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Marine Sector Analysis Report: Aquaculture

Final Report | October 31, 2014

prepared for:

The Washington Coastal Marine Advisory Council

prepared by:

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NOTICE

The information presented in this report reflects data collected from readily available sources and the opinions of a limited number of individuals knowledgeable about this sector, including representatives of private business interests. The views and opinions expressed herein are those of the individuals consulted and are not necessarily representative of the views of any state agency or of the perspectives of other experts or participants in the marine spatial planning process, either within or outside the sector. Industrial Economics, Inc. is solely responsible for the content of this report.

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACOE	US Army Corps of Engineers
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DFW	Washington Department of Fish and Wildlife
DNR	Washington Department of Natural Resources
DOH	Washington Department of Health
Ecology	Washington Department of Ecology
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FDA	US Food and Drug Administration
FWS	US Fish and Wildlife Service
ISSC	Interstate Shellfish Sanitation Conference
MSP	Marine Spatial Plan
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NSSP	National Shellfish Sanitation Program
RHA	Rivers and Harbors Act
SEPA	State Environmental Policy Act
SMP	Shoreline Master Program
USDA	US Department of Agriculture
WCMAC	Washington Coastal Marine Advisory Council
WGHSGOA	Willapa Grays Harbor Shellfish Growers Association

PREFACE

The Washington Department of Ecology is leading an effort to develop a marine spatial plan (MSP) for Washington's Pacific coast. The plan is being developed in coordination with an interagency team that includes the Office of the Governor, the Washington Department of Natural Resources (DNR), the Washington Department of Fish and Wildlife (DFW), Washington Sea Grant, and the Washington State Parks and Recreation Commission.[1] The planning process also involves and engages coastal stakeholders, the public, and local, tribal and federal governments. In particular, the Washington Coastal Marine Advisory Council (WCMAC) is advising on the development of the plan. The WCMAC is a 26-member advisory group established in the Governor's office and comprised of a diverse range of stakeholder interests. In support of the planning effort, DNR has engaged Industrial Economics, Incorporated and BST Associates to develop reports on five major sectors of the state's marine economy: aquaculture; non-tribal fishing; marine renewable energy; recreation and tourism; and shipping. These reports are intended to help state agencies, the WCMAC, and other stakeholders understand the trends and potential issues associated with economically important activity in the marine environment.

This report focuses on the aquaculture sector. It synthesizes information from publicly available sources to provide an overview of current economic activity, major trends in activity, and potential future resource uses and needs. In addition, the report draws on perspectives and insights from industry experts and relevant government agencies to highlight critical issues affecting the sector – including any current or potential future conflicts within the sector or with other sectors – and the role of marine spatial planning in addressing these issues (see Appendix A for a complete list of individuals interviewed). It also identifies key remaining questions, data quality issues, and data gaps.

WASHINGTON MARINE SPATIAL PLANNING OVERVIEW

Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine environments to achieve ecological, economic, and social objectives. The MSP will address issues resulting from increasing pressures on the resources in the area, as well as conflicts between and among existing and proposed new uses of these resources. The planning process will also involve and

[1] For additional information on Washington's marine spatial planning efforts, see RCW 43.372 and http://www.msp.wa.gov. An interactive mapping tool is available at: www.msp.wa.gov/explore/mapping-application.

engage coastal stakeholders, the general public, and local, tribal, and federal governments. The MSP will develop a comprehensive plan for addressing these types of potential activities to avoid and minimize impacts, reduce potential conflicts, and foster a healthy ecosystem. In addition, the MSP provides a basis for improving coordination and implementation of existing state and local laws, regulations and policies. It also provides an opportunity to coordinate with federal agencies and tribes related to their authorities. The law does not create any new authority under the MSP, nor does the MSP have authority to affect any existing or proposed project, use, or activity during the development of the plan (RCW 43.372.060). Instead, the MSP provides a consistent information framework for agencies to use when applying their existing authorities in response to particular project proposals and permit processes.

As part of the MSP planning process, the State Environmental Policy Act (SEPA) requires the state to develop an Environmental Impact Statement (EIS); the SEPA scoping summary was recently released (Ecology 2014). The EIS should be finalized within the next year; the MSP is expected to be finalized by December 2016 (Ecology 2013).

SECTOR ANALYSIS STUDY AREA

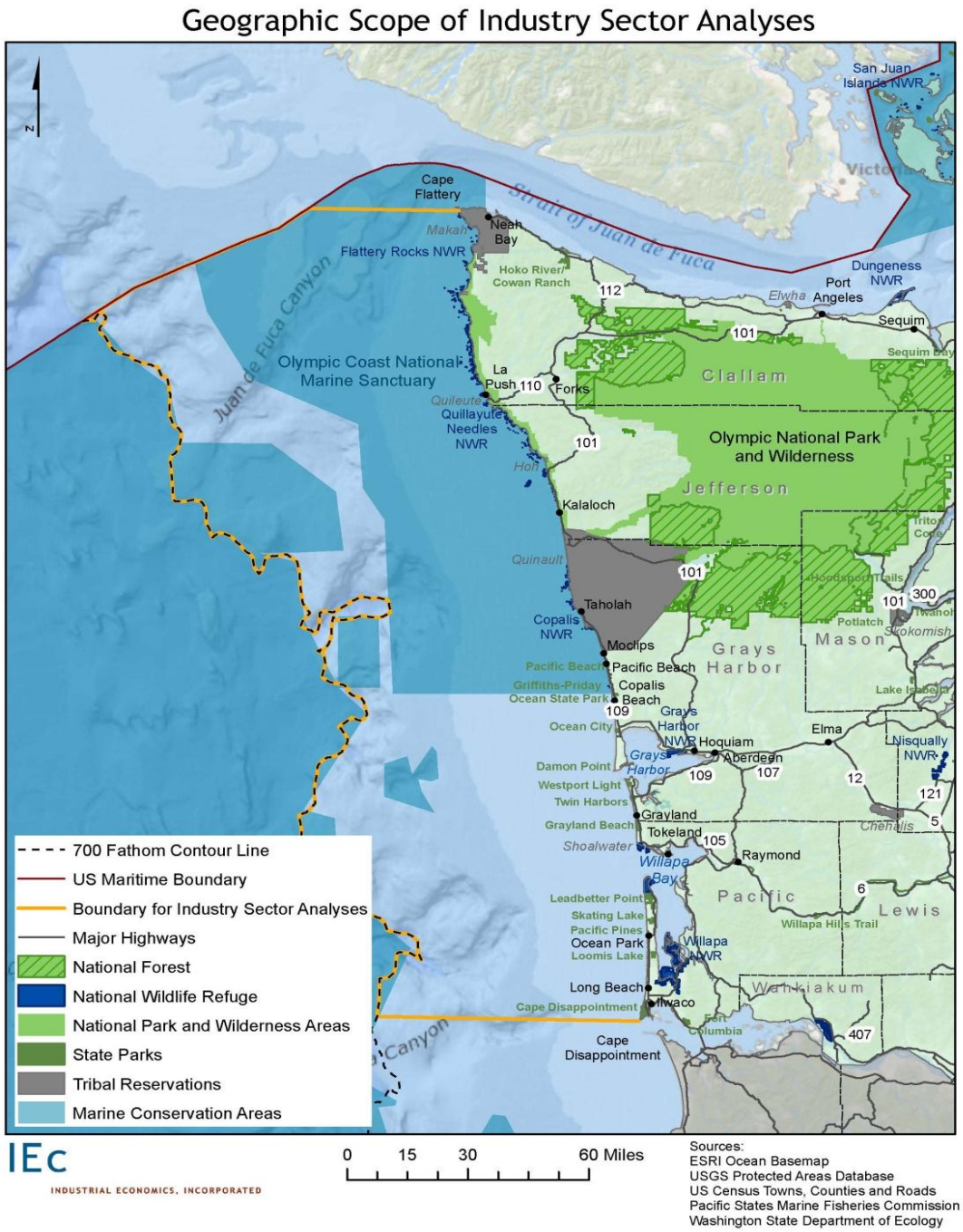
The activities considered in this sector profile are those which occur or may in occur in the future in marine or estuarine waters off the Washington Pacific coast. The area of interest includes state and federal waters from Cape Disappointment north to Cape Flattery and seaward to a depth of 700 fathoms, including Willapa Bay and Grays Harbor. The marine shoreline bordering this area includes roughly 157 miles of Pacific coastline, 89 miles in Grays Harbor, and 129 miles in Willapa Bay (Ecology 2001). The study area does not include the Strait of Juan de Fuca, the Lower Columbia River Estuary, or Puget Sound. The study area is illustrated in Exhibit P-1.

The Washington Pacific coast is mostly rural, and is supported by an economy based on tourism, recreation, and natural resources (e.g., commercial fisheries and timber). The region includes four counties: Jefferson, Clallam, Grays Harbor, and Pacific. In 2013, the total population of these counties was roughly 194,000, or three percent of the state population (Census Quickfacts 2014). In recent years, population growth and economic growth in these counties has been below the state average.

The Olympic Coast National Marine Sanctuary makes up most of the northern half of the study area, running north from the mouth of the Copalis River along the coast and extending seaward between 25 to 40 miles, including 2,408 square nautical miles of marine waters (Olympia Coast National Marine Sanctuary 2014). Olympic National Park occupies significant portions of the Clallam and Jefferson County coastlines. Other marine conservation areas in the study area include various federally-designated Essential

Fish Habitat areas. In addition, areas off the Washington coast are designated training and testing areas for the U.S. Navy.[2]

EXHIBIT P-1. MAP OF STUDY AREA INCLUDING KEY FEATURES



[2] The Naval Undersea Warfare Center Keyport Range Complex is located within the study area. For more information see U.S. Navy 2014, www.nwtteis.com.

The Makah, Quileute, Hoh, Quinault, and Shoalwater Bay Indian tribes have reservation lands along the coast. Ocean resources are both economically and culturally important to these tribes, as are the tourism and recreation benefits offered by their coastal locations.

The southern portion of the coast is more heavily developed than the northern coast, with a greater number of urbanized areas and a greater concentration of marine industry and infrastructure. Developed areas in the southern half of the coast include the cities of Hoquiam and Aberdeen and the Port of Grays Harbor, as well as the coastal towns of Pacific Beach, Ocean Shores, Westport, Ocean Park, Seaview, Long Beach, and Ilwaco. Numerous state park facilities are located along the southern half of the Washington coast. In addition, Willapa Bay, in the southern portion of the study area, contains the Willapa Bay National Wildlife Refuge, and is the site of an economically important oyster industry.

SCOPE OF ECONOMIC INFORMATION CONSIDERED

This report focuses on the ocean economy, considering economic activity within the state that derives all or part of its inputs from the ocean (Colgan 2007). The report further focuses on current activities or activities that may occur in the reasonably foreseeable future. As a general guide we consider activities that are expected to occur within a planning horizon of 20 years. This timeframe should be sufficient to guide long-term planning, provided the MSP is periodically updated to take new information into account.

ORGANIZATION OF THE REPORT

The remainder of the report is organized as follows:

- Section 1 provides an introduction to the sector.
- Section 2 summarizes the current status of the sector.
- Section 3 describes the key issues facing the sector.
- Section 4 provides an inventory of the available economic data for the sector, and highlights limitations of the existing data and data gaps.

SECTION 1 | INTRODUCTION TO THE AQUACULTURE SECTOR

The aquaculture industry in Washington produces a diverse variety of products, including net-pen-raised salmon, marine plants, and a variety of shellfish species. The facilities that produce many of these products are located outside the study area (for example, in rivers or within Puget Sound). Aquaculture production within the bounds of our study area (i.e., the Pacific coast and coastal estuaries) is currently limited to cultivation of shellfish.

DEFINITION OF THE SECTOR

STATEWIDE CONTEXT

Washington State is recognized nationally and worldwide as a premier producer of farmed shellfish, with the Pacific oyster serving as its marquee product. The most recently published U.S. Census of Aquaculture (2005) places Washington first in value of sales of farmed mollusks ($63,710,000), with Washington-grown shellfish accounting for 31 percent of the value of U.S. farmed shellfish production (USDA 2006). According to the 2012 Census of Agriculture, 171 shellfish farms are based in Washington (USDA 2014a).

STUDY AREA CONTEXT

The aquaculture industry on the Pacific coast of Washington is concentrated primarily within Willapa Bay (Pacific County) and, to a lesser extent, Grays Harbor (Grays Harbor County). The communities of South Bend and Nahcotta, both on Willapa Bay, serve as the primary centers of industry activity. All but one of the shellfish farms operating within this region are family-owned businesses. They range in size and complexity from small, "mom and pop" operations that may farm a relatively small parcel of aquatic land to larger, vertically-integrated farms with many thousands of acres.

According to the 2012 Census of Agriculture, there were 25 shellfish farms in Pacific County and 8 in Grays Harbor County, of a total of 171 shellfish farms statewide (USDA 2014a). Data provided by DFW indicate that 20 farms in Pacific County and 6 farms in Grays Harbor County reported sales of shellfish products in 2012.

According to harvest data collected by DFW, Pacific oysters account for the overwhelming majority (82 percent) of shellfish farmed and harvested in the study region, followed by Manila clams (16 percent). In 2013, Pacific oysters comprised 83 percent ($16,235,388) of the total farm-gate value of farmed shellfish harvest in Pacific and Grays Harbor Counties, while Manila clams accounted for 11 percent of the total value ($2,058,998). The majority of oysters harvested in the region are shucked and

processed for market, but the amount of oysters sold in-shell (i.e., singles) is growing in response to consumer demand, and may be nearing 20 percent (Personal comm. T. Morris 2014, Personal comm. K. Nisbet 2014).

HISTORY, TRENDS AND OPPORTUNITIES

The shellfish community in Willapa Bay and Grays Harbor was initially dominated by the native Olympia oyster, *Ostrea lurida*. Heavy commercial exploitation by the region's early white settlers resulted in the commercial extinction of this species by the early 1900s.[3,4] To support the industry that had grown around harvest of this species, numerous attempts were made to transplant and establish other species of oysters to these waters (University of Washington Biology Department 2013a). This process led to the development of the first oyster farms (De Alessi 1996). Beginning in 1928, Pacific oysters, *Crassostrea gigas*, were transplanted as spat from Japan.[5] Imports of Japanese spat continued until the mid-1970s, when the local industry finally established a reliable hatchery production of larvae of this species (University of Washington Biology Department 2013a). A thriving oyster industry has existed in the region ever since.

