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Shellfish Spotlight: 2008

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NewHampshire EstuariesProject

Shellfish SPOTLIGHT

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A Watershed Perspective to Enhance Shellfish

The Road to Healthy New Hampshire shellfish populations begins far from the coast.

Each year Granite State shellfishers search shallow briny waters in search of delicious mussels, clams, or oysters for the dinner table. Those who are skilled often are rewarded with full buckets, but few shellfishers realize that good harvests in New Hampshire's Seacoast owe much to activities occurring far upstream.

The quality of the water and amount of available nutrients that sustain a clam or oyster is directly related to the condition of the rivers and streams that drain the land. The Hampton-Seabrook Estuary is fed by approximately 46 square miles of surrounding land. An even larger system, the Piscataqua River Estuary that includes Great Bay, is supplied by a watershed that is 1,023 square miles.

Development within the coastal watershed area has profound impacts on the amount of contaminants flowing to the sea. Sediment washed from roadways and bare soil flows downstream and collects in the estuary where it smothers shellfish beds in extreme cases. Nutrients, primarily nitrogen, are contributed by wastewater treatment plants, septic systems, and land use activities such as lawn fertilizing. Excessive nutrients threaten the ecological balance of the estuaries and thus the survival of shellfish populations. Finally, bacteria from failing septic systems, pet waste, or damaged sewer systems create a human health hazard in estuarine waters.

Seabrook Station

The Hampton-Seabrook Estuary is influenced by surrounding land development activities.

Because shellfish filter great amounts of water to take in food and oxygen, they absorb contaminants from the water that accumulate in their flesh. Therefore, a watershed that flushes large amounts of contaminants downstream will deliver many of these contaminants to shellfish and reduce their numbers or often make them unsafe to eat.

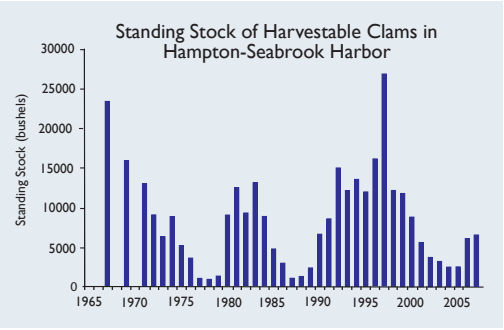
It is this close relationship between coastal watershed function and shellfish health that caused the New Hampshire Estuaries Project (NHEP), and many partnering agencies, to monitor shellfish in New Hampshire and make their restoration and maintenance a priority. The NHEP Management Plan includes many strategies that improve water quality throughout the watershed that will in turn improve shellfish populations and open more harvesting areas.

INSIDE

Status of New Hampshire Shellfish

CLAMS

Granite State clammers are a patient group who know that clams in the sandy flats of Hampton-Seabrook Harbor have their good years and bad. Long-term monitoring of the number of harvestable clams, called "standing stock", shows that it routinely peaks and crashes. Recent assessments of standing stock have been giving some clammers hope that the clam population has bottomed out and an improvement may be on the horizon.



Data Source: FPL Seabrook Station and New Hampshire Fish and Game Department

The standing stock of clams increased from 2006 to 2007 from 6,188 to 6,519 bushels. Optimism should be tempered since the improvement is still 23% below the 30-year average of 8,500 bushels and larval density declined a bit from 2006 to 2007. But two years of standing stock improvement is a positive sign for a clam resource that declined from 1998 to 2005.

Historic standing stock peaks occurred in 1967 and 1997 when researchers estimated that there were about 25,000 bushels of harvestable clams in Hampton-Seabrook Harbor. The resource hit bottom in 1978 and 1987 when the flats held less than 1,000 bushels.

