Project Progress Report

Award Number: NA10NMF4270214

Reporting Period: 06/01/2013 – 11/30/2013

We continue to determine best methods for rearing sea scallop larvae to produce sufficient spat for coastal stock enhancement programs. To date, we have encountered inconsistent results using similar methodologies with: 1) larval rearing; 2) metamorphosis; and, 3) juvenile growth and development. During this period, sea scallop broodstock were induced to spawn on three occasions (5/15; 10/27; and 12/10).

15 May 2013: Larvae were reared for 48 days at temperatures between 12-14^{o}C. (This process involved the use of multiple 400 L tanks that were inspected daily, larvae fed each day a 1:1:1:1 mix of *Isochrysis galbana*, *Chaetoceros muelleri*, *Rhodomonas salina*, and *Tetraselmis maculatus* totaling 30,000 cells ml^{-1}, and tanks drained every other day using a series of sieves [64-125µ]). This rearing period was among the longest intervals that individuals remained as larvae since we began our investigations in 2010. On 2 July, we determined that larvae were ready to settle to the bottom and metamorphose by the presence of a relatively large foot. In the past, we had used trays lined with 125-micron Nitex screening for this step; however, this substrate did not seem heterogeneous enough to stimulate many individuals to settle. During this same time, we have been investigating culture scenarios for blue mussels, *Mytilus edulis*, and found that this species will settle quite nicely on various types of rope (Fig. 1).

Figure 1. Various rope types used for experiments with settling blue mussels. In July 2013, we used similar ropes to determine whether sea scallop larvae would successfully metamorphose onto ropes.

We hypothesized that similar types of ropes would be suitable for scallop settlement, and tested this hypothesis by stretching ropes on a PVC frame that was positioned in each of four 400-L conical tanks. Approximately 100,000 animals were placed into each tank with the rope configuration (Fig. 2).

Figure 2. PVC frame used to stretch ropes across. One frame was placed into each of four 400-L conical tank at the same time larvae were beginning to settle out of the water column. We hypothesized that rope surfaces would provide a substrate that would encourage larvae to metamorphose.

Over the next month, water was drained in each tank every other day, and a similar algal diet fed to the developing juveniles.

On 12 August, the rope units were moved into a large, flow-through tank (35,400 liters) where the scallops were allowed to feed on natural phytoplankton until August 12th. Several days later, the ropes were removed from the tank and inspected for the presence of spat. We observed relatively large numbers of scallops approximately 0.5-1 mm in size. The number of scallops was difficult to estimate but a conservative estimate was approximately 100,000 animals/unit. During the next month, the units remained in the flow-through tank and were then moved to a smaller system (1,300 liter tank) with a flow through water system where the diet of the juvenile scallops could be enhanced daily with cultured algae with additional natural algae which entered the tank via the flow through system.

In October the animals were removed from the ropes by vigorously shaking the rope units over seawater in the 1,300 liter tank. Half of the animals were placed on floating trays in the tank and half were allowed to reside on the bottom of the tank. In November all animals were

moved to floating trays for ease of handling. Some losses occurred after animals were removed from the ropes. Approximately 200,000 animals remain from this spawning. These are being held in trays in the hatchery over the winter and are fed daily.

27 October 2013: We induced broodstock to spawn, and reared larvae for three weeks (14-15^{o}C), at which point all larvae died due to stalked ciliate infestation. The infestation apparently occurred from accidental transfer/spawning of epibenthic ciliates on the external shell surfaces of the broodstock. That is, stalked ciliates on the shell of some of the broodstock apparently spawned while the scallop broodstock were being induced to spawn. Typically, broodstock shells are washed for several minutes in a 10% Betadyne solution prior to inducing spawning. And, while this biosecurity measure was performed on the broodstock, the length of time or concentration of the microbicide was insufficient to kill all ciliates. Another hypothesis is that the larvae of the ciliates entered through the water lines and filter system; however, larvae of other species (*Mercenaria mercenaria*, *Mytilus edulis*) that were being cultured in the facility at the same time showed no signs of ciliate intrusions.