Although Pacific oysters have naturalized in the region, hatchery development began in earnest in the 1970s to help assure a more stable production level was available to meet market needs. Today, shellfish farmers rely on a mix of natural set and hatchery larvae production to meet demand (Personal comm. B. Sheldon 2014). Beginning in the mid-2000s, both Willapa Bay and Grays Harbor began to experience a failure of the natural set. Although the cause of this change is not confirmed, oceanographers suspect it is due to an increase in the acidity of coastal waters stemming from climate change (Welch 2012) and upwelling events that bring acidic water to the surface (Great American Adaptation Road Trip 2014). As a result of this failure, most farms now must rely upon the purchase of larvae from hatcheries to seed their beds. For one operation, this need has increased the cost of the seeding process alone by five to six times, and has required the purchase of additional equipment that was previously unnecessary, along with other impacts described later in this report (Personal comm. B. Sheldon 2014). Another company has opened a hatchery in Hawaii to hedge against the potential complications of producing larvae in acidifying water (Personal comm. K. Nisbet 2014, Welch 2012). There have been some successful natural set events in recent years, but at a much smaller and more localized scale than in the past. Farmers are hopeful that a new climate cycle may restore natural sets to historic levels, but the potential for this to occur is uncertain

[3] One industry expert noted other causes of the decline of the native oyster, including a loss of habitat when development and logging activities accelerated the rate of sedimentation in coastal waters, increases in the presence of eel grass, and a lack of understanding that propagation required replacement of oyster shells into the system (Personal comm. B. Sheldon 2014).

[4] Native oysters do still naturally spawn and produce high numbers of viable larvae; however, they are currently limited by the availability of viable habitat (Personal comm. B. Sheldon 2014).

[5] The term "spat" refers to young oysters that have completed the larval phase of development and have settled and attached to a hard substrate (NOAA 2014d).

(Personal comm. B. Sheldon 2014, Personal comm. K. Weigardt 2104, Personal comm. M. Ballo 2014).

Currently, the aquaculture industry is enjoying strong demand for its products.[6] If growers are able to innovate and adjust to changing climatic conditions and other challenges, such as invasive, noxious, and nuisance species, and if the regulatory structure permits the industry the flexibility needed to adapt to changing conditions, experts believe the industry can continue to grow with minimal expansion of the area it has historically farmed. Experts interviewed for this report cited ongoing experimentation with culture of geoduck clams, and a substantial opportunity to further develop production and markets for Manila clams, as potential areas of expansion (Personal comm. B. Sheldon 2014, Personal comm. D. Cooper 2014).

SUMMARY OF KEY ISSUES

Exhibit 1-1 summarizes the key issues confronting the aquaculture industry, as identified by the experts interviewed. These issues generally fall into six categories: invasive/noxious/nuisance species; regulatory requirements; climate change; water quality; workforce; and space use conflicts. Those who were interviewed identified concerns related to the spread and treatment of invasive, noxious, and nuisance species as the most critical issue currently faced by the industry. They also cited what they describe as a complex, cumbersome, and resource-intensive regulatory system as the other primary issue of present concern. Climate change and declines in water quality were cited as issues of less immediate concern to the industry. With respect to marine spatial planning, some industry experts noted concern that placement of marine renewable energy projects could alter the natural characteristics growers rely on to maintain the quality of their growing areas. A potential increase in shipments of crude oil through the Port of Grays Harbor was also noted as a concern, due to the accompanying increase in the risk of oil spills. Lastly, industry representatives expressed serious concerns over the Army Corps of Engineers (ACOE) plan to deepen the Grays Harbor navigational channel, citing past effects of dredging on the industry, including loss of oyster beds and loss of protection from surge due to migration of sand.

[6] One industry representative indicated that while oysters are popular now, this may not always be the case (Personal comm. K. Nisbet 2014).

EXHIBIT 1-1. LIST OF ISSUES OF CONCERN TO THE AQUACULTURE SECTOR

ISSUE	CONCERNS
Invasive, Noxious, and Nuisance Species	• Burrowing shrimp (*Neotrypaea californiensis* and *Upogebia pugettensis*) • Japanese eelgrass (*Zostera japonica*) • Oyster drills (*Ceratostoma inornatum and Urosalpinx cinerea)*
Regulatory Requirements	• Complexity and cost of current structure • Concern about potential for increasingly limiting environmental requirements • Ability to maintain overwater structures/processing infrastructure
Climate Change	• Ocean acidification • Rising water temperatures • Failure of natural set
Water Quality	• Pathogens, viruses, and toxins; upland runoff • Oil spill risks (stemming from increased rail transport)
Workforce Availability	• Concerns about availability of employees to fill processing jobs
Space Use Conflicts	• Potential for new uses such as marine renewable energy to negatively affect conditions required for shellfish growth • Concerns about growth in transportation of crude oil in the region • Concerns about impacts of dredging in Grays Harbor

SECTION 2 | SECTOR STATUS

RANGE OF ACTIVITIES

LOCATION

Aquaculture production on Washington's Pacific coast (i.e., within our study area) occurs exclusively within Willapa Bay (Pacific County) and Grays Harbor (Grays Harbor County). Willapa Bay is the definitive center of the shellfish aquaculture industry in this region, with the communities of South Bend and Nahcotta serving as primary centers of activity. Exhibit 2-1 shows the location of these communities. Willapa Bay can be characterized as a "Grade A Working Estuary." Although it has always been a working harbor, the low population base has allowed water quality to remain high. Grays Harbor is substantially more developed, with pulp mills and an active port (Personal comm. D. Nisbet 2014).

Shellfish farms are operated on privately owned tidelands, as well as on tidelands that are owned by the State and are leased through DNR to shellfish growers for farming. According to data collected by Pacific Shellfish Institute for a 2013 report (Northern Economics, Inc. 2013), in 2010 there were a total of 17,288 commercially farmed acres in Pacific County and 2,288 farmed acres in Grays Harbor County (of a total farmed acreage of 29,663 acres statewide).[7] DNR reports that in 2010 shellfish farmers held a total of 82 leases on the coast, with 1,714 acres of leased tidelands being actively farmed (Personal comm. B. Pruitt 2014). In addition, DFW owns several tracts of land that are managed as oyster reserves from which licensed individuals may harvest naturally occurring oysters.

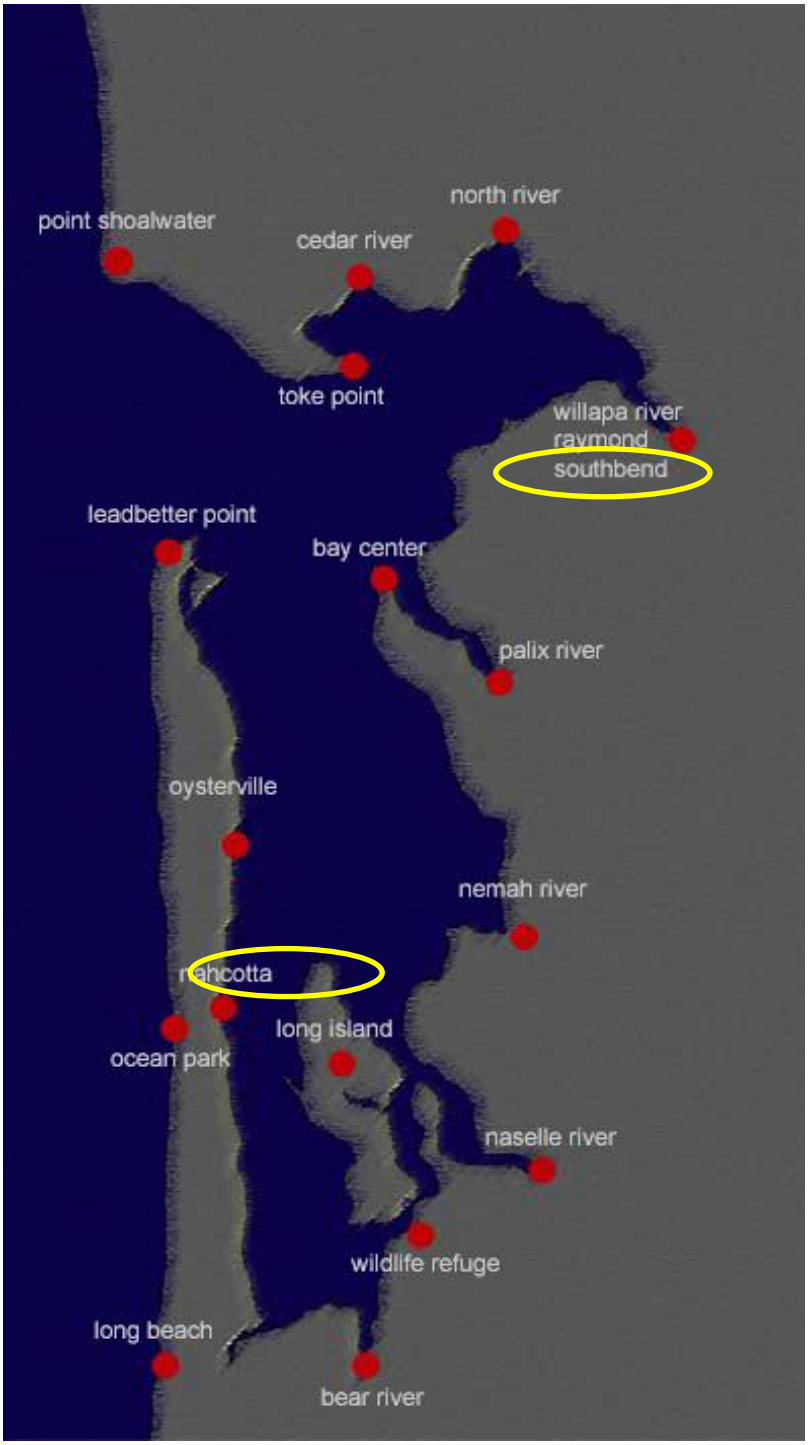
PRODUCTION[8]

According to interviewed experts and data provided by DFW, the key aquaculture products grown within the study area include Pacific oysters and, to a lesser extent, Manila clams. Small amounts of secondary crops may be grown by some farms, and there has been some experimentation with geoduck production (Personal comm. B.Sheldon 2014, Personal comm. D. Nisbet 2014, Personal comm. T. Morris 2014).

[7] The source of these data is unknown, as they are attributed to both the DOH and DFW.

[8] Because oysters represent the vast majority of harvest by weight and value in the study area, this discussion focuses on oyster production.

EXHIBIT 2-1. MAP OF WILLAPA BAY SHOWING LOCATION OF NAHCOTTA AND SOUTH BEND



Source: University of Washington Biology Department 2013b.

Production methods for oysters include wild or natural set, as well as artificial cultivation. Wild set operations rely upon the natural recruitment and settlement of larvae onto tidelands that have been covered with oyster shells. Artificial cultivation relies upon the purchase or growth of oyster larvae. The larvae are placed in upland tanks of warmed water that have been loaded with bags of oyster shells onto which the larvae settle. After about five to ten days the shells are removed and placed into a nursery area. Next, they are moved to a "grow-out ground" within the estuary where they grow to a size at which they can be transplanted to a "fattening bed," where they mature and grow until they reach a harvestable size. Historically, much of the oyster-growing industry on the coast relied upon wild set methods. In the 1970s efforts increased to develop reliable hatchery methods to assure that annual production could meet market demands. In 2005, however, local growers began to experience significant reductions or a total failure of natural sets. This continued until 2012, when some more significant sets occurred on a more localized basis. As a result, most growers in the region were forced to switch to hatchery-raised larvae for production (Personal comm. B. Sheldon 2014, Personal comm. K. Nisbet 2014, Personal comm. M. Ballo 2014).[9]

Oysters can be cultured using a variety of methods, including bottom culture, as well as off-bottom techniques, such as longlines, flip bags, and racks and bags. Between 85 and 90 percent of oyster production in Willapa Bay and Grays Harbor use bottom culture (Personal comm. B. Sheldon 2014).

Oyster processing generally takes one of two forms. Some are sent to shucking houses where the meat is removed from the shell and packaged for sale. Shucked meats may also be used for other value added products, such as smoked oysters. Others are sold in the shell as "dozens" for cooking (e.g., on the grill) or to be consumed on the half shell (i.e., raw). Generally speaking, larger oysters are sent to Asia, medium and small oysters remain in the U.S., and extra small oysters specifically are sent to oyster bars on the West coast. The majority of oysters harvested in the region are shucked and processed for market, but the amount of oysters sold in-shell (i.e., singles) is growing due to increasing demand, and certain farms have focused heavily on developing and expanding their in-shell production (Personal comm. B. Sheldon 2014, Personal comm. D. Cooper 2014, Personal comm. T. Morris 2014, Personal comm. K. Nisbet 2014).

PARTICIPATION

Businesses that participate directly in the production of shellfish for market include hatcheries that supply larvae to growers, farms that cultivate, grow, and harvest shellfish, and processors that handle and prepare shellfish for sale. In many cases, businesses are integrated to some extent (most, if not all, processors also cultivate, grow, and harvest shellfish) (Personal comm. B. Sheldon 2014).

[9] See Section 3 – Issues Facing the Sector for a more detailed description of this issue and its effects.

Hatcheries

Four companies provide the majority of hatchery larvae to farms within the study area. These companies include the Whiskey Creek Shellfish Hatchery of Netarts, Oregon; Taylor Shellfish of Shelton, Washington; Coast Seafoods Company of Bellevue, Washington (hatchery operated out of Quilcene, Washington); and the Nisbet Oyster Company of Bay Center, Washington.[10] Some other companies are able to produce larvae for their own operations, but generally cannot produce a quantity sufficient to fulfill their entire need and do not sell larvae to other companies (Personal comm. B Sheldon 2014, Personal comm. D. Nisbet 2014).

Most hatchery production occurs within the study area or elsewhere in the Pacific Northwest (i.e., in Shelton or in Oregon). However, Coast Seafoods operates a hatchery in Kona, Hawai'i. While Coast Seafoods is not hatching oyster larvae in Hawai'i at this time, the facility was created to provide additional capacity; currently, the firm sends clam larvae there to take advantage of rapid growing conditions (Personal comm. T. Morris 2014). In addition, in response to concerns about ocean acidification and the large-scale hatchery failures of the mid 2000s (Welch 2012), the Nisbet Oyster Company has developed a substantial hatchery operation on the Hilo side of the Big Island of Hawai'i. This issue is discussed in more detail in Section 3.

Farming

All but one of the shellfish farms operating within the study area are family-owned businesses. They range in size and complexity from small, "mom and pop" operations that may grow on a relatively small parcel of aquatic land to the family owned, vertically-integrated Taylor Shellfish Farms, Inc., which operates internationally and is the largest producer of farmed shellfish in the United States. Both Taylor Shellfish and Coast Seafoods have grow-out operations located in Kona, Hawai'i to take advantage of the good growing climate (Personal comm. K. Nisbet 2014, Personal comm. T. Morris 2014).

