HOOD CANAL COORDINATING COUNCIL

Hood Canal Shellfish Initiative

Action Plan

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Follow the Hood Canal Shellfish Initiative

Learn more about the Hood Canal Shellfish Initiative and track implementation progress at HCCC.wa.gov/ShellfishInitiative and OurHoodCanal.org.

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List of Abbreviations

BMPs: Best Management Practices
DNR: Washington State Department of Natural Resources
DOH: Washington State Department of Health
EPA: Environmental Protection Agency
GIS: Geographic Information System
GPS: Global Positioning System
HCCC: Hood Canal Coordinating Council
HCRPIC: Hood Canal Regional Pollution Identification and Correction
HCSI: Hood Canal Shellfish Initiative
IWP: Integrated Watershed Plan
LIO: Local Integrating Organization
MSP: Marine Spatial Planning
NEP: National Estuary Program
NOOC: Native Olympia Oyster Collaborative
OSPI: Washington State Office of Superintendent of Public Instruction
OSS: On-site Septic System
PCSGA: Pacific Coast Shellfish Growers Association
PIC: Pollution Identification and Correction
PSI: Pacific Shellfish Institute
PSRF: Puget Sound Restoration Fund
SDM: Structured Decision Making
WDFW: Washington State Department of Fish and Wildlife
WSDA: Washington State Department of Agriculture
WSI: Washington Shellfish Initiative

Executive Summary

The Hood Canal Shellfish Initiative (HCSI) supports and expands Hood Canal's thriving shellfish populations by identifying coordinated and mutually beneficial strategies and actions that honor Tribal treaty rights, build resilience, pursue ecosystem protection and restoration, and support careful stewardship of commercial shellfish activities and recreational harvest now and into the future.

The HCSI Action Plan operationalizes this goal and guides shellfish planning and funding efforts across Hood Canal. The Action Plan contains a comprehensive review of the barriers to and opportunities for sustaining robust Hood Canal shellfish resources and supporting a healthy ecosystem and community. Objectives, focal policy areas, and priority actions identified in the Action Plan serve to support the ecological, commercial, recreational, and human wellbeing dimensions of Hood Canal shellfish.

A Foundation of Collaboration

The HCSI is built on a foundation of collaboration. In the years preceding the development of the HCSI Action Plan, HCCC staff and members of its Board of Directors formed an ad hoc steering group with local shellfish partners to identify objectives for the HCSI to pursue, and generally build interest and momentum around the idea and concepts of the HCSI. Their work set the foundation and provided early guidance for HCSI Action Plan development.

Aa representative and inclusive workgroup representing a variety of Hood Canal shellfish interests developed the action plan using a transparent and consensus-based decision-making process over the course of 10 meetings. A full list of HCSI Workgroup participants is listed in Appendix A.

HCSI Action Plan Recommendations

The HCSI Action Plan contains six objectives, and 69 prioritized actions to achieve the HCSI goal.

Objectives

Six objectives were developed based on the preliminary guidance from the steering group. The objectives represent interests expressed from across the workgroup and create the framework for balanced approaches to advance their work while avoiding adverse impacts.

HCSI Action Plan Objectives:

1. Protect and improve Hood Canal's water quality
2. Protect and improve shellfish habitat
3. Promote cultural appreciation of Hood Canal shellfish
4. Support a sustainable Hood Canal commercial shellfish industry
5. Expand harvest opportunities for treaty Tribes, local communities, and visitors
6. Restore native Olympia oyster populations in Hood Canal

Action Plan Prioritization

The HCSI Workgroup developed specific actions to achieve each HCSI objective (see Appendix B for a full list of HCSI Actions). A sub-set of 18 actions, listed below, were identified as the HCSI's top priorities, selected for their overall impact to achieve the objectives.

HCSI Priority Actions

Rank	Action
1	1.A.1: Implement Pollution Identification and Correction (PIC) programs
2	5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites
3	2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat
4	2.D.4: Support culvert removal and restoration for important shellfish habitat
5	1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)
6	1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs
7	2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques
8	2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species
9	1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds
10	2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat
11	1.A.5: Ensure on-site septic system maintenance records are up to date
12	6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan
13	3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish
14	6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal
15	3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate
16	4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs
17	5.C.2: Develop a guide for boat-in shellfishing access and best practices
18	4.B.2: Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")

The top rated HCSI action is Action 1.A.1. Implement Pollution Identification and Correction (PIC) programs. As the primary means of marine water quality protection to find and prevent non-point pollution from impairing the nearshore ecosystem – and essential for healthy shellfish beds – PIC work has a critically important role across the entire HCSI. Multiple actions under Objective 2 (Shellfish Habitat) also make up the priority list. There are many interconnected and multi-beneficial actions on this priority list. When undergoing implementation, these connections should be explored and

coordinated whenever possible, to sequence projects as necessary, leverage resources, and maximize beneficial project outcomes.

Next Steps

The HCSI Action Plan is a starting point for focused efforts to achieve the HCSI goal – to support and expand Hood Canal's thriving shellfish populations, honor Tribal treaty rights, build resilience, pursue ecosystem protection and restoration, and support careful stewardship of commercial and recreational shellfish harvest now and into the future.

The HCCC Board of Directors will provide ongoing oversight and direction as the HCSI enters its implementation phase, the funding strategy is developed and future funding sources are identified, and as adaptive management occurs. A sub-group of HCCC's Integrated Watershed Plan (IWP) Steering Committee will be formed to provide ongoing technical expertise to inform specific actions and guide their implementation, develop funding recommendations, and revise action plan priorities.

Implementation

HCSI Action Plan development was funded as a Puget Sound Action Agenda Near Term Action (2018-0386) with an Environmental Protection Agency (EPA) National Estuary Program (NEP) grant (federal assistance agreement PC-01J18001/WA Dept. of Health contract number: CBO24135) selected by the Hood Canal Local Integrating Organization (LIO). The HCSI NEP grant includes funds to jumpstart action plan implementation. Continued implementation of the HCSI will rely on partner commitments to use this plan and obtain and sustain funding for project implementation. HCCC will pursue implementation via the following approaches:

Hood Canal Partner Commitments

The success of the HCSI will be determined by its adoption and use as an authoritative plan for Hood Canal shellfish protection. HCCC will work with Hood Canal shellfish partners to gain commitments from local governments, ecosystem recovery partners, and industry partners to use the HCSI Action Plan as a framework to guide programmatic efforts and direct available funding sources.

Public-Private Partnerships

The commercial shellfish industry's reliance on clean water and healthy marine ecosystems closely connects growers and harvesters with the local governments and Tribes who protect and steward those resources. Tribes, local governments, and private industry have resources and tools to contribute to the health and sustainability of the Hood Canal ecosystem. HCCC will cultivate public-private partnerships to leverage these combined resources to advance actions that address both the Hood Canal commercial shellfish industry's and the public's needs.

Grant Funding

HCCC anticipates that many of the actions presented in the HCSI Action Plan will be funded by grants. HCCC will pursue grant sources for targeted project implementation based on the priority actions.

Adaptive Management

Integration with the Hood Canal Integrated Watershed Plan

The development of the Hood Canal Shellfish Initiative is a longstanding priority in HCCC's Integrated Watershed Plan (IWP), the strategic priorities to protect and recover Hood Canal's social-ecological system (learn more about the IWP at OurHoodCanal.org). The HCSI Action Plan will be integrated into HCCC's IWP, allowing the IWP to expand and amplify its shellfish protection strategies, goals, and priorities. The IWP Steering Committee and HCCC Board of Directors will continue to provide oversight and guidance of HCSI implementation, funding pursuits, adaptive management, and accountability.

Evolving Priorities

The HCSI will continue to evolve as ecosystem conditions change and science develops. HCCC anticipates revisiting the HCSI priorities every four years, to reassess the urgency of specific actions and address emerging issues. The IWP Steering Committee sub-group for the HCSI will be tapped to lend their expertise to an updated prioritization process, and public feedback will be sought from the broader community of Hood Canal shellfish partners.

HCCC anticipates hosting a regular Hood Canal Shellfish Summit as funding allows, to bring together and strengthen partnerships among Hood Canal shellfish interests, share HCSI progress and achievements, and affirm new priorities. HCCC will look to both public and private shellfish partner contributions to facilitate a regular community event.

Effectiveness Monitoring

HCCC will use the HCSI monitoring plan to track progress made toward each objective and measure the long-term effectiveness of the HCSI. Each objective was assigned a performance measure that will be monitored over time to evaluate the success of the objective (Table 3). Aspirational targets were set for each objective, representing the desired level of performance. Appropriate and timely data sources were selected to accurately measure the performance measures, and a contact was identified for each dataset. The monitoring plan will be adaptively managed over time to reflect the latest knowledge and data.

The Hood Canal Shellfish Initiative

The Hood Canal Coordinating Council (HCCC) is working with Hood Canal shellfish partners to build on the momentum of the Washington Shellfish Initiative (WSI) introduced by the Washington State Governor's office in 2011 and advanced in 2016 to develop a Hood Canal Shellfish Initiative focused on local issues and priorities to produce locally beneficial outcomes.[1]

HCCC member governments' jurisdictional boundaries dissect the Hood Canal watershed, including Jefferson, Kitsap, and Mason Counties, and the lands and waters of the Port Gamble S'Klallam and Skokomish Tribes. HCCC brings these governments together to address transboundary resource management issues with a mission to work with partners and communities to advance a shared regional vision to protect and recover Hood Canal's environmental, economic, and cultural wellbeing.

The Hood Canal Shellfish Initiative (HCSI) is a collaborative effort to enhance Hood Canal's shellfish resources that seeks the following **opportunity for action** defined by the HCSI workgroup:

> Hood Canal is characterized by its iconic shellfish, which are ecologically, culturally, and economically critical to local communities. The opportunity to promote resilience of Hood Canal shellfish to environmental and human pressures is uniquely served by a collaborative, diverse network of stakeholders invested in Hood Canal's long-term vitality and identity.

HCCC worked with Hood Canal shellfish partners in a collaborative and inclusive process with a goal to support and expand Hood Canal's thriving shellfish populations, honor Tribal treaty rights, build resilience, pursue ecosystem protection and restoration, and support careful stewardship of commercial and recreational shellfish harvest now and into the future. The HCSI Workgroup identified coordinated and prioritized strategies and actions to achieve this goal in accordance with key values that ensure the effectiveness of this effort:

- Develop multi-benefit strategies that are inclusive of all shellfish users
- Emphasize local issues and locally specific solutions:
    - Ensure feasibility and selectivity: Focus efforts where they will be most effective
    - Build on the Washington Shellfish Initiative

HCSI Goal

To support and expand Hood Canal's thriving shellfish populations, honor Tribal treaty rights, build resilience, pursue ecosystem protection and restoration, and support careful stewardship of commercial and recreational shellfish harvest now and into the future.

For the purposes of this action plan, "shellfish" is broadly defined to include all native and non-native bivalves and crustacean species that occupy Hood Canal waters.

The Hood Canal Shellfish Initiative Action Plan (Action Plan) contains a comprehensive review of the barriers and opportunities to sustain robust shellfish populations that support a healthy ecosystem and community. It establishes objectives, selects policy areas of focus, and prioritizes actions to address the commercial, recreational, ecological, and human wellbeing aspects of Hood Canal shellfish. The Action Plan presents a collaboratively prioritized list of actions to guide the planning of shellfish protection, management, and funding efforts across Hood Canal.

[1] Washington Governor Jay Inslee. *Gov. Inslee's Shellfish Initiative*. https://www.governor.wa.gov/issues/issues/energy-environment/shellfish.

Hood Canal's Shellfish Connection

Hood Canal is a narrow fjord fed on its west side by steep river drainages that cascade from the forests and glacial mountains of the Olympic Peninsula to produce a regular supply of cold fresh water, spilling out onto its wide tidal flats, and creating perfect habitat for vast shellfish populations. Humans have harvested shellfish here since time immemorial. Those practices continue today by the area's local residents and its numerous visitors, and remain of critical importance to Native American Tribes whose members harvest in Hood Canal. Beyond our human connections to shellfish, they are considered "ecosystem engineers" for the outsized role they play in forming, modifying, and maintaining habitat. Shellfish also provide ecosystem services, including regulating and supporting services, such as their abilities to stabilize the nearshore benthic environment, filter vast quantities of water and cycle nutrients, as well as the provisioning of food and human cultural benefits.[2, 3]

Our relationship to shellfish is built on more than their economic and environmental benefits - they are also a key component of the region's identity. In the 2018 Puget Sound Partnership human wellbeing Vital Signs survey, Hood Canal residents reported that they harvest shellfish recreationally, for subsistence, or ceremonially an average of one to two times per season and 45% reported participating in activities or traditions related to the environment at least once a month; over 85% said that they are attached or very attached to the natural environment.[4]

The local economy is buoyed by natural resource industries, with commercial shellfish operations maintaining a prominent role in Hood Canal's livelihood and identity, in addition to the invaluable ceremonial and subsistence value of shellfish to Hood Canal Tribes. The shellfish industry in Hood Canal (including aquaculture, and Tribal and non-Tribal wild harvest) supplied 13.2% of the state's shellfish production in 2015 (4M lbs.).[5] There are an estimated 520 shellfish aquaculture industry jobs across Jefferson, Kitsap and Mason counties and every dollar spent in the shellfish aquaculture industry results in a $1.82 return in economic activity.[6] Additional jobs and value is created by Tribal commercial shellfish harvest on public and private lands.

Put simply, Hood Canal means shellfish. Its locales are recognized on oyster tasting menus throughout Puget Sound, across the U.S., and abroad. Tourism is now the principal economic driver in the area, driven in part by access to shellfish.[7] Folks continue to visit their favorite spots on Hood Canal's beaches where they and their families have harvested clams and oysters for generations.

While the shellfish industry's importance to the region cannot be over-stated, the tradeoffs of resource use cannot be ignored. Shellfish both need and cannot be separated from the ecosystem – the acts of producing and harvesting them at higher than natural rates have effects on other species and ecosystem

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[2] Pacific Shellfish Institute. *Ecosystem Services. http://www.pacshell.org/ecosystem-services.asp*.
[3] Wagner, E. *Gifts from the sea: shellfish as an ecosystem service*. Encyclopedia of Puget Sound. 12/11/2014. https://www.eopugetsound.org/magazine/shellfish.
[4] Fleming, W., Biedenweg, K. *Visualizing Human Wellbeing in the Puget Sound. A report on the 2018 Subjective Human Wellbeing Vital Signs*. Puget Sound Partnership. 2018. https://kellybiedenweg.weebly.com/uploads/9/4/0/6/94065145/visualizing_human_wellbeing_in_the_puget_sound_2018report.pdf.
[5] WA Department of Fish and Wildlife. *Aquatic Farm Permit Data (2013-2019).* 2020.
[6] Northern Economics, Inc. *The Economic Impact of Shellfish Aquaculture in Washington, Oregon and California*. Prepared for Pacific Shellfish Institute. April 2013. http://www.pacshell.org/pdf/economic_impact_of_shellfish_aquaculture_2013.pdf.
[7] Wellman, K. *Hood Canal Economic Data*. Northern Economics. July 11, 2016.

processes, which requires careful management and continued research in order to better understand and minimize impacts.

Hood Canal's communities and its local and Tribal governments are committed to maintaining its place-based identity by protecting its shellfish from the increasing impacts of water pollution, land use changes from the region's dynamic population growth, increasing recreational and commercial demand, and the changing climate's effects on water temperature and chemistry.

Integration with HCCC's Integrated Watershed Plan

The development of the Hood Canal Shellfish Initiative is a longstanding priority in HCCC's Integrated Watershed Plan (IWP), the strategic priorities to protect and recover Hood Canal's social-ecological system (learn more about the IWP at OurHoodCanal.org). The 2017 HCCC IWP (the Hood Canal LIO Ecosystem Recovery Plan) includes the HCSI as a priority strategy (strategy 4.0).[8]

Moving forward, the HCSI Action Plan will be integrated into the IWP to expand and amplify its shellfish protection strategies, goals, and priorities. The IWP Steering Committee and HCCC Board of Directors will continue to provide oversight and guidance of HCSI implementation, funding pursuits, adaptive management, and accountability.

HCSI Action Plan Development

HCSI Workgroup

In the years preceding the development of the HCSI Action Plan, HCCC staff and members of its Board of Directors formed an ad hoc steering group with local shellfish partners to identify objectives for the HCSI to pursue, and generally build interest and momentum around the idea and concepts of the HCSI. Their work set the foundation and provided early guidance for HCSI Action Plan development.

Building from the ad hoc steering group, HCCC reached out to partners with a variety of perspectives related to shellfish in Hood Canal to form a representative and inclusive HCSI Workgroup and to develop HCSI Action Plan content. The HCSI Workgroup provided expert advice to guide the development of the HCSI framework, and detailed contributions to formulate HCSI Action Plan priorities. A full list of HCSI Workgroup participants is listed in Appendix A.

The Workgroup met 10 times over the course of 2020. Subgroups also convened intermittently to discuss Action Plan content in more detail. Agendas, presentations, and notes from each workgroup meeting can be found in HCCC's online library (hccc.wa.gov/resources). Workgroup meetings began in-person but were adapted to virtual-only meetings as the COVID-19 pandemic began to spread in spring 2020 and in-person gatherings were restricted. This resulted in more frequent, but shorter meetings than originally planned as the workgroup adapted to the new work environment.

Workgroup decisions were arrived at by consensus, ensuring that diverse perspectives were captured and included in the Action Plan, making it a robust reference for inclusive, integrated, and effective

[8] Hood Canal Coordinating Council. *Hood Canal Local Integrating Organization Ecosystem Recovery Plan*. 2017. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20LIO%20Recovery%20Plan%2BAppendix_20170630.pdf.

shellfish actions that benefit the entire Hood Canal watershed. The HCSI Workgroup developed HCSI Action Plan recommendations for the HCCC Board of Directors' review and approval.

Structured Decision Making

HCCC applied a Structured Decision Making (SDM) framework to facilitate a transparent action planning process that considered shared values across the various interests represented by the workgroup. SDM is a collaborative decision-making process focused on developing a common understanding of an issue, common objectives for the issue, and then creating, evaluating, selecting, and implementing innovative solutions to meet those objectives. It is a combination of engaging partners to elicit their values, qualitatively framing an issue based on these values, and then conducting quantitative alternative consequence analysis for decision-making.[9]

Paramount to SDM is combining factual evidence with the values partners care about to inform decisions. This helps avoid the common problem in action planning processes of identifying actions that address the problem without first getting clarity on the values driving the action's selection and implementation. Following an SDM process ensures that the alternatives selected are accepted, high-quality, credible, and ultimately responsive to the values of partners.[10]

The HCSI Workgroup provided high-level guidance for the Action Plan in the form of an opportunity statement, goal, and objectives. With this framework in place, the workgroup then developed specific actions to address each objective. The full objectives-actions hierarchy can be found in Appendix B.

HCSI Objectives

Six objectives were developed to address needs across Hood Canal's shellfish partners and create the framework for balanced approaches to advance their efforts while avoiding adverse impacts. Performance measures were assigned to each objective to monitor the HCSI objectives' progress and effectiveness over time.[11]

Considerable overlap exists among the topics addressed by each objective, reflecting the many social-ecological system connections between the health of the Hood Canal watershed, shellfish, and the community. Most actions developed under each objective also impact other objectives. These synergies were integrated into HCSI Action Plan prioritization.

Resilience to future pressures associated with climate change (e.g. sea level rise, warming temperatures), ocean acidification, and changes to land use, are integrated throughout the objectives.

HCSI Objectives	
1	Protect and improve Hood Canal's water quality
2	Protect and improve Hood Canal shellfish habitat
3	Promote cultural appreciation of Hood Canal shellfish
4	Support a sustainable Hood Canal commercial shellfish industry
5	Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors
6	Restore native Olympia oyster populations in Hood Canal

[9] Dyson, B., et al.
[10] Ibid.
[11] See Monitoring Plan section for more details.

Objective 1. Protect and improve Hood Canal's water quality

Safeguard healthy shellfish populations and the community by supporting local water quality protection and enforcement programs, and preparing for climate impacts, such as temperature changes and ocean acidification, that directly affect their continued viability.

Good water quality is critical for healthy shellfish that are also safe to eat. Protecting and improving water quality will ensure that shellfish have the necessary conditions to grow healthy and productively. Healthy water quality has a positive impact on all other objectives; it is foundational to ensuring robust shellfish resources for their environmental and human wellbeing benefits.

Hood Canal water quality faces challenges from both natural and human sources. The topography of the area and bathymetry of Hood Canal itself can exacerbate poor conditions, as a sill near the narrow northern entrance prevents mixing of layers and blocks the inward flow of fresh cold water from the Strait of Juan de Fuca and the flushing of warm low oxygenated water out. Although Hood Canal has portions of extremely deep water, it shallows out at its southern terminus. Winds can push surface waters offshore pulling poorly oxygenated deep water up to the surface. All of these conditions can result in very low dissolved oxygen levels, which has led to fish kill events. Additionally, nearly all of Hood Canal is surrounded by communities using approximately 30,000 on-site septic systems (OSS) for wastewater treatment. Many of the systems are nearing their average lifespan of 30 years and many do not have regular maintenance, which protects systems and prevents problems. Sewage from failing OSS is a common source of shellfish bed closures in the area. Untreated stormwater runoff from roads and other impervious surfaces, agricultural runoff that transports fecal and chemical pollution from fertilizers and pesticides, sedimentation from upland forest road disturbance that has dramatically reshaped river flows and nearshore processes, algal blooms, marine debris, plastic pollution (both marine debris and microplastics and fibers),[12] and warming temperatures all exacerbate (or are exacerbated by) these conditions. The combination of these natural and human pressures makes water quality protection a top priority for the entire Hood Canal ecosystem. Oysters, clams, and mussels are especially susceptible to poor water conditions as they are mostly sessile species that cannot escape to seek better water elsewhere. The commercial shellfish industry and recreational and subsistence shellfish harvesters directly and immediately feel the impact of poor water quality conditions in Hood Canal when the State Department of Health closes beaches and growing areas due to these factors.

Objective 2. Protect and improve Hood Canal shellfish habitat

Protect and improve nearshore habitat through effective ecosystem restoration efforts and regional planning and policy approaches to address future social pressures from development and population growth that change our community's demands on Hood Canal natural resources and ecosystem services, and prepare for the increased impacts on habitat availability from climate pressures, such as sea level rise.

Protecting and improving nearshore habitat is critical for the continued propagation of shellfish, and other marine and terrestrial species in Hood Canal. Oyster reefs create important habitat and provide ecosystem services for hundreds of marine species, including fish, invertebrates, and other shellfish like

[12] Plastic pollution impacts from shellfish aquaculture debris is addressed in Objective 4

shrimp, crab, and mussels.[13] A regional ecosystem approach is needed to protect and improve important shellfish and nearshore habitat areas throughout Hood Canal. This objective recognizes that naturalized shellfish like Pacific oysters and Manila clams are commercially important for the local Hood Canal economy, provide food security for local Tribal and non-tribal communities, and are well established. Simultaneously, it is important that we sustain and improve native shellfish species in their native habitats and densities, focusing on those with reduced populations. A balanced approach will focus on actions that benefit both naturalized and native shellfish. Collaboratively identifying the holistic needs of important shellfish species, how they interact with other species, and the impact of nearshore habitat alterations on other species, coupled with pursuing appropriate regional protection and restoration of nearshore habitats will ensure that shellfish and the rest of the nearshore ecosystem continues to thrive in Hood Canal. Additionally, future pressures to the region related to population growth threaten shellfish habitat (e.g. shoreline infrastructure, water withdrawals, diversions and pollution, invasive species, harvest pressure, and oil spills), and need a coordinated response to mitigate potential impacts from these activities.[14] Climate change impacts from sea-level rise, warming marine waters, ocean acidification and other causes also present future pressures to shellfish habitat, and are addressed through actions in this objective[15].

Objective 3. Promote cultural appreciation of Hood Canal shellfish

Conduct and support outreach and education efforts that promote widespread cultural appreciation, and a placed-based identity connected with Hood Canal shellfish among the Hood Canal community and the numerous visitors who travel here to harvest, such as strengthening the connection between local food and Hood Canal's ecosystem, recognizing the importance of shellfish to Tribal communities, integrating shellfish topics into local school curricula, supporting programs, events, and resources about Hood Canal shellfish issues, and promoting community science programs.

Hood Canal shellfish are very important to the cultural identity of Hood Canal. Shellfish are not just a resource to be harvested; they also contribute to a strong sense of place, identity, and community cohesion held by Tribes, residents, and visitors. Tribal communities in Hood Canal have strong ceremonial and cultural connections to shellfish that provide a source of identity and pride for these communities. Data from the Puget Sound Partnership's *Visualizing Human Wellbeing in the Puget Sound* survey shows that at least once a year, 75% of Hood Canal residents participate in activities or traditions related to the environment (including shellfishing) that are important to their families or communities at least once a year, and nearly 50% participate at least once a month[16]. This shows a strong cultural attachment to this activity, and the value residents place on shellfish. The importance of shellfishing as a cultural activity is also reflected in the popularity of shellfish-related tourism in Hood Canal. Popular websites like ExploreHoodCanal.org and the Washington Shellfish Trail feature Hood Canal-specific shellfishing information, and popular events like the Hama Hama Oyster Rama, Brinnon Shrimpfest, OysterFest, and the Fjordin Crossin all prominently feature Hood Canal shellfish. Social media posts and email marketing campaigns promoting Hood Canal shellfish are continually popular with high levels of "open rates" and "clicks" to read linked information.[17] Strong connections among chefs and the broader

[13] NOAA Fisheries. *Oyster Reef Habitat.* https://www.fisheries.noaa.gov/national/habitat-conservation/oyster-reef-habitat.
[14] Hood Canal Coordinating Council. *Hood Canal Local Integrating Organization Ecosystem Recovery Plan*.
[15] Plastic pollution impacts from shellfish aquaculture debris is addressed in Objective 4
[16] Fleming, W., Biedenweg, K.
[17] Rachel Hansen. Northwest Event Organizers. *Personal communication*. Oct. 1, 2020.

culinary world also highlight Hood Canal shellfish in their restaurants, and organizations like the Olympic Culinary Loop strengthen these connections locally.

Objective 4. Support a sustainable Hood Canal commercial shellfish industry

Work to ensure that Hood Canal's commercial shellfish industry is strengthened and aligned with community and ecological values by promoting sustainable aquaculture and harvesting practices that minimize harmful environmental impacts and addressing operational barriers.

This objective seeks to support Hood Canal commercial shellfish industry while balancing the needs for sustainable growth, sound environmental practices, and ecosystem protection. The commercial shellfish industry is a sustainable natural resource industry with roots that go back many generations in Washington State and Hood Canal, where it is an important driver of the regional economy, providing jobs, attracting tourism, and contributing to the tax base in Hood Canal's rural counties. The Hood Canal commercial shellfish industry prides itself on its stewardship of the land and waters on which it operates.

Commercial shellfish operations in Hood Canal include both aquaculture production of oysters, clams, mussels, and geoduck using a variety of methods, as well as wild harvest of oysters, clams, geoduck, crab, and shrimp. Hood Canal Tribes conduct wild harvests on both leased and privately-owned tidelands. Figure 1a shows total Hood Canal shellfish aquaculture harvest trends over the past seven years while Figure 1b shows the trends in Hood Canal shellfish aquaculture harvest by species.

