The Dredge

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Setting the Sound up for Success:

Deploying remote-set, disease-resistant oyster seed on a natural bed in biodegradable netting

Aboard a commercial oystering vessel, student researcher Hillary Kenyon accompanies fishermen whilst dredging the experiment's chosen lease. This large pile of oysters, clams, and other marine fauna were removed from the site prior to deploying the oyster set-on shell. (Photos by Inke Sunila)

By Hillary Kenyon

Long Island Sound (LIS) is an estuarine habitat that is home to a variety of plants and animals. The eastern oyster, *Crassostrea virginica,* is a keystone species in Connecticut's coastal environment. Like the wedge-shaped keystones of ancient Roman arches, the oysters of the Sound bring together the building blocks of the ecosystem and bear the weight of maintaining its healthy state. As the predominant filter-feeding organisms, Connecticut oysters are critical to preserving water quality. By filtering plankton, these oysters make a tasty smoothie of the water column and cleanse it of harmful pollutants in the process. Natural oyster beds in LIS are large areas where old shell, or cultch, from past oyster generations cover the sea floor. These beds provide a hard, three-dimensional surface where oyster larvae may attach. Here the seed oysters, or spat as they are called just after settlement, may grow free from the adversity of the suffocating sediment.

In addition to these ecosystem services, the eastern oyster is a major economic asset to Connecticut. A resilient species, they flourish throughout the coast and over 86,000 acres of Connecticut's seafloor are mapped and managed shellfish growing areas. It is necessary to note, however, that only a mere fraction of this area can be considered natural oyster beds. The majority of the growing areas are privately leased from the State to be farmed and harvested by the hardworking harvesters that rely on the Sound for their livelihood. Oyster farmers toil away for grueling hours, and whether it's under the summer sun's unforgiving rays, or the icy winter's howling winds, these men and women are passionate about their jobs and love being out on the water. The industry, however, has seen considerable fluctuations in years past. Despite a

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Remote Setting

The remote-set oysters were stocked in biodegradable netting traditionally used in the mussel culture industry. (Photo by Inke Sunila)

resurgence of oystering in the 1980s and 1990s due to enhancements made on the natural seed oyster beds, disease outbreaks and extensive time periods with no natural sets have caused years with minimal harvests and overall irregularity in the industry.

The protozoan parasite *Haplosporidium nelsoni* (MSX) is responsible for considerable oyster mortality in Connecticut. Following the devastating outbreak of 1997, there were no commercially significant sets on record and a period of low production followed. Such a profound gap in natural oyster sets struck a blow to the industry. In response, Connecticut Sea Grant has provided funding for a research project that aims to devise a technique for enhancing the State's natural oyster beds which provide the seed that the vast majority of the industry depends upon. In the case of a disease epizootic, or during a time with little to no natural recruitment, this method would provide an economic cushioning for the oyster industry. Headed by Dr. Inke Sunila, Shellfish Pathologist from the Department of Agriculture/Bureau of Aquaculture (DA/BA), the research employs a biodegradable mussel netting or sock used to deploy remote-set hatchery reared oysters. The idea behind the project is that the socking provides a degree of protection from predators.

Inke, a brawny woman who hails from Finland, is the brainpower behind the project. With a diligent work ethic and lifetime of experience with shellfish, she has adopted the remote setting technique for a novel purpose – to boost the seed supply for Connecticut's commercial industry. Conventional culturing practices involve hatchery-raised oyster larvae settling on tiny shell fragments. This produces single (cultchless) oysters that require a nursery stage, elevated from the sea floor in either submerged cages or bags. Remote setting, however, circumvents this phase and allows oyster larvae to settle on full shells as they do in the wild. Just as natural set, settling on cultch enables hatchery-raised oysters to grow directly on the bottom. In simple terms, remote setting simulates Connecticut's existing practices of collecting set from natural oyster beds and transplanting them to be grown on private leases.

In addition to filling the gap between natural oyster sets, this form of remote-setting disease-resistant oysters could potentially enhance currently unproductive natural beds and provide further economic prosperity.

There is the added benefit of selective breeding—potential for increased oyster survival and growth. The "Clinton" strain of oysters has shown significant resilience and was chosen for the experiments. "Clinton" broodstock were obtained from Clinton, Connecticut following the MSX-outbreak of 1997 and have been selectively bred over numerous generations. Using previously developed hatchery techniques, Karen Rivera and Kate Blacker of the Noank Aquaculture Cooperative conditioned and spawned the "Clinton" oysters. Larval oysters were then allowed to settle on cultch and grown in ...

