Feasibility of a Commercial Mussel Hatchery in Maine

Final Report

Introduction

While wild blue mussel (*Mytilus edulis*) harvesting accounts for most of the landings of mussels in Maine, mussel aquaculture is a small but stable sector of Maine's aquaculture industry. Farmed mussels can be sold at a premium compared to wild harvested mussels, since they are considered to be higher quality with a superior taste. While farmed mussels only accounted for roughly a third of total mussel landings in 2025, they made up nearly 90% of the entire fishery's value ($5.64 million out of total $6.37 million; DMR 2025). Mussel farms in Maine utilize both suspension and bottom culture and are located from Casco Bay to Bar Harbor.

High market demand

Maine's mussel aquaculture industry is well-positioned for growth. The Gulf of Maine Research Institute's *Farmed Shellfish Market Report*, published in 2024, shows domestic demand for blue mussels exceeding supply. The report estimates that the Maine farmed mussel industry can grow approximately +30% over the next 5 year planning horizon, and that demand for aquacultured Maine mussels is projected to increase approximately +40% above current supply by 2028. The expansion of the industry in Maine will be determined by the growth of existing farmed mussel operations (either by increasing output per acre and/or lease acreage expansion) and by the establishment of new businesses, although this projected growth may be a challenge to achieve due to long wait times for new aquaculture lease applications. Competition with Canada for the US domestic market is a barrier to expansion, with close to two-thirds of the US supply currently sourced from Canada due to a $0.50/lb cost advantage over domestic mussels (Farmed Shellfish Market Report, 2024).

Mussel seed supply

Despite the opportunities for growth, farmers are becoming concerned about increasingly inconsistent mussel seed supply. Historically, the Maine mussel industry relied on the collection of wild mussel seed for stocking farm sites. Blue mussels typically spawn in the late spring and spend about two weeks in the water column before settlement. Mussel growers place spat collectors in the water just before maximum spatfall is predicted. Mussels settle on collectors and attach using their byssal threads and remain on the collectors until the mussels grow to about a half-inch in length, at which point they are stripped and either socked onto growout lines or seeded on the bottom at appropriate stocking densities for growout (Morse & Rice, 2010).

Over the last few decades, industry members and researchers have noted a significant decline in wild blue mussel abundance and reduced recruitment of wild spat in the Gulf of Maine (Sorte et al. 2017). Given that both wild and farmed mussel landings in Maine are currently heavily dependent on the recruitment and survival of wild mussel spat, population decline poses a major threat to both sectors. In response to this, there has been growing interest and demand for hatchery reared mussed seed.

The Downeast Institute's mussel hatchery

The Downeast Institute (DEI), a nonprofit marine research laboratory and education center located in Beals, Maine, operates a mussel hatchery that produces pre-seeded mussel ropes of Maine Gold™ mussels for Blue Hill Bay Mussels, a local mussel farm. Mussel hatchery techniques were developed at DEI when mussel farmer Evan Young of Blue Hill Bay Mussels approached Dr Brian Beal at DEI about producing mussel seed after several years of failed mussel sets on his collectors. Since then, this technology has been optimized at DEI and through selective breeding, a strain of mussels with golden shells and high meat yield (Maine Gold™) has been developed for Young's farm. However, the demand for mussel seed has increased in recent years as other operations in the state have experienced unpredictable sets, requiring a scale of production beyond what DEI is able to produce. This has prompted a collaborative effort between DEI and the Maine Aquaculture Innovation Center (MAIC) to explore the feasibility of expanding hatchery reared mussel production in the Northeast as a standalone, commercial operation.

Scope of work

DEI and MAIC received funding from the Builders Initiative to initiate industry conversations about the feasibility of a commercial mussel hatchery. Two meetings were held: a mussel hatchery roundtable with Maine mussel producers, held virtually in October 2025; and a mussel hatchery session at the Northeast Aquaculture Conference & Exposition in January 2026. Following the meetings, informal phone interviews and an anonymous survey were conducted with industry members and hatchery operators to collect data about willingness to pay for hatchery products.