Since 1989 Pacific oyster and Manila clam have been the staple species of Hood Canal aquaculture, with mussel culture expanding in 2010. Pacific oysters have averaged 20% of Hood Canal shellfish aquaculture harvests over the past seven years, mussels made up 17%, Manila clams were 60% (with substantial increases over the past 15 years),

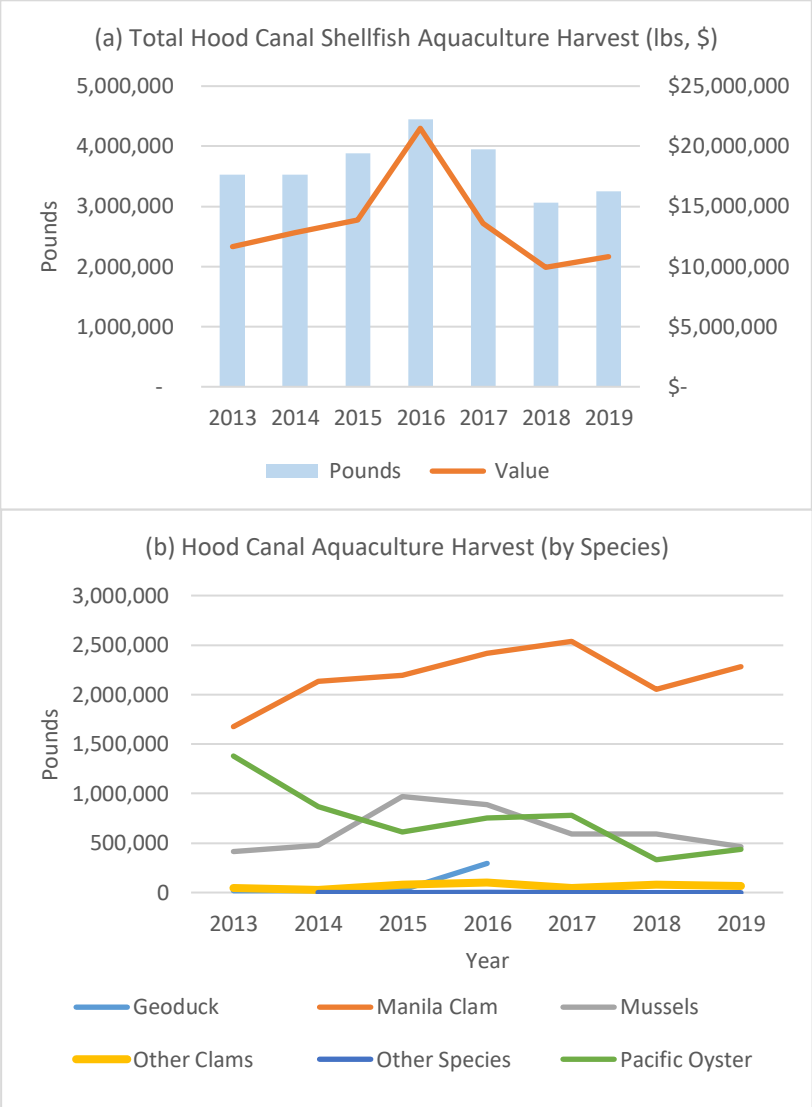

Figure 1: Hood Canal Shellfish Aquaculture Harvest (WDFW Aquatic Farm Permit data). (a) Total harvest measured in pounds and dollar value from 2013-2019. (b) Harvest by species from 2013-2019.

and geoduck were 1.4%, with other clam species at 1.7%.[18] Much of the oyster, clam, and mussel shellfish products are distributed domestically, both in the Pacific Northwest and across the United States, while a large majority of geoduck as well as oysters are exported to Asian markets.

The industry is sensitive to both variable environmental conditions and market fluctuations due to seasonal supply and demand issues, and trade policies.

Questions remain about the interactions between shellfish aquaculture and the sensitive marine nearshore environment – the eelgrass beds, benthic habitat, and wild species who share those areas. Many concerns are focused on geoduck farming, which puts young geoduck in large vertical PVC tubes placed closely together along the lower reaches of a tide flat during their first few years of growth. Considerable research has been conducted in Hood Canal and elsewhere in the state to understand potential impacts from shellfish aquaculture as well as the beneficial ecosystem services crops and gear provide.[19, 20, 21, 22, 23, 24, 25] This research has informed the Pacific Coast Shellfish Growers Association Environmental Codes of Practice as well as the various required shellfish aquaculture permits. Alternatives to PVC tubing are being explored in some areas of Puget Sound including Hood Canal, where at least one company has eliminated the use of PVC tubes, cover nets, and bands from farmed geoduck operations completely – relying instead on one piece polyethylene mesh tubes during the critical first two years that juvenile geoducks require predator protection.[26] Implementation of the HCSI provides an opportunity to identify knowledge gaps for future research on these topics to better assess and understand impacts and develop sustainable solutions.

Shellfish aquaculture also provides ecosystem benefits that enhance water quality, increase habitat availability for some species, and remove nutrients at harvest. Commercial shellfish beds can also maintain health better than wild beds that contain older, non-harvested populations. Shellfish reared in

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[18] WA Department of Fish and Wildlife. *Aquatic Farm Permit Data (2013-2019).*

[19] Washington Sea Grant. *Geochemical and Ecological Consequences of Disturbances Associated with Geoduck Aquaculture Operations in Washington*. https://wsg.washington.edu/research/geochemical-snd-ecological-consequences-of-disturbances-associated-with-geoduck-aquaculture-operations-in-washington/.

[20] Washington Sea Grant. *Community and Multitrophic Implications of Structure Additions Associated with Intertidal Geoduck Aquaculture*. https://wsg.washington.edu/research/sea-grant-aquaculture-research-program-2010-community-and-multi-trophic-implications-of-structure-additions-associated-with-intertidal-geoduck-aquaculture/.

[21] Washington Sea Grant. *An Ecosystem Approach to Investigate Direct and Indirect Effects of Geoduck Aquaculture Expansion in Washington State*. https://wsg.washington.edu/research/an-ecosystem-approach-to-investigate-direct-and-indirect-effects-of-geoduck-aquaculture-expansion-in-washington-state/.

[22] Washington Sea Grant. *Determining Whether Native Eelgrass and Pacific Oysters Synergistically Enhance Their Environments*. https://wsg.washington.edu/research/zostera-marina-and-crassostrea-gigas-as-potential-partners-in-a-changing-ocean/.

[23] Ryan, C. M., McDonald, P. S., Feinberg, D. S., Hall, L. W., Hamerly, J. G., and Wright, C. W. *Digging Deep: Managing Social and Policy Dimensions of Geoduck Aquaculture Conflict in Puget Sound, Washington*. Coastal Management, 45:1, 73-89. December 6, 2016. doi: 10.1080/08920753.2017.1252628.

[24] Pacific Shellfish Institute. *Off-Bottom Oyster Culture - Effects and BMPs*. http://www.pacshell.org/off-bottom.asp.

[25] University of Maryland. *Maryland-led, Multi-institutional Research Team Receives $10M to Transform Shellfish Farming with Smart Technology*. Maryland Robotics Center. June 24, 2020. https://robotics.umd.edu/release/marylandled-multiinstitutional-research-team-receives-10m-to-transform-shellfish-farming-with-smart.

[26] Joth Davis. Baywater Shellfish Company. *Personal communication*. Oct. 14, 2020.

aquaculture have less disease, higher densities, more water filtration, and greater mitigation capacity for managing nutrient pollution.[27, 28]

Marine debris is a persistent threat to Hood Canal. Aquaculture gear – the netting, anchors, tubing, mesh bags and other materials used to secure or protect shellfish as they grow on the tide flat – can break loose and wash up on beaches. Tides and currents can cause the debris to accumulate in some areas, which impairs the nearshore, blocks access, and negatively impacts beachgoer's experiences. Shellfish growers are currently required to label their gear and periodically patrol beaches in the vicinity of their farms for escaped gear as a condition of their Army Corps of Engineers permits, but more can be done to prevent and clean-up debris.

Public-private partnerships have been successful in researching and piloting new technologies to better understand species interactions with shellfish aquaculture crops and to minimize impacts with non-natural aquaculture infrastructure and gear. The industry continues to participate in research to seek innovations to maintain viability and sustainability as environmental conditions change and threats like ocean acidification affect operations in real time.

Efforts are needed to balance regulatory ecosystem protections and efficient processes to enable shellfish operators' success. Regulatory inefficiencies have been highlighted across the various federal, state, and local regulatory and permitting processes that create barriers for new businesses entering the industry and result in confusion and uncertainty about environmental impact preventions. The Washington State Shellfish Initiative established the Shellfish Interagency Permit Team to address the complex and inefficient process. Permitting issues have increased urgency with the June 2020 invalidation of the Army Corps of Engineers' Nationwide Permit (NWP) 48 for Washington's commercial shellfish operators. As of this writing, the implications of NWP 48 being vacated are still being determined, and an appeal of the ruling is underway. If the legal decision is upheld, it is assumed that the Army Corps of Engineers will conduct additional and new assessments of potential environmental impacts resulting from each individual permit's associated aquaculture activities. HCCC will continue to track the case as it proceeds and any future impact assessments of Hood Canal aquaculture activities to inform adaptive management of the HCSI Action Plan.

Objective 5. Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors

Expand opportunities for recreational and Tribal ceremonial and subsistence harvest of Hood Canal shellfish by increasing shellfish abundance and improving access to beaches, while protecting ecosystem health by minimizing impacts from increased harvest pressure.

The ability to harvest shellfish safely, frequently, and easily is necessary to maintain the Hood Canal community's sense of place and traditions. This objective does not address commercial shellfish operations but is focused on ceremonial and subsistence harvest for Tribes, and recreational harvest for

[27] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #4*. May 7, 2020. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Shellfish%20Initiative%20-%20Workgroup%20Meeting%20%234%20Notes_20200507_1.pdf.

[28] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #6*. May 28, 2020. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Shellfish%20Initiative%20-%20Workgroup%20Meeting%20%236%20Notes_20200529_0.pdf.

non-Tribal people. This objective seeks increased harvest opportunities to sustainable levels, ensuring they do not have negative ecosystem impacts.

Hood Canal beaches are very popular destinations for recreational shellfishing by both residents and visitors. Crab and shrimp harvest days during the summer are extremely popular events and attract many visitors. WDFW estimates that in 2017 there were 79,924 trips made on Hood Canal beaches to harvest clams and oysters and 20,410 angler trips during the five-day spot shrimp fishery.[29] Access to public beaches remains a constraint on recreational harvest despite the activity's growing popularity. Many public beaches with ample shellfish resources are only accessible by water, resulting in concentrations of harvesters on just a few easily accessible public tidelands at levels the resource cannot support in some locations. Recent years have seen management quotas exceeded and instances of poaching at certain locations, which challenged resource managers to make in-season adjustments. In response to these uneven and fluctuating harvest pressures, some recreational harvest seasons have been shortened or the timing has been shifted.

Objective 6. Restore native Olympia oyster populations in Hood Canal

Restore native Olympia oysters to self-sustaining populations on beaches throughout Hood Canal, including planning actions to identify priority sites, enhance habitat, ensure seed supply, and conduct propagation activities, effectiveness monitoring, and outreach to build awareness of our native shellfish species.

Large Olympia oyster beds once existed in Quilcene Bay, at the Seal Rock and north Dosewallips tidelands, and on the Union River and Big and Little Mission Creek(s) deltas, with smaller populations and individuals occurring throughout Hood Canal. Currently, Olympia oysters can be found as individuals or small aggregations throughout Hood Canal, but large beds are absent. The small populations present within the middle reach and in northern portions of Hood Canal appear to be self-sustaining, but that is not the case in the southern reaches of the Canal. To ensure populations rebuild, at-risk and functional habitat needs to be improved and maintained. Achieving this objective will rely heavily on WDFW's *Plan for Rebuilding Olympia Oyster (*Ostrea lurida*) Populations in Puget Sound with a Historical and Contemporary Overview* to inform and guide Olympia oyster restoration efforts in Hood Canal. This plan contains detailed steps to re-establish, rebuild, and enhance natural native oyster assemblages for the purpose of ensuring the species' long-term survival in the face of multiple pressures (e.g. changing water temperature, chemistry, sea levels, and competing uses of Puget Sound marine waters and tidelands).[30] Restoration sites are targeted for Quilcene Bay and the Union River and Big and Little Mission Creek(s) deltas.[31] Work under this objective will also collaborate closely with the Puget Sound Restoration Fund's Olympia oyster restoration efforts to rebuild dense, breeding populations of Olympia oysters in

[29] Washington Department of Fish and Wildlife. *2017 WA State Sport Catch Report*. https://www.google.com/url?client=internal-element-cse&cx=004044055337366278373:rf85ltn-vai&q=https://wdfw.wa.gov/publications/02108&sa=U&ved=2ahUKEwi5u9XHlJfsAhXiPn0KHU8-AcQQFjABegQICRAB&usg=AOvVaw1R3MRLZWO05y33La6Sybsd.

[30] Blake, B., Bradbury, A. *Washington Department of Fish and Wildlife Plan for Rebuilding Olympia Oyster (Ostrea lurida) Populations in Puget Sound with a Historical and Contemporary Overview.* Washington Department of Fish and Wildlife. https://erb7v36cnte3ws6d42lk0gge-wpengine.netdna-ssl.com/wp-content/uploads/2019/02/olympia_oyster_restoration_plan_final.pdf.

[31] Ibid.

historical areas of abundance, and to restore the structured oyster bed habitat and ecosystem services provided by dense accumulations of living oysters.[32]

HCSI Action Plan Priorities

HCSI Actions

Specific actions were developed to achieve each HCSI objective. See Appendix B for the full list of HCSI Actions and their descriptions.

Prioritization Process Overview

SDM guidance was utilized to prioritize the HCSI Action Plan. The objectives were first ranked and assigned a weighted value based on their perceived importance to meet the HCSI's values. The actions were also rated based on how well they address the objectives. The actions were rated (using a survey) for their impact on their "home" objective, under which they were originally developed, as well as across each of the six objectives to account for synergistic effects a single action may have on multiple objectives. Appendix C includes survey results of the action ratings within their "home" objective, while Appendix D includes the action ratings across all objectives. Each action's six objective pairing scores were then combined with the objective weights and added across all objectives to produce a final cumulative action rating, summarized in Figure 2. These final action ratings determine the ranked list of all HCSI actions (Appendix E).

A detailed description of the prioritization process, data analysis, and results is included in Appendix F.

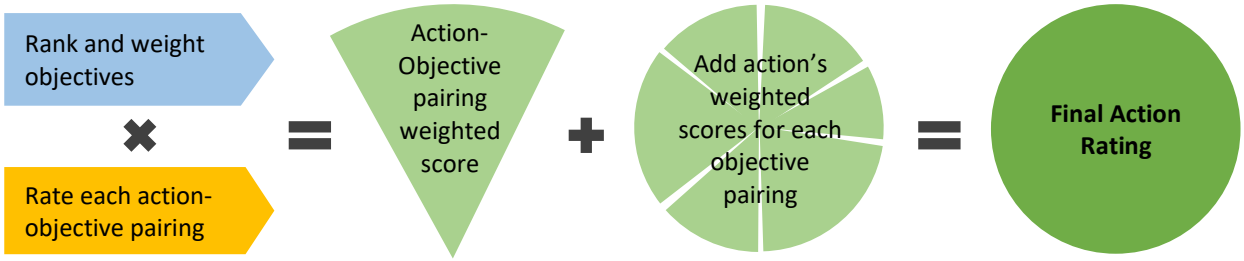

Figure 2: HCSI Action Evaluation and Prioritization Process

Priority Actions

After reviewing the results of the action rating and prioritization process (Appendix E), a sub-set of 18 actions were identified as the HCSI's top priorities (Table 1), selected for their overall impact to achieve the objectives. The top 10 ranked actions, with the highest likelihood to impact all objectives, were selected, as well as the top two actions within each of the six objectives (if not already included in the top 10).

[32] Puget Sound Restoration Fund. *Olympia Oyster Restoration*. https://restorationfund.org/programs/olympiaoysters/.

Table 1: HCSI Priority Actions

Rank	Action
1	1.A.1: Implement Pollution Identification and Correction (PIC) programs
2	5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites
3	2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat
4	2.D.4: Support culvert removal and restoration for important shellfish habitat
5	1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)
6	1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs
7	2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques
8	2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species
9	1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds
10	2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat
11	1.A.5: Ensure on-site septic system maintenance records are up to date
12	6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan
13	3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish
14	6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal
15	3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate
16	4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs
17	5.C.2: Develop a guide for boat-in shellfishing access and best practices
18	4.B.2: Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")

The top rated HCSI action is Action 1.A.1. Implement Pollution Identification and Correction (PIC) programs. As the primary means of marine water quality protection to find and prevent non-point pollution from impairing the nearshore ecosystem – and essential for healthy shellfish beds – PIC work has a critically important role across the entire HCSI. This action was rated very highly across many objectives – for example, it was also the second highest rated action to achieve Objective 4 (Sustainable Industry). Multiple other water quality actions in the priority list also contribute to PIC work, including the fifth, sixth, and 11th ranked actions, 1.A.2. *Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies*, 1.A.3. *Coordinate a cross-jurisdictional approach for dedicated/sustainable funding for PIC programs and on-site sewage (OSS) management programs*, and 1.A.5. *Ensure On-Site Sewage System (OSS) maintenance records are up to date*, respectively. Given their high rankings, funding opportunities should be sought to address these four actions collectively, with closely coordinated project outcomes.

Multiple actions under Objective 2 (Shellfish Habitat) also make up the priority list. These actions are similarly multi-beneficial, ranking highly across many objectives. The four top rated habitat actions were also among the top-rated actions to achieve Objective 4 (Sustainable Industry). Many of these actions have coordinated strategic plans to address their specific topics. In some cases, an action was identified to develop a strategic plan, but may not have been prioritized as highly as the action to implement those plans. Such is the case with eighth ranked priority action, 2.A.1. *Create a list of viable shellfish habitat protection and restoration areas for native species*, which would inform the implementation of the fourth and seventh ranked actions, 2.D.4. *Support culvert removal and restoration for important shellfish habitat*, and 2.D.5. Support removal of shoreline armoring and appropriate usage of soft armoring techniques, respectively. As habitat work is complex with many interrelated components and ecosystem effects, HCCC recommends appropriate strategic plans and best practices be utilized whenever possible to guide habitat restoration and protection efforts.

When undergoing implementation, the multi-beneficial connections across objectives should be explored and coordinated whenever possible, to sequence projects as necessary, leverage resources, and maximize beneficial project outcomes.

Table 2 breaks out the priority actions from each objective.

Table 2: Priority Actions from Each Objective

Priority Ranking	Action
Obj. 1. Water Quality	
1	1.A.1. Implement Pollution Identification & Correction (PIC) programs
5	1.A.2. Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)
6	1.A.3. Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC programs and on-site sewage (OSS) management programs
9	1.A.7. Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds
11	1.A.5. Ensure on-site septic system maintenance records are up to date
Obj. 2. Shellfish Habitat	
3	2.E.2. Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat
4	2.D.4. Support culvert removal and restoration for important shellfish habitat
7	2.D.5. Support removal of shoreline armoring and appropriate usage of soft armoring techniques
8	2.A.1. Create a list of viable shellfish habitat protection and restoration areas for native species
10	2.E.1. Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat
Obj. 3. Cultural Appreciation	
13	3.A.2. Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish
15	3.A.1. Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate
Obj. 4. Sustainable Industry	

16	4.B.1. Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs
18	4.B.2. Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")
Obj. 5. Harvest Opportunities	
2	5.B.4. Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites
17	5.C.2. Develop a guide for boat-in shellfishing access and best practices
Obj. 6. Olympia Oysters	
12	6.B.1. Develop and implement a Hood Canal-specific Olympia oyster restoration plan
14	6.A.1. Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal

HCSI Next Steps

The HCSI Action Plan is a starting point for focused efforts to achieve the HCSI goal – to support and expand Hood Canal's thriving shellfish populations, honor Tribal treaty rights, build resilience, pursue ecosystem protection and restoration, and support careful stewardship of commercial and recreational shellfish harvest now and into the future.

The HCCC Board of Directors will provide ongoing oversight and direction as the HCSI enters its implementation phase, the funding strategy is developed, and future funding sources are identified, and as adaptive management occurs. A sub-group of HCCC's IWP Steering Committee will be formed to take on the role of the sunsetting HCSI Workgroup, to provide ongoing technical expertise to inform specific actions and guide their implementation, develop funding recommendations, and revise action plan priorities.

As the HCSI moves into implementation, opportunities will be explored to compliment and leverage shellfish protection and recovery efforts in neighboring areas to find synergies where possible and support aligned strategies and actions.

Implementation

HCSI Action Plan development was funded as a Puget Sound Action Agenda Near Term Action (2018-0386) with an EPA NEP grant (federal assistance agreement PC-01J18001/WA Dept. of Health contract number: CBO24135) selected by the Hood Canal Local Integrating Organization (LIO). The HCSI NEP grant includes funds to jumpstart action plan implementation. Following adoption, one or more of the priority actions identified in the action plan will be immediately implemented. Continued implementation of the HCSI will rely on partner commitments to utilize this plan and obtain and sustain funding for project implementation. HCCC will pursue implementation via the following approaches:

Hood Canal Partner Commitments

The success of the HCSI will be determined by its adoption and use as an authoritative plan for Hood Canal shellfish protection. HCCC will work with Hood Canal shellfish partners to gain commitments from local governments, ecosystem recovery partners, and industry partners to utilize the HCSI Action Plan as a framework to guide programmatic efforts and direct available funding sources.

Public-Private Partnerships

The commercial shellfish industry's reliance on clean water and healthy marine ecosystems closely connects growers and harvesters with the local governments and Tribes who protect and steward those resources. Tribes, local governments, and private industry have resources and tools to contribute to the health and sustainability of the Hood Canal ecosystem. HCCC will cultivate public-private partnerships to leverage these combined resources to advance actions that address both the Hood Canal commercial shellfish industry's and the public's needs. Such partnerships will be best put to use addressing issues targeted in Objective 4 (Sustainable Industry), such as derelict shellfish aquaculture gear, regulatory barriers and inefficiencies, and emerging science around aquaculture's ecosystem interactions.

Grant Funding

HCCC anticipates that much of the actions presented in the HCSI Action Plan will be funded by grants. HCCC will pursue grant sources for targeted project implementation based on the priority actions. The priority actions will be submitted as Near Term Actions in the Puget Sound Action Agenda, making them eligible for federal EPA NEP funding. HCCC will also pursue state water quality grant programs as appropriate for Objective 1 ("Water Quality") actions, and various federal grant programs addressing nearshore ecosystem restoration, advancing the commercial shellfish industry, understanding climate impacts, and supporting community-based habitat restoration, among other funding sources.

Adaptive Management

Evolving Priorities

The HCSI will continue to evolve as ecosystem conditions change and science develops. HCCC anticipates revisiting the HCSI priorities every four years, to reassess the urgency of specific actions and address emerging issues. The IWP Steering Committee sub-group for the HCSI will be tapped to lend their expertise to an updated prioritization process, and public feedback will be sought from the broader community of Hood Canal shellfish partners.

HCCC anticipates hosting a recurring Hood Canal Shellfish Summit as funding allows to bring together and strengthen partnerships among Hood Canal shellfish interests, share HCSI progress and achievements, and affirm new priorities. HCCC will look to both public and private shellfish partner contributions to facilitate the community event.

Effectiveness Monitoring

The HCSI monitoring plan will track progress made toward each objective and measure the long-term effectiveness of the HCSI. Each objective was assigned a performance measure that will be monitored over time to evaluate the success of the objective (Table 3). Aspirational targets were set for each objective, representing the desired level of performance. Appropriate and timely data sources were selected to accurately measure the performance measures, and a contact was identified for each dataset. The monitoring plan will be adaptively managed over time to reflect the latest knowledge and data.

Table 3: HCSI Performance Measures

Objective	Performance Measure (Unit)	Target
Protect and improve Hood Canal's water quality	Shellfish growing area classifications (acres)	100% of potentially harvestable growing area acres are open for harvest
Protect and improve Hood Canal shellfish habitat	Net change in permitted shoreline armor (mi)	Total miles of shoreline armor removed is greater than the total miles added in Hood Canal
Promote cultural appreciation of Hood Canal shellfish	Participation in cultural practices (satisfaction)	Maintain or increase the satisfaction of participation in cultural practices
Support a sustainable Hood Canal commercial shellfish industry	Regional volume (lbs.) and/or Regional value ($)	Maintain or increase the current volume and/or value of harvested shellfish
Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors	Locally harvested foods (harvest frequency)	Maintain or increase harvest frequencies
Restore native Olympia oyster populations in Hood Canal	Density (adult oysters per m^2)	30-100 adult oysters per m^2

Appendix G provides a detailed monitoring plan with a discussion of each performance measure, its target, data sources, and notes for future monitoring.

Appendix A: HCSI Workgroup Participants

Table 4: HCSI Workgroup participants

Name	Title	Organization
Phil Best	Secretary	Hood Canal Environmental Council
Kelly Biedenweg*	Assistant Professor, Department of Fisheries & Wildlife	Oregon State University
Scott Brewer‡	Executive Director	HCCC
Laura Butler	Director of Strategic Initiatives	WA Department of Agriculture
Joth Davis	Owner	Baywater Shellfish Company
Kate Dean†	Commissioner	Jefferson County
Bill Dewey‡	Director of Public Affairs	Taylor Shellfish Farms
Jeff Dickison‡	Assistant Natural Resources Director	Squaxin Island Tribe
Jennifer Doughty	Shellfish and Water Quality Project Manager	Hood Canal Salmon Enhancement Group
Aaron Dufault	Puget Sound Shellfish Manager	WDFW
Christopher Eardley	Puget Sound Shellfish Policy Coordinator	WDFW
Sarah Fisken	Member	Jefferson County Marine Resources Committee
Dave Fyfe	Shellfish Biologist	Northwest Indian Fisheries Commission
Jacqueline Gardner	Member	Jefferson County Marine Resources Committee
Rachel Hansen	President	Northwest Event Organizers
Daniel Hanson	Owner	Hood Canal Snail
Dawn Hanson Smart	Owner	Hood Canal Snail
Haley Harguth*	Watershed Program Manager	HCCC
Dave Herrera†‡	Policy Advisor	Skokomish Indian Tribe
Bobbi Hudson	Executive Director	Pacific Shellfish Institute
Teri King	Aquaculture and Marine Water Quality Specialist	Washington Sea Grant
Paul McCollum†‡	Natural Resources Director	Port Gamble S'Klallam Tribe
Elizabeth McManus‡	Local Integrating Organization Coordinator/Principal	Alliance for a Healthy South Sound/Ross Strategic
Blair Paul	Shellfish Biologist	Skokomish Indian Tribe
Alex Paysse	Environmental Health Manager	Mason County
Larry Phillips	South Puget Sound and Coast Region Director	WDFW
Joel Pillers	South Sound Area Manager	Washington State Parks and Recreation Commission
Kevin Shutty†‡	Commissioner	Mason County
Barbara Ann Smolko	Watershed Coordinator	Pierce County/Alliance for a Healthy South Sound
Eric Sparkman‡	Shellfish Biologist	Squaxin Island Tribe
Camille Speck	Puget Sound Intertidal Bivalve Manager	WDFW
Molly Spiller‡	Research Associate	Ross Strategic

Andrea Thorpe	Natural Resources Program Manager	Washington State Parks and Recreation Commission
Jodie Toft	Deputy Director	Puget Sound Restoration Fund
Dan Tonnes	Aquaculture Coordinator (OR and WA)	National Oceanic and Atmospheric Administration
Kelly Toy	Shellfish Management Program Manager	Jamestown S'Klallam Tribe
David Trimbach*	Postdoctoral Research Associate, Department of Fisheries & Wildlife	Oregon State University
Nate White*	Watershed Projects Coordinator	HCCC
David Windom‡	Community Services Director	Mason County
Jonathon Wolf	Natural Resources Deputy Director	Skokomish Indian Tribe
Sandy Zeiner	Shellfish and Enforcement Policy Analyst	Northwest Indian Fisheries Commission

* HCSI Facilitator
† HCCC Board member
‡ Original HCSI Steering Group Member

Appendix B: HCSI Actions

HCSI objectives and actions are listed in Table 5. Full descriptions of each action are included below. Much of the information contained in the action descriptions below was provided by HCSI Workgroup members. Meeting notes are referenced where appropriate, unless otherwise cited. All HCSI Workgroup meeting notes are available on HCCC's website at hccc.wa.gov/ShellfishInitiative.

