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Shellfish Outreach Project

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SHELLFISH OUTREACH PROJECT



A Final Report to

The New Hampshire Estuaries Project

Submitted by

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Executive Summary

The Shellfish Outreach project has been a successful effort for the Aquaculture Education and Research Center on many different levels. This project represents AERC's first work supported by NHEP using shellfish to educate the public on aquaculture issues and local aquatic conservation. The project also served to usher the organization into a new area of public programming that has put AERC in the spotlight through news coverage in the printed media, and established program funding to help support general operations.

AERC staff made more than 300 contacts to promote the shellfish outreach programs developed under this project, and gave educational talks to 40 different special interest groups, including camps, school classrooms, retirement facilities, and hobby clubs. Creative displays showcasing local research efforts with shellfish were presented at events like Portsmouth's Market Square Day, bringing the outreach message to an estimated 100,000 people. Newspaper articles detailing the conservation status of New Hampshire's recreational shellfisheries explained the safe and correct way to dig clams to a readership of 30,000 seacoast residents.

You will see from the details of this report that we were overwhelmed at times with the amount of public interest in some of the shellfish programs, particularly the "Clam Digging for Dummies" workshop that was a collaboration between AERC and the Sandy Point Discovery Center. In all, AERC received over 200 requests to participate in the workshop, with only 20 spaces available. Clearly, there is an audience on the seacoast ready to explore recreational shellfishing, and willing to learn how they can collect shellfish in a responsible, educated manner.

Staff and volunteers look forward to continuing AERC outreach efforts through educational programs, special events displays, future clam digging workshops, and the use of the new shellfish curriculum guide in classrooms. We plan to continue to pursue funding for shellfish programming, and to maintain contact with the advisory team that keeps AERC staff up-to-date on local shellfish research and activities.

Dyanna I. Smith
Executive Director
Aquaculture Education and Research Center

Introduction

The purpose of the Shellfish Outreach project was to disseminate educational information to the greater seacoast community on the value of aquaculture, status and opportunities in shellfishing, and hands-on local conservation strategies in an exciting visual and experiential manner.

The Aquaculture Education and Research Center (AERC) became active in the seacoast community as a conservation nonprofit in 2000. Staff and volunteers spent the first few years establishing outreach programs directed to all-aged audiences throughout the New Hampshire seacoast and Piscataqua River watershed. As a development of initial outreach programming, AERC received funding from the Greater Piscataqua Community Foundation (GPCF) to hire a part time Outreach Coordinator. Using the coordinator's time and funding as a match for the Shellfish Outreach project, the coordinator and director worked together to create new programming focused on aquaculture, aquatic environments, and conservation with a specific focus on shellfish.

The entire project was designed to combine three primary methods of distributing information to the public: traveling programs, curriculum design, and field experience. Audiences for all three programs were to receive maps, updated shellfish-related information, and/or details promoting environmentally sound aquaculture practices. Subject matter covered during these programs was designed to focus on basic shellfish biology and natural history, the history of the seacoast shellfish fishery, current status and concerns, education on predator control, proper collecting techniques, and what people need to know to collect shellfish safely on the New Hampshire coast.

The project was also designed to establish a new level of collaboration between AERC and other conservation agencies in the seacoast through the organization of a shellfish outreach advisory team. The team was to contribute largely to the gathering of up-to-date information needed to complete the programs.

The project was based out of AERC's location in Hampton. Outreach activities were to target a broad range of municipalities in the area designated Zone A, rather than focus on one or two specific areas only.

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

1. Dyanna Innes Smith, Executive Director; responsible for coordination of project, including curriculum development, Bounty of the Bay organization, writing columns and press releases;
2. Chris Baker, Outreach Program Coordinator; responsible for scheduling and presentation of hour-long program talks and assisting in coordination of project;
3. Neil Savage, Research Coordinator and board member; acting in advisory capacity for project, overseeing the shellfish outreach advisory team, contributing to program and curriculum development, and reviewing final work products.

Project Goals and Objectives

Success of the program will be achieved by organizing 10, one-hour shellfish talks, one Bounty of the Bay clamming pilot program, and creating a classroom project curriculum. Six columns will be written highlighting information on local research projects, natural history of the area, and opportunities to participate in shellfishing activities.

A small advisory team, referred to as the Shellfish Outreach Advisory Team, will be put together which may include, but is not limited to representatives from Department of Environmental Services, University of New Hampshire Sea Grant/Cooperative Extension, New Hampshire Fish and Game/Sandy Point, New Hampshire Estuaries Project, Office of State Planning Coastal Program. This team will help provide resources to AERC regarding current shellfishing information that can be incorporated into the outreach program.

The team will be used to edit and comment on drafts of the curriculum project and information used in the column series. It will also serve as a sounding board for presentation subject matter and methods. The team will collaborate informally and as needed, recognizing the time and scheduling constraints of team members.

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-10: Provide information regarding public access to shellfish beds through distribution of maps/booklets

SHL-15: ...Promote environmentally sound aquaculture practices

High

EDU-1: Use media to enhance educational efforts

Priority

SHL-9b: Increase outreach and education about methods to control shellfish predators

SHL-9d: Increase productivity by discouraging harvest of immature shellfish

SHL-11: Establish Bounty of the Bay shellfishing field education program

SHL-13: Update materials and improve distribution of shellfish-related

information

Activities

The Shellfish Outreach Project's traveling program consisted of a one-hour talk on shellfish conservation, natural history and local issues. It included a media presentation, question and answer period, and hands on experience with live animals. It was marketed to a wide range of audiences, including schools, after-school programs, vacation camps, public libraries, senior centers, recreation centers, and adult special interest groups.