The reasons for the variable clam population are unclear and as with most things in life, there is not just one answer. Some scientists believe the clam ups and downs are typical of a common predator-prey relationship. Put simply, it means that when there are many clams, predators (including humans) eat them. Once it becomes hard to find clams, the predators back off and the clams rebound. Others believe a clam disease, called sarcomastous neoplasia, may significantly impact clam populations. Current research at the University of New Hampshire is examining the prevalence of this disease throughout the region (see "Research Examines the Extent of a Deadly Clam Disease"). Yet another reason may be the prevalence of predatory green crabs, as documented by past NHEP-funded studies in Hampton-Seabrook Harbor. Finally, the water itself makes life tough for clams, too. Swift currents displace clams, shifting sand suffocates them, and thick ice sheets scour the bottom and crush them.

Even with the various dangers that face New Hampshire clams, their numbers appear to be improving. Hopefully historical trends will hold true and New Hampshire clamming will continue to get better for the next several years.

OYSTERS

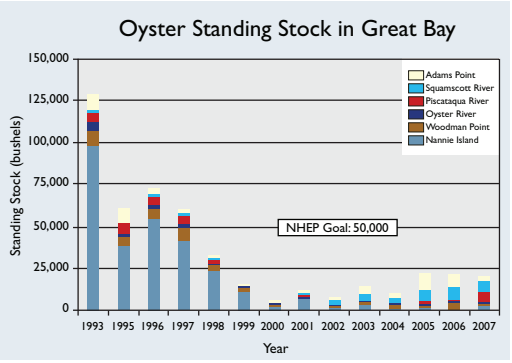
The number of harvestable oysters, called "standing stock", in recent years has improved, but unfortunately there is no consistent upward trend that suggests the improvements will continue.

In 2007, standing stock of oysters was 6,231 bushels in areas open for harvesting and 20,023 bushels for all beds, which is just 16% of the recent maximum observed in 1993. At that time the largest beds held about 120 harvestable oysters per square meter. Currently those same beds have about 7 harvestable oysters per square meter.

There are some positive signs that may improve oyster standing stock in the future. A successful breeding season in 2006 resulted in a strong year class on Nannie Island beds and other areas in the Great Bay system. To encourage this year class to replenish the populations, New Hampshire Fish and Game in 2008 reduced the oyster limit to a half a bushel and asked for harvesters to avoid the adult oysters at Nannie Island that will produce the oysters of the future (see "New Hampshire Fish and Game Takes Steps to Protect Oysters in Great Bay"). Also, The Nature Conservancy in partnership with the University of New Hampshire is conducting oyster restoration projects that are aimed at improving future stocks (see "Oyster Conservationist Program" and "Restoring Oysters Likely Benefits Many Species").

Most of the harvestable-size, adult oysters are in beds in the tributaries that are closed for harvesting, such as the Squamscott River and Piscataqua River. Information about these beds, such as their size and standing stock estimates, are difficult to interpret because of yearly fluctuations in the adult oyster density. Bed dimensions need to be remapped to verify the bed sizes.

Many people have asked "What caused the massive decline in Great Bay oysters?" Major declines from historic abundance levels are largely attributed to overharvesting and pollution. The more recent decline from 1993 abundance levels is thought to have been primarily caused by two oyster diseases, MSX and Dermo, that weaken oysters and either kill them outright or make them more susceptible to other hazards. Recovery of the oysters is being hampered by continuing impacts from these oyster diseases, as well as ongoing water quality problems associated with excessive sedimentation.



Data Source: NH Fish and Game Department

Oyster Conservationist Program

Since 2006, a number of citizens around the Great Bay Estuary have taken a very active role in restoring depleted oyster populations. Called Oyster Conservationists, they are fifteen volunteer families with docks in the estuary who have committed to raising young oysters for a season to be used in restoration projects in the estuary.

Each Conservationist receives training, equipment, and 500 young oysters the size of a pinky fingernail, called spat, that are attached to approximately 50 adult-size oyster shells. The oyster shells are caged and hung from docks below the tide line in early summer. Weekly, Conservationists pull up the cages, remove oyster predators and fouling organisms, and monitor oyster health and size. By late fall the oysters will have tripled in size and are ready to be placed on restoration reefs.

