

Aquaculture in Shared Waters: Lessons for Diverse and Inclusive Workforce Training

by Teresa R. Johnson and Jessica Veo

INTRODUCTION

Maine's ocean economy has a long cultural and economic history, from ship building to commercial fishing, and more recently marine aquaculture. With recognition of vulnerability along Maine's coast due to an over dependence of communities on the American lobster fishery (Acheson and Acheson 2020) and demographic change associated with youth outmigration, amenity migration, and gentrification (Johnson 2020), there exists significant interest in the expansion of Maine aquaculture, or the farming of aquatic fish and shellfish. Maine farmers produce a variety of species, including salmon, oysters, and mussels, seaweeds, sea scallops, eels, to name a few. Shellfish and seaweed aquaculture are especially advocated for as ways to achieve more sustainable and resilient working waterfronts. In 2021, the *Maine Aquaculture Road Map* identified four broad goals as critical to sustainably strengthening Maine's aquaculture sector over the next ten years, with diversity, equity, and inclusion (DEI) as "paramount to the sustainable future of the aquaculture sector" (Sadusky et al. 2022: ii).

This commentary reflects on lessons learned from the Aquaculture in Shared Waters (AQSW) training program.¹ We describe the program, share key accomplishments and challenges, and consider opportunities for enabling more inclusive and equitable entry into the aquaculture sector.

AQUACULTURE IN SHARED WATERS

Initially funded by a grant from the NOAA National Sea Grant program to the University of Maine, AQSW began in February 2013, with its curriculum focused on shellfish and seaweed aquaculture. AQSW is a transdisciplinary collaboration between the University of Maine researchers and Maine Sea Grant, the Maine Aquaculture Association, the Maine Aquaculture Innovation Center, and Coastal Enterprises, Inc. The original aim of the program was to help diversify fishers' incomes via transfer of knowledge and technology through training in shellfish and seaweed aquaculture.

Shellfish and seaweed are the focus as they are expected to be more compatible with existing commercial fishing operations, with relatively lower start-up costs compared to finfish (e.g., salmon and groundfish). The program's name reflects the team's recognition of aquaculture as one of many uses of Maine's coastal region and the need for prospective farmers to consider both environmental and social dimensions when selecting a site and starting operations in a community.

Funded primarily by NOAA Sea Grant, the course has shifted locations, timing, targeted audiences, and delivery formats (Table 1). The program has been offered in 8 towns and virtually via Zoom to 12 different cohorts and to over 300 participants. Due to COVID-19, the course shifted to virtual delivery via Zoom in 2020. In 2021, the course was entirely virtual, while in 2023 the course was offered via a hybrid format, with both an in-person and a virtual attendance option. Program instructors also have offered

TABLE 1: Summary of Aquaculture in Shared Waters Course, 2013–2021

Year	Course Location	Course Length	Course Timing
2013	Harpwell	11 weeks	Feb to April
2013	Corea	11 weeks	Feb to April
2015	Harpwell	8 weeks	Feb to April
2016	Thomaston	12 weeks	Jan to April
2017	Ellsworth	12 weeks	Feb to May
2018	Bath	12 weeks	Feb to June
2018	Machias	12 weeks	Feb to May
2019	Brunswick	12 weeks	Dec to March (Two sections, multiple weeks apart)
2020	Brunswick and Belfast	12 weeks	Jan to April (Streamed across sites; shifted to Zoom due to COVID 19)
2021	Virtual	12 weeks	Nov to Feb
2023	Hybrid	14 weeks	Jan to April

several advanced training opportunities via short, focused workshops of topical interest to farmers. A unique aspect of the course compared to other training programs has been the inclusion of social science researchers, led by Teresa Johnson, whose applied research has been used by the instructors to shape the curriculum and delivery of the program.

A group of experts with extensive technical, logistical, and extension expertise in aquaculture develops and implements the curriculum. The comprehensive curriculum covers all aspects related to starting an aquaculture business, including site selection, biology of species, husbandry, disease and biosecurity, equipment, permitting and regulation, marketing and sales, and social license. The core education and extension team includes experts from the Maine Sea Grant, the Maine Aquaculture Association, the Maine Aquaculture Innovation Center, and Coastal Enterprises, Inc. Beyond the core team, other aquaculture experts contribute to the curriculum via guest lectures, such as staff from the Maine Department of Marine Resources, the University of Maine, the US Army Corps of Engineers, and Kennebec River Biosciences, as well as farmers and other industry stakeholders. This network serves as a continuing resource for the participants as they continue their business development after finishing the course. In addition to in-class content delivery, guest speakers, and hands-on activities, the program has also offered field trips, and the instructors have made themselves available for follow-up assistance.

