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Dockside Shellfish Aquaculture Project, Smith, B

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DOCKSIDE SHELLFISH AQUACULTURE PROJECT

A Final Report to

The New Hampshire Estuaries Project

Submitted Jointly by

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Executive Summary

The intent of this project was to train private dock owners and marina personnel how to deploy and maintain “spat collectors” under their docks in an effort to capture commercially important shellfish larvae, scallops and oysters in particular, with a minimum amount of effort and cost. The New Hampshire Estuaries Project (NHEP) provided major funding for this phase of the project, with addition funding from the New Hampshire Department of Environmental Services (NHDES) and the Gulf of Maine Council (GOMC). This year’s effort expands upon the pilot studies that were funded previously by the New Hampshire Coastal Program (NHCP) and the Greater Piscataqua Community Foundation (GPCF).

The larvae of most shellfish are free swimming, and can be carried by the tides, currents and wind a great distance. Most of the larvae never survive due to predation and lack of suitable habitat. If it were possible to capture even a small percentage of the larvae within a suitable predator free habitat, the resulting grown out shellfish could be used to enhance the existing beds of wild population shellfish. There are such programs currently being managed, including the Wild Scallop Enhancement Program in Maine and the Oyster Gardening Project on Chesapeake Bay.

AERC was able to recruit a number of volunteers, or “Shellfish Stewards”, from the entire seacoast region to join in the project. Although there were challenges, the project was a success. The scallop spat collectors proved to work efficiently with minimal loss over the winter. Lots of shellfish larvae were found growing in the spat bags, with no predators present. Unfortunately, none of the targeted species were found in the bags. The oyster bags did not work as well; only three of the nine bags were covered to date. They may weigh too much, or have fouled too heavily and sank. The bags recovered had lots of shellfish spat growing on them, just no oysters.

The next logical step in future efforts with the dockside aquaculture projects would be to consider the options of placing “pre-seeded” collectors onto the sites. AERC attempted to import scallops from the Maine enhancement program last summer as a contingency plan, but the transfer never occurred due to weather and logistical problems encountered at the time.

AERC would like to thank our funding agencies for their support and aid in this research. Thanks as well to all of our shellfish stewards who dedicated their dock space, time and effort to help restore an important natural resource. Special thanks to Bill Marshall of the New Castle Conservation Committee, who was instrumental in recruiting our many shellfish stewards in New Castle. Bill also assisted the AERC staff in the deployment phase and was even there to tow us out of the mud during the retrieval operations.

Jennifer Kennedy and Stanley Sinitski
AERC Board of Directors

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Introduction

The purpose of the Dockside Shellfish Aquaculture Project was to directly involve the seacoast New Hampshire community in shellfish aquaculture and coastal conservation, to apprise shoreline property owners of water quality benefits of shellfish, and to enhance local shellfish beds for future productivity.

The Dockside Shellfish Aquaculture Project allowed AERC to collaborate with coastal property owners by recruiting and training volunteer “keepers” to collect juvenile shellfish from the waters around their docks. The hope of the project is that collected shellfish can be used to reseed known local shellfish beds. The Dockside Shellfish Aquaculture Project grew out of pilot projects funded by the New Hampshire Coastal Program (NHCP) and the Greater Piscataqua Community Foundation (GPCF).

The NHCP funded six pilot research sites to test the methodology of using collectors to gather shellfish seed, or spat, close to the shoreline. Pilot sites were at Wentworth Marina, Barker's wharf on the Piscataqua River, the New Castle Coast Guard pier, the pier at Star Island at the Isles of Shoals, Rye Harbor Marina, and Great Bay Marine in Newington.

The GPCF funded the development of a database of interested shoreline property owners who could be recruited to participate in growing shellfish under their docks. The project detailed in this report is a result of a request for NHEP support to launch the Dockside Shellfish Aquaculture Project in the community, and targeted establishing 20 locations to collect spat from summer 2003 until spring 2004.