The program was started by Dr. Ray Grizzle and Jennifer Greene of the UNH Jackson Estuarine Laboratory as a component of a larger restoration effort. Grizzle and his laboratory staff developed the training materials, recruited volunteers, and delivered the oysters to the Conservationists for deployment. Even though the program showed promise, grant funding for the Oyster Conservationist Program at the University expired and Grizzle could no longer spearhead the project. In 2008, The Nature Conservancy (TNC) stepped in with the aid of the National Oceanic and Atmospheric Administration's Community-based Restoration Program. Now, the program is a partnership of The Nature Conservancy, UNH Jackson Estuarine Laboratory, NH Sea Grant/Cooperative Extension, and New Hampshire Fish and Game Department and is aimed at furthering restoration efforts. Ray Konisky, TNC's Marine Conservation Ecologist, now leads a two-year project that will continue Grizzle's work. Konisky notes the importance of this project, "The restoration of healthy, sustainable reefs is critical to the overall ecological health of the Great Bay Estuary. The amount of water that oysters can filter while feeding is so large that they will actually help clean the water of sediments and excess nutrients that disrupt the system." Konisky goes on to explain that, "We plan to use clam and oyster shell to build an experimental reef in the Oyster River, totaling about 0.2 acres. The oysters from the Conservationists will be used to seed that reef."

TNC hopes to grow the ranks of Oyster Conservationists in the 2009 season. Those dock owners wishing to participate in this program next year should contact Ray Konisky by email at rkonisky@tnc.org.

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New Hampshire Fish and Game Department Takes Steps to Protect Oysters in Great Bay

To help address declining oyster numbers, the New Hampshire Fish and Game Department (NHFG) in 2008 restricted the daily oyster harvest to half a bushel per harvester.

The state agency added this restriction to reduce harvest of spawning stock and to protect the 2006 year class of young oysters. The goal is to encourage the growth of the overall spawning stock of oysters in Great Bay so they can begin to rejuvenate the oyster population that has declined 84% in the past 14 years.

NHFG also asked oyster harvesters to do several voluntary actions aimed at helping the oyster population to recover. Harvesters are asked to avoid areas where many young two to three inch oysters are found, such as the popular beds around Nannie Island in Great Bay. Small oysters should be carefully culled from harvesting tongs and returned to the bed so they can become future breeders.

In addition to adjusting harvesting practices, NHFG asked harvesters to support restoration efforts by returning the oyster shells to the beds or donating the oyster shells to restoration researchers at the UNH Jackson Estuarine Laboratory at Adams Point.

To learn more about oyster harvesting regulations and oyster management, contact the NHFG Marine Fisheries Division at 603-868-1095.

Grizzle

Extremely high numbers of oyster spat from the 2006 and 2007 year classes may improve oyster harvesting in the future if current harvesters carefully return young oysters to the beds where they can breed.

Restoring Oysters Likely Benefits Many Species

Dr. Ray Grizzle, with funding from the New Hampshire Estuaries Project and New Hampshire Coastal Program, is conducting a research project that not only added about 1.75 acres of new oyster reefs in Great Bay but also examines how other creatures benefit from this once abundant habitat. It is hoped that a better understanding of the ecological role of oyster reefs will improve support for future restoration efforts in Great Bay.

Grizzle's experiments were fairly straightforward. In tanks at the UNH Jackson Estuarine Laboratory, Grizzle placed disease-resistant juvenile oysters, called spat, onto oyster shells collected through the oyster shell recycling program. The "seeded" shells were then used to construct a total of 12 small circular reefs, about 15 to 20 feet across, near Nannie Island in Great Bay. Each reef was seeded at a rate of roughly 500 juvenile oysters per square yard.

Reef construction took place in the fall of 2007, and Grizzle returns to the reefs periodically to examine the oysters' progress and to collect samples of creatures living among the oysters. During his visits to determine the status of the oysters, Grizzle collected small sections of six reefs and counted and measured all living oysters. He then returned the oysters to the experimental reefs. For comparison, he repeated the process on an adjacent natural reef.

To study the plant and animal communities, the researcher collected the algae, fish, worms, crabs, and all other creatures that lived among the oysters on the constructed reefs and adjacent natural reef. This periodic sampling will continue throughout the year until the Bay becomes ice covered. The project will pick up again when ice free conditions return in 2009. The information gathered through this process will be used to determine the variety, density, and amount of living creatures on both the experimental and natural reefs.