The program boasts numerous accomplishments beyond the development and delivery of the comprehensive curriculum. Based on the attendance and rosters shared by the instructors or collected by researchers, 375 individuals

attended the AQSWS program between 2013 and 2023, with 15 individuals identified as having repeated the course at least once. This number does not include those individuals participating in the more advanced courses and workshops. Additionally, 30 new aquaculture businesses have been established and more than 60 jobs expanded or retrained through economic diversification. In 2020, the AQSWS program team was awarded the Superior Outreach Programming Award from the National Sea Grant Program.

Generally, the course was well received by participants across all programs. Participants consistently applauded the expertise and enthusiasm of the instructors and the comprehensiveness of the material shared. When asked to rate their satisfaction with the course, 93 percent of respondents said they were satisfied or very satisfied with the course, while only 5 percent of respondents said they were very unsatisfied. Overall, both men and women reported high levels of satisfaction with the program. One survey respondent's comment illustrates the kinds of feedback typically received from participants:

The teachers, guest speakers, [and] behind the scenes people did a really fantastic job with this class. You can really tell the passion everyone has for aquaculture and the essence of community is something really special and I am happy to be a part of it.

DIVERSITY, EQUITY, AND INCLUSION CONSIDERATIONS

Following the publication of the *Maine Aquaculture Roadmap*, the Maine Aquaculture Hub identified the need to consider and support opportunities to enhance diversity, equity, and inclusion in the sector, and especially

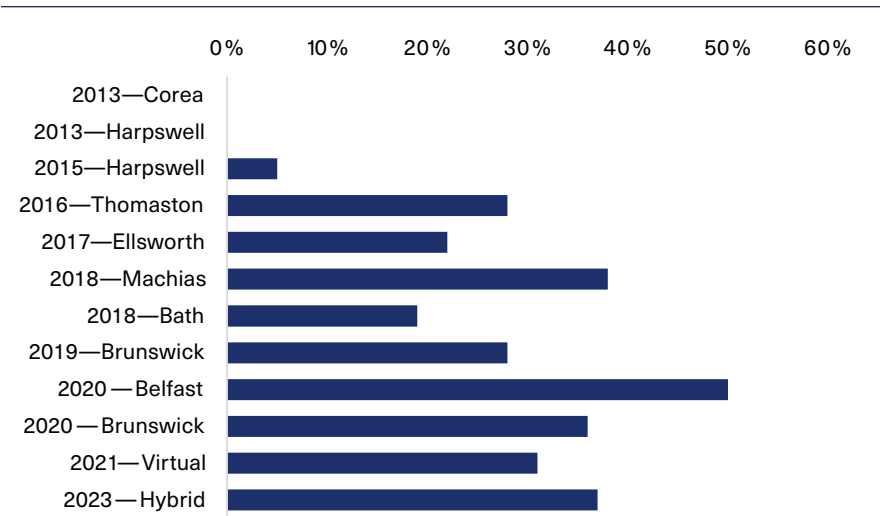
in the Aquaculture in Shared Waters program. With this goal in mind, we analyzed attendance, survey, and interview data collected over the last 10 years of the program. Our observations and data collected indicate that the AQSWS program has served a diverse group of participants in many different ways; however, in other ways its reach has been somewhat limited.

In terms of age, participants attending the AQSWS program ranged from 14 to 88 years old, and of those reporting their age ($n=308$), the average age of adults taking the course (18 and over) was 45 years. This age is younger than the average age of Maine lobster harvesters, which is 54 years. Participants' educational backgrounds ranged from completion of less than high school/GED to postgraduate degrees; of those reporting their education ($n=309$), 39 percent had completed a bachelor's degree and 20 percent held a postgraduate degree. Individuals from different households and family sizes have taken the course; 55 percent of participants reported being married or in a domestic partnership, with 72 percent reporting not having children living at home ($n=269$). Geographically, while most classes have been offered in the midcoast region, program organizers have also targeted communities in Downeast Maine, and participants from across Maine's coast connected remotely via Zoom. Course participants range from those with and without connections to fisheries; although the majority had some connection as this was the target of the program, some individuals reported not having any connection to the fisheries sector. Interestingly, while many participants attended the class with no experience in aquaculture, some individuals were already growing species or holding a lease or license.