Table 5: HCSI Action Plan Objectives and Actions Hierarchy

1. Objective
1.A. Sub-Objective
1.A.1. Action
1. Protect and improve Hood Canal's water quality
1.A. Monitor and enforce pollution sources
1.A.1. Implement Pollution Identification and Correction (PIC) programs
1.A.2. Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)
1.A.3. Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs
1.A.4. Update county on-site septic system management plans
1.A.5. Ensure on-site septic system maintenance records are up to date
1.A.6. Provide rebates and incentives for on-site septic system maintenance
1.A.7. Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds
1.A.8. Assess effectiveness of Hood Canal Marine Recovery Areas
1.B. Protect water quality and prevent pollution
1.B.1. Seed shellfish beds in targeted areas with water quality issues
1.B.2. Implement best management practices to collect and treat stormwater runoff and maintain natural hydrology
1.B.3. Support efforts to decommission unmaintained forest roads
1.B.4. Support forest logging practices that reduce runoff impacts
1.B.5. Assess status of and update oil spill response plans
1.B.6. Assess the impacts and solutions for high concentrations of seals on man-made structures in important shellfish areas
1.B.7. Remove creosote pilings
1.B.8. Assess sufficiency of boaters' access to pump-outs throughout Hood Canal
1.C. Public outreach and education on water quality best management practices
1.C.1. Outreach to landowners on how to prevent impacts from stormwater runoff
1.C.2. Outreach to landowners on proper septic systems maintenance
1.C.3. Improve public awareness of DOH Shellfish Safety Map
1.C.4. Outreach to boating community about preventing boat waste
1.C.5. Provide port-a-potties/septic and trash facilities for high use recreational fishing and shellfishing sites
2. Protect and improve Hood Canal shellfish habitat
2.A. Establish protection and restoration targets for native shellfish species in decline

2.A.1. Create a list of viable shellfish habitat protection and restoration areas for native species

2.B. Research population dynamics and threats to native shellfish in decline

2.B.1. Conduct a regional shellfish population density study for native species

2.C. Assess, control, and minimize the threat of invasive species to Hood Canal shellfish populations

2.C.1. Monitor and control European green crab in Hood Canal

2.C.2. Monitor and control oyster drills in Hood Canal

2.C.3. Monitor and control nonnative eelgrass in Hood Canal

2.D. Support physical shellfish habitat improvements

2.D.1. Establish clam gardens

2.D.2. Enhance clam beaches with gravel and shell

2.D.3. Enhance oyster beaches with shell

2.D.4. Support culvert removal and restoration for important shellfish habitat

2.D.5. Support removal of shoreline armoring and appropriate usage of soft armoring techniques

2.D.6. Clean up "ghost gear"

2.E. Support shellfish habitat policy

2.E.1 Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat

2.E.2. Conduct an assessment of shellfish-related land use policies and regulations for impacts to shellfish habitat

3. Promote cultural appreciation of Hood Canal shellfish

3.A. Incorporate shellfish education into Hood Canal and regional schools

3.A.1. Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate

3.A.2. Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish

3.A.3. Support school, 4H, and Future Farmers of America club efforts to incorporate shellfish and local cultural practices

3.A.4. Develop ideas and track outcomes of shellfish research projects by college/university students

3.B. Share local shellfish information with Hood Canal audiences

3.B.1. Host local education efforts about Tribal treaty rights for shoreline landowners and shellfish growers

3.B.2. Work with local shellfish educators to host events featuring shellfish topics

3.B.3. Host local public forums on shellfish-related community benefits, impacts, and activities

3.B.4. Work with chefs to promote culinary outreach highlighting Hood Canal shellfish

3.B.5. Highlight WDFW and Tribes' co-management of shellfish resources on WDFW website

4. Support a sustainable Hood Canal commercial shellfish industry

4.A. Prevent impacts from shellfish aquaculture marine debris

- 4.A.1. Establish Hood Canal shellfish industry marine debris reduction program
- 4.A.2. Conduct regular public beach clean-ups partnering the shellfish industry and stakeholders

4.B. Address shellfish industry inefficiencies and barriers to entry for new commercial shellfish operations

- 4.B.1. Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs
- 4.B.2. Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")
- 4.B.3. Establish program to develop and strengthen local, qualified workforce
- 4.B.4. Assess opportunities for, and implement, improved local regulatory processes for shellfish growers

4.C. Build resilience in shellfish industry and ecosystem interactions

- 4.C.1. Pilot projects to research efficacy of localized carbon refuge projects in Hood Canal
- 4.C.2. Support aquaculture industry research needs on disease, breeding methods, equipment, and technology development, and pilot innovations in the field
- 4.C.3. Identify research gaps and support efforts to explore the environmental interactions and impacts of shellfish aquaculture systems

5. Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors

5.A. Improve shellfish harvest management modeling and implementation

- 5.A.1. Support data-driven quota-setting process
- 5.A.2. Develop outreach and education activities to encourage adherence to recreational harvest management regimes
- 5.A.3. Develop guidance to manage when harvest quotas are exceeded

5.B. Pursue ways to increase tideland access and shellfish harvest opportunities

- 5.B.1. Develop and implement a comprehensive strategy to identify all public shoreline properties and access points
- 5.B.2. Acquire, protect, and improve access at properties that provide public access to tidelands in priority areas (uplands and shoreline)
- 5.B.3. Convene a forum of land trusts and other landowners to assess allowing public access to tidelands using conservation easements
- 5.B.4. Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites

5.C. Public outreach to promote harvest opportunities, techniques, and best practices

- 5.C.1. Develop a public-facing shellfishing information website
- 5.C.2. Develop a guide for boat-in shellfishing access and best practices
- 5.C.3. Develop a program to teach shoreline owners to conduct self-monitored shellfish population and harvest surveys on private land

6. Restore native Olympia oyster shellfish populations in Hood Canal

6.A. Establish baseline population data and coordinated monitoring methodologies

- 6.A.1. Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal
- 6.A.2. Conduct a multi-year assessment of existing Olympia oyster locations

6.B. Develop coordinated planning infrastructure and strategies to guide Hood Canal Olympia oyster restoration

6.B.1. Develop and implement a Hood Canal-specific Olympia oyster restoration plan

6.B.2. Establish a primary Olympia oyster restoration coordination entity to coordinate Hood Canal Olympia oyster projects and community partners

6.C. Support Olympia oyster restoration projects

6.C.1. Increase Olympia oyster seed supply via Puget Sound Restoration Fund methods

6.C.2 Increase aged shell availability for Olympia oyster restoration efforts

6.C.3. Implement shell stack efforts to measure recruitment

HCSI Action Descriptions

Objective 1. Protect and improve Hood Canal's water quality

Sub-objective 1.A. Monitor and enforce pollution sources

Action 1.A.1. Implement Pollution Identification and Correction (PIC) programs

Pollution Identification and Correction (PIC) programs protect and restore water quality by cleaning up and preventing fecal pollution. PIC programs are an effective tool to combat water pollution and protect shellfish resources by systematically monitoring the shoreline for pollution, investigating potential pollution sources in polluted drainages, and working with the property owner at the source to identify and implement pollution corrections. PIC investigations are also used to respond to pollution complaints. In addition to each county's PIC program and Tribal water quality programs, HCCC coordinates the Hood Canal Regional Pollution Identification and Correction Program, including Jefferson, Kitsap, and Mason health jurisdictions and conservation districts, the Port Gamble S'Klallam Tribe, the Skokomish Tribe, stormwater programs, state agencies, educators, and citizen volunteers The HCPRIC Program provides regional coordination (see Action 1.A.2), as well as supplemental funding for local health jurisdictions. This provides opportunities to share tools and techniques, discuss concerns and priorities, coordinate effective strategies to solve water quality challenges, communicate with decision-makers, and conduct outreach to Hood Canal property owners and residents on best management practices for septic system and stormwater management.

This action will support the implementation of local PIC programs and the specific water quality actions outlined in PIC workplans to ensure current and emergent pollution issues continue to be addressed. Broader non-point pollution issues beyond just OSS (such as nutrification issues, impacts from NPDES permitted sites (e.g. wastewater treatment sites, hatcheries), may also be addressed by a PIC approach.

Action 1.A.2. Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)

A regionally coordinated workgroup of water quality partners has been shown to enhance water quality protection and provide added value for efficiency and effectiveness. The Hood Canal Regional Pollution Identification and Correction (HCRPIC) Program currently provides a venue for this regional collaboration across jurisdictional boundaries. A regional approach provides cost savings by streamlining and combining preparation of grant applications, contracts, quality assurance plans and reporting. The regional PIC program's greatest added value has been shown to be the relationships between governments and entities it facilitates- Tribal and non-Tribal collaboration, cross-jurisdictional information and resource sharing, coordination between local-state-and federal partners - all enhance

water quality workers' abilities and effectiveness to address challenging PIC problems.[33] The HCRPIC Program is currently grant funded, and future funding remains uncertain. This action supports the continuation of the HCRPIC Program and efforts to secure sustainable funding into the future.

Action 1.A.3. Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs

This action will pursue sustainable funding sources for PIC and OSS management programs so they can operate reliably into the future. Currently, not all Hood Canal health jurisdictions have sustainable funding to consistently maintain water quality protection activities. The Hood Canal Regional Pollution Identification and Correction (HCRPIC) program is funded through grants and has no dedicated ongoing funding. These funding constraints put long-term water quality improvements in jeopardy. Potential activities include assessing the viability of various sustainable funding mechanisms and working with and supporting local Hood Canal jurisdictions to develop appropriate strategies (e.g. social marketing research) to secure funding.

Action 1.A.4. Update HCCC member counties on-site septic system management plans

The state is currently updating OSS regulations via the DOH Onsite Rule Revision Committee, and all counties will be required to update their OSS Management Plans accordingly. The revision was expected to take effect January 2021 but has been delayed to July 2021 due to COVID-19 impacts. County OSS Management Plan updates will be expected thereafter.[34] This action will support regional coordination and feedback on the updates, and support HCCC member counties in their update process.

Action 1.A.5. Ensure on-site septic system maintenance records are up to date

Ensuring up to date OSS maintenance records helps prevent future OSS failures and documents that OSS records match actual conditions. Up to date records enables Hood Canal counties to act upon OSS maintenance regulations and strategically plan activities to improve water quality conditions. This action will support local Hood Canal public health jurisdictions to update OSS maintenance records. There is currently a lag in entering OSS records into the counties' online OSS database (e.g. OnlineRME).[35]

Action 1.A.6. Provide rebates and incentives for on-site septic system maintenance

This action will provide rebates and incentives to homeowners for OSS repairs, maintenance, and replacement. OSS maintenance costs are rising, and a failing OSS is expensive to repair or replace, with new systems costing $15,000 or more.[36] Regular OSS maintenance can catch small problems before they cause a failing system. Unrepaired or failing OSS systems can impair water quality and cause beach closures that impact the shellfish economy and Hood Canal community. Providing OSS maintenance and repair and replacement rebates and incentives to homeowners is an effective way to proactively address water pollution problems caused by failing OSS.[37] The HCRPIC Program successfully utilizes a rebate

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[33] Hood Canal Coordinating Council. *Hood Canal Regional Pollution Identification & Correction Program.* http://hccc.wa.gov/PIC.

[34] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #6*.

[35] Ibid.

[36] Washington Department of Ecology. *On-site sewage system projects*. https://ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Water-Quality-grants-and-loans/On-site-sewage-projects.

[37] Jackson, M., Mengis, A. *Survey of On-site Sewage System Industry Professionals about Operation and Maintenance of On-site Sewage Systems in King County, Washington*. Environmental Health Services Division.

program for OSS maintenance and small repairs, and Jefferson County is currently developing an OSS repair/abatement cost-share program. Additional examples include the Regional On-site Sewage System Loan Program (RLP) through Ecology, Washington State Department of Health (DOH), local county health departments, and Craft3 (a non-profit third-party lender).[38]

Action 1.A.7. Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds

Monitoring toxic chemicals in the Hood Canal marine environment will ensure that Hood Canal shellfish remain safe to eat. Shellfish are filter feeders and as such can accumulate pollutants making them unsafe to eat. Sampling is needed to determine the biggest threats of toxic pollution in Hood Canal to prevent costly harvest closures.[39] This action will focus on monitoring toxics in shellfish, fish, and eelgrass and other seaweeds. The Port Gamble S'Klallam and Skokomish Tribes occasionally sample forage fish, geoduck, Dungeness crab, and mussels, and the Navy has had success tracing pollutants from their original deposition to their final fate in the marine environment as part of Project ENVironmental inVESTment (ENVVEST).[40] Other activities could include monitoring for the cumulative impact of non-point pesticide and herbicide pollution on Hood Canal shellfish, and analyzing National Pollutant Discharge Elimination System (NPDES) permits for other potential sources of toxic discharges into Hood Canal. The action will base efforts on similar toxic pollutant monitoring work contained in Water Resource Inventory Area (WRIA) plans and the Puget Sound Ecosystem Monitoring Program (PSEMP).[41, 42] It could also develop research and monitoring programs for "chemicals of emerging concern" (e.g. flame retardants, pharmaceuticals, estrogen-like compounds, industrial chemicals, personal care products, nanoparticles, and detergents) with potential significant impact on human health and aquatic life,[43] the causes and impacts of harmful algal blooms, and research on microplastics and fiber contaminants to increase understanding of their impacts in Hood Canal. Given the multitude of monitoring needs, a focused and prioritized approach is needed to direct efforts.

Action 1.A.8. Assess effectiveness of Hood Canal Marine Recovery Areas

Marine Recovery Areas (MRAs) are aquatic areas with degraded water quality and enhanced onsite sewage oversight. Enhanced local programs identify and inventory OSS located within the MRA boundary and require them to be inspected. MRAs and the actions taken within them are monitored to ensure that they are working to protect public health and Puget Sound water quality.[44] This action will

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Public Health – Seattle & King County. April 2019. https://kingcounty.gov/depts/health/environmental-health/piping/~/media/depts/health/environmental-health/documents/pic/survey-oss-professionals.ashx.

[38] Craft3. *Clean Water Loans*. https://www.craft3.org/Borrow/clean-water-loans/clean-water-loans-washington

[39] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #6*.

[40] Strivens, J.E., Johnston, R.K., Schlafer, N., Brandenberger, J.M. *ENVVEST Ambient Monitoring Program: In-Progress Summary 2009–2017*. PNNL-28116, prepared for the Puget Sound Naval Shipyard and Intermediate Maintenance Facility under Project ENVVEST by the PNNL Marine Sciences Laboratory, Sequim, Washington. September 2018.

[41] Washington Department of Ecology. *Watershed plan archive.* https://ecology.wa.gov/Water-Shorelines/Water-supply/Streamflow-restoration/Watershed-plan-archive.

[42] James, C.A., Jordan, R., Langness, M., Lanksbury, J., Lester, D., O'Neill, S., Song, K., Sullivan, C. *2018 Salish Sea Toxics Monitoring Synthesis: A Selection of Research*. PSEMP Toxics Work Group. Puget Sound Ecosystem Monitoring Program. 2019. https://www.eopugetsound.org/sites/default/files/features/resources/PSEMP_2018SalishSeaToxicsMonitoringSynthesis.pdf#overlay-context=articles/2018-salish-sea-toxics-monitoring-synthesis.

[43] US Environmental Protection Agency. *Chemicals of Emerging Concern in the Columbia River*. https://www.epa.gov/wqc/contaminants-emerging-concern-including-pharmaceuticals-and-personal-care-products.

[44] Washington State Legislature. *RCW 70A.110.010.* https://app.leg.wa.gov/rcw/default.aspx?cite=70A.110.010.

review where MRAs are designated by Hood Canal counties, assess their effectiveness at achieving their stated goals, and explore if the policy tool can be expanded to further protect important areas of Hood Canal.

Sub-objective 1.B. Protect water quality and prevent pollution

Action 1.B.1. Seed shellfish beds in targeted areas with water quality issues

This action will seed and regularly harvest shellfish beds to improve conditions in areas with excess nutrient pollution and degraded water quality. Actively growing shellfish populations maintain shellfish bed health better than older, non-harvested populations with less potential for disease, higher densities, and more filtration and mitigation of nutrient pollution.[45, 46] This action may only be appropriate in approved and/or conditionally approved shellfish growing areas, where water quality does not jeopardize public health. The seeding and harvesting of shellfish beds should be carefully conducted to match site-specific species and conditions, follow WDFW seed transfer permit guidelines, and assess potential ecosystem impacts.[47] The public harvest of shellfish for consumption should not be encouraged in areas of impaired water quality. These areas would be subject to normal pollution monitoring and harvest closures to protect public health. Successful projects like PSRF's community shellfish gardens can be emulated to provide localized water quality improvements. This action should be coordinated with local health jurisdictions to also address upland pollution sources while mitigating nearshore water quality conditions.

Action 1.B.2. Implement best management practices to collect and treat stormwater runoff and maintain natural hydrology

This action will implement stormwater best management practices (e.g. raingardens, pervious pavement, and other green infrastructure development techniques that maintain natural hydrology) to collect, treat, and divert stormwater runoff from impermeable surfaces (such as roads and parking lots) away from Hood Canal shellfish beds. Stormwater pollutes shellfish beds by introducing harmful bacteria, viruses, pathogens, heavy metals, and other pollutants that can lead to shellfish beach closures, and transporting excess sediment that blocks the penetration of light and inhibits the growth of aquatic plants on which shellfish depend., .[48] High volumes of runoff piped through insufficiently sized culverts can also smother shellfish habitat with excess sediment, and destroy habitat through erosive force (see Action 2.D.4).

Action 1.B.3. Support efforts to decommission unmaintained forest roads

This action will identify unmaintained forest roads no longer in use that contribute excess stormwater to Hood Canal and support efforts to decommission them. Runoff from forest roads can contribute to shellfish closures.[49] Older and unmaintained roads are especially prone to erosion and excessive

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[45] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #4*. May 7, 2020. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Shellfish%20Initiative%20-%20Workgroup%20Meeting%20%234%20Notes_20200507_1.pdf.

[46] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #6.*

[47] Washington Department of Fish and Wildlife. *Shellfish import and transfer permits*. https://wdfw.wa.gov/licenses/fishing/shellfish-import-transfer.

[48] Washington State University Extension. Shore Stewards. *Understanding the Impacts of Runoff.* https://shorestewards.cw.wsu.edu/faq/understanding-the-impacts-of-runoff/.

[49] Washington Department of Ecology. *Stormwater and runoff.* https://ecology.wa.gov/Water-Shorelines/Water-quality/Runoff-pollution.

runoff.[50] Potential activities include applying the Washington Road Surface Erosion Model (WARSEM) that uses a standardized calculation to average annual road surface erosion and sediment delivery. The model is specifically designed for forest roads in Washington State, and it can be applied on a variety of scales ranging from single road segments to all roads within a watershed.[51]

Action 1.B.4. Support forest logging practices that reduce runoff impacts

This action will support implementation of Forest Practices Rules across Hood Canal, especially in areas where forestry runoff is an acute issue (e.g. Holly and Dewatto areas).[52] The Washington State Forest Practices Act establishes standards for forest practices including timber harvest, pre-commercial thinning, fertilization, forest chemical application, and road construction. It contains many requirements for protecting water quality by reducing runoff.[53]

Action 1.B.5. Assess status of and update oil spill response plans

Oil spills present a major threat to Washington's inland marine water quality and shellfish resources.[54] This action will review current oil spill response plans for Hood Canal and update them as needed to ensure they represent current best practices and understanding of threats. In addition to marine oil spill response plans, the review will also focus on terrestrial oil spills threats from road vehicles and other land uses.

Action 1.B.6. Assess the impacts and solutions for high concentrations of seals on man-made structures in important shellfish areas

This action will assess the impacts of high concentrations of seals hauled out on man-made structures in important shellfish areas. Seals often congregate on man-made structures like docks, rafts, and booms. Too many seals in small areas can impact water quality by their release of high volumes of fecal matter.[55] Potential activities include sampling areas of high seal concentrations and conducting microbial source tracking analysis to identify fecal sources. The removal of structures, prevention devices, or other methods could be explored to mitigate seal impacts in high priority shellfish areas.

Action 1.B.7. Remove creosote pilings

Derelict creosote pilings from past uses such as docks and piers still dot the Hood Canal shoreline. Timber was treated with creosote, a mix of chemicals including highly toxic polycyclic aromatic hydrocarbons (PAHs), to preserve the wood and prevent decay. [56] Shellfish are known to absorb the

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[50] Madej, M.A. *Erosion and sediment delivery following removal of forest roads*. Earth Surf. Process. Landforms, 26: 175-190. December 5, 2000. https://doi.org/10.1002/1096-9837(200102)26:2<175::AID-ESP174>3.0.CO;2-N.

[51] Washington Department of Natural Resources. *Washington Road Surface Erosion Model.* *https://www.dnr.wa.gov/washington-road-surface-erosion-model.*

[52] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #4*.

[53] Washington Department of Natural Resources. *Forest Practices Rules and Board Manual Guidelines.* https://www.dnr.wa.gov/about/boards-and-councils/forest-practices-board/forest-practices-rules-and-board-manual-guidelines#Forest%20Practices%20Rules.

[54] Neel, J., Hart C., Lynch, D., Chan, S., Harris J. *Oil Spills in Washington State: A Historical Analysis.* Washington Department of Ecology. April 1997. https://www.lib.washington.edu/msd/norestriction/b63148675.pdf.

[55] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #4*.

[56] Washington Department of Natural Resources. *Creosote Piling Removal Program.* https://www.dnr.wa.gov/programs-and-services/aquatics/restoration/creosote-removal.

PAHs and other chemicals leached from creosote pilings.[57] Creosote removal has been shown to decrease the amount of PAHs found in shellfish tissue in Port Gamble Bay.[58] Creosote removal projects have sometimes been shown to increase the concentration of toxic chemicals in surrounding marine waters caused by the disturbance of sediments and piling breakage.[59] These effects should continue to be studied, and best management practices strictly used. [60]

This action emphasizes continued creosote removal efforts in Hood Canal in important shellfish growing and harvesting areas. These efforts are led by the WA Department of Natural Resources (DNR), but progress is limited by funding and the abundance of creosote treated timber in Puget Sound marine waters. The MyCoast app enables citizens to report derelict creosote wood in Puget Sound, which aids DNR's tracking and prioritization of its removal. [61] Public awareness of this tool should be broadened among Hood Canal residents and visitors.

Action 1.B.8. Assess sufficiency of boaters' access to pump-outs throughout Hood Canal

A pump-out is a means to empty a boat's on-board sewage waste holding tank. This action will ensure that there are sufficient pump-outs available to boaters in Hood Canal so that sewage, fecal coliform, and other wastewater pollutants are properly disposed of and not released into the marine environment.

Sub-objective 1.C. Public outreach and education on water quality best management practices

Action 1.C.1. Outreach to landowners on how to prevent impacts from stormwater runoff

This action focuses on educating Hood Canal landowners on the multiple ways they can prevent harmful stormwater pollution on their properties. Properties ranging from single family residences to farms will be targeted. Outreach will focus on water quality pollutants from common household products like fertilizers and pesticides, the negative impacts caused by pet waste, the harm to local shellfish beds caused by soil erosion, and other locally relevant water quality issues.

Action 1.C.2 Outreach to landowners on proper septic systems maintenance

This action will conduct outreach to Hood Canal landowners to provide septic system maintenance education and other relevant septic information. Proper septic system maintenance reduces water quality pollution by preventing overflows and leaks that contribute sewage and fecal coliform to local waters. This action should be coordinated with other outreach efforts, such as OSS maintenance vouchers (Action 1.A.6), to gain property access for parcel surveys in order to provide site-specific information.

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[57] Parametrix. *Creosote Release from Cut/Broken Piles, Asarco Smelter Site.* June 2011. https://preservedwood.org/portals/0/documents/archive/CreosoteReleasefinal110614.pdf.
[58] Washington Department of Ecology. *Port Gamble Bay and Mill Site*. https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Cleanup-sites/Puget-Sound/Port-Gamble-baywide.
[59] Parametrix.
[60] Washington Department of Natural Resources. *Derelict Creosote Piling Removal Best Management Practices For Pile Removal & Disposal.* January 25, 2017. https://www.dnr.wa.gov/publications/aqr_rest_creosote_bmps_pilings.pdf?5dra7.
[61] Washington Department of Natural Resources. *MyCoast: Washington*. https://mycoast.org/wa.

Action 1.C.3. Improve public awareness of DOH Shellfish Safety Map

This action will focus on improving public awareness of the DOH Shellfish Safety Map by better integrating it with other shellfish harvest and water quality information. The map identifies the harvest status of public beaches (e.g. closed, open, conditionally open, and unclassified). It also has information on vibriosis advisory areas and marine biotoxin closure zones.[62]

Action 1.C.4. Outreach to boating community about preventing boat waste

This action will educate the boating community about proper ways to prevent boat waste to decrease the amount of raw sewage emitted into Hood Canal. It will highlight the locations and proper use of pump-out stations by boaters, and the proper maintenance of the stations by marina and dock owners. Education and outreach on safe fueling practices will also be included.

Action 1.C.5. Provide port-a-potties/septic and trash facilities for high use recreational fishing and shellfishing sites

This action will inventory popular fishing and shellfishing areas, assess the solid waste and sewage disposal needs for each site, and provide facilities where needed. Providing proper waste disposal facilities at popular fishing areas and shellfishing beaches ensures that solid and human waste is not released into the marine environment.

Objective 2. Protect and improve Hood Canal shellfish habitat

Sub-objective 2.A. Establish protection and restoration targets for native shellfish species in decline

Action 2.A.1. Create a list of viable shellfish habitat protection and restoration areas for native species

This action will create lists of needed and viable habitat protection and restoration areas for native shellfish species, including Olympia oysters, littleneck clams, cockles, shrimp, crab, and geoducks, focused on creating shellfish habitat that encourages naturally occurring population levels. Relevant plans and other guiding documents for particular species (e.g. Olympia oysters) will be consulted to inform the list. Collaboration between Tribal, state, county, and other decision makers will be facilitated to survey their needs, areas, and ideas for potential inclusion in the restoration lists.

Sub-objective 2.B. Research population dynamics and threats to native shellfish in decline

Action 2.B.1. Conduct a regional shellfish population density study for native species

Population densities data for various Hood Canal native shellfish species is important to determine the sustainable and natural reproduction rates of these species, yet this data is incomplete. There is some Olympia oyster density information, but it is scattered and not routinely collected or standardized. Native littleneck clams are in decline across their entire range (including Hood Canal). Cockles are also in decline in some areas of Hood Canal, but current biomass surveys are not perfectly suited to precisely measure their decline. Recruitment for these species is episodic with wide swings.[63] Shrimp have

[62] Washington State Department of Health. *Shellfish Safety Information.* https://fortress.wa.gov/doh/biotoxin/biotoxin.html.

[63] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7.* June 18, 2020. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Shellfish%20Initiative%20-%20Workgroup%20Meeting%20%237%20Notes_20200618_0.pdf.

experienced low abundances in central Hood Canal, but have improved in northern and southern Hood Canal, and central Hood Canal populations rebounded in 2020 after two years of decreased abundance.[64, 65] Crab have experienced low abundances south of Ayock Point, but 2020 crab test fishery data shows the highest catches since 2015, though crab abundance remains substantially depressed in southern Hood Canal (where recreational harvest has been closed for two years).[66, 67]

This action will conduct a regional shellfish population density study of species not currently monitored via the co-managers' annual test-fisheries or periodic surveys, including Olympia oysters, littleneck clams, and cockles to fill these knowledge gaps. Potential activities include developing a standard protocol for monitoring adult species and recruitment at sites across Hood Canal, with data shared through a common portal. Wherever possible, studies will support existing research and survey teams (including the Jamestown S'Klallam, Port Gamble S'Klallam, Skokomish, and Suquamish Tribes and WDFW) to collect this data.