This project focused on collecting the spat of two types of molluscan shellfish found locally in the wild: sea scallops *Placopecten magellanicus*, and American and European oysters *Crassostrea virginica*, *Ostrea edulis*. Because sea scallops are presently a commercially harvested species, providing for additional spat collection will aid in recruitment and restoration of the fishery. Stock replacement currently relies solely on replenishment by natural settlement and recruitment. The NHEP Management Plan identifies "limited availability of suitable larvae attachment substrate" as a likely factor in shellfish population decline (page 6-4). This project explores the feasibility of natural population replenishment through artificial (aquacultural) means by providing alternative "substrate" for settlement in the form of mesh bags.

AERC designed its approach based on the input of other researchers and a successful model for under-dock oyster collecting in Chesapeake Bay that involves community volunteers (*see online reference list in Appendix*). The Chesapeake Bay program, called "Oyster Gardeners" is a highly successful campaign to reseed Bay oyster beds and educate the public on the issues of water quality in the Bay. This project applies a similar method and philosophy to Great Bay and coastal NH waters.

There is current spat collection research being done in the Gulf of Maine, but the sites are primarily in deeper ocean water. Collecting seed oysters and scallops at or near existing docks has the advantage of easy accessibility. By contrast, placing spat collectors at sites that can

only be accessed by boat and tended by divers intensifies labor effort and expense. This project relied heavily on volunteer “keepers” to provide care and maintenance of the collectors, report any findings, and be “first responders” in an exigency. Such intensive care should have advantages over leaving collectors to the mercies of the current, tide, and foul weather, possibly for days and weeks.

Releasing the collected juvenile shellfish may help in restoring depleted populations on grounds that formerly held scallop and oyster beds. Wild oysters are presently a recreationally harvested species but are known to play an important role (as most bivalve mollusks do) as "living filters" - improving water clarity and quality. Therefore, there are never too many oysters working in any bay impacted by human activity. The need to restore and enhance existing oyster bars in Great Bay and Little Bay is great.

The project was based out of Hampton, where AERC is located. Collection sites were targeted from Great Bay down to Seabrook Harbor, tidal waterways where larval shellfish were anticipated.

Aquaculture Education and Research Center staff and board members involved in this project were:

1. Dyanna (Innes) Smith, Former Executive Director; responsible for project coordination, including participant recruitment, workshop organization, web site expansion, and writing columns and press releases.
2. Neil Savage, board member and volunteer research coordinator. Neil will be donating his time in a professional capacity on the pilot site research under NHCP funding, overseeing the shellfish outreach advisory team, contributing to workshop and overall project development, and reviewing final work products.
3. Jennifer Kennedy, board member; responsible for assisting in preparation of this report. Jen is the director of Blue Ocean Society for Marine Conservation and lends her knowledge of seacoast NH dock sites and non-profit management experience to this project.
4. Stanley Sinitzki, board member and AERC volunteer. Stan owns and operates Aquatic Research Organisms and lends his aquaculture and management experience to this project. Stan assisted in the preparation of this report.

Project Goals and Objectives

The overall goal of this project was to develop a group of volunteers to deploy and monitor twenty mesh spat collection bags on private and public docks and to promote aquaculture and shellfish restoration efforts to seacoast communities through a variety of outreach methods.

The following work tasks were outlined to achieve this goal:

- *Augment and convene the project advisory team* – AERC will add to their Shellfish Advisory Team two members of the NHEP Management Committee: Brad Sterl, State of Maine and Ian Walker, Aquaculture Resource Development. AERC will arrange a meeting of this advisory group to review the plans for the project and to help AERC create a Shellfish Re-Seeding Plan.
- *Shellfish Re-Seeding Plan* – AERC will submit to the NHEP office an electronic version of a “Shellfish Re-seeding Plan” that indicates origin of the seed stock, schedule of releases, priority release areas, a map of the release sites, a justification of the plan and written permission from the New Hampshire Fish and Game Department to release the seed stock.
- *Identify Spat Collection Sites* – AERC will provide the NHEP office documentation of the 20 spat collection sites, a recruitment summary that identifies recruitment methods and success, and digital photos of the typical deployment of a spat collection device.
- *Conduct Training Workshops* – AERC will conduct two training workshops and two collection workshops for participants in the program. AERC will provide the NHEP office digital copies of the workshop agenda, handouts, worksheets, electronic presentations, and a list of the workshop attendees.
- *Promote Project* – AERC will determine the most appropriate method to foster project interest and enthusiasm about the project among private dock owners. AERC will also create signs for the public docks that identify the project’s goals, approach and funding partners. Some type of outreach action will occur at all 20 spat collection locations. AERC will also set up a display at Portsmouth’s Market Square Day in June 2003 that highlights the Dockside Shellfish Aquaculture project along with other AERC information. AERC will submit digital photos of all promotional materials (signs, display, etc.) and any related handouts to the NHEP office.
- *Media Outreach* – AERC will develop three newspaper columns for the Atlantic News and the Beach News that highlight the project. AERC will also create two press releases related to the project that they will send to the NHEP press release list provided by the NHEP office. AERC will submit electronic copies of all press releases and columns, and an appropriate funding credit and NHEP local shall appear on all final work products and materials intended for public distribution.

