Oregon Marine Aquaculture: Barriers, Opportunities and Policy Recommendations

Photo: Alex Manderson, ODA

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Executive Summary

Oregon's small marine aquaculture sector is characterized by a handful of small-scale shellfish and seaweed operations in estuarine and inland coastal areas. Oregon has vast natural resources and a largely undeveloped coastline, which may provide ample opportunities for expansion of sustainable marine aquaculture. Increasing the cultivation of various seafood products has the potential to boost economic growth and food security in rural coastal areas and decrease pressure on wild-caught fisheries and imports as the demand for seafood grows. Oregon Sea Grant is situated to provide outreach, engagement and research to support coastal communities, including aquaculture operations. To provide relevant resources, current information regarding the needs and barriers to sustainable aquaculture expansion is needed. The purpose of this report is to bring awareness to the status of the Oregon marine aquaculture industry, identify barriers to expansion from perspectives of multiple sectors, and highlight opportunities to support sustainable expansion with informed regulations that reduce environmental impacts. This report is split into two parts.

Part 1 provides results of a 2021 needs assessment conducted via an online survey that targeted current and prospective marine aquaculture operators, agencies, researchers and others involved in the aquaculture industry. Part 1 provides the reader with the current status of the industry, barriers to entry and expansion, perspectives on Oregon aquaculture from multiple sectors, and recommendations based on survey results. Our results indicated that there is ample interest in expansion of currently grown species, such as Pacific oysters, and novel species for Oregon, such as kelp. The top perceived barriers to expansion among all surveyed sectors were permitting/regulations, lack of available space to lease, lack of external support/resources, climate/ecological constraints and technological constraints. The primary research needs selected by current researchers were effects of stressors on aquaculture, effects of aquaculture on the environment, and seaweed aquaculture. Current and prospective growers expressed a need for outreach materials on potential products, technologies and assistance with the permitting process.

Part 2 provides an overview of the regulatory framework for marine aquaculture in Oregon, various efforts that have been made in other states to streamline the permitting process for aquaculture operations and expand them to other habitats or systems, and recommendations for policies and tools that may be applicable to Oregon. This section was composed in response to results of the needs assessment and other reports that identified navigating permitting processes as a prominent barrier to aquaculture expansion. Part 2 includes a summary of policies and regulatory tools, and opportunities for policy change in Oregon that would streamline the permitting process. In this section, we propose the following six recommendations: 1) expand current processes for shellfish aquaculture permitting to all aquaculture species and systems; 2) provide detailed instructions for the permitting and leasing process; 3) review the current regulatory structure for redundancies; 4) explore new policies to enhance aquaculture products, environments and technologies; 5) provide funding for aquaculture outreach and research; and 6) develop a statewide aquaculture plan.

Introduction

Aquaculture refers to the "breeding, rearing, and harvesting of fish, shellfish, algae, and organisms in all types of water environments" (NOAA, 2021). For the purpose of this report, marine aquaculture will refer to operations taking place in marine and estuarine environments, and in land-based tanks with salt or brackish water. Currently, about half of global seafood comes from aquaculture (NOAA Fisheries, 2021a). As demand for seafood increases, aquaculture will be key to meeting this need. Wild fisheries continue to supply valuable seafood around the world, but their landings have plateaued (FAO, 2020), making aquaculture a viable option to increase seafood production and reduce the potential for overfishing. In the United States (U.S.), the majority of consumed seafood – both wild caught and from aquaculture – is imported. Compared to other countries, U.S. marine aquaculture is underdeveloped, even though the country has a large coastal region. There are ample opportunities to increase domestic aquaculture production, which has the potential to provide economic resources and local food sources, particularly for rural coastal communities. This may also reduce the environmental impacts of global seafood production because aquaculture and fisheries in the U.S. are subject to strict regulations to protect human health and prevent environmental harm whereas regulations may not be as stringent in other countries (Davies et al., 2019).

The U.S. government has taken several actions to enhance domestic aquaculture development. In May 2020, the president signed executive order 13921, which is titled Promoting American Seafood Competitiveness and Economic Growth. It aims to increase domestic seafood production and includes a focus on offshore aquaculture. The order designated the National Oceanic and Atmospheric Administration (NOAA) as the governing agency for offshore aquaculture. The order requires NOAA to identify 10 offshore Aquaculture Opportunity Areas and reduce barriers to aquaculture permitting. In January 2021, the U.S. Army Corps of Engineers (USACE) updated the nationwide permit for shellfish mariculture and created two nationwide permits to streamline siting and permitting for finfish and seaweed aquaculture in federal waters. These actions have begun to improve the landscape for aquaculture investment, but there are still many barriers.

U.S. aquaculture includes various species, methods and environments and ranges from small- to large-scale publicly and privately owned operations. Species produced in the U.S. include salmon, tilapia, sturgeon, catfish, oysters, mussels, clams, abalone, seaweed and ornamental fish. The major food fish species grown in the U.S. is catfish, with a sales value of $379 million in 2019 (USDA, 2020).

Oregon aquaculture includes salmonid hatcheries, freshwater finfish farms, estuarine shellfish farms and land-based seaweed culture. Marine aquaculture in Oregon constitutes a significant portion of aquaculture operations. Pacific oysters and dulse seaweed are the major crops; pilot projects for purple sea urchin ranching are in the works. Oregon is home to approximately two dozen marine aquaculture operations, with 19 oyster and four dulse farms, and a prominent shellfish seed producer, Whiskey Creek Shellfish Hatchery, at the time of publication. Oysters are grown in Tillamook Bay, Netarts Bay, Yaquina Bay, Umpqua River and Triangle, and Coos Bay using on- and off-bottom techniques. Dulse is grown on land in tank systems in Bandon, Port Orford and Garibaldi. Oregon's production value lags behind other West Coast states. The total sales value of aquaculture for Oregon in the U.S. Department of Agriculture's (USDA) 2018 census of aquaculture was $23 million compared to $207 million for Washington and $106 million for California (USDA, 2019). It is important to note that because these numbers are self-reported by farms, they are likely underestimated. There has been slow growth of aquaculture operations and

economic gain in the last 20 years, but despite some obstacles, Oregon has the resources and space to increase aquaculture and bring economic resources to the state.

The purpose of this report is to bring awareness to the status of the Oregon marine aquaculture industry, identify barriers to expansion from perspectives of multiple sectors, and highlight opportunities to support sustainable expansion with informed regulations that reduce environmental impacts. Part I presents the results of a needs assessment conducted by Oregon Sea Grant that focused on barriers to aquaculture expansion from the perspectives of multiple sectors. Part II outlines policy recommendations that may address regulatory and permitting barriers and encourage sustainable and well-regulated aquaculture.

Part 1: Needs Assessment

Background and Goals

Studies have identified barriers to aquaculture expansion in Oregon, but they are limited by low sample size, broad recommendations and outdated information. Sea Grant's National Seaweed Hub, a science-based non-advocacy group that provides resources for the U.S. seaweed aquaculture industry, conducted a needs assessment from January 2019 to February 2020. This assessment included respondents from Oregon, but only six people responded and several questions were skipped. The survey focused only on seaweed, which constitutes very few aquaculture operators in Oregon. A group of aquaculture stakeholders, including the Oregon Aquaculture Association, several state agencies, industry members and academics, compiled several recommendations for aquaculture expansion in a report produced by the Oregon Department of Agriculture (ODA) about investing in sustainable aquaculture in Oregon (ODA, 2015). These recommendations were broad and applicable to all aquaculture operations, including freshwater and inland. They may be out of date because they were published more than five years ago. The Pacific Shellfish Institute, which researches sustainable shellfish aquaculture, surveyed shellfish growers in Oregon about topics for regional West Coast reports, such as economic impacts (Hudson, 2016; Northern Economics, Inc., 2013). These surveys, however, occurred almost 10 years ago and had low representation from Oregon. Although these surveys and the report provide knowledge about Oregon aquaculture, there is a lack of updated information from multiple perspectives that can inform outreach and engagement efforts.

Several factors have created challenges for expansion of shellfish and seaweed aquaculture in Oregon. The ODA has described barriers that apply to statewide investment in freshwater, marine and inland aquaculture (ODA, 2015). Many of these are particularly relevant to coastal shellfish and seaweed aquaculture. For example, public perceptions of aquaculture are generally negative due to a lack of knowledge and perceived environmental risks, such as spread of disease, introduction of invasive species, habitat alteration and reduced water quality. Although these impacts have occurred, technological advances, regulations and sustainable practices can eliminate many of the risks if implemented properly (Naylor et al., 2021). Nonetheless, outdated and incorrect information continues to fuel negative public attitudes, particularly around finfish aquaculture. Additionally, unfortunate past events in the state have led to environmental and political consequences. For example, a failed privately owned salmon ranching operation in Newport and Coos Bay released hatchery-raised Coho and Chinook salmon into the wild in the 1990s (Kaplan, 2020). However, negative perceptions of aquaculture may be less prominent regarding oyster farming in Oregon. A study conducted by PSI in 2016 showed that Oregon coastal residents found

shellfish aquaculture to be more favorable than finfish, and they were generally supportive of shellfish farming (Hudson, 2016). Additionally, oyster aquaculture has a relatively low environmental impact and may instead provide positive ecosystem services, such as water filtration and provision of habitat to otherwise unstructured mudflat areas (Dumbauld et al., 2009). Pacific oysters are unlikely to reproduce on their own due to the low water temperature in Oregon estuaries (Pauley et al., 1988). There is also potential to raise native oysters for commercial and restoration purposes.

Another barrier noted in the ODA report, as well as other literature (e.g., Kim et al., 2019; Knapp and Rubino, 2016; van Senten et al., 2020), is navigating the permitting process. Oregon lacks a lead agency for aquaculture permitting for many types of operations. For Pacific oysters, the ODA is the main permitting agency. The ODA provides shellfish grower licenses and plat leases for state-owned tidelands and assists with coordinating permits from other agencies. For all other products, the permitting process is not well-defined and depends on land ownership, water rights, water quality and species- and habitat-specific regulations (ODA, 2015). Oregon has no regulatory framework for offshore aquaculture in the territorial sea, which extends out 12 nautical miles (NM) and includes state waters 0-3 NM from the coast, or in the U.S. exclusive economic zone, which stretches 200 NM off the coast. Both areas are targeted for large-scale kelp and finfish farming as well as some types of bivalves. Oregon also has legislation that prohibits seaweed harvest (and therefore aquaculture) in state waters (OAR 141-125-0110) (NOAA Fisheries, 2021b).

