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# Who's Who in Maine Aquaculture? Understanding the Landscape of Aquaculture Actors and Priorities

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## Understanding the Landscape of Actors, Policy Priorities, and Funding

by Caitlin Cleaver, Robin Fail, Molly Miller, Emily Farr, Jessica Batchelder, Marissa McMahan, and Maeve Staab

ABSTRACT

Maine's aquaculture sector has evolved rapidly over the last 15 years and is seen as a potential area of economic development for the state. There is, however, little clarity around the policy priorities and funding opportunities that are shaping the sector and how these are shifting. We seek to answer the following questions: Which organizations play a role in aquaculture development? What policy priorities and funding opportunities are shaping the sector? We document the role of different actors and summarize the types of research and development funded. Our findings can inform ongoing efforts to advance equity and inclusion in the Maine aquaculture sector, as well as inform future policy and funding recommendations.

### INTRODUCTION

Aquaculture is the fastest growing food production system in the world. As commercial fisheries have declined or plateaued, aquaculture production has increased and now supplies the global population with more than 50 percent of its seafood (FAO 2022). As a result, many countries including the United States are expanding their freshwater and marine aquaculture industries. The growth potential for marine aquaculture in the United States, in particular, is enormous due to the length of coastline, water quality, and strict environmental regulations (Knapp and Rubino 2016). Maine is one of the leading producers of marine aquaculture in the country, with production volume and value more than doubling since 2014 (Sadusky et al. 2022). Due to aquaculture's significant social, ecological, and economic impacts on Maine's coastal communities and the state at large (Johnson et al. 2020), we are interested in understanding which organizations are involved in the growth of the aquaculture industry and the role they play in the sector's development.

Both governmental and nongovernmental organizations (NGOs) guide aquaculture development and public discourse at the global scale (Lindland et al. 2019). Much of the literature around NGO involvement in the aquaculture sector globally discusses how these organizations work to limit aquaculture development by generating negative media coverage, organizing consumer boycotts, and lobbying at the state and national levels for policies that restrict sector growth (Vormedal 2017). However, this is not the case in Maine. In a review of NGO involvement in Maine's aquaculture industry, Miller (2021) found that most of the organizations work to support sustainable development of aquaculture. NGO support is often demonstrated through funding, education and outreach programming, technical assistance, and training and facilitation, as well as by building local capacity (Ashmawy 2018; Espinosa-Romero et al. 2014).

In Maine, a number of organizations engage in aquaculture development with a variety of aims. Little attention has been given to which organizational priorities are advancing aquaculture development, how those priorities have evolved over time, and who benefits, which has implications for equity and inclusion in the Maine aquaculture sector. Our paper seeks to answer the following questions: Which organizations play a role in aquaculture development? What are the policy priorities and funding opportunities that are shaping the sector?

A number of aquaculture planning documents authored by state agencies, the Maine legislature, a governor task force, industry associations, and other organizations since the 1990s provide documentation about priorities related to aquaculture development. While specific priorities have shifted over time, these documents demonstrate an emphasis on growing the aquaculture sector for its potential to

contribute to Maine's economy despite consistent tension between promoting and limiting its growth. This focus on the economic contributions of aquaculture has the potential to exclude recent evidence that Mainers hold a suite of values related to aquaculture development beyond the economic benefits (Britsch et al. 2021).

In 1990, the Maine State Planning Office and Maine Department of Marine Resources (DMR) commissioned a report, An Aquaculture Development Strategy for the State of Maine, with the primary purpose of identifying and addressing bottlenecks in shellfish and finfish aquaculture (Maine SPO 1990). Around the same time, prompted by controversy surrounding the salmon net-pen industry, the Maine Legislature reviewed and assessed the ability of existing laws and regulations to prevent and mitigate negative environmental impacts of aquaculture activity (Maine OPLA 1990). In 1997, DMR developed The Maine Aquaculture Strategy, which focused on the industry's potential to be an economic driver at the state level and outlined goals to increase aquaculture's economic contribution, the number of aquaculture-related jobs and businesses in operation, and the amount of acres dedicated to aquaculture production (Maine DMR 1997). In 2004, a gubernatorial task force developed a report, Planning and Development of Marine Aquaculture in Maine, which sought to determine strategies for balancing competing ocean uses while facilitating aquaculture growth (Governor's Task Force 2004). The task force laid out a vision and principles that centered aquaculture as an important component of Maine's coastal economy, while simultaneously assessing its compatibility with existing uses, environmental sustainability, and local participation in decision-making.

In 2010, the Maine Aquaculture Association (MAA) released an Economic Development Plan for Maine aquaculture (Belle et al. 2010) and in 2022 the Maine Aquaculture Hub (a collaborative between Maine Sea Grant, MAA, the Maine Aquaculture Innovation Center, Coastal Enterprises, Inc., the University of Maine Aquaculture Research Institute, and the University of Maine School of Marine Sciences) released a 10-year vision entitled Maine Aquaculture Roadmap (Sadusky et al. 2022). The Roadmap outlines four primary goals focused on streamlining aquaculture licensing and permitting processes while balancing the rights of the applicant and the public, increasing integration and understanding of aquaculture in Maine's communities, expanding and promoting the Maine seafood brand, and making Maine a leader in triple-bottom-line sustainable aquaculture. It also highlights the importance of considering cross-cutting themes of climate change impacts and increasing diversity, equity, and inclusion in the aquaculture sector.