Action Plan Items Addressed

The project was designed to address the following NHEP Action Plans:

Highest

EDU-5: Support for volunteer organizations active in water quality, habitat or other estuarine watershed natural resource issues

SHL-8: Develop and implement a plan for shellfish resource enhancement and habitat restoration.

SHL-15: Evaluate and address perceived and real institutional barriers to aquaculture and promote environmentally sound aquaculture practices

High

EDU-1: Use media to enhance educational efforts

Priority

SHL-9b: Decrease shellfish mortality and increase productivity through outreach and education about methods to control shellfish predators.

"Goals for Shellfish Resources:

- Provide opportunities and strategies for restoration of shellfish communities and habitat.
- Support coordination to achieve environmentally sound shellfish aquaculture activities."

-NHEP Management Plan, p. 3-5

"Goals for Education and Outreach:

- Raise awareness and engage participation of communities, government agencies, organizations, and individuals in the responsible use and stewardship of New Hampshire's estuaries.
- Engage the active participation of communities, government agencies, organizations, and individuals in achieving the goals for water quality, land use habitat protection, and restoration; and shellfish for New Hampshire's estuaries."

-NHEP Management Plan, p. 3-6

"Declining shellfish populations and associated habitats are among the most significant living resource problems in coastal New Hampshire." (p.6-1)

Activities

The project was based out of Hampton, where AERC is located. Collection sites were targeted for Great Bay, the Piscataqua River, Hampton-Seabrook Harbor, Rye Harbor, and other tidal waterways where larval shellfish are anticipated.

The project advisory team added two new members, Brad Sterl, State of Maine and Ian Walker, Aquaculture Resource Development. In June the new members came out to AERC's offices in Hampton and were briefed on the current project's objectives and goals. Their insight and knowledge of past efforts were valuable in refining the objectives of this project. The advisory team was there to support the AERC staff throughout the project. Although the full board could not meet due to conflicting schedules and commitments, they were readily available by phone or email when the need arose.

The project was promoted through articles in the *Boston Globe North*, *The Portsmouth Herald*, and *Tidelines*, a display at Portsmouth's Market Square Day, and through word-of-mouth. Two press releases were written by AERC staff members about the project and submitted to the media, and three articles were written for *Atlantic News* and submitted for printing. Potential keepers, or "Shellfish Stewards", contacted AERC about participating in the program. They spoke to Dyanna Smith to get information about the project, and to see if their site was feasible for spat collection. This was often followed by a visit to the AERC facility by the steward, and a site visit to the steward location to identify the best spot for deployment, and to train the steward in their responsibilities. Often a second site visit was conducted specifically for deployment.

At Portsmouth's Market Square Day on June 14, 2003, AERC's booth displayed signage recruiting shellfish stewards and described the basics of the dockside project. The "touch tank" containing live shellfish that could be handled by any willing onlooker drew hundreds of people to the booth. We successfully recruited two shellfish stewards that participated in this years project.