Additional potential barriers that have been outlined in the reports mentioned above and other literature include technological constraints, limited leasing space, permitting and other costs, as well as climate and environmental limitations (e.g., ocean acidification, diseases/pathogens, invasive species) (Mabardy et al., 2015; ODA, 2015; Robidoux and Chadsey, 2020; van Senten et al., 2020, 2020; King et al., 2021). With multiple potential barriers and a lack of current information from the industry, agencies and researchers regarding aquaculture potential in Oregon, there was a need to assess challenges from multiple perspectives.

Oregon Sea Grant's (OSG) 2021 needs assessment fills this gap. The main questions were:

1. Is there an interest among current and prospective growers in increasing marine aquaculture production in Oregon?
2. What are the major barriers to expanding marine aquaculture operations in Oregon?
3. What resources are needed for expansion?

Methods

The authors of this paper asked individuals involved in marine aquaculture in Oregon to complete an online survey between May and July 2021. They included current aquaculture operation owners/growers, prospective growers, agency staff and researchers. Participants were identified through online searches of shellfish and seaweed aquaculture businesses, agencies and university researchers and through personal communication with staff at state agencies and faculty at Oregon State University (OSU). Additional shellfish growers and plat lease holders were identified via public records provided by the ODA. The survey, which was created in Qualtrics, was emailed to these individuals It was also shared on OSG's Instagram, Facebook and Twitter accounts to reach previously unidentified groups.

Within the survey, there were five different questionnaires: one for each sector and an "other" category for respondents who did not fit into the predetermined sectors. The grower survey consisted of 20 questions and focused on the following: business information, regulations/permitting, interest in

expansion, barriers, and preferences for outreach topics and avenues. The prospective grower survey had 19 questions with topics similar to those in the grower survey but framed for individuals who do not yet have an established business. The agency survey consisted of 11 questions focused on familiarity with and recommendations for permitting/regulations and barriers to aquaculture development. The researcher survey consisted of seven questions focused on current research, aquaculture research needs, barriers to aquaculture development, and familiarity with permitting/regulations. The other survey had nine questions about respondents' relevant work in aquaculture, barriers to aquaculture development, and familiarity with permitting/regulations. The questionnaires were approved by OSU's human research protection program and institutional review board. All respondents gave written consent to participate.

Responses were summarized into counts and percentages for each sector. All percentages were calculated out of the total number of responses, rather than the number of respondents, so that the total percent for each question would not exceed 100 for "select all that apply" questions. These included questions about species grown, growing methods, barriers, research needs and outreach preferences. For questions that were limited to one response, the response/respondent percentage calculations are equivalent.

Results

Sample

The survey was distributed to 62 individuals, although we may have received a small number of responses from social media or forwarding of the survey that would not be accounted for in this number. A total of 38 respondents filled out the survey, resulting in a 61% response rate. This sample is representative of the small marine aquaculture industry in Oregon (Figure 1). Responses came from current (n=9) and prospective (n=5) aquaculture operation owners/growers, agencies (n=13), researchers (n=9) and other (n=2) individuals involved in aquaculture outreach and coastal businesses. Two additional respondents who filled out the "other" survey were employees at agencies. These responses were re-categorized as agency responses, which is reflected in these counts. Answers from overlapping questions among the two surveys were included in the agency survey results.

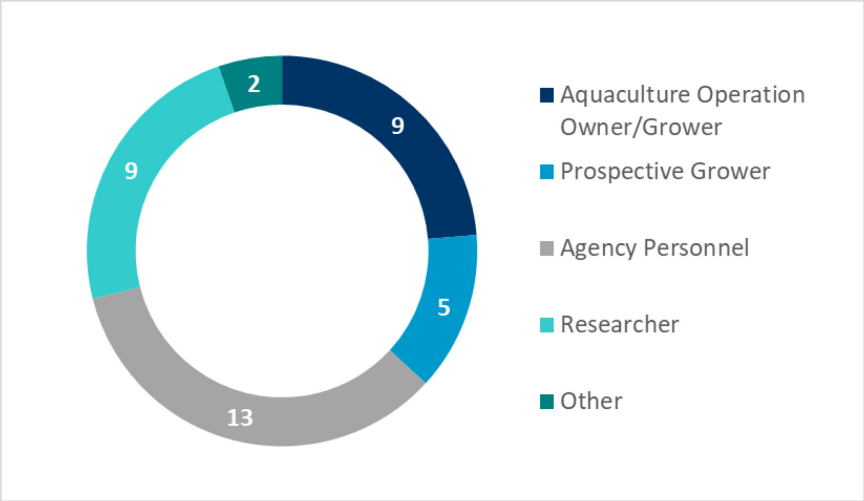


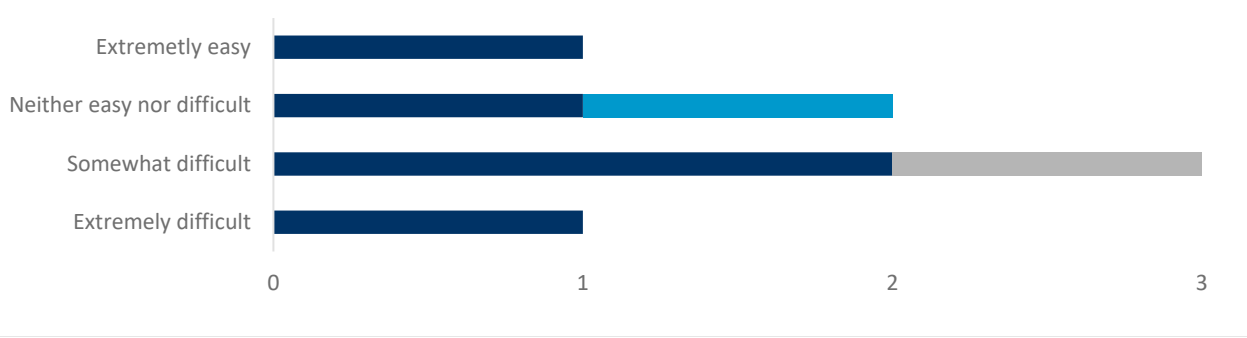
Figure 1. Number of respondents to the Oregon aquaculture needs assessment online survey separated by sector.

Current and Prospective Growers

The current aquaculture growers who responded to the survey produce Pacific oysters (58%; n=7), Kumamoto oysters (17%; n=2), Olympia oysters (8%; n=1), shrimp (8%; n=1), and dulse seaweed (8%; n=1). Several growing techniques were reported, such as rack and bag, longlines and recirculating tanks. The most common method was bottom culture (31%; n=5). Current growers reported that their businesses had been operational for one to over 100 years, and it took one to four years for setup. Current growers were definitely (78%) or probably (11%) interested in expanding their business by producing more of the same products, and 55% expressed interest in adding new products, such as oysters (33%; n=6), seaweed (17%; n=3), clams (17%; n=3), abalone (11%; n=2), mussels (6%; n=1), prawns (6%; n=1) and sea urchins (6%; n=1). In addition, 67% wanted to incorporate new technologies.

Prospective growers expressed interest in growing Pacific oysters (30%; n=3), kelp (30%; n=3), dulse seaweed (20%; n=2), mussels (10%; n=1) and sea urchins (10%; n=1) in the nearshore (60%; n=3) or offshore (40%; n=2) environment. Similar to current growers, bottom culture was the most commonly selected growing method (44%; n=4). Two prospective growers had started setting up their business, while three had not.

When asked about experiences with the initial permitting and leasing process, current and prospective growers had varying opinions. Current growers reported that the process was extremely easy (14%; n=1), neither easy nor difficult (29%; n=2), and somewhat (43%; n=3) or extremely (14%; n=1) difficult (Figure 2A). In contrast, no prospective growers said the process was easy, with 40% (n=2) reporting neither easy nor difficult and 60% reporting either somewhat (40%; n=2) or extremely (20%; n=1) difficult (Figure 2B). Prospective growers who reported extreme difficulties with the process were not planning to grow oysters, which makes sense given the lack of clear regulations and procedures for non-oyster aquaculture in contrast to the better-documented process for oyster permitting and leasing. In their comments, growers expressed several challenges with obtaining permits and leases, particularly sparse information about timelines, lack of coordination among agencies and limited space and other resources (Table 1).



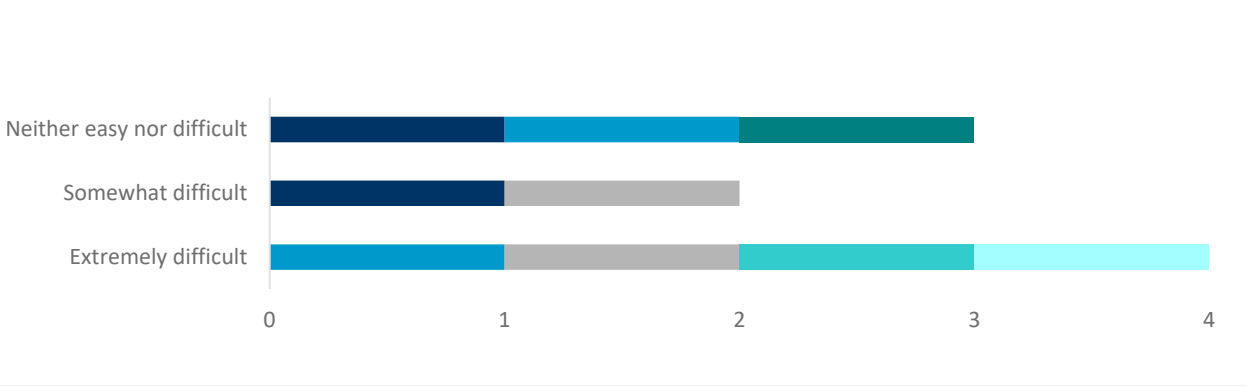


Table 1. Quotes from current and prospective growers regarding challenges with the permitting and leasing process, and barriers to the initiation and expansion of aquaculture operations.