Programs consisted of one-hour talks using live shellfish, and audiences have primarily been youth. Staff took oysters, clams, and mussels to group presentations and allowed hands-on activities and demonstrations (such as watching the razor clams create a current in the water using siphon action). The programs were so well received, that a one-page flier was distributed to local schools to encourage more program requests (*see attached flier*).

Shellfish Outreach Project curriculum was written to target junior and senior high classrooms, with the ability to be adapted to other audiences (*see attached Bivalve Shellfish Curriculum*). It includes references to, and promotes activities of, local agencies working on shellfish and water quality issues. The curriculum highlights responses from different agencies in the seacoast regarding current issues, such as the University of New Hampshire's Open Ocean Aquaculture pilot study. This piece was designed to enhance existing aquaculture curriculum by adding a 4-page section on shellfish to a larger binder of previously designed pieces on fish culturing and aquatic science (a project currently funded through the NH Office of State Planning Coastal Program).

The field education component consisted of an experiential, on-location program on clam digging (*see "Clam Digging for Dummies" attachments*). This program served as a pilot for designing other field techniques classes or workshops, that can be expanded and adapted for the general public or for targeted audiences. AERC established a new partnership with Sandy Point Discovery Center to create the program, and presented it to the general public on March 29, 2003. The field day included speakers from NH DES, Fish and Game, and AERC (*see attached agenda*). Materials already in use by NH Fish and Game, NHEP, DES and others were distributed to the audience (*see attached information packet*). Two members of the local media were in attendance, and chose to spend the day participating in all aspects of the workshop. Their interest caused them to write elaborate pieces detailing conservation strategies, correct clam digging techniques, information on safety and flat closings, that took the educational message beyond the 20 participants of the day, to over 30,000 seacoast residents!

A series of six columns were written by AERC staff for publication to the greater Hampton community through the Atlantic News (dist. 5500 weekly) and the Beach News (free dist. 1500 weekly). These columns promoted the Shellfish Outreach Project and were another vehicle for educating the general public on the subjects of local shellfish issues. Information from various members of the advisory team contributed greatly to the depth of material included in each column (*see attached columns, and sample clippings*).

Press releases to local media, to promote the Shellfish Outreach Project were distributed to schools and special interest groups (*see "Shellfish Tour" flier*). These press releases included AERC's role in the project, our collaboration with other agencies in the region, and opportunities to participate in the outreach program.

AERC put together a display booth at Portsmouth's Market Square Day in June, 2002 (*see photographs attached*). The display (along with *all* of AERC's programming) defined aquaculture and promoted environmentally sound aquaculture practices. The booth had small aquariums that attracted a substantial crowd. Spinney Creek Shellfish Co. provided live shellfish (razor clams, quahogs, oysters, cherrystone clams, and mussels) which were displayed for people to touch and observe. Soft shelled clams squirted onlookers, to the delight of many, and mussels spawned, triggered by the heat of the day.

There were "china hats" for larval growout in oyster aquaculture, ropes used in mussel culturing, and other spat collection devices. Staff and advisors were on hand to talk to folks about all the projects they learned about through the advisory team, plus natural history information on the shellfish species on display. An estimated 500 people visited the booth during the day. Pro Portsmouth, organizers of the event, estimates that 100,000 people attended the days events. The booth was set up at other events during the year, including science teacher training days, and a large outdoor expo in Salem.

An advisory team was recruited, whose members include: Chris Nash, DES; Peter Flanagan, researcher; Ken Levalley, Spinney Creek Shellfish Co.; Rich Langan, UNH; Sally Soule, NHEP; Verna Delauer, NHCoastal Program; Ray Grizzle, Jackson Lab; and Bruce Smith, NHF&G as a silent member. The team is still expanding (*see Advisory Team List*). The team was primarily responsible for source material, contributing articles and information related to their research on shellfish. Communications consisted of verbal interpretation of current findings as discussed by our advisory team regarding their work in the region. The information was transferred to all of our audiences, including outreach talks, the series of newspaper articles, curriculum, and the clam workshop. They also supplied equipment and resources for the display at Market Square Day. The advisory team was active in the project, and is participating in new shellfish outreach activities.

Results and Discussion

Chris Baker was hired as the Outreach Coordinator for AERC. Chris worked with AERC from April to September and contacted over 40 of New Hampshire's largest day care centers, 120 camps in NH and into Massachusetts, and 40 local schools. Between the combined efforts of Chris and other staff members, AERC scheduled and ran 40 outreach programs, reaching over 500 people in a small group setting. AERC also presented displays and booths at Market Square Day, NH Science Teachers Association Conference, and the Coastal Watershed Forum, taking the message of aquatic conservation to hundreds more.