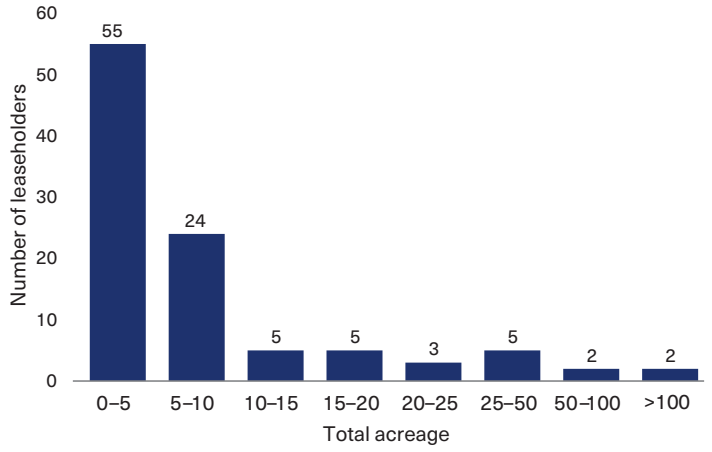
The balancing of competing interests, highlighted in the 2004 Governor's Task Force report, has become increasingly important in recent years because the Maine aquaculture sector has evolved rapidly. Aquaculture activity is permitted by DMR and requires individuals or businesses to hold a limited purpose aquaculture (LPA) license, an experimental lease, or a standard lease. LPA licenses are for small (400 sq ft or <0.1 acres) sites and are renewed on an annual basis; experimental leases permit farms up to four acres in size for three years of operation without the option to renew unless for research or educational purposes, while standard leases permit operations up to 100 acres in size for 20 years of activity before the holder needs to renew the lease. No individual or entity can hold more than 1,000 acres of lease area (or 1,500 acres if authorized by DMR) or more than four LPAs. Finfish can only be grown on permitted lease sites, whereas shellfish species and marine algae can be grown on leases or LPAs.

Since 2010, the total number of aquaculture leases and LPAs has steadily increased. As of August 2023, there are 164 active leases held by 101 unique leaseholders, and 725 LPAs held by 282 unique license holders (including 16 individuals who held both a lease and an LPA).[1] Leases range in size from 0.06 to 89.7 acres, with an average size of 10.21 acres (Figure 1). Notably, 54 percent of leaseholders operate on less than 5 acres total, and the number of LPAs increased 18-fold from just 44 in 2007 to 804 in 2021 (Maine DMR 2022a). This number demonstrates that the majority of aquaculture farmers operate on a relatively small scale. On active leases and LPAs, shellfish species make up the majority of product grown, followed by marine algae and finfish (Maine DMR 2022b, c). The combined value of shellfish and marine algae aquaculture was over $12 million in 2022 (Maine DMR 2022d).

## PRIORITIES OF ORGANIZATIONS INVOLVED IN AQUACULTURE

We used a multipronged approach to collate a comprehensive list of organizations involved in aquaculture development and to identify organizational priorities, including consulting with experts in the field, reviewing organizational websites and testimony submitted in response

FIGURE 1: **Distribution of Lease Sizes by Leaseholder**




Note: Excluding limited purpose aquaculture licenses. Lease acreage is aggregated to include all leases held by an individual or aquaculture business.

to aquaculture-related legislation proposed within the last five years, and identifying organizations that had received grant funding to implement aquaculture research or projects. The testimony and funding analyses helped identify organizations that may not have aquaculture priorities explicitly included in their mission statements but have been influencing the sector's development by participating in the policy process and advancing aquaculture priorities through research. Finalizing the list of organizations involved in aquaculture was an iterative process whereby the authors generated an initial list that was then verified and modified by experts in the field. The final list included in the analysis identifies 38 organizations that have actively participated in the Maine aquaculture industry in the last five years.

To understand specific roles organizations are playing in shaping the aquaculture sector, we reviewed the mission statement of each organization and categorized the organizational role into six themes: research and development, education, economic development, advocacy, conservation, and funding. Research and development organizations conduct research and use the findings to provide insight and improvements to the aquaculture industry. Education organizations host educational programs for students or highlight aquaculture education and awareness programs that they provide. Economic development organizations contribute to workforce development and provide technical assistance for the aquaculture industry. Advocacy organizations participate in both writing and providing testimony for legislation at state and municipal levels, often through the lease hearing process. We note, however, that organizations that do not identify advocacy in aquaculture as an explicit priority are often still involved in advocacy around legislation. Conservation-oriented organizations cite the importance of sustainability and typically identify the need to protect the marine environment; the majority of these organizations work in opposition to some, if not all, types of aquaculture. Funding organizations provide grants, loans, and other financial services that include the aquaculture industry as beneficiaries.