Sub-objective 2.C. Assess, control, and minimize the threat of invasive species to Hood Canal shellfish populations

Action 2.C.1. Monitor and control European green crab in Hood Canal

This action localizes state efforts to monitor and control invasive European green crab in Hood Canal. Green crab prey on, compete with, and pose a threat to Washington's shellfish. In areas where green crab are established, they have dramatic impacts on other species like smaller shore crab, clams, small oysters, and important nearshore habitat like seagrasses. The primary method of control is to prevent and limit spread. WDFW coordinates these activities at the state level. Early detection and monitoring of suitable green crab habitat is critical to eliminate populations and reduce the spread of this species.[68]

The potential for green crab to move into Hood Canal is high. Currently, green crab monitoring occurs near Point Julia near the mouth of Hood Canal, and a citizen group coordinated through Washington Sea Grant monitors for green crab near Zelatched Point, near the mouth of Dabob Bay.[69] Other activities could include green crab education at Hood Canal state parks (e.g. wanted posters and ranger programs) to increase identification and reporting of green crab populations.

Action 2.C.2. Monitor and control oyster drills in Hood Canal

Oyster drills are another invasive species harmful to shellfish. They eat oysters and other bivalves and are difficult to control.[70] The primary method of control is to prevent and limit their spread. This action will monitor and control oyster drills in Hood Canal prior to habitat restoration efforts to improve the chances of restoration project success. The action will build on current efforts by the Skokomish Tribe and shellfish growers who hand pick oyster drills and their eggs off of shellfish in the Skokomish River delta and various shellfish farms in Hood Canal and investigate other control methods. Similar to the

[64] Ibid.
[65] Christopher Eardley.
[66] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7.*
[67] Christopher Eardley.
[68] Washington Department of Fish and Wildlife. *European green crab*. https://wdfw.wa.gov/species-habitats/invasive/carcinus-maenas.
[69] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.
[70] McCoy, L., Tichenor, J. *Oyster Drills*. Ruesink Lab. March 19, 2013. https://depts.washington.edu/jlrlab/oysterdrills.php.

approach taken for European green crab monitoring and control, outreach and education efforts should be developed to train citizen scientists and alert the public about the impacts from this invasive species.

Action 2.C.3. Monitor and control nonnative eelgrass in Hood Canal

Nonnative eelgrass, such as Japanese eelgrass, is difficult to control, and negatively impacts the shellfish industry.[71] This action will focus on efforts to monitor and control (where appropriate) this invasive species in Hood Canal to improve shellfish habitat and shellfish growing conditions. Japanese eelgrass can comingle with native eelgrass. Any control efforts will carefully consider adverse impacts to the ecological benefits provided by Japanese eelgrass and its surrounding habitat.

Sub-objective 2.D. Support physical shellfish habitat improvements

Action 2.D.1. Establish clam gardens

Northwest coast indigenous people cultivate small clam gardens to enhance food production and increase food security. Clam gardens are made by constructing rock walls at the low tide line in sheltered and soft-sediment bays to re-slope the beach into more level terraces.[72] This creates habitat benches of various designs where clams naturally set and grow in higher densities, making them easier to harvest. This is a small-scale practice utilizing natural ecosystem processes. Once constructed, clams are thinned, the substrate is aerated and supplemented with shell pebbles, and predators are removed. [73] Clam gardens increase food productivity without seeding and can improve substrate habitat over time.[74]

This action will re-establish clam gardens among Hood Canal Tribes for active usage. They will create shellfish habitat for a diverse assemblage of native clam species (e.g. little neck clams) and naturalized clam species (e.g. Manila clams) to benefit Tribal food security. Invasive varnish clams will be discouraged by excluding them from tidal elevations shared with native clams using rock barriers. While Manila clams are a non-native, naturalized species, it is unrealistic to exclude them from clam gardens because they occupy the same habitat range and have an orders of magnitude greater population than native clams in Hood Canal.[75] Additionally, Manila clam seed is readily available, and they provide another important subsistence food source and commercial activity for Tribal people. Opportunities for non-Tribal clam gardens on private tidelands should also be explored.

Action 2.D.2. Enhance clam beaches with gravel and shell

This action will identify appropriate Hood Canal beaches needing enhancement and enhance them with gravel and shell. Shellfish harvest productivity of treated beaches often increases following the addition of gravel and shell.[76] Clam larvae are particularly attracted to calcium enriched habitat.[77] This practice has occurred in Hood Canal, and while it is expensive and permitting can be challenging, lessons from

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[71] Washington State Noxious Weed Control Board. *Japanese Eelgrass*. https://www.nwcb.wa.gov/weeds/japanese-eelgrass.

[72] Groesbeck, A., Rowell, K., Lepofsky, D., Salomon, A. K., *Ancient clam gardens of the Northwest Coast of North America.* Encyclopedia of Puget Sound. December 2014. https://www.eopugetsound.org/articles/ancient-clam-gardens-northwest-coast-north-america.

[73] Groesbeck, A., Rowell, K., Lepofsky, D., Salomon, A. K.

[74] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.

[75] Blair Paul. Skokomish Indian Tribe. *Personal communication*. Dec. 4, 2020.

[76] Ibid.

[77] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #4*.

past projects by WDFW, the Skokomish Indian Tribe, and Hood Canal commercial shellfish growers can be applied to minimize setbacks. Beaches will be carefully selected based on clam species, population presence, and current habitat conditions.

Action 2.D.3. Enhance oyster beaches with shell

Adding shell to oyster beaches is a particularly effective enhancement action for increasing oyster productivity.[78] This action will be done at appropriate times for larvae settlement and planned with specific recruitment goals in mind to ensure success. Beaches will be carefully selected based on oyster species, population presence, and current habitat conditions.

Action 2.D.4. Support culvert removal and restoration for important shellfish habitat

High volumes of water flowing out of undersized culverts can have an erosive effect on shellfish habitat. This "firehose" effect can erode and smother the substrate that many shellfish rely on, impacting the productivity of affected beaches.[79] This has occurred on the north, west, and east shores of Hood Canal, as well as in Dyes Inlet and other areas in Puget Sound.[80] This action will identify where particular culverts contribute to erosion, and support culvert removal projects that reduce high volume flows and improve habitat. When culverts are removed as part of salmon habitat protection/restoration efforts, projects should follow the best management practices outlined in Action 2.E.1.

Action 2.D.5. Support removal of shoreline armoring and appropriate usage of soft armoring techniques

This action will support efforts to remove hard armoring and, when appropriate and needed, encourage the installation of soft armoring to restore the sediment processes of affected shellfish beaches in Hood Canal. Coastal development, including erosion control structures like shoreline armoring, severs the natural erosion caused by drift cells and other sediment sources like bluffs, reduces shallow water habitats, and degrades ecosystem services.[81] Additionally, the benthic setting adjacent to shoreline armor is generally absent of complex, structured habitats, including those produced from shellfish.[82] Removing armor or replacing it with more natural soft armoring if erosion protection is still needed will restore these natural erosive processes and return shellfish beaches to a more productive state. When appropriate and needed, this action can promote soft armoring using existing programs like Shore Friendly Kitsap. Outreach on the effectiveness and limitations of soft armor for mitigating sea level rise will also be provided. When at all possible, shoreline armoring of any type should be avoided to maintain natural beach forming processes.

Action 2.D.6. Clean up "ghost gear"

This action will work with partners to identify and clean up "ghost gear" in Hood Canal. Ghost gear is abandoned, derelict fishing and shellfishing gear and even sunken vessels that continue to trap shellfish and smother habitat.[83] The Northwest Straits Initiative, in cooperation with WDFW and federal and state agencies, operates a derelict fishing gear removal project where ghost gear can be reported and

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[78] NOAA Fisheries. *Oyster Reef Habitat.*

[79] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.

[80] Ibid.

[81] Bilkovic, D., Roggero, M. *Effects of coastal development on nearshore estuarine nekton communities*. Marine Ecology Progress Series, 358:27–39. April 21, 2008.

[82] Scyphers, S. B. et al. *Oyster reefs as natural breakwaters mitigate shoreline loss and facilitate fisheries*. PloS one vol. 6,8 (2011): e22396. August 5, 2011. https://doi.org/10.1371/journal.pone.0022396

[83] NOAA Fisheries. *What is Ghost Fishing?* https://oceanservice.noaa.gov/facts/ghostfishing.html.

removed. It is a "no-fault" system that does not assess penalties for reporting ghost gear.[84] Additionally, the Jefferson County Marine Resources Committee has an educational program focused on crab pot loss prevention, and the Northwest Straits Foundation has a derelict crab pot removal program that can be utilized.[85]

Sub-objective 2.E. Support shellfish habitat policy

Action 2.E.1. Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat

This action builds on HCCC's previous work assessing the interactions between salmon habitat restoration and nearshore habitat.[86] There is an increasing amount of overlap between salmon habitat restoration projects and areas with key shellfish resources in the nearshore environment in Hood Canal, as well as potential conflict between shellfish and fishing activities in restored areas (e.g. mussel rafts interfering with Tribal commercial salmon net fisheries). The potential interactions between these efforts need to be included in project planning to avoid unintended impacts.[87] This action will create best management practices based on the study's recommendations to ensure that the lessons learned from this research are incorporated into salmon and nearshore habitat protection and restoration projects. When culverts are removed as part of salmon habitat protection/restoration efforts, projects should incorporate the elements outlined in Action 2.D.4. Research on the impacts of commercial shellfish farming and recreational shellfish harvesting practices on salmon, forage fish, and other threatened and endangered species is included in Objective 4 actions.

Action 2.E.2. Conduct an assessment of shellfish-related land use policies and regulations for impacts to shellfish habitat

Various land uses and their associated regulations affect shellfish and shellfish habitat. Physical uses of land like building residences and logging operations can increase harmful stormwater and sediment flows.[88] County, state, and federal land use regulations such as Shoreline Master Programs, OSS management programs, Critical Area Ordinances, Hydraulic Project Approvals permits, shoreline Substantial Development permits, Clean Water Act permits, Habitat Conservation Plans, National Forest and National Park land management plans and various other regulations affecting shoreline armoring, overwater structures, and stormwater all contribute to the condition and quality of shellfish habitats.[89]

This action will build on HCCC's previous work assessing how land use impacts ecosystems and will document the variation of land use regulations among HCCC member governments. . This effort will incorporate the Washington Shellfish Initiative's Shellfish Interagency Permitting Team's work to assess

[84] Washington Department of Fish and Wildlife. *Derelict fishing gear removal project.* https://wdfw.wa.gov/species-habitats/habitat-recovery/derelict-gear.
[85] Jefferson County Marine Resources Committee. *Crabber Outreach and Derelict Gear Removal.* https://www.jeffersonmrc.org/projects/crabber-outreach-derelict-gear-removal/.
[86] Confluence Environmental Company. *Final Assessment of Interactions between Salmon Habitat Restoration and Bivalve Shellfish Resources.* September 2017. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Salmon%20Habitat%20Restoration%20and%20Shellfish%20Interactions_FINAL_9-13-2017.pdf
[87] Ibid.
[88] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.
[89] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #4*.

improvements in shellfish permitting processes.[90] This action will coordinate closely with HCCC member counties to explore appropriate systems to assess the limits of current regulatory frameworks in addressing the impacts associated with the growth of commercial aquaculture activities, such as increased tideland cultivation, plastic use in the marine environment, and escaped and derelict gear pollution. Various partners, such as the Skokomish Indian Tribe, the Port Gamble S'Klallam Tribe, citizen groups, and local, state and, federal governments already monitor and respond to various land use activities in Hood Canal. This action will build on these collective efforts to improve our understanding of how land use policies can support healthy shellfish habitat and balance potential impacts from intensified use of the nearshore environment.

Objective 3. Promote cultural appreciation of Hood Canal shellfish

Sub-objective 3.A. Incorporate shellfish education into Hood Canal and regional schools

Action 3.A.1. Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate

This action will increase understanding of the cultural value of shellfish in public schools. It will work with the Washington Office of Superintendent of Public Instruction (OSPI) to incorporate Tribal and non-Tribal cultural practices and identity associated with shellfish into public school curricula where appropriate, with an emphasis on the importance of Hood Canal species and overall ecosystem health to local cultures and identity. There are currently shellfish learning units taught in fourth grade curriculum related to OSPI lesson plans on Tribal sovereignty that can be expanded to other grades.[91] The Skokomish Indian Tribe also teaches local school children about shellfish during an annual Earth Day event to broaden their understanding about the local environment and economy.[92] This action will require a collaborative workgroup of teachers, school board officials, Tribal officials, parents, and other local champions to advise curriculum development.

Action 3.A.2. Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish

This action will create and provide funding opportunities (such as scholarships and grants) and hands-on learning experiences (such as internships and apprenticeships with local shellfish growers) for K-12 and college students to study Hood Canal shellfish cultures and identity. These funds could also be used to defray transportation costs and other logistics related to shellfish field trips and other in-person learning opportunities. These funding opportunities will emphasize studying the importance of the biological roles of Hood Canal species and overall ecosystem health to local shellfish cultures and identity. Funding awards can be provided through organizations like Rotary Clubs and local shellfish growers, state organizations like Washington Sea Grant, and events like science fairs and shellfish festivals. For example, the Hama Hama Oyster Company currently provides funding to the Hood Canal Education

[90] Washington Department of Ecology. *Shellfish Interagency Permitting team*. https://ecology.wa.gov/Water-Shorelines/Shoreline-coastal-management/Aquaculture/Shellfish-Interagency-Permitting-Team.
[91] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #5*. May 19, 2020. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Shellfish%20Initiative%20-%20Workgroup%20Meeting%20%235%20Notes_20200520_1.pdf.
[92] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*. June 30, 2020. http://hccc.wa.gov/sites/default/files/resources/downloads/Hood%20Canal%20Shellfish%20Initiative%20-%20Workgroup%20Meeting%20%238%20Notes_20200630_1.pdf.

Foundation through proceeds generated from the Hama Hama Oyster Rama.[93] This funding supports the educational needs and goals of the Hood Canal School District that fall outside of traditional funding sources.[94]

Action 3.A.3. Support school, 4H, and Future Farmers of America club efforts to incorporate shellfish and local cultural practices

This action supports adding shellfish education into existing school and extra-curricular natural resources clubs and establishing new shellfish clubs in Hood Canal schools. Potential activities include obtaining a no-cost lease from WDFW to establish a student shellfish farm and selling shellfish to fund trips to learn about shellfish companies in other regions. Open class divisions at the Mason County Fair and other Washington Fair Association events provide a unique showcase opportunity for student shellfish projects. Partnerships with the Washington State University Extension's 4-H program, Future Farmers of America, school districts, conservation districts, the Pacific Shellfish Institute, the Pacific Coast Shellfish Growers Association, and other partners can be pursued to build or expand shellfish education, memory making, and identification with shellfish via their various outlets.

Action 3.A.4. Develop ideas and track outcomes of shellfish research projects by college/university students

This action will develop a list of applied shellfish research proposals for college, graduate, and post-graduate students to pursue as part of their studies. These research proposals will be shared with local university departments interested in natural resource issues, human wellbeing, sociology, and other related fields interested in the natural and cultural aspects of shellfish. This action will also develop a method to track recent shellfish research by other entities, and a process to monitor research projects underway so that results can be shared with interested parties.

Sub-objective 3.B. Share local shellfish information with Hood Canal audiences

Action 3.B.1. Host local education efforts about Tribal treaty rights for shoreline landowners and shellfish growers

This action seeks to prevent conflict from misunderstandings about the various rules, regulations, and consultation processes related to treaty rights and privately-owned shellfish beds. A need exists to educate shoreline landowners and shellfish growers about Tribal treaty rights and to provide a non-contentious venue for dialog.[95] Educational events and other forums on this topic will be established to provide opportunities to address various aspects of Tribal treaty rights and identity related to shellfish, such as Tribal co-management with the state, Tribal harvesting of private tidelands, and the critical cultural significance of shellfish to Tribes. Potential activities include hosting clam bakes on local beaches to raise awareness with neighbors about treaty rights and Tribal identity associated with shellfish and forming a workgroup of shoreline owners and Tribes to guide education efforts and address conflicts.

Action 3.B.2. Work with local shellfish educators to host events featuring shellfish topics

Beach walks are an effective way to educate about various aspects of shellfish culture.[96] This action will work with local shellfish educators to host beach walks and other events featuring shellfish topics like

[93] Hama Hama Oyster Company. *Oyster Rama*. https://hamahamaoysters.com/pages/oyster-rama.
[94] Hood Canal Education Foundation. *Hood Canal Education Foundation*. http://hoodcanaleducationfoundation.com/.
[95] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*.
[96] Washington Sea Grant. *Shellfish in Washington*. https://wsg.washington.edu/our-northwest/shellfish/.

identification, regulations, Tribal shellfish culture and identity, Tribal treaty rights, ecosystem values, commercial and non-commercial shellfish growing and harvesting practices, and individual harvest techniques and best practices (e.g. filling in holes). These walks can be modeled after similar events held at Hama Hama Oysterama, Shellfests, the Fjordin Crossin, ShrimpFest, and local shellfish farm tours. Shellfish educators from Marine Resources Committees, the Pacific Coast Shellfish Growers Association, Washington Sea Grant, and Washington State Parks can be engaged to create the content for, and lead, the beach walks. "Digging for dinner" guided trips that teach how to safely process and consume shellfish can also be promoted. Materials addressing 'how we harvest shellfish in Hood Canal' can be distributed at events to drive home the message of the regional cultural importance of shellfish. Collectively, these events will connect the Hood Canal community with positive shellfish-related memories and bolster the regional identity associated with shellfish.

Action 3.B.3. Host local public forums on shellfish-related community benefits, impacts, and activities

This action will provide forums and other educational opportunities for the public to learn about shellfish issues, the benefits they provide, and potential impacts. Partnerships with the commercial shellfish industry, Tribes, state agencies, local governments and organizations, and others will use the expertise of these entities. Potential topics include shellfish tourism, recreational harvest, human wellbeing derived from participating in shellfish-related activities, cross-cultural viewpoints on the importance of shellfish, the economic benefits of shellfish (e.g. the number of direct shellfish jobs, economic multiplier calculations, revenues generated for local governments and other institutions, etc.), commercial and non-commercial shellfish growing and harvesting practices, effective shellfish habitat and restoration practices, balancing impacts from shellfish aquaculture, and more. Events can be independent or part of existing shellfish events.

Action 3.B.4. Work with chefs to promote culinary outreach highlighting Hood Canal shellfish

This action will work with local and national chefs to highlight and promote Hood Canal shellfish in their restaurants. Work can build off of existing efforts such as the Hama Hama Oyster Company's award-winning partnerships with chefs across country, and chefs involved in the Olympic Culinary Loop and the Washington Shellfish Trail.[97] Information about Hood Canal Tribal and non-Tribal shellfish identity and culture, the importance of maintaining water quality, and the unique characteristics of Hood Canal shellfish can all be promoted, among other relevant information.

Action 3.B.5. Highlight WDFW and Tribes' co-management of shellfish resources on WDFW website

This action will emphasize and explain Tribal and state co-management of shellfish resources on the WDFW website. The WDFW website currently has salmon co-management information but does not include shellfish. Homeowners and current and prospective commercial shellfish growers look for this info when planning harvests to make sure their harvest plans are in compliance with the law.[98] Co-management information on the Northwest Indian Fisheries Commission website can be used as template for presenting this information.

[97] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*.
[98] Ibid.

Objective 4. Support a sustainable Hood Canal commercial shellfish industry

Sub-objective 4.A. Prevent impacts from shellfish aquaculture marine debris

Action 4.A.1. Establish Hood Canal shellfish industry marine debris reduction program

While sources of marine debris vary, this action focuses on debris from shellfish aquaculture growers. It will work with Hood Canal commercial shellfish aquaculture partners to develop best management practices (BMPs) based on the Pacific Coast Shellfish Growers Association's (PCSGA) Environmental Codes of Practices related to marine debris prevention. It will also work with Hood Canal growers to develop customized farm plans to implement codes of practices for their operations. BMPs will acknowledge the dynamic nature of commercial shellfish operations and will avoid applying overly prescriptive rules that restrict adaptation to new practices. Outreach events like workshops and field days can demonstrate effective BMPs in action and encourage grower adoption. Other efforts like installing debris collection sites, collaborating with pre-existing marine debris collection services, outreach to spread the word about PCSGA's 1-800 # for debris reporting, and marking hobby farm and shellfish gardener gear so that escaped gear can be returned to the proper owner can all expand the impact of this action.

Action 4.A.2. Conduct regular public beach clean-ups partnering the shellfish industry and stakeholders

This action will provide regular opportunities for the public to join shellfish industry-led marine debris cleanup efforts. It will build on past efforts in Hood Canal to clean up derelict aquaculture sites. Efforts will also be made to expand the Pacific Coast Shellfish Growers Association's (PCSGA) biannual South Sound beach cleanups into Hood Canal, and seek opportunities to join with other Puget Sound-wide marine debris cleanup efforts to maximize the regional impact of marine debris removal. Data will be gathered on the debris collected to monitor the type and amount of debris so that the shellfish industry can identify proactive solutions to prevent future waste.

Sub-objective 4.B. Address shellfish industry inefficiencies and barriers to entry for new commercial shellfish operations

Action 4.B.1. Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs

This action will use Marine Spatial Planning (MSP) analysis to inform responsible aquaculture siting in Hood Canal, avoid land use and ecosystem conflicts, and ensure sufficient habitat quality. MSP is a type of marine spatial analysis that provides a framework for the appropriate siting of marine uses. It relies on representative and authoritative data (e.g. remote sensing platforms, GIS layers, GPS-based technologies, regulatory data, etc.) to inform the MSP process. This data is used to identify prospective aquaculture sites with the highest return on investment, and to evaluate an aquaculture project area for potential environmental impacts, space-use conflicts, and compliance with applicable laws.[99] MSP will only be used as a tool to facilitate appropriate development and protection needs, and not to designate exclusive uses. An MSP process must be collaborative and inclusive, and proactively coordinate with Hood Canal Tribes to avoid infringements on treaty rights. Potential activities include mapping existing shellfish farms in Hood Canal, identifying prioritized culverts impacting shellfish habitat for removal, and identifying high priority nearshore habitat areas needing soft armoring and/or armor removal, among

[99] Jossart, J., Theuerkauf, S. J., Wickliffe, L. C., Morris, J. A. Jr. *Applications of Spatial Autocorrelation Analyses for Marine Aquaculture Siting*. Front. Mar. Sci. 6:806. January 2020. https://doi.org/10.3389/fmars.2019.00806.

others. Similar efforts in WA and other coastal states, as well as federal resources, should be explored to inform best practices for the design of an MSP approach in Hood Canal.

Action 4.B.2. Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")

This action will develop a pre-permitting process for identifying priority aquaculture development sites in Hood Canal. Obtaining an aquaculture permit to farm seafood requires an expensive and extensive process requiring review and consultation with multiple government agencies. Pre-permitting of carefully selected marine areas for aquaculture can ease this burden for new entrants into the industry. Pre-permitting significantly lowers the regulatory burden for prospective shellfish growers by conducting the various reviews related to aquaculture siting in advance. Growers can then initiate their operations with much of the permitting process complete. This process maintains public comment and input into the permitting process. Examples of pre-permitted marine aquaculture areas include the Ventura Shellfish Enterprise and the Humboldt Bay Mariculture Pre-Permitting Project.

Pre-permitting processes should be combined with Marine Spatial Planning (Action 4.B.1) to identify priority aquaculture sites and be incorporated into marine enterprise zones (MEZs). MEZs sublease public trust waters from the state to individual growers, with the state acquiring permits from the various agencies ahead of time. The state then approves areas that comply with the regulations, and prospective shellfish growers can then submit an application to lease a site within the preapproved area. This removes the need for the state to survey individual permits on a case-by-case basis and only requires the grower to submit one application for approval instead of multiple applications. Leases within MEZs are typically longer to foster the growth and development of new shellfish operators. The action will also include research into other MEZs around the country to glean best practices for its application in Hood Canal. A pre-permitting process and/or MEZ must ensure that process efficiencies maintain proper assessment of potential ecosystem impacts, and public notice and review.
can then for its application in Hood Canal. A pre-permitting process and/or MEZ must ensure that process efficiencies maintain proper assessment of potential ecosystem impacts, and public notice and review

A project submitted to implement this action must be conducted in close coordination with regulatory agencies at all levels (state, county, etc.), and include a collaborative advisory group of all relevant stakeholders.

Action 4.B.3. Establish program to develop and strengthen local, qualified workforce

This action will focus on establishing a local program to develop and train workers with the technical skills needed to work on commercial shellfish farms. There is currently a deficit of qualified shellfish farm workers, which negatively impacts the ability of shellfish growers to operate and grow their business and adapt to changing market conditions.[100] Potential actions include strengthening existing connections with Bellingham Technical College's Fisheries and Aquaculture Sciences program and expanding internship opportunities with Hood Canal growers. The action could also support Mason County School District's efforts to establish a new high school focused on natural resources and include a strong focus on aquaculture in its charter.

[100] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #5*.

Action 4.B.4. Assess opportunities for, and implement, improved local regulatory processes for shellfish growers

This action will explore opportunities to improve Hood Canal shellfish industry regulatory processes. Current regulatory processes can be time consuming, expensive, and difficult to navigate for shellfish growers, while also a challenge for the public to follow, resulting in an unclear decision-making process for the assessment of environmental impacts. Better coordination is needed between regulatory entities to streamline permitting and limit duplicative reporting.[101] This action will pursue a flexible regulatory process that acknowledges growers dynamic growing practices and avoids prescriptive regulations that can restrict growers from adapting to changes, while providing clear opportunity for public engagement. It will build on the existing Washington Shellfish Initiative's Shellfish Interagency Permitting Team report to implement recommendations that outline how to improve commercial shellfish permitting and the permit application process with Hood Canal jurisdictions.[102] Land use policies and habitat protections related to shellfish are described in action 2.E.2.

Sub-objective 4.C. Build resilience in shellfish industry and ecosystem interactions

Action 4.C.1. Pilot projects to research efficacy of localized carbon refuge projects in Hood Canal

This action will build on previous work completed by the Marine Resources Advisory Council, Washington Department of Ecology, and others to implement and research the effectiveness of localized projects to combat the impacts of ocean acidification in Hood Canal. Hood Canal and other marine waters in Washington State are particularly vulnerable to ocean acidification due to a variety of factors, including the amount of carbon dioxide in the atmosphere, the upwelling of corrosive and nutrient-rich waters off of the coast, high rates of plankton growth and die off that reduce oxygen levels in local waters, and human activities such as stormwater runoff and industrial emissions of acidic gases.[103] Existing research projects using kelp and seaweed farming to create refuges for growing shellfish in acidic conditions can be investigated for opportunities to apply and/or expand those approaches in Hood Canal.[104]

Action 4.C.2. Support aquaculture industry research needs on disease, breeding methods, equipment and technology development, and pilot innovations in the field

This action will provide a variety of technical assistance related to disease, breeding methods, equipment, and technology development to support commercial shellfish aquaculture operations. The commercial shellfish aquaculture industry faces many challenges to regularly produce shellfish. Disease, weather, equipment failures and other setbacks can severely limit the productivity of shellfish growers. Providing technical assistance where needed can overcome these barriers and encourage the spread of innovation in the field.[105]

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[101] Ibid.

[102] Washington Department of Ecology. *Shellfish Interagency Permitting team*.https://ecology.wa.gov/Water-Shorelines/Shoreline-coastal-management/Aquaculture/Shellfish-Interagency-Permitting-Team.

[103] The University of Washington. *Washington Ocean Acidification Center*. https://environment.uw.edu/research/major-initiatives/ocean-health/washington-ocean-acidification-center/.

[104] Washington Sea Grant. *Kelp Aquaculture.* https://wsg.washington.edu/community-outreach/kelp-aquaculture/.

[105] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #5*.