Teachers see the talks as a unique way to bring animals into the classroom that students don't normally get to see. It proved to be a great local activity since most of what was talked about can be found right here in everyone's back yard. This is feedback from the evaluation forms about the traveling programs:

- "I liked the animals to hold and the way Chris answered the children's questions, also the way he interacted with the children." - Nutfield YMCA
- "Add more animals to look at and touch. The presentation was fun!" – Childspace, Hampton
- "We liked the hands on parts. They (staff) are great with the children. I wouldn't change anything. The kids seemed to get a lot out of it. They enjoyed all of the different fish." –Village Preschool, North Hampton
- "Very enjoyable and enlightening – well presented. The staff are knowledgeable and friendly." –East Kingston Grange
- "Excellent slide presentation showing building and pollution; presentation of live species very well received. Slide show could be longer." – Sacred Heart School, Hampton

The curriculum piece consists of a 4 pages that has the look of AERC's three larger curriculum guides, and can be included in those as an insert, or used separately. The piece lists resources for live shellfish to be used in classrooms (i.e. where to find them easily if you don't live on the coast), activities and experiments teachers can do with shellfish (such as putting sand in a wide-mouthed jar, placing clams near the edges, and getting a good look at how they move down through the sand against the glass), and natural history information on different species of interest. Agencies that teachers can contact to find out projects local to them, such as their state Fish and Game departments and DES, are listed as well. The main effort was to encourage teachers to try new activities with shellfish by making it easy to find the resources they need, and starting with simple information. Many teachers are interested in using live aquatic animals in the classroom, but hesitate, even after training, because they are afraid they will kill them accidentally. The shellfish curriculum does not focus on keeping them for a long time, only on temporary experiments.

Collaborating with Sandy Point Discovery Center proved to be a natural partnership for the clam digging workshop. The facility at Sandy Point was an excellent work and meeting space, and it was easy for participants to find. To make the workshop the most interesting, staff decided to make it as hands-on as possible. In order to maximize the quality of the workshop, enrollment was limited to 20 participants. The schedule for the workshop included morning presentations by local shellfish experts, a build your own clamming bucket activity, and lunch with cooking demonstrations. The final part of the workshop was a field trip to the Hampton mud flats for a clamming demonstration. Fish and Game staff handled issuing the licenses to all participants, and provided clam forks for the day.

Involving Chris Nash, of NH DES was a great way to make sure all the information that was important reached the clambers. The flats were open the day of the workshop which improved the experience, although folks understood that everything would go according to plan if they were closed from the weather, except for the actual collecting.

The excitement generated over the “Clam Digging for Dummies” workshop is almost impossible to describe. Signage, web site announcements and email contacts all informed the public of the March workshop simultaneously. Within 3 days, the 20 workshop spots were filled, and the waiting list contained a list of over 60 names. Then a number of newspaper announcements hit, leaving AERC with a list of 200 people interested in future workshops.

As people were turned away, staff took the opportunity to talk to many of the callers to find out the general feeling behind the interest in the workshop. Most people had stories of clamming with their older relatives when they were kids. The workshop stimulated those fond memories, and excited what seemed like a whole new generation, anxious to expose their children and grandchildren to the wonders of clam digging. One common interest was location – where to go to find clams. Many people claimed to have given up on clam digging because “there is nothing here anymore.” Folks were amazed that all the information given to them during the workshop was available online through the NH DES website. And people were, in general, very uneducated in the basics – safety issues, flat closings going on and why, and licensing. By the time we went out on the mud flats, our group was astonished to see how many people were already out there, digging away. It was like a sub-culture they never knew existed right under their noses.

In hindsight, the pricing for the event was a problem, because participants paid less to attend than to normally purchase a license. Although they understood that the license fees were underwritten by the grant, the price confused the general public, and a few angry people called, thinking the licenses were being given away by Fish and Game. A simple change in pricing, and that would have been avoided. Compare that to all the people who called after the workshop was filled, offering to get their own licenses, just so they could attend and get the information.

Evaluation of the Clam Digging for Dummies workshop consisted of verbal communications during the program. As a whole, the day was a delight, with the

excitement from each participant keeping momentum going during a long day filled with a great deal of information. Participants were all aware of the competition for the 20 places at the workshop. After they heard how the day was funded, and that the goal was to protect the resource during collection, it gave a “reverence” to the day that was unexpected. During Chris Nash’s talk on the DES regulations of the flats and explaining what closings were all about, one participant shouted out “we’re glad you’re here!” A nice change from the regular grumblings from folks shut out by flat closings.

The general atmosphere was that people had no idea there were do many details involved, and once they heard everything were empowered to approach the resource in a new way. Here are some comments AERC received from participants, or callers, regarding clam digging in New Hampshire:

- I used to clam every year with my grandfather, but I don’t renew my licenses because there’s nothing there any more.
- Wanted something they could do outside with their families.
- People signed up others based on a known, long-standing interest in learning how to dig for clams.
- Several people had licenses but had never gone clamming.
- Had been clamming before but wanted to improve their skills, and learn more detail.
- Wanted to learn more about the ecology of the flats.
- The resource is too limited to promote clam digging. *(These folks were pleased to hear that the whole point was to protect the resource through education.)*
- Non-local residents have no right to the flats.

There is a fascination with the “romance” of clam digging. Many people have stories about older generations going out regularly and teaching them when they were young. Clam digging, and shellfishing in general, seems to have skipped a generation or two. Offering the workshop tapped into that fascination. Once out on the flats, sinking into the mud, having limited success, and realizing just how long it takes to get their limit, most participants stayed a little while then left satisfied that now they know what is involved. One couple left saying, “From now on, we’re going to the store for our clams!” About four diggers stayed to collect their limits.