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Remote Setting

mesh cages at the hatchery prior to deployment.

On a sunny afternoon in early June, I arrived at the Bureau of Aquaculture lab in Milford. As an undergraduate student researcher from the University of Connecticut serving as the co-principal investigator for the project, I accompanied Inke to the Norm Bloom & Son oyster fishing dock in Norwalk. To prepare the shellfish grounds for the experiment, the first order of business was to remove existing shellfish, predators and other marine fauna from the lease. This is done by dredging. Captained by Jim Bloom, the dual-armed dredging boat repeatedly dragged along the sea floor and lifted the load onto the deck. An enormous pile of oysters, clams, snails, crabs, and other creatures quickly mounted as I scurried around the deck collecting and identifying specimens. When the pile towered over ten feet, the captain retired the dredge and headed back to the dock. The lease was then ready for the project and the researchers had a clear picture of what species they should expect to inhabit the area.

A few weeks later, Tessa Getchis, aquaculture extension specialist from Connecticut Sea Grant, met Inke and me at the lab. It was the day we set aside to mark the experimental grid. Like all scientific research, however, a seemingly simple task proved to be more difficult in the field. In this case, the area was about two feet deeper at low tide than the charts show. Though not a problem for the oysters, it was a difficulty for two women in wetsuits. As our feet barely grazed the bottom, Tessa and I awkwardly moon bounced along as we measured and buoyed the transects within the lease.

The next day, Kate arrived at the Milford lab with her rumbling red truck filled with bags of oyster seed. She proudly released the tailgate and carefully lifted a mesh bag from the truck bed. We immediately lit up as Kate placed the bag on the outdoor picnic table. Only a few millimeters in length, the oysters clung to the shells upon which they settled.

“They look amazing!” Inke exclaimed, as I examined a single cultch shell covered in baby oysters. Tessa, nodded in approval. At this point, our all-women research team had gotten off to an assuring start and eagerly sorted the oysters for deployment.

Photo of oysters three months after deployment shows extremely rapid growth and numerous fouling organisms. (Photo by Inke Sunila)

Not more than a few hours later, we reloaded the truck and set off for the Bloom oystering dock. The plan was to manually deploy the oysters on the lease, now marked with bamboo poles and cinder blocks. In due time, the oysters were released over the boat edge: half with the biodegradable netting, and half without. Two types of netting were utilized as potential predator control, one made of pure cotton, the other with a polyester base material. Both served as predator deterrents in the early weeks after deployment when growth is most critical. Bare (seedless) cultch was also deployed on the lease to serve as a comparison to natural oyster recruitment for this season.

In order to track growth and survival rates, the researchers have begun a monthly sampling of the oysters that will continue into the next year. They predict that this approach of using biodegradable netting for oyster bottom culture has the potential to promote Connecticut oyster production in many ways. In addition to filling the gap between natural oyster sets, this form of remote-setting disease-resistant oysters could potentially enhance currently unproductive natural beds and provide further economic prosperity. In terms of ecological significance, establishing successful beds will also promote improved water quality and overall improved biodiversity and health of Long Island Sound.

State Responds to the Threat of Naturally Occurring Bacteria in Long Island Sound

By Kristin DeRosia-Banick

A number of U.S. states faced illness outbreaks related to shellfish consumption during the summer of 2012. A foodborne-disease outbreak is defined by the Centers for Disease Control (CDC) and Prevention as an incident in which two or more persons experience a similar illness resulting from the ingestion of a common food. These outbreaks were caused by elevated levels of *Vibrio parahaemolyticus*, a naturally occurring bacteria associated with the extremely warm water temperatures experienced throughout this year in many parts of the country. While *Vibrio* infections are considered rare (but serious), what is of concern to the CDC and the State is the increase in incidence of *Vibrio* infections over the last five years (Figure 1).

The symptoms of *V. parahaemolyticus* infection include diarrhea, stomach cramps, nausea, vomiting, headache, fever, and chills. Symptoms usually appear 12-24 hours after eating contaminated shellfish, and can last two to seven days. Consumers may be exposed to these pathogenic (disease-causing) bacteria by eating raw or undercooked shellfish, including oysters, clams, lobster, and crab. *Vibrio* infections can be life-threatening for immune-compromised people or those with chronic liver disease. Individuals who regularly take antacids, heart or diabetes medication, or who've recently had antibiotic or cancer treatments are at greater risk. The bacteria can also cause an infection of the skin when an open wound is exposed to seawater containing the bacteria.

