2018 OYSTER CONSERVATIONIST PROGRAM FINAL REPORT

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THE NATURE CONSERVANCY

2018 Oyster Conservationist Program

FINAL REPORT

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Introduction

The eastern oyster, *Crassostrea virginica,* is an important keystone species in the Great Bay Estuary, NH. As an ecosystem engineer, oysters provide several ecosystem services to both people and wildlife. Oysters filter excess nutrients and suspended solids from the water column improving water quality and clarity (Coen et al., 2007). In addition, oyster reefs provide important habitat for fish and invertebrates by building large vertical complex reef structures (Coen et al., 2007). Historically, Great Bay Estuary was filled with acres of healthy oyster reef. However, due to pollution, disease, sedimentation, and historical harvesting these numbers have decreased by over 90% resulting in only a little over a 100 acres of oyster reef today. With this drastic loss of oyster reefs, Great Bay has experienced a similar loss in the important ecosystem services that oysters provide to estuarine ecosystems. For this reason, The Nature Conservancy (TNC) of New Hampshire has been working collaboratively with The University of New Hampshire's Jackson Estuarine Laboratory (UNH-JEL) to restore oyster reefs to Great Bay since 2009. The Oyster Conservationist (OC) Program is an important community engagement component of oyster reef restoration in Great Bay.

An Oyster Conservationist is a community member in the coastal area of New Hampshire who advocates or acts for the protection and preservation of the environment and wildlife. Participants in the OC Program work towards improving the health of Great Bay by raising oyster spat for TNC's oyster reef restoration projects. Volunteers adopt a cage with spat on shell for an eight-week period cleaning and caring for the cage while also collecting data throughout the summer on survival, growth, invasive species, and wild oyster spat settlement. In 2018, the OC program had participants at 89 sites in Maine and New Hampshire. Spatially these sites are located across Great Bay, Little Bay, Piscataqua River, coastal NH, and its seven tributaries (Figure 1). The data collected provides information on conditions for oyster growth, survival, and wild oyster spat settlement to inform future oyster restoration efforts in Great Bay Estuary.

Methods

Recruitment and Training

OC volunteer sites in 2018 spanned across 16 towns in NH and ME: Dover, Durham, Greenland, Newington, Stratham, Exeter, Portsmouth, Newcastle, Rye, Newmarket, Newfields, Hampton, Eliot, Kittery, Kittery Point, York, and the Isles of Shoals (Figure 1). 75 of these sites were returning volunteers, with 14 new sites in Newmarket, Durham, Dover, Isles of Shoals, Portsmouth, Greenland, Kittery, Eliot, Newcastle, Newfields, and Kittery Point. New volunteers received one on one training during cage deliveries on cage management, data collection, oyster ecology, and restoration efforts. New volunteers heard about the OC program by word of mouth or recent press articles about the OC Program. Due to the high number of returning volunteers recruiting new volunteers was not necessary for the 2018 season. TNC's Oyster Conservation Coordinator, Brianna Group, was available throughout the season to answer questions and provide feedback to volunteers as needed.

