Washington Coast Shellfish Aquaculture Study
Workshop 1: Information Needs

The Washington Coast Shellfish Aquaculture Study's first workshop produced a list of over 50 information needs in service of the study's objectives and ecosystem-based management in Willapa Bay and Grays Harbor. Specific information needs are listed below, grouped by theme. Information needs were collected through three rounds of breakout group discussions among the working group members, workshop presenters and collaborating scientists. Each group was instructed to discuss their highest-priority information needs during the first round and proceed in priority order through the second and third rounds. The numbers following each information need indicate the priority assigned via discussion round. Repeated numbers indicate that the information need was discussed during that same round in multiple breakout groups.

The information needs are presented here after being processed for clarity. For the complete list of information needs as they were originally stated by the breakout groups, see Appendix A. The project team applied the following adjustments to the original material for this report:

- To minimize repetition, we combined closely related information needs.
- Information needs may relate to multiple themes. We have placed these information needs under the theme with which they are most connected to in service of the study.
- Some information needs contained two distinct ideas that correspond to separate themes. In these cases, we have split the information need into two distinct needs.

1. Define the problem: how do species and habitat types in the Willapa Bay and Grays Harbor estuaries interact?

These information needs ask how burrowing shrimp function and interact with tideland habitats and other species at the site scale or bay-wide, on and off shellfish farms. The first subcategory is focused on shrimp biology within estuarine ecosystems, while the following subcategories focus on interactions between habitats and species within the ecosystem. Priorities include burrowing shrimp interactions with food webs, eelgrass species and protected or managed species (such as salmonids, Dungeness crab, waterbirds and sturgeon).

a. Shrimp biology

i. Describe the seasonal phenology of burrowing shrimp, including reproduction and pelagic stages, to potentially identify a vulnerable season or part of life-history to target shrimp [1, 2, 3, 3]

ii. Understand shrimp dynamics in Puget Sound [1]

iii. Understand burrowing shrimp habitat selection. For example: why are shrimp present/dense in some areas over others? [2]

iv. Understand how the parasitic isopod may be affected by the bacteria and microfauna inside a shrimp burrow [2]

v. Understand how razor clam population dynamics in Willapa Bay and Grays Harbor correlate with ghost shrimp population dynamics, with the potential to inform predictive modeling for ghost shrimp [3]

b. Food web dynamics

i. Understand how burrowing shrimp affect diatoms/biofilms and associated invertebrate prey for migratory and resident shorebirds in Willapa Bay and Grays Harbor [1, 2]

ii. Develop a better understanding of the burrowing shrimp diet [1]

iii. Understand the effect of benthic diatom/shrimp interactions on the rest of the food web in Willapa Bay and Grays Harbor [3]

c. Community interactions

i. Identify the relationships between densities of burrowing shrimp and native/non-native eelgrass. For example, do either species of eelgrass keep shrimp out? How do rhizomes interact with burrowing activity? [1, 1,1, 2]

ii. Understand the differences in species diversity, abundance between shrimp beds of different densities, and other habitat types at the site and system-scale level in the Willapa Bay and Grays Harbor estuaries [1, 2, 3]

iii. Ecosystem study of the effect of burrowing shrimp on the estuaries, including public lands [1]

d. Aquaculture and the ecosystem

i. How do different aquaculture gear types/practices affect eelgrass, the benthic community, oyster grazing on phytoplankton, and the ecosystem? Research the impacts, consequences, effects. [2, 2]

ii. Research why the big summer shellfish die-off may have occurred, and on mortality/lack of recruitment for clams [2]

2. Understand the Willapa Bay/Grays Harbor systems: use monitoring, mapping and modeling to recognize ecosystem and/or environmental change