Industry Roundtable

On October 29, 2025, the Maine Aquaculture Innovation Center and the Downeast Institute convened a virtual, 2-hour roundtable with five mussel aquaculture industry members. After a short introduction to the project, participants were asked to discuss a series of preprepared questions (Appendix A) about the level of interest in a commercial hatchery source for mussel seed. The conversation is summarized below.

Results

Mussel aquaculture industry members have experienced inconsistent spatfall across sites, posing a significant threat to the stability and profitability of their businesses. Spatfall is plentiful and cheap to collect in good years ($2/rope), resulting in farmers being reluctant to commit to the costs of hatchery-produced seed.

Despite this cost, farmers agreed that a mussel hatchery will be needed, especially in the future as the climate, and water quality, continues to change. Farmers are especially concerned about ocean acidification and its effects on larval survival. Beyond the consistency and assurance provided by a hatchery, farmers agreed on other benefits of a hatchery, including the ability to breed selectively for desired traits, including fast-growth, byssal thread strength, high meat yield, and temperature tolerance. Seeded ropes seem to be the most desired hatchery product. This would be more expensive to produce than eyed larvae, but cost would decrease with production level.

One challenge to implementing hatchery seed on farms is the nursery phase. Juvenile mussels on ropes need a warm, calm farm site with little current or disturbance from tides for fast growth. Blue Hill Bay Mussels' unique farm site, which is located in a salt pond, provides these ideal conditions for the growth of spat and contributes to the farm's success. Farmers agreed that to make a hatchery financially viable, enough farmers would need to commit to seeding a percentage of the farm from hatchery-grown seed while maintaining wild collection of spat. This would likely involve an advance purchase agreement to guarantee that the hatchery would be economically sustainable. One next step is to develop a business plan for a mussel hatchery that costs out the price of seed at different production levels and the cost of producing seed to determine viability. Farmers are also interested in increased monitoring of wild spatfall and changing ocean conditions.

Mussel Hatchery Feasibility Workshop

The mussel hatchery feasibility workshop, held during the Northeast Aquaculture Conference & Exposition (NACE) in January 2026, expanded upon the grower roundtable by including the perspectives of NACE attendees. The workshop began with a series of short presentations: Kyle Pepperman, Executive Director of the Downeast Institute, delivered a short presentation on the hatchery techniques used to produce blue mussel spat at the Downeast Institute. Carissa Maurin, Aquaculture Program Manager at the Gulf of Maine Research Institute, presented a summary of the Farmed Shellfish Market Report. Lastly, Sydney Avena of the Maine Aquaculture Innovation Center gave a summary of the conversation that occurred during the October industry roundtable discussion. Following these presentations, Pepperman facilitated a panel

discussion on the same questions discussed in the industry roundtable.