Once volunteers were obtained and sites were designated, deployment dates were determined based on intending to deploy within 40 days after a local spawning event, which typically happens in early September for sea scallops and June through August for oysters. To monitor for such events, we periodically towed plankton nets at least once a week throughout late summer, to look for evidence of larvae of the target species in the water column. Upon finding scallop larvae, and determining from the age of the larvae the urgency of the deployment, we would direct that the 'shellfish stewards' deploy their spat bags. AERC went to the sites to deploy and train the stewards at the same time. We tried twice to schedule group training but it did not happen. Only 1-2 people responded both times.

Based on results from the pilot project at six sites, AERC went through several gear modifications to improve collector survivability. Attachment lines were strengthened and plastic swivels with a 600-pound breakaway strength were used on collector bags. The initials AERC and AERC's phone number were painted on all marker buoys to better identify the

project buoys and aid in outreach efforts. The new collectors were deployed to 21 sites (Table 1) and sash weights were used to hold them underwater. Spat bags were attached to rope with swivels. There were 1-2 bags on each float.

Table 1. Locations where oyster and scallop spat collectors were deployed, and the number of collectors deployed at each.

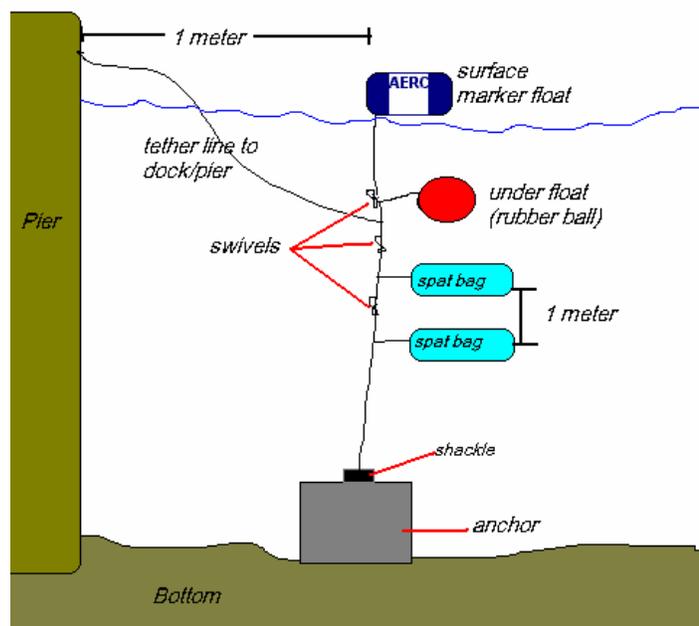
Oyster Spat Collectors		
Location	Site #	# Sites With Collectors
Wentworth-By-the-Sea Marina,	218	1
Great Bay Marine, Inc.	219	1
Durham Point,private	220	1
Rye Harbor, Commercial Pier	216	1
Little Bay, private	221	1
Total		5

Sea Scallop Spat Collectors		
Location	Site #	# Sites With Collectors
Hart's Cove, New Castle,	201,202	2
Star Island Pier	213	1
Seacoast Sailing School	209,210	2
Wentworth-By-the-Sea Marina,	217	1
Off Appledore Island, SML	214	1
Rye Harbor, Commercial Pier	215	1
New Castle, Piscataqua	203	1
Kittery Point Yacht Club	204	1
New Castle, Causeway	205, 206	2
New Castle, Pest Island	207, 208	2
ISSCO Barker's Wharf	211,212	2
Total		16

AERC attempted to schedule training sessions for keepers, or “Shellfish Stewards”, twice, but they were canceled due to low participation, so keepers were trained one-on-one instead and each was given a Shellfish Stewards Manual.

Methods for deploying each type of spat collector are detailed below. See Figure 1 for a diagram of a typical deployment setup.

Figure 1. Typical spat collector deployment setup.



American and European Oyster Spat Collectors – Methods

Clean, dried scallop and surf clam shells were loaded into plastic mesh bagging. The bags were 1 mm thick, heavy black plastic tubing, about the same length as the scallop collectors, dotted with 1.5 mm holes. The bags were sewn shut at one end, using 30 lb test 'squidding' line. Then alternating layers of scallop and surf clam half-shells (about 30 to 40 half-shells per bag) were added. The other end was sewn with more squidding line. A white break-away swivel was lashed to each bag.