Among the 38 organizations identified for their involvement in shaping the aquaculture industry, 21 percent provide research and development services, 32 percent provide educational programming, 18 percent provide economic development services, 24 percent identify advocacy as the primary role for their organization, 21 percent identify conservation as the primary role, and 16 percent provide financial services. Additionally, 45 percent of the organizations identified multiple aquaculture-related priorities in their mission statements. Some organizations combined priorities of research and development, economic development, and funding to support Maine's aquaculture industry. Organizations that identify education as a component of their mission statements typically do not mention aquaculture specifically as a priority, but rather include it as one of the many subjects for which they provide educational classes, programs, or materials. Conservation and advocacy priorities were often linked and were tied to organizations that have made efforts to oppose aquaculture development at the municipal or state level. Of the nine organizations that identify advocacy as a part of the organization's mission, one does not lobby on aquaculture-related issues, one supports aquaculture, and seven oppose at least some scale and species of aquaculture production. While it is common for groups opposed to aquaculture to cite conservation as a primary concern, it is notable that two of the organizations cite opposition to aquaculture as the primary purpose of the organization. Two additional organizations discuss the preservation of historical fisheries and uses of the marine environment, and also oppose the growing aquaculture sector. Organizations that have made opposing aquaculture development a key tenet of their work are all small municipal or regional efforts that

participate by proposing bills to inhibit aquaculture growth or by attending lease hearings to oppose development of specific farms. Meanwhile, there is only one organization whose primary mission is supporting the development of aquaculture through advocacy. This pattern creates a dialogue surrounding aquaculture development in which the anti-aquaculture groups are incredibly active and vocal about preventing further development of the sector.

## TESTIMONY ON AQUACULTURE-RELATED BILLS

Another lens through which we gained insight into organizational participation in guiding aquaculture development is the analysis of written testimony submitted to the Maine Legislature in response to proposed aquaculture-related bills. Our analysis included bills submitted between January 2017 and June 2023 or from the last five years, which we identified using the Maine Legislature's bill tracking feature and the following search terms: "aquaculture," "mariculture," "waterfront," "blue economy," "finfish," "shellfish," and "seaweed." We excluded bills not explicitly related to aquaculture and those without written testimony. We only analyzed written testimony or spoken testimony that had a written copy included. Our final list included 39 relevant pieces of legislation with an associated 696 individual pieces of testimony. For a full list of the legislation included in this analysis, see Appendix B available online.[2] For each proposed bill, we collated basic information including sponsor name and political party, year, status, and brief summary of the bill. For each piece of testimony, we captured the individual's name and affiliation, stated position to the bill (e.g., support or oppose), and whether their position aligned with the bill's outcome (e.g., if they expressed support of the bill and it passed, we coded this as "desired outcome"). The primary goal of the testimony analysis was to glean some understanding of which organizations and entities are directly participating in policy processes, understand their stance in relation to recent legislation, and analyze how various actors' priorities intersect with legislative outcomes.

To answer the question of who is participating in the legislative policy process, we identified nine categories of actors that submitted legislative testimony related to aquaculture: citizens (those who do not list a specific organizational affiliation), growers, wild harvesters, NGOs, advocacy organizations, academia, municipal government, state government, and supporting businesses (e.g., Atlantic Sea Farms and FocusMaine). Though there is overlap between NGOs and advocacy organizations, we assigned this category based on the entities' primary function. If the organization's primary aim is advocacy (e.g., MAA, Maine Lobstermen's Association, Protect Maine's Fishing Heritage), then we categorized it as advocacy. If its functions are more varied and combine other priorities beyond advocacy (e.g., Island Institute, Sierra Club, Coastal Enterprises, Inc.), we categorized it as an NGO. In total, growers (33 percent) and citizens (27 percent) account for 60 percent of the testimony included in our analysis. Notably, the majority of testimony from citizens is concentrated on a few particularly contentious pieces of legislation, such as LD 1473—An Act To Exempt Land-based Aquaculture Facilities from the Maine Uniform Building and Energy Code Requirements—and LD 1146—An Act To Protect Maine's Ocean Waters and Support Regulatory Oversight and the Long-term Health of the Aquaculture Industry. Our analysis included 696 pieces of testimony from 448 unique entities and individuals. While this may seem like a large number of participants for only 39 bills, analysis of which organizations or entities commented on five or more separate pieces of legislation shows consistent participation by only 11 actors: DMR; MAA; Island Institute; Coastal Enterprises, Inc.; Mere Point Oyster Co.; Sierra Club Maine; Maine Municipal Association; Muscongus Bay Aquaculture; Bar Harbor Oyster Co.; Eros Oyster; and Maine Ocean Farms.

These results show the most frequent participation from DMR and MAA—an unsurprising finding, given that these organizations are, respectively, the primary management entity and industry association for the sector. Consistent engagement by the Island Institute and Coastal Enterprises, Inc. reflects each organization's stated priorities regarding the possibilities for economic opportunity, preservation of maritime employment and working waterfronts, and job diversification provided by aquaculture. Of the 11 entities that commented on five or more bills, only one, Sierra Club Maine, is a consistent opponent of aquaculture growth. Other than the Maine Municipal Association, which takes a largely neutral stance on aquaculture development and seeks to ensure municipal engagement, the remaining entities are proponents of industry growth. Of the growers included in this list (Mere Point, Muscongus Bay, Bar Harbor Oyster, Eros Oyster, Maine Ocean Farms), four are in the top 25 percent of leaseholders by acreage (9.86 acres and above), and one operates on LPAs only. Among the