Though the course has reached a diverse audience in terms of location, education, and aquaculture experience, past course participants have not been as diverse in regards to gender and race. A review of the attendance and survey data indicated that the program has served predominantly individuals identifying as male and White (Figure 1).² Data regarding race and ethnicity were only collected in 2023; however, they indicate that the majority of participants served by the program have been White (90 percent), with 4 percent identifying as one of the other options provided (pooled for confidentiality), and 6 percent choosing not to share this information. Only 31 percent of participants were women, not counting instructors, guests, and other lecturers. This gender disparity reflects the program’s initial recruitment strategy, which was focused on commercial fishermen, the majority of whom are male although opportunities for women in the fishing industry are generally under-recognized and increasing (Van Allen 2014). Women’s enrollment in the program has increased over time, but the proportion of attendance by women has never exceeded 50 percent (Figure 1).

While women’s satisfaction with the program was generally high across course offerings, comments in the surveys and interviews indicate accessibility issues and the need to better assist women’s entry into aquaculture. Other recommendations from women included the need for hands-on training, especially for those not necessarily from a fisheries background. As one female participant explained, “there’s no good resources for how to really get in on the ground level, and especially geared towards women.” Another set of recommendations involved ensuring more representation of women in the curriculum, as until recently most of the instructors and guest farmers were

Figure 1: *Proportion of Women Attending the Aquaculture in Shared Waters Program, 2013–2023*



male. Training courses with mostly male instructors cause female participants to feel alienated and unwelcome (Lord 2022). One female respondent echoed this, noting that sometimes male instructors’ “demeanor can be off putting and [they] really have to stay centered to hear past it and mine their nuggets of wisdom.” The following observation and recommendation is especially insightful for efforts to enhance DEI in these kinds of programs:

I think [AQSW organizers] need to be better equipped to address the needs that women have, in aquaculture. And they need to be better about encouraging and supporting women being in that space. There just aren’t many—there weren’t many in that class, and I think that that’s due to lots of just inherent systemic reasons.

ACCESSIBILITY CONSIDERATIONS

The mode of course delivery is an important consideration for DEI as it impacts accessibility. As one participant

responding to the 2021 survey observed: “The online format allowed for a number of folks who otherwise would have been unable to attend, to actually take the class.” This fact is seen in attendance, where the 2021 course offered entirely by Zoom had the highest average levels of attendance (87 percent), with the 2020 remotely offered courses in Belfast and Brunswick being slightly lower, but still high (76 percent and 60 percent, respectively). Most participants who responded to the 2020 survey indicated they did not have any trouble with using the Zoom technology. However, for others this made the course material less accessible, with some participants expressing frustration over the technical difficulties of connecting virtually and desire for in-person learning and site visits. In 2023, when the program was offered both in person and online, attendance declined slightly from 2021 levels, and we heard mixed responses regarding the hybrid mode in 2023. Feedback from the class suggests engagement and technical issues reduced some participants’ satisfaction.

Timing of the course is another aspect that affects accessibility for some individuals. Most courses ran through the winter, starting in November, December, or January and ending in the spring (April–May, or as late as June). Fishers repeatedly mentioned the importance of having the course offered not during the fishing season. When the course ran into the commercial fishing season, attendance at the end of the course often declined. For example, in the 2018 Bath course, attendance dropped by between 23 percent and 35 percent at the end of the course in June. If the target of the course is commercial fishers, the timing of the end of the course and the start of the fishing season should be considered. Time of day is important as well: in 2015, there was low attendance in classes held during or very near low tide because of the presence in the class of clambers and other intertidal shellfish harvesters. To allow more participation by these harvesters, classes should be scheduled around high tide, especially in early to mid-spring after the ice is off the flats. Several participants in 2020 commented that having the course in the evenings was difficult and recommended an earlier start time. Feedback from many students indicate that the length of each class sometimes made attending difficult for them. Typically, the course would be held for two to two and a half hours, though sometimes longer. Several students suggested that capping the course at two hours would be best, especially if there were no hands-on activities or field trips. For some, the length of each class was more of an issue for their ability to attend than the number of classes.

The overall accessibility of the information is also an important issue. Participant feedback regarding the content and instructors were generally very positive. As one participant shared in