Processing

As described previously, processing of shellfish can range from simply cleaning the shells to prepare them for sale in shell, to shucking and packaging. Due to the requirements implemented by the Washington State Department of Health (DOH) and need for specialized equipment, shucking-based processing is generally carried out by a limited number of larger businesses. Some product is shipped out of the region to be processed elsewhere (Personal comm. B Sheldon 2014).

There are four primary oyster processors operating in the Willapa Bay area. Coast Seafoods is the largest producer, followed by the Nisbet Oyster Company, Wiegardt and Sons, and Ekone Oyster Company (all of which have roughly the same level of production). Although Taylor Shellfish is a substantial producer of oysters in the region, it ships its product out of the study area to a facility in Shelton, Washington for

[10] Coast Seafoods Company is now owned by Pacific Seafood of Clackamas, Oregon.

processing. Processing capacity in Grays Harbor is much more limited, with Brady's Oysters and Lytle Seafood serving as the only processors of oysters in the area (Personal comm. D. Nisbet 2014, Personal comm. M. Ballo 2014).

STATISTICS

According to the 2012 U.S. Census of Agriculture published by the U.S. Department of Agriculture (USDA), Washington ranked first among all states in sales of aquaculture products, with a total value of $187,222,000 (USDA 2014a). The most recently published U.S. Census of Aquaculture (2005) also places Washington first in value of sales of farmed mollusks ($63,710,000), with Washington-grown shellfish accounting for 31 percent of the value of U.S. farmed shellfish production (USDA 2006). In the context of state-wide agricultural production, aquaculture (all products) ranks ninth in value in Washington, accounting for 2.1 percent of the total sales of agricultural products in the state (USDA 2014b).

The counties within the study area make a substantial contribution to state-wide aquaculture production. Pacific County ranked third among all Washington counties, and 15th among all U.S. counties, in aquaculture production, with sales of $22,360,000 in 2012 (USDA 2014c). Grays Harbor County ranked seventh state-wide, and 43rd nationally, with aquaculture sales of $7,756,000 (USDA 2014d). For mollusk production specifically, Pacific County had the second highest sales in the state (behind Mason County) in 2012 ($21,304,000), accounting for 23 percent of state farmed mollusk sales. Grays Harbor County ranked fourth among Washington counties with sales of $5,559,000 (6 percent of state-wide sales) (USDA 2014a).

PARTICIPATION

According to the 2012 Census of Agriculture, Washington had a state-wide total of 171 shellfish farms, with 25 in Pacific County and 8 in Grays Harbor County (USDA 2014a). Data provided by DFW indicate that in 2012, 20 farms in Pacific County and 6 farms in Grays Harbor County reported sales of shellfish products. Exhibit 2-2 shows the number of farms reporting shellfish sales in both counties annually between 2004 and 2013, according to DFW data.

Although production and sales data are likely to provide the most accurate characterization of active harvesting businesses, license data also offer insights on participation in the industry in this region. We reviewed farm registration information provided by DFW as one potential source of additional information, but found these data, which are self-reported by the industry, to be incomplete. Licensing data from DOH, however, provide a sense of the number of businesses that participate in various aspects of the industry. According to its website, the DOH issues the following types of licenses:

- **Harvester (HA):** operations are limited to harvesting shellstock (live, unshucked product) and selling to other licensed dealers in Washington. Harvesters cannot sell at the retail level.

EXHIBIT 2-2. NUMBER OF FARMS REPORTING SALE OF AQUACULTURE PRODUCTS, 2004-2013

YEAR	NUMBER OF FARMS		
	GRAYS HARBOR COUNTY	PACIFIC COUNTY	TOTAL
2004	12	24	**36**
2005	9	21	**30**
2006	7	23	**30**
2007	8	24	**32**
2008	6	21	**27**
2009	5	18	**23**
2010	7	18	**25**
2011	4	17	**21**
2012	6	20	**26**
2013	6	16	**22**

Source: Data provided by DFW, June 2014.

- **Shellstock Shipper (SS):** operations can cultivate and harvest shellstock. They can buy, sell, and ship shellstock at retail or wholesale in Washington, to other states, and to other countries.
- **Wholesale Only Shellstock Shippers:** are limited to wholesale activities, that is, buying, selling, and shipping shellstock. They cannot cultivate or harvest shellfish.[11]
- **Shucker-Packer (SP):** operations can perform all activities allowed for Harvesters and Shellstock Shippers, and can shuck shellstock for packing in jars or similar containers (Washington Department of Health 2014).

Exhibit 2-3 presents the number of businesses holding each type of license in Pacific and Grays Harbor County between 2006 and 2014.

[11] Data provided by DOH do not identify any businesses in Pacific or Grays Harbor County that hold this type of license.

EXHIBIT 2-3. NUMBER OF FARMS HOLDING WASHINGTON DEPARTMENT OF HEALTH SHELLFISH LICENSES BY COUNTY, 2006-2014

LICENSE TYPE	LICENSE YEAR	COUNTY		TOTAL
		GRAYS HARBOR	PACIFIC	
HA	2006	6	10	16
	2007	5	10	15
	2008	5	10	15
	2009	5	10	15
	2010	5	8	13
	2011	4	8	12
	2012	4	6	10
	2013	4	5	9
	2014	4	7	11
	2015	3	4	7
SP	2006	5	8	13
	2007	5	8	13
	2008	5	8	13
	2009	5	9	14
	2010	5	7	12
	2011	6	7	13
	2012	5	7	12
	2013	5	7	12
	2014	5	8	13
	2015	1	7	8
SS	2006	19	41	60
	2007	17	41	58
	2008	15	42	57
	2009	16	43	59
	2010	14	43	57
	2011	20	42	62
	2012	20	40	60
	2013	19	40	59
	2014	17	34	51
	2015	7	7	14
Total	2006	30	59	89
	2007	27	59	86
	2008	25	60	85
	2009	26	62	88
	2010	24	58	82
	2011	30	57	87
	2012	29	53	82
	2013	28	52	80
	2014	26	49	75
	2015	11	18	29

Notes:
HA = Harvester
SP = Shucker-Packer
SS = Shellstock Shipper
Source: Data provided by DOH, June 2014.

EMPLOYMENT

Statewide, the only source of employment data identified in our research comes from the 2013 report "The Economic Impact of Shellfish Aquaculture in Washington, Oregon and California" (Northern Economics, Inc. 2013). In that study, survey respondents reported 1,266 direct jobs in the shellfish aquaculture industry, which was used to develop an estimate of a total of 1,900 direct jobs industry-wide. The minimum employment among surveyed firms was 0.1 persons per farmed acre (1 person per 100 farmed acres), and the maximum was 5 people per farmed acre (500 people per 100 farmed acres). Survey results did not indicate any clear relationship between number of farmed acres and number of employees. Note that these data represent the shellfish aquaculture industry state-wide, and are not specific to the study area. This survey also found no direct correlation between the extent of farmed acres within a county and the employment in that county. For example, almost 65 percent of the reported farmed acres are in Pacific County, but only 27 percent of the total reported employees are residents of Pacific County. In contrast, Mason County is home to 32 percent of the reported employees, but only 4 percent of the farmed acres (Northern Economics, Inc. 2013).

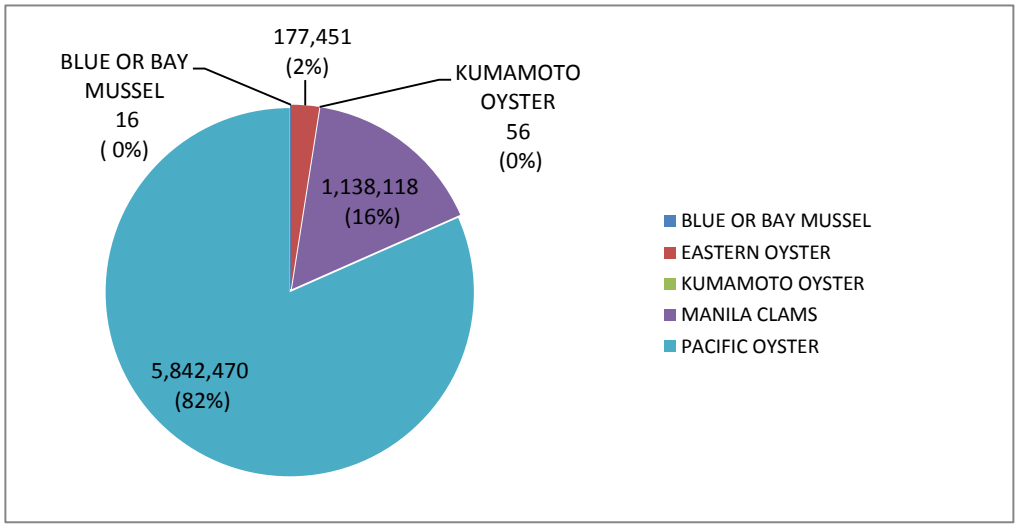
We were not able to identify any comprehensive source of industry employment data specific to the study area. The best available data on employment in the aquaculture sector within the study area come from a series of surveys commissioned by the Willapa Grays Harbor Oyster Growers Association (WGHOGA). The most recently conducted survey (2008) identified a total of 443 employees working for these businesses (Powell, Seiler & Co., 2010). It is important to note, however, that surveys were only administered to WGHOGA members, only a subset of whom responded. Thus, this figure represents employment at only a subset of growers in the study area (i.e., those that responded to the survey).

PRODUCTION AND VALUE

The aquatic farm permits issued by DFW require growers to keep complete and accurate records showing the quantity of products sold and to supply that information to the department quarterly. This information is the primary source of data on the production and value of farmed shellfish in Washington; however, these data are generally viewed by both industry and DFW itself as incomplete. It is difficult for DFW to verify the production numbers submitted, and there is little if any incentive for growers to provide accurate information to the agency. For these reasons, DFW believes that the figures reported to it understate actual production (Personal comm. D. Ayers and B. Kauffman, 2014). The information presented below should be considered with this caveat in mind.

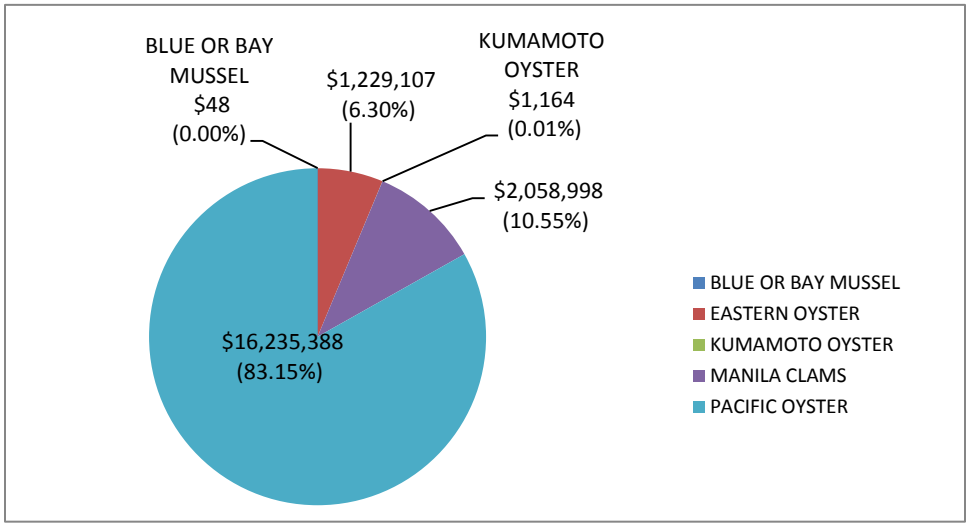
According to the reports submitted to DFW, Pacific oysters account for the overwhelming majority (82 percent) of shellfish farmed and harvested in the study region, followed by Manila clams (see Exhibit 2-4). In 2013, Pacific oysters comprised 83 percent ($16,235,388) of the total value of the farmed shellfish harvest in Pacific and Grays Harbor Counties, while Manila clams accounted for 11 percent of the total value ($2,058,998) (see Exhibit 2-5).

EXHIBIT 2-4. RELATIVE HARVEST (ROUND POUNDS) OF FARMED SHELLFISH PRODUCTS IN PACIFIC AND GRAYS HARBOR COUNTIES, 2013



Source: Based on data provided by DFW, June 2014.

EXHIBIT 2-5. RELATIVE VALUE (DOLLARS) OF FARMED SHELLFISH PRODUCTS IN PACIFIC AND GRAYS HARBOR COUNTIES, 2013



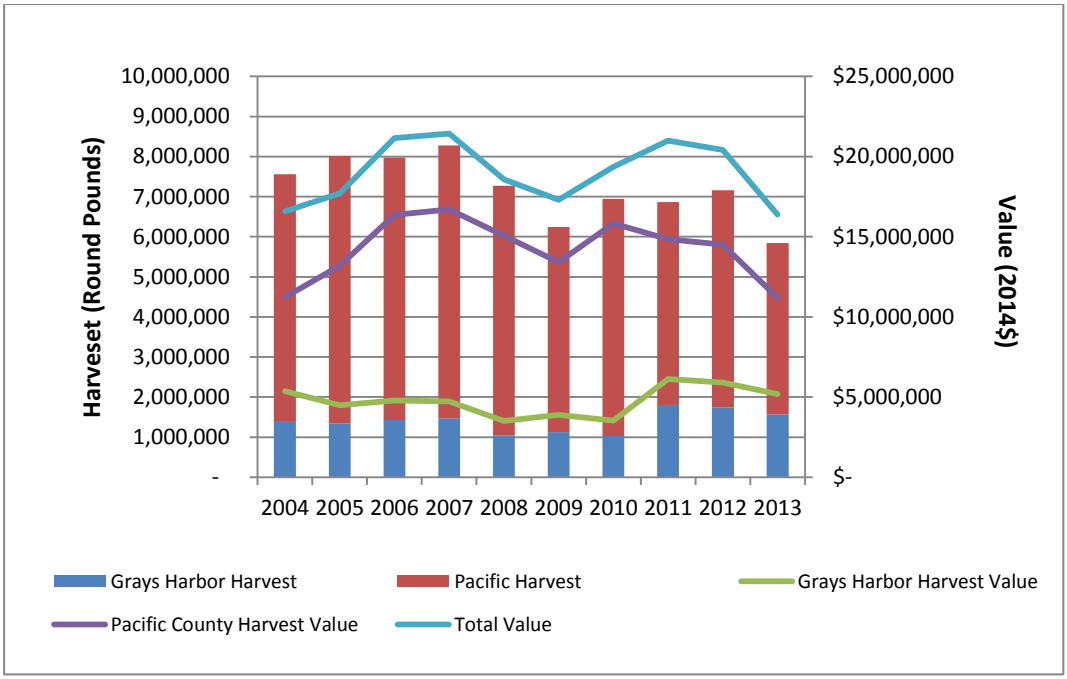
Source: Based on data provided by DFW, June 2014.