The Connecticut Department of Agriculture Bureau of Aquaculture is the shellfish authority for the State. The Bureau performs standard bacteriological seawater and shellfish tissue analyses using fecal coliform bacteria as an indicator for classification of shellfish growing areas. Naturally occurring bacteria such as *Vibrio* present a challenge for regulators. Traditional indicators such as fecal coliform, used to identify the presence of sewage contamination, do not correlate with levels of pathogenic *Vibrio* species in the growing areas. This is because *Vibrio* bacteria occur naturally in the estuarine environment and, unlike fecal coliforms, they are not introduced via pollution sources such as storm water runoff or sewage.

Additional methods of testing for naturally occurring bacteria are becoming increasingly necessary to ensure that shellfish continue to be a safe food source. Advances in molecular technologies have recently allowed shellfish control authorities to apply polymerase chain reaction (PCR) techniques to the identification and enumeration of naturally occurring marine bacteria such as *Vibrio* and the identification of pathogenic species. The Bureau of Aquaculture intends to apply these new technologies to shellfish growing areas to develop a better understanding of *Vibrio* levels and their correlation

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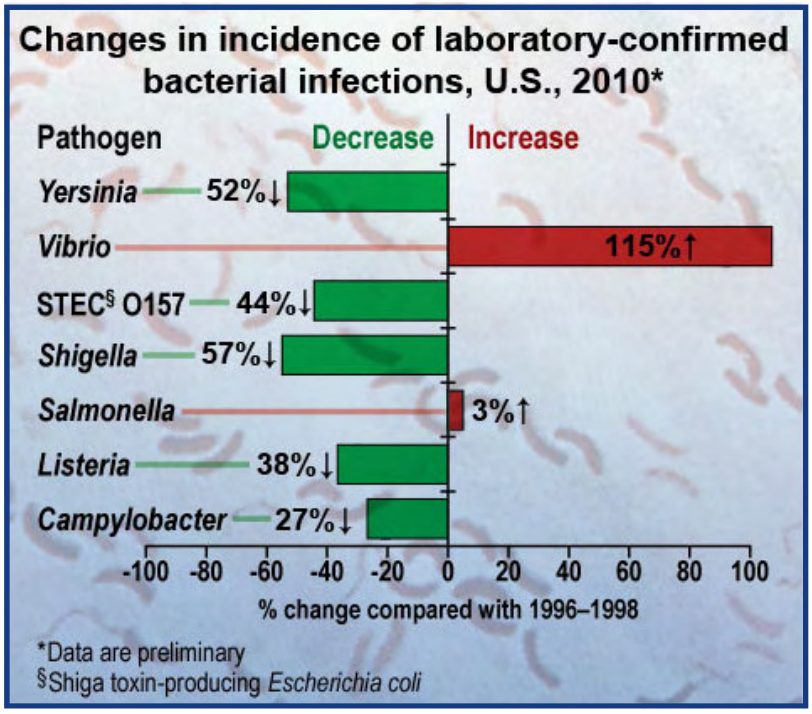

Figure 1. Trends in Foodborne Illness, 1996–2010. Center for Disease Control and Prevention. Last accessed on 10/16/12 from: http://www.cdc.gov/foodborneburden/trends-in-foodborne-illness.html

Aquaculture and Restoration:
A Partnership and Conference

The Northeast Aquaculture Conference and Exposition (NACE) will be held on December 12-15, 2012 at the Mystic Marriott Hotel in Groton, Connecticut. This conference and trade show is held every other year to bring together producers, industry vendors, NGO, researchers, extension staff and regulatory agencies to discuss current issues and ongoing research within the industry. This year the conference will be a joint meeting of NACE, the Milford Aquaculture Seminar, and the International Conference on Shellfish Restoration.

The schedule is organized into six main sessions: shellfish culture, finfish culture, seaweed culture, general aquaculture, business of aquaculture, and shellfish restoration. In addition to researcher presentations and featured vendors, various workshops and field trips are also scheduled. For registration and information, visit: http://www.northeastaquaculture.org/ or contact:

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Bacteria

with a variety of environmental parameters such as depth, salinity, and water temperatures. The data will be used to identify the presence and concentration of *Vibrio* bacteria across shellfish harvest areas, in order to provide management recommendations to harvesters. By establishing real-time bacteria levels and associated risk, the Bureau can permit companies and recreational harvesters to continue harvesting safely, even during periods when elevated levels of the bacteria may exist elsewhere.