These information needs point to understanding the spatial and temporal dynamics of abiotic factors and key species through monitoring and mapping, with particular

focus on burrowing shrimp species, eelgrass species and managed or protected species over time. Some information needs include how localized tideland conditions and dynamics relate to large-scale drivers such as climate change, salinity regimes, and Pacific Ocean variability (such as upwelling and the Pacific Decadal Oscillation). This information will further the understanding of the system's ecology, the geographic and temporal scales at which burrowing shrimp impact the system, and whether these changes are confined to shellfish farms.

a. Monitoring, mapping, and modeling

i. Develop monitoring tools and increase information (i.e. population counts, recruitment patterns, larval dispersal) on burrowing shrimp populations on tidelands [1, 1, 3]

ii. Develop burrowing shrimp population dynamic models using historical data on populations and climate to hindcast and forecast in Willapa Bay and Grays Harbor [1]

iii. Develop widely accessible mapping tools for both estuaries to understand trends, change, and current distributions including layers for *Z. japonica, Z. marina*, burrowing shrimp, erosion of shorelines and bluffs, plastic on the beach, DNR lands, tax parcels [1, 1, 2]

b. Climate

i. Identify connections between climate (e.g. freshwater/salinity regimes, upwelling, PDO, temperature and precipitation), burrowing shrimp recruitment/reproduction, and historical patterns in Willapa Bay and Grays Harbor. Use this to inform a predictive model [1, 2]

3. Identify paths forward: what strategies and tools meet our objectives?

These information needs point toward strategies for reaching ecosystem-based solutions to burrowing shrimp/eelgrass/shellfish aquaculture issues in Willapa Bay and Grays Harbor and evaluating the study's success over time, including ways to move forward with Integrated Pest Management (IPM), understanding the economic values and production data of the system, and seeking strategic lessons learned from previous experiences in natural resource management.

a. IPM

i. Find compatibility of different shellfish aquaculture practices with handling burrowing shrimp [1]

ii. More information on biological controls of burrowing shrimp, including parasites (e.g. isopods) and predators (e.g. green sturgeon) [1]

iii. Collect information on agricultural perspectives around integrated pest management, form a commission or appoint an individual who can advise what IPM entails and its feasibility in Willapa Bay and Grays Harbor. For example, how much do you invest in the crop? What is the cost per acre? How do you manage non-target species? [2, 3]

iv. Research the biological and physical effect of mechanical treatment for burrowing shrimp on substrates and other organisms [3]

v. Vet any proposed mechanical control method with Army Corps of Engineers [3]

b. Economics and production

i. Determine the economic value and production data of different growing practices in different parts of Willapa Bay and Grays Harbor [1, 2]

ii. Find ways to possibly incentivize shellfish farmers who are using on-bottom aquaculture to adopt different growing methods [2]

iii. Determine the economic value of ecosystem services provided by shellfish aquaculture [3]

iv. Gather more economic data about the impacts (increased cost/decreased revenue) caused by burrowing shrimp, and how that affects the local community [3]

c. Social science needs

i. Learn from *Spartina* efforts in Willapa Bay and Grays Harbor. For example, how do we connect shrimp impacts to issues that everyone can relate to? [1]

ii. Create a collaborative research system that includes shellfish growers as part of the data collection [1]

iii. Tie burrowing shrimp population dynamics to socio-economic impacts on local community in a model [1]

iv. Find ways to deal with entrenched (public) opposition to chemical controls for burrowing shrimp [1]

v. Collect more information on public perceptions/opinions of shellfish aquaculture in Willapa Bay and Grays Harbor and the control of burrowing shrimp [2, 2]

vi. Find models of other cooperative management or interdisciplinary case studies that shellfish aquaculture could utilize, such as the timber industry [2, 3]

vii. Define the mechanism for advancement of research of this study [2]

viii. Make a socially viable IPM for burrowing shrimp [2]

ix. Find ways to communicate this story beyond Willapa Bay and Grays Harbor, local representatives, and community [3]

Sea Grant
Washington

University of Washington
3716 Brooklyn Ave NE
Seattle, WA 98105-6716
206.543.6600
coastshellfishstudy@uw.edu
wsg.washington.edu