Current growers	*"Conditions on plats change in many ways frequently (mother nature), yet the permitting regulations do not change per plat, which we have to re-apply or appeal in order to edit. Oysters take 3 years on average to mature. I think each plat should be able to edit the regulations with each generation grown."* *"...Oregon needs an advocate for shellfish farming, we need someone who can work to open new leasing areas to prospective or existing small farmers and help farmers navigate the Army Corps permitting process. This is an untapped resource."*
Prospective growers	*"[The permitting and leasing process] is not difficult, but is taking a long time with no updates."* *"...I fully expected that the process and permitting would take time, but I have felt like information and next steps have come after each step, rather than having visibility upfront into the process and timeline..."* *"I would state the permitting challenges in two parts. One, it has evolved. Meaning, that I am unaware that there is a permit that I will need to apply for, or a step that needs to be completed as part of the process until I am*

	told. There is an opportunity here to have that information defined upfront in detail, along with timelines for the permitting process. There have been flow diagrams provided by ODA, but not timelines. If this upfront documentation was available, one could plan accordingly and look to align their efforts and information with visibility into when completion of the permitting process would occur. Two, some folks in the permitting process have been consistently unresponsive, thus creating an environment of uncertainty of next steps and outcomes. This ultimately is a business that I am trying to start, and the ambiguity creates anxiety around whether or not I am going to be able to realize my goal." *"Currently there does not seem to be anyone in charge of this kind of permitting and all the potential agencies are just throwing all their paperwork at it."* *"I feel like the lack of centralized permitting is a huge barrier. Attempting to search around through all the different state agencies and organizations is daunting."* *"Finding that there is not an easy well-worn path to starting a kelp growing operation in Oregon."*

The top three perceived barriers to aquaculture expansion identified by current growers were permitting/regulations (25%; n=6), workforce constraints (17%; n=4), and number of employees (17%; n=4) (Figure 6). For prospective growers, the top reported barriers were permitting/regulations (27%; n=3), technological constraints (18%; n=2), and lack of external support/resources (18%; n=2) (Figure 6). They also provided additional needs in the comments, including internship placements, seaweed hatchery training, an Oregon seaweed farm coordinator and use of title companies to record lease information. Both groups identified permitting/regulations, potential technologies, potential products and product development as preferred topics for outreach materials.

Agencies

Agency personnel who responded to the survey were from the ODA, Oregon Department of Fish and Wildlife (ODFW), Oregon Department of State Lands (ODSL), Oregon Department of Land Conservation and Development (DLCD), Oregon Department of Environmental Quality (ODEQ) and Business Oregon. This sector had the highest number of survey responses (n=13) and included most of the major regulatory agencies responsible for aquaculture permitting at the state level. We did not receive any responses from federal agencies (i.e., NOAA, USACE), although they were included in the survey distribution.

When asked about familiarity with aquaculture permitting and regulations, most respondents were familiar with the process. Agency personnel reported being extremely familiar (23%; n=3), very familiar (31%; n=4), moderately familiar (38%; n=5) and not familiar at all (8%; n=1). Several of the respondents were not directly responsible for issuing or reviewing permits but have other duties related to aquaculture such as providing natural resource information, managing lands and waterways, researching shellfish habitat, and being involved in estuary planning.

We asked agency staff which state or federal agencies they thought should take a lead role in permitting for three types of aquaculture: offshore, nearshore and inland. The top choices were ODFW for nearshore (23%; n=10) and offshore (24%; n=9) and ODA for inland (26%; n=10) (Figure 3). These patterns were further explored by looking at which agencies chose these leadership preferences. For nearshore and offshore, ODFW was chosen by at least one employee at each agency, and similarly for inland aquaculture, ODA was chosen by all agencies. This indicates some consensus among state agencies that ODFW should manage both nearshore and offshore, and the ODA should manage inland aquaculture. These responses do not reflect the current regulatory structure for aquaculture permitting in Oregon at the state level. Currently, the ODA takes a lead role in permitting nearshore oyster aquaculture. For other nearshore shellfish and inland operations, several agencies are involved, but ODFW provides the major permits, and ODSL and local municipalities manage leases. Oregon lacks a structured permitting process for offshore operations.

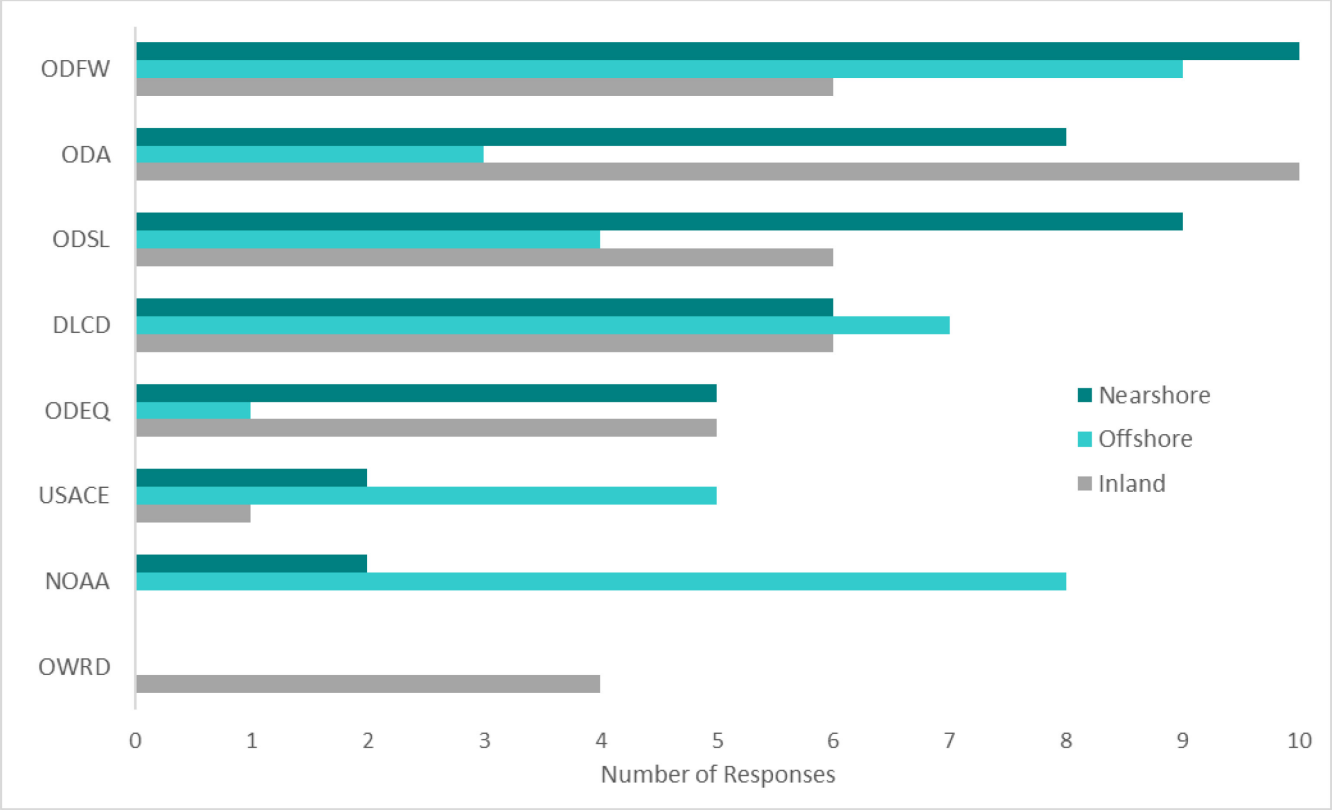


Figure 3. Number of the responses from agency staff (n=11) for which agency should take a lead role in coordinating the permitting process for nearshore, offshore and inland aquaculture in Oregon.

Agency personnel chose climate/ecological constraints (16%; n=6), lack of available leasing space (16%; n=6), and permitting/regulations (13%, n=5) as the top perceived barriers to aquaculture expansion in Oregon. This was the only sector where permitting/regulations was not chosen as the top barrier. Also, about a third of agency respondents chose lack of interest in expansion as a barrier (11%; n=4). Additional barriers and challenges with the permitting process experienced by agency staff are outlined in Table 2.

Table 2. Quotes from agency staff regarding challenges with the permitting process and barriers to aquaculture expansion.

"Though we have few administrative rules, we are relied upon to provide habitat and ecological data and analysis on proposed facilities."
"A barrier for me is a lack of knowledge about the existing process, such as: who covers what? how are permits acquired and managed? does monitoring occur to ensure the permitted activities aren't causing unanticipated impacts? what are the requirements for aquaculture activities? how is production reported?"
"There is a significant difference between aquaculture operations that are on land versus in natural bodies of water. In addition to other permits, a US Army Corps of Engineers permit is required for estuary-based aquaculture activities."
"[The agency I work for] wants to support the growth of aquaculture in Oregon but wants to see how this will create living wage jobs in rural areas and an income sources for our rural communities. We are not a regulatory agency but we are limited by what we can support because of regulations. We also see limitations in start-up costs, workforce training, and general knowledge and understanding of what aquaculture is by elected officials and the public."

Researchers

Although this survey reached only a small sample of researchers (n=9), it captured a wide range of research topics, with only two not being selected (economics and human nutrition). Respondents conducted research in all areas of the Oregon coast, with two also working in multiple states on the U.S. West Coast. Most researchers who responded focus on shellfish (23%; n=7) and seaweed (13%; n=4) aquaculture, effects of stressors on aquaculture (13%; n=4), and invasive species (10%, n=3) (Figure 4). The top research needs in Oregon and the Pacific Northwest identified by researchers were effects of stressors on aquaculture (18%; n=7), effects of aquaculture on the environment (13%; n=5), and seaweed aquaculture (10%; n=4) (Figure 5).