Conclusions

Through the Shellfish Outreach Project, AERC staff, volunteers, colleagues, and program participants have accomplished the following:

- Direct citizen participation in estuarine and shellfish management;
- Generate excitement, credibility, and newsworthiness to environmental shellfish projects that have influenced opinions and attitudes in coastal communities;
- Raised public awareness about shellfish on the NH coast, and protect and improve environmental quality through public education;
- Educate the public on the benefits of healthy shellfish beds, and how they can contribute to the health of shellfishing grounds;
- Provided current shellfish resource management, water quality, and public health information to stakeholders who are most directly effected by citing sources including the NH DES, UNH, Jackson Marine Lab, Great Bay Estuarine Reserve, and the NH Fish and Game Departments;
- Increase shellfishers' sense of participation in the management of the resource during the community workshop;
- Benefits to the shellfish resource from better-informed harvesters practicing less destructive digging techniques, and understanding their impacts on the shellfishing habitat; and encouraging shellfishers to become active supporters of estuarine water quality improvements;
- More knowledgeable recreational harvesters will help maintain a healthy, sustainable resource, contributing to a healthy environment;
- Shellfish harvesters will know how to find and access productive beds, and are provided with the resources to identify and safely utilize these areas;
- Introduce a new constituency of shellfish harvesters which are: bringing needed support to new shellfish management programs and efforts; continuing a rich New Hampshire tradition; helping to improve shellfish resources and water quality by building the support of a more informed public; and providing a fun, newsworthy media event creating a spotlight on shellfish, water quality, and the host of current management activities.

This outreach project has served to establish a solid record of programming activity in the community that not only promotes our young organization it provides income to the agency with its program fees. All of our programs have topics that directly serve our overall mission of aquaculture education and aquatic conservation. The Board and staff of AERC are very pleased with the outcomes of this effort, and see this as an important step towards building the organizational capacity that will sustain us in the long term. Specifically, we will be able to use our outreach efforts to guide a new venture for the agency in developing a traveling outreach center to bridge the gap between requests for on and off site programs without the use of a publicly accessed building.

Recommendations for Future Work

The public response to the field experience/workshop reveals an untapped audience for similar workshops and repeat clam digging opportunities. Since completion of this grant project, AERC has scheduled two more clam digging workshops, and the forty spaces made available filled up in two days from the waiting list alone. There is a big opportunity here to run more workshops on clam digging in the near future. There is also opportunity to create new shellfish workshops, such as oystering, mussel collecting, and even scalloping. Perhaps the most illuminating part of the workshop's success is the depth of interest the general public has in learning all the aspects of proper shellfishing. They are open to new information that explains the science and conservation behind the rules and regulations, not just where and how to dig.

With the success of AERC programs, comes the need for qualified and trained staffing. Running outreach programs to meet the requests of the public will require a full time staff member who can be dedicated to outreach and education. It requires more time than initially planned for. One of the things we did not anticipate was that Chris was so successful at scheduling and making new contacts, that the first half of his time with AERC was largely focused on making these arrangements. By the time he got to put on his programs, he was so booked that he ran out of time to continue marketing. By the end of September, he was finished with programs, but had no new ones scheduled to keep him going. One conclusion we have made from this experience is that to accomplish an ongoing level of programming in the community, we have to think in terms of one full time position, with a small team of volunteers to implement the outreach component of AERC.

As a result of focusing on shellfish, AERC is currently working on a pilot project to collect shellfish spat at dock sites along coastal New Hampshire and into tidal rivers, estuaries and Great Bay. The opportunities for outreach into the community are great, by recruiting community dock owners to take ownership of individual spat collectors hosted at their docks during the summer and fall. This dockside shellfish initiative could be expanded to setting up dozens of spat collectors that not only involve the community in shellfish conservation, but ultimately reseed the local known shellfish beds with the young shellfish collected. If this project proves effective during its first year, AERC will look to expand the project's reach in the following years.

AERC is now looking into developing a teacher workshop based on the community clam digging workshop, and the shellfish curriculum. This workshop would distribute the new shellfish curriculum for teacher training on using live shellfish in their classroom, issue collection permits with the help of NH Fish and Game, and take teachers on a clamming field trip out of Seabrook. The workshop would send teachers home with the curriculum guide, practical experience using the activities in the guide, and live shellfish to keep in the classroom.

Another approach to long-term outreach on shellfish issues and experiences is to include shellfish themes in AERC's development of a mobile teaching unit. The unit is in the

early stages of development, with current efforts focused on creating a preliminary design plan for a motor home that can be converted into a mobile lab and teaching center.

Shellfish Outreach Advisory Team

Neil Savage, Aquaculture Education and Research Center
Research Coordinator and interim president, Shellfish research principal investigator.

Ray Grizzel, University of New Hampshire (UNH), Jackson Estuarine Laboratory
Senior laboratory member, provides assistance to AERC and forwards resources.

Rich Langan, University of New Hampshire, Cooperative Institute for Coastal Estuarine
Environmental Technology (CICEET)
Expert on shellfish aquaculture.

Marsden Brewer, Commercial fisherman
Mr. Brewer directs wild scallop enhancement projects in several coastal communities
throughout Maine.

Craig Pendleton, Director, Northwest Atlantic Marine Alliance (NAMA), Saco ME.
NAMA is conducting a wild scallop enhancement project in Saco Bay.

Brian Beal, University of Maine, Machias. Shellfish researcher
Employed at Beal Island Hatchery, sea scallop biologist.

Peter Flanigan, Commercial fisherman, Rye NH.
Represents local knowledge and fishery experience.

Christopher Nash, NH Department of Environmental Services (DES).
Qualifies areas for shellfish harvesting; shellfish sanitation survey.

Ken Lavalley, Senior Biologist, Spinney Creek Shellfish Co, Elliot ME.
Provides live shellfish for educational purposes, aquaculture support in general.

Sally Soule, New Hampshire Estuaries Project (NHEP)
Oversees current funding for AERC's shellfish outreach project.

Verna Delauer, New Hampshire Coastal Program (NHCP)
Outreach Coordinator, co member of Coastal Education Initiative with AERC

Roland Barnaby, UNH Cooperative Extension
Open Ocean Aquaculture Project Coordinator.