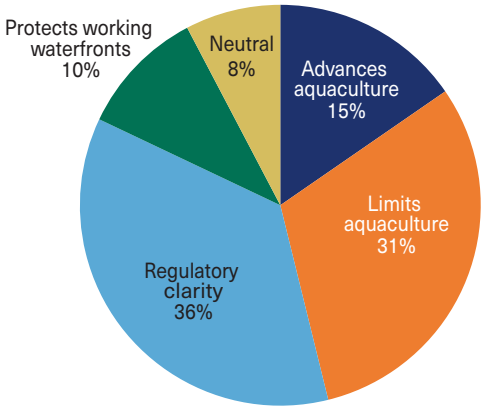
many organizations interested in shaping aquaculture development, these findings point to DMR, MAA, a handful of larger farms, Island Institute, Coastal Enterprises, Inc., and Sierra Club Maine as particularly engaged actors in the policy arena.

To answer the question of which priorities are negotiated in the legislative sphere, we assigned each bill to one of five categories that were reflected across the 39 bills: advances aquaculture, limits aquaculture, neither advances nor limits aquaculture (neutral), provides regulatory clarity, or protects working waterfronts. The majority (36 percent) of the bills we analyzed were related to regulatory clarity, followed by bills limiting aquaculture (31 percent) (Figure 2).

In 2023, there was a clear leap in the total number of aquaculture-related legislation introduced and debated, particularly legislation aimed at limiting aquaculture. Seventeen aquaculture bills were introduced in 2023, compared to an average of just 4.4 bills per year between 2017 and 2022. This increase is likely attributed to proposed aquaculture operations that were particularly contentious and garnered widespread public attention, including American Aquafarms' unsuccessful proposal for salmon farms in Frenchman Bay and Kingfish Maine, Inc.'s, successful bid for permits to build a recirculating aquaculture system (RAS) facility in Jonesport. Despite the over 160 currently active lease sites with an average size of 10.2 acres, a handful of large projects seem to have captured the attention of both the public and policymakers and shaped the trajectory of proposed legislation. While the introduction of bills suggests increasing interest in limiting aquaculture, the outcome of these bills, seen in Figure 3, tells a slightly different story.

Though there are a number of bills related to limiting aquaculture, the majority do not pass. Most legislation that passes is related to regulatory clarity. This is a logical finding: as the industry evolves, so, too, does the regulatory structure. However, these regulatory bills and the flurry of bills that aim to place limits on aquaculture development shed light on the reactive nature of the current regulatory process in Maine. For example, LD 1930, a bill aimed at regulatory clarity, proposed amendments to Maine's leasing laws that included time requirements for lease expansion and notice of leases

FIGURE 2: **Primary Priority of Bills Related to Aquaculture, January 2017–June 2023**




involving discharge to Maine's Department of Environmental Protection. LD 1951, a bill we categorized as limiting aquaculture, recommended a stocking density limit on Maine finfish operations. Given recent calls for a strategic visioning process to guide aquaculture development in Maine, it is notable that there are far more bills geared towards reacting than towards proactive planning for aquaculture growth and development.

With a basic understanding of the actors participating in the legislative process and the aim of introduced legislation related to aquaculture, we then sought to understand how the legislative outcomes align with the priorities of the

FIGURE 3: **Outcome of Bill by Priority of Bill**

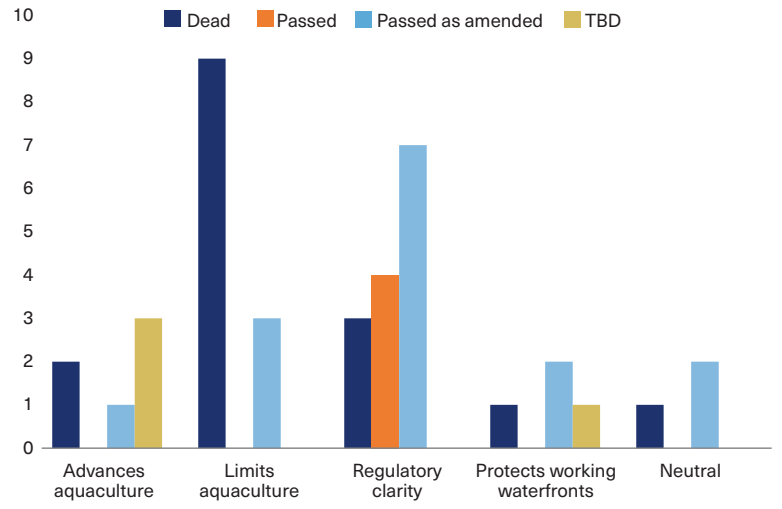
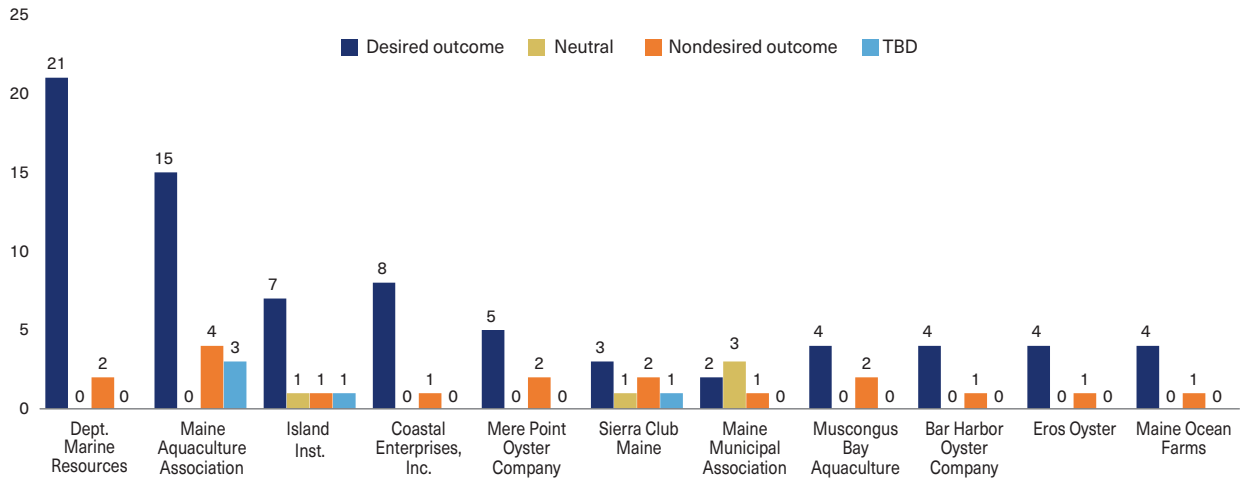