Oyster spat collectors were deployed (Table 1) during mid-late July after a few straight-hinge state larvae that looked like oysters were found in a plankton tow. Additionally, oysters typically spawn in mid-July so this seemed to be the right time to deploy the collectors.

Sea Scallop Spat Collectors – Methods

The ideal method of capturing scallop spat involves deploying mesh spat bags attached to anchored lines about 10 to 15 feet off the bottom (to limit predation and fouling from the bottom), and about 10 to 15 feet below the surface (to avoid wave and storm damage, as well as more fouling from above). In the middle space, are attached a set number of bags (as general rule about one every 6 feet or so). Above the topmost bag, the lines have a toggle buoy to keep the line upright, and a buoy at the surface.

At collection sites, collector bags were mesh material about the size of a pillowcase that was stuffed with additional polyethylene material, or "NETRON", which provided a large enough surface area to which scallop larvae could attach their byssal threads. Human access was provided by a top opening held shut with a sewn-in drawstring. The mesh of the bag (1 to 2 mm) was selected to prevent the growing larvae from falling out and, at the same time, protect them from predators such as sea stars. The young scallops want to attach to something and collector bags such as these provide an ideal environment. These collector bags were positively buoyant, which kept the bags from chafing and silting in when set near the bottom, and promotes proper water flow through the bag, necessary to good spat collection and development.

Re-seeding

The shellfish advisory board recommended some local lobstermen who could assist in the re-seeding part of the project. Several fishermen were contacted about helping re-seed shellfish beds. One contact agreed to help if spat were collected.

AERC applied for and obtained the necessary permits for collecting, importing and dispersing spat (see Appendix for AERC scientific permit from NH Fish and Game dated 1/16/03, AERC letter to NH Fish and Game dated May 5, 2003 regarding importing and dispersing scallop spat, and NH Fish and Game import permit # 2003-15 dated June 16, 2003).

As a backup plan in case no spat were collected locally, AERC staff communicated with Marsden Brewer, a commercial fisherman and leader of Maine's "Wild Scallop Enhancement Project" about importing and distributing spat from his project.

In March 2004, all 16 sites were visited by AERC staff members to retrieve the collectors and look for spat, with the exception of the collectors at the Appledore winter mooring and Star Island Pier, which were not yet retrieved at the time of this writing due to the difficulties of accessing the Isles of Shoals at this time of year.

Results and Discussion

Media coverage and word-of-mouth generated many interested keepers to deploy spat collectors at their docks. Initially, spat collectors were going to be deployed when plankton tows indicated the presence of target species. Potential oyster spat was found on July 18, and spat collectors were deployed near that time (Table 2). Since evidence of scallop or oyster spawn were not found in other tows, other collectors were deployed based on usual spawning times for oysters and scallops (Tables 3 and 4). There were a total of 5 oyster spat collector sites and 16 scallop spat collector sites (see site maps in Appendix). However, upon retrieval, no spat was found on any collector. Although the collectors worked as planned to collect molluscan shellfish larvae, they were unsuccessful at capturing either of the target species (Tables 3 and 4). As the methods of collection were different for each species, oyster and scallop results and discussion are separated below.

Table 2. Plankton tow dates and results.

Date	Location	Site #	Results (oyster, sea scallop)
7/1/03	Wentworth-by-the Sea Marina	217	Negative
7/2/03	Hart's Cove, New Castle	201	Negative
7/10/03	Great Bay Marine, Inc.	219	Negative
7/17/03	Great Bay Marine, Inc.	219	Negative
7/18/03	Durham Point, Little Bay	220	Potential oyster
7/31/03	Durham Point, Little Bay	220	Negative
8/9/03	Glow-in-the-Dark Cruise, Gosport Harbor		Negative
9/10/03	R/V Kingsbury, Appledore Island	214	Negative
9/11/03	Star Island float dock	213	Negative
9/19/03	New Castle, composite sample	multi.	Negative
10/2/03	Kittery Point Yacht Club, New Castle	204	Negative
10/17/03	Rye Harbor, Commercial Dock	215	Negative
11/2/03	Rye Harbor, Commercial Dock	215	Negative

Oyster Spat Collectors

Oyster spat collectors were deployed at five different sites, with a total of nine collector bags deployed (Table 3). Three of the bags were recovered, with five lost and one pending. As mentioned above, no oyster spat were found on any of the recovered bags. We did find many *Anomia sp.* (jingleshells), in fact, there were so many *Anomia* that there wasn't any room for oyster spat to collect.