Shellfish Columns

All Things Aquatic: American Oyster

Our coastal waters are home to a variety of bivalve molluscs that serve as an important link in keeping our aquatic ecosystem healthy and stable. This is the first in a series of six shellfish columns from the Aquaculture Education and Research Center (AERC) in Hampton.

Let's start with the **American oyster**, *Crassostrea virginica*, a hardy species that lives in a range of temperatures and salinities but does best in the brackish waters of Great Bay and other seacoast estuaries. The heavy shell has a rough, sculptured appearance and can usually be found attached to rocks or other hard, submerged objects, sometimes in great clusters. If you have a permit to collect oysters, these clusters are a shellfishing bonanza!

Oysters are among the few animals that people of the world still eat alive and raw. Market size (3 inches) is reached in from two to five years, depending on how salty and warm the water is. In colder waters, some oysters have lived for more than 100 years.

One of the most remarkable and useful things about oysters is that they can actually clean the water they live in! An oyster feeds by pumping water through its body and filtering out its food (mostly algae and detritus, or decaying plant material). This is called filter feeding. A healthy market-size oyster can filter approximately 50 gallons of water a day. Historically, there may have been enough oysters in Great Bay to filter the entire bay in just a few days. Can you imagine the impact that would have on our water quality today?

A natural oyster bed provides habitat (shelter and food) for a community that includes many other organisms: plants, crabs, worms, fish, and so on. Creatures that prey on oysters include: humans, oyster drills, moon snails, or whelks (snails that feed on oysters by drilling holes through the shells).

Oysters are blue-blooded, having copper rather than iron (red-blooded) to carry oxygen and carbon dioxide. Like other bivalve molluscs, oysters do not have a true brain, but do have a nerve center called the ganglia located at the top toward the hinge.

Typically, an oyster can spawn when it is one year old. You cannot distinguish male oysters from females by examining their shells. While oysters have separate sexes, they may change sex one or more times during their life span. When the water warms above a minimum temperature of 20°C (68°F), oysters spawn at intervals over a period of four to six weeks - that's in June and July around here.

Fertilization takes place in the open water and the fertilized egg develops into a microscopic larva. For about three weeks, the little larva swims and drifts in the tidal currents and may travel far from the spawning area. Once the oyster reaches the size of a

grain of pepper it is ready to stop swimming and settle to the bottom to search for an appropriate substrate to attach to.

When the oyster finds a suitable, clean, hard surface, a gland on the animal's probing foot ejects a tiny pool of cement-like adhesive. The little oyster then turns on its left side, cements itself to the object, and remains immobile for the rest of its life. Henceforth, it can feed only on what food the water brings and is unable to escape overcrowding or flee from enemies.

For the oyster, this process is very stressful. Mortalities are often severe during settlement, sometimes exceeding 90%. Only about one in a million fertilized eggs survive to settle and grow to maturity. On the other hand, the planktonic oyster larvae have a very important function in the ecosystem as a food source for other critters and are part of the aquatic food web.

There are efforts underway to restore our oyster populations. Off-bottom culture is the technique currently used raise oysters in NH's Great Bay. Rafts are suspended above the bay floor, to which plastic cones, called "Chinese hats" are strung like beads on rope. This rig allows the 'seed' oysters to grow in suspension until they reach the desired length – about the size of a thumbnail. Finally, they are separated and placed on trays that are suspended in the water. Held in suspension, the oysters grow quickly and develop plumper meats than those that are bottom-grown.

If you have a dock or access to the shoreline, you can help restore our oysters. AERC is launching a new program to collect seed oysters on docks throughout the seacoast using a small line weighted 4-6 feet into the water. With the help of the New Hampshire Estuaries Project, the Office of State Planning's New Hampshire Coastal Program, and the Greater Piscataqua Community Foundation, we will train you to become one of a team of local "shellfish stewards" throughout the community, working to collect baby oysters to reseed the bay. Contact AERC at 603/926-1650 or look online at www.teachfish.org for details on the project.

This article is first in a series of six shellfish columns this winter, sponsored by a grant from the New Hampshire Estuaries Project. AERC is a nonprofit organization promoting aquaculture and aquatic conservation through education and research.

All Things Aquatic: Ocean Quahog

The longest-lived animal on earth may be a cold-loving clam!

The **ocean quahog**, *Arctica islandica* (also known as a mahogany clam, mahogany quahog, black quahog, and black clam), lives longer than any other bivalve mollusc, and may live longer than any other animal. Just as with the rings that show in the cross section of a tree-trunk, check lines (growth rings) on a clam's shell signify age. The oldest ocean quahog specimen yet discovered had 220 such lines!

Ocean quahogs seem to have been held over from a time during the last ice age when ocean waters were far colder than today. In relatively chilly New Hampshire waters you can currently find ocean quahogs as close as three miles from shore. A few local boats still fish for them, but these shellfish grow very slowly and populations are small, perhaps even diminishing.

New Hampshire's ocean quahog also tend to be younger and smaller than their mid-Atlantic counterparts, with the largest specimens having shells about 70 mm (2.8 inches) long. The larger clams, living in the deeper waters of the mid-Atlantic continental shelf, grow to be about 2 inches longer.

Called 'quahogs' because they roughly resemble the bay quahog (hard clam, *Mercenaria mercenaria*) in size and shape, a ocean quahog differs from a hard clam because of a dark mantle called a periostracum that covers the outside of the shell. The dark layer tends to peel away from the shell, especially after the clam dies. As the clam gets older, this periostracum turns from a dark cherry or mahogany color to jet black.