Exhibit 2-6 presents the total harvest and value of Pacific oysters in the region annually since 2004, by county. Since 2004, the Pacific oyster harvest has ranged from a high of 8,274,431 pounds in 2007 (with a value of $21,429,323) to a low of 5,842,470 pounds in 2013 (with a value of $16,381,505). In 2013, 73 percent of the Pacific oyster harvest in the region came from Pacific County. On average over the last 10 years, 81 percent of the oyster harvest has come from Pacific County.

Exhibit 2-7 presents the total harvest and value of Manila clams in the region annually since 2004. Because the harvest of Manila clams in Pacific County was significantly higher than in Grays Harbor County, we combine the data for purposes of this graph. Exhibit 2-8 provides a detailed review of the relative level of harvest for each of the two counties annually. Since 2004, the Manila clam harvest has ranged from a high of 1,196,821 pounds in 2012 (with a value of $1,893,053) to a low of 704,529 pounds in 2004 (with a value of $1,647,259). In each of the last 10 years, 99 percent or more of the Manila clam harvest has come from Pacific County.

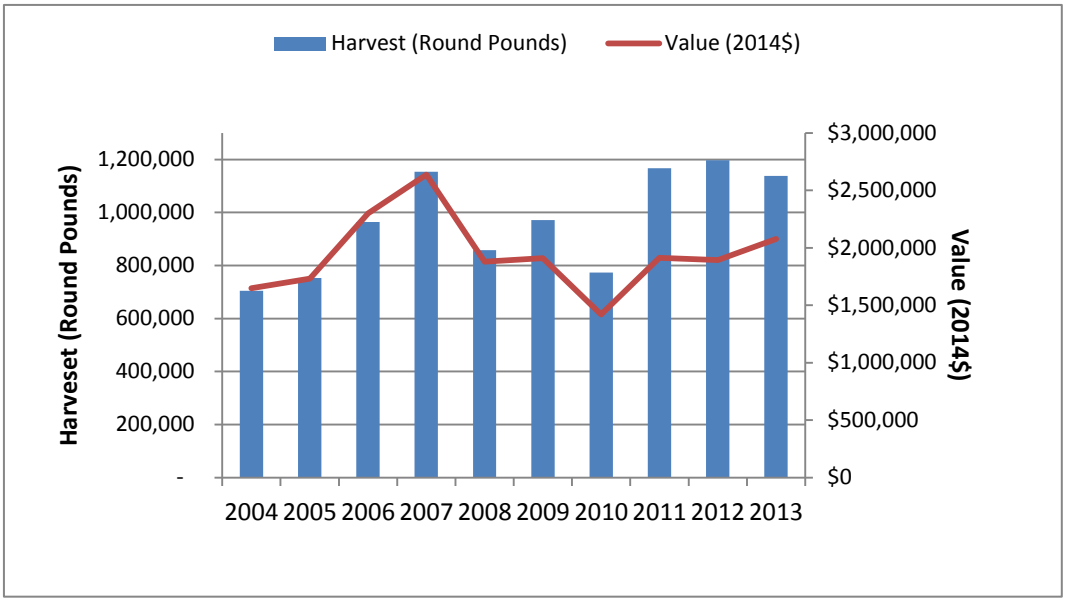
A complete summary of the volume and value of aquaculture products in Grays Harbor and Pacific Counties between 2004 and 2013 is provided in Exhibit 2-8.

EXHIBIT 2-6. TOTAL ANNUAL HARVEST AND VALUE OF PACIFIC OYSTERS IN PACIFIC AND GRAYS HARBOR COUNTIES, 2004-2013



Source: Based on data provided by DFW, June 2014.

EXHIBIT 2-7. TOTAL ANNUAL HARVEST AND VALUE OF MANILA CLAMS IN PACIFIC AND GRAYS HARBOR COUNTIES, 2004-2013



Source: Based on data provided by DFW, June 2014.

EXHIBIT 2-8 SUMMARY OF HARVEST AND VALUE OF AQAUCULTURE PRODUCTS IN GRAYS HARBOR AND PACIFIC COUNTIES, 2004-2013

YEAR	SPECIES	GRAYS HARBOR		PACIFIC		TOTAL	
		Harvest (Round Pounds)	Value (2014$)	Harvest (Round Pounds)	Value (2014$)	Harvest (Round Pounds)	Value (2014$)
2004	MANILA CLAMS	83	$300	704,446	$1,646,959	704,529	$1,647,259
	PACIFIC OYSTER	1,378,664	$5,362,290	6,180,734	$11,229,481	7,559,398	$16,591,771
	RAINBOW/STEELHEAD TROUT	583	$1,967	-	$0	583	$1,967
	TOTAL	**1,379,330**	**$5,364,558**	**6,885,180**	**$12,876,440**	**8,264,510**	**$18,240,997**
2005	MANILA CLAMS	-	$0	753,085	$1,732,832	753,085	$1,732,832
	PACIFIC OYSTER	1,339,464	$4,498,958	6,678,105	$13,200,741	8,017,569	$17,699,699
	TOTAL	**1,339,464**	**$4,498,958**	**7,431,190**	**$14,933,573**	**8,770,654**	**$19,432,531**
2006	KUMAMOTO OYSTER	-	$0	13	$365	13	$365
	MANILA CLAMS	-	$0	964,638	$2,299,524	964,638	$2,299,524
	OLYMPIA OYSTER	-	$0	26	$2,318	26	$2,318
	PACIFIC OYSTER	1,428,407	$4,795,239	6,549,961	$16,368,502	7,978,368	$21,163,741
	TOTAL	**1,428,407**	**$4,795,239**	**7,514,638**	**$18,670,709**	**8,943,045**	**$23,465,949**
2007	MANILA CLAMS	-	$0	1,153,198	$2,638,361	1,153,198	$2,638,361
	PACIFIC OYSTER	1,470,898	$4,722,114	6,803,533	$16,707,209	8,274,431	$21,429,323
	TOTAL	**1,470,898**	**$4,722,114**	**7,956,731**	**$19,345,570**	**9,427,629**	**$24,067,685**
2008	MANILA CLAMS	-	$0	857,954	$1,879,131	857,954	$1,879,131
	PACIFIC OYSTER	1,045,443	$3,519,614	6,223,723	$15,069,042	7,269,166	$18,588,655
	TOTAL	**1,045,443**	**$3,519,614**	**7,081,677**	**$16,948,173**	**8,127,120**	**$20,467,786**
2009	MANILA CLAMS	-	$0	971,965	$1,911,637	971,965	$1,911,637
	PACIFIC OYSTER	1,123,869	$3,886,081	5,120,725	$13,417,880	6,244,594	$17,303,961
	TOTAL	**1,123,869**	**$3,886,081**	**6,092,690**	**$15,329,516**	**7,216,559**	**$19,215,597**
2010	BLUE OR BAY MUSSEL	-	$0	46	$98	46	$98
	KUMAMOTO OYSTER	-	$0	28	$368	28	$368
	MANILA CLAMS	-	$0	773,012	$1,419,160	773,012	$1,419,160
	PACIFIC OYSTER	1,030,586	$3,533,584	5,911,653	$15,819,795	6,942,239	$19,353,379
	TOTAL	**1,030,586**	**$3,533,584**	**6,684,739**	**$17,239,420**	**7,715,325**	**$20,773,004**
2011	BLUE OR BAY MUSSEL	-	$0	145	$302	145	$302
	KUMAMOTO OYSTER	-	$0	91	$818	91	$818
	MANILA CLAMS	-	$0	1,166,665	$1,911,876	1,166,665	$1,911,876
	PACIFIC OYSTER	1,804,434	$6,134,273	5,063,760	$14,852,997	6,868,194	$20,987,270
	TOTAL	**1,804,434**	**$6,134,273**	**6,230,661**	**$16,765,993**	**8,035,095**	**$22,900,267**
2012	KUMAMOTO OYSTER	-	$0	13	$541	13	$541
	MANILA CLAMS	9,034	$24,983	1,187,787	$1,868,071	1,196,821	$1,893,053
	PACIFIC OYSTER	1,740,822	$5,908,801	5,420,646	$14,505,751	7,161,468	$20,414,553
	RAINBOW/STEELHEAD TROUT	64	$1,520	315	$1,936	379	$3,456
	TOTAL	**1,749,920**	**$5,935,304**	**6,608,761**	**$16,376,298**	**8,358,681**	**$22,311,602**

YEAR	SPECIES	GRAYS HARBOR		PACIFIC		TOTAL	
		Harvest (Round Pounds)	Value (2014$)	Harvest (Round Pounds)	Value (2014$)	Harvest (Round Pounds)	Value (2014$)
2013	BLUE OR BAY MUSSEL	-	$0	16	$48	16	$48
	EASTERN OYSTER	-	$0	177,451	$1,240,168	177,451	$1,240,168
	KUMAMOTO OYSTER	-	$0	56	$1,174	56	$1,174
	MANILA CLAMS	2,950	$8,037	1,135,168	$2,069,492	1,138,118	$2,077,529
	PACIFIC OYSTER	1,565,904	$5,187,446	4,276,566	$11,194,059	5,842,470	$16,381,505
	TOTAL	**1,568,854**	**$5,195,482**	**5,589,257**	**$14,504,942**	**7,158,111**	**$19,700,425**

Source: Data provided by DFW, June 2014.

Prompted by concerns about the accuracy of data reported to DFW, the WGHOGA has commissioned a number of surveys designed to more thoroughly characterize the shellfish industry in this region. The surveys included questions regarding the value of the shellfish harvest, as well as employment and payroll information. Exhibit 2-9 presents the data reported for the two available surveys (data from a more recent survey is anticipated shortly). It is important to note that the survey results represent figures and values reported by only a subset of businesses in the study area (i.e., those WGHOGA members who responded to the survey) and thus are not representative of the industry as a whole.

In comparing the data provided in Exhibit 2-8 with those provided in 2-9, DFW reports a comprehensive value for 2008 of $20,467,786, while the WGHOGA data report a value of $23,881,118. Given that the WGHOGA data represent only a subset of the industry, it appears quite likely that the gross sales values provided by DFW do in fact under-represent the industry's actual sales.

EXHIBIT 2-9. WILLAPA GRAYS HARBOR OYSTER GROWERS ASSOCIATION SURVEY RESULTS

METRIC	2002[1]	2007[2]	2008[2]
No. of employees	575	470	443
Gross Payroll Dollars	$9,667,090	$8,949,093	$9,332,078
Gross Sales Farmed	$30,360,220	$23,741,030	$23,881,118
Gross Sales Total (i.e., processed value)	Not collected	$61,062,276	$65,427,414
Bushels of Oysters	Not collected	851,484	831,046
Gallons of Oysters	Not collected	555,428	491,471
Dozens of Oysters	Not collected	1,050,737	955,043
Pounds of Manila Clams	Not collected	1,091,736	1,087,421

Notes: Data were not collected from every grower in the two surveyed counties. The data presented here only represent those producers who responded to the surveys.

1. Survey results identify that "most of the growers participated," though this statement presumably refers to members of the WGHOGA only. Identifies 19 companies that did not participate.
2. Survey results from 20 WGHOGA members of 34 solicited.

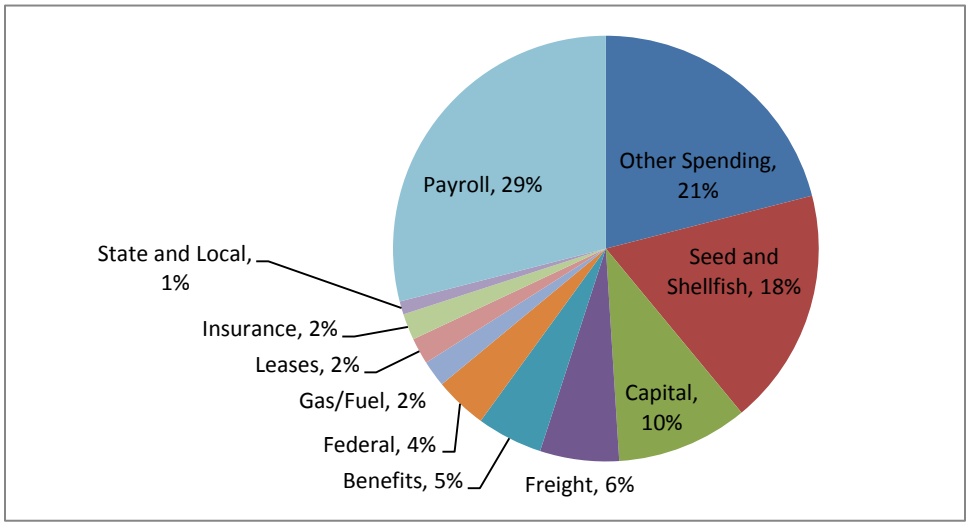
Source: Powell, Seiler & Co., P.S. 2002, 2010.

ECONOMIC IMPACT OF THE INDUSTRY

The most recent and comprehensive data on the economic impact of shellfish aquaculture in Washington was developed by Northern Economics for the Pacific Shellfish Institute (Northern Economics 2013).[12] This analysis sought to derive a specific production function for the industry based upon detailed information on expenditures collected through targeted interviews and surveys. This expenditure information was used to conduct an input-output analysis to assess the economic impact of the shellfish industry in Washington as a whole, and within particular counties.

Survey results identified the breakdown of expenditures in several cost categories based on 2010 spending (see Exhibit 2-10). The top three expense categories for surveyed businesses were Payroll (29 percent), Other Spending (21 percent) and Seed and Shellfish (18 percent).[13] The authors report that on average, shellfish farms spend approximately $3,100 for every acre owned or leased, and $4,988 for every acre farmed.

EXHIBIT 2-10. WASHINGTON SHELLFISH AQUACULTURE EXPENDITURES BY TYPE, 2010



Source: Recreated from Northern Economics 2013.

[12] Although previous research has attempted to identify the economic impact of the shellfish industry (e.g., Bonacker and Cheney 1988, Inveen 1987, Conway 1991) according to the authors of this most recent report, most of these studies rely on multipliers that were not specific to the shellfish industry, or did not gather expenditure data of sufficient detail upon which to base a robust analysis.