Action 4.C.3. Identify research gaps and support efforts to explore the environmental interactions and impacts of shellfish aquaculture systems

This action supports research of commercial shellfish growing practices that provide ecosystem services and minimize negative effects on the Hood Canal marine environment. Research will be conducted with willing growers on working commercial farms to mimic real-world conditions. Continued work is needed to build on a variety of existing research into these challenges. For example, the Nature Conservancy (TNC), NOAA, and the Pacific Shellfish Institute are using underwater photography and other methods to monitor species interactions with aquaculture crops, equipment, and eelgrass.[106] Other research analyzing the impacts of geoduck aquaculture, identifying best management practices for off-bottom shellfish culture, and using remote sensing for identifying appropriate bottom culture sites can be built on by this action.[107, 108, 109, 110, 111, 112, 113] The results and recommendations from this research will be disseminated to shellfish growers, the public, policymakers and others to build awareness.

Objective 5. Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors

Sub-objective 5.A. Improve shellfish harvest management modeling and implementation

The specific activities below address shellfish harvest management activities led by the state's co-managers (treaty Tribes, WDFW, and DNR) and are emphasized here for their importance and urgency in Hood Canal. Implementation of these actions should be undertaken by the co-managers. Opportunities should also be sought by HCSI partners in coordination with the co-managers to support research, and outreach and education, around the specific resource management challenges included below.

Action 5.A.1. Support data-driven quota-setting process

This action supports shellfish co-managers to continue to improve data-driven quota-setting processes that collect and analyze salient data. Information gaps and research needs should be identified to support and further these efforts. Where appropriate, data gathering by community scientists or students to aid quota-setting decisions should be explored. Accurate shellfish quotas ensure that

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[106] NOAA Fisheries. *Milford Lab's GoPro Aquaculture Project*. https://www.fisheries.noaa.gov/new-england-mid-atlantic/aquaculture/milford-labs-gopro-aquaculture-project.

[107] Washington Sea Grant. *Geochemical and Ecological Consequences of Disturbances Associated with Geoduck Aquaculture Operations in Washington*.

[108] Washington Sea Grant. *Community and Multitrophic Implications of Structure Additions Associated with Intertidal Geoduck Aquaculture*.

[109] Washington Sea Grant. *An Ecosystem Approach to Investigate Direct and Indirect Effects of Geoduck Aquaculture Expansion in Washington State*.

[110] Washington Sea Grant. *Determining Whether Native Eelgrass and Pacific Oysters Synergistically Enhance Their Environments*.

[111] Ryan, C. M., McDonald, P. S., Feinberg, D. S., Hall, L. W., Hamerly, J. G., and Wright, C. W. *Digging Deep: Managing Social and Policy Dimensions of Geoduck Aquaculture Conflict in Puget Sound, Washington*. Coastal Management, 45:1, 73-89. December 6, 2016. doi: 10.1080/08920753.2017.1252628.

[112] Pacific Shellfish Institute. *Off-Bottom Oyster Culture - Effects and BMPs*. http://www.pacshell.org/off-bottom.asp.

[113] University of Maryland. *Maryland-led, Multi-institutional Research Team Receives $10M to Transform Shellfish Farming with Smart Technology*. Maryland Robotics Center. June 24, 2020. https://robotics.umd.edu/release/marylandled-multiinstitutional-research-team-receives-10m-to-transform-shellfish-farming-with-smart.

shellfish are harvested at sustainable rates. Precise and timely data is necessary to ensure that quotas are accurately set to optimize harvest and protect the sustainability and health of the resource.[114]

Action 5.A.2. Develop outreach and education activities to encourage public adherence to recreational harvest management regimes

This action supports state shellfish managers in their development of mechanisms to incentivize and encourage the public to stay within shellfish harvest management regimes, including quotas and seasonal restrictions. Signage is not enough to educate shellfish harvesters.[115, 116]. Working with partners like Washington Sea Grant, this action will develop messaging and other outreach and educational tools educating on sustainable fishery management approaches utilized in co-managed fisheries. Educational resources and outreach techniques for non-English proficient harvesters will be emphasized. This information will be incorporated into relevant public education resources like the Washington State University Extensions' Shore Stewards "Guide for Shoreline Living" information booklet.

Action 5.A.3. Develop guidance to manage when harvest quotas are exceeded

This action will support shellfish co-managers' resource management processes that address real-time response when quotas are exceeded. Significant increases in recreational harvest pressure in certain areas of Hood Canal has elevated this issue in recent years, as well as past instances of poaching and illegal harvesting. Adequate responses to these issues require improved tools to assist real-time resource management, and reduce impacts from over-harvesting and poaching.[117] These responses may include prevention measures such as outreach materials guiding harvesters to other nearby locations or species and educational information about the importance of quota limits, and the consequences of poaching, and consideration of appropriate enforcement efforts to stop poachers. When over-harvesting at specific sites is expected mid-season, immediate area closures are sometimes necessary and would benefit with outreach directing visitors elsewhere. Improved modeling can help predict harvest patterns to prepare response measures in-season. Information and enforcement gaps should be identified, and research conducted to address uncertainties and develop improved tools.

Sub-objective 5.B. Pursue ways to increase tideland access and shellfish harvest opportunities

Action 5.B.1. Develop and implement a comprehensive strategy to identify all public shoreline properties and access points

This action will fill the knowledge gap around public shoreline access by developing strategies for identifying these resources in Hood Canal. There is currently a lack of accurate tideland ownership maps and boundary marks in the field. Very few private tidelands are surveyed, as they are expensive and there are not many qualified surveyors available. Work will coordinate and engage closely with local Hood Canal jurisdictions and state agencies (WDFW, DNR, etc.) to properly inventory their public access points. WDFW is in the process of adding public shoreline access information in their Fish Washington app. This work will coordinate with them to streamline and highlight relevant shellfish-related public access information in this resource. Work will also build on similar work done by the Washington Department of Ecology's Washington Marine Shoreline Access Project and Washington State Coastal Atlas that identified the ownership, location, and length of all public marine shoreline in the state of

[114] Ibid.
[115] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.
[116] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*.
[117] Ibid.

Washington.[118, 119] Beach Identification Numbers (BIDN) will be used to identify and catalog appropriate public shoreline properties and access points, while recognizing that it may not be feasible to map every sub-unit of state land. When creating new access points, this action will closely coordinate with neighbors to avoid creating attractive nuisances and enforcement issues. Action 5.B.2. Acquire, protect, and improve access at properties that provide public access to tidelands in priority areas (uplands and shoreline)

This action will focus on acquiring and protecting upland and shoreline properties suitable for public access, as well as improving access infrastructure at existing public sites. Acquisition priorities will be determined by existing plans and prioritization analyses, and/or determined by a stakeholder engagement process.

Action 5.B.3. Convene a forum of land trusts and other landowners to assess allowing public access to tidelands using conservation easements

This action will convene a forum of Hood Canal-area landowners and land trusts to assess the location and level of public access allowed by conservation easements to Hood Canal tidelands and explore options to increase accessibility within their limits. The opening of new publicly accessible beaches should consider enforcement implications and available resources.

Action 5.B.4. Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites

This action will support existing and new shellfish enhancement efforts by the state, Tribes, and others on public and Tribal beaches. Enhancing beaches extends harvest seasons and increases harvest opportunities.[120, 121] This action will build on existing enhancement efforts by the Skokomish Indian Tribe and state to enhance Tribal and public tidelands in the Skokomish estuary, and by the Port Gamble S'Klallam Tribe, Skokomish Indian Tribe, and WDFW to do public tideland enhancement on public and Tribally-owned lands north of Ayock Point. Efforts will be made to select appropriate sites and overcome permitting challenges. Funding for this action may be available through federal and/or state funding programs like the Aquatic Lands Enhancement Account (ALEA). A project submitted to implement this action must be conducted in direct coordination and under the guidance of WA state's shellfish co-managers: the WA Department of Fish and Wildlife, and the Skokomish Tribe and/or Port Gamble S'Klallam Tribe, as appropriate.

Sub-objective 5.C. Public outreach to promote harvest opportunities, techniques, and best practices

Action 5.C.1. Develop a public-facing shellfishing information website

Shellfishing information is currently spread across multiple websites and information sources, updated frequently to reflect current harvest conditions and restrictions, and is highly location-based. This makes it difficult for prospective shellfish harvesters to access and comprehensively understand the

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[118] Archer, J.A, Bennett, J.J. *The Washington Marine Shoreline Public Access Project*. Beach Environmental Assessment, Communication and Health (BEACH) Program. Washington State Department of Ecology. May 2009. https://portofpa.com/DocumentCenter/View/1754/WA-Marine-Shoreline-Public-Access-Project-2009?bidId=.

[119] Washington Department of Ecology. *Washington State Coastal Atlas Map*. https://fortress.wa.gov/ecy/coastalatlas/tools/map.aspx.

[120] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.

[121] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*.

regulations, safety information, and best practices relevant to harvesting shellfish.[122] This action will coordinate with relevant state partners to develop a public-facing website containing accurate and real-time information relevant to shellfishing in Hood Canal. Existing shellfish resources like in DOH's Washington Shellfish Safety Map should be enhanced to include relevant Hood Canal shellfish information such as WDFW's list of the best daylight tides to harvest shellfish, information related to Tribal treaty rights and co-management, tideland ownership, invasive species control, and alternative species available to harvest when target species are closed. The website should be designed to be visually appealing and easily accessible, with video and graphics to disseminate information in a variety of ways and languages. Broad marketing and outreach efforts should be coordinated with third parties like Explore Hood Canal to promote the website and attract website visitors.

Action 5.C.2. Develop a guide for boat-in shellfishing access and best practices

There is currently no known information designed specifically for shellfishing at boat-in beaches in Washington State.[123, 124] This action will develop a guide focused exclusively on educating the public about publicly accessible boat-in beaches in Hood Canal and best practices for visiting a boat-in beach. Work will focus on overcoming common challenges to publicizing and encouraging public access, such as ensuring accurate maps of tideland boundaries and ownership, enforcement feasibility and concerns for remote places, and other long-term management concerns related to routine maintenance, monitoring of cumulative impacts, and overuse. This work should be coordinated with WDFW to incorporate boat-in public beach access to their map of public shorelines in their "Fish Washington" app, and with Washington State University Extension to incorporate boat-in shellfishing access and best practices into their Shore Stewards "Guide for Shoreline Living" information booklet, as well as other places where it can be disseminated widely. The guide and any educational work will focus on known boat-in shellfishing sites.

Action 5.C.3. Develop a program to teach shoreline owners to conduct self-monitored shellfish population and harvest surveys on private land

Private recreational harvest on private lands is not routinely monitored and the extent of this activity in Hood Canal is generally unknown. Capturing this information will be useful for harvest management and quota-setting purposes. This action should be coordinated with Sub-Objective 5.A actions.[125, 126] This action will teach shoreline owners how to collect shellfish harvest information on private lands and conduct self-monitored shellfish population surveys. Work will coordinate with Tribes to avoid potential treaty rights issues (e.g. shoreline owner surveys potentially conflicting with Tribal surveys and harvests on private lands), develop a potential data collection system based on the system currently used by Tribes to survey private tidelands, and add collected data to Tribes' existing databases containing this information. Work can also focus on better understanding tideland boundaries to know the geographic extent of data collection efforts on private beaches. Information collected from private shoreline owners will fill gaps in understanding about how private residents interact with their land, and supplement existing information collected by professional researchers. It will not be solely relied upon to make shellfish management decisions.

[122] Ibid.
[123] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7.*
[124] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*.
[125] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #7*.
[126] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #8*.

Objective 6. Restore native Olympia oyster populations in Hood Canal

Sub-objective 6.A. Establish baseline population data and coordinated monitoring methodologies

Action 6.A.1. Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal

Knowledge gaps exist about the distribution and densities of Olympia oysters in Hood Canal. Some of this information is collected, but it is scattered among different agencies and restoration groups and is not robust enough to produce reliable population estimates.[127] This baseline data is important to plan effective restoration efforts. This action encourages Hood Canal Olympia oyster restoration practitioners and non-local researchers to collaborate to improve understanding of Olympia oysters**.** The Native Olympia Oyster Collaborative (NOOC). NOOC is a network of West Coast oyster scientists, practitioners, educators and aquaculturists that shares scientific, management, and educational resources to complement local and regional Olympia oyster conservation and restoration efforts.[128] Potential activities may include encouraging public and private landowners to submit Olympia oyster locations to NOOC's Olympia oyster mapping database, and developing and deploying a standard methodology for determining Olympia oyster population density. Much of this work can be done outside of NOOC in a format appropriate for local conditions. Collaboration with NOOC and other non-local groups who may be unfamiliar with local conditions is encouraged only where appropriate and cost-effective.

Action 6.A.2. Conduct a multi-year assessment of existing Olympia oyster locations

Accurate geolocation information of existing Olympia oyster populations is important for long-term success of Olympia oyster restoration. This action will conduct a multi-year assessment of existing Olympia oyster population locations, building off of Puget Sound Restoration Fund's existing work assessing site characteristics to prioritize restoration work . This data will fill a key knowledge gap related to current distribution of Olympia oysters in Hood Canal (measured by presence/absence) and their population densities (measured in square meters). Data will also be used to monitor various environmental improvements (e.g. water quality, land use impacts), inform restoration efforts (e.g. habitat enhancement, seeding), and for population modeling of Olympia oysters in Hood Canal using localized source/sink analysis to understand connectivity between populations. Invasive species (such as oyster drills) will also be monitored during these assessments. This information will be collected on public beaches via a crowd-sourced volunteer model by the Beachwatchers, Marine Resources Committees, and other community science groups using a mobile app that allows users to drop a pin and take a photo of where Olympia oysters are found. Efforts will also be made to train private tideland owners to document Olympia oyster locations on their lands. Collected data will be evaluated by professional experts for quality control.

Sub-objective 6.B. Develop coordinated planning infrastructure and strategies to guide Hood Canal Olympia oyster restoration

Action 6.B.1. Develop and implement a Hood Canal-specific Olympia oyster restoration plan

This action will build off of the WDFW Olympia oyster Restoration Plan to create a Hood Canal-specific Olympia oyster restoration plan to guide and prioritize Olympia oyster restoration actions in Hood Canal. The plan should incorporate Hood Canal-specific information and research such as a list of potential

[127] Jodie Toft. Puget Sound Restoration Fund. *Personal communication*. Sept. 4, 2020.
[128] Native Olympia Oyster Collaborative. *About Us*. https://olympiaoysternet.ucdavis.edu/about.

restoration projects, an evaluation of the success of existing restoration sites, and how sites may be impacted by future climate and development pressures. Regional and beach-specific restoration targets based on multi-year assessments (Action 6.A.2) should also be included for different parts of Hood Canal. The plan should include details about desired habitat types and conditions to pursue, how to successfully outplant Olympia oysters based on experience and emerging science, and lessons learned from successful Olympia oyster projects conducted elsewhere that can be adopted in Hood Canal. The plan should be collaboratively developed by engaging the public, Tribes, NGOs, landowners, shellfish companies and other Hood Canal shellfish partners.

Action 6.B.2. Establish a primary Olympia oyster restoration coordination entity to coordinate Hood Canal Olympia oyster projects and community partners

This action is based on the concept of salmon recovery Lead Entity coordinators, positions that coordinate watershed-based groups who implement salmon habitat restoration actions. . Lead entity coordinators work with a committee of technical experts, a committee of local community members, and a grant administrator to guide the implementation of restoration projects and funds. They use technical expertise and local knowledge to identify and rank restoration projects and support their implementation.[129] Existing partnerships in Hood Canal could be formalized and expanded to create an entity that provides this level of coordination for collaborative and regional Olympia oyster restoration. . For example, Puget Sound Restoration Fund currently collaborates with numerous partners to conduct their restoration work, with WDFW contributing technical assistance.

This action borrows from the salmon recovery Lead Entity concept, it does not propose to design a similar statutory recovery system based Endangered Species Act requirements, nor does it propose to start a project funding process similar to the Salmon Recovery Funding Board. Rather, this action mimics the coordination aspects of the salmon lead entity structure to ensure that communication and collaboration amongst Olympia oyster practitioners in Hood Canal is executed strategically. Sub-objective 6.C. Support Olympia oyster restoration projects

Action 6.C.1. Increase Olympia oyster seed supply via Puget Sound Restoration Fund methods

There is currently a limited amount of hatchery-produced Olympia oyster seed that meets restoration-grade developed by Puget Sound Restoration Fund (PSRF) and partners to maintain genetic diversity of seed.[130] Each batch of seed must have fidelity to the basin in which the restoration work is to be done, meaning the seed must be produced from adult broodstock from within the basin at a minimum. Hood Canal is one of five basins in Puget Sound. PSRF can only produce two runs of restoration-grade seed each year, so there can be a lag for seed production for a specific basin (e.g. Hood Canal) while seed is produced for restoration in other basins.[131] Additionally, PSRF seed production is limited by relative demand for seed in a given basin (e.g. small-batch and piecemeal seeding efforts are often inefficient and infeasible). This backlog limits the seeding efforts undertaken. This is particularly relevant in South Hood Canal, where seed enhancement is needed to kickstart the population.[132]

[129] Washington State Recreation and Conservation Office. *Lead Entities*. https://rco.wa.gov/salmon-recovery/managing-organizations/lead-entities/.
[130] Puget Sound Restoration Fund. *Conservation Hatchery*. https://restorationfund.org/programs/hatchery/.
[131] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #5*.
[132] Hood Canal Coordinating Council. *Hood Canal Shellfish Summit*. October 22, 2020. https://hcccwagov.box.com/s/emxbgsmjlubk4uaa001vvuqlft5urkn6.

This action focuses on increasing the supply of Olympia oyster seed using PSRF methods to supply this excess demand and enable additional seeding projects. Work will focus on efficient large-batch seeding projects for the entire Hood Canal basin and will coordinate with WDFW to target specific locations where Olympia oyster seed is needed. It will include a test seed capture program to capture local Hood Canal oysters to produce seed that is adapted to the Hood Canal watershed. It may also include research to fill knowledge gaps related to Hood Canal Olympia oyster genetics. For example, it is still unknown if the Olympia oysters inhabiting the multiple sub-basins of Hood Canal are unique sub-populations, or part of one population (PSRF currently uses sub-basin-specific restoration seed for Hood Canal Olympia oyster out-plantings). There is also a lack of knowledge on the historical genetic structure of Hood Canal Olympia oysters.[133] This research will ultimately influence the selection of the brood stock source for Hood Canal Olympia oyster seed.

Action 6.C.2. Increase aged shell availability for Olympia oyster restoration efforts

Aged Pacific oyster shells are used for Olympia oyster restoration efforts to provide a surface for oyster larvae to settle and grow. Because Olympia oysters and Pacific oysters thrive in slightly different microhabitats, aged shell will be placed at precise tidal elevations to reduce the risk of Pacific oysters colonizing Olympia oyster restoration sites.[134] Canneries and shellfish farms are the biggest sources of shell.[135] Work will also coordinate with WDFW to revisit ideas about shell recycling programs from restaurants and other end-users so that shell can be used after it is properly aged. Demand for shell currently exceeds supply due to the time necessary to age the shell. The current aged shell supply is insufficient for restoration projects. This action will explore ways to increase aged oyster shell availability to meet this demand.

Action 6.C.3. Implement shell stack efforts to measure recruitment

Shell stacking is a popular method of measuring Olympia oyster recruitment as it provides a snapshot of the amount of recruitment in a specific location. The method involves stacking clean Pacific oyster shells on a piece of rebar and placing the stack in the intertidal area. Larval Olympia oysters then settle onto the shell stack, where they grow into juveniles, which can then be counted. Marine Resources Committees, the Skokomish and Port Gamble S'Klallam Tribes, and PSRF currently use this method in a variety of locations in Hood Canal. WDFW has prototype parts in storage and has also employed this method in other areas of Puget Sound.[136] This action will focus on implementing shell stack efforts throughout Hood Canal, including processing and analyzing resulting data to assess spatial and temporal changes in Olympia oyster recruitment.

[133] Ibid. Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #5*.
[134] Hood Canal Coordinating Council. *Hood Canal Shellfish Summit*.
[135] Hood Canal Coordinating Council. *Hood Canal Shellfish Initiative (HCSI) Workgroup Meeting #6*.
[136] Ibid.

Appendix C: HCSI Action Ratings Within Each Objective

The graphs and tables below display the raw survey results for the action ratings within each objective.

Objective 1. Protect and improve Hood Canal's water quality

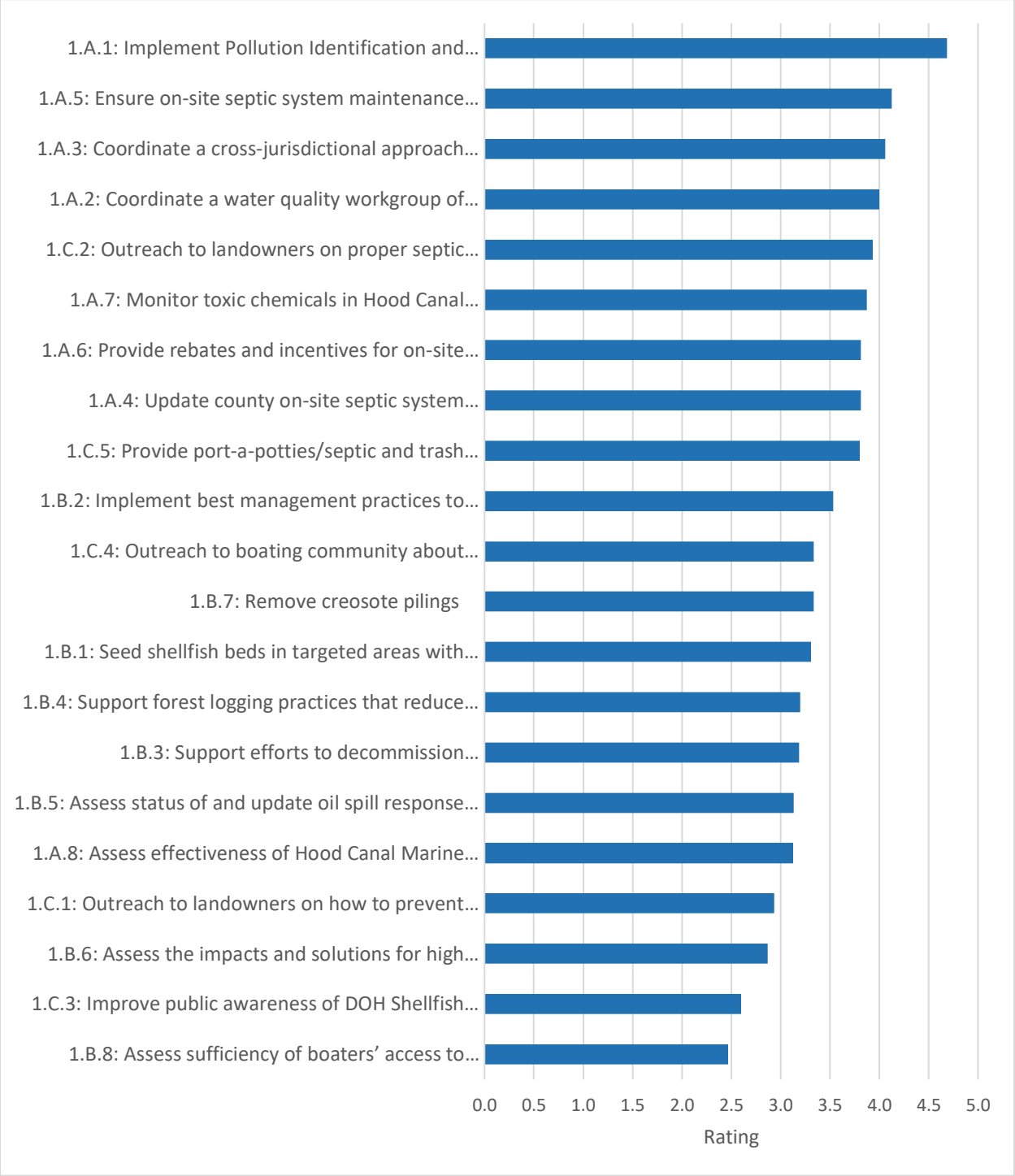

Figure 3: Objective 1. Water Quality action ratings

Table 6: Objective 1. Water Quality action ratings

Action	Rating
1.A.1: Implement Pollution Identification and Correction (PIC) programs	4.7
1.A.5: Ensure on-site septic system maintenance records are up to date	4.1
1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs	4.1
1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)	4.0
1.C.2: Outreach to landowners on proper septic systems maintenance	3.9
1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds	3.9
1.A.4: Update county on-site septic system management plans	3.8
1.A.6: Provide rebates and incentives for on-site septic system maintenance	3.8
1.C.5: Provide port-a-potties/septic and trash facilities for high use recreational fishing/shellfishing sites	3.8
1.B.2: Implement best management practices to collect and treat stormwater runoff and maintain natural hydrology	3.5
1.B.7: Remove creosote pilings	3.3
1.C.4: Outreach to boating community about preventing boat waste	3.3
1.B.1: Seed shellfish beds in targeted areas with water quality issues	3.3
1.B.4: Support forest logging practices that reduce runoff impacts	3.2
1.B.3: Support efforts to decommission unmaintained forest roads	3.2
1.B.5: Assess status of and update oil spill response plans	3.1
1.A.8: Assess effectiveness of Hood Canal Marine Recovery Areas	3.1
1.C.1: Outreach to landowners on how to prevent impacts from stormwater runoff	2.9
1.B.6: Assess the impacts and solutions for high concentrations of seals on man-made structures in important shellfish areas	2.9
1.C.3: Improve public awareness of DOH Shellfish Safety Map	2.6
1.B.8: Assess sufficiency of boaters' access to pump-outs throughout Hood Canal	2.5

Objective 2. Protect and improve Hood Canal shellfish habitat

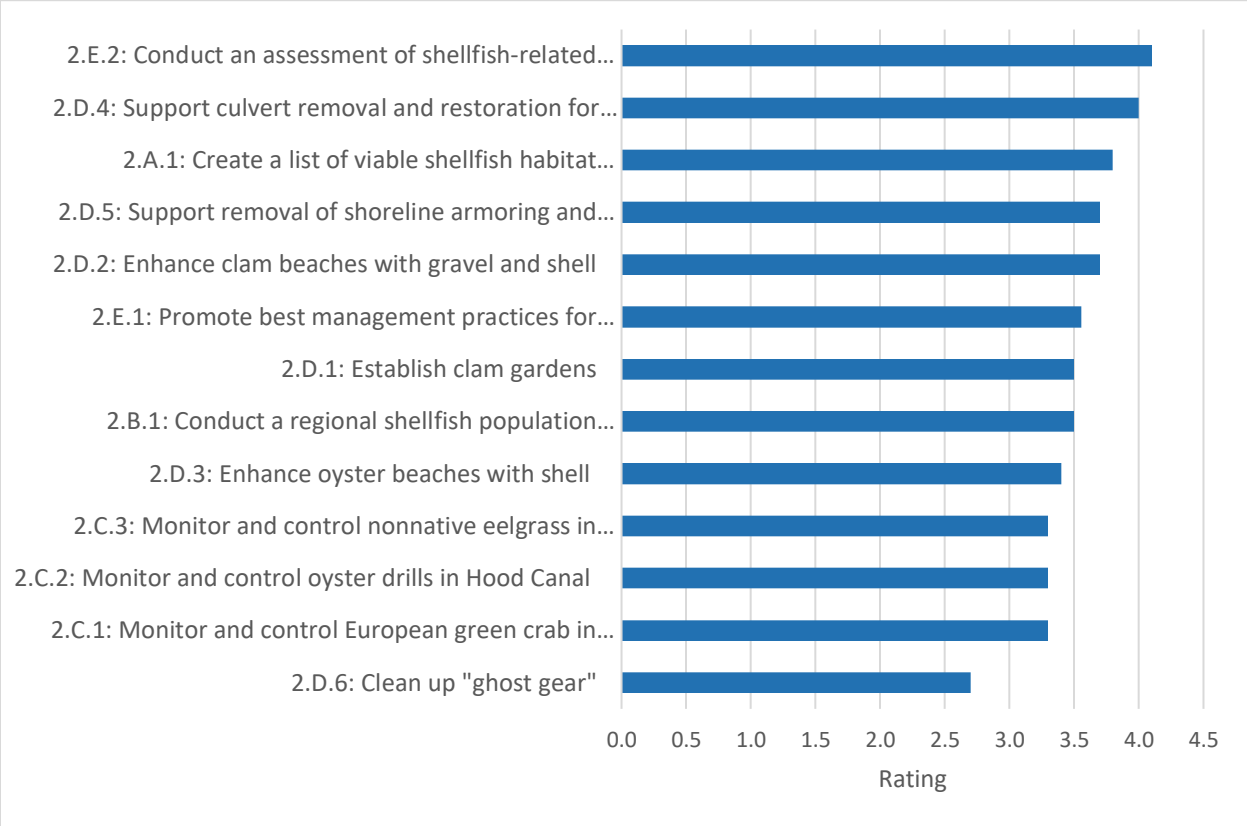

Figure 4: Objective 2. Shellfish Habitat action ratings

Table 7: Objective 2. Shellfish Habitat action ratings

Action	Rating
2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat	4.1
2.D.4: Support culvert removal and restoration for important shellfish habitat	4
2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species	3.8
2.D.2: Enhance clam beaches with gravel and shell	3.7
2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques	3.7
2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat	3.6
2.D.1: Establish clam gardens	3.5
2.B.1: Conduct a regional shellfish population density study for native species	3.5
2.D.3: Enhance oyster beaches with shell	3.4
2.C.2: Monitor and control oyster drills in Hood Canal	3.3
2.C.1: Monitor and control European green crab in Hood Canal	3.3
2.C.3: Monitor and control nonnative eelgrass in Hood Canal	3.3
2.D.6: Clean up “ghost gear”	2.7