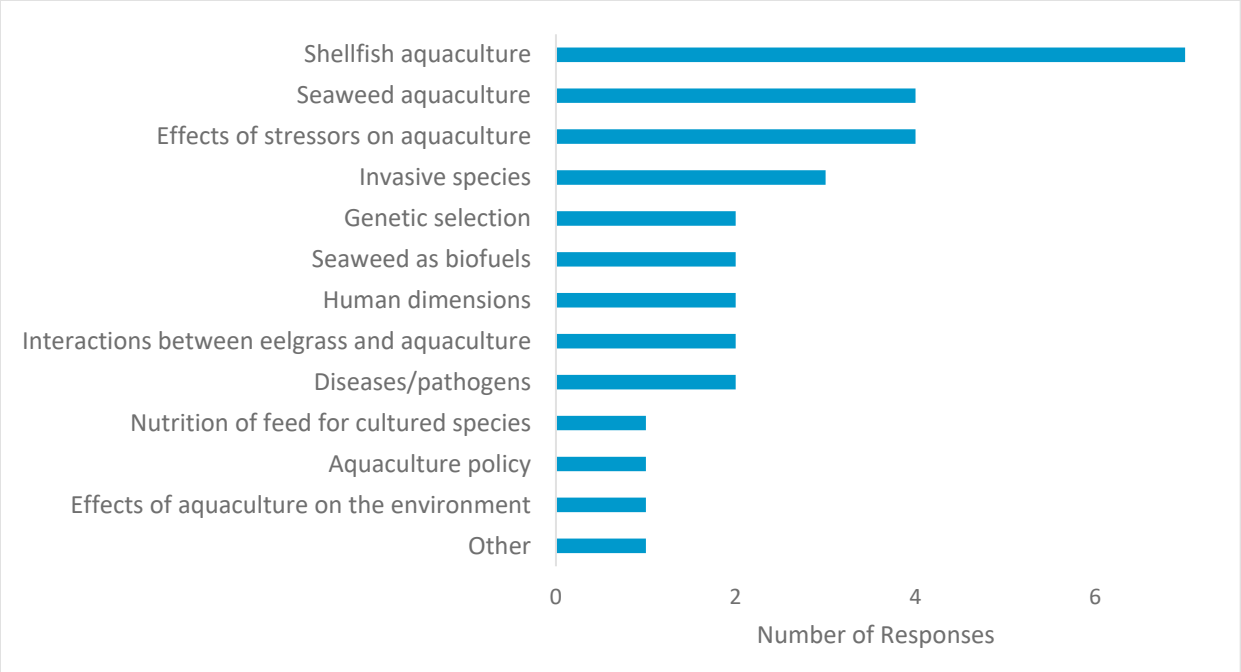


Figure 4. Current research topics reported by researchers (n=9).

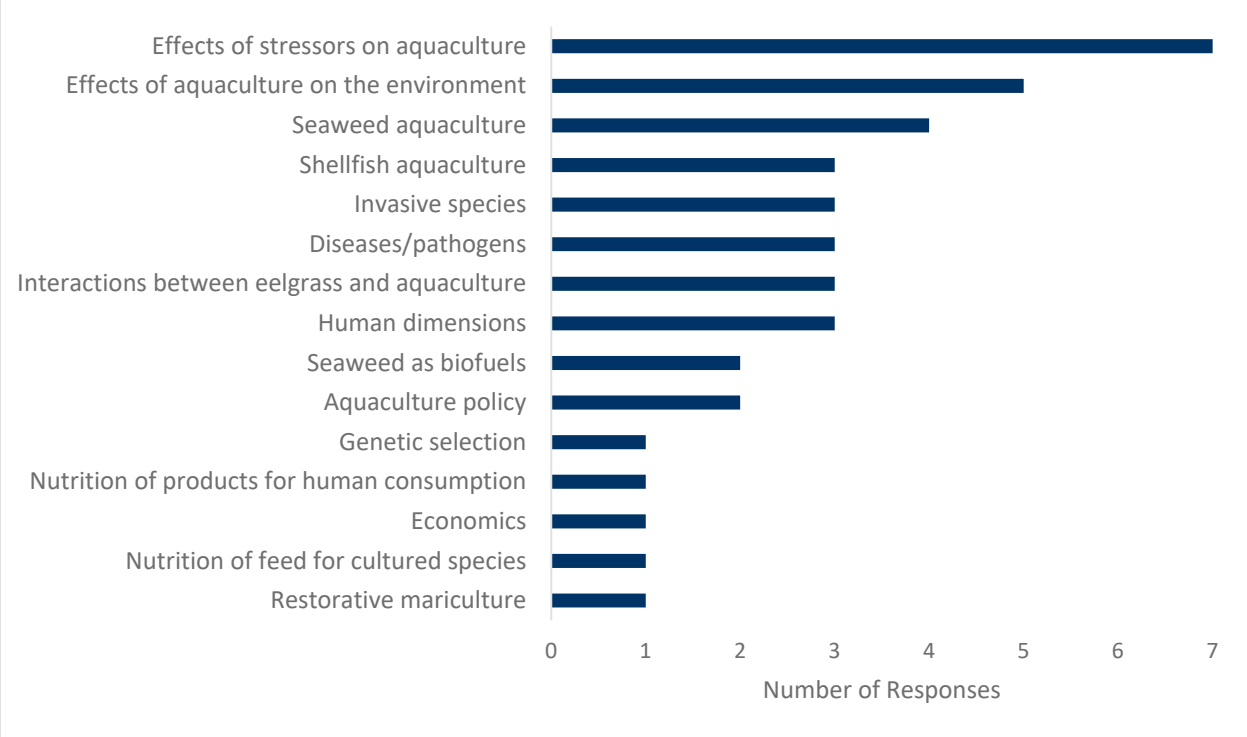


Figure 5. Top aquaculture research needs in Oregon and the Pacific Northwest reported by researchers (n=9).

In general, researchers did not have a thorough understanding of aquaculture regulations. They reported being moderately familiar (44%; n=4), slightly familiar (33%; n=3) and not familiar at all (22%; n=2). The major percieved barriers to aquaculture development selected by this group were

permitting/reguations (18%; n=6), lack of external support/resources (15%; n=5), lack of market for products (12%; n=4) and climate/ecological constraints (12%; n=4). Although researchers listed permitting and regulations as the primary barrier, aquaculture policy was only selected as a research need by two respondents. Additional barriers and needs provided in comment boxes are in Table 3.

Table 3. Quotes from current researchers regarding barriers and needs for aquaculture expansion.

"Community perception of aquaculture and negative stance of the fishing industry towards aquaculture, especially fish aquaculture. The fishing industry has a loud voice and strong political influence."
"Green crabs will be a major impediment to aquaculture in the near future."
"There is a need for enhanced support and resources to encourage and promote partnerships between researchers and producers. There is an opportunity to encourage restorative mariculture of seaweeds and shellfish. This approach will require new approaches to permitting and redirection of resources. There is an opportunity to "rebrand" aquaculture, particularly ocean aquaculture, aka mariculture."

All Groups

When perceived barriers chosen by all groups are combined, the top barriers were permitting/regulations, lack of available space to lease, lack of external support/resources, climate/ecological constraints and technological constraints (Figure 6). Identified barriers varied among sectors, and there were different opinions among industry and those involved in research and the regulatory environment. Current growers, prospective growers and researchers listed permitting/regulations as the top barrier to expansion, but almost all agency respondents marked climate/ecological constraints as the top barrier. Similarly, researchers chose lack of market for products as one of the top three barriers, while no growers and prospective growers marked this as a barrier at all. This lack of consensus may indicate both the presence of several significant barriers and a lack of knowledge about what is driving the limited aquaculture expansion in Oregon.

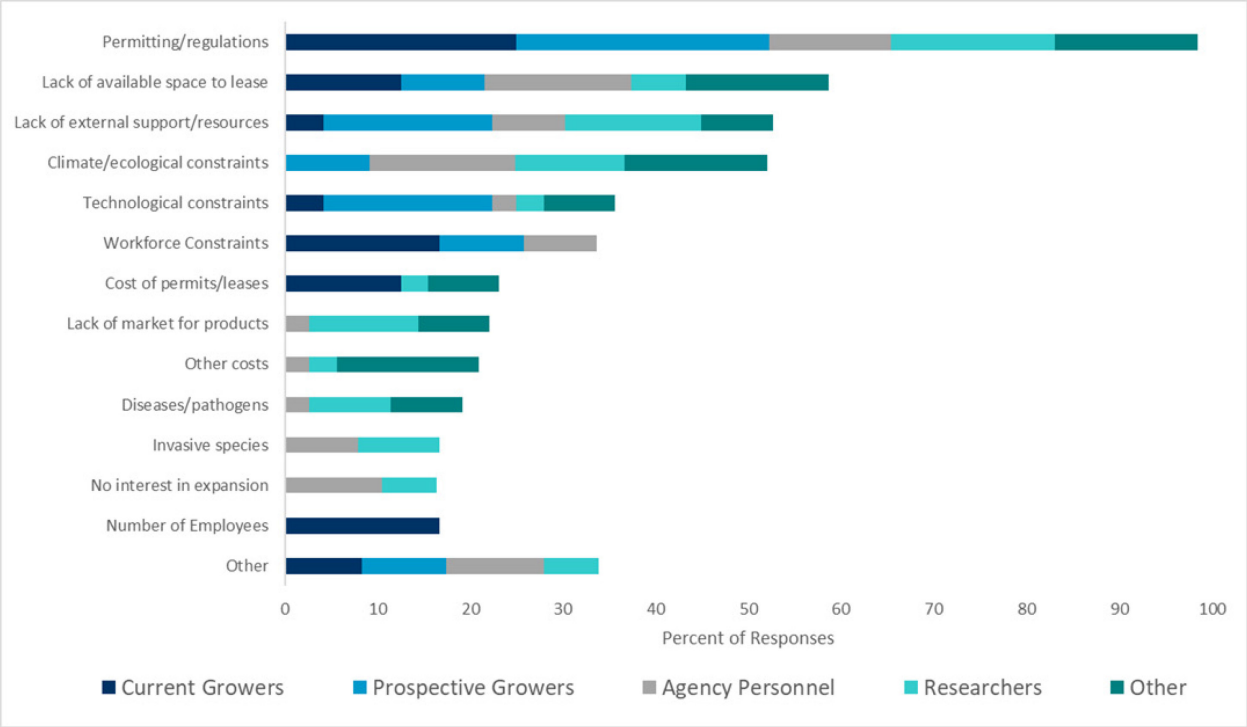


Figure 6. Percentage of responses for perceived aquaculture barriers separated by sector: current growers (n=9), prospective growers (n=5), agency personnel (n=13), researchers (n=9) and other (n=2) Percentages are out of the number of responses within each sector. Other barriers listed: dairy pollution, plat specific regulations about growing/harvesting/planting (current growers); hatchery training, seaweed seed production (prospective growers); available land and water, coastal public perception, ocean acidification (agency personnel); time-consuming process for permits/leases, lack of partnerships between researchers and producers of emerging products (researchers).

Addressing many of these barriers will require collaboration among researchers and the aquaculture industry. Our survey indicated that prospective growers are slightly more willing to collaborate on pilot projects than current growers. Most prospective growers said they would definitely be interested (80%; n=4), with one individual reporting they might or might not be interested (20%; n=1). Current growers had more variable answers, reporting they would definitely (33%; n=3), probably (22%; n=2), might or might not (11%; n=1), probably not (11%; n=1), and definitely not (22%; n=2) be interested.