[13] The report does not identify the types of expenses included in the "Other Spending" category.

Based upon the survey data, and extrapolating to those farms that were not included in the survey results, the expenditures were applied in an input-output analysis that generated the following state-wide results for 2010:

- The shellfish aquaculture industry in Washington spent $101.4 million in the Washington economy in 2010, and generated $184 million in economic activity (1.8 times direct expenditures);
- The industry was responsible for 1,900 direct jobs, which in turn generated 810 additional jobs, for a total of 2,710 total jobs in the state; and
- The industry paid $37 million in wages, which generated additional labor income of $39.9 million, for a total of $77.1 million in labor income in the state.

The economic multipliers calculated through this analysis are as follows:

- Every $1 spent by the industry generates $1.82 of economic activity in the state;
- Every $1 spent by the industry generates $0.76 in wages in the state; and
- Every $1 million spent by the industry generates approximately 27 jobs in the state.

Based on the assumption that output, employment and labor income are correlated to the proportion of tidelands owned or leased by shellfish farms, the authors calculate the output, employment and labor income generated by county.[14] These data are presented in Exhibit 2-11.

EXHIBIT 2-11. ECONOMIC IMPACT OF SHELLFISH AQUACULTURE BY COUNTY, 2010

COUNTY	OUTPUT	EMPLOYMENT	LABOR INCOME	PERCENT OF TOTAL FARMED ACRES STATE-WIDE REPRESENTED BY COUNTY
Grays Harbor	$11,966,300	210	$5,957,500	8%
Pacific	$90,416,800	1,580	$45,014,700	58%
Total	**$156,911,400**	**2,710**	**$77,236,900**	

Notes:
1. Labor income is a subset of output.
2. It is not clear why the total output identified in the county-by-county table (11) upon which this table is based does not equal the total output reported elsewhere in the report.

Source: Northern Economics 2013.

[14] Although the report indicates that the calculated proportion is based on leased tidelands only, other information provided in the report indicates that they intended to refer to both leased and owned tidelands.

In considering these figures, it is important to note that the economic impact calculated in this report is not representative of the *total value* of the industry. For example, this analysis does not consider revenue generated through shellfish sales to the public in retail markets, restaurants, or at other events.

REVENUE GENERATED BY THE STATE

As described previously, some proportion of shellfish farming in Willapa Bay and Grays Harbor occurs on state-owned land that DNR leases to shellfish farmers. DNR estimates that approximately 10 percent of farmed lands in Grays Harbor and one to two percent of farmed lands in Willapa Bay are lands that are leased from DNR.[15] These leases provide an active stream of revenue for the state. The annual rent being generated by these leases in 2010 was approximately $327,230 ($190/acre/year) (Personal comm. B. Pruitt 2014).

License and permit fees paid by shellfish farmers provide an additional stream of revenue to the state. As of publication of this report we have not yet identified a comprehensive source for these data.

WDFW also manages the state-owned Willapa Bay Oyster Reserves. Access to these tidal oyster and clam tracts is made available to commercial harvesters via a sealed bidding process. Over the past 20 years oyster sales have generated an average of $173,500 in revenue per year. Clam sales, which began more recently, have averaged $15,000 over the past six years. As directed by RCW 77.60.160, the majority of the funds generated by these sales are used to fund bivalve shellfish research and development activities (Personal comm. D. Ayers and B. Kauffman, 2014).

EXISTING LAWS, REGULATIONS AND POLICIES

Aquaculture on Washington's Pacific coast is managed under an array of laws, regulations, and policies implemented by Federal, State and local governments. In this section, we identify the relevant agencies and their areas of jurisdiction, and summarize the key laws, regulations, and policies applicable to the aquaculture industry.

ROLES OF KEY FEDERAL AND STATE AGENCIES

The general role of each entity is described below. Additional detail on the laws, regulations, and policies referred to in this discussion is provided in Exhibit 2-12.

- **U.S. Army Corps of Engineers (ACOE):** Regulates work in navigable waters under Section 10 of the Rivers and Harbors Act and discharge of dredge and fill materials into waters of the U. S., including wetlands, under Section 404 of the Clean Water Act; proposed aquaculture activities may be authorized under a general permit (e.g., Nationwide Permit 48) or a standard individual permit (Personal comm. P. Sanguinetti, 2014).

[15] Although the percentage of farmed lands that are owned by DNR is higher in Grays Harbor, the total acreage of DNR-owned lands is much higher in Willapa Bay.

- **National Oceanic and Atmospheric Administration (NOAA):** Implements a Marine Aquaculture Policy geared towards development of a sustainable marine aquaculture industry in the context of its other missions and socioeconomic goals; implements a National Shellfish Initiative aimed at increasing populations of shellfish through production and conservation; provides regulatory oversight of the industry through implementation of the Endangered Species Act (ESA) and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act; provides funds to study technology development and environmental interactions (Personal comm. L. Hoberecht 2014).
- **Washington State Department of Ecology (Ecology):** Participates in the Washington Shellfish Initiative adopted in 2011, including co-lead of the model permitting program. Ensures consistency with the federal Coastal Zone Management Act (CZMA) through state shoreline and ocean management statutes and their implementing guidelines of Chapter 173-26 WAC. Also implements Section 401 of the CWA and issues water quality permits for aquatic application of herbicides and pesticides, commercial salmon net pens and other uses (Personal comm. C. Bouta 2014).
- **Washington State Department of Natural Resources (DNR):** Leases state-owned lands and authorizes use of those lands for aquaculture operations (Personal comm. B. Pruitt 2014).
- **Washington State Department of Health (DOH):** State shellfish authority as designated by the Food and Drug Administration (FDA) to implement the National Shellfish Sanitation Program (NSSP). Responsible for ensuring food safety, including overseeing sanitation of facilities and monitoring water quality for toxins, pathogens, and viruses (Personal comm. R. Porso 2014).
- **Washington State Department of Fish and Wildlife (DFW):** Manages oyster reserves, processes aquatic farm registrations, issues emerging commercial fishery licenses, and authorizes in-state and out-of-state shellfish importation and transfer.

KEY LAWS, REGULATIONS AND POLICIES

Exhibit 2-12 summarizes the key laws, regulations and policies applicable to the aquaculture industry.

EXHIBIT 2-12. SUMMARY OF KEY LAWS, REGULATIONS AND POLICIES

LAW/REGULATION/POLICY	RESPONSIBLE AGENCY(S)	DESCRIPTION	RELEVANT LINK(S)
Federal			
U.S. Department of Commerce Aquaculture Policy	U.S. Department of Commerce	The purpose of this policy is to support the development of sustainable aquaculture within the context of the Department of Commerce's goals of encouraging economic growth and employment opportunities in the United States and of enhancing United States competitiveness in, and exports to, global markets (U.S. Department of Commerce 2011).	http://www.nmfs.noaa.gov/aquaculture/docs/policy/doc_aquaculture_policy_2011.pdf
National Oceanic and Atmospheric Administration (NOAA) Marine Aquaculture Policy	NOAA	The purpose of this policy is to enable the development of sustainable marine aquaculture within the context of NOAA's multiple stewardship missions and broader social and economic goals. The policy outlines nine specific commitments of the agency to foster development of this industry (NOAA 2011).	http://www.nmfs.noaa.gov/aquaculture/docs/policy/noaa_aquaculture_policy_2011.pdf
National Shellfish Initiative	NOAA	The goal of the National Shellfish Initiative is to increase populations of bivalve shellfish in our nation's coastal waters through commercial production and conservation activities (NOAA 2014a).	http://www.nmfs.noaa.gov/aquaculture/policy/shellfish_initiative_homepage.html
Coastal Zone Management Act (CZMA)	NOAA (Authority delegated to WA Dept. of Ecology)	Passed in 1972, the CZMA is intended to meet the challenges of continued growth in the coastal zone. It sets forth a national policy to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations" (NOAA 2014b).	http://coastalmanagement.noaa.gov/czm/czm_act.html
Clean Water Act (CWA) Section 401: Water Quality Certification	US EPA (Authority delegated to WA Dept. of Ecology)	Requires that any applicant for a federal license or permit provide a certification that any discharges from the facility into navigable waters will comply with the CWA, including its water quality standards (U.S. EPA 2014a).	http://water.epa.gov/lawsregs/guidance/cwa/waterquality_index.cfm
Clean Water Act (CWA) Section 404: Dredge and Fill	US ACOE	Allows for the issuance of permits for the discharge of dredged or fill material into navigable waters at specific disposal sites (U.S. EPA 2014b).	http://water.epa.gov/lawsregs/guidance/wetlands/sec404.cfm
Rivers and Harbors Act (RHA) Section 10 Structures and Work in Navigable Waterways	US ACOE	Prohibits the construction of any in-water structure that would inhibit the navigable capacity of US waters without the express authorization of Congress (U.S. EPA 2014c).	http://water.epa.gov/lawsregs/guidance/wetlands/sect10.cfm

LAW/REGULATION/POLICY	RESPONSIBLE AGENCY(S)	DESCRIPTION	RELEVANT LINK(S)
National Shellfish Sanitation Program (NSSP)	FDA (Authority delegated to DOH)	The NSSP is the federal/state cooperative program recognized by the U. S. Food and Drug Administration (FDA) and the Interstate Shellfish Sanitation Conference (ISSC) for the sanitary control of shellfish produced and sold for human consumption. The purpose of the NSSP is to promote and improve the sanitation of shellfish (oysters, clams, mussels and scallops) moving in interstate commerce through federal/state cooperation and uniformity of state shellfish programs (U.S. FDA 2014).	http://www.fda.gov/food/guidanceregulation/federalstatefoodprograms/ucm2006754.htm
State			
Clean Water Act (CWA) Section 401 Water Quality Certification (State implementation)	WA Dept. of Ecology	Issuance of a CWA 401 water quality certification indicates that Ecology has been reasonably assured that an activity associated with discharges to state waters will comply with state water quality standards and resource protection policies and requirements under Ecology's jurisdiction (Ecology 2014f).	http://www.ecy.wa.gov/PROGRAMS/sea/fed-permit/index.html
NPDES Authority	WA Dept. of Ecology (Authority delegated from EPA)	Authorized by the CWA (Clean Water Act), NPDES permits control water pollution by regulating point sources. Ecology is authorized by EPA to administer NPDES permits for finfish net pens, stockyards, the use of aquatic pesticides, wastewater treatment plants, and other point sources. NPDES permits assure discharges comply with state water quality, sediment quality, and resource protection standards.	http://www.ecy.wa.gov/programs/wq/permits/index.html
Coastal Zone Management Consistency Determination (State implementation)	WA Dept. of Ecology	An activity requiring a Federal permit (including shellfish aquaculture, which requires permits from ACOE under the CWA and RHA) must be determined by Ecology to be consistent with the policies and guidelines laid out in the state's Coastal Zone Management Program "to the maximum extent practicable" (Ecology 2014f).	http://www.ecy.wa.gov/PROGRAMS/sea/fed-permit/index.html
Washington Shellfish Initiative	Multiple federal and state agencies, and non-governmental organizations	Prompted by development of the National Shellfish Initiative, the Washington Shellfish Initiative outlines three steps (including specific actions) geared towards protecting and enhancing shellfish. These steps include creation of a public/private partnership for shellfish aquaculture, promotion of native shellfish restoration and recreational shellfish harvest, and ensuring clean water to protect and enhance shellfish beds (Washington State Shellfish Initiative 2011).	http://pcsga.org/shellfish-initiative/ http://www.psp.wa.gov/shellfish.php

LAW/REGULATION/POLICY	RESPONSIBLE AGENCY(S)	DESCRIPTION	RELEVANT LINK(S)
Shoreline Management Act (RCW 90.58)/Shoreline Master Program Guidelines (Chapter 173-26 WAC, Part III)	WA Dept. of Ecology	A goal of the Shoreline Management Act is to "prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Shoreline master programs are local policies and regulations designed to manage shoreline use. The Shoreline Master Program (SMP) Guidelines (Chapter 173-26 WAC, Part III), developed by Ecology with stakeholder input, provide the state standards to which local governments must adhere in developing their shoreline master programs (Personal comm. C. Bouta 2014).	http://www.ecy.wa.gov/programs/sea/sma/st_guide/intro.html http://www.ecy.wa.gov/programs/sea/sma/guidelines/index.html
Implementation of National Shellfish Sanitation Program	DOH	DOH licenses and regulates companies that commercially harvest and sell shellfish, certifies harvest sites as being safe for shellfish aquaculture, and monitors water quality to ensure the safety of shellfish being harvested for human consumption (Personal comm. R. Porso 2014).	http://www.doh.wa.gov/CommunityandEnvironment/Shellfish/CommercialShellfish.aspx
Aquatic Farm Registration Program (RCW 77.115.040 and WAC 220-76)	DFW	Authorizes an individual to commercially manage and farm cultured aquatic products on privately owned lands (DFW 2014a).	http://wdfw.wa.gov/licensing/commercial/misc_additional_permits.html
Prevention and Suppression of Disease and Pests (RCW 77.12.455)	DFW	The state Fish and Wildlife Commission can prohibit any activity which may result in the transmission of a disease or pest that might affect fish or shellfish (WA State Legislature 2014).	http://apps.leg.wa.gov/RCW/default.aspx?cite=77.12.455
Imported Oyster Seed – Permit and Inspection (RCW 77.60.080 and WAC 22-72-076)	DFW	Requires anyone importing live shellfish into the state from waters or facilities outside of Washington to obtain a permit from DFW, including conditions to ensure that the product is free of disease, pests, or other substances that present a threat to shellfish in state waters. Also requires anyone transferring shellfish, shellfish aquaculture products, aquaculture equipment, or marine organisms that adversely affect shellfish from one water body to another to obtain a permit, including conditions that reduce the risk of transferring marine pests from one water body to another (DFW 2014b).	http://apps.leg.wa.gov/rcw/default.aspx?cite=77.60.080 http://wdfw.wa.gov/licensing/shellfish_import_transfer/
State Oyster Reserves (RCW 77.60.010)	DFW	Originally established to preserve stocks of the native Olympia oyster, these reserves now host naturally spawning Pacific oysters. The reserves are managed as a fishery from which licensed harvesters can collect Pacific oysters (Dumbauld et al. 2011).	http://apps.leg.wa.gov/rcw/default.aspx?cite=77.60.010
Aquatic Land Use Authorization	DNR	Requires an authorization from DNR for projects in, on, or over state-owned lands. These authorizations specifically outline the terms and conditions of the use, and require rent for certain property rights (DNR 2014a).	http://www.dnr.wa.gov/BusinessPermits/Topics/ShellfishAquaticLeasing/Pages/aqr_aquatic_land_leasing.aspx

LAW/REGULATION/POLICY	RESPONSIBLE AGENCY(S)	DESCRIPTION	RELEVANT LINK(S)
Leasing of State-Owned Aquatic Lands, including forthcoming Habitat Conservation Plan	DNR	DNR offers leases of state-owned lands for a variety of purposes, including growing oysters, clams, and mussels. Leases typically have a ten-year duration, during which time a shellfish grower can farm as he would on private property, adhering to the terms of his authorization for use of the land. In 2012, the state, through DNR, completed a draft of a Habitat Conservation Plan (HCP) for state aquatic lands. If approved, this HCP will implement strategies on state lands (and require implementation of these strategies by tenants) that enhance habitat for at-risk species (DNR 2014b, DNR 2014c).	http://www.dnr.wa.gov/BusinessPermits/Topics/ShellfishAquaticLeasing/Pages/aqr_aquatic_land_leasing.aspx http://www.dnr.wa.gov/Publications/em_fs11_019_leasing_soal.pdf http://www.dnr.wa.gov/researchscience/topics/aquatichcp/pages/aqr_aquatics_hcp.aspx
Local			
Shoreline Master Program (Guidelines at Chapter 173.26 WAC, Part III)	Multiple County, City and Town governments	Local shoreline master programs (SMPs) are policies and regulations designed to implement the Shoreline Management Act (90.58) at the local level by managing future shoreline use and addressing use conflicts. They typically encompass comprehensive plan elements, a zoning ordinance and a permit system. These programs address public access and no net loss of shoreline ecological functions, and require mitigation of environmental impacts. Restoration plans also are created as part of the SMP planning process (Personal comm. C. Bouta 2014).	http://www.ecy.wa.gov/Programs/sea/shorelines/smp/index.html

Sources: In addition to the references cited above, this table was informed by the following sources:

1. Shellfish Interagency Permitting Team 2013.
2. Personal comm. C. Bouta 2014.
3. Personal comm. R. Porso 2014.
4. Personal comm. B. Pruitt 2014.