Like the bay quahog, the ocean quahog lives in a shallow temporary burrow. With the siphons protruding only a tiny bit out of the shell, this clam would be more likely spotted by a deep diver seeing the top edge of its shell, because this clam has virtually no 'neck'. (Not like the clams you can see along the beach with their siphons sticking out.)

Ocean quahogs take about 15 to 20 years to mature. Compare this to the oyster, which can spawn at one year of age! By the time ocean quahogs mature, their shells are about 6 cm (2.4 inches) long. Spawning occurs all summer long and throughout early fall.

The free-floating larvae develop slowly in the cold water, and remain planktonic for 32 to 60 days until settling. Thus, these larvae can drift far from their parents, depending on currents as far as the opposite shore of the Gulf of Maine, which would be Nova Scotia.

This species' love of extreme cold would be really obvious if you were able to watch ocean quahogs reburrow after pulling them from artificial clam beds (plastic dish pans) where they share a tank of seawater with surf clams. Noted for their energetic reburrowing, surf clams readily push out the quahogs under ordinary circumstances and 'take over' the clam beds. However, under winter conditions, with

water temperatures hovering around the freezing mark, ocean quahogs 'turn the tables' and persistently shove out the now benumbed surf clams!

Truth be told, no cold-blooded creature loves the icy chill of near-freezing seawater more than the aptly named *Arctica islandica*.

This article is second in a series of six shellfish columns this winter, sponsored by a grant from the New Hampshire Estuaries Project. AERC is a nonprofit organization promoting aquaculture and aquatic conservation through education and research. For more information visit AERC online at www.teachfish.org.

All Things Aquatic: Surf Clam

The **surf clam**, *Spisula solidissima*, is the largest bivalve mollusc on the Atlantic coast, growing up to 9 inches long. It is also one of the most active. Surf clams have triangular, heavy, white, finely lined shells, which are partly covered with a dark outer membrane. Scientists believe that some individuals may live more than 30 years.

Surf clams are usually found in sandy habitats well mixed by strong currents and tides. In the Gulf of Maine, these clams can often be found on sandbars at or just below the low water mark. They also live in deeper water (up to 75 meters), and are harvested from the deeper depths by hydraulic harvesters. Like most clams, this species feeds by filtering the water to extract phytoplankton.

This clam is not a deep burrower, and is usually found only 2-3 centimeters into the substrate. The surf clam uses a long muscular 'foot' to pull itself into the sand where it remains burrowed, except for the tips of the siphons that bring water in and out of the body for oxygen, food and wastes. The foot, which comprises up to one third of total soft tissue weight, is served in restaurants as 'clam strips' and is a main ingredient in some the most famous chowders in New England. The juveniles, called "skimmers", commonly escape predators by using this foot to leap out of the sand, and 'tiddleywink' their way to a new site - quite a comical move for a clam!

Besides humans, few animals depend on adult surf clams for food, because their exterior is tough and their tactics for evading capture energetic. Moon snails, crabs, cod, and some marine mammals have been reported as occasional predators. Gulls may find the beached adults after a coastal storm and drop them from great heights to split the shells. Sea stars and whelks sometimes prey on younger 'skimmer' clams. Common names for this clam include: hen clam, sea clam, giant clam, and bar clam.

Surf clams are capable of reproduction in their first year of life, although full maturity may not be reached until the second year. Spawning occurs from late June to August. It takes six years of growth for a surf clam to reach harvestable size, at a shell length of 6 inches.

Due to its energetic habits, this clam has a relatively high metabolism and is vulnerable to low oxygen concentrations. Off the New Jersey coast, massive water blooms have led to widespread surf clam mortalities, not because the plankton is toxic to the clams but because the blooms deplete bottom waters of their oxygen content as the plants die off.

Collecting the skimmers can be a challenging but entertaining experience. Try wading out to a nearshore sandbar at low tide and 'arming' for the clams (reaching down to sift through the loose underwater sand with your fingers). If you are not quick about your work, you may soon observe several young clams leap from their burrows and scoot away from you. Watch where they land and reburrow, because that's where you are mostly likely to put your hand on your next 'prize'.

For more tips on clamming, join AERC and Sandy Point Discovery Center for our "Clam Digging for Dummies" workshop in March. We'll spend the day learning about shellfish protection on the seacoast, making clam pails, preparing new recipes in the kitchen at lunch, and then moving out into the clam flats for digging lessons! The workshop is scheduled for Saturday, March 29. Registration is \$20 and includes a 2003 collecting permit. Call AERC at 603/926-1650 for information and early registration, or visit our website at www.teachfish.org.

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All Things Aquatic: Blue Mussel

The **blue mussel**, *mytilus edulis*, is a bivalve mollusc familiar to all who visit rocky intertidal areas along our coast. Mussels grow quickly and profusely, two traits that make them ideal for aquaculture. Europeans and others have cultured mussels for many centuries. The blue-black shells are elongate, triangular and joined by a rubbery hinge ligament on the upper side. Mussels grow so successfully on so many kinds of hard surface, that they are regarded as a fouling pest on the hulls of modern vessels and marine structures, even floating buoys.

Mussels usually spawn in late spring or early summer. A few hours after fertilization in the open water, the embryo begins to swim. Development progresses through a series of larval stages, from trochophore, to straight hinge, to veliger. In 3 to 4 weeks, the mussel larva grows to a quarter millimeter in size. It then develops a foot and gills and is ready to change into a juvenile mussel, and settle on a suitable hard substrate, such as a rock, wharf, boat, or among other mussels. It does this by secreting bristly threads from its "bysuss gland" near its foot, thereby anchoring itself to the surface where it will grow into a mature mussel.