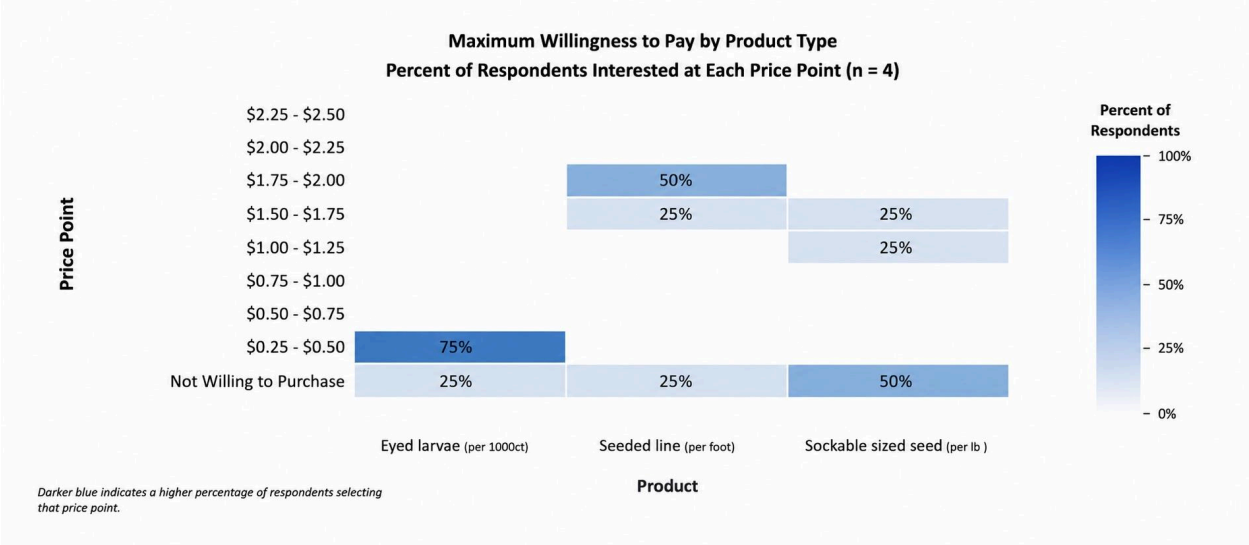
Results

The workshop drew approximately 20 participants consisting of aquaculture industry members, support nonprofits, and researchers. Only two mussel growers, Evan Young and Alex de Koning, were able to join the panel discussion due to illness and travel complications. de Koning described Hollander & de Koning's 80-acre mussel operation that produces over one million pounds annually. He highlighted growing challenges with inconsistent wild seed recruitment since 2005, including recent shifts in timing (e.g., winter sets). Young and Pepperman noted that mussel seed produced in DEI's hatchery and grown out on Young's farm achieves about 52% meat yield compared to much lower regional benchmarks, despite faster growth producing thinner shells (breakage remains under 1%). Farmers face barriers to developing their own hatcheries due to high costs, seasonal use, and scale limitations, while existing shellfish hatcheries prioritize more profitable Eastern oysters and would require significant infrastructure expansion to meet the scale required to produce mussels. Operationally, survival improves when seed is transferred to warmer, calmer waters, and the use of fuzzy looped lines has shown better settlement success.

Willingness to pay survey

Following semi-structured interviews, a willingness to pay survey was circulated among participants to determine what sorts of products participants would purchase from a hatchery and at what price (n = 5; Appendix B). The most desired hatchery products was seeded line (80%), followed by eyed larvae (60%), and sockable-sized seed (40%). Farmers were willing to pay $0.25 - $0.50 / 1000ct for eyed larvae, $1.75 - $2.00 / foot for seeded line at 500-2,000ct per foot, and $1.00-$1.75/lb for sockable-sized (12 mm) seed (see Figure 1). While a direct comparison to oyster seed prices is difficult due to differences in production and scale, eyed oyster larvae cost on average $0.50 per 1,000ct and 12 mm oyster seed (the closest comparison to sockable-sized mussel seed) costs on average $46.63 per 1,000ct.

Figure 1. Willingness to pay by Product Type



All mussel farmers responded that they would commit to purchasing at least 50% of their seed from a hatchery ahead of the season if seed prices were within their acceptable range. Sixty percent of farmers responded that they would consider 11-15% of their gross revenue acceptable to spend on seed, while 40% responded that they were willing to spend 0-5% of their gross revenue.

Opportunities, challenges, and areas for future research

Conversations with mussel industry members, researchers, and industry support groups as part of this project highlighted important opportunities, challenges, and areas for future research.

Opportunities

Selective breeding & genetic diversity: Participants agreed that a mussel hatchery in Maine has the potential to improve resiliency and encourage growth of the mussel aquaculture sector. Selective breeding for desirable traits, which has already been proven with the Maine Gold™ line, is a valuable addition to the hatchery process. Developing strains with traits such as fast growth, byssal thread strength, high meat yield, and temperature tolerance can increase yield and efficiency of farms, as shown by Blue Hill Bay Mussels.

However, preserving the genetic diversity of wild mussel populations was considered during industry conversations. Unlike the oyster aquaculture industry, there are interactions between established wild mussel populations and cultured animals. Developing selectively bred lines has the potential to decrease the genetic diversity of wild populations through these interactions. Nonetheless, mussel farmers were not significantly concerned with the potential reduction of genetic diversity because farmed mussels could introduce beneficial traits, such as temperature tolerance, to wild populations to increase their resiliency.