As previously mentioned, we thought we found oyster larvae when doing a plankton tow, so we felt timing was right and oyster larvae were present at the time of deployment.

Table 3. Oyster spat collector locations, deployment and recovery dates, and spat found in recovered collectors. Pending = Recoverable only with logistical assistance from owner or operations staff, due to the conditions under which collectors were deployed. Recoveries are planned for the month of April.

Site #	# Spat Collectors	Location	Deployed	Recovered	Target Species
221	1	Little Bay	7/24/2003	PENDING	UNKNOWN
220	2	Durham Point, Little Bay	7/18/2003	LOST	UNKNOWN
218	2	Wentworth Marine	7/1/2003	3/21/2004	NONE
219	2	Great Bay Marina	7/10/2003	LOST	UNKNOWN
216	2	Rye Harbor	7/18/2003	3/20/2004	NONE

In the future, AERC or other organizations may wish to take advantage of opportunities to collaborate with 'oyster gardening' initiatives currently being contemplated by Maine Sea Grant. AERC could conceivably import oyster seed and attempt to grow it out at suitable Great Bay and Piscataqua River sites, and also Rye and Gosport Harbors for European oysters, using the current volunteer force of “keepers”.

Scallop Spat Collectors

Nineteen sea scallop spat collectors were deployed at eleven sites (Table 4). Twelve collectors were recovered, three collectors were lost and four collectors at two sites are pending due to accessibility for retrieval. As previously mentioned, no sea scallop spat was found on any of the recovered collectors, although there were other organisms: seasquirts (tunicates), skeleton shrimp, an unidentified clam, and *Mya truncate*.

Table 4. Scallop spat collector locations, deployment and recovery dates, and spat found in recovered collectors. Pending = Recoverable only with logistical assistance from owner or operations staff, due to the conditions under which collectors were deployed. Recoveries are planned for the month of April.

Site #	# Spat Collectors	Location	Deployed	Recovered	Target Species
201,202	2	Harts Cove, near Coast Guard Station	9/9/2003	LOST	UNKNOWN
203	1	Piscataqua	9/19/2003	3/21/2004	None
204	1	Kittery Point Y.C.	9/18/2003	3/20/2004	None
205,206	2	Back Channel, causeway	9/18/2003	3/26/2004	None
207,208	2	Back Channel, Pest Island	9/11/2003	3/26/2004	None
209,210	2	Back channel, Sailing school	9/19/2003	3/26/2004	None
217	2	Wentworth Marine	9/12/2003	3/21/2004	None
211,212	2	ISSCO(Barker) Dock	9/20/2003	3/20/2003	None
213	2	Star Island Pier	9/10/2003	PENDING	UNKNOWN
215	2	Rye Harbor	9/15/2003	3/20/2004	None
214	2	Appledore Island	9/14/2003	PENDING	UNKNOWN

Scallop spat collection is not only site specific; it is time sensitive. Others' experience has shown that the young scallops tend to settle in the collector bags between mid-September and early-October. If the spat collectors are deployed too early, then predatory sea stars will settle in the bags and prey freely on the scallops; if the spat collectors are deployed too late, the spatfall from a local spawning may be entirely missed and the bags become dirty and less effective for collecting the next set (if there is another, from a more remote spawning bed). Fouled with marine growth, there is no guarantee that much scallop spat at all will settle in the bags. If the bags do succeed in capturing scallop larvae, the majority of spat arising from a local spawning event should arrive within a 'window' of a several hours, or at most one to two days.

No potential predators of bivalve mollusk seed were found inside the bags. Green crabs have occasionally been observed on the outsides; otherwise, our observations agree with theory expectations. So far, the species of bivalve mollusks that settle are themselves an integral part of the fouling organism community. As such, they would be expected to be attracted, not repelled, by all the marine fouling.

