# Performance Progress Report - NA10NMF4270214

Title: **Enhancing Sea Scallop Stocks in Eastern Maine through Applied Aquaculture Research and Technology Transfer**

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Project Period: **June 1, 2010, through June 30, 2013**

Report Period: **June 1, 2012 through November 30, 2012 (Fifth Progress Report)**

## New Project Objective:

To develop culture techniques in both the hatchery environment and our field nursery site to create repeatable, effective methodologies for mass culture of sea scallop spat and juveniles.

## Activities from 1 June 2012 through 30 November 2012

Beginning in early June, we collected broodstock every two months from the waters of Cobscook Bay to go with our existing broodstock. To induce animals to undergo gametogenesis at schedules consistent with culture conditions, we manipulate both food and temperature. The shells of animals are immediately brushed to remove fouling organisms, and are then are placed into conditioning tanks making sure not to mix male and females, as we have found that if both sexes are placed in the same tank, sometimes uncontrolled spawning events occur. Beginning at 10$^{o}$C, we drop the temperature to 6$^{o}$C for the first week, then increase over a 10 to 12-day period back to 10oC, and then keep temperature at/near 10$^{o}$C for 35-40 days that it takes to fully condition animals. This conditioning occurs in the new "boreal aquaculture" room that was built at DEI at the beginning of the project. Scallops are fed daily a mixed diet of equal parts of six unicellular microalgae: three diatoms, one prymnesiophyte, and one cryptomonad (*Thalassiosira weissflogii* [CCMP 1336; ACTIN], *Skeletonema marinoi*[= *costatum*] [CCMP 1332; SKEL], *Chaetoceros muelleri* [CCMP 1316; CHGRA], T. *Isochrysis galbana* [CCMP 1324; TISO], and *Rhodosorus marinus* [CCMP 1338; RHODO]). Algae are reared daily under clean conditions beginning with sterile transfers in 125 ml flasks, and subsequent transfers to 500 ml, 3000 ml, and 5-L carboys (Fig. 1, 2). Broodstock are fed from carboys.


**Fig. 1. 500 ml flasks of cultured microalgae**

**Fig. 2. 5-Liter carboys with cultured microalgae**

The broodstock scallops are held in trays in the boreal culture room (Fig. 3), and once they have completed the conditioning process (a general inspection of the gonads shows that fully mature males have a cream white gonad whereas females have a darker red or orange coloration; Fig. 4), are stimulated to spawn by physical stimulation (flowing seawater; vigorous air bubbling; or removal from the seawater for a period of 5 minutes, and then placing them back into the tank)

**Fig 3. Broodstock held on floating tray inside tank at DEI**

**Fig. 4. Male scallop (left) and female (right) that are fully mature after 35 days of conditioning at DEI.**

The conditioning phase of culturing sea scallops appears to be straightforward, as we have encountered few problems, and the methods described above have worked consistently over the past year. It is rearing the larvae that is the bottleneck in the production of sea scallop spat, and this phase has not been as straightforward or successful during the past six months.

To date, we have produced approximately 30,000 sea scallop juveniles since the beginning of this Report Period. Although this is an order of magnitude greater than what we have accomplished in the past, it is two orders of magnitude less than what we have set as a goal. Our goal is to rear, at minimum, one million juveniles for stock enhancement purposes. After losing 100% of the larvae from two separate spawnings (one in late July after 22 days in culture, and the other in early September after 19 days in culture), we were successful in getting larvae to settle onto pieces of Netron®, a plastic mesh that we have used in the collection of wild spat, that was added to the larval tanks on day 34 (in late September; Fig. 5).

The juveniles we have reared are currently overwintering in several floating trays on the surface of a flow-through tank (7,000-L) at the Downeast Institute (Fig. 5).

**Fig. 5. Sea scallop post-set on mesh netting (Netron®). Photo taken on 30 October 2012. Animals range from 2-14 mm as of 8 December 2012.**

During larval culture, we have focused on: 1) bacteria (and have used a broad-spectrum antibiotic containing sodium sulfathiazole, sodium sulfamethazine, and sodium sulfacetamide in the larval tanks); 2) diet (and have varied diets using some of the species used to condition broodstock); 3) seawater temperature (ranging from 8$^{o}$C to 14$^{o}$C); 4) Ultra-violet light vs. seawater physically filtered through a 1-micron bag filter; 5) handling (using a 2-day vs. a 4-day drain-down schedule); 6) initial scooping of trochophores from the water column 2 days after spawning rather than draining larvae onto 44µm mesh sieves; and, 7) varying the size of the culture tanks. Not all factors have been varied simultaneously, but we have narrowed down what we think are the factors that explain most of the mortality, and are proceeding with experiments through the late fall 2012 and early winter 2013 as described below.

Currently, we are examining the effect of four treatments on sea scallop larval survival. Treatments are: 1) Untreated seawater filtered physically through 1-micron bags; 2) UV-treated seawater; 3) Seawater treated with antibiotic (as described above); and 4) seawater sterilized with sodium hypochlorite (bleach) and then neutralized with sodium thiosulfate (a method of sterilization used in DEI's mass culture of microalgae for carboy's and larger culture units). Four replicates of each treatment are being used. Larvae are being reared in 80-L flat-bottom cylinders (ca. 30 cm wide x 1.2 m tall), and approximately 400,000 larvae (5/ml) have been added to each experimental unit (cylinder). Larvae were scooped using a 40-micron net approximately 24 hours after spawning when trochophores rise and

slowly accumulate near the surface of the tank (this method minimizes the amount of bacteria associated with dead/dying larvae and unfertilized eggs and spent sperm on the bottom of the spawning tank). Larval diet is similar across each treatment. From the first feeding (day 2) through the first two weeks, larvae are fed small microalgae (2-5 microns). This includes: T. Isochrysis galbana, *Rhodosorus marinus*, and *Pavlova lutheri* (CCMP 1325; MONO). Beginning on day 15, when larvae have reached a veliger shell length of a minimum of 100-microns, an additional species (*Chaetoceros muelleri*) is added to the mix. Animals are reared at 12-14oC, and are drained every two days.

At/near day 25, metamorphosis can begin, but sometimes we have seen this development stage delayed until day 35. When larvae are competent to settle (pediveligers with relatively large, and active feet), pieces of Netron® will be placed in each tank and examined microscopically over the next 3-4 weeks to determine if any treatment performed better than another.

We plan to continue similar experiments through June 2013 in an attempt to reach our goal.