The State has taken proactive measures in response to the unfolding *Vibrio* situation. The Bureau instituted innovative management practices to prevent *Vibrio* illness outbreaks from occurring. These measures included conducting a mandatory educational seminar with Connecticut Sea Grant for licensed shellstock harvesters and dealers, testing for *Vibrio* in shellfish growing areas with the assistance of the U.S. Food and Drug Administration Dauphin Island Laboratory, and closing to harvest those areas which showed elevated levels of the bacteria and/or a history of previous illnesses. The Bureau collaborated with shellfish growers to establish *Vibrio* control plans for individual operations to prevent proliferation of this bacteria in harvested shellfish and thereby prevent illnesses, while allowing the majority of harvesters to continue working safely. To date, there has been no outbreak of *Vibrio* illness related to shellfish harvested in Connecticut.

The Bureau continues to monitor shellfish growing areas for *Vibrio*, and expects to see a decline in levels as water temperatures decrease. The Bureau is working with Connecticut Sea Grant and the State Department of Public Health Food Protection Program to create educational literature for retail operations and recreational harvesters regarding proper handling of shellfish to reduce the risk of illness caused by *Vibrio* bacteria. By working cooperatively with harvesters, wholesale dealers and consumers, we strive to stay ahead of emerging public health threats and to keep shellfish consumers safe while enjoying the bounty of Long Island Sound.

Kristin DeRosia-Banick is an environmental analyst with the CT Bureau of Aquaculture.

Survey Results to Inform New Programs & Opportunities for the Connecticut Shellfish Industry

By Tessa Getchis

Connecticut Sea Grant (CTSG) recently distributed a survey to all licensed Connecticut shellfish producers. The purpose of the survey was to quantify the economic impacts of commercial shellfish production and identify typical production practices in order to better inform local, regional and federal policy makers of the status and importance of the State's shellfish industry. More specifically, our office has been working with legislators, other (non-regulatory) government agencies and producer associations such as the East Coast Shellfish Growers Association to improve Connecticut shellfish producer eligibility for programs such as disaster assistance, crop insurance, grants, loans and cost-share programs.

The responses to the survey questions are invaluable when it comes to justifying shellfish producers' rights to existing government programs designed for farmers, for which they are not currently eligible, for adapting programs not originally designed for shellfish producers, and for developing new programs designed specifically with this industry in mind.

So, while the Connecticut Sea Grant program is known for hosting informational workshops and providing educational resources, the staff are also working in the background with many different agencies and individuals to make sure that shellfish producers have as many financial tools and business opportunities available to them as possible.

Thank you to those who have already submitted their survey response. Please fill out your survey form and send it back if you haven't; the answers are very important to our efforts and the efforts of our partners to help the industry.

The aforementioned producer programs (disaster assistance, etc.) will be discussed at the upcoming Northeast Aquaculture Conference & Exposition Farm Risk Management session (see page 7).

Did you know?

- While shellfish producers around the country have participated in government disaster assistance programs, nearly **90% of Connecticut's shellfish producers are ineligible**.
- While crop insurance-type programs exist for both oysters and clams, **the number of Connecticut shellfish producers eligible for such programs is zero**.
- As a result of university research, a government cost-share program to help producers implement conservation practices on their farms **will soon be made available to eligible producers in Connecticut.**
- While wastewater treatment facilities across the State are receiving payments for removing nutrients from Connecticut water bodies, **shellfish producers have not been the recipients of any such credits for nitrogen removal.**

2013 Census of Aquaculture

The United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) is about to initiate the next Census of Aquaculture. As the primary source of American agricultural statistics, the census is conducted every five years and provides production and economic data.

The Census covers all U.S. aquaculture operations that sell and distribute more than $1,000 of product during the census year. The census provides the pertinent information on which federal aquaculture policies are based. As such, every farmer-harvester, regardless of size or type of operation, is encouraged to participate. Look for updates in the next issue of *The Dredge*.

Research implicates sea squirts as potential vectors of harmful algal introductions