Observations indicated that fouling is a persistent problem inshore, especially during the warmer months of June, July, and August.

Re-seeding

If the target species larvae settled in the spat collectors as planned, AERC and their stewards would have abundant spat to return to the wild this summer. What to do with that spat were issues the shellfish advisory board helped deal with. In addition, a contingency plan was proposed that would have “jump started” the enhancement programs this past summer.

It was AERC's intent to retrieve the spat collectors this spring. In the event of a successful capture of oyster or scallop seed, the collectors would be cleaned off and redeployed to allow the larvae to grow out. Collectors not containing desired spat would be removed and cleaned for future use. The grow-out spat would eventually reach a size of 1 cm and could then be dispersed back onto existing shellfish beds to enhance the natural population. The shellfish advisory board recommended some local lobstermen who could assist in this aspect of the project. Sites would be chosen based on habitat suitability, which means a favorable bottom type and an area free of conflicting usage, such as dredging or bottom trawling.

There was no precise release site or location chosen at the time, so no map locations are documented. As of this date, no target spat have been found in any of the collectors, so no further action has been taken.

AERC and the shellfish advisory board did recognize the fact it was possible the collectors may not acquire the targeted species, since the plankton tows showed few larvae present in the water column. Marsden Brewer of the board is involved in Maine's wild scallop enhancement program. He offered to supply AERC with some of Maine's

spat during the summer of 2003. AERC would rely on the lobstermen to scatter the seed spat this summer when they arrived. AERC proceeded to obtain the necessary permits to import and distribute the spat. Unfortunately, due to high temperatures this summer, Marsden was unable to transport the spat to us. AERC had made arrangements with a local fisherman who had a refrigerated truck to help with the spat transfer. Weather conditions prevented the successful transfer of Marsden's spat for 2003. AERC remains in contact with the Maine project, and hopes to continue attempts to obtain spat in future seasons that the dockside project continues.

Volunteer Involvement and Other Collaboration

The intent of the project was that collecting seed oysters and scallops at or near existing docks would convey the advantage of easy accessibility. By contrast, placing spat collectors at sites that can only be accessed by boat and tended by divers, intensifies labor effort and expense. However, shallow sites present their own sets of problems, specifically fouling and chafing. Many collectors were lost in this project.

This project depended on volunteer keepers to provide most of the care and maintenance of the collectors, report any findings, and be the first responders in an emergency. Such 'intensive care' should have advantages over leaving collectors to the mercies of the current, tide, and foul weather, possibly for days and weeks. However, AERC personnel ended up doing the majority of the work involved in deploying, maintaining and recovering the collectors, with guidance from marina managers and New Castle's Conservation Committee Chairman.

Individual training was determined to be the best method of reaching stewards about the project. While volunteers were willing to use their sites for collectors, it was difficult to convene them for a scheduled group volunteer training. We ended up doing one-on-one training with individual stewards at the deployment sites, which ensured that we were able to complete the training for each steward and allowed us to not be bound by the group's schedules.

This project was designed for deployment at shallow dock sites, which are abundant in the seacoast region. Most private dock sites are limited by the average of 6 foot depth at low tide. At sites that could support two collection bags per rope, they were deployed with two. In questionable depth sites, we opted for one collector bag to ensure that the bags would not be touching the bottom at low tide.

Outreach

Interest in the project was strong. The press releases on the project resulted in lengthy educational articles in major publications reaching our target audience perfectly. The addition of articles and columns in the newspaper with the booth at Market Square Day put our outreach efforts at an all time high for the organization. Since most of the sites were not available or open for the general public to see, we decided to forgo and replace that mode of outreach with the printing of the project logo on copper travel mugs for

distribution to the stewards and other related participants in the project. The mugs are of excellent appearance and quality, and we feel they promote the project in to a broader audience than limited signage may have. The idea behind the mugs are that stewards would use them in their daily travels and have a conversation piece to describe the project to potential new stewards.