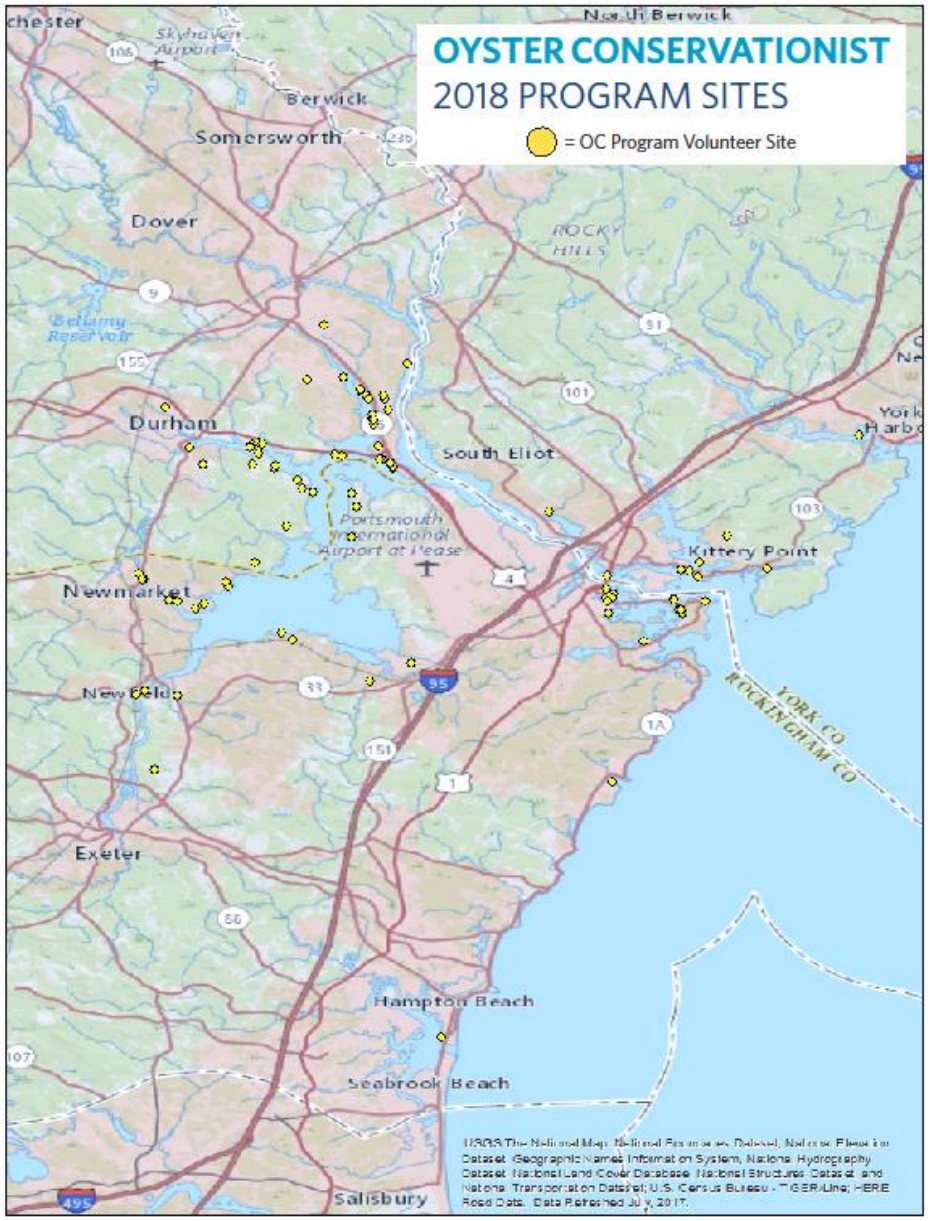

Figure 1. Map displaying general location of 89 Oyster Conservationist Sites (yellow circles) across NH and ME. Sites not included in the map include the Isle of Shoals Marine Lab and Star Island.

Oyster Spat Production

Permitting

The Nature Conservancy acquired the permits required for the Oyster Conservationist Program from New Hampshire Department of Fish and Game (Permit # MFD 1836) and Maine Department of Marine Resources (Special License # 2018-75-00) for growing oyster spat at OC sites in accordance with state shellfish regulations.

Shell collection and preparation

Recycled oyster shell was collected from local restaurants in NH and ME through the UNH Shell Recycling Program and Coastal Conservation Association, then quarantined for the necessary amount of time before being used. This recycled oyster shell was used to fill 164 UNH cages 1/2 to 2/3 full at the University of New Hampshire's Jackson Estuarine Laboratory (JEL) in May. Once filled, the cages were placed in 4 remote setting tanks at JEL. The 91 Oyster Conservationist cages were cleaned and repaired in preparation for the 2018 season.

Spat-On-Shell Production

Remote-setting of larvae occurred at JEL in Durham, New Hampshire under the supervision of Dr. Ray Grizzle and Krystin Ward. Twelve million larvae were purchased from Muscongus Bay in Bremen, ME and arrived via FedEx on June 27th. Krystin and Dr. Grizzle measured out and divided larvae between the four setting tanks based on tank capacity. During this process Dr. Grizzle and Krystin monitored spat settlement, water quality, and maintained notes on the process. Larvae settled on the oyster shells within a few days to produce live spat-on-shell. On July 2nd cages were moved from the four tanks to the floating nursery raft at Adams Point for further growth until spat counting week.