University of New Hampshire

Researchers install an experimental oyster reef in Great Bay.

Grizzle has some initial thoughts on how the oyster reef habitat is used by other creatures. "So far, we have found abundant invertebrates and macroalgae on the constructed reefs, but fewer fish than predicted. We expect continued colonization by other plants and animals this year as the reefs continue to develop."

This study will conclude in 2009.

Invasive Species Alert! Watch for Chinese Mitten Crab

This invasive crab has become established in Chesapeake Bay and is moving northward. Four have been captured as far north as the Hudson River in New York. The northern range of this crab is unknown, but some believe it could reach New Hampshire. It can damage fishing gear, displace native crabs, disrupt fresh and saltwater ecology, and cause erosion in coastal watersheds. It can be found in both fresh and salt water. If you catch a mitten crab, freeze it, note the exact location where it was found, and contact New Hampshire Sea Grant at 603-749-1565.

IDENTIFICATION

- white-tipped, hairy claws
- juveniles found in freshwater, adults found in saltwater
- no swimming legs
- shell 4" wide

Rabitsch, University Wien

Research Examines the Extent of a Deadly Clam Disease

Cellular biologist Dr. Charles Walker at the University of New Hampshire has been studying the clam disease "neoplasia" at the cellular level for a decade.

After countless experiments, he has developed a very good understanding of how the disease kills a clam, but only has a hunch as to what may be causing the disease. He suspects that environmental contaminants in the mud where the clam lives may play a major roll. To follow-up on his hunch Walker teamed up with Dr. Stephen Jones, Associate Professor at the UNH Jackson Estuarine Laboratory, who is well-versed in toxic contamination issues in New Hampshire estuaries. Together they were awarded a grant from the Saltonstall Kennedy Grant Program to collect and test hundreds of clams from numerous areas in New Hampshire and Maine with the goal of understanding the extent of the problem and to see if there is a correlation between the disease and contaminated sediments.

Even though clam neoplasia can easily kill a clam, it is harmless to humans and other creatures who consume the mollusks. Within a clam, the disease causes an increased number of malformed blood cells that, in turn, increases the animal's need for oxygen. During warm summers when oxygen in the water is at its lowest levels, diseased clams simply suffocate in the mud.

Clammers cannot tell if a clam has neoplasia simply by looking at it. Many times, but not always, an infected clam will be lethargic and slow to withdraw into its shell when handled. For a definitive diagnosis, a clam blood sample must be analyzed in a laboratory. Some clams that are mildly affected by neoplasia can recover, although those with a high degree of infection have only about an 8% chance of survival.

No one knows how widespread this disease has become. Walker has documented up to 11% of the clams in New Bedford, Massachusetts die from the disease each year. Clams from places like Ogunquit, Maine, on the other hand, are disease-free. No data exist for Great Bay Estuary, but FPL Energy Seabrook Station has been monitoring clam neoplasia in the Hampton-Seabrook Estuary since 1986 and their data suggest that at least 5% of adult clams in the harbor die each year from the disease.

One New Hampshire area that is especially interesting for Walker and Jones is North Mill Pond in Portsmouth which has long been closed to shellfish harvesting due to high levels of toxic contaminants and bacteria. If the researchers' hunch is correct, the clams in this area should have a higher incidence of neoplasia than less contaminated areas in the estuaries. If a correlation can be established, then the presence of clam neoplasia may tell us something about the overall health of the environment.

2008 Red Tide Was Worst in Years

This year New Hampshire coastal beaches saw more swimmers than usual – at least several billion. These are not vacationers, but the free-swimming forms of microscopic marine algae from the genus *Alexandrium*.

Normally sharing the water with natural flora is not a problem, but *Alexandrium* produce a toxin that is concentrated in the tissues of clams, oysters, and mussels that feed on the algae. When *Alexandrium* numbers are high, a "red tide" is declared and shellfish harvesting is restricted to protect the public from paralytic shellfish poisoning, or PSP. The New Hampshire coast experienced red tide conditions earlier this year and to a greater extent than usual.