SECTION 3 | ISSUES FACING THE SECTOR

The industry experts interviewed for this report identified a number of recent and anticipated challenges and conditions that they perceive have affected or could potentially affect the viability and economic success of the aquaculture industry within the study area. The primary concerns identified include invasive and nuisance species control, regulatory burden and uncertainty, the recent failure of the natural oyster set, climate change, water quality, workforce availability, and conflicting uses of marine space. With respect to space use conflicts, three concerns were noted. First, industry representatives noted varying degrees of concern that the placement of new uses such as marine renewable energy projects could have detrimental effects on the conditions in Willapa Bay and Grays Harbor that shellfish require to survive and thrive. Next, various industry representative indicated that increased shipments of oil in the region would increase the risk of oils spills, which could be devastating for the industry. Lastly, there is concern that ACOE dredging activities in Grays Harbor could harm oyster beds.

INVASIVE, NOXIOUS AND NUISANCE SPECIES

A variety of invasive and native noxious and nuisance species are currently perceived by the interviewed industry representatives to be the greatest threat to the continued economic viability of the aquaculture industry in Grays Harbor and Pacific counties. Although the control of non-native *Spartina alterniflora* is considered to have been successful, Japanese eelgrass (*Zostera japonica),* burrowing shrimp (*Neotrypaea californiensis* and *Upogebia pugettensis*), and two species of non-native oyster drills *(Ceratostoma inornatum* and *Urosalpinx cinerea)* present a continuing challenge to maintaining suitable growing areas for oysters and clams. Known chemical treatments for these species are environmentally controversial and subject to permit limitations and controls administered by Ecology. In addition, one industry representative noted that as shipping increases in Grays Harbor, there is increased risk of introduced species (Personal comm. M. Ballo 2014).

BURROWING SHRIMP (*NEOTRYPAEA CALIFORNIENSIS* AND *UPOGEBIA PUGETTENSIS)*

Two species of burrowing shrimp, *Neotrypaea californiensis* and *Upogebia puttensis*, cause oysters to sink into the substrate and suffocate (Ecology 2014e). Although these species are native to the area, oyster growers in some estuaries have reported substantial increases in populations of these species since the 1950s, and expanded distribution within the estuaries. Although there is not conclusive scientific evidence to explain this expansion, potential causes include declining populations of shrimp predators, channel

dredging, soil erosion, the effects of El Niño, and possible changes in salinity levels in some estuaries (Oregon State Department of Lands date unknown).

In the late 1950s, the Washington Department of Fisheries (now part of DFW) initiated research to develop an effective pest management tool to help control the expansion of burrowing shrimp. In 1963, permitting was put in place to allow the use of the pesticide Carbaryl for the control of burrowing shrimp. In 2001, Ecology began requiring a NPDES permit. The first National Pollution Discharge Elimination System (NPDES) permit for the control of burrowing shrimp was issued in 2002. In 2006, Ecology renewed the permit for the control of burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. This permit continues to cover the control of burrowing shrimp, and is currently under an administrative extension following a timely submittal of an application for permit reissuance. The WGHOGA has submitted an application to Ecology for a NPDES permit to use a new pesticide, Imidacloprid, to control burrowing shrimp. EPA issued a federal registration for this use in June of 2013. This permit application is currently under review. Ecology is presently developing an EIS under the State Environmental Policy Act (SEPA) and anticipates publishing a draft EIS later this year (Ecology 2014e).[16]

Several industry representatives raised the issue of the high cost to their companies in order to support the permitting process to maintain a burrowing shrimp control program; one company has spent nearly $0.5 million in dealing with this issue, and another notes this has been among his company's largest expenses over the past several years (Personal comm. D. Nisbet 2014, Personal comm. T. Morris 2014, Personal comm. K. Weigardt 2014). In addition, the efficacy of Impidacloprid is still in question, and the results of the first year of experimental use of this pesticide on commercial shellfish beds are anxiously awaited by the industry (Personal comm. D. Nisbet 2014, Personal comm. T. Morris 2014, Personal comm. K. Weigardt 2014).

JAPANESE EELGRASS, *ZOSTERA JAPONICA*

Zostera japonica is a non-native eelgrass that has colonized historical sand and mud flats, limiting the ability to culture oysters and other shellfish in these areas (Ecology 2014b). In 2012, at the urging of coastal shellfish growers, the State listed *Z. japonica* as a Class C noxious weed where it occurs on commercial shellfish beds. The listing was updated in 2013 to apply to all lands where it occurs (Washington Noxious Weed Control Board 2014). Its Class C listing allows shellfish growers to voluntarily control the plant on their shellfish beds, and a county to require control if it is beneficial to the County (Ecology 2014a).

In January 2014 the State released for review a draft EIS and a draft general permit (including a NPDES permit and State Waste Discharge General Permit) for the application of the herbicide Imazamox to commercial clam beds in Willapa Bay (Ecology 2014c). The State released the final revised permit on April 2, 2014. The release of the

[16] For more information on the ongoing permitting process, see Ecology, 2014e.

permit is currently being appealed by the Coalition to Protect Puget Sound Habitat et al. (Landye Bennet Blumstein LLP Attorneys 2014).[17]

Opposition to the use of Imazamox is focused on its potential impacts to other species, including the native eelgrass *Z. marina*, and the ecosystem in general, through potential toxicity and the loss of habitat that is used by other species (Ecology 2014d).

OYSTER DRILLS

Two species of non-native oyster drill, the eastern oyster drill (*Urosalpinx cinerea*) and the Japanese oyster drill (*Ocinebrellus inornatus*), present a substantial threat to oysters in Willapa Bay. These oyster drills are non-native marine snails that feed on oysters by drilling holes through their shells. An adult oyster drill is capable of consuming up to three oysters every week (White 2014).

Both species of oyster drills were introduced when oysters were imported from Japan and the East coast of the U.S. in order to replace the declining populations of the native Olympia oyster (White 2014). The eastern drill established in Willapa Bay in the early 1900s, and the Japanese drill was identified as a major threat in 1965 (University of Washington Biology Department 2013c). Since then, Washington State has enforced regulations prohibiting the transfer of oysters from infested areas (University of Washington Biology Department 2013c).

In 2010, the Japanese oyster drill was reported to be widespread in the central and northern regions of Willapa Bay where most of the commercial oyster beds are located, and eastern oyster drills were found in the southern bay (Heimbinger 2010). Oyster growers have had to abandon entire oyster beds due to predation by these snails (Washington State University 2009). Taylor Shellfish Farms, Inc. reports 500 of its 6,500 acres are infested to the point that growing is not possible (Heimbinger 2012). More recently, problems with oyster drills in Willapa Bay have been primarily limited to the southern portion of the Bay, and have not been as problematic in the north (Personal comm. D. Nisbet 2014).

Efforts to control oyster drill populations have been funded by NOAA, the University of Washington, Washington State University Vancouver, and the State of Washington (White 2014, University of Washington Biology Dept. 2013c, Heimbinger 2012). Currently, the only known control measure consists of manually removing oyster drill egg capsules from oyster shells in order to inhibit drill reproduction (Washington State University 2009). Recent research has focused on the development of a pheromone attractant to bring drills to a specific location where they can be manually harvested (Personal comm. B. Sheldon 2014). The use of molluscide spray is not likely in the near future due to difficulties in targeting only the drills without causing harm to other organisms or human consumers (Heimbinger 2012).

[17] For more information on the ongoing permitting process, see Ecology 2014c.

REGULATORY STRUCTURE AND REQUIREMENTS

Industry representatives cite what they perceive to be a complex, prescriptive, and ever-changing set of regulations as a key challenge to their industry (Personal comm. B. Sheldon 2014, Personal comm. D. Cooper 2014, Personal comm. D. Nisbet 2014, Personal comm. K. Nisbet 2014, Personal comm. K. Weigardt 2014, Personal comm. M. Ballo 2014, Personal comm. T. Morris 2014). Appendix B displays graphically the existing permitting process applicable to the shellfish aquaculture industry in Washington. Interviewed industry representatives perceive the existing regulatory structure as a threat to the continued success of the industry in several ways.

- For smaller farms without substantial administrative infrastructure, the resources required to comply and keep up with permit applications/renewals, reporting requirements, etc. are believed by industry to be extremely burdensome (Personal comm. B. Sheldon 2014, Personal comm. M. Ballo 2014). One interviewee noted that "staying on top of" all issues related to permitting and regulation could employ someone full-time (Personal comm. K. Nisbet 2014).
- With each additional permit required, the industry is vulnerable to additional challenges from conservation organizations, which can result in expensive legal processes and substantial delays in obtaining required permits to begin/continue operations (Personal comm. D. Cooper 2014, Personal comm. K. Weigardt 2014).
- The environmental requirements with which shellfish farms must comply are difficult to operate under. For example, industry representatives interviewed identified difficulty in obtaining permits to control nuisance species, restrictions related to the ESA, and guidelines being developed by DNR under the Habitat Conservation Plan (e.g., required buffers between shellfish bed and eelgrass, restrictions related to use of herbicides and pesticides) as inhibiting the ability of shellfish farms to operate and prosper (Personal comm. D. Cooper 2014, Personal comm. B. Sheldon 2014, Personal comm. K. Nisbet 2014, Personal comm. D. Nisbet 2014).
- Industry experts noted that some of the difficulty in operating under existing regulations is tied to the fact that the industry is regulated as a "fishery" rather than as an agricultural producer that is operating primarily on private lands with issues more in line with the agriculture industry (Personal comm. B. Sheldon 2014, Personal comm. D. Nisbet 2014, Personal comm. M. Ballo 2014). This fact makes it difficult to "work our own ground and solve our own problems" (Personal comm. D. Nisbet 2014).
- One processor noted significant concern with the potential for future regulations to limit his ability to maintain and rehabilitate existing critical over-water infrastructure, such as offloading docks (Personal comm. D. Nisbet 2014, Personal comm. K. Nisbet 2014).

Industry experts contend that the issues identified above are symptomatic of a system that is not designed to promote an expanding aquaculture industry.

CLIMATE CHANGE

OCEAN ACIDIFICATION

Ocean acidification presents a significant and immediate threat to the aquaculture industry, and is one that has garnered significant attention in recent years. As ocean acidity increases, the calcium carbonate upon which young oysters rely to grow their shells becomes less available. This increase in acidity leads to thinner shells, slower growth rates, and higher mortality rates. Oysters and other shellfish are most vulnerable to the effects of ocean acidification when they are young; scientists believe that ocean acidification is the likely cause of the failure of the natural set in recent years, and of significant die offs of hatchery produced larvae that were being grown in local seawater (NOAA PMEL Carbon Program 2014).[18] One industry representative noted concern that continued escalation of ocean acidification, as is suggested by Dr. Richard Feely of NOAA, may have effects on oysters at other life stages in the future, perhaps ultimately even affecting adult oysters (Personal comm. D. Nisbet 2014).

Recognizing the severity of this issue in a state whose economy and culture is so connected to shellfish and the marine environment, the Governor's office has taken a number of steps to promote research and actions to address this issue (Washington State Blue Ribbon Panel on Ocean Acidification 2012). In 2012, Governor Gregoire convened a Washington State Blue Ribbon Panel on Ocean Acidification to develop actions to address the causes and consequences of acidification. The recommendations of the Panel, documented in *Washington State Blue Ribbon Panel on Ocean Acidification* (2012), resulted in Executive Order 12-07, which directs Ecology and other cabinet agencies to implement the Panel's key early actions (Washington State Office of the Governor 2013).

WATER TEMPERATURE

While changes in water temperature were not cited by representatives of the aquaculture industry as of great immediate concern, DOH considers it to be one of the biggest emerging threats to the industry. Increasing water temperatures can have a deleterious effect on water quality. Specifically, as water temperature increases, more severe forms of existing pathogens and toxins, as well as entirely new strains of the same, may appear. DOH is currently conducting a scoping process related to a policy that would result in an automatic closure of shellfish beds to harvest if the water exceeds a specified temperature (Personal comm. R. Porso 2014).

Additional concerns related to long-term declines in water quality are discussed in the section on Water Quality, below.

[18] While not denying that the pH of the ocean is shifting and that this may affect the industry, some industry representatives believe the failure of the natural set may be related to natural cycles, rather than changing environmental conditions (Personal comm. K. Weigardt 2014, Personal comm. T. Morris 2014).

FAILURE OF NATURAL SET

Historically, many of the shellfish farms in Willapa Bay relied upon the natural set of oysters to seed actively farmed beds. Beginning in the mid 2000s, the area began to experience a failure of this natural set (Personal comm. B. Sheldon 2014, Personal comm. D. Cooper 2014, Personal comm. K. Nisbet 2014). Although the cause of this change is not confirmed, oceanographers suspect it is likely due to increased water acidity resulting from climate change (Welch 2012). Other potential factors include cooler coastal temperatures or the upwelling of colder, more acidic water (Personal comm. B. Sheldon 2014).