Recommendations

The results of this needs assessment point to several next steps and recommendations for reducing barriers to expansion of marine aquaculture. The majority of current growers indicated a desire for expanding their current business. Several prospective growers showed interest in setting up aquaculture operations with new species that have not been explored in Oregon. These opportunities could bring jobs and economic growth to rural coastal areas, but current and prospective growers will face several challenges along the way. If the state of Oregon wants to support this economic growth, the following are some specific recommendations to meet the needs of growers and others in the aquaculture realm.

Recommendation 1: Address permitting and regulatory hurdles

Regulations and permitting were clearly identified as prominent barriers to marine aquaculture expansion, particularly by current and prospective growers. However, current growers had varying experiences with the initial permitting process, with about half reporting that it was easy or neither easy nor difficult. This aligns with feedback from agency regulators that the permitting process is less complex than other neighboring states, such as California and Washington, and is in its infancy. However, quotes from the industry indicated that the major issue is a lack of specific information about the permitting process. Therefore, in the short term, it is recommended that detailed written guidance be developed and made available online to prospective growers. Ideally, this documentation would include a full list of required permits/documents, timelines and contact information for each step of the process.

In the long term, particularly if interest in shellfish aquaculture expansion grows, assessing the feasilibility of opening additional shellfish plat leasing areas may be beneficial. Lack of available space for leasing was the second most reported barrier by all groups; this restriction likely results from the small number of estuaries in which the ODA has approved shellfish leases. However, a specialist from the ODA expressed that there is available leasing space for individuals who want to go through the permitting process. Therefore this challenge could be addressed by first assessing the current usage of space and providing clear documentation of available leases, and then also monitoring additional areas within approved estuaries and new areas in other estuaries that have yet to be assessed for shellfish aquaculture potential.

Lastly, reviewing, updating and inplementing new regulations and policies could support sustainable development of both marine and freshwater aquaculture in Oregon. This may include developing a statewide aquaculture plan, assigning a lead agency to coordinate aquaculture permitting, reviewing current processes for redundancy, and developing a regulatory framework that allows for new species and production areas (e.g., offshore, inland), including a state process for aquaculture in federal waters. Many states have implemented policy and educational tools to support aquacutlure development, and more details about these tools and how they may be implemented in Oregon are provided in section two of this paper.

Recommendation 2: Support research to address climate/ecological-related challenges and technological advancements

Climate and ecological constraints, along with technical issues, were major barriers identified by most groups in the survey. Climate and ecological challenges were the top barriers identified by agencies. Further research could help clarify which constraints are most important and ways to address them. In general, Oregon's marine and estuarine environments are dynamic and have already seen impacts from ocean acidification, such as reduced oyster spat survival. At the Whiskey Creek Shellfish Hatchery, spat die-offs were addressed with research and development of technology to detect and buffer acidified estuarine water before it reaches the hatchery tanks (Barton et al., 2015). This example illustrates the potential for using resources that are already in place to address current and future challenges of farming marine organisms in these ever-changing environments. There is a lot of ongoing research to address these types of challenges, and continued funding and resources are necessary.

One challenge brought up by a researcher was a need to support ongoing partnerships among researchers and current/new growers. Efforts to build trust and support among these groups are essential to address these critical research endeavors. These efforts will likely require increased personnel at aquaculture-adjacent organizations and funding to promote research and industry partnerships. A dedicated

aquaculture Extension specialist focused on coastal aquaculture in Oregon could help facilitate collaboration and seek funding for research to benefit the aquaculture industry. Additional personnel and funding from Business Oregon could also enhance collaborative research projects, such as the Oregon Aquaculture Explorer, an online geospatial siting and financial planning aquaculture tool that Business Oregon partially funded. Marine aquaculture could also be included as a focus area for the Oregon Ocean Science Trust, a group established by the Oregon Legislature to promote collaboration and research on ocean and coastal resources and eventually to provide grants when funds are available. Oregon House Bill 3114 (2021) provided $1.75 million for research related to ocean acidification and hypoxia, much of which can be used to inform aquaculture efforts for industry, management and researchers. Larger grant funding agencies, such as NOAA, frequently provide opportunities for collaboration between academia, Extension and industry. For example, NOAA provided $2.4 million to examine the effects of ocean acidification and multiple stressors on shellfish aquaculture in the U.S.

Recommendation 3: Support the aquaculture workforce

Current growers reported that workforce constraints and number of employees were major barriers to expanding their operations. There has been a general decline in young people entering the seafood workforce and this has been identified as a barrier among wild fisheries as well. Finding ways to support and increase the fisheries, seafood processing and aquaculture workforce is needed to sustain current operations and support future aquaculture development. One recommendation to accomplish this is implementing training, professional development and curriculum on careers in fisheries in aquaculture. The National Sea Grant Office initiated the young fishermen's development grant program in response to the Young Fishermen's Development Act, which became law in January 2021. This program funds outreach and technical assistance to young fishermen. A joint planning grant between Oregon and Washington Sea Grant includes scoping training initiatives for new aquaculture growers and employees. This is a good start to support workforce development but will require further funding and resources for implementation.

Recommendation 4: Increase aquaculture literacy and availability of information

One researcher mentioned in the survey that the fishing industry strongly opposes marine aquaculture and is very influential in the state. While this was not a prominent barrier identified by other groups in this survey, we know from other studies that opposition to and a lack of understanding of aquaculture is common among the public (Langdon, 2009). Additionally, there was a clear indication in the survey that lack of information about aquaculture is a barrier to development. This points to an opportunity to engage specific groups as well as provide outreach to the public to increase aquaculture literacy. Evidence shows that commercial fisheries and marine aquaculture can coexist successfully and will likely need to in the future as demand for seafood continues to rise (Froehlich et al., 2021; Gephart et al., 2021). Specific engagement with the fishing industry focused on how these industries can exist concurrently may be necessary in the near future. Outreach with the public to increase overall awareness and highlight the environmental, social and economic benefits of aquaculture could help address general opposition in the Pacific Northwest. NOAA created a community of practice for aquaculture literacy and provided funding specifically for aquaculture literacy. These efforts at the federal level could be leaned on to address more specific needs at the state level.

Current Initiatives and Next Steps

At the state level, multiple organizations and agencies have been working to support and streamline aquaculture investment. In the past 10 years, the Oregon Aquaculture Association (OAA) has taken initiative to strengthen their membership and support systems, convene working groups to address policy issues, and obtain funding for outreach initiatives. State agencies have instituted pre-application meetings with prospective shellfish growers to coordinate the permitting process for new operations. A partnership among OSU faculty, OSG, the Institute for Natural Resources and OAA obtained funding to expand the Oregon Aquaculture Explorer to include marine species. Within the past few years, OSG has been increasing outreach, engagement and involvement in local and regional grant-funded projects related to marine aquaculture. In addition to these actions, the Oregon Legislature mandated the DLCD to make shellfish plat leasing information publicly available in 2020. This led to the development of the shellfish mariculture tool that is hosted on the Oregon Aquaculture Explorer platform.

In response to this survey, OSG is planning next steps to address barriers and needs for aquaculture development. It is in the early stages of compiling resources for permitting guidance. OSG is also creating educational materials for the public about aquaculture in Oregon to increase literacy on the subject. It continues to collaborate on projects with the aforementioned groups and pursue grant opportunities to address aquaculture needs in the state.

Part 2: Marine Aquaculture Policy Recommendations

Purpose

Part 2 of this report was written to address permitting and regulations, which were identified as prominent barriers to marine aquaculture expansion in the needs assessment. In this section, we review the current regulatory framework for aquaculture in Oregon, summarize regulatory improvements from other states, and provide opportunities to implement relevant tools and policies in Oregon to encourage well-regulated sustainable aquaculture.

Background

At the federal level, marine aquaculture in the U.S. is regulated under the Clean Water Act and the Rivers and Harbors Act. Section 402 of the Clean Water Act refers to the national pollutant discharge elimination system permit program. Section 404 refers to the dredge and fill permit program, both of which regulate discharges into U.S. waters. Section 10 of the Rivers and Harbors Act governs the use of structures in navigable waters. It is common for aquaculture operations to discharge effluent to and place equipment in nearshore waters, and therefore they require special permits for these activities. Permitting is coordinated among several federal agencies, including the Environmental Protection Agency EPA, USACE and NOAA, though some of the permits may be issued by state agencies on behalf of these programs. In 2022, NOAA published the Guide to Permitting Marine Aquaculture in the United States, which outlines the federal permitting process. For shellfish aquaculture, USACE has implemented nationwide permit 48 to streamline permitting for operations with minimal environmental impacts. The permit allows shellfish aquaculture operators to install equipment and dredge/fill materials for native or previously grown nonnative species. At the state level, marine aquaculture regulations and permitting vary and often involve multiple state and local agencies. Many states fall under the Coastal Zone Management Act, which allows states to review permits for aquaculture and other activities that take place in federal waters to ensure consistency with laws that protect state waters. This gives states the ability to amend or deny permits in federal waters.

In the past two decades, federal support for increasing domestic marine aquaculture production has been demonstrated through executive orders, inclusion in the U.S. Department of Commerce's 2018-22 strategic plan, funding for aquaculture research, establishment of the NOAA Office of Aquaculture, and development of USACE nationwide permits for offshore seaweed (NWP 55) and finfish aquaculture (NWP 56). While the federal government has been working to support sustainable development of aquaculture and streamline regulatory processes, most marine aquaculture takes place in state waters, so federal policy changes may have minor effects on current aquaculture operations. Each state has different laws and regulations pertaining to aquaculture, resulting in at least 22 different regulatory frameworks for operations in state marine and estuarine waters (O'Connell, 2018). Efforts to enhance aquaculture development by addressing challenges in the regulatory environment have been implemented by some states. They include updated permitting processes, regulatory guidance, statewide aquaculture plans, designated aquaculture staff at agencies/Extension, research support and formal education programs.

Research indicates that the U.S. has substantial potential for sustainable marine aquaculture development. According to a study that evaluated governance and biophysical suitability in 144 countries, the U.S. was

found to be an ideal country for investment in offshore aquaculture due to effective regulations to reduce environmental harm, suitable biophysical conditions, and low offshore production (Davies et al., 2019). This study also found that most marine aquaculture takes place in countries that are the least suitable, in terms of appropriate regulations and biophysical characteristics that result in more productive outputs and reduce environmental impacts (Davies et al., 2019). Therefore, focusing on increasing aquaculture in countries with higher potential for success may increase production while minimizing environmental harm. Gentry et al. (2017) found that marine aquaculture could supply the same amount of seafood (i.e., bivalves and finfish) as wild fisheries by using 0.015% of productive ocean area for aquaculture, demonstrating that a minute portion of the ocean could be devoted to aquaculture to produce significant amounts of protein.

