Expanding sustainable shellfish aquaculture: Optimizing growth and survival in a bay scallop nursery system

SARE PROJECT FNE16-861

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Project Location

Cape Cod, Massachusetts

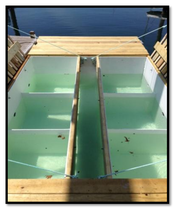
Red Box: Megansett Harbor, North Falmouth

White Boxes: 10 acre growout area

Ward Aquafarms, LLC, is located in North Falmouth, and the farm covers a total of 10 acres spread across 3 sites in Megansett Harbor and adjacent Fiddler's Cove. The farm produces eastern oysters (*Crassostrea virginica*), quahogs (*Mercenaria mercenaria*) bay scallops (*Argopecten irradians*), and sugar kelp (*Saccharina latissima*).

Background

The bay scallop (*Argopecten irradians*) commercial fishery in New England which was once robust and profitable for fishermen, has been in rapid decline since the 1980's due to overfishing, habitat loss, and coastal water quality degradation. Over the past decade there has been a renaissance in shellfish production throughout New England, though the oysters and clams are now being produced through farming instead of through wild harvest. Shellfish farmers are currently seeking new species to grow, in order to increase revenue and diversify risk, and given the high market demand for bay scallops combined with a lack of significant wild supply, they are an ideal aquaculture candidate.



Left: Floating downweller constructed by Ward Aquafarms in 2016. Three silos on either side of a central trough (6 total).

Right: Each silo can hold 6 trays (36"W x 36"L x 4"H)

However, current bay scallop aquaculture techniques are not efficient, lead to high mortalities, high labor and gear costs, and therefore, further investigations into the nursery, as well as the growout and overwintering phases, are needed to help make bay scallop aquaculture viable. Ward Aquafarms starting farming bay scallops in 2014, and they quickly realized that simply copying existing oyster farming methods was not going to work to produce scallops. In 2015 Ward Aquafarms designed and constructed a floating downweller system for the bay scallop nursery phase, which greatly improved survival and growth, leading to much more efficient techniques. In 2016, Ward Aquafarms further investigated optimization of the nursery phase to increase cultivation viability, with the goal of faster growth rates, higher survival and higher stocking densities.

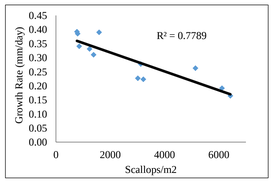
Methods

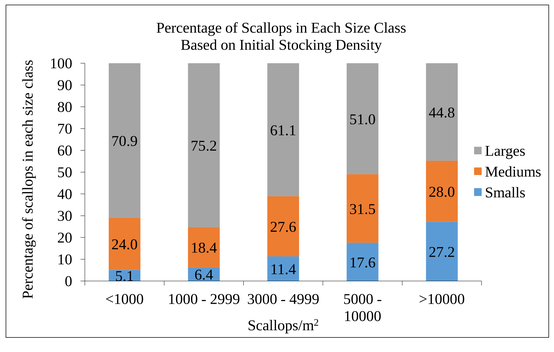
Four different initial stocking densities were compared over three, two-week sampling periods throughout the nursery season. Given that the downwellers increase water flow, and maintain enhanced flow rates, and therefore higher food availability, we increased the stocking density in the four treatments to either 2X, 4X or 8X standard stocking density (1:2:4:8 ratios) as compared to the published stocking densities for a system without augmented flow. Scallops were grown in downweller systems for 10 weeks from July through September, with sampling starting after two weeks of acclimation to the system. Every 14 days, all of the twelve stocked silos were assessed in an identical manner. Incoming water flow was sampled for flow rate and food (microalgae) availability as the water entered the downweller, after which, all of the nested trays holding the bay scallops were removed from the silos. Scallops from each silo were then graded to separate size classes. Once separate, shell heights were recorded for twenty individuals per size class, individual counts were taken of live scallops per 100 ml, total volumes were recorded for each size class for each individual silo.

Clockwise from upper left: Scallops after 7 days in downweller system (Shell height 5 mm); 24 days in downweller (SH 10 mm); 48 days in downweller (SH15 mm); 60 days in downweller (SH 22 mm).

Results and Conclusions

Starting number of scallops/m²	Percent Survival
900 - 2000	83.9 ± 9.5
2300 - 3600	85.9 ± 3.9
4500 - 5000	85.3 ± 11.6
7200 - 9500	82.9 ± 6.6
>18000	77.9 ± 11.0





Initial stocking densities ranged from 900 scallops/m² to 36,626 scallops/m², which resulted in survival ranging from 77.9% - 86.2% and growth rate range from 0.05 mm/day – 0.70 mm/day. Flow rates between the silos ranged from 1,478 cm³/sec – 5,666 cm³/sec, though there was no correlation between flow rate and growth or survival. As is common in the natural environment, there was high variability in observed chlorophyll a and phycocyanin values, which resulted in either no correlation, or a weak relationship between available microalgae and production statistics.

Provided there was sufficient available food, initial stocking density (scallops/m²) was shown to be the primary factor which determined growth rate and survival. It was demonstrated that with augmented water flow, bay scallops can be grown at very high densities, with no apparent decrease in growth or survival until the stocking density exceeds 18,000 scallops/m², at an average shell height exceeding 11.8 mm. The results indicate that as the initial stocking densities are increased, overall bay scallop growth decreases; however, stocking density did not have significant effect on survival, as very little mortality was seen at any stocking density during the entire nursery phase. Neither flow rates nor food availability proved to significantly impact growth or survival of bay scallops at any tested stocking densities. Due to the successful SARE project, Ward Aquafarms has been able to increase bay scallop seed production, which has allowed many other farmers in New England to farm bay scallops as well. This increase in aquaculture production will help increase farm revenue, and reduce risk due to increased stock diversification for farmers in the northeastern United States.

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