Conclusions

AERC's investigation of the feasibility of collecting scallop and oyster spat at inshore docks, floats, and piers did indeed find spat, just not the species we were targeting. What creatures we did capture were interesting, for example: lots of tunicates or sea squirts; skeleton shrimp; and the seed of at least two common clam species. The clam spat we could readily identify were close relatives of the soft-shell, or 'steamer' clam. We even trapped a few fish (sticklebacks) and an occasional green crab. While there were no spat collected from the target species, this project provided valuable information towards forming a community program in aquaculture that will in the long term be a successful shellfish enhancement project on the seacoast. The following list is a summary of useful conclusions regarding local spat collection potential:

- Local citizens are interested in participating in shellfish aquaculture.
- The bags used in this project need to be cleaned periodically to avoid fouling.
- Deployment sites were close to adult shellfish beds; providing good location for future re-seeding.
- Plankton tows were a good predictor of what the collectors got. In the future, we could rely on plankton sampling for guidance as to where to place the collectors.
- The spat collectors themselves worked well; although, we did lose a few to current, tide, and related factors and modifications on attaching them securely will need to be made.
- If we continue to target collection of free swimming larval shellfish, it appears that more settlement will occur in deeper water sites.
- If we continue to use shallow water dock sites for shellfish aquaculture, we should look into starting with settled spat, using the dock sites for grow-out locations, to be tended by the stewards.

Recommendations

Several recommendations came out of this project that can help increase the success of future projects:

Deployment

- Current flows may be an important factor in qualifying a deployment site as suitable. Not only is current responsible for carrying spat into the collectors, it determines the extent of forces that tug on the bags and scour off marine fouling organisms such as ascidians (sea squirts). We recommend that collectors be placed in areas with strong current for maximum effectiveness.
- The rise and fall of tides is suspected to create problems for collection gear tethered to a fixed pier. Such action causes the weighted lines to oscillate from taut to slack, thereby putting stress on the lines and creating forces that increase the risk of the bags parting from the lines. We suspect that such tidal action may be at the root of problems with gear that was lost at the Star Island pier.
- Ice pans that move around and about the site can scrape at the weighed lines, sever them and remove the sash weights or anchors. Ice that covers a site but stays in place throughout the winter and just melts in the spring is not as harmful as slush or pack ice. If ice does cover a site, the lines can be ripped and shredded by the ice, causing the collectors sink to the bottom. Sites that are well-sheltered from high winds, waves and ice may be more suitable for collection gear deployment.
- The bivalve molluscs and other creatures we did catch were a subset of the 'fouling community' - those organisms that typically attach to and carpet docks, floats, moorings, and boat hulls, if you do not scrape them regularly. That turned out to be one important lesson we learned: setting out spat bags inshore, where fouling organisms are especially abundant, invites them to take over the collectors. Another lesson learned at many of our sites was that bags set inshore get dirty rather quickly and need to be cleaned often to have the best chance of collecting spat.

In addition to having less room to collect target spat, another problem created by heavy physical and biological fouling is that collected spat may not get enough food to survive and grow. Bivalve mollusks are filter feeders, meaning that they filter water for food; heavy fouling restricts water flow to bivalves not accustomed to living amongst lots of fouling organisms.

Because of the dangers presented by fouling, it is recommended that in future projects, collection bags are cleaned regularly.

- Sash weights were used to hold collection rigs underwater. Whereas the bottom at our sites are usually muddy, we were concerned that anchors might embed,

requiring considerable force for volunteers to pull them out without mechanical assistance. On rocky or sandy bottoms, anchors can be more easily maneuvered but they can also be snagged by passing boats and dragged. At future sites, another way to hold the rigs underwater may be by using two large cement cinder blocks tied together as anchors at the end of a main drop line.

Outreach

- As previously mentioned, community interest in this type of project appears to be strong. Future efforts should take advantage of outreach opportunities at public deployment sites through making educational signs and brochures availability.
- As it was difficult to get volunteers together for group training, similar projects in the future may need to factor one-on-one training into their project.

Appendices

Project budget

Permits

Maps of deployment sites

Photos of deployment

- Oyster deployment
- Sea scallop deployment and retrieval

Outreach Efforts

- Shellfish Stewards flyers
- Press
- Market Square Day acceptance letter and photos

Shellfish advisory board

AERC board member list

Online shellfish reference list

Shellfish Stewards Manual and Training Checklist