FIGURE 4: **Alignment between Desired Outcome and Bill Outcome**




Note: For organizations that submitted testimony on five or more bills between January 2017 and June 2023.

participants most active in the policy process. We defined the most active participants as those who submitted testimony on five or more separate bills within the five-year timeframe of this analysis (Figure 4).

The frequency with which DMR's priorities align with the bill outcome (for 91 percent of the testimony they submitted) may in part be a function of the department proposing legislation to improve the regulatory process and reflect the legislature's reliance on expertise of state agencies when deciding which legislation to move into law. The next three most active players—MAA, Island Institute, and CEI—also achieved their desired outcomes for a majority of the bills for which they submitted testimony. These findings suggest some level of political power that often results in desirable policy outcomes.

These results also led us to question how often DMR and MAA align in their policy positions. DMR and MAA both submitted testimony for 16 bills included in our analysis and the two entities held aligned positions for 14 of them. The two bills for which DMR and MAA did not align do not represent substantive differences in their respective priorities. For LD 1844, which proposed allowing DMR to subject certain leases to special fees, MAA opposed the fees, and they were removed from the amended version that passed. This observation raises the important point that examining the relationship between testimony and amendments should be part of a thorough analysis of political influence. While our analysis did include attention to amendments, we do not report on those findings here. For LD 1930, which proposed amending various aspects of the leasing laws, MAA's stated objections centered on the terms of lease revocation and the proposition that growers would be responsible for food-safety-testing fees. The bill did not pass. This alignment is certainly a function of both entities working toward an increasingly functional and productive aquaculture industry, but it also raises questions about the extent to which special interest groups shape state management priorities. This topic warrants future research about the alignment of advocacy groups in other industries with state regulatory bodies.

This testimony analysis can also shed light on which issues generate the most conflict and which appear relatively uncontentious. Of the 39 bills we analyzed, the average number of testimonies submitted per bill was 19, but the range varied from one testimony for several bills, to 167 pieces of testimony for LD 1146—An Act To Protect Maine's Ocean Waters and Support Regulatory Oversight and the Long-term Health of the Aquaculture Industry. Five of the bills (LDs 1473, 1211, 1146, 508, and 586) were particularly contentious with testimony from more than 40 individuals. Four of these bills aim to limit aquaculture in some way, and one to advance it, and only one bill (LD 508, which requires DEP to develop standards for waste discharge modeling for finfish facilities) passed. Of these controversial

bills, two explicitly focus on land-based RAS facilities (LD 1473 and LD 586). These bills proposed exempting RAS facilities from Maine's building and energy codes and establishing new water quality standards for RAS facilities, respectively. MAA and DMR did not testify on either bill, and in both cases, most testimony came from citizens opposed to RAS development.

LD 1146, which received far more testimonies than any other bill, proposed a number of regulatory changes including an end to transferability of aquaculture leases, limiting lease size to 50 acres, and requiring DMR to create a strategic plan for aquaculture that "advances the interests of the people of the State." DMR, MAA, Island Institute, CEI, and 97 percent of the growers who testified opposed the bill. A majority of the citizens (58 percent) who submitted testimony also opposed the bill, making LD 1146 the only one of these controversial bills in which the majority of citizens' positions aligned with that of key players in the aquaculture industry. Protect Maine's Fishing Heritage, conservation groups, and the majority of wild harvesters (76 percent) who submitted testimony supported the bill. In many ways, these controversial bills present caricatures of the social conflict surrounding aquaculture development in Maine, with the aquaculture industry on one side and conservation groups, citizens, and sometimes wild harvesters on the other. However, it is possible that the controversy surrounding these bills reflects the issues that are brought to the legislature and does not capture the complexity and nuance of broader issues and the values held by diverse stakeholders in aquaculture development.