As a result of this failure, most farms now rely upon larvae from hatcheries to seed their beds. For one operation, this need has increased the cost of the seeding process alone by five to six times, and has required the purchase of additional equipment that was previously unnecessary (Personal comm. B. Sheldon 2014). As discussed earlier, one company opened a hatchery in Hawai'i in response to this issue (Welch 2012, Personal comm. K. Nisbet 2014). Other consequences of the natural set failure include (Personal comm. B. Sheldon 2014, Personal comm. M. Ballo 2014, Personal comm. K. Weigardt 2014):

- Reduced production, and an inability to meet market demand due to the additional labor required to maintain production;
- The inability of certain farms to maintain production, due either to lack of appropriate grounds for hatchery-based operations or constraints on the supply of hatchery seed (especially for smaller farms that lack substantial purchasing power);
- Heightened economic risks stemming from the substantial upfront costs associated with relying on hatchery seed, coupled with the potential for harvests to fail due to a variety of factors, including the threat posed by burrowing shrimp; and
- Reduced production from DFW reserves.[19]

More recently, industry representatives note that the natural set has begun to come back in the south end of Willapa Bay, which has lessened the seed shortage somewhat (Personal comm. T. Morris 2014, Personal comm. K. Weigardt 2014).

WATER QUALITY

Because shellfish are filter feeders, they are extremely sensitive to the quality of the water in which they are living. The effects of water quality can include impacts to the health of the animal itself, as well as accumulation of bacteria (pathogens), toxins, and viruses into the organism that can be passed on to humans through consumption of the animal. Water quality can be affected by a number of factors, including development (which leads to

[19] WDFW has seen a 30 percent reduction in the number of bushels of oysters sold from the Willapa Bay oyster reserve over the last five years compared to sales from the previous ten years (Personal comm. D. Ayers and B. Kauffman 2014).

increased anthropogenic discharges (i.e., upland runoff) into the water) and natural conditions such as increases in water temperature that can lead to harmful algal blooms and changes in the nature and composition of the bacteria, toxins, and viruses found in the water.

DOH is responsible for monitoring water quality in shellfish growing areas. Since 2003, DOH has issued 38 closures of growing areas in Willapa Bay and Grays Harbor due to water quality concerns. Typically, problems with viruses tend to occur in cooler months, bacteria tend to be more problematic in warmer months, and toxins are problematic throughout the year. At present, the primary water quality concerns for coastal waters relative to cultivated shellfish are paralytic shellfish poisoning and vibrio bacteria (Personal comm. R. Porso 2014).

As water temperatures rise with climate change, DOH is concerned that the nature and severity of toxins found in the water will turn to new and more dangerous forms. While cooking can eliminate pathogens from food products, it does not affect toxins. This situation may ultimately limit the ability of DOH to approve raw oysters for consumption. Additionally, the State's capacity and resources to conduct testing for emerging health threats such as these is extremely limited, and is unlikely to be sufficient to cover new threats.[20] If funds are not sufficient to provide for adequate testing relative to human health concerns, the default action would be to close all shellfish growing areas. DOH and others are investigating the possibility of moving toward a system based on environmental triggers that could predict in advance when conditions are ripe for an algal bloom, which may help to alleviate this concern (Personal comm. R. Porso 2014).

Existing development around both Grays Harbor and Willapa Bay contribute to upland runoff that enters the estuaries. Although development pressure in the Willapa Bay area is likely substantially less than what is seen in other coastal areas of the country, it is an issue that could in the future affect the region's water quality (Personal comm. R. Porso 2014, Personal comm. D. Cooper 2014). The development and industrialization of Grays Harbor presents substantial issues related to water quality within the estuary. During heavy rains, for example, the harbor may be shut down for harvest for a week at a time (Personal comm. T. Morris 2014). The quality of the water in the estuary has also been affected by discharges from two pulp mills (one of which remains in operation), an extremely active port, and a river system that transports water of poor quality from as far away as Centralia and Chehalis, WA.

The possibility of up to three separate developments related to transportation of crude oil by rail also presents a threat to water quality in the Grays Harbor estuary (Personal comm. B. Engvall 2014, Personal comm. M. Ballo 2014, Personal comm. T. Morris). Along the shorelines of both estuaries, the potential conversion of timberland to residential and commercial development poses an additional threat to water quality

[20] The State is presently considering adding a fee onto recreational fishing licenses to generate more funds for testing (Personal comm. R. Porso 2014).

(Personal comm. B. Sheldon 2014). In particular, as Pacific County updates its Shoreline Master Plan, one industry expert noted concerns that this process could reduce coastal setback requirements, allowing development close to the water that could be detrimental to the industry (Personal comm. K. Weigardt 2014).[21]

WORKFORCE AVAILABILITY

The issue of workforce availability was noted primarily by companies involved in the processing side of the industry, although the issue affects both the farming and processing sides of their businesses (Personal comm. K. Weigardt 2014, Personal comm. T. Morris 2014, Personal comm. M. Ballo 2014). At current wage levels, companies have difficulty attracting documented workers willing to do the type of manual labor the industry requires. This is particularly problematic for smaller companies, who may be unable to raise wages and remain competitive with large producers (Personal comm. M. Ballo 2014). Larger companies may have more ability to absorb a wage increase; however, a representative from one of the larger companies was concerned that immigration reform could impact the availability of labor (Personal comm. T. Morris 2014).

SPACE USE CONFLICTS

CONFLICTS WITH NEW USES OF MARINE SPACE

Several industry representatives noted concerns about possible direct and indirect impacts to shellfish farms due to potential new uses of marine space, such as marine renewable energy sites. Shellfish farms rely on uninterrupted currents that bring natural food to their growing areas. In addition, the growing beds themselves are best suited to areas in which currents are stable, and are extremely sensitive to changes in flow. Finally, as filter feeders, shellfish are extremely sensitive to water quality, and require clean water to survive and thrive. To the extent that development and operation of marine energy projects might affect these conditions in Willapa Bay or Grays Harbor, industry representatives would be concerned (Personal comm. B. Sheldon 2014, Personal comm. D. Nisbet 2014, Personal comm. T. Morris 2014). As private marine land owners, shellfish farms are also concerned about how potential new uses allowed under MSP may impact their marine lands (Personal comm. B. Sheldon 2014).

CONFLICTS WITH OIL TRANSPORT INDUSTRY

Several industry representatives cited the potential for increased transportation of crude oil as cause for concern (Personal comm. T. Morris 2014, Personal comm. M. Ballo 2014). This concern centers on the increased risk of an oil spill, and how any spill could devastate the industry. The decline of the shellfish industry in the Gulf of Mexico after the oil spill in 2010 was cited as justification for their concerns, as well as the lack of an adequate response plan should a spill occur.

[21] Pacific County is currently updating its Shoreline Master Plan, a draft Shoreline Inventory, Analysis, and Characterization is due out in September 2014 (see . http://www.co.pacific.wa.us/dcd/SMP%20Update.htm)

DREDGING IN GRAYS HARBOR

Dredging in Grays Harbor, including the ACOE plan to deepen the Grays Harbor navigation channel, was cited as a concern by several industry representatives (Personal comm. T. Morris 2014, Personal Comm. M. Ballo 2014, KXRO 2014). Past dredging is believed to have affected tidal flow and caused migration of sediment/sand with the following detrimental effects:

- Loss of oyster beds now buried by sand;
- Decreased protection from wave action; and
- Mud bottom being sanded over, which in turn disrupts the ecosystem functions that support oyster production.

In addition, deepening the channel will support a greater volume of shipping traffic, such as expansion of crude oil shipping out of the Port of Grays Harbor. As discussed above, the potential increase in such traffic is of concern to the aquaculture industry due to the associated increase in the risks of a spill.

SECTION 4 | INVENTORY OF AVAILABLE DATA

SUMMARY AND REVIEW OF EXISTING DATA SOURCES

Exhibit 4-1 summarizes the key sources of information that are currently available to support development of an economic analysis of the aquaculture industry. We include in this inventory the name and owner of the data source, a brief description of its contents, any known caveats or limitations to using the data, and a contact or website from which the data are available.

EXHIBIT 4-1. INVENTORY OF KEY DATA SOURCES RELATIVE TO THE AQUACULTURE INDUSTRY

DATA SOURCE TITLE (DATE)	OWNER	DESCRIPTION	CAVEATS AND LIMITATIONS	AVAILABLE FROM
Washington State Farm Registration Data (ongoing)	Washington Department of Fish and Wildlife	Data collected by DFW through the farm registration process include ownership/management information, acres of managed and cultivated property, anticipated crops, and culture methods.	Industry is greatly suspect of the accuracy of these data, and DFW acknowledges they are subject to significant limitations. Data are self-reported by industry, and DFW lacks the resources to enforce accuracy in reporting.	Marjorie Morningstar WA Dept. of Fish and Wildlife Commercial Harvest Data Team Manager
Washington State Aquaculture Production Data (ongoing)	Washington Department of Fish and Wildlife	All registered farms are required to report the type and volume of species harvested from their managed properties.	Industry is greatly suspect of the accuracy of these data, and DFW acknowledges they are subject to significant limitations. Data are self-reported by industry, and DFW lacks the resources to enforce accuracy in reporting.	Marjorie Morningstar WA Dept. of Fish and Wildlife Commercial Harvest Data Team Manager
Aquaculture License Data	Washington Department of Health	Data collected by DOH that identify the number of businesses holding each type of shellfish license issued by the agency.	Data reflect businesses licensed to perform certain operations, but do not confirm whether or not business is actually actively participating in the industry.	Rick Porso WA Department of Health Manager, Licensing and Certification Healthy Communities and Environment Environmental Public Health Division

DATA SOURCE TITLE (DATE)	OWNER	DESCRIPTION	CAVEATS AND LIMITATIONS	AVAILABLE FROM
USDA 2012 Census of Agriculture (2014)	US Department of Agriculture, National Agricultural Statistics Services	The Census of Agriculture accounts for all U.S. farms and ranches and the people who operate them. The Census, taken only once every five years, looks at land use and ownership, operator characteristics, production practices, income and expenditures. Data available for aquaculture include a State Report that provides statewide figures for the number of farms and value by crop category (e.g., "mollusk"); County Profiles that provide market value, state rank and U.S. rank for aquaculture products as a whole.; County Reports that provide number of farms and value by crop category (e.g., "mollusk") and county; and rankings of market value of all agricultural products in aggregate (i.e., not by specific crop).	Data cannot be isolated to specific species.	http://www.agcensus.usda.gov/ http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Washington/
2005 Census of Aquaculture (2006)	US Department of Agriculture, National Agricultural Statistics Services	The 2005 Census of Aquaculture expanded the aquaculture data collected from the 2002 Census of Agriculture and provides a current and comprehensive picture of the aquaculture sector at the state and national level. The aquaculture census collected detailed information relating to production methods, surface water acres and sources, production, sales, point of first sale outlets, aquaculture distributed for restoration, conservation, or recreational purposes, and farm labor.	Currently available data are dated, but Aquaculture Census associated with the 2012 Agriculture Census should be available by the time economic analysis is underway (due out in October 2014). All data reported at a state-wide level. Cannot be isolated to county.	http://www.agcensus.usda.gov/Publications/2002/Aquaculture/

DATA SOURCE TITLE (DATE)	OWNER	DESCRIPTION	CAVEATS AND LIMITATIONS	AVAILABLE FROM
Economic Impact of Shellfish Aquaculture in Washington, Oregon and California (2013)	Northern Economics for the Pacific Shellfish Institute	The objective of this analysis was to assess the economic impact of shellfish aquaculture production in the states of Washington, Oregon, and California. The intent was to identify the production function of the industry through detailed interviews with key informants and a general survey of producers.	Analysis was state-wide and thus includes the value of the shellfish industry outside of our study area. Data as presented do not allow for isolation of the value to Pacific and Grays Harbor counties. Does not include sales trends, demand factors, or consider impacts of shellfish consumption.	http://www.pacshell.org/pdf/Economic_Impact_of_Shellfish_Aquaculture_2013.pdf
Washington State Shellfish Production and Restoration – Environmental and Economic Benefits and Costs and associated technical memoranda (unknown)	Pacific Shellfish Institute	A primary objective of this project was to identify and quantify the environmental costs and benefits of commercial shellfish harvest strategies and shellfish restoration in Washington, and quantify these costs and benefits in economic terms where possible. There are numerous technical memoranda that were generated as part of this project, many of which may be relevant to the forthcoming economic analysis. See p. 13 of the report for a list of memoranda, all of which can be downloaded from the Pacific Shellfish Institute website.		http://pacshell.org/pdf/NMAIeconfinalreport.pdf http://www.pacshell.org/publications.asp

DATA SOURCE TITLE (DATE)	OWNER	DESCRIPTION	CAVEATS AND LIMITATIONS	AVAILABLE FROM
Assessment of Benefits and Costs Associated with Shellfish Production and Restoration in Puget Sound (2010)	Northern Economics for the Pacific Shellfish Institute	Technical memorandum associated with the report "Washington State Shellfish Production and Restoration – Environmental and Economic Benefits and Costs" This report describes the suite of economic, social, and environmental benefits and costs associated with shellfish production and restoration in Puget Sound using information derived from a literature review, stakeholder focus groups, and quantitative and qualitative analysis.	Report is focused outside of our study area (i.e., in Puget Sound).	http://www.pacshell.org/pdf/AssessmentBenefitsCosts.pdf
Willapa Grays Harbor Oysters Growers Association (WGHOGA) Survey (2002)	Powell, Seiler & Co. P.S. for the Willapa Grays Harbor Growers Association	Results of survey conducted on behalf of the WGHOGA. Data for Pacific and Grays Harbor Counties in 2002 includes: - Total Employees - Total Annual Payroll - Total Annual Sales	Only includes a subset of members of WGHOGA, and thus is not representative of the entire industry in the study area. Percentage of total industry represented by the survey is unknown.	Brian Sheldon Secretary/Treasurer WGHOGA
Willapa Grays Harbor Oysters Growers Association (WGHOGA) Survey (2010)	Powell, Seiler & Co. P.S. for the Willapa Grays Harbor Growers Association	Results of survey conducted on behalf of the WGHOGA. Reports totals (2007 and 2008) from the responses of 22 of 34 WGHOGA members on: - Number of Employees - Gross Payroll Dollars - Sales farmed vs. sales total - Bushels, Gallons, and Dozens of Oysters - Pounds of Manila Clams	Only includes members of WGHOGA, and thus is not representative of the entire industry in the study area. Percentage of total industry represented by the survey is unknown. Data are not separated by county.	Brian Sheldon WGHOGA Secretary/Treasurer

DATA SOURCE TITLE (DATE)	OWNER	DESCRIPTION	CAVEATS AND LIMITATIONS	AVAILABLE FROM
Information collected for Nationwide Permit 48	U.S. Army Corps of Engineers (ACOE)	ACOE maintains a national database of permit actions that includes NWP 48. Data consist of the district, action type, applicant, water body, latitude and longitude, and acreage. Industry experts identified these data as being of potentially great value to this report (Pers. Comm. D. Cooper 2014).	Data can only be requested through the Freedom of Information act process.	Pamela Sanguinetti Seattle District ACOE
Notes: Interviewees identified a number of other data sources that might be of potential use for this report and the upcoming economic analysis, including Environmental Impact Statements developed for consideration of herbicide and pesticide permitting, as well as the Pacific Coast Shellfish Growers Association. We did not identify data of particular relevance or utility through these sources.				

