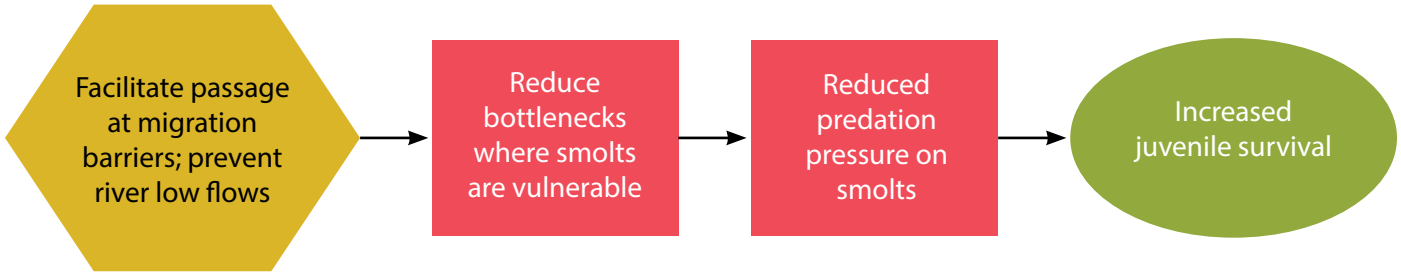
SIMPLIFIED RESULTS CHAINS FOR KEY STRATEGIES

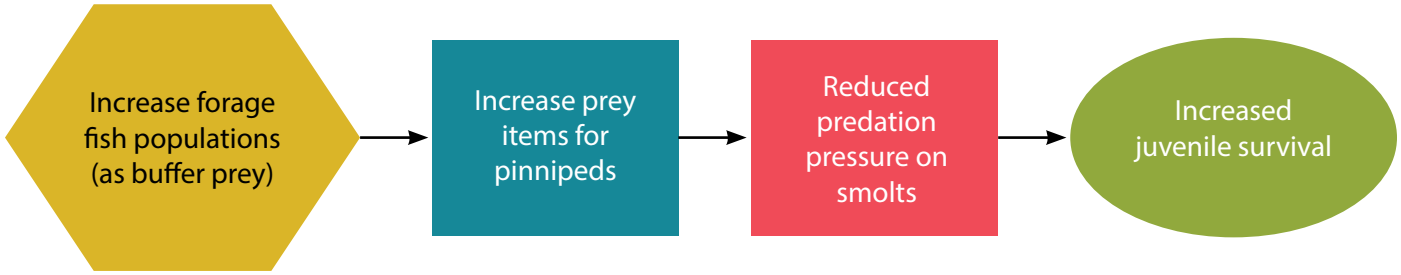
The following results chains are meant to be tailored, updated, and built out by local teams as part of the adaptive management process to incorporate the Salish Sea Marine Survival Project findings into recovery plans and processes.



Result Chain for increasing buffer prey: This logic model includes forage fish as a recovery strategy for salmonids; other strategies incorporate forage fish as an ecosystem component.



Result Chain for facilitating migration locally: This logic model assumes that more smolts moving through an unobstructed migration pathway will result in decreased predation overall and increased survival of the populations using these pathways.



Result Chain for increasing buffer prey: This logic model includes forage fish as a recovery strategy for salmonids; other strategies incorporate forage fish as an ecosystem component.

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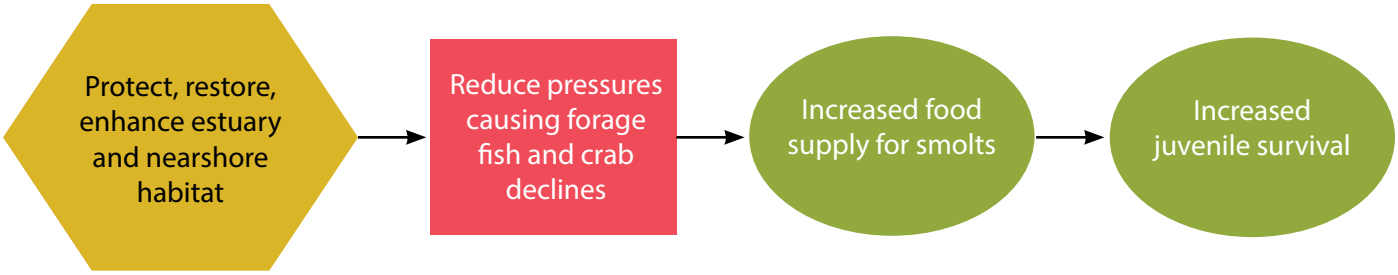
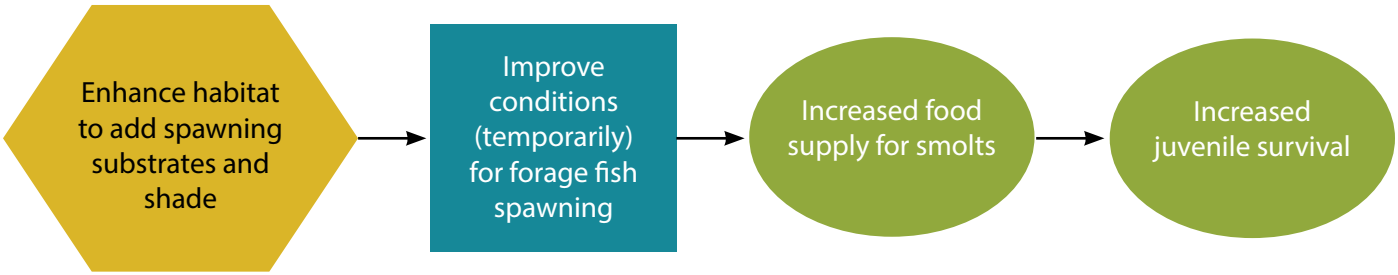
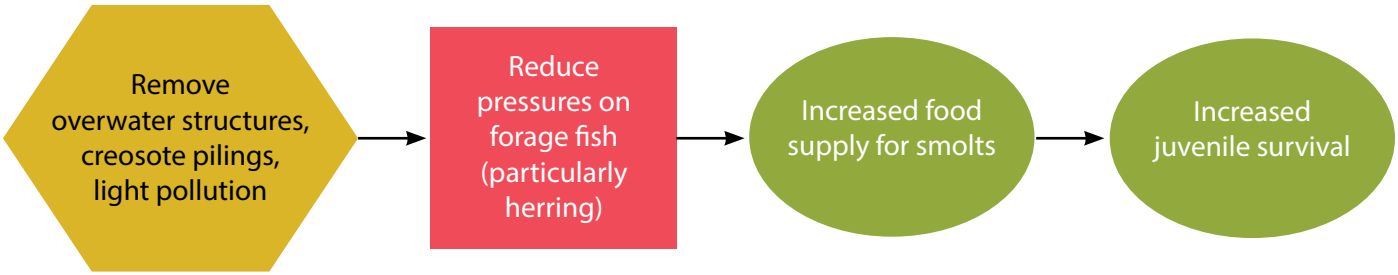


Result Chain for increasing food supply: This logic model follows the findings that marine survival is directly related to growth rates, which increase as fish rear in functional habitats and food supply is abundant and available (in the right place at the right time). There are myriad other benefits to estuary and nearshore protection and restoration not included in this simplified chain.



Result Chain for increasing buffer prey: This logic model includes forage fish as a recovery strategy for salmonids; other strategies incorporate forage fish as an ecosystem component.



Result Chain for increasing Pacific herring: This logic model represents recommendations from the Assessment and Management of Pacific Herring in the Salish Sea report; in addition, monitoring and understanding habitat requirements for herring are important.