It is also useful to consider the bills that were least contentious, which we determined based on those with few submitted pieces of testimony and successful passage. Most of these seemingly uncontroversial bills sought to provide regulatory clarity. The lack of testimony could be due to many factors: perhaps the public is less interested in matters of regulatory clarity, or growers have an appetite for increased regulatory clarity. Perhaps it indicates a degree of social license for the inevitable and incremental regulatory changes that are required as the industry evolves, compared to the surge of opposition to bills that substantively shift the status quo. Though we cannot determine the reasons for lack of engagement, this analysis clearly points to some hot-button issues that are likely to generate ongoing social conflict.

This testimony analysis offers insight into which actors are actively engaging in the legislative process guiding aquaculture development. It highlights the role of key players in working to advance aquaculture at the policy level, and the frequent alignment between these institutions' priorities and policy outcomes. This testimony analysis also reflects the coalitions that have formed in response to aquaculture development and that are often characterized by conflicting priorities between aquaculture groups, conservation groups, wild harvesters, and the general public. It offers insight into how certain projects—particularly those that are new and large scale—serve as flash points for the legislative process. The leap in the number of proposed bills in 2023 likely reflects both the influence that a given aquaculture project can have on public reaction to the industry, but also public's rejection of large-scale and industrial operations.

## FUNDING FOR MAINE AQUACULTURE

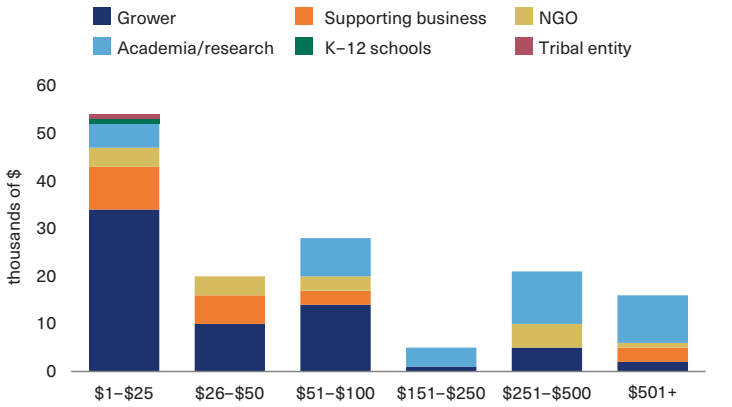
Our final analysis explored the organizations and types of research that are receiving funding to implement aquaculture-related projects in Maine. We generated a list of various funding sources including organizations and agencies that offer grant opportunities as well as companies that provide private financing (see online Appendix C for grant opportunities).[3] As part of the process for developing the 2022 Aquaculture Road Map, a focus group involving institutions that provide loans and other financing was held to discuss how private financing could support aquaculture development (Sadusky 2022). Participating organizations included the Maine Venture Fund; Maine Angels; First National Bank; Coastal Enterprises, Inc.; Masthead Venture Partners; Pavan Enterprises, Inc.; and Montserrat Group, LLC. We reviewed the companies' websites to determine if and how they currently support aquaculture. Websites for Maine Angels and the Maine Venture Fund provided a list of businesses that had received financial support; Maine Angels has supported American Unagi and Atlantic Sea Farms, and the Maine Venture Fund has supported American Unagi, Atlantic Sea Farms, and Katahdin Salmon. American Unagi is the only operation in Maine piloting and commercializing the farming of eels; Atlantic Sea Farms is expanding the marine algae market and working with wild harvesters who want to diversify into kelp farming; and Katahdin Salmon is running a RAS facility for salmon in Millinocket. No additional information about the amount of financing received, the terms or type of financing, or the type of work being supported was publicly available. That information is likely proprietary and

may affect business success if shared; however, we believe it is important to acknowledge that these funding sources exist and likely play an important role in shaping the opportunities for development in the aquaculture sector.

To determine the number and types of projects funded and which organizations received those funds, we searched online grant project databases for projects in Maine that were funded between January 1, 2017, and June 30, 2023. Online funding agency project databases included those collated by National Sea Grant, Maine Sea Grant, NOAA Fisheries Saltonstall-Kennedy grant program, NOAA Fisheries Atlantic States Marine Fisheries Commission regional pilot projects, USDA Northeast Sustainable Agriculture Research and Education (SARE), USDA Small Business Innovation Research Program, USDA Special Research Grants Program, USDA Agriculture and Food Research Initiative, USDA Beginning Farmer and Rancher, USDA Value-added Producer Grants, USDA Specialty Crop Block Grant Program, Sea Pact, Maine Department of Agriculture, Conservation and Forestry (MDACF) Agricultural Development Grant, MDACF Agricultural Infrastructure Investment program, FocusMaine Propel Mini Grants, Maine Technology Institute, and Buoy Maine. Not all grant opportunities or funding agencies had databases that could be searched, so projects that received grant support from agencies or organizations without an online project database were not captured in our analysis.

Project database search terms included: "aquaculture," "marine," "farm," "mussel," "oyster," "seaweed," "salmon," and "scallop." Additional information was collected about each project including the lead institution, the project title and summary, year funded, and award amount. We categorized the lead institution into organization type (e.g., NGO, research institution, aquaculture farm or grower, supporting business, tribal entity, or K–12 school), identified the aquaculture species of focus, and categorized the primary purpose of the research (e.g., hatchery/nursery stage, species biology, climate impacts). Each project was categorized under one research purpose based on the publicly available project summary or project title; however, we recognize that a number of these projects were multifaceted and involved multiple partner organizations or farmers. We did not capture that complexity in this analysis.