Regulatory hurdles may halt the promising potential for expansion and economic resources, particularly in countries with strict regulations. Prior research shows that countries with more stringent environmental regulations for aquaculture development, such as the U.S., have lower aquaculture growth rates (Abate et al., 2016). Additionally, regulatory limitations have significant costs for aquaculture farms, beyond the actual cost of permits and licenses. For example, a study of the Pacific coast shellfish industry found that the total annual regulatory burden for California, Oregon and Washington shellfish farms was around $15.6 million, which was mainly associated with costs outside of individual permits, such as manpower and equipment to comply with regulations, and legal expenses (van Senten et al., 2020). An additional $110 million and $170 million were estimated annually for lost sales and business opportunities, respectively, as a result of regulations (van Senten et al., 2020). For context, the approximate total sales value for mollusks in California, Oregon and Washington was $176 million in the USDA's 2013 census of aquaculture[1] (USDA, 2019). Although most of the regulatory costs reported were lower per farm in Oregon compared to Washington and California, they were still significant and present a major barrier to entry and expansion for shellfish growers (van Senten et al., 2020). Regulatory costs for Pacific coast shellfish farms were in alignment with a prior study on U.S. salmonid farms that demonstrated notable regulatory costs outside of obtaining permits (Engle et al., 2019), indicating that the regulatory burden is limiting aquaculture production. Therefore, streamlining permitting processes to remove redundancy and improve efficiency could reduce costs and environmental impacts and pave the way for sustainable seafood production.

The needs assessment outlined in Part 1 showed that regulations and permitting were top barriers to marine aquaculture expansion. Feedback from respondents indicated that the main issues were lack of information about steps and timelines and poor responsiveness and coordination among agencies. Therefore, improving the permitting process and lessening the cost and time burden on new and existing producers should include tools to improve access to information and encourage cooperation among agencies. The following sections of the report will provide 1) an overview of aquaculture regulations and permitting in Oregon; 2) a list of improvement efforts from other states that may help streamline the permitting process and support sustainable aquaculture development; and 3) recommendations for implementing relevant efforts in Oregon.

Aquaculture Regulations and Permitting Processes in Oregon

Oregon marine aquaculture takes place within state waters, mainly on estuarine mudflats, or on land in

[1] The total sales for Washington mollusks were not reported for 2018 so the 2013 USDA census values were used for all states.

tank systems. There are no offshore aquaculture operations. Shellfish aquaculture contributes to the majority of the economic value for the state, and the main defined regulatory framework focuses on this type of permitting. In Oregon, shellfish aquaculture refers primarily to the culture of Pacific oysters. Some leased areas where the lease was in effect before June 1, 1997, allow for a small percentage of the land to be used for mussels and clams. The permitting process for shellfish aquaculture is managed by the ODA. They lease state-owned tidelands, or plats, to shellfish growers, provide shellfish grower licenses, and coordinate the permitting process among state agencies. If an operation does not occur on state lands, leasing is done by the local municipality that owns the land (e.g., city, county, port, etc.). The ODA has established six approved growing areas that have been evaluated for water quality and pollution sources: Tillamook Bay, Netarts Bay, Yaquina Bay, Umpqua River and Triangle, Coos Bay and the South Slough (in Coos Bay). Shellfish leases are not issued for state-owned tidelands in other estuaries.

To initiate the permitting process, a new grower would contact the ODA's food safety program to schedule a pre-application meeting with the ODA, ODFW and Department of Land Conservation and Development (DLCD) (ORS 622.248). The purpose of the meeting is to identify a suitable leasing area that is more likely to result in a successful application. After the meeting, the grower is required to provide an application packet, map of plat lease, affidavit of public notice in a local paper for two weeks, and a $250 nonrefundable plat filing fee. The ODA has 90 days to review the application, provide it to other regulatory agencies (e.g., ODFW), summarize agency and public comments, and approve or deny the application. Upon approval, the grower must have a licensed surveyor survey the leasing area and provide an official map with plat boundaries. Then the ODA sends the map and application to the USACE to obtain a federal land use permit. This will also require a federal consistency review through the Oregon coastal management program at DLCD. If the USACE permit and federal consistency are granted, the ODA may approve the lease. After approval, the grower must obtain a shellfish grower license from the ODA and a permit to transport shellfish from ODFW. Additionally, the grower must obtain an ODA food safety license before selling products for human consumption. The ODA has provided the following resources on its website to assist with this process:

- Overview of shellfish plat leasing requirements and regulations
- Flow chart of the permitting process (pdf)
- Plat lease application instructions (pdf)
- Map of approved growing areas (pdf)

For products other than shellfish, the permitting process is less structured, has additional rules, and depends on land ownership, water rights and water quality. The process will likely involve multiple agencies and permits. There is not an assigned coordinating agency, nor are there comprehensive guidance materials. ODFW provides the major permits for fish propagation and transport, which are required for salmonid hatcheries and private aquaculture operations that produce finfish and other non-shellfish species. The Oregon Department of State Lands (ODSL) is in charge of leasing and permitting for state-owned lands and waterways. ODSL issues state-owned waterway authorizations for several types of activities in submerged and submersible land. For culture of species other than shellfish, a grower would apply for an authorization/lease from ODSL (ODSL, 2018). Again, if the area is not owned by the state, the municipality would issue the lease (e.g., city, county, port, etc.). Regardless of the land ownership, growers may also need to apply for a removal-fill permit from ODSL if the culture methods require removal or alteration of the bed or banks of the waterbody. Other agencies that are likely to be involved in the permitting process are the Oregon Department of Environmental Quality (ODEQ), Oregon Water Resources Department, DLCD, NOAA and USACE. The agencies involved will depend on the

species and type of growing system. For example, if the system will discharge wastewater, a permit from ODEQ will be required.

Improvement Efforts

Efforts to streamline and improve the permitting process for marine and freshwater aquaculture have been implemented across the United States at federal, state and local levels. These efforts have included legislative actions, changes to permitting processes, technological tools, outreach and education. Research has examined specific recommendations that support aquaculture development. Some groups that have worked to support aquaculture investment in Oregon have provided similar recommendations (ODA, 2015; Knapp and Rubino, 2016; Oregon Shellfish Task Force, 2016; O'Connell, 2018; Oregon Aquaculture Association, 2018; Lester et al., 2021). The Oregon shellfish task force, which was established by the Oregon Legislature through House Bill 2209 in 2015, determined goals and recommendations for conserving and expanding shellfish resources, which included some aquaculture-related recommendations. OAA, in collaboration with the ODA, has convened several stakeholders since 2004 to engage in outreach and education, and address needs and opportunities for advancing aquaculture in the state. The following publications are a result of these groups:

- Summary of recommendations for the Oregon shellfish initiative (pdf)
- Developing additional investment in aqua farming in Oregon: a roadmap for sustainable development (pdf)
- Guidelines and references for aquaculture in Oregon: considerations when strategically developing an innovative aqua farming program (pdf)
- Oregon aquaculture users guide (pdf)

Some recommendations have already been implemented in Oregon, mainly for the culture of oysters, and others are the focus of ongoing work. The following is a synthesis of state-level improvement efforts from the literature that may reduce barriers for sustainable aquaculture development, and ways that some of them have been implemented in Oregon, across five focal areas.

1. State Agency Staffing and Coordination

Recommendations from literature

- **Lead state agency:** Because most marine aquaculture in the U.S. takes place in state waters or land-based operations (Lester et al., 2021), state agencies play a large role in regulating existing and new operations. Assigning a lead agency and a "one-stop-shop" approach are prominent recommendations for streamlining permitting processes (ODA, 2015; Knapp and Rubino, 2016; Oregon Shellfish Task Force, 2016; O'Connell, 2018).
- **State aquaculture coordinator:** A state aquaculture coordinator within the lead agency (O'Connell, 2018; ODA, 2015), as well as staff that focus specifically on aquaculture at other state agencies, are key to the one-stop-shop approach. However, the need for staff will depend on the number of operations, among other considerations, and may be limited until significant aquaculture growth occurs.

- **Pre-application meetings:** More efficient permitting processes within state agencies are often facilitated through pre-application meetings with prospective operators that include the major permitting agencies and take place upon initiation of a new permit (ODA, 2015; Oregon Shellfish Task Force, 2016; O'Connell, 2018; Oregon Aquaculture Association, 2018).
- **Integrated local and state permitting:** For cases where leases are granted on county, city, port, or other non-state lands, integrating local government authority into state permitting so that the process remains consistent may help alleviate issues with lack of experience and expertise among local authorities responsible for infrequent aquaculture permitting (O'Connell, 2018; Oregon Aquaculture Association, 2018).

Implementation Status in Oregon

In 2017, the Oregon Legislature passed House Bill 2784, which designated the ODA as the lead agency for coordinating shellfish aquaculture permitting. However, Oregon lacks a lead agency to oversee and coordinate aquaculture permitting for other marine and freshwater species and systems. Both the OAA and the Oregon shellfish task force have shown support for assigning the ODA as the lead agency for all aquaculture. Oregon Rep. David Brock Smith, R-District 1, has introduced bills to the Oregon Legislature in several consecutive sessions to assign the ODA as the main coordinating agency for all aquaculture, but this bill has not gained traction. In 2019, pre-application meetings for new shellfish operators were mandated for new shellfish plat leases by the Oregon Legislature in response to recommendations from the Oregon shellfish task force (HB2574; ORS 622.248). These meetings are led by ODA and typically include personnel from ODFW and DLCD, although other state and federal agencies may also participate. These meetings are only required for new shellfish operators, but in at least one instance, have been convened for a non-oyster species (Personal Communication, ODA, 2021). State agencies in Oregon that are responsible for aquaculture permitting do not have dedicated aquaculture staff nor is there a state aquaculture coordinator.

2. Planning and Permitting

Recommendations from literature

Permitting for aquaculture can be streamlined to reduce redundancies, costs and time by implementing processes that reduce the number of permits, websites to access and individuals involved.