Objective 3. Promote cultural appreciation of Hood Canal shellfish

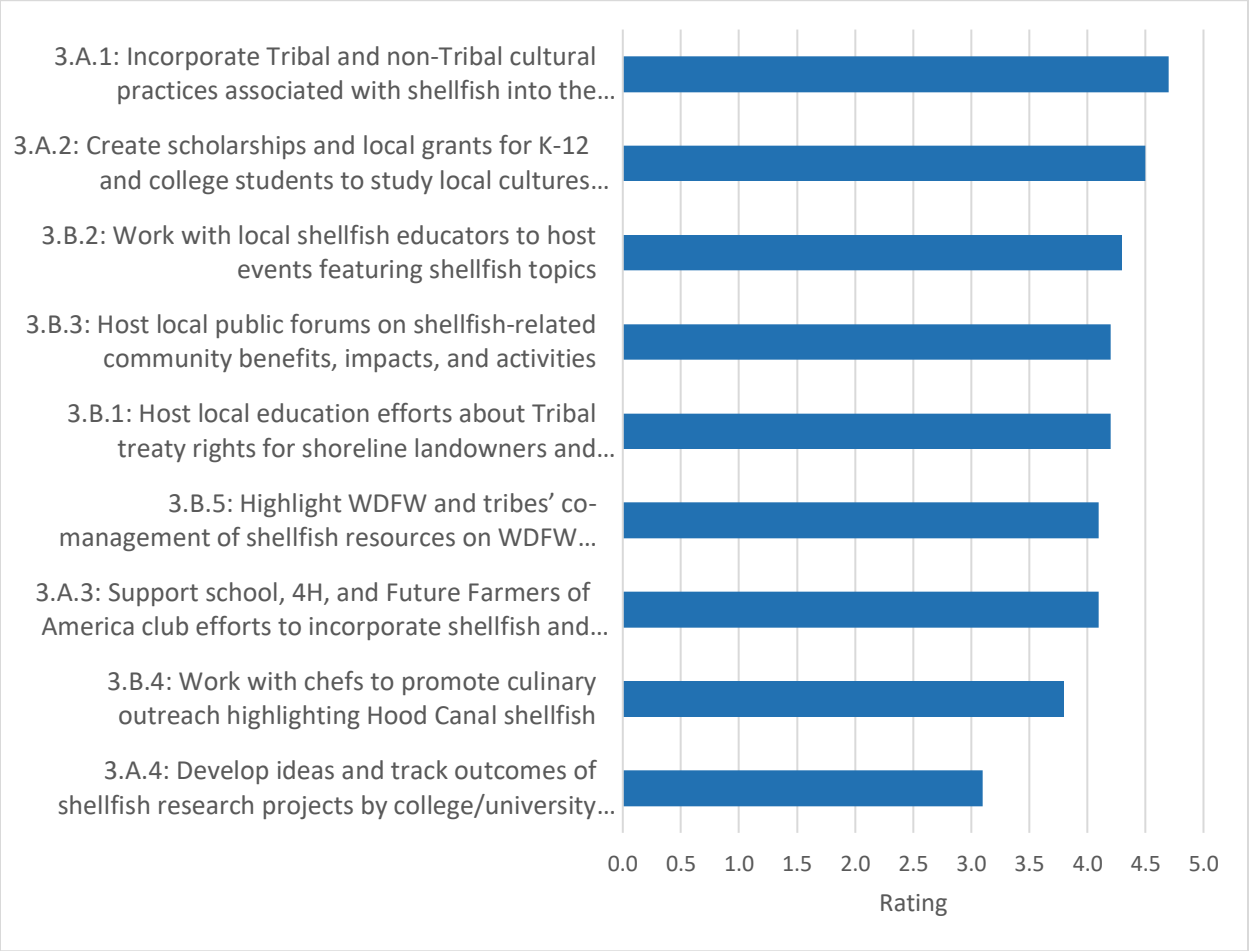

Figure 5: Objective 3. Cultural Appreciation action ratings

Table 8: Objective 3. Cultural Appreciation action ratings

Action	Rating
3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate	4.7
3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish	4.5
3.B.2: Work with local shellfish educators to host events featuring shellfish topics	4.3
3.B.1: Host local education efforts about Tribal treaty rights for shoreline landowners and shellfish growers	4.2
3.B.3: Host local public forums on shellfish-related community benefits, impacts, and activities	4.2
3.A.3: Support school, 4H, and Future Farmers of America club efforts to incorporate shellfish and local cultural practices	4.1
3.B.5: Highlight WDFW and Tribes' co-management of shellfish resources on WDFW website	4.1
3.B.4: Work with chefs to promote culinary outreach highlighting Hood Canal shellfish	3.8
3.A.4: Develop ideas and track outcomes of shellfish research projects by college/university students	3.1

Objective 4. Support a sustainable Hood Canal commercial shellfish industry

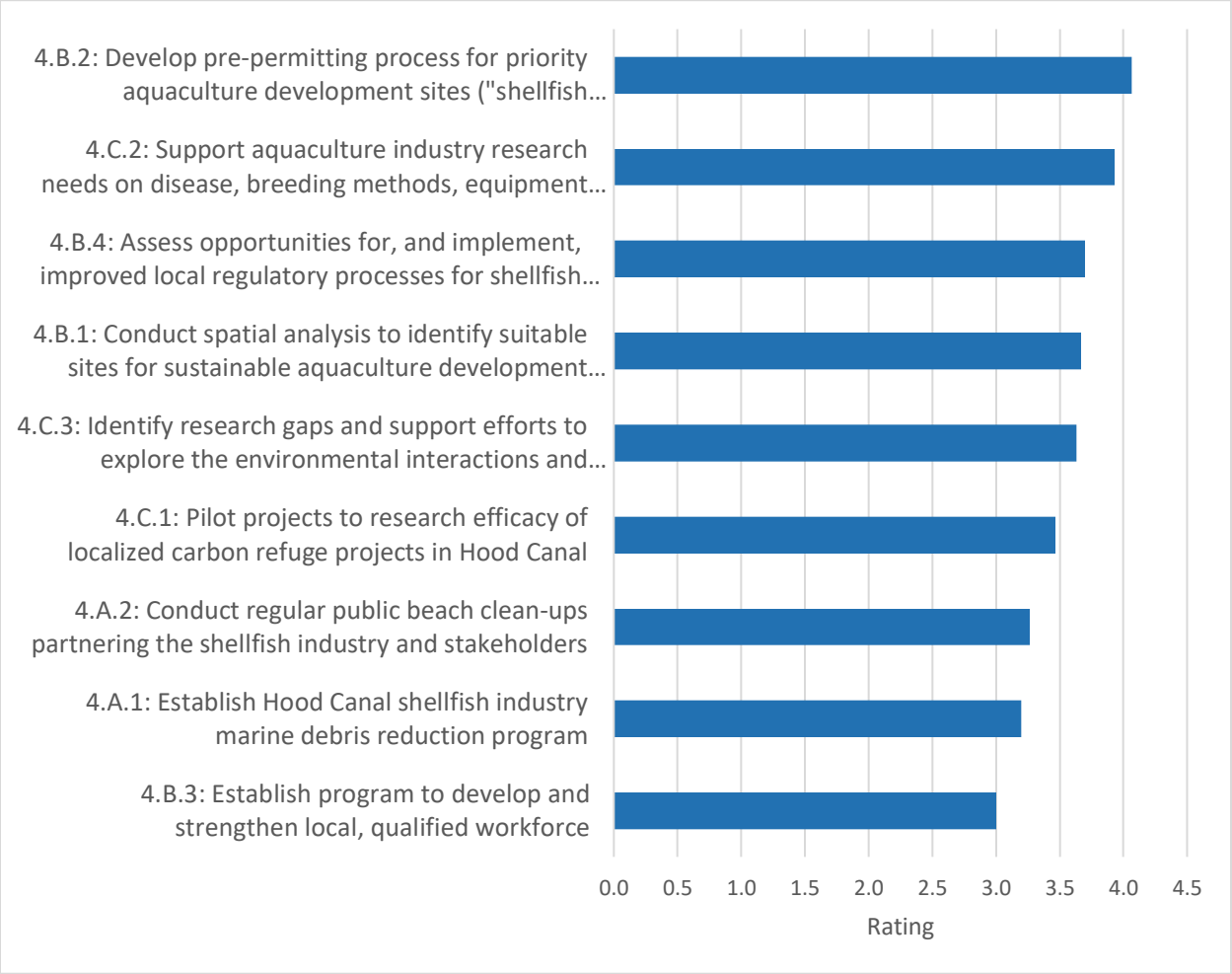

Figure 6: Objective 4. Sustainable Industry action ratings

Table 9: Objective 4. Sustainable Industry action ratings

Action	Rating
4.B.2: Develop pre-permitting process for priority aquaculture development sites (“shellfish enterprise zones”)	4.1
4.C.2: Support aquaculture industry research needs on disease, breeding methods, equipment and technology development, and pilot innovations in the field	3.9
4.B.4: Assess opportunities for, and implement, improved local regulatory processes for shellfish growers	3.7
4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs	3.7
4.C.3: Identify research gaps and support efforts to explore the environmental interactions and impacts of shellfish aquaculture systems	3.6
4.C.1: Pilot projects to research efficacy of localized carbon refuge projects in Hood Canal	3.5
4.A.2: Conduct regular public beach clean-ups partnering the shellfish industry and stakeholders	3.3
4.A.1: Establish Hood Canal shellfish industry marine debris reduction program	3.2
4.B.3: Establish program to develop and strengthen local, qualified workforce	3.0

Objective 5. Expand harvest opportunities for treaty Tribes, local communities, and visitors

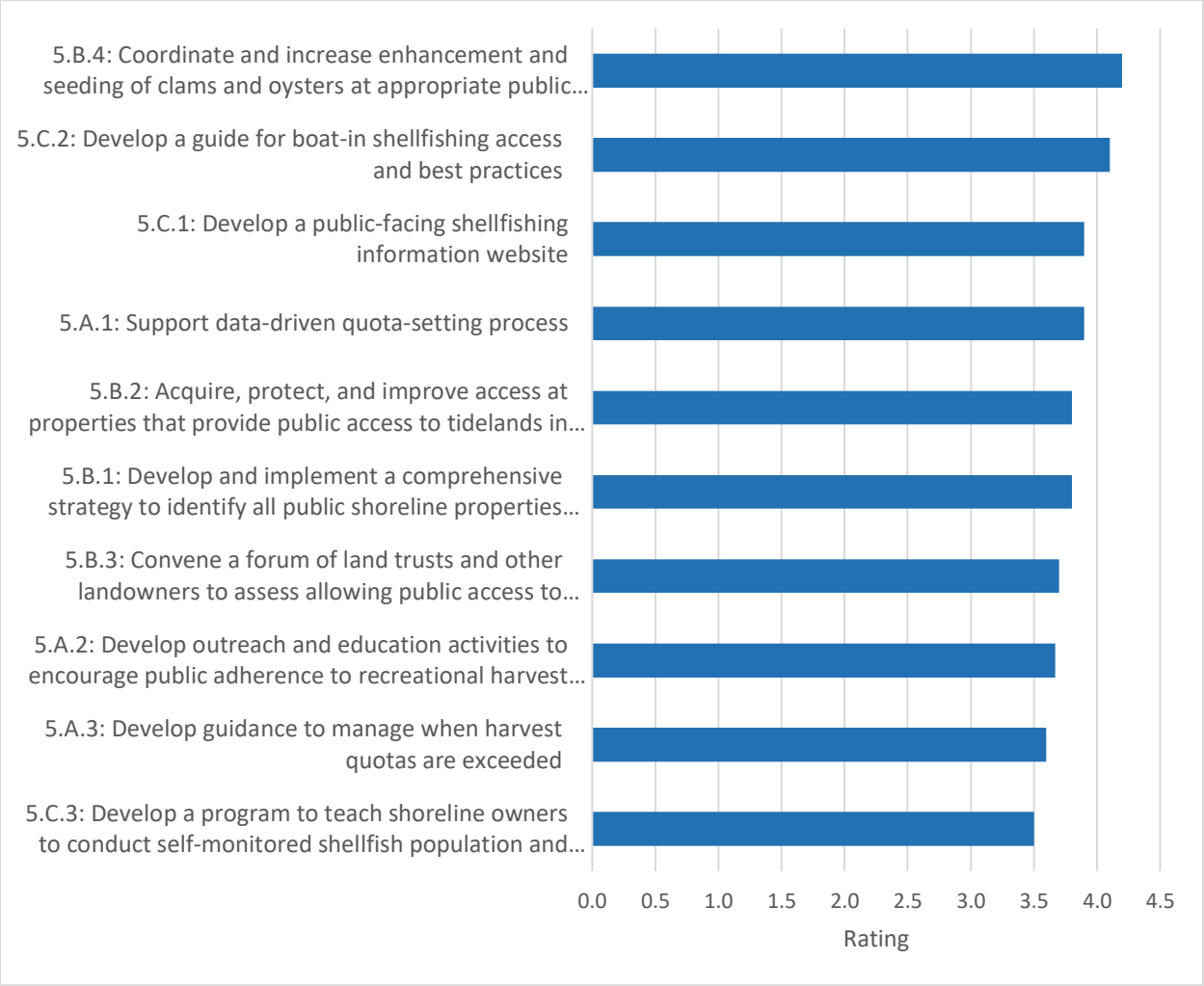

Figure 7: Objective 5. Harvest Opportunities action ratings

Table 10: Objective 5. Harvest Opportunities action ratings

Action	Rating
5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites	4.2
5.C.2: Develop a guide for boat-in shellfishing access and best practices	4.1
5.C.1: Develop a public-facing shellfishing information website	3.9
5.A.1: Support data-driven quota-setting process	3.9
5.B.1: Develop and implement a comprehensive strategy to identify all public shoreline properties and access points	3.8
5.B.3: Convene a forum of land trusts and other landowners to assess allowing public access to tidelands using conservation easements	3.7
5.A.2: Develop outreach and education activities to encourage public adherence to recreational harvest management regimes	3.7
5.A.3: Develop guidance to manage when harvest quotas are exceeded	3.6
5.C.3: Develop a program to teach shoreline owners to conduct self-monitored shellfish population and harvest surveys on private land	3.5

Objective 6. Restore native Olympia oyster populations in Hood Canal

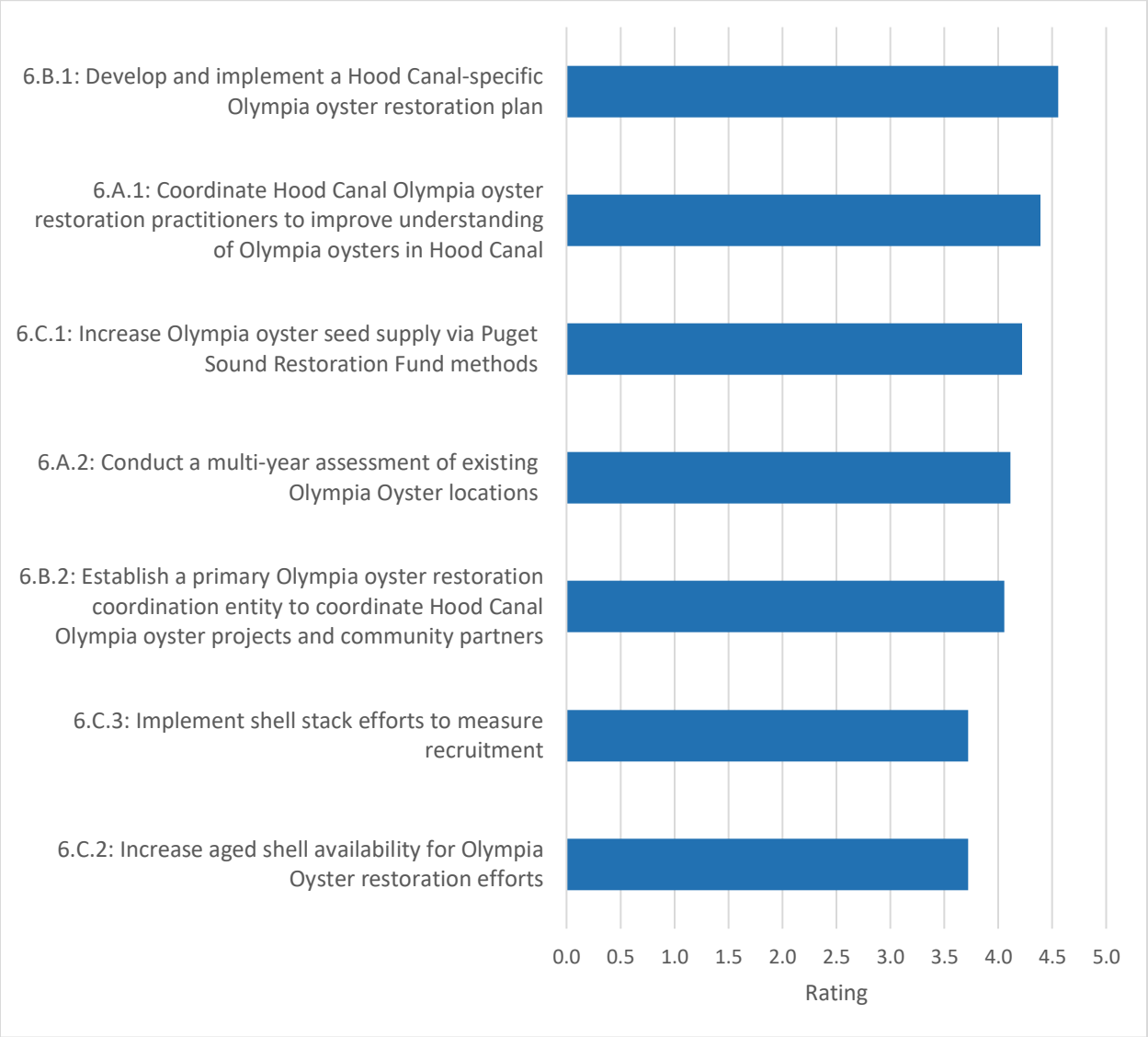

Figure 8: Objective 6. Olympia Oyster action ratings

Table 11: Objective 6. Olympia Oyster action ratings

Action	Rating
6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan	4.6
6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal	4.4
6.C.1: Increase Olympia oyster seed supply via Puget Sound Restoration Fund methods	4.2
6.A.2: Conduct a multi-year assessment of existing Olympia oyster locations	4.1
6.B.2: Establish a primary Olympia oyster restoration coordination entity to coordinate Hood Canal Olympia oyster projects and community partners	4.1
6.C.2: Increase aged shell availability for Olympia oyster restoration efforts	3.7
6.C.3: Implement shell stack efforts to measure recruitment	3.7

Appendix D: HCSI Action Ratings Across All Objectives (Unweighted)

The figures and tables below display each objective's actions rated across all objectives, without the objective weights applied.

Objective 1. Protect and improve Hood Canal's water quality

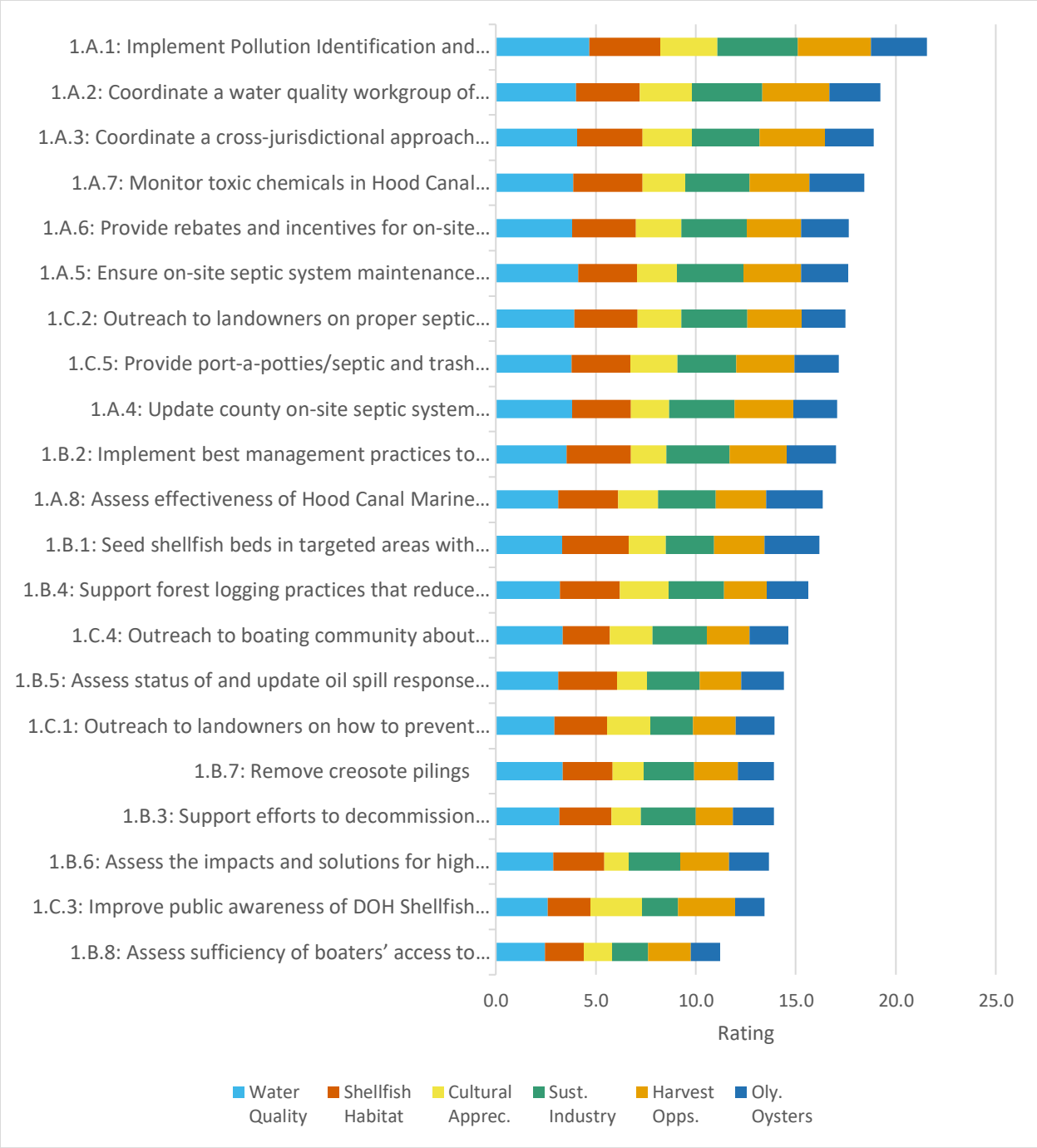

Figure 9: Objective 1. Water Quality action ratings across all objectives (unweighted)

Table 12: Objective 1. Water Quality action ratings across all objectives (unweighted)

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
1.A.1: Implement Pollution Identification and Correction (PIC) programs	4.7	3.5	2.9	4.0	3.7	2.8	21.6
1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)	4.0	3.2	2.6	3.5	3.3	2.6	19.2
1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs	4.1	3.3	2.5	3.4	3.3	2.4	18.9
1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds	3.9	3.5	2.1	3.2	3.0	2.8	18.4
1.A.6: Provide rebates and incentives for on-site septic system maintenance	3.8	3.2	2.3	3.3	2.7	2.4	17.7
1.A.5: Ensure on-site septic system maintenance records are up to date	4.1	2.9	2.0	3.3	2.9	2.4	17.6
1.C.2: Outreach to landowners on proper septic systems maintenance	3.9	3.1	2.2	3.3	2.7	2.2	17.5
1.C.5: Provide port-a-potties/septic and trash facilities for high use recreational fishing/shellfishing sites	3.8	2.9	2.4	2.9	2.9	2.2	17.1
1.A.4: Update county on-site septic system management plans	3.8	2.9	1.9	3.3	2.9	2.2	17.1
1.B.2: Implement best management practices to collect and treat stormwater runoff and maintain natural hydrology	3.5	3.2	1.8	3.1	2.9	2.5	17.0
1.A.8: Assess effectiveness of Hood Canal Marine Recovery Areas	3.1	3.0	2.0	2.9	2.5	2.8	16.3
1.B.1: Seed shellfish beds in targeted areas with water quality issues	3.3	3.3	1.9	2.4	2.5	2.8	16.2
1.B.4: Support forest logging practices that reduce runoff impacts	3.2	3.0	2.4	2.8	2.1	2.1	15.6
1.C.4: Outreach to boating community about preventing boat waste	3.3	2.4	2.1	2.7	2.1	1.9	14.6
1.B.5: Assess status of and update oil spill response plans	3.1	2.9	1.5	2.6	2.1	2.1	14.4
1.C.1: Outreach to landowners on how to prevent impacts from stormwater runoff	2.9	2.6	2.1	2.1	2.1	1.9	13.9
1.B.7: Remove creosote pilings	3.3	2.5	1.6	2.5	2.2	1.8	13.9
1.B.3: Support efforts to decommission unmaintained forest roads	3.2	2.6	1.5	2.7	1.9	2.1	13.9

1.B.6: Assess the impacts and solutions for high concentrations of seals on man-made structures in important shellfish areas	2.9	2.6	1.2	2.6	2.4	2.0	13.7
1.C.3: Improve public awareness of DOH Shellfish Safety Map	2.6	2.1	2.6	1.8	2.9	1.5	13.4
1.B.8: Assess sufficiency of boaters' access to pump-outs throughout Hood Canal	2.5	1.9	1.4	1.8	2.1	1.5	11.2