FIGURE 5. **Proportion of Grants Awarded by Type of Lead Organization, January 2017–June 2023**




Note: (n=144).

We identified a total of 157 grant-funded projects awarded between January 2017 and June 2023; of those 157, 144 included information about total award amount. Based on 144 grants with the total award amount known, we calculated that more than $34,810,621 has been awarded, with an average award amount of $241,740, a minimum amount of $2,522 and maximum of $10,000,000. We categorized the type of lead institution for the total 157 grants: growers led 43 percent of the projects, academic or research institutions led 29 percent of the projects, supporting businesses led 15 percent, NGOs led 13 percent, and both tribal entities and K-12 schools led less than 1 percent of the projects. Based on the 144 grants with an award amount included, we calculated that academic and research institutions received 68 percent of the total grant funds, growers received 15 percent, supporting businesses received 8 percent, NGOs received 9 percent of total funds while K–12 schools and tribal entities received less than 1 percent of total funds.

Growers tended to receive more grant awards at a lower funding amount with most less than $150,000, while NGOs and research institutions tended to receive higher funding amounts (Figure 5). This funding distribution is not surprising given the varying eligibility criteria for grant opportunities, which might exclude growers from being the lead institution on a proposal, as well as the common practice of partnering between research institutions, NGOs, and K–12 schools with aquaculture businesses to pursue grant opportunities. In addition, there can be an administrative burden associated with managing large grant awards, which research institutions and NGOs usually have the in-house

capability to do while smaller businesses or start-ups may not. It is important to note that this summary simplifies receipt and distribution of grant funds by categorizing the number of projects and amount of funding received by type of lead organization; a number of these projects likely involved subawards and subcontracts to K–12 schools, growers, NGOs, and other groups, which was not captured in this analysis.

Based on the lead institution identified for the 157 grants found, the University of Maine received a total of 19 grants (12 percent) since 2017. Winnegance Oyster Farm, Maine Shellfish Developers LLC, American Unagi, Mook Sea Farm, and Springtide Seaweed had five or more grant-funded projects within the same period. Several of these aquaculture farms are experimenting with completely new farming techniques; both American Unagi and Maine Shellfish Developers are developing land-based aquaculture technology to grow eels and oysters, respectively, while Springtide Seaweed is working to grow the marine algae aquaculture industry by expanding the species grown in Maine. Research institutions receive a greater proportion of the total award amount. Colby College, in partnership with Bigelow Laboratory for Ocean Sciences, received $10,000,000 from USDA Sustainable Agriculture Systems Program to study algae-based feed to improve the environmental sustainability of the dairy industry (Bigelow Laboratory for Ocean Sciences 2021). Grant funds and private financing can be critical to support the innovation necessary to establish husbandry techniques and markets for new products that expand and diversify the existing aquaculture sector.

For 151 grants, we were able to categorize which species of aquaculture the project focused on. Oyster-related projects received the greatest number of grants (25 percent) followed by those focused on multiple species (21 percent) while seaweed received 16 percent and finfish received 10 percent. When considering the proportion of total grant funding received and based on 142 grants where we were able to identify an award amount and the species of focus, 46 percent of grant funding was awarded to projects pursuing studies about seaweed aquaculture and 16 percent to finfish while oyster-related research received seven percent of the award amount. Marine algae and finfish aquaculture appear to be priorities either directed by funding agencies or by the number of organizations in Maine interested in working on these two aspects of aquaculture. Individuals and companies farming finfish and marine algae represent a relatively small proportion of total participants in Maine's overall aquaculture industry. All finfish aquaculture is currently permitted to only one leaseholder, Cooke Aquaculture, which holds 15 percent of active leases or 24 standard leases overall. Marine algae aquaculture is an emerging opportunity within the Maine aquaculture sector and is permitted on 28 percent of active leases (46 leases overall) and 16 percent of LPAs or 132 LPAs overall (Maine DMR 2023a, b). In 2022, Maine DMR reported unclassified seaweed landings from just eight individuals, which can be assumed to be farmed marine algae; this does not include the commercial wild harvest of rockweed.[4] In that same year, the value of the marine algae aquaculture harvest was less than 5 percent that of shellfish aquaculture harvest. Despite few leaseholders and active harvesters, seaweed aquaculture represents an area where funding is being directed to help establish and grow that industry.