DATA GAPS AND KEY ECONOMIC QUESTIONS

DATA GAPS

This report relies upon existing information to develop a characterization of the non-tribal aquaculture industry in Washington's Pacific coastal estuaries. Through this process, we identified a number of gaps in the existing information that limited our ability to develop a complete characterization. These gaps may present a similar challenge for the state's forthcoming economic analysis. The most important data issues are described briefly below.

- **Participation information:** The number of businesses actively engaged in shellfish aquaculture is critical to accurately characterizing this industry. Various entities collect information that should allow for identification of the number of businesses licensed to operate in the study region, as well as those that are actively participating in the industry. Farm registration data reported to DFW by the industry, which would allow for identification of all registered businesses, are incomplete. DOH licensing data, however, appear to be an accurate source of information on the number of licensed businesses in the region. More critical is information on the number of businesses that are actively farming and harvesting. DFW harvest information reported by industry to DFW is the primary source for these data (in the form of farms that reported harvest in each year by species), but it is generally believed by both industry and the agency to be incomplete and inaccurate. DFW currently lacks the resources to enforce accurate reporting of these data.
- **Employment:** Data on employment in the aquaculture sector has been collected by various entities; however, these data provide only a snapshot in time of a subset of businesses. We did not identify any comprehensive source of employment data that is collected regularly and rigorously, and captures the entire universe of businesses in the industry.
- **Harvest Volume:** Based on our research, DFW appears to be the only state entity regularly collecting information on harvest volume by species for shellfish farms in Washington. Due to a variety of factors, including misreporting and a lack of funding to enforce reporting requirements, both industry and DFW acknowledge that these data are incomplete and inaccurate, and underrepresent the true productivity of the industry. Because harvest volume information is critical to DOH in fulfilling its obligations, the agency is working with DFW through a committee focused on improving data collection. Until the recommendations of this committee are implemented, this will continue to be a critical data gap.
- **Harvest (Farm Gate) Value:** For the same reasons described above related to harvest volume, available data on the farm gate value of shellfish harvested in the study area are believed to be inaccurate and under-representative of the true harvest value. We were not able to identify a comprehensive alternate source for this information.

- **Harvest (Total) Value:** The total value of shellfish harvested in the region is not regularly collected by any entity that we were able to identify. Although the industry itself has attempted to track this information, the data generally represent snapshots in time and only reflect a subset of active farms.
- **Processing:** Industry experts provided conflicting information as to the proportion of oysters being sold as an in-shell product, versus those that are shucked. As these products fetch different prices, and are sold into different markets, this information would be valuable for any economic analysis of the industry.
- **Multipliers for Economic Impact Analysis:** Development of accurate input-output multipliers for an industry allows one to translate expenditures and employment in that industry into a total regional economic impact. Numerous attempts have been made to identify representative multipliers for this industry, including efforts by Northern Economics (2013) and others (which were summarized in Northern Economics (2013)). Although Northern Economics (2013) provides the most detailed and specific set of multipliers developed to date, that study focused solely on the economic impacts of the production of cultured shellfish, and did not include sales trends and demand factors. Further, it did not include the economic impacts of shellfish consumption, which may be significant.

KEY ECONOMIC QUESTIONS

Due to substantial shortcomings in the data that are currently collected, some of the key economic questions requiring attention are as basic as developing an accurate profile of production and harvest value for the aquaculture industry. In addition to filling the key data gaps described above, other key economic questions worthy of consideration include the following:

- **Economic contribution of aquaculture to regional economy:** To what extent is the regional (e.g., county, coastal) economy dependent upon the aquaculture industry? How does the economic contribution of this industry compare to that of other industries?
- **Added value:** What is the fate/distribution pathway for shellfish harvested in this region, and what price is being paid for various products along each step of the supply chain?
- **Failure of natural set:** How has the failure of the natural set affected businesses financially? How have they changed their operations to adapt to the new regime?
- **Permitting costs:** How much are businesses spending annually in labor costs and fees associated with the permitting process?
- **Ecological costs and services:** What are the ecological costs and benefits associated with shellfish aquaculture in the region?

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Personal communication with Laura Hoberecht, PhD, National Oceanic and Atmospheric Administration, April 28, 2014.

Personal communication with Mark Ballo, Brady's Oysters, August 28, 2014.

Personal communication with Pamela Sanguinetti, U.S. Army Corps of Engineers, July 15, 2014.

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APPENDIX A

SUMMARY OF EXPERT INTERVIEWS AND ADDITIONAL COMMUNICATIONS

EXHIBIT A-1. SUMMARY OF EXPERT INTERVIEWS

CONTACT NAME (AFFILIATION)	DATE OF INTERVIEW	CONTACT INFORMATION	MODE OF CONTACT
Cedar Bouta (WA Dept. of Ecology)	April 17, 2014	Washington Department of Ecology SEA Program PO Box 47600 Olympia, WA 98504-7600 Phone: 360-407-6406 Fax: 360-407-6902 Email: CEBO461@ECY.WA.GOV	In person
Laura Hoberecht, PhD (NOAA)	April 28, 2014	NWR Aquaculture Coordinator NOAA National Marine Fisheries Service 7600 Sand Point Way Building 1 (F/NWR2) Seattle, WA 98115 Phone: 206-526-4453 Fax: 206-526-6736 Email: laura.hoberecht@noaa.gov	By phone
Rick Porso, RS, REHS (WA Dept. of Health)	April 30, 2014	Manager, Licensing and Certification Healthy Communities and Environment Environmental Public Health Division Washington State Department of Health PO Box 47824 Olympia, WA 98504-7824 Phone: 360-236-3302 Fax: 360-236-2257 E-mail: Rick.Porso@doh.wa.gov	In person
Brad Pruitt (WA Dept. of Natural Resources)	May 1, 2014	Aquaculture Program Manager Aquatic Resources Division Washington State Department of Natural Resources Phone: 360-902-1083 Fax: 360-902-1786 E-mail: Brad.pruitt@dnr.wa.gov	In person
Brian Sheldon (Northern Oyster Company, WCMAC)	May 7, 2014	Owner Northern Oyster Company Nahcotta, WA 98637 Phone: 360-665-2804 E-mail: oysters@willapabay.org	By phone
Diane Cooper (Taylor Shellfish Farms)	May 19, 2014	Director of Regulatory Affairs Taylor Shellfish Farms 130 SE Lynch Road Shelton, WA 98584 Phone: 360-432-3340 E-mail: dianec@taylorshellfish.com	In person
Dave Nisbet (Nisbet Oyster Company, Inc.)	August 26, 2014	Founder Nisbet Oyster Company, Inc. 7081 Niawaukum Street Highway 101 Bay Center, WA 98527 Phone: 360-875-6629 Email: dave@goosepoint.com	By phone

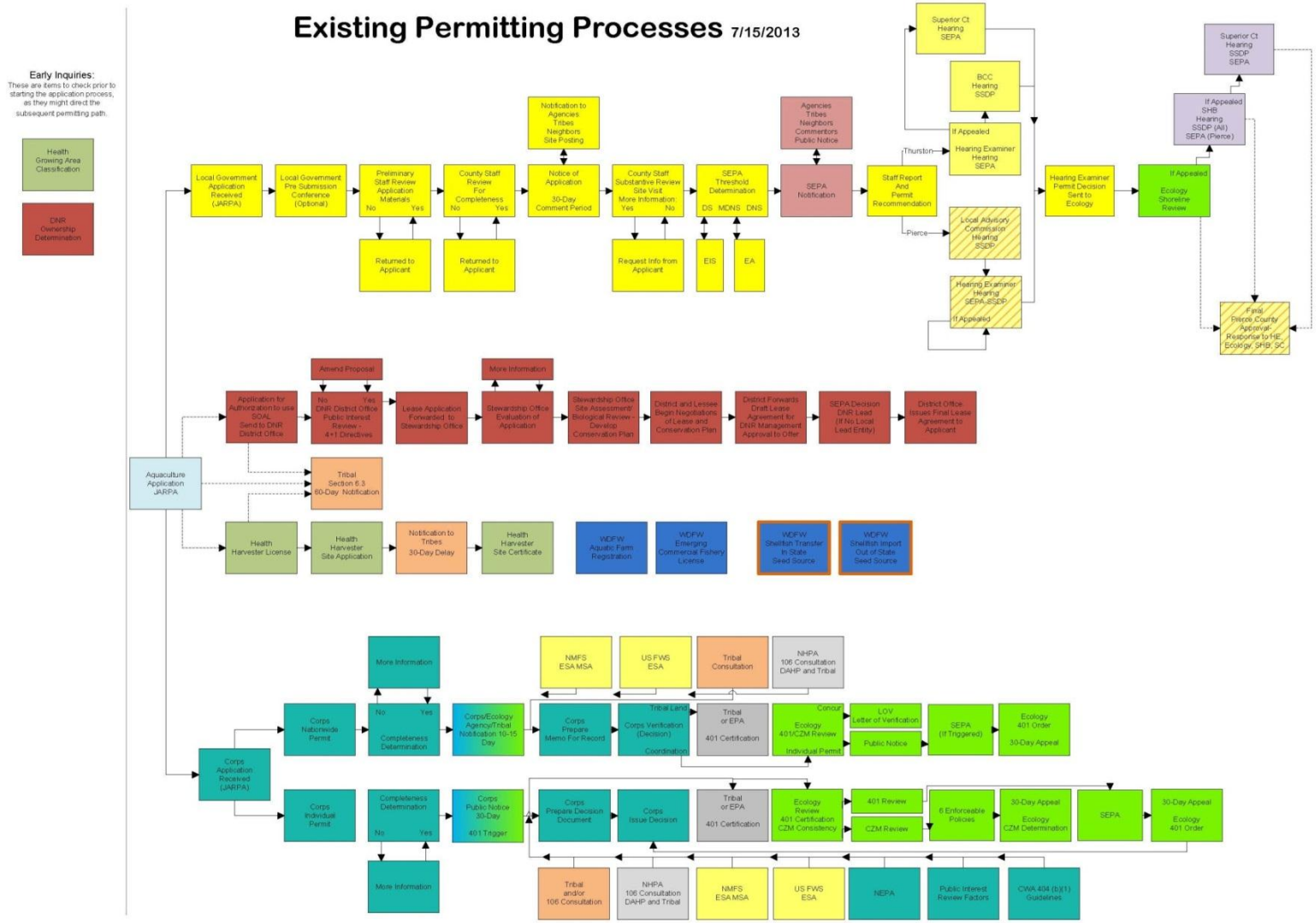
CONTACT NAME (AFFILIATION)	DATE OF INTERVIEW	CONTACT INFORMATION	MODE OF CONTACT
Kathleen Nisbet-Moncy (Nisbet Oyster Company, Inc.)	August 26, 2014	Chief Operations Officer Nisbet Oyster Company, Inc. 7081 Niawaukum Street Highway 101 Bay Center, WA 98527 Phone: 360-875-6629 Email: Kathleen@goosepoint.com	By phone
Tim Morris (Coast Seafoods Company)	August 26, 2014	Farming Manager for Pacific Shellfish Coast Seafoods Company 1200 Robert Bush Drive West South Bend, WA 98586 Phone: 360-875-5557 Email: TMorris@coastseafoods.com	By phone
Mark Ballo (Brady's Oysters)	August 28, 2014	Operations Manager, Co-owner Brady's Oysters 3714 Oyster Place Westport, WA 98595 Email: Southbayballo@gmail.com	By phone
Ken Wiegardt (Wiegardt and Sons Inc.)	September 2, 2014	Manager Wiegardt and Sons Inc./Weigardt Brothers Ocean Park, WA 98640 Phone: 360-665-4111 Email: oysterman73@hotmail.com	By phone

EXHIBIT A-2. ADDITIONAL SOURCES CONSULTED

CONTACT NAME (AFFILIATION)	DATE OF COMMUNICATION	NATURE OF COMMUNICATION
Margaret Barrette (Pacific Shellfish Growers Association)	May 15, 2014	Confirmed that PSGA does not collect data on participation, harvest, or value of aquaculture farms, but provided suggestions of other data sources.
Wendy Vance (US Department of Agriculture)	May 20, 2014	Requested a summary of and clarifications on information contained in the most recent Census of Agriculture and Census of Aquaculture. Confirmed timing of release of next Census of Aquaculture.
(WA State Dept. of Agriculture)	May 20, 2014	Requested information on any data they collect relative to aquaculture production and value. Was told that the agency does not collect any data of this nature.
Majorie Morningstar (WA State Dept. of Fish and Wildlife)	Various dates, May-June, 2014	Requested and received data on aquaculture farm registrations and production.
Katie Krueger (Quileute Nation)	July 12, 2014	Provided comments on draft Aquaculture Sector Analysis Report.
Pamela Sanguinette (US Army Corps of Engineers)	July 15, 2014	Received comments clarifying the role of ACOE in aquaculture regulation, and information on data that are available from the agency through a Freedom of Information Act request.
Brady Engvall (Brady's Oysters)	July 15, 2014	Provided comments on draft Aquaculture Sector Analysis Report.
Dan Ayers (WA State Dept. of Fish and Wildlife)	July 15, 2014	Provided comments on draft Aquaculture Sector Analysis Report.
Bruce Kauffman (WA State Dept. of Fish and Wildlife)	July 15, 2014	Provided comments on draft Aquaculture Sector Analysis Report.

APPENDIX B

SCHEMATIC OF EXISTING PERMITTING PROCESS



Source: Shellfish Interagency Permitting Team 2013.