Objective 2. Protect and improve shellfish habitat

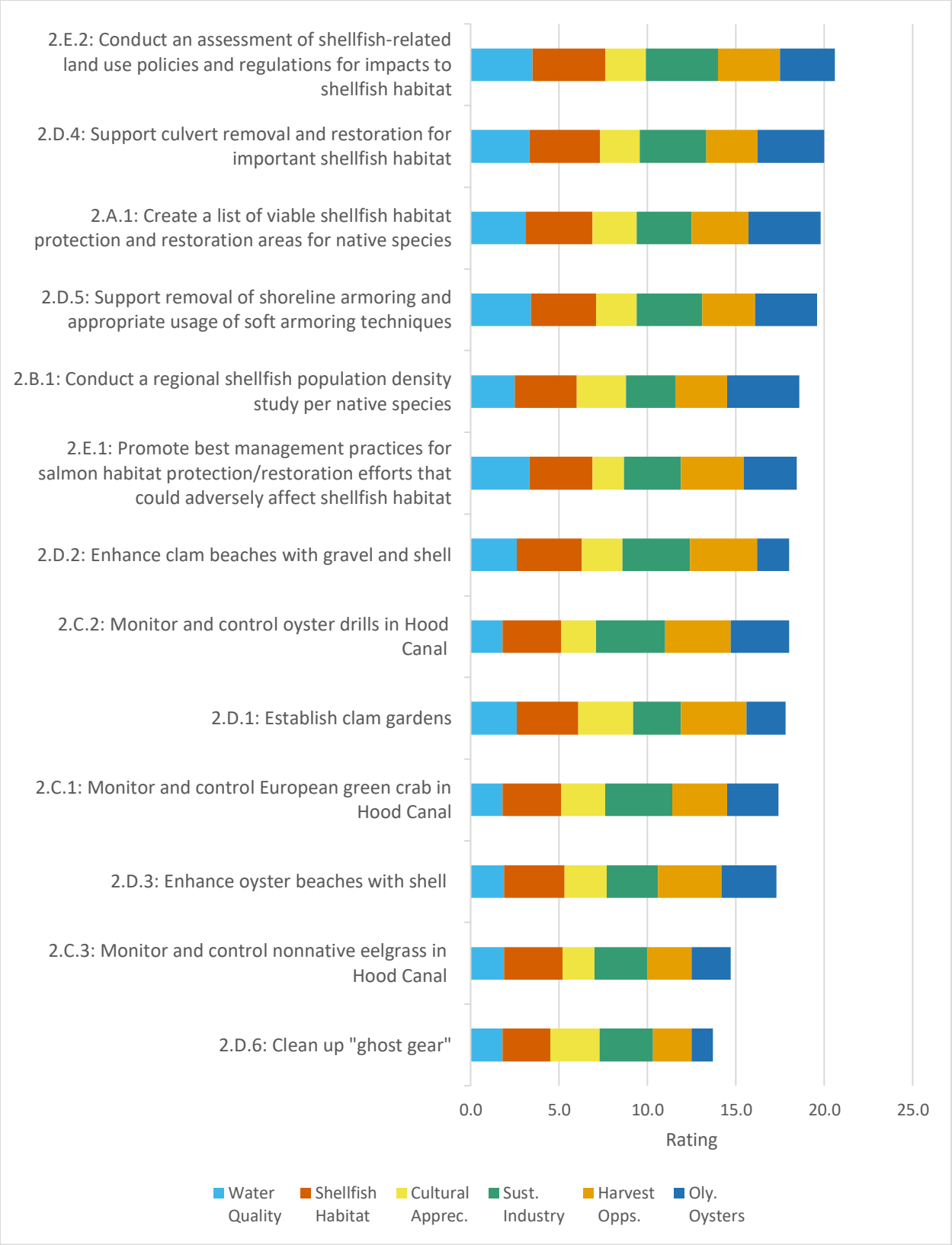

Figure 10: Objective 2. Shellfish Habitat action ratings across all objectives (unweighted)

Table 13: Objective 2. Shellfish Habitat action ratings across all objectives (unweighted)

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat	3.5	4.1	2.3	4.1	3.5	3.1	20.6
2.D.4: Support culvert removal and restoration for important shellfish habitat	3.3	4.0	2.2	3.8	2.9	3.8	20.0
2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species	3.1	3.8	2.5	3.1	3.2	4.1	19.8
2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques	3.4	3.7	2.3	3.7	3.0	3.5	19.6
2.B.1: Conduct a regional shellfish population density study for native species	2.5	3.5	2.8	2.8	2.9	4.1	18.6
2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat	3.3	3.6	1.8	3.2	3.6	3.0	18.4
2.D.2: Enhance clam beaches with gravel and shell	2.6	3.7	2.3	3.8	3.8	1.8	18.0
2.C.2: Monitor and control oyster drills in Hood Canal	1.8	3.3	2.0	3.9	3.7	3.3	18.0
2.D.1: Establish clam gardens	2.6	3.5	3.1	2.7	3.7	2.2	17.8
2.C.1: Monitor and control European green crab in Hood Canal	1.8	3.3	2.5	3.8	3.1	2.9	17.4
2.D.3: Enhance oyster beaches with shell	1.9	3.4	2.4	2.9	3.6	3.1	17.3
2.C.3: Monitor and control nonnative eelgrass in Hood Canal	1.9	3.3	1.8	3.0	2.5	2.2	14.7
2.D.6: Clean up “ghost gear”	1.8	2.7	2.8	3.0	2.2	1.2	13.7

Objective 3. Promote cultural appreciation of Hood Canal shellfish

Figure 11: Objective 3. Cultural Appreciation action ratings across all objectives (unweighted)

Table 14: Objective 3. Cultural Appreciation action ratings across all objectives (unweighted)

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
3.B.3: Host local public forums on shellfish-related community benefits, impacts, and activities	2.5	2.7	4.2	3.2	3.1	2.4	18.1
3.B.2: Work with local shellfish educators to host events featuring shellfish topics	2.3	2.6	4.3	2.8	3.4	2.2	17.6
3.A.3: Support school, 4H, and Future Farmers of America club efforts to incorporate shellfish and local cultural practices	2.6	2.8	4.1	2.8	2.8	2.3	17.4
3.A.4: Develop ideas and track outcomes of shellfish research projects by college/university students	2.6	2.6	3.1	3.0	3.3	2.4	17.0
3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish	2.2	2.7	4.5	2.2	2.9	2.4	16.9
3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate	2.3	2.6	4.7	2.1	2.9	2.0	16.6
3.B.1: Host local education efforts about Tribal treaty rights for shoreline landowners and shellfish growers	1.9	2.1	4.2	2.9	3.3	1.6	16.0
3.B.5: Highlight WDFW and Tribes' co-management of shellfish resources on WDFW website	1.8	1.9	4.1	2.9	3.6	1.2	15.5
3.B.4: Work with chefs to promote culinary outreach highlighting Hood Canal shellfish	1.3	1.4	3.8	3.4	2.5	1.2	13.6

Objective 4. Support a sustainable Hood Canal commercial shellfish industry

Figure 12: Objective 4. Sustainable Industry action ratings across all objectives (unweighted)

Table 15: Objective 4. Sustainable Industry action ratings across all objectives (unweighted)

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
4.C.1: Pilot projects to research efficacy of localized carbon refuge projects in Hood Canal	2.6	2.2	4.9	3.5	1.9	2.1	17.2
4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs	2.8	3.0	1.9	3.7	2.4	2.7	16.4
4.A.2: Conduct regular public beach clean-ups partnering the shellfish industry and stakeholders	2.8	2.8	2.9	3.3	2.1	1.7	15.6
4.C.2: Support aquaculture industry research needs on disease, breeding methods, equipment and technology development, and pilot innovations in the field	2.2	2.3	1.6	3.9	2.6	2.5	15.2
4.C.3: Identify research gaps and support efforts to explore the environmental interactions and impacts of shellfish aquaculture systems	2.4	2.7	2.2	3.6	2.1	2.1	15.2
4.A.1: Establish Hood Canal shellfish industry marine debris reduction program	2.6	2.7	2.2	3.2	2.1	1.7	14.4
4.B.2: Develop pre-permitting process for priority aquaculture development sites (“shellfish enterprise zones”)	1.7	1.9	1.5	4.1	2.3	2.1	13.6
4.B.4: Assess opportunities for, and implement, improved local regulatory processes for shellfish growers	1.6	1.4	1.7	3.7	1.9	1.5	11.9
4.B.3: Establish program to develop and strengthen local, qualified workforce	1.2	1.6	2.1	3.0	1.8	1.5	11.2

Objective 5. Expand harvest opportunities for treaty Tribes, local communities, and visitors

Figure 13: Objective 5. Harvest Opportunities action ratings across all objectives (unweighted)

Table 16: Objective 5. Harvest Opportunities action ratings across all objectives (unweighted)

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites	3.0	3.7	3.5	3.7	4.2	3.2	21.3
5.C.1: Develop a public-facing shellfishing information website	2.3	2.7	3.8	3.2	3.9	2.3	18.2
5.C.3: Develop a program to teach shoreline owners to conduct self-monitored shellfish population and harvest surveys on private land	2.2	2.9	3.8	2.7	3.5	2.7	17.8
5.B.2: Acquire, protect, and improve access at properties that provide public access to tidelands in priority areas (uplands and shoreline)	2.4	2.5	3.4	3.1	3.8	2.2	17.4
5.A.2: Develop outreach and education activities to encourage public adherence to recreational harvest management regimes	2.3	3.0	2.4	3.2	3.7	2.2	16.9
5.B.1: Develop and implement a comprehensive strategy to identify all public shoreline properties and access points	2.3	2.5	2.9	2.9	3.8	2.3	16.7
5.A.1: Support data-driven quota-setting process	2.2	2.9	2.3	3.1	3.9	2.1	16.5
5.A.3: Develop guidance to manage when harvest quotas are exceeded	2.3	2.6	2.3	3.3	3.6	1.9	16.0
5.B.3: Convene a forum of land trusts and other landowners to assess allowing public access to tidelands using conservation easements	2.0	2.5	3.3	2.4	3.7	1.6	15.5
5.C.2: Develop a guide for boat-in shellfishing access and best practices	2.1	2.1	3.6	1.9	4.1	1.6	15.4

Objective 6. Restore native Olympia oyster populations in Hood Canal

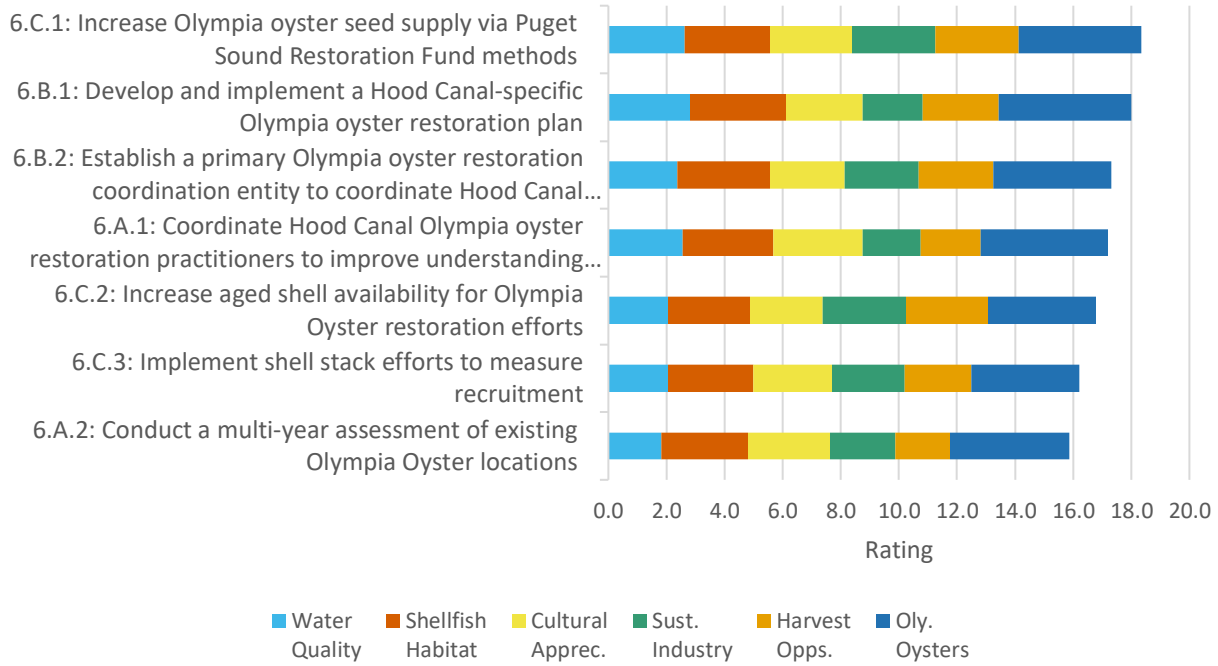

Figure 14: Objective 6. Olympia Oyster action ratings across all objectives (unweighted)

Table 17: Objective 6. Olympia Oyster action ratings across all objectives (unweighted)

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
6.C.1: Increase Olympia oyster seed supply via Puget Sound Restoration Fund methods	2.6	2.9	2.8	2.9	2.9	4.2	18.3
6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan	2.8	3.3	2.6	2.1	2.6	4.6	18.0
6.B.2: Establish a primary Olympia oyster restoration coordination entity to coordinate Hood Canal Olympia oyster projects and community partners	2.4	3.2	2.6	2.6	2.6	4.1	17.3
6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal	2.6	3.1	3.1	2.0	2.1	4.4	17.2
6.C.2: Increase aged shell availability for Olympia oyster restoration efforts	2.1	2.8	2.5	2.9	2.8	3.7	16.8
6.C.3: Implement shell stack efforts to measure recruitment	2.1	2.9	2.7	2.5	2.3	3.7	16.2
6.A.2: Conduct a multi-year assessment of existing Olympia oyster locations	1.8	3.0	2.8	2.3	1.9	4.1	15.9

Appendix E: HCSI Action Plan Prioritization Results

Table 18: Weighted action ratings across all objectives ranked by cumulative final action rating

Action	Water Quality	Shellfish Habitat	Cultural Apprec.	Sust. Industry	Harvest Opps.	Oly. Oysters	Total
1.A.1: Implement Pollution Identification and Correction (PIC) programs	1.4	1.0	0.5	0.5	0.5	0.2	**4.1**
5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites	0.9	1.1	0.6	0.5	0.5	0.3	**3.9**
2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat	1.0	1.2	0.4	0.5	0.5	0.2	**3.9**
2.D.4: Support culvert removal and restoration for important shellfish habitat	1.0	1.2	0.4	0.5	0.4	0.3	**3.7**
1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC Program)	1.2	0.9	0.5	0.5	0.4	0.2	**3.7**
1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs	1.2	0.9	0.4	0.4	0.4	0.2	**3.6**
2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques	1.0	1.1	0.4	0.5	0.4	0.3	**3.6**
2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species	0.9	1.1	0.5	0.4	0.4	0.3	**3.6**
1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds	1.1	1.0	0.4	0.4	0.4	0.2	**3.5**
2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat	1.0	1.0	0.3	0.4	0.5	0.2	**3.4**
1.A.6: Provide rebates and incentives for on-site septic system maintenance	1.1	0.9	0.4	0.4	0.4	0.2	**3.4**
1.C.2: Outreach to landowners on proper septic systems maintenance	1.1	0.9	0.4	0.4	0.4	0.2	**3.4**
1.A.5: Ensure on-site septic system maintenance records are up to date	1.2	0.9	0.4	0.4	0.4	0.2	**3.4**
2.D.2: Enhance clam beaches with gravel and shell	0.8	1.1	0.4	0.5	0.5	0.1	**3.4**
2.D.1: Establish clam gardens	0.8	1.0	0.6	0.4	0.5	0.2	**3.3**

1.C.5: Provide port-a-potties/septic and trash facilities for high use recreational fishing/shellfishing sites	1.1	0.8	0.4	0.4	0.4	0.2	**3.3**
2.B.1: Conduct a regional shellfish population density study for native species	0.7	1.0	0.5	0.4	0.4	0.3	**3.3**
1.A.4: Update county on-site septic system management plans	1.1	0.9	0.3	0.4	0.4	0.2	**3.3**
3.B.3: Host local public forums on shellfish-related community benefits, impacts, and activities	0.7	0.8	0.8	0.4	0.4	0.2	**3.3**
1.B.2: Implement best management practices to collect and treat stormwater runoff and maintain natural hydrology	1.0	0.9	0.3	0.4	0.4	0.2	**3.3**
5.C.1: Develop a public-facing shellfishing information website	0.7	0.8	0.7	0.4	0.5	0.2	**3.2**
6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan	0.8	1.0	0.5	0.3	0.3	0.4	**3.2**
3.A.3: Support school, 4H, and Future Farmers of America club efforts to incorporate shellfish and local cultural practices	0.8	0.8	0.7	0.4	0.4	0.2	**3.2**
6.C.1: Increase Olympia oyster seed supply via Puget Sound Restoration Fund methods	0.8	0.9	0.5	0.4	0.4	0.3	**3.2**
5.C.3: Develop a program to teach shoreline owners to conduct self-monitored shellfish population and harvest surveys on private land	0.6	0.8	0.7	0.4	0.5	0.2	**3.2**
3.B.2: Work with local shellfish educators to host events featuring shellfish topics	0.7	0.8	0.8	0.4	0.4	0.2	**3.2**
5.B.2: Acquire and protect properties that provide public access to tidelands in priority areas (uplands and shoreline)	0.7	0.7	0.6	0.4	0.5	0.2	**3.1**
2.C.2: Monitor and control oyster drills in Hood Canal	0.5	1.0	0.4	0.5	0.5	0.3	**3.1**
3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish	0.6	0.8	0.8	0.3	0.4	0.2	**3.1**
6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal	0.7	0.9	0.6	0.3	0.3	0.4	**3.1**
3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate	0.7	0.8	0.8	0.3	0.4	0.2	**3.1**
3.A.4: Develop ideas and track outcomes of shellfish research projects by college/university students	0.8	0.8	0.6	0.4	0.4	0.2	**3.1**

6.B.2: Establish a primary Olympia oyster restoration coordination entity to coordinate Hood Canal Olympia oyster projects and community partners	0.7	0.9	0.5	0.3	0.3	0.3	**3.1**
1.A.8: Assess effectiveness of Hood Canal Marine Recovery Areas	0.9	0.9	0.4	0.4	0.3	0.2	**3.1**
2.D.3: Enhance oyster beaches with shell	0.6	1.0	0.4	0.4	0.5	0.2	**3.1**
5.A.2: Develop outreach and education activities to encourage public adherence to recreational harvest management regimes	0.7	0.9	0.4	0.4	0.5	0.2	**3.1**
2.C.1: Monitor and control European green crab in Hood Canal	0.5	1.0	0.5	0.5	0.4	0.2	**3.1**
1.B.4: Support forest logging practices that reduce runoff impacts	0.9	0.9	0.4	0.4	0.3	0.2	**3.0**
1.B.1: Seed shellfish beds in targeted areas with water quality issues	0.9	0.9	0.3	0.3	0.3	0.2	**3.0**
4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs	0.8	0.9	0.3	0.5	0.3	0.2	**3.0**
4.A.2: Conduct regular public beach clean-ups partnering the shellfish industry and stakeholders	0.8	0.8	0.5	0.4	0.3	0.1	**3.0**
5.A.1: Support data-driven quota-setting process	0.6	0.8	0.4	0.4	0.5	0.2	**3.0**
5.B.1: Develop and implement a comprehensive strategy to identify all public shoreline properties and access points	0.7	0.7	0.5	0.4	0.5	0.2	**3.0**
6.C.2: Increase aged shell availability for Olympia oyster restoration efforts	0.6	0.8	0.5	0.4	0.4	0.3	**2.9**
5.A.3: Develop guidance to manage when harvest quotas are exceeded	0.7	0.8	0.4	0.4	0.5	0.2	**2.9**
6.C.3: Implement shell stack efforts to measure recruitment	0.6	0.9	0.5	0.3	0.3	0.3	**2.9**
3.B.1: Host local education efforts about Tribal treaty rights for shoreline landowners and shellfish growers	0.6	0.6	0.8	0.4	0.4	0.1	**2.9**
1.C.4: Outreach to boating community about preventing boat waste	1.0	0.7	0.4	0.4	0.3	0.2	**2.8**
5.B.3: Convene a forum of land trusts and other landowners to assess allowing public access to tidelands using conservation easements	0.6	0.7	0.6	0.3	0.5	0.1	**2.8**
1.B.5: Assess status of and update oil spill response plans	0.9	0.8	0.3	0.3	0.3	0.2	**2.8**
4.C.3: Identify research gaps and support efforts to explore the environmental interactions and impacts of shellfish aquaculture systems	0.7	0.8	0.4	0.5	0.3	0.2	**2.8**

5.C.2: Develop a guide for boat-in shellfishing access and best practices	0.6	0.6	0.6	0.2	0.5	0.1	**2.8**
6.A.2: Conduct a multi-year assessment of existing Olympia oyster locations	0.5	0.9	0.5	0.3	0.2	0.3	**2.8**
3.B.5: Highlight WDFW and Tribes' co-management of shellfish resources on WDFW website	0.5	0.6	0.7	0.4	0.5	0.1	**2.8**
4.A.1: Establish Hood Canal shellfish industry marine debris reduction program	0.7	0.8	0.4	0.4	0.3	0.1	**2.8**
1.B.7: Remove creosote pilings	1.0	0.7	0.3	0.3	0.3	0.1	**2.7**
2.C.3: Monitor and control nonnative eelgrass in Hood Canal	0.6	1.0	0.3	0.4	0.3	0.2	**2.7**
1.C.1: Outreach to landowners on how to prevent impacts from stormwater runoff	0.9	0.8	0.4	0.3	0.3	0.2	**2.7**
1.B.3: Support efforts to decommission unmaintained forest roads	0.9	0.8	0.3	0.4	0.2	0.2	**2.7**
4.C.2: Support aquaculture industry research needs on disease, breeding methods, equipment and technology development, and pilot innovations in the field	0.6	0.7	0.3	0.5	0.3	0.2	**2.6**
4.C.1: Pilot projects to research efficacy of localized carbon refuge projects in Hood Canal	0.7	0.6	0.4	0.5	0.2	0.2	**2.6**
1.B.6: Assess the impacts and solutions for high concentrations of seals on man-made structures in important shellfish areas	0.8	0.7	0.2	0.3	0.3	0.2	**2.6**
2.D.6: Clean up "ghost gear"	0.5	0.8	0.5	0.4	0.3	0.1	**2.6**
1.C.3: Improve public awareness of DOH Shellfish Safety Map	0.8	0.6	0.5	0.2	0.4	0.1	**2.6**
3.B.4: Work with chefs to promote culinary outreach highlighting Hood Canal shellfish	0.4	0.4	0.7	0.4	0.3	0.1	**2.3**
4.B.2: Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")	0.5	0.6	0.3	0.5	0.3	0.2	**2.3**
1.B.8: Assess sufficiency of boaters' access to pump-outs throughout Hood Canal	0.7	0.6	0.3	0.2	0.3	0.1	**2.2**
4.B.4: Assess opportunities for, and implement, improved local regulatory processes for shellfish growers	0.5	0.4	0.3	0.5	0.3	0.1	**2.0**
4.B.3: Establish program to develop and strengthen local, qualified workforce	0.4	0.5	0.4	0.4	0.2	0.1	**1.9**

Appendix F: HCSI Action Plan Prioritization Process

Prioritization Process Overview

SDM guidance was utilized to prioritize the HCSI Action Plan. The objectives were first ranked and assigned a weighted value based on their perceived importance to meet the HCSI's values. The actions were also rated based on how well they address the objectives. The actions were rated for their impact on their "home" objective, under which they were originally developed, as well as across each of the six objectives to account for synergistic effects a single action may have on multiple objectives. Appendix C includes survey results of the action ratings within their "home" objective, while Appendix D includes the action ratings across all objectives. Each action's six objective pairing scores were then combined with the objective weights and added across all objectives to produce a final cumulative action rating, summarized in Figure 15. These final action ratings determine the ranked list of all HCSI actions (Appendix E).

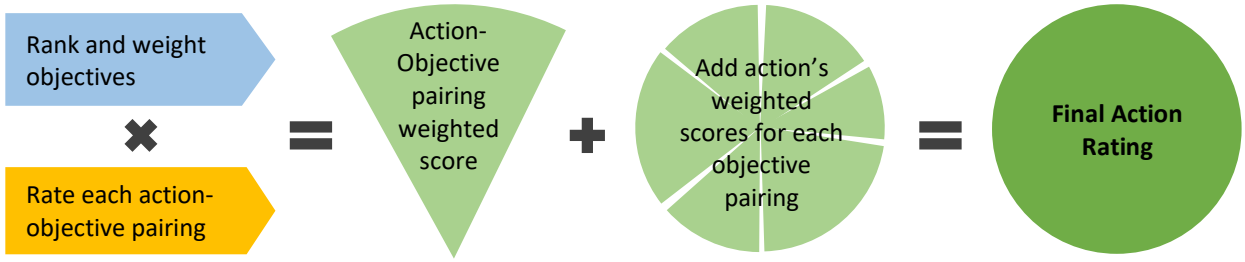

Figure 15: HCSI actions prioritization process

Weighting Objectives

A real time online polling tool was used to rank the six HCSI objectives by workgroup consensus to reflect the group's values and their perception of the HCSI's relative priorities. The initial objective ranking is listed below:

1) Protect and improve Hood Canal's water quality
2) Protect and improve Hood Canal shellfish habitat
3) Promote cultural appreciation of Hood Canal shellfish
4) Support a sustainable Hood Canal commercial shellfish industry
5) Expand harvest opportunities for Hood Canal treaty Tribes, local communities, & visitors
6) Restore native Olympia oyster shellfish populations in Hood Canal

Once these initial rankings were established, the group discussed and agreed upon the extent to which each objective was more highly ranked than the others. An informal comparative scale was used to guide this discussion in order to translate qualitative statements about relative importance into a numeric value (Figure 16). This exercise enabled the expert elicitation of the workgroup and integrated the inputs of available data, qualitative expertise, and lived experience to produce a value reflecting the relative importance of each objective.

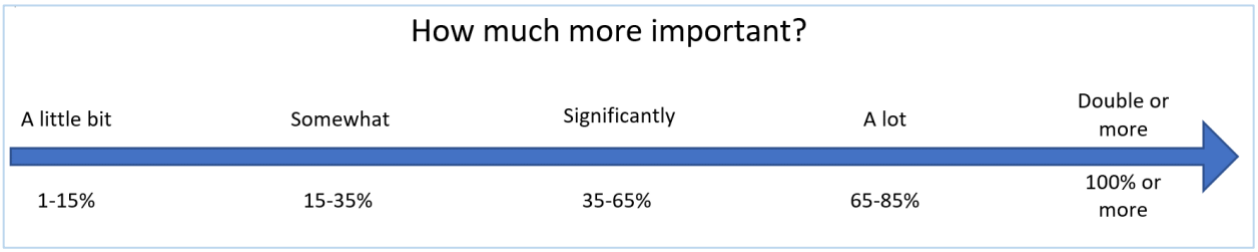

Figure 16: HCSI Objectives Weighting Scale

The objectives ranking exercise began at the bottom of the ranked order and asked the question: how much more important is the second to last objective (Harvest Opportunities) than the last objective (Olympia Oyster)? Once responses were collected and a value was agreed upon, the question was asked for the next objective (Sustainable Industry) above the previous objective, and repeated this way until all objectives were weighted.

For example, the Harvest Opportunities objective was determined to be about 65% more important than the Olympia Oyster objective. The relative ranking determined the weights assigned to each objective. The weights were calculated as a percentage of one based on these agreed upon relationships. The final weights for each objective are listed in Table 19.

The Water Quality and Shellfish Habitat objectives were equally weighted as the most important objectives. The Cultural Appreciation objective was the second highest ranked objective. The Sustainable Industry and Harvest Opportunities objectives were equally ranked as the third most important objectives. The Olympia Oyster objective was ranked the least most important of all six objectives.