In addition to looking at the organizations and aquaculture species receiving the most funding, we categorized grant-funded projects by the primary purpose of the research for 106 grants where we were able to find project summary information. Categories for primary research purpose included advancing knowledge about different stages of the farming process, expanding markets, or understanding impacts of climate change. A number of the grants have been for improving various aspects of the farming process, including the nursery stage/hatchery development (11 percent of the projects, 10 percent of the amount awarded), gear improvements to make husbandry practices more efficient (19 percent projects, 11 percent amount awarded), product handling and processing (13 percent projects, 8 percent amount awarded), and brand or value-added product development (16 percent projects, 40 percent amount awarded). In addition, efforts are being made to establish aquaculture practices for new species (12 percent projects, 3 percent amount awarded) and to develop hubs or clusters to collate best available science and practices about certain topics, such as finfish, seaweed, and scallop aquaculture (7 percent projects, 12 percent amount awarded). Brand, market and product development is an area that has received the greatest proportion of funding followed by gear improvements/husbandry and developing hubs or clusters. Only 1 percent of awarded grants are devoted to climate change impacts, which is at odds with the steady refrain that aquaculture is an important resiliency strategy for climate

change adaptation and the reality that many aquaculture species are susceptible to warming waters, ocean acidification and invasive species. The social dimensions of aquaculture growth, such as exploring public perceptions and values related to aquaculture or understanding points of contention as well as policy options to guide a growing industry, are not well represented in the types of research projects that were funded. This lack may be due to the types of funding opportunities available, which often prioritize certain topic areas or types of research to be carried out.

Overall, the funding directed towards aquaculture development in Maine has been received by a subset of organizations and certain growers. The funding has also been directed towards particular focus areas. Certain organizations may be better suited to receiving grant funding and better able to seek out opportunities, write proposals, and administer grant funds; however, we believe that understanding the funding landscape is an important aspect of identifying actors involved in aquaculture development and the priorities that are being advanced.

Grant opportunities vary widely in eligibility criteria, frequency with which they are available, and geographic scope. This analysis provides a lens through which we can understand the funding landscape, though we were limited by the amount of publicly available information. In addition, we were not able to glean information about the collaborating organizations on these projects, which would have provided additional insight into who are involved in aquaculture research in Maine. Finally, the inability to track down information about private funding also skews our understanding of the funding landscape supporting Maine aquaculture development.

## CONCLUSION

Our aim was to identify and describe the organizations and the priorities that are shaping the development of Maine's aquaculture sector. We used publicly available information including aquaculture planning documents, DMR lease and license data, organizational mission statements and website text, testimony submitted in response to legislative bills, and summaries of grant-funded projects. Based on our analysis of DMR lease and license data and from our collective experience working with the aquaculture sector, aquaculture growers are diverse in the size of their operation, the species they farm, and their visions for the future of aquaculture; however, the diversity of viewpoints is muted in the policy and funding arenas where only a small subset of growers receive grants and regularly participate in the policy process. Only five farms submitted testimony on five or more bills, which suggests that participation in the policy process may not be representative of the diversity of species farmed and the scale that exists within Maine's aquaculture industry. It is also possible that growers who are members of the MAA assume their interests are represented by MAA staff who submit testimony. In the funding space, the growers receiving the highest number of grants and greatest proportion of funding are on the cutting edge or are driving innovation in aquaculture by developing new techniques, or growing species not previously farmed in Maine or the United States. These are not unexpected findings; participating in the policymaking process and pursuing and managing grants require capacity many small businesses do not have, and grant funding is often needed to establish a farming process and markets for emerging species and to make innovative technology mainstream. In addition, funding opportunities have varying eligibility criteria, which may not always be available to industry, and often individuals only submit testimony when a proposed bill will directly affect their operation. However, understanding who is engaging in aquaculture policy-making and the types of research projects that receive funding provides insight into the priorities shaping Maine aquaculture development.

While we have provided an overview of the organizations shaping Maine aquaculture, we recognize that there are limitations to our approach. Receiving grant funds and submitting testimony represent a subset of the ways organizations can engage in shaping the direction of the sector. Maine is relatively small, and organizations often collaborate on projects in other areas. Connections and discussions often happen outside of the public sphere or in ways that are not written or documented. Categorizing and coding organizational priorities, positions on legislation, and research projects makes it challenging to identify nuance. In addition, the nuance and complexities of the many facets of aquaculture development may not emerge in the legislative space since it tends to highlight the controversy rather than collaborative work.

Future work could explore more fully the gaps in funding and the effectiveness of knowledge transfer between research institutions and industry. The social and ecological dimensions of aquaculture growth are currently understudied and underfunded, while the focus has been on promoting growth and development of aquaculture

products. Future work could also explore the dynamics, participation, and influence of other industry groups to understand whether the political processes guiding aquaculture development are typical, or whether they represent unique cooperation between regulatory bodies and industry groups. Finally, given the rate of aquaculture development and the amount and diversity of research happening in this sector, it is important to make sure there are avenues for sharing knowledge. Organizations such as Maine Sea Grant often provide a link between research and community in addition to venues such as the Maine Fishermen's Forum and the Northeast Aquaculture Conference and Expo; these are important relationships and opportunities to transfer knowledge and lessons learned. However, many farmers are unable to attend such events and communities are often left out of the discourse. More resources are needed to communicate and educate both farmers and community members about the state of the aquaculture industry and advancements as they occur in real time.

## NOTES

1 https://www.maine.gov/dmr/aquaculture/maine-aquaculture-leases-and-lpas/table-of-active-limited-purpose-aquaculture-lpa-licenses; https://www.maine.gov/dmr/aquaculture/maine-aquaculture-leases-and-lpas/aquaculture-lease-decisions-table

2 https://doi.org/10.53558/PTTW1734

3 https://doi.org/10.53558/PTTW1734

4 https://www.maine.gov/dmr/aquaculture/maine-aquaculture-leases-and-lpas/aquaculture-lease-decisions-table

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