the survey, “This program provided all encompassing information and training on aquaculture. I have really learned a lot, and feel I can use this information in the future.” Some students who felt overwhelmed with the number of PowerPoint slides or length of lectures, however, also expressed very positive views about the thoroughness of the content. Suggestions were made to tighten the syllabus and lectures; as one participant wrote: “There was a ton of info and I appreciated that, but a lot of the biology could have been presented much more succinctly.” In surveys, participants consistently asked for more hands-on material and field trips. Interviews suggest these activities were viewed as more effective than lectures and slideshows, especially by participants who had not been in school recently. One respondent noted that “it felt very classroomy and a lot of the fishermen aren’t classroomy.” Another lamented that the “digital take home material was not very accessible.” Field trips were appreciated and considered an essential form of content delivery. Guest lectures were especially praised, especially lectures by farmers who shared their experience. Given the volume of material covered and learning styles, some students expressed a desire for more conversation with the instructors and other class members to help process information shared, as well as to network and build collaborations. Indeed, frequent suggestions to improve the course echoed the participant recommending: “More time for participants to share stories, ask questions, build relationships, network.” A similar, and specific recommendation was for “an optional social 30 minutes before class so people can discuss topics and progress as they proceed through the class.” The program organizers responded to these suggestions to the best they could in the COVID-19 and post-COVID-19

environment; for example, the 2023 program included an optional dinner before class.

SUMMARY: LESSONS LEARNED AND RECOMMENDATIONS

The Aquaculture in Shared Waters training program has served an impressive number of individuals over the last 10 years. Instructors have delivered content to participants across Maine’s coast and both in person and online, to experienced and novice farmers, to those within and outside of fishing, to men and women, and to those wanting to be commercial farmers and to researchers and hobbyists. The program organizers are committed to improving the course, as evidenced by investments in social science research to better understand opportunities to enhance DEI in the program, as well as modifications made to the course over the years in response to participant feedback.

Lessons from the AQSW research suggests efforts to enhance DEI in these kinds of programs should consider logistical issues such as course locations, class lengths, and format and delivery of the course content, as well as course content. As Maine seeks a diverse, equitable, and inclusive blue economy, investment in future training should consider and address the diverse motivations and needs of potential new entrants into the sector, including women and other minority groups. A single course will unlikely accommodate all needs. One respondent expressed frustration with a diverse classroom, noting: “Some participants were obviously not new to the business and their in-depth questions tended to confuse the issues.” Novice farmers may feel intimidated by experienced farmers, and having the same material for experienced and novice farmers may leave one

or both groups lacking the training they need. Our research also suggests the content and delivery geared towards men may not meet the needs of women farmers. We suggest aquaculture training programs should make more effort to consider the needs of subgroups within the classroom, or possibly target classes to more homogenous groups (e.g., courses for women). Although there is increasing interest in enhancing DEI in the aquaculture sector, there is a significant data gap regarding the involvement of minorities in Maine. The AQSW program has aimed to address this challenge through the inclusion of social science researchers. Finally, this study reminds us that representation matters to advancing DEI, so training programs should strive to include a diversity of instructors and guest speakers. Continuing to broaden the representation of the aquaculture industry may encourage other minority groups to seek careers in the industry.

NOTES

- 1 Examples of other aquaculture training programs include the Island Institute's Aquaculture Business Development (ABD) Program (<https://www.islandinstitute.org/ii-solution/aquaculture-business-development-program/>), which ran from 2016 to 2019; the Aquaculture Top Gun (<https://www.gmri.org/projects/aquaculture-top-gun/>) entrepreneur development program, sponsored by FocusMaine, which was held in 2018 and 2020; and the Maine Shellfish and Seaweed Aquaculture Apprenticeship program (<https://maineaqua.org/apprenticeship/>) started in 2023.
- 2 To determine gender of class participants, the team reviewed data collected in pre- and postcourse surveys, electronic news articles, and social media or business websites. Instructors also helped identify several individuals for whom gender was not identifiable based on existing information. It is recognized that these may not reflect preferred gender identities of some participants. Future course registrations and surveys should aim to collect these data more accurately.

REFERENCES

- Acheson, James, and Ann Acheson. 2020. "What Does the Future Hold for Maine's Lobster Industry?" *Maine Policy Review* 29(2): 83–90. <https://doi.org/10.53558/JQMB2317>.
- Johnson, Teresa R. 2020. "Reflecting on Maine's Changing Productive Coastal Region." *Maine Policy Review* 29(2): 91–97. <https://doi.org/10.53558/NTJY6080>.
- Lord, Natalie. 2022. "A Rising Tide? The Role of Alternative Networks for Women Oyster Farmers in Maine and New Hampshire." Masters thesis, University of New Hampshire. <https://scholars.unh.edu/thesis/1649/>.
- Sadusky, Heather, Christian Brayden, Gayle Zydlewski, and Sebastian Belle. 2022. *Maine Aquaculture Roadmap 2022–2032*. Maine Aquaculture Hub.
- Van Allen, Jennifer. 2014. "Maine Women Welcome a Sea of Opportunities." *Portland Press Herald*, October 5, 2014.

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