For spat counting week, 10 UNH cages with live spat-on-shell were moved from the raft to the dock for counting. Spat counting week was scheduled for July 19-24th. Nature Groupie posted the event and distributed it to various media outlets to recruit volunteers for the event. Volunteers that participated in spat counting included community members, camps, school groups, partner organizations, and Oyster Conservationists. Volunteers counted shells and spat-on-shell on 30 random oyster shells for an initial data point for each Oyster Conservationist cage before delivery.

Program Delivery

Figure 2. OC cage (©Kara McKeton)

Once Oyster Conservationist cages were prepped and counted, TNC staff distributed the cages to each OC site. Each site received a folder with caliper, brush, informational materials, permit, waiver, datasheet, and how-to use caliper sheet. OC cages contained 50 recycled shells (mainly oyster with some clam shells) with live spat-on-shell and a bait bag with only clam shell (Figure 2). Some volunteers also received a float or screw anchor if needed. Throughout the eight-week season volunteers collected data on two days (August 22nd and September 23rd). OC volunteers measured 30 random spat and counted spat on 30 random recycled oyster shells. Similarly, OC's monitored invasive species, predators,

fouling agents, and wild spat (on the clam shell in the bait bag). In addition, OC's were asked to check on the cage weekly and to clean it to ensure water flow. The Oyster Conservation Coordinator, Brianna Group, was available to answer questions during this period. In addition, TNC's Oyster Restoration Conservation Assistant GLOBE (Growing Leaders on Behalf of the Environment) Intern, Taja Harper, helped throughout the OC Season with volunteer training and engagement, shell collection and preparation, spat-on-shell production, and program delivery. In late September-early October, the OC Coordinator picked up the OC cages and folders. Cages were kept at JEL until the second spat counting week from October 1st-4th. Nature Groupie posted the event and assisted in recruiting volunteers. During this event, volunteers measured 30 random spat (mm) and counted spat on 30 random recycled oyster shells from each OC cage.

Once the cages were counted and measured they were condensed by town into fish totes. On October 12th, OC's placed the oysters grown by the Oyster Conservationist Program on a shell pile at the oyster restoration site at Woodman Point in Great Bay from aboard the classic Gundalow Ship (Figure 3). This marked the end of the 2018 Oyster Conservationist Season.