Under the most favorable conditions, a mussel can take as little as 18-24 months to grow to marketable size (about 50 mm).

Mussels are suspension feeders; they feed by actively filtering particles from the water. Phytoplankton cells are the main source of food and decomposed macrophytes or resuspended detritus may also supplement their diet. At full maturity a blue mussel can pump 4 litres of water an hour, which make them invaluable at cleansing seawater of many impurities. Therefore, you should also be careful about where you collect your mussels from if you plan to eat them; because, as with many other bivalves, they can concentrate pollutants in their flesh. Generally speaking, clean water means clean mussels. But if the water is even slightly contaminated with, for example, antifouling paint or industrial or waste discharges, you should seek your meal elsewhere.

Note: you can buy commercially raised mussels any time of year without concern because they are constantly monitored to be food safe.

In NH, mussels are cultured at an open ocean site near the Isles of Shoals, on a rig that is anchored securely at both ends and supported by floats tied at intervals along the length of the rig. Rope collectors hung on the long lines collect the spat (seed mussels) throughout the summer. When the spat have grown to about 15 mm, the collectors are then covered by lengths of cotton mesh tubing called socks. The socks are then tied at intervals onto another long line where they grow to market size in about 2 years. These cultured mussels appear to spend more time and energy growing body mass instead of growing shell, as wild mussels do. The result is mussel with a lighter shell and plumper, more tender meat. They are therefore a better food value with a higher meat to shell ratio than the wild variety.

Mussels have a mild, delicate flavor all their own, not like the stronger flavors of clams and oysters. They are one of the world's most perfect foods, being extremely high in proteins, calcium, and iron, and low in fat and calories. Mussels are also among the best shellfish for your heart, containing high amounts of a naturally occurring fatty acid that is believed to lower blood pressure. They are also one of the easiest, tastiest and most economical shellfish to prepare.

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All Things Aquatic: Soft-shell Clam

The **soft-shell clam**, *Mya arenaria*, comprises the principle recreational shellfishery in NH, and is the source of "fried clams". For more than a hundred years, shellfishery managers have looked for ways to increase the fishery. However, with notable exceptions, nature seems more directed at simply sustaining the species rather than maximizing harvests to clammers. Unpredictable survivorship of juvenile clams has long frustrated conservation efforts, and green crabs are a major predator of immature individuals in our area.

Also known as the soft clam, or steamer, this clam will burrow in sediments, living at depths ranging from the intertidal zone to about 30 feet (9 meters) below sea level. Soft-shell clams have a set of double siphons at one end, bound together in what is called the "neck" of the clam. Drawing on fluid in its mantle cavity, a clam can rapidly extend or retract this neck. At the other end a muscular, tongue-shaped organ, the clam's "foot", enables the clam to anchor itself in the sediment. This is the clam that squirts you as you walk over its burrow... Perhaps you've seen it?

Experts estimate the age of a clam - and also gauge its health - by looking at the surface of the shell, which displays elliptical growth marks (rings). A healthy clam's shell grows fastest in late spring (when algae the clam feeds on are in full bloom) and stops in winter, producing a telltale "check" line. Shell growth is rapid in young clams (at best about 3 cm in the first year) and slows down during the later years (to less than 1 cm per year). In NH waters, soft-shell clams reach maturity at a shell size between 3 and 4 cm, by which time they are normally about 2 years old. Under favorable conditions, clams can attain minimum harvestable size (5.1 cm, or 2 inches) in about 3 years locally.

Because of heavy harvesting pressure, you rarely find any really old clams, such as those with a shell length of more than 7 cm, and aged 6 years or more. The maximum reported size for a soft-shell clam is about 15 cm (6 inches), which would indicate such a clam is about 20 years old - roughly equivalent to a human age of 100 years.

Clams will filter-feed on whatever the tide brings to them. But the ideal food for clams are un-armored, one-celled, microscopic organisms that have whip-like threads (flagella) for moving through the water. Such phytoplankters are known as dinoflagellates.

Scientists have found soft-shell clams difficult to protect and manage. Just often enough to avoid clam stocks in Hampton-Seabrook Estuary from becoming completely depleted, new recruits arrive off the NH seacoast, evidently borne along by currents carrying the plumes, or patches, of planktonic larvae, which wash into Hampton Harbor. Survival of these recruits is helped by flat closings for the summer season and by other, occasional, closings for sanitary reasons (high bacterial counts in the water).

Whereas, virtually no juvenile clams settle in some years, other years yield incredible densities. Such recruitment is highly localized within each tidal flat; it tends to be highest in sheltered areas and lowest where waves, winds, and currents conspire to shift the

sediment around. But simply seeing a lot of baby clams on the flat in the fall does not necessarily portend a good harvest down the road. The same hydrodynamic influences responsible for initially seeding the flats can often re-suspend and relocate the tiny seed clams, so that they end up someplace else.

After settlement of the baby clams, they begin to make tiny burrows. Throughout most of the colder months, these "spat" have to burrow, because direct contact with ice crystals on the flat surface is fatal. When spring comes, the survivors are those that succeeded in making shallow but permanent homes in the sand.

As a clam grows larger, it becomes increasingly unable to reburrow. At a length of 25 mm (1 inch) only about half of the young clams can successfully reburrow if disturbed. This has important implications for predation; that is, digging out juvenile clams usually leaves them exposed for predators to find. Some management practices even include "replanting" clams that are too small to be legally harvested, with their necks upright and covered by a thin layer of sand to reduce exposure.