By Maria Rosa

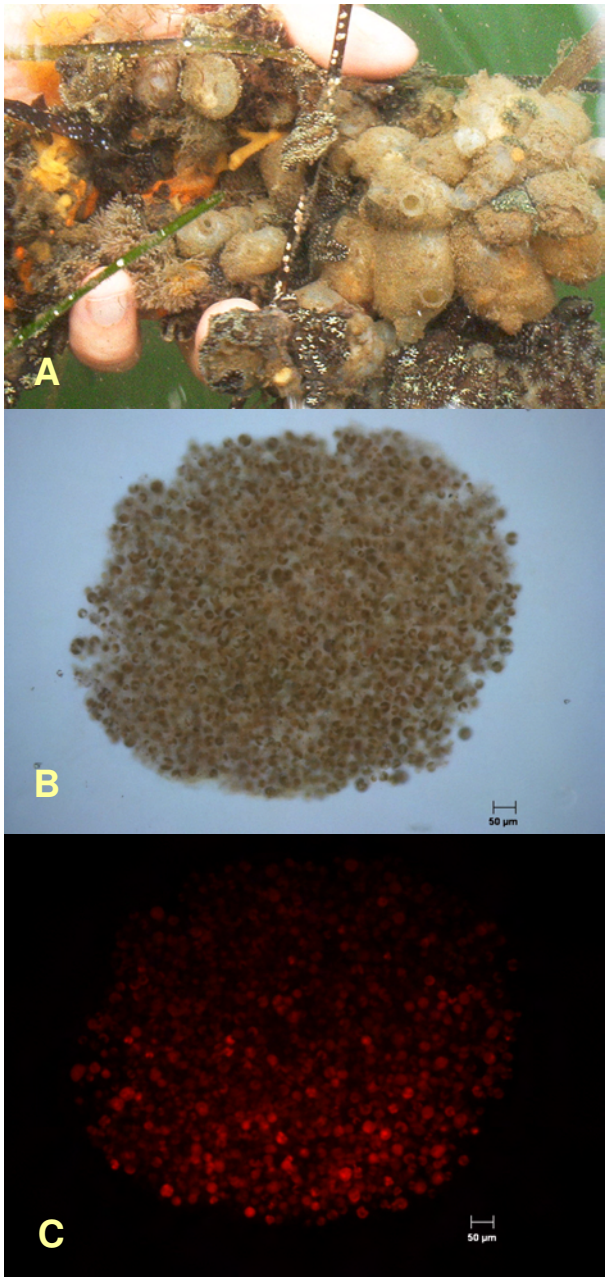
Biofouling ascidians, or sea squirts as they are commonly known, are found worldwide in coastal ecosystems. Both native and non-native species can be found in Long Island Sound and are among the main colonizers of aquaculture gear and many other hard substrates. Our research team set out to determine if the transport, removal, and transfer of these organisms by aquaculturists has the potential to concentrate and further distribute harmful-algal cells to new areas. In this study, wild-caught sea squirts were exposed individually to cultured strains of various species of harmful algae at simulated high or "bloom" cell densities. Next the squirts were transferred to seawater and their biodeposits collected and analyzed periodically over several days to learn if any harmful algae cells remained. Collected biodeposits were also grown in culture tubes for several weeks to see if a bloom would form from the ingested cells.

What we found was concerning, as cells of all harmful algal bloom (HAB) species were found to pass intact through the ascidian digestive system, remained viable and in many cases were capable of re-establishing HAB populations for at least three days.

Industry and managers should recognize the potential threat and ecological impact of spreading biofouling ascidians and employ the following best management practices (BMP) to mitigate impacts:

1. **Remove fouling material and discard to a landfill.**
2. **Compost removed fouling material for a minimum of five days.**
3. **Allow gear to dry and fouling organic material to flake off, and rotate with new gear during this time period.**

While these measures may represent an increase in production duties and costs, extension specialists have been working with USDA to develop a new cost-share program designed to help producers who initiate environmental conservation measures on their farms. Together, the implementation of these BMP should help to mitigate the risks associated with moving fouled aquaculture gear.



A) Biofouling communities contain various species including native and non-native ascidians. B) Fecal pellet from *Ciona intestinalis* that was exposed to the harmful alga *Alexandrium fundyense*. Under a light microscope, packed algal cells are visible. C) The red fluorescence filter of the same image shows that the cells have chlorophyll after being ingested and passing through the digestive system, suggesting that cells are potentially viable.

To learn more about this research, please contact:
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Aquaculture America 2013

Nashville, Tennessee, February 21-15, 2013

Aquaculture 2013 conference and exposition will be held on February 21-25th, 2013 in Nashville, Tennessee. The Triennial combines the annual conferences of the Fish Culture Section of the American Fisheries Society, the World Aquaculture Society, and the National Shellfisheries Association. This is the largest aquaculture conference in the world and attendees are expected from over ninety countries!

The conference and trade show is the premiere event to learn about current aquaculture research and to view the new products and technologies of the field. Scientists will present their work and attendees have the opportunity to partake in a variety of workshops. Sessions will encompass various research projects organized into disease, nutrition, engineering and culture techniques of aquatic organisms. Additional topics will include economic and policy related concerns, corresponding environmental issues, and many more. Visit: http://www.was.org and view “meetings”.