Restoration: Another potential application for hatchery-reared mussel seed is wild mussel bed restoration. Current intertidal mussel populations in the Gulf of Maine have declined by more than 60% compared to benchmarks recorded in the 1970s (Sorte et al. 2017), however, it is not yet known whether wild mussel beds are in decline or simply moving to deeper, subtidal areas as temperatures warm (GMRI). Large beds go through natural cycles, where silt and shell build up as mussel larvae settle onto existing reefs, and can be broken up during large storms or heat waves (Maine DMR 2022). However, commercial harvesting and the impacts of climate change including warming temperatures, increased storm activity, and species invasions may be negatively impacting populations (Sorte et al. 2017). More research is needed on the status of wild mussel beds in the Gulf of Maine before widespread restoration efforts can occur, but nonetheless this presents an opportunity for hatchery-reared seed that could be set on biodegradable lines. Researchers noted that mussel spat intended for restoration purposes would need to be from broodstock that is native to the restoration areas instead of strains bred for production to preserve the genetic integrity of wild populations. There would also need to be some form of protection for the bed from wild harvest.

One successful example of mussel restoration comes from New Zealand, where researchers and Māori partners deployed biodegradable lines (taura kuku) as spat collectors for green-lipped mussels (*Perna canaliculus*). The biodegradable lines lasted 3-5 months attached to the raft before falling with the mussels intact to the seafloor, resulting in three new early-stage mussel beds within close proximity of the restoration stations (Paul-Burke et al. 2022).

Predation is a major challenge to any restoration project. Mussel seed would need to be large enough (10-20 mm in length) to withstand predation, primarily from green crabs and especially if seed was transplanted in the subtidal zone. One potential solution would be to increase the shell thickness of mussel spat, either through strain selection or conditioning. Hatchery-reared mussels for aquaculture production typically have thinner shells compared to their wild counterparts since blue mussels in the DEI hatchery are selectively bred for meat yield, diverting energy away from shell growth.

The permitting required for restoration would also have to be considered. In Maine, there is no distinct permitting process for shellfish restoration projects in state waters and any restoration project would likely have to go through the permitting process that exists for shellfish aquaculture, or be done in conjunction with a municipal shellfish conservation program (Kraitchman 2025). This presents a potential barrier due to the restrictions and regulations placed on shellfish aquaculture permits.

Challenges

A major challenge is obtaining commitment from farmers to purchase a set volume of mussel seed each season. Conversations with potential customers would have to be conducted well in advance of the hatchery season to determine interest. Advance purchase agreements between the hatchery and customers are needed to ensure there is enough revenue to cover hatchery expenses and staff salary. A mussel hatchery would also have to be able to produce volumes needed at scale, resulting in a high start-up cost. The problem of scale was cited as the biggest

challenge for developing a mussel hatchery in the willingness to pay survey. A scaled-up farm would be a good candidate for having a single-farm sized hatchery (with potential to grow) that could avoid the financial constraints of a stand-alone hatchery that depends on customers. The vertical integration model may reduce the risk involved in starting a hatchery, and allow a hatchery to begin with smaller production levels before scaling.

Another challenge is workforce training, as shellfish hatcheries require a team of dedicated staff highly trained in hatchery and biosecurity techniques. Shellfish hatcheries are typically seasonal endeavors, but hatchery staff would require year-round employment to retain talent and knowledge within the enterprise. One potential solution would be to incorporate a nursery operation into the hatchery, which would result in a larger and more expensive product but would also enable farmers to stock production rafts directly without needing a separate nursery site.

The nursery phase of hatchery seed is also a challenge to consider. Fragile mussel seed requires calmer, warmer waters than larger mussels, and tend to fall off lines in areas with high currents or large tides. Therefore, nursery sites would need to be established for the initial growout either by the farmer, the hatchery, or an intermediate third party. Salt ponds, as used by Evan Young at Blue Hill Bay Mussels, were noted to be particularly effective for the growout of mussel seed. A scoping exercise to find appropriate nursery sites may be a necessary step in developing nursery culture for hatchery-reared seed.