Anyone interested in learning more about the soft-shell clam, and how to dig for clams successfully in our area is invited to come to our March 29th "Clam Digging for Dummies" workshop. AERC is co-hosting the workshop with Sandy Point Discovery Center in Stratham, and the day will be full of the latest information on local flats. We will make collection buckets, have cooking demos for lunch, and have a guided tour of the flats to learn the tricks of the trade. Everyone attending will be issued a 2003 clamming license. For information or to register visit our website at www.teachfish.org, or call AERC at 603/926-1650.

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All Things Aquatic: Sea Scallop

The **sea scallop**, *Placopecten magellanicus*, is the largest, northernmost and deepest living of all scallop species. These scallops are found on sand and gravel bottoms from Maine to North Carolina and grow to 8" (20 cm) in size. With swift claps of their valves (as though taking a bite out of the water), scallops propel themselves by strong jets of water forced out through the hinge. Scallops have from 30 to 40 brilliant blue 'eyes' that line the edge of their mantle. These eyes are light-sensitive organs but cannot "see" as our eyes do (that is, form actual images).

Scallops feed and breathe by drawing water in between the shells, their organs taking in the oxygen or the minute food particles they need, and then passing the water out near the hinge. Scallops reproduce by females shedding many small eggs into the water, which become fertilized by sperm from the males. Larval scallops drift with the tides, along with innumerable other planktonic creatures, and in turn, the larvae are food for numerous plankton feeders in the Gulf of Maine. Predators on adult sea scallops include sea stars, crabs, carnivorous snails, rays, and people.

Scallops are among the safest of all bivalve molluscs to eat during 'red tide' outbreaks, because consumers are served only the well-developed muscle that the scallop uses to open and close the shell. The digestive and other organs, which can accumulate much of the toxin, are discarded. This is different than when we eat clams, muscles and oysters.

Sea scallop farming entails collecting the spat (baby scallops) from the wild using 1.5 mm mesh spat collector bags, stuffed with a stiff, polyethylene settlement material called Netron. The tubular material is cut into seven foot lengths, and one end is then pulled inside itself - as you might do with a pair of socks. Finally, the Netron tubing is inserted into the collector bags, so that each bag ends up 'inflated' to approximately the size of a pillow.

To investigate the best time to collect scallop seed, and the best locations to place the collector bags, the Aquaculture Education and Research Center (AERC) recently set out some of these spat bags to try to collect the baby sea scallops at six sites at dock facilities along the New Hampshire seacoast. [Other conservation agencies have similar spat collecting programs ongoing in Saco and Stonington ME.]

If captured, the tiny scallops should remain in the bags throughout the winter. In the spring, the survivors will have grown to about the size of a thumbnail and be ready to be removed from the bags. Any baby scallops recovered would then be available to reseed depleted scallop beds (spread over selected bottom sites and left to grow to a harvestable size), or to be grown out further, either in trays in a shellfish facility or in pearl nets suspended in the open ocean.

Collecting and sheltering the young in spat bags greatly increases the chances of survival at a time in the life cycle when sea scallops are particularly vulnerable and subject to high mortalities. In this way, the activity enhances stock recruitment, thereby helping to

manage New Hampshire's molluscan shellfish resources sustainably, through a combination of aquaculture, applied research, technology transfer, and public education.

If you or someone you know has a dock site on coastal waters, you can participate in AERC's shellfish restoration project and become a Shellfish Steward. AERC is leading two workshops this spring to train stewards in deployment of the spat collectors, how to check the bags periodically for invaders (like small starfish), and how to collect the seed scallops and oysters at the end of the season. All the juvenile shellfish we collect through this program will be sprinkled into local waters where they can thrive and grow to replenish the wild population.

To be a Shellfish Steward, contact AERC at 926-1650, or visit our website at www.teachfish.org.

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Clam Digging for Dummies Participant List

Mike and Lynette Gagnon, Somersworth

Lynn Skogseth, Exeter

Justin Kane, Exeter

Mary Ann Kane, Exeter

Lucinda Grondin, Rochester

JB Black, Fairfax, VA

Jeanne and Joseph Beland, Durham

Dave Hansen, Portsmouth

Carey Curtain, Dover

Jim Lubove, Portsmouth

Liz Briggs, Dover

Joe Sulkous, Dover

Terry Date, Newmarket

Norman Brandt, East Kingston

Lauren Chuslo-Shur, Seacoast Newspapers, Hampton

Chuck Ward, Durham

Katherine Magness, Kittery, ME

Shanna Fredyma, Dover

Lynne Capp, North Hampton

Agenda: Clam Digging for Dummies

March 29, 2003

- 10:00 am Registration

- 10:30 am Introduction and Overview
 About the organizations
 Why talk about clams?
 NHEP funding for project

- 10:45 am Shellfish Biology
 Dissection and Natural History Lesson

- 11:15 am Chris Nash, DES
 Flat locations, closings, environmental protection

- 11:45 am Make Clam Pails and Lunch Cooking Demo
 Issue Clam Licenses

- 1:00 pm Field Trip to the Flats
 Digging demo and safety tips

Begin Clamming, staggered ending time...

(3-4 pm low tide)

List of Attachments

Sample “All Things Aquatic” Columns

Shellfish Curriculum

Sample Communications with Shellfish Advisory Team

“Shellfish Tour” Outreach Flier

“Clam Digging for Dummies” Flier

Newspaper Coverage of “Clam Digging for Dummies”

“Clam Digging for Dummies” Information Packet

Photographs