10 December 2013: We induced broodstock to spawn, and sieved the eggs from the females in an attempt to remove/remediate ciliates. Approximately 12 million larvae remain from an initial spawning that produced 20 million fertilized eggs. At this time, larvae are 20 days old (Fig. 3, 4; see http://www.youtube.com/watch?v=aSGFDFKYWXY for a video of the larvae taken on 12-29-2013), and we are hopeful that, barring unforeseen circumstances, these larvae will continue to do well under the current culture conditions and settle onto rope sometime in January 2014. We feel confident that the ropes used for mussel culture will provide an excellent substrate for scallop settlement and intend to use that same method of settlement in 2014. We intend to continue to examine different types of ropes to build upon our success using ropes to settle scallop larvae from trials conducted during Spring 2013,

We intend to move ropes with settled sea scallop juveniles into field trays once animals have attained sizes of 2 mm rather than trying to grow them in tanks due to large losses associated with handling. Future work will examine methods to grow out the juveniles under field nursery conditions to produce animals that are large enough to transfer to the bottom.

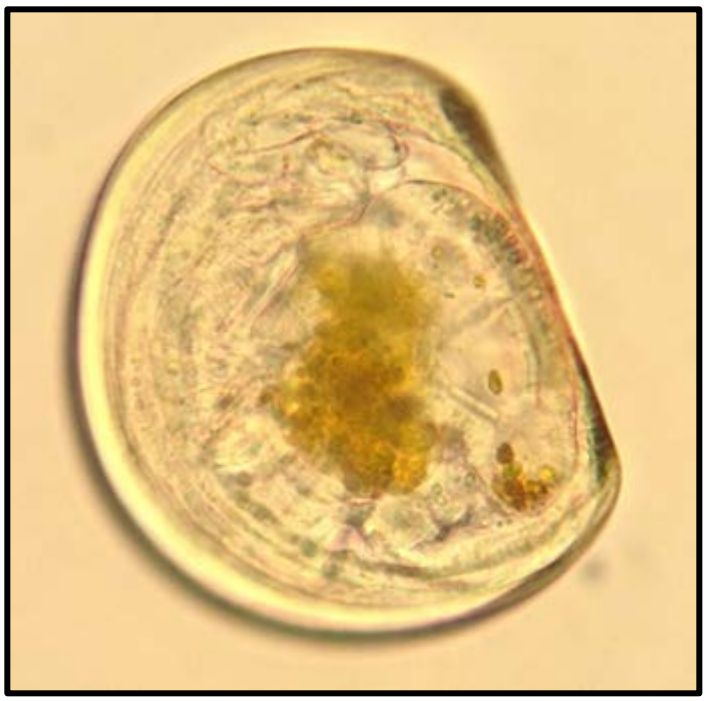

Figure 3. 20 day-old sea scallop larvae. Photomicrograph taken on 12-29-2013 at the Downeast Institute. The D-veliger width (from umbo to ventral margin) is approximately 100-microns. The dark object in the center is the gut filled with algal cells that are being digested.

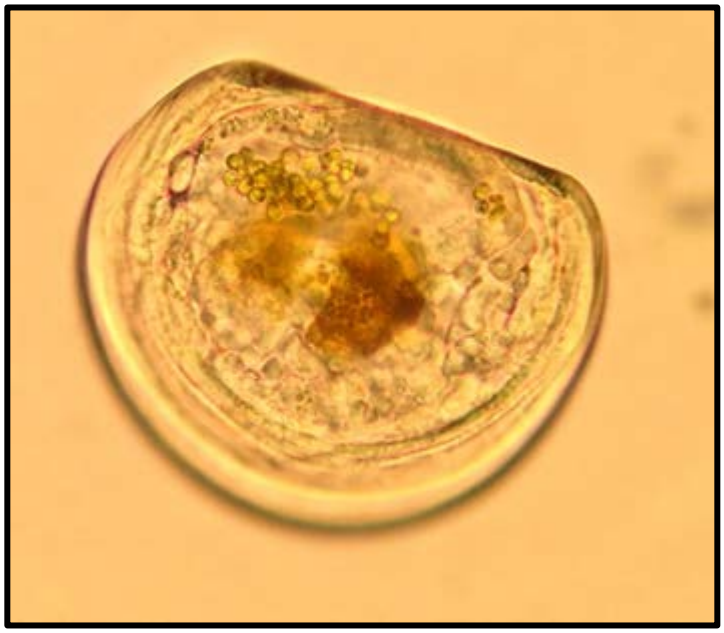

Figure 4. 20 day-old sea scallop larvae. Photomicrograph taken at the Downeast Institute on 12-29-2013.