- **Joint agency permit application**: One step is creating a joint agency permitting application (O'Connell, 2018) that combines one or more agency permits. This reduces the number of permits and redundant information submitted to multiple agencies.
- **One-stop permitting website**: Permitting efficiency can be further enhanced by setting up a one-stop permitting website (O'Connell, 2018) that, at a minimum, contains links to all of the required permits, or ideally, combines all of the permit applications into an online permitting portal.
- **State/local general permits**: Permitting and planning can also be improved when states create and use state/local general permits (Oregon Shellfish Task Force, 2016), similar in practice to the federal general permits issued by USACE for operations expected to have minimal environmental impacts.
- **Statewide aquaculture plan:** Perhaps the most comprehensive method to address permitting and planning is to establish a statewide aquaculture plan (ODA, 2015; Oregon Aquaculture

Association, 2018; Lester et al., 2021) that supports and facilitates sustainable aquaculture investment.

Implementation Status in Oregon

Oregon has a piecemeal permitting structure that is split among multiple local, state and federal agencies. The state lacks a one-stop permitting approach and website and has limited information online regarding permitting. However, for shellfish permitting, the ODA has a website dedicated to shellfish farming leases that includes a leasing process flow chart (pdf) for state lands. ODFW provides information about private fish hatcheries and fish propagation licenses on its website, but other state agency websites have little to no information regarding aquaculture permits, particularly for species other than oysters and salmonids. The ODA produced an aquaculture users guide (pdf) in 2015 that includes information about permitting and starting an aquaculture business, but it is short and lacks specific information about varied types of aquaculture operations. Overall, the state lacks a comprehensive permitting guide and a statewide aquaculture plan that would apply to multiple species and production systems.

3. Management of Environmental Risks

Recommendations from literature

- **Best management practices**: One of the major hindrances to aquaculture development is the aim of preventing environmental impacts. Many forms of aquaculture have a minimal impact on the environment with certain technological advancements and adequate siting. Therefore, composing and instituting best management practices for different types of aquaculture could outline which types of aquaculture are appropriate for sustainable production with minimal environmental harm (Oregon Shellfish Task Force, 2016; Lester et al., 2021).
- **Predetermined sites and spatial planning**: Siting is an important aspect of reducing environmental impacts and can be more efficient when predetermined suitable sites, zoning, and spatial planning are implemented specifically for marine aquaculture operations (Knapp and Rubino, 2016; Lester et al., 2021).

Implementation Status in Oregon

To our knowledge, Oregon does not have best management practices for marine aquaculture, but they are available from other sources. There are predetermined approved sites for shellfish aquaculture plat leases, but until recently, information about the locations was not available online, and instead could be requested from the ODA. In late 2021, shellfish plat lease locations were made available through the shellfish mariculture tool.

4. Outreach and Education

Recommendations from the Literature

Outreach and education at local, state and regional scales can support aquaculture development, particularly when legislative change is not possible or delayed.

- **Aquaculture permitting guidance**: Permitting guides, provided by the state or other groups (e.g., Sea Grant), can assist new and existing operators in navigating complex permitting processes (O'Connell, 2018; Lester et al., 2021). However, the utility of these guides is dependent on the level of detail and up-to-date information.
- **Business planning tools**: Business planning tools and training are also important because aquaculture businesses can be high-risk investments and require ample upfront research to ensure there is potential for a profitable operation (O'Connell, 2018; ODA, 2015).
- **Formal education and training:** Formal and informal education for the public may be needed to increase aquaculture investment. Formal education and training at community colleges and universities can support the aquaculture workforce and potentially spur investment in new businesses (ODA, 2015; Knapp and Rubino, 2016; Oregon Aquaculture Association, 2018).
- **Public education:** Public education with fact-based information on aquaculture impacts and benefits is needed to address general opposition to aquaculture that has originated from outdated claims about the industry (O'Connell, 2018; ODA, 2015).
- **State aquaculture associations**: State aquaculture associations are important for providing outreach and educational materials, as well as providing support and connections for new and existing operators.
- **Aquaculture Extension**: Aquaculture Extension staff at land and Sea Grant institutions also play a key role in connecting current research to the industry (ODA, 2015; Knapp and Rubino, 2016; Oregon Aquaculture Association, 2018).

Implementation Status in Oregon

Several education and outreach efforts are in development but are in need of resources to support their longevity. OAA provides outreach to current and prospective growers, although they operate with limited resources. They recently redesigned their website and are involved in the development of the Oregon Aquaculture Explorer (Personal Communication, Oregon Explorer Planning Team, 2021). The platform, which was launched in January 2022, includes business planning and siting tools for three freshwater finfish and will be expanded to include marine systems in the next two to three years. OSG and OSU are also involved in this project and are expanding outreach and research through grants, funding an aquaculture-focused fellow, and planning to hire a marine aquaculture Extension faculty member. OSU has been involved in several recent aquaculture outreach and educational efforts. Faculty at OSU published a white paper to propose increased development in university aquaculture research and education programs, created the OSU aquaculture website, and facilitated a workshop on designing an OSU Seafood Systems and Innovation Center. OSU also offers two courses in aquaculture that will use the Oregon Aquaculture Explorer as part of the curriculum starting in the fall of 2022.

5. Research & Technology

Recommendations from the Literature

Research and technological advancements are key to the future of aquaculture in the United States and have already significantly improved the environmental, social and economic sustainability of the industry. In regards to state policies, research and technology can help facilitate the permitting process and provide information for sustainably increasing aquaculture investment.

- **Mapping/siting tools:** One of the key aspects of setting up an aquaculture business is selecting a site. Having statewide mapping/siting tools available online can greatly improve the siting process (O'Connell, 2018).
- **Expedited permitting for research:** Increased opportunities for research can also be supported through expedited permitting processes for small-experimental operations that will provide useful information for future operations and are unlikely to cause significant environmental harm (Knapp and Rubino, 2016; O'Connell, 2018).
- **Research priorities:** Current and informed science needs/research priorities can be developed to address uncertainty in the environmental risk assessment process (O'Connell, 2018).

Implementation Status in Oregon

OSU is researching shellfish, seaweed and finfish aquaculture, including production methods, alternative feeds and disease prevention. Much of this research is in collaboration with the aquaculture industry and aims to develop innovations to solve industry challenges. For example, the molluscan broodstock program at OSU researches genetic traits of Pacific oysters that enhance commercial production. The program produces seed with these desirable traits for commercial oyster operations. Additionally, the USDA Agricultural Research Service (USDA-ARS) in Newport, Oregon, supports research on improving survival, productivity and sustainability of Pacific shellfish aquaculture. The Oregon Shellfish Task Force developed research and policy recommendations for shellfish aquaculture, but priorities have yet to be developed for other marine aquaculture systems.

Regulatory Recommendations

If the major players in Oregon aquaculture development (i.e., Oregon Legislature, state and local agencies, universities, Sea Grant, aquaculture industry) are interested in streamlining the regulatory and permitting process for aquaculture operations, the following actions may be useful in guiding this process. These options were selected, and in some cases modified, from the literature and reports discussed above. They were chosen based on what would make sense given the status of aquaculture in Oregon. This is not a comprehensive list of actions. We recommend that people consult the reports linked above for more information.

Recommendation 1: Expand current processes for shellfish aquaculture to all types of aquaculture. Assign a lead agency, institute pre-application meetings and establish predetermined suitable sites.

In the past five years, Oregon has made efforts to streamline the process for shellfish aquaculture permitting through legislation that consolidated permitting coordination and public records access, but other types of marine and freshwater aquaculture have been left behind. In our needs assessment, responses suggested that oyster permitting was less difficult to navigate than the process for other species. Agency personnel have also indicated that state agencies work collaboratively within pre-application meetings to establish suitable sites and advise on new applications (Personal Communication, ODFW, 2021). Extending these processes to other marine and freshwater species and environments, and designating a lead coordinating agency, could benefit new applicants and state and federal agencies that administer the permits. One agency could either serve as the lead for all aquaculture, or different agencies could be assigned based on the type of aquaculture. The former would be easiest for the user but may not

be practical with the current staffing and permitting processes. There was some indication from the needs assessment that agency staff would prefer different agencies to lead permitting for different environments, with ODFW taking the lead in nearshore and offshore areas and the ODA leading inland operations. In Oregon, shellfish permits are issued mainly for oysters and only for approved growing areas in estuaries that have been assessed and monitored for water quality and suitable growing conditions. This information was recently made publicly available through the shellfish mariculture tool, which should significantly improve the siting process for new growers. This siting tool could be expanded later to include areas that have high potential for other marine species and have few conflicts with other marine and estuarine uses. Allocating funding to assess growing areas for multiple species is important for expanding and diversifying aquaculture.

Oregon receives few applications for marine aquaculture farms each year, approximately 3-4 for shellfish (Personal Communication, ODFW, 2021), so the need for staff who focus primarily on aquaculture is low. With so few applications, hiring a state coordinator for marine and freshwater aquaculture and staff to focus specifically on aquaculture may not be justifiable. However, if significant aquaculture expansion occurs, this may become an important option for state agencies. In Virginia, shellfish aquaculture permit applications increased from about 100 annual applications to 300 in a span of 10 years, which resulted in multiple pending applications due to a lack of staff to keep up with this increase (O'Connell, 2018). It would make sense to start planning for additional staff, including a state aquaculture coordinator, in the long term. In the meantime, keeping track of increases in applications, designating a lead coordinating agency, and including aquaculture permitting in staff training may suffice.

Recommendation 2: Provide detailed instructions for the permitting and leasing process that includes timelines and contacts from local, state and federal agencies.

For species other than shellfish, the aquaculture permitting process is not well-defined for shellfish, the instructions are missing some key pieces. Several prospective growers who have reached out to OSG and those who participated in the survey shared challenges with finding aquaculture permitting information online. Some specific issues that were identified in the needs assessment include timelines for each step, contact information and details about the permits from each agency.

Creating a permitting guide with clear instructions for the permitting process would be useful for new applicants, existing growers, and agency staff who infrequently interact with aquaculture permit applications. Other West Coast states have created different formats of permitting guidance. For example, the Washington shellfish interagency permitting team provided a list of all permits (pdf), a flow chart with each step of the process (pdf), and a supplemental narrative with details of each step (pdf). All of these are provided on the team's website. California's aquaculture permitting guide consists of a website with lists of required permits organized by agency, and links to additional resources. A more sophisticated option is to have an interactive permitting website that walks the user through the permitting process, similar to the one created in Massachusetts and the permitting portal launched by the Alaska aquaculture interagency working group.

Recommendation 3: Review and update current regulatory structure for clarity, unnecessary steps, and redundancy in the permitting process.