"This year's red tide bloom was among the most severe we have ever seen," notes Chris Nash, Shellfish Program Manager for the NH Department of Environmental Services. "This spring, locations in the estuaries showed high levels of toxicity much earlier than in previous years. At one location in the Piscataqua River, the laboratory technicians were so surprised at the high toxin levels, they wondered if field staff had accidentally mislabeled the samples." However, follow-up sampling confirmed the high levels at that location.

Eating clams, oysters, or mussels with PSP toxin can fatally affect the human central nervous system. Scallops usually do not pose a PSP threat since the edible parts do not absorb the toxin. Nash and his colleagues routinely monitor the amount of PSP toxin in the tissues of blue mussels throughout late spring and summer to determine when harvesting areas should be closed for filter-feeding shellfish species. In New Hampshire, three weeks of test results that show low levels of PSP toxin are required before areas are reopened to harvesting.

Much like the severe PSP event in 2005, toxin levels rose very quickly in early May 2008 at the Isles of Shoals, then eventually subsided by mid-July. Nash reported the effects of the algae bloom were seen in nearshore areas like Hampton-Seabrook at the same time, which is earlier than usual. Red tide closures also occured in Maine and Massachusetts.

Typically in the spring and early summer, *Alexandrium* experience population explosions, called blooms, of its free-swimming life stage. Environmental factors, such as increased sunlight, abundant nutrients, warming temperatures, and other factors cause dormant algae resting in ocean sediments to transform and swim in the water. During this time, they feed on nutrients and reproduce. A single cell of *Alexandrium* multiplies to several hundred in just a few weeks. Once the bloom has depleted the nutrients, the free-swimming cells change and become dormant in the sediments.

Lobster Tomalley Found to Contain PSP Toxin

On July 18, 2008 New Hampshire's Departments of Environmental Services, Health and Human Services, and the Fish and Game Department issued a consumption advisory for lobster tomalley as a result of elevated levels of PSP toxin detected in the tomalley of lobsters from the Isles of Shoals. This is the first time PSP toxin has been detected in New Hampshire lobsters. The lobster meat was not affected and officials emphasized that consumers were not being advised to stop consuming lobster meat. The State of Maine and Canada issued similar advisories.

Places to Find More Information on Shellfish in New Hampshire

New Hampshire Fish and Game Department Clam Hotline: 1-800-43-CLAMS

New Hampshire Department of Environmental Services Shellfish Program: http://des.nh.gov/organization/divisions/water/wmb/shellfish/index.htm. or (603) 559-1509

University of New Hampshire Oyster Restoration Program http://www.oysters.unh.edu/

The Nature Conservancy Marine Conservation Ecologist, (603) 659-2678 ext 13

NHEP Shellfish Indicator Report, 2005. http://www.nhep.unh.edu/resources/pdf/env-ind-shellfish-nhep-05.pdf

Oyster Shell Recycling

In addition to plastic bottles and aluminum cans, there is another item that can be recycled to improve the environment. It is oyster shell.

A major obstacle to oyster restoration efforts in Great Bay is a shortage of oyster shell on which to grow hatchery-reared larvae. Young oysters need a hard substrate to grow on prior to being placed in the bay as part of restoration reef-building efforts.

To solve this problem, an oyster shell recycling program was developed by UNH Jackson Estuarine Laboratory, in cooperation with NH Fish and Game Department, NH Sea Grant, and UNH Cooperative Extension. After oysters have been enjoyed at the dinner table, researchers ask that the waste oyster shell be donated to the lab for their restoration projects.

Shell recycling bins at Adams Point in Durham, NH.

Shells can be recycled at Adams Point in Durham, NH, where shell recycling bins are located at the end of Adams Point Road (just past the stone pillars). At the recycling site, simply place oyster shells in the bin, latch the lid, and fill out the log book to record the amount of shell donated and the source of shell.

Since the program began in 2006, more than 100 bushels of shell have been successfully recycled and used in restoration efforts.