Areas of future research

One next step for establishing a mussel hatchery is to conduct an economic analysis with information from the willingness to pay survey to determine the break-even point of a commercial operation. Industry members also identified the need for ocean acidification research as “essential”, as growers anecdotally report smaller mussel sets and eroded shells. Ocean acidification research on mussel sets is an acute need in the near future and will likely determine farmer’s willingness to purchase seed at volume from a hatchery.

Conclusion

This preliminary investigation concludes that the time is right for a commercial scale mussel hatchery in Maine. The Downeast Institute (DEI) has demonstrated the feasibility of a mussel hatchery by developing hatchery protocols and selectively-bred lines for cultivation. Mussel industry members agree that the increasingly unpredictable spat falls necessitate a hatchery source for mussels, as well as more research to determine the causes of this variation. Other opportunities include mussel restoration projects, as more data is collected about shifting mussel beds in the Gulf of Maine. The establishment of a commercial mussel hatchery in the near term will support the resilience and growth of the mussel aquaculture sector amid changing environmental conditions.

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Appendices

Appendix A: Industry roundtable discussion questions

These questions were also used to guide the discussion at the NACE workshop.

1) Current state of wild spat collection
    a) Have you noticed any trends/changes in spat collection over the past decade?
        i) Geographic trends/changes?
        ii) Temporal trends/changes? i.e. year to year; seasonality
        iii) Reliability? Consistency? Quality? E.g. changes in survival, growth rate, shell thickness, meat quality?
        iv) Have you changed your spat collection methods (timing? equipment? place?) at all in response to changes?
2) Is there interest in a mussel hatchery for sustaining or growing your business and why?
3) What could a mussel hatchery look like?
    a) What is the product you are looking for out of the hatchery? The product out of the hatchery will determine the site and setup.
        i) Eyed larvae ($)? Seeded lines ($$)? Seed ready to be socked ($$$)?
    b) What sort of strains are you interested in? What traits are desirable and why? Ex. Heat tolerance, stronger byssal threads, thicker shell
    c) What is seed collection currently costing you?
    d) What percentage of your operating costs could you dedicate to hatchery costs? (Oyster comparison info below)
    e) What could it look like? Large standalone hatchery, many smaller ones, cooperative, what is the ideal model?

Appendix B: Willingness to pay survey questionnaire

The following questions are about a **hypothetical commercial hatchery** producing mussel seed for purchase. We are trying to get a sense of what farmers would be willing to pay for seed and how much they would commit to purchasing.

What product(s) would you be most interested in from this mussel hatchery?

- Would not purchase hatchery products for mussel farming.
- Eyed larvae
- Seeded line
- Sockable-sized seed
- Other:

Suppose this hatchery can reliably supply the following products of consistent size and quality. What is the maximum price you would be willing to pay per unit?

- Eyed larvae

    - Not willing to purchase
    - $0.25 - $0.50 per 1000ct
    - $0.50 - $0.75 per 1000ct
    - $0.75 - $1.00 per 1000ct
- Seeded line (500-2000ct per foot)
    - Not willing to purchase
    - $1.50 - $1.75 / foot
    - $1.75 - $2.00 / foot
    - $2.00 - $2.25 / foot
    - $2.25 - $2.50 / foot
- Sockable sized seed (ct variable based on requested size)
    - Not willing to purchase
    - $0.50 - $0.75 / lb
    - $0.75 - $1.00 / lb
    - $1.00 - $1.25 / lb
    - $1.50 - $1.75 / lb

If seed prices were within your acceptable range, what percentage of seed would you commit to purchasing from a hatchery ahead of the season?
0% to 100%; in increments of 10%

What percentage of your gross revenue would you consider acceptable to spend on seed?

- I would not purchase hatchery seed
- 0% - 5%
- 6% - 10%
- 11% - 15%
- 16% - 20%
- 21% - 25%
- 26% - 30%
- Other:

In your opinion, what is the biggest challenge to developing a successful mussel hatchery in Maine?