In the past five years, some of Oregon's shellfish aquaculture regulations and laws have been updated. At least three bills were passed, driven by recommendations from the Oregon shellfish initiative, that have helped to streamline the permitting process for shellfish aquaculture. House Bill 2784 (2017) directed ODA to lead shellfish permitting. House Bill 2574 (2019) required ODA to facilitate pre-application meetings for new growers, and mandated the creation of the shellfish mariculture tool by DLCD). These updates only covered a fraction of the recommendations from the initiative and have been limited to shellfish only. Additionally, the regulatory system in the United States allows for individual interpretation by permit writers and inspectors, often resulting in bias and inconsistencies (van Senten et al., 2020). In Oregon, this may be exacerbated by having few permit applications each year and a lack of defined instructions for the process. A full review and assessment of the relevant state laws and policies and their interpretation for practice could illuminate areas ripe for improvement, particularly for non-shellfish species.

Redundancies and inefficiencies in aquaculture permitting can result in significant costs and delays for new and existing owners of aquaculture operations (van Senten et al., 2020). Once the process is well-defined (recommendation 2), a good next step would be to assess each permit for areas of overlap. This could inform opportunities for joint permits among state agencies that would help decrease the amount of paperwork to be filed. This has been implemented in Alaska, which has combined permits from the departments of Fish and Game, Natural Resources, and Environmental Conservation into a joint application (pdf).

Recommendation 4: Explore new policies that allow for cultivation of additional species and environments, including offshore areas.

The needs assessment showed that prospective aquaculture operators are interested in novel systems, but there are questions about the biological and ecological feasibility of growing different species in Oregon's dynamic and often harsh environments. Additionally, a ban on seaweed cultivation in state waters limits the capacity of expansion (OAR 141-125-0110). These concerns could be addressed by implementing a reduced permitting burden for small, low-risk, experimental operations to help determine possibilities and uncertainties. These operations can also serve as educational facilities for the public and other groups that influence decision making (e.g., regulators, fishing industry). One such facility is currently undergoing the permitting process in Florida for an offshore net pen finfish operation to produce Almaco jack (*Seriola rivoliana*) in the Gulf of Mexico off the coast of Sarasota (Sims et al., 2019). The project is known as the Velella Epsilon Project and is led by Kampachi Farms LLC, which has set up smaller demonstration pens off the coast of Kona, Hawaii (Sims, 2017). The goals for this project include exploring the feasibility and potential impacts of offshore net pen finfish culture and serving as an educational facility to help promote sustainable aquaculture (Sims et al., 2019). The group has also shared information about the permitting process for offshore environments to pave the way for future operations.

There is some evidence of support for facilities of this nature in the Pacific Northwest. A report from a forum on offshore aquaculture held at Hatfield Marine Science Center in Newport, Oregon, in 2008 provided two overarching recommendations for the future evaluation of offshore aquaculture in the Pacific Northwest. One of these was to establish demonstration projects that evaluate the technical feasibility, benefits and potential impacts of offshore aquaculture systems (Langdon, 2009). In addition,

researchers in Washington, including from Washington Sea Grant, set up an experimental kelp farm to assess the potential for macroalgae to buffer impacts of ocean acidification (Washington Sea Grant, 2020). This project resulted in a successful sugar kelp operation and has prompted interest in sustainable production of seaweed and uses in food and other products (Washington Sea Grant, 2020). With increasing interest in aquaculture in Oregon, supporting these experimental operations through funding and policy could provide information about feasibility, impacts and benefits, with associated environmental risks occurring at a smaller scale.

Recommendation 5: Provide funding for aquaculture outreach and research.

Education and research are key to expanding aquaculture, especially with changes in climate and multiple stressors that operators must overcome to maintain a successful operation. Researchers at OSU are already working on many of these emerging issues, demonstrated by a recent publication on oysters' response to ocean acidification (Durland et al., 2021). Recently, the Oregon Ocean Science Trust expanded opportunities for research funding through a grant program to assess effects of ocean acidification in Oregon's coastal waters that includes impacts to commercially important shellfish. In terms of outreach, the OSU Extension Service could answer questions, help build relationships among researchers and industry, and develop projects that benefit the industry. Oregon could benefit from a list of research and outreach priorities which could be supported by funders like OOST, NOAA and the Western Regional Aquaculture Center. Development of best management practices is also an important long-term step that could be supported by these partnerships.

Recommendation 6: Develop a statewide aquaculture plan.

Developing a statewide aquaculture plan would be a useful tool. A statewide plan addresses technical, social, ecological and economic aspects of aquaculture. It may provide recommendations to overcome constraints and invest in sustainable development (Oregon Aquaculture Association, 2018). The OAA published a report titled Guidelines and References for Aquaculture in Oregon. The document draws from other states with successful statewide plans and lays the groundwork for developing a plan with considerations that are specific to Oregon.

Appendix

Additional Resources

State by State Summary of Shellfish Aquaculture Leasing/Permitting Requirements (NOAA Fisheries 2021) (pdf)

State by State Summary of Seaweed Aquaculture Leasing/Permitting Requirements (NOAA Fisheries 2021) (pdf)

State by State Summary of Finfish Aquaculture Leasing/Permitting Requirements (NOAA Fisheries 2021) (pdf)

Guide to Permitting Marine Aquaculture in the United States (NOAA Fisheries 2022) (pdf)

Aquaculture Permitting in West Coast States

Washington

With approximately 110 shellfish farms (USDA, 2019), Washington is a major producer of farmed shellfish, including Pacific oysters, geoduck clams and mussels. It also has offshore finfish and kelp farms and one land-based seaweed operation. The sales value of Washington aquaculture was $207 million in 2018.

In Washington, permitting for shellfish and seaweed follows the same general process. Like Oregon, the state lacks a lead coordinating agency for all aquaculture but has established a shellfish interagency permitting team, a joint application form, and guidance documents to help streamline and accelerate the process. The first step in the permitting process is determining an adequate site and obtaining a lease from the appropriate authority. The Washington Department of Natural Resources (WDNR) is the major agency responsible for leasing tidelands on state-owned lands. In areas owned by other municipalities, local planning offices (e.g., city, county, port) oversee leases. Typically, the local planning office will hold a pre-submission conference to explain the permitting process and ensure the applicant understands the application requirements. Then the applicant is required to submit a joint aquatic resources permit application, which is used to obtain a lease from WDNR or a local planning office as well as permits from USACE and the Washington Department of Ecology. Applicants must submit other individual permit applications to the Washington Department of Fish and Wildlife, Washington Department of Health, tribes, NOAA Fisheries and the U.S. Fish and Wildlife Service. Multiple treaty tribes will likely be involved in the permitting process at several points because of their role in Washington State as co-managers. Tribes have treaty rights in many growing areas that guarantee access to shellfish harvesting and usual and accustomed fishing areas (Northwest Indian Fisheries Commission, n.d.).

The shellfish interagency permitting team has provided several guidance documents to assist with the permitting process:

- Overview table of all required permits (pdf)
- Flow chart of permitting process (pdf)
- Narrative to accompany the flowchart (pdf)

Although the team has recommended assigning a lead agency to aquaculture permitting, this has not occurred.

California

California permits and grows several species of shellfish, including oysters, mussels, clams and abalone, as well as various seaweed products in tank-based systems, including dulse, giant kelp, nori and sea lettuce. The sales value of California aquaculture was $106 million in 2018 (USDA, 2019). There is no finfish or seaweed aquaculture in state or federal waters, but there is interest. Some prospective aquaculture operators have shared that the process of obtaining offshore permits is extremely expensive and difficult.

In California, the Department of Fish and Wildlife (CDFW) regulates and oversees the state's aquaculture program. A state aquaculture coordinator serves as the initial contact to guide prospective growers through the permitting process. Similar to other states, the first step is determining the location of the growing operation, which will determine where to obtain a lease. CDFW will issue leases for aquaculture on state-owned water bottoms. It also handles facility registration, importation permits and wild broodstock collection permits. Areas not owned by the state are leased by the appropriate jurisdiction (e.g., county, city, port, federal agency). After the lease and CDFW permits are submitted, a California Environmental Quality Act initial study is required to determine potential environmental impacts. Other permits may be required from the California Coastal Commission, USACE, California Department of Public Health, California State Water Resource Control Board. Consultation with tribal governments, the U.S. Coast Guard, NOAA and local jurisdictions will likely be necessary as well. Prospective growers should consult with the state aquaculture coordinator early on in the process for assistance.

The CDFW website contains several comprehensive documents outlining the pertinent regulations and applications required. There is also a link to the Permit Guide to Aquaculture in California, which is a website with lists of agencies and their required permits. It contains links to different documents and webpages, although some of the links go to long informational leaflets or the CDFW website rather than the actual application. There is also a link to the CalGold website, which contains a tool to determine the permits required from local jurisdictions.

Alaska

In Alaska, aquaculture farms grow several species of shellfish and seaweed. Commercial aquaculture is limited to indigenous species, except Pacific oysters. Finfish aquaculture is prohibited. In the USDA census report, the sales value of Alaska's aquaculture was $1.8 million, with 22 farms reported (USDA, 2019). Alaska Sea Grant's website says there are over 60 farms.

Applications for new aquatic farms on state-owned tidelands in Alaska are only accepted between Jan. 1 and April 30. The Alaska Department of Natural Resources (ADNR), the Alaska Department of Fish and Game (ADFG), and the Alaska Department of Environmental Conservation (ADEC) oversee state aquaculture permitting. For farms on state lands, the ADNR leases tidelands; the ADFG issues operation, transport and acquisition permits; and the ADEC issues shellfish harvest, processor, shipper and food safety permits. New growers must submit a completed joint-agency aquatic farming application packet, which consolidates permit application materials for all three agencies to reduce paperwork. Applicants are encouraged to schedule a pre-application meeting with ADNR and/or ADFG before submitting the application. If the application is for on-bottom culture, ADFG will perform a site survey, which adds costs and up to one year to the approval process. Applicants are required to contact relevant federal agencies (USACE, USDA, USFWS) to ensure they get the correct federal authorizations. Permit renewals are required every 10 years. In 2019, legislation was introduced to simplify the first renewal process (HB116) but was not passed into law.

All of the permitting processes, forms and other helpful information are outlined on the Alaska aquaculture permitting portal. The website includes a detailed flow chart with instructions for navigating the permitting process at local, state and federal levels. There is also information about farm siting and what to do before applying for permits. The website launched in November 2021. Prior to this, the forms and processes were on ADFG's website, and they still are. There is a training slide deck (pdf) that goes over agency involvement and coordination, permit types and siting

considerations. There is also a document (pdf) explaining the joint-agency application in a step-by-step manner.

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