Table 19: Final HCSI Objective Weights

Objective	Weight
1. Water Quality	0.29
2. Shellfish Habitat	0.29
3. Cultural Appreciation	0.18
4. Sustainable Industry	0.13
5. Harvest Opportunities	0.13
6. Olympia Oyster	0.08

Synergies between objectives made it challenging to determine their rankings and weights. The foundational aspects of objectives one (Water Quality) and two (Habitat) were recognized and led to their equal weighting at the top of the list. Significant discussion informed the decision to place objective three (Cultural Appreciation) above objectives four (Sustainable Industry) and five (Harvest Opportunities). Consensus was reached around the idea that the cultural appreciation of shellfish and shellfishing is a driver of the commercial shellfish market and recreational, subsistence, and ceremonial shellfishing. And that without it, those activities would not exist, as demand drives the shellfish industry and individual interest drives participation in shellfishing. However, the relative weights of those three objectives indicate that their importance is very closely ranked. Objective six (Olympia Oysters) was lowest ranked because they are not currently a highly sought-after species for harvest, and their wild populations are relatively stable or improving in Hood Canal, though work remains to restore those populations to their historic levels.

Ranking Actions

Actions Survey

An online survey tool (Figures 17 and 18) was used to facilitate the ranking of HCSI actions for their perceived ability to address each of the six objectives. The actions were broken up into two anonymous surveys to minimize the workload of each one. Table 20 shows the topics included in each survey and the corresponding number of respondents.

Table 20: HCSI Actions Surveys Topics and Response Rates

Survey	Objectives	Respondents
Actions Survey #1	Olympia Oyster	18
	Water Quality	
	Sustainable Industry	
Actions Survey #2	Shellfish Habitat	10
	Harvest Opportunities	
	Cultural Appreciation	

Figure 17 shows the survey format. The left column contains the actions associated with each objective, in this case, the Olympia Oyster objective. The top row contains all six objectives.

Workgroup members rated each of the actions on a scale of 0-5 based on the extent to which they believed the action would impact each of the objectives (drawing on their expertise, experience, or data), using the following scale for guidance:

0 = This action will not affect this objective
3 = This action will moderately affect this objective
5 = This action will greatly affect this objective

Respondents were asked not to rate actions or objectives that they were unsure of or for which they lacked expertise. As most actions are likely to impact multiple objectives, respondents were asked to place a score in each box associated with each action-objective pairing. Respondents were encouraged to be selective with their ratings to better ensure variable results so that priorities emerge among the actions.

Figure 18 shows a hypothetical response in which the respondent thinks the "Coordinate restoration practitioners..." action will greatly affect the Olympia Oyster objective (a score of 5), moderately affect the Habitat, Water Quality, and Cultural Appreciation objectives (scores of 3 and 4), and not likely affect the Sustainable Industry and Harvest Opportunities objective (scores of 2 and 1).

Figure 17: HCSI Actions Survey #1 screenshot

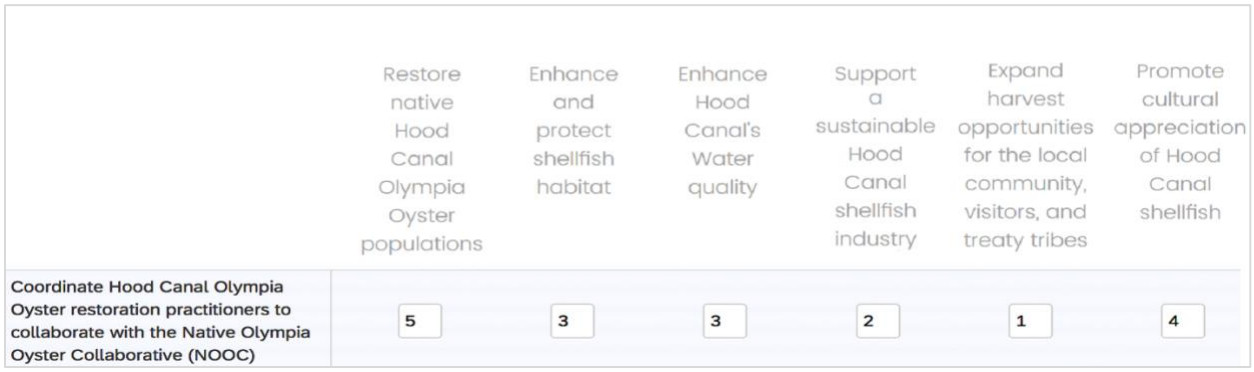

Figure 18: A sample question and response from HCSI Actions Survey #1

Survey Results

Scores were averaged across all responses for each action-objective pairing. Appendix C includes the raw results of the action ratings within their "home" objective that they were initially designed to address, and Appendix D includes the results of the perceived impact for each action across all objectives, illustrating which actions are most likely to have the highest impact across the entire action plan.

Priority Actions

To prioritize the action plan, the objective weights were applied to the action rating results for each action-objective pairing. These scores were then added together across all six objectives to produce a cumulative final action rating for each action and a ranked list of actions (Appendix E).

After reviewing the results of the action rating and prioritization process, a sub-set of 18 actions were identified as the HCSI's top priorities (Table 21). These 18 actions were selected for their overall impact to achieve the objectives. The top 10 ranked actions with the highest likelihood to impact all objectives were selected, as well as the top two actions within each of the six objectives (if not already included in the top 10). This approach to select the final priority actions was determined by workgroup consensus in reaction to the initial action ranking. There was discomfort with the absence of some objectives' actions in the top tier of the ranking. This result is likely due to the relative objective weights that were applied to each action rating. Instead of reassessing the weights, the workgroup elected to honor the results of the original weighting exercise and simply add the top actions from each objective to the priority list. The result is a more inclusive and diverse list of priorities.

Table 21: HCSI Priority Actions

Rank	Action
1	1.A.1: Implement Pollution Identification and Correction (PIC) programs
2	5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites
3	2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat
4	2.D.4: Support culvert removal and restoration for important shellfish habitat
5	1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC)
6	1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs
7	2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques
8	2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species
9	1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds
10	2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat
11	1.A.5: Ensure on-site septic system maintenance records are up to date

12	6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan
13	3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish
14	6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal
15	3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate
16	4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs
17	5.C.2: Develop a guide for boat-in shellfishing access and best practices
18	4.B.2: Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")

This approach was a departure from a more objective and transparent survey-based rating and prioritization process. but Structured Decision Making's end goal is to produce a result that is aligned with the stakeholders' values. If the values of the group are not represented in the list of priority actions, then the criteria must be revisited until the workgroup is comfortable with the results.

Table 22 provides the 18 priority actions in order of priority and also shows each actions' overall ranking (1-69), as well as the action's ranking within its "home" objective, under which each action was originally created. Note that the Water Quality and Harvest Opportunities objectives have more actions than others due to these objectives' higher weights and because actions that support water quality and habitat are likely to impact all other objectives. For example, the sixth rated action within the Water Quality objective ("Monitor toxic chemicals…") is ranked higher than top actions in other objectives, which are not ranked highly overall. This is a result of the prioritization structure that emphasized synergistic effects on multiple objectives.

The second action for the Sustainable Industry objective ("Conduct spatial analysis…") in the 18 priority actions is the fourth ranked action within that objective. This exception to the prioritization criteria was the result of an agreement among workgroup members to elevate this action because it complements and should be completed prior to the first prioritized action in the objective ("Develop pre-permitting process…").

Table 22: HCSI priority actions with ranking results

HCSI Priority Ranking	Overall Ranking	Action	Objective	Ranking Within Objective
1	1	1.A.1: Implement Pollution Identification and Correction (PIC) programs	Water Quality	1
2	2	5.B.4: Coordinate and increase enhancement and seeding of clams and oysters at appropriate public and Tribal harvest sites	Harvest Opportunities	1
3	3	2.E.2: Conduct an assessment of shellfish-related land use policies/regulations for impacts to shellfish habitat	Shellfish Habitat	1

4	4	2.D.4: Support culvert removal and restoration for important shellfish habitat	Shellfish Habitat	2
5	5	1.A.2: Coordinate a water quality workgroup of Tribes, local jurisdictions, and state agencies (e.g. HCRPIC)	Water Quality	4
6	6	1.A.3: Coordinate a cross-jurisdictional approach for dedicated and sustainable funding for PIC and on-site sewage (OSS) management programs	Water Quality	3
7	7	2.D.5: Support removal of shoreline armoring and appropriate usage of soft armoring techniques	Shellfish Habitat	4
8	8	2.A.1: Create a list of viable shellfish habitat protection and restoration areas for native species	Shellfish Habitat	3
9	9	1.A.7: Monitor toxic chemicals in Hood Canal shellfish, fish, eelgrass, and seaweeds	Water Quality	6
10	10	2.E.1: Promote best management practices for salmon habitat protection/restoration efforts that could adversely affect shellfish habitat	Shellfish Habitat	6
11	13	1.A.5: Ensure on-site septic system maintenance records are up to date	Water Quality	2
12	22	6.B.1: Develop and implement a Hood Canal-specific Olympia oyster restoration plan	Olympia Oysters	1
13	30	3.A.2: Create scholarships and local grants for K-12 and college students to study local cultures around Hood Canal shellfish	Cultural Appreciation	2
14	31	6.A.1: Coordinate Hood Canal Olympia oyster restoration practitioners to improve understanding of Olympia oysters in Hood Canal	Olympia Oysters	2
15	32	3.A.1: Incorporate Tribal and non-Tribal cultural practices associated with shellfish into the Washington Office of Superintendent of Public Instruction's Native American curriculum, where appropriate	Cultural Appreciation	1
16	41	4.B.1: Conduct spatial analysis to identify suitable sites for sustainable aquaculture development and ecosystem protection needs	Sustainable Industry	4
17	53	5.C.2: Develop a guide for boat-in shellfishing access and best practices	Harvest Opportunities	2
18	67	4.B.2: Develop pre-permitting process for priority aquaculture development sites ("shellfish enterprise zones")	Sustainable Industry	1

Future Process Improvements

Some concern was raised about the lack of participation at times in the workgroup prioritization selection process caused by COVID 19 pandemic consequences. These consequences included required furlough days for state employees, severe economic hardship experienced by shellfish growers affecting their availability to participate, and a lack of access to digital tools to participate in virtual-only HCSI

Workgroup meetings. Limited participation from a broader mix of partners may have affected the ultimate selection of priorities, seen in both the number of action rating survey responses and the participants available for the objective weighting exercise. The public review and feedback process, including the Hood Canal Shellfish Summit event, brought in a broader audience of shellfish partners to provide input on the action plan. Ongoing efforts will continue to incorporate additional voices and perspectives into the HCSI and its priorities.

It would be worthwhile to revisit the objective weights at a subsequent opportunity to update the HCSI Action Plan priorities. These values have a significant influence on the prioritization results and the exercise is largely determined by the voices in the room at the time. Given the participation constraints described above, broader perspectives may change the objective weights and improve the prioritization results.

Additionally, an error in the transcription of the actions for the online survey resulted in the combining of two unrelated actions into one. Action 5.C.1. “Develop and implement a comprehensive strategy for identifying all public shoreline properties and access points” was combined with a relic of another action, “Improve real-time harvest management models”. This relic action had been replaced by an updated version, action 5.B.2. “Improve data-driven quota setting process,” which was included in the survey as its own action. The relic “Improve real-time harvest management models” was mistakenly included and combined with an unrelated action. To account for this error, the rating results for the combined action were applied to only action 5.C.1. These results may not reflect the true assessment of action 5.C.1.’s impacts on the objectives and should be re-evaluated at a future opportunity.

Appendix G: HCSI Monitoring Plan

The HCSI monitoring plan will track progress made toward each objective and measure the long-term effectiveness of the HCSI. Each objective was assigned a performance measure that will be monitored over time to evaluate the success of the objective (Table 23). Aspirational targets were set for each objective, representing the desired level of performance. Appropriate and timely data sources were selected to accurately measure the performance measures, and a contact was identified for each dataset. The monitoring plan will be adaptively managed over time to reflect the latest knowledge and data.

Table 23: HCSI Performance Measures

Objective	Performance Measure (Unit)	Target
Protect and improve Hood Canal's water quality	Shellfish growing area classifications (acres)	100% of potentially harvestable growing area acres are open for harvest
Protect and improve Hood Canal shellfish habitat	Net change in permitted shoreline armor (mi)	Total miles of shoreline armor removed is greater than the total miles added in Hood Canal
Promote cultural appreciation of Hood Canal shellfish	Participation in cultural practices (satisfaction)	Maintain or increase the satisfaction of participation in cultural practices
Support a sustainable Hood Canal commercial shellfish industry	Regional volume (lbs.) and/or Regional value ($)	Maintain or increase the current volume and/or value of harvested shellfish
Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors	Locally harvested foods (harvest frequency)	Maintain or increase harvest frequencies
Restore native Olympia oyster populations in Hood Canal	Density (adult oysters per m^2)	30-100 adult oysters per m^2

A detailed discussion of each performance measure, its target, data sources, and notes for future monitoring is provided below.

Objective 1. Protect and improve Hood Canal's water quality

Performance measure

Shellfish growing area classifications (acres)

Shellfish growing area classifications (measured in acres) measures the performance of water quality improvements by tracking the number of acres open for shellfish harvest. This performance measure focuses on commercial shellfish growing areas, but acts as a surrogate for water quality across the entire Hood Canal.

Target

100% of potentially harvestable growing area acres are open for harvest

The target aspires to a net positive amount of shellfish growing acres open to harvest, with the goal of 100% of potentially harvestable acres open for harvest (shellfish resources are still subject harvest quotas). This target recognizes that some shellfish growing area classifications will not be upgraded as the areas are not available for harvest (e.g. prohibited growing areas near sewage treatment plants, marinas, and other persistent or fluctuating pollution sources).[137] Therefore, it focuses efforts on areas that can be upgraded, e.g. keeping approved areas open for harvest, and reopening conditionally approved or prohibited growing areas that are eligible to reopen for harvest after addressing temporary water quality impairments. Shellfish area upgrades will be sought in close coordination with the Washington Department of Health (DOH).

Data source(s)

DOH Growing Areas Report
Contact: Available for download from the DOH Commercial Shellfish online Map Viewer

The DOH Growing Areas Report lists the growing area classification status (measured in acres) for shellfish growing areas under DOH's jurisdiction. It contains the number of acres classified as Approved, Conditional, Restricted, and Prohibited, and the date the information was updated. The information will be filtered to report the number of growing area acres located within HCCC's LIO boundary.

Objective 2. Protect and improve Hood Canal shellfish habitat

Performance measure

Net change in permitted shoreline armor (mi)

Due to the broad scope of this objective, it is difficult to identify a single performance measure that accurately measures progress towards protecting and improving shellfish habitat. Any one performance measure will only monitor a component of complex nearshore ecosystem services. The net change in permitted shoreline armor (measured in miles) offers a consistent data set to monitor the amount of altered shoreline in general, and the amount of infrastructure affecting shoreline sediment processes. Shoreline armor (e.g. bulkheads, seawalls, and rip rap, etc.) is the most common type of shoreline modification in the Puget Sound area. These structures directly diminish shellfish habitats by impacting the sediment distribution and other geologic processes that supply, build, and maintain beaches and spits.[138] While the short-term impacts on shellfish from removing shoreline armor can be disruptive (by smothering shellfish via increased shoreline erosion), the long-term impacts are generally positive after beach processes stabilize and create more beach material for shellfish habitat.

Target

Total miles of shoreline armor removed is greater than the total miles added in Hood Canal

This target recognizes that shoreline armoring is a permitted shoreline use and will likely continue to be installed in Hood Canal and the broader Puget Sound. As a result, removing more shoreline armor in

[137] Washington State Department of Health. *Shellfish Growing Areas.* https://www.doh.wa.gov/CommunityandEnvironment/Shellfish/GrowingAreas.
[138] Puget Sound Partnership. *Progress Measures: Net change in permitted shoreline armor*. https://www.pugetsoundinfo.wa.gov/ProgressMeasure/Detail/42/VitalSigns.

Hood Canal than the amount of armor being installed will result in net improvements to shellfish habitat.

Data source(s)

Puget Sound Partnership's Shoreline Armoring Vital Sign Indicator: Net change in permitted shoreline armor
Contact: Vital Sign Indicator Lead (WDFW)

The Puget Sound Partnership's Net change in permitted shoreline armor Vital Sign indicator dataset is based on WDFW Hydraulic Project Approval (HPA) permits for shoreline armor. Records of the cumulative net change of shoreline armor (e.g. new minus removed armor) date back to 2011. While the net change in permitted shoreline armor dataset covers the entire Puget Sound, it will be filtered for only those results located within HCCC's Local Integrating Organization (LIO) boundary.

The HPA permit database used to make the net change in permitted shoreline armor calculations is the most accurate and comprehensive data available to track shoreline alterations, however, it does have limitations. It was originally developed to track submission and approval of HPA permit applications, and not specific details like the length of permitted armor installed or removed. It also does not track if all of the specifications in the permit were met (e.g. if the project used the materials specified in the permit, followed the permitted design, etc.). The database also does not include projects for which an HPA was not required, such as some federal and Tribal projects.[139] However, despite these limitations net change in permitted shoreline armor dataset is still the most authoritative data to track shoreline alterations.

Objective 3. Promote cultural appreciation of Hood Canal shellfish

Performance measure

Participation in cultural practices (satisfaction)

It is difficult to identify a single metric to measure a place's or community's culture. Participation in cultural practices in Hood Canal (measured by satisfaction) provides a measure of the people's satisfaction from participating in cultural events or activities. This information will provide an indicator for how often cultural activities are practiced, if the available opportunities are meeting the needs of the community, and how well cultural appreciation is being promoted in Hood Canal.

Target

Maintain or increase the satisfaction of participation in cultural practices

This target aspires to increase Hood Canal residents' satisfaction with participating in Hood Canal cultural practices, including shellfish harvest.

Data source(s)

Puget Sound Partnership's Cultural Wellbeing Vital Sign Indicator: Participation in cultural practices
Contact: Vital Sign Indicator Lead (Oregon State University Human Dimensions Lab)

[139] Ibid.

The OSU Human Dimensions Lab facilitates a biannual survey of Puget Sound residents to measure attitudes about various indicators related to human well-being for the Puget Sound Partnership's Vital Signs.[140] The relevant survey question related to this target asks respondents how satisfied they were with their level of participation in the following cultural activities or traditions related to the environment:

- Native Practices or Activities (canoe journey, Tribal center events, potlatch, etc.)
- Spiritual or religious practices related to the environment (meditation, prayer, solstice observance, etc.)
- Environmental practices or activities important to your heritage (formal or informal family or community events, etc.)
- Environmentally oriented social activities (environmental clubs, festivals, outdoor events, etc.)

Responses to each category are elicited on the following scale:

- Dissatisfied
- Somewhat dissatisfied
- Neither satisfied or dissatisfied
- Somewhat satisfied
- Satisfied
- I do not engage in this activity or tradition
- Don't know

This data is being collected for the first time in 2020, so results will be compared in 2022 (after two biannual monitoring cycles).

Objective 4. Support a sustainable Hood Canal commercial shellfish industry

Performance measure

Regional volume (lbs.) and/or Regional value ($)

This objective will monitor two, interrelated performance measures: regional volume of shellfish harvested commercially (measured in pounds), and regional value of shellfish harvested commercially (measured in dollars). These measures track commercial harvest trends over time, such as the amount of the resource harvested (e.g. if closures or harvest restrictions affect volume of harvest) and market shifts (e.g. fluctuating prices due to global and domestic trade issues).

Target

Maintain or increase the current volume and/or value of harvested shellfish

This target aspires to achieve consistent or increasing commercial harvest volumes and/or value of shellfish harvested in Hood Canal. Maintaining or increasing the volume and value of shellfish harvested by the Hood Canal commercial shellfish industry will keep the industry viable and able to continue to

[140] Stiles, K., Biedenweg, K., Wellman, K.F., Kintner, L., Ward, D. *Human Wellbeing Vital Signs and Indicators for Puget Sound Recovery: a Technical Memorandum for the Puget Sound Partnership*. Technical Report 2015-01. Puget Sound Partnership. April 2015.

provide employment, tax income, and maintain the cultural identity of the Hood Canal communities where they operate.

Data source(s)

WDFW Aquatic Farm Permits
Contact: Pacific Shellfish Institute (via WDFW)

The WDFW Aquatic Farm Permit dataset contains commercial shellfish farm data gathered from WDFW's quarterly production harvest reports. The permits contain data on the production volume (measured in pounds) and quarterly value generated by different shellfish species (measured in dollars). Some species, such as oysters, are measured in gallons (for shucked meat) or dozens (for halfshell oysters) or bags (for oyster larvae or seed sold), and are converted to pounds by WDFW using conversion factors. The Aquatic Farm Permit data also includes volume and value data from WA DNR's Wild Geoduck Fishery program. This program divides half of the sustainable, allowable geoduck catch among state and Tribal co-managers then offers the state's half of the harvests to commercial shellfish growers at public auctions throughout the year.[141] The Aquatic Farm Permit data is organized by WDFW catch areas. Catch areas 42E, 42D, 42C, 42H, 42F, and 42L are located within HCCC's LIO boundary, and are used for monitoring progress toward the target.

The Aquatic Farm Permit dataset is the most authoritative source of commercial shellfish industry production data in Washington. However, it does have some limitations. For example, the quarterly value estimates included in the annually updated dataset are based on static, one-time quarterly estimates, and do not accurately represent the dynamic pricing in the shellfish market. Furthermore, WDFW does not verify the production numbers submitted by the commercial shellfish growers, which invites the possibility of inaccurate reporting. This is compounded by a misconception within the commercial shellfish industry that WDFW permit data is used to determine taxes levied on individual businesses, which can result in underreporting.

The Aquatic Farm Permit dataset has incomplete Tribal commercial and wild harvest shellfish data. Tribal commercial harvest is not permitted by WDFW, so production and value information is not required to be reported. Some Tribes voluntary report their shellfish harvest production and value information to WDFW, but overall, Tribal information is incomplete. Additionally, commercial Tribal shellfish growers are often listed by a business name that may not indicate their Tribal affiliation, making Tribal production tracking difficult. The Aquatic Farm Permit data also does not include information on Tribal wild harvest on private tidelands, nor non-Tribal shellfish harvest on private land. The Aquatic Farm Permit data also does not include recreational harvest data.

Despite these limitations, WDFW's Aquatic Farm Permit data is still considered to be the most comprehensive, accurate, available, and consistently gathered data related to commercial shellfish harvest production and value over time. HCCC will obtain this data from h the Pacific Shellfish Institute, who regularly requests and analyzes the WDFW Aquatic Farm Permit data.

[141] Washington Department of Natural Resources. *Washington's Wild Geoduck Fishery*. https://www.dnr.wa.gov/programs-and-services/aquatics/shellfish/washingtons-wild-geoduck-fishery

Objective 5. Expand harvest opportunities for Hood Canal treaty Tribes, local communities, and visitors

Performance measure

Locally harvested foods (frequency of harvest)

The frequency of shellfish harvested locally is a direct measure of the level of recreational, subsistence and ceremonial harvest opportunities available to treaty Tribes, local communities, and visitors. Monitoring the frequency of harvest will indicate the relative availability of harvest opportunities.

Target

Maintain or increase harvest frequencies

This target aspires to establish sustainable harvest opportunities for shellfish harvest sites across Hood Canal. An emphasis on maintaining harvest opportunities allows harvest to remain at sustainable levels in areas currently at capacity. Simultaneously, encouraging increased harvest in underutilized areas can reduce the pressure on areas with high harvest pressure.

Data source(s)

Puget Sound Partnership's Local Foods Vital Sign Indicator: Locally harvestable foods
Contact: Vital Sign Indicator Lead (Oregon State University Human Dimensions Lab)

This target also uses the OSU Human Dimensions Lab Human Well Being survey data. The relevant survey question related to this target asks respondents to evaluate their frequency in hunting, harvesting, or collecting clams, geoducks, oysters, mussels, crabs, and shrimp on a five-point scale:[142]

- Frequently: more than 10 times per season
- Regularly: 6-8 times per season
- Occasionally: 3-5 times per season
- Rarely: 1-2 times per season
- Never

Survey respondents' demographic information is also collected. The harvest frequency results can be filtered by this demographic information to determine harvest frequencies for specific populations. However, the demographic information does have some limitations. For example, Tribal people are sampled as a proportion of the total population (around ~2%), which underreports Tribal harvest by showing lower proportional harvest frequencies for this community. It also does not ask for specific Tribal affiliation, so it is assumed that Tribal respondents are affiliated with the local Tribe at their location, however, this may not always be true. The survey also does not ask specifically where respondents harvest shellfish.

[142] Fleming, W., Biedenweg, K.

Objective 6. Restore native Olympia oyster populations in Hood Canal

Performance measure

Density (adult oysters per square meter)

The density of Olympia oysters (measured in number of adult oysters per square meter) is a critical measurement to assess reproductive success and the degree of functional habitat created for other marine life. A density performance measure complements WDFW's Olympia oyster restoration objectives, which focuses on the biological conservation of the species and its associated habitat through "re-establishing, rebuilding and enhancing natural native oyster assemblages" to improve species numbers, among other efforts.[143]

Target

30 – 100 adult oysters per m^2

A ranged target allows variance for different levels of Olympia oyster restoration. The lower range (30 adult Olympia oysters per m^2) identifies a density at which a reproductively active adult Olympia oyster population is able to sustain itself in a persistent population. The upper range (100 adult Olympia oysters per m^2) identifies a density that is sufficient to provide functional oyster bed habitat for the benefit of other species.[144] The range allows flexibility for HCSI shellfish partners to identify what criteria are most appropriate at a given site and time.

Data source(s)

N/A
Contact: Puget Sound Restoration Fund

There is currently no established program for regular monitoring of Olympia oyster density, so a consistent baseline of density data is not available. However, some scattered density data does exist for specific sites in Hood Canal that are recommended for restoration in WDFW's Olympia oyster restoration plan: Quilcene Bay, the Seal Rock and north Dosewallips River tidelands, and on the Union River and Big and Little Mission Creek(s) deltas.[145]

Quilcene Bay: The Puget Sound Restoration Fund has Olympia oyster density data dating from 2016, but it is in a raw format and needs to be processed, which is expected to occur by early 2021.[146] According to the WDFW Olympia oyster restoration plan, source population function appears to be absent or diminished in the northern reaches of Hood Canal, so densities can be expected to be less than 30 adult Olympia oysters per m^2 at this site.[147]

Seal Rock/north Dosewallips tidelands: No known Olympia oyster density data is collected at this site. According to the WDFW Olympia oyster restoration plan, source population function appears to

[143] Blake, B., Bradbury, A. *Washington Department of Fish and Wildlife Plan for Rebuilding Olympia Oyster (Ostrea lurida) Populations in Puget Sound with a Historical and Contemporary Overview*.
[144] Jodie Toft. Puget Sound Restoration Fund. *Personal communication*. August 28, 2020.
[145] Ibid.
[146] Jodie Toft. Puget Sound Restoration Fund. *Personal communication*. Sept. 4, 2020.
[147] WDFW Olympia Oyster Restoration Plan.

be present within the middle reach of Hood Canal (including this area), so it can be assumed that there are densities near 30 adult Olympia oysters per m^2 to create these conditions.[148]

Union River and Big and Little Mission Creek(s) deltas: Surveys of Olympia oysters in this area after enhancement efforts in 2013 and 2015 yielded no oysters near Mission Creek, but an average of 6-8 adults per m^2 at Twanoh, 7-8 miles west of Mission Creek.[149] According to the WDFW Olympia oyster restoration plan, source population function appears to be absent or diminished in the southern reaches of Hood Canal, so densities can expected to be less than 30 adult Olympia oysters per m^2.[150]

Going forward, monitoring efforts will focus on the areas identified above to collect consistent Olympia oyster density data and monitor trends over time.

[148] Ibid.

[149] Valdez, S.R., Peabody, B., Allen. B., Blake, B., Ruesink. J.L. *Experimental test of oyster restoration within eelgrass*. Aquatic Conserv: Mar Freshw Ecosyst. 2017;27:578–587. December 29, 2016. https://doi.org/10.1002/aqc.2722.

[150] WDFW Olympia Oyster Restoration Plan.