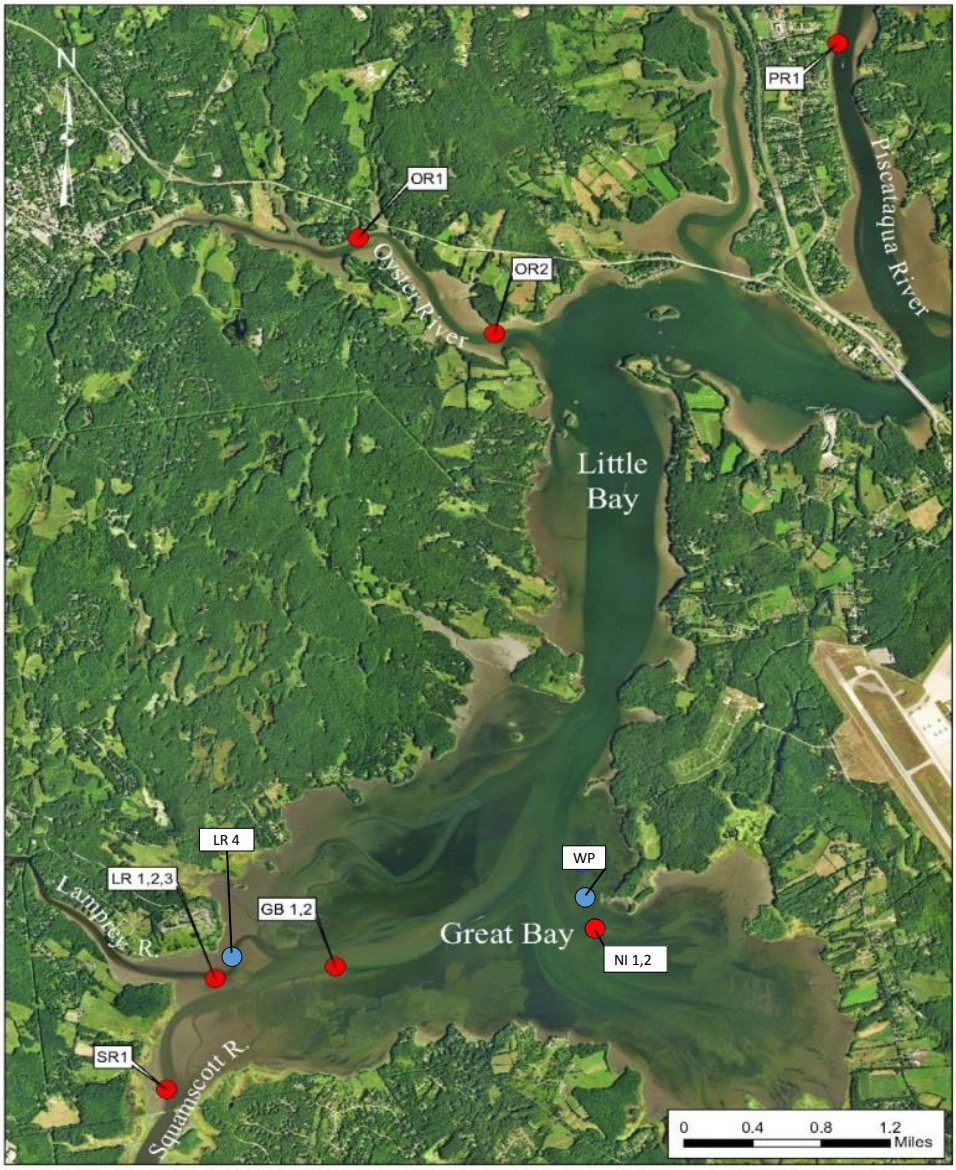

Figure 3. Map of Great Bay Estuary showing The Nature Conservancy's oyster reef restoration sites (red=historical restoration sites and blue circles =current restoration sites). Oysters grown by Oyster Conservationists in 2018 were placed on the oyster restoration site at Woodman Point on October 12th (WP, blue circle).

Initial Spat

Oyster spat were counted during the July spat counting week before delivery to the OC volunteers for an initial count. While these oysters were visible, they were too small to measure at <5mm in size. Initial spat per shell varied with a range of 0 to 94 oyster spat per shell and an overall average of 6.7 spat per shell ± 0.16 (mean ± standard error). Initial spat per shell counts varied according to the remote setting tank at JEL they originated from (Figure 4). Tank B had the highest average spat per shell count (13.61 spat per shell), while Tank D had the lowest spat per shell count (3.23 spat per shell). TNC delivered an estimated 27,122 oyster spat to the Oyster Conservationist volunteers in July. OC's measured and counted their oyster spat twice throughout the 8-week period.

Tank	Average spat per shell
A	9.42
B	13.61
C	4.84
D	3.23

Figure 4. Average spat per shell by remote setting tank during July spat counting week (A, B, C, D). Tank B had the highest average, Tank D had the lowest average spat per shell.

Growth

Average growth (measured as average shell length in mm at the end of the OC season) across all sites was 32.1 ± 1.06 mm (mean ± standard error). The ending size of spat ranged from 7 mm to 65 mm. The largest spat shell length recorded was 65 mm from three sites in the Oyster River (Figure 5). To analyze the data spatially, OC sites were grouped together by location. Similar to previous years, sites in the Bellamy River, Oyster River, and Little Bay experienced the fastest growth. Slowest growth occurred at sites in the Lamprey River, Squamscott River, and Winnicut River (Figure 6). Overall, average growth was higher this year than previous years (23.3 ± 1.6 mm in 2017 and 30.1± 1.20 mm in 2016) and can most likely be attributed to excellent growing conditions in Great Bay Estuary in 2018 (Personal Communication).

Figure 5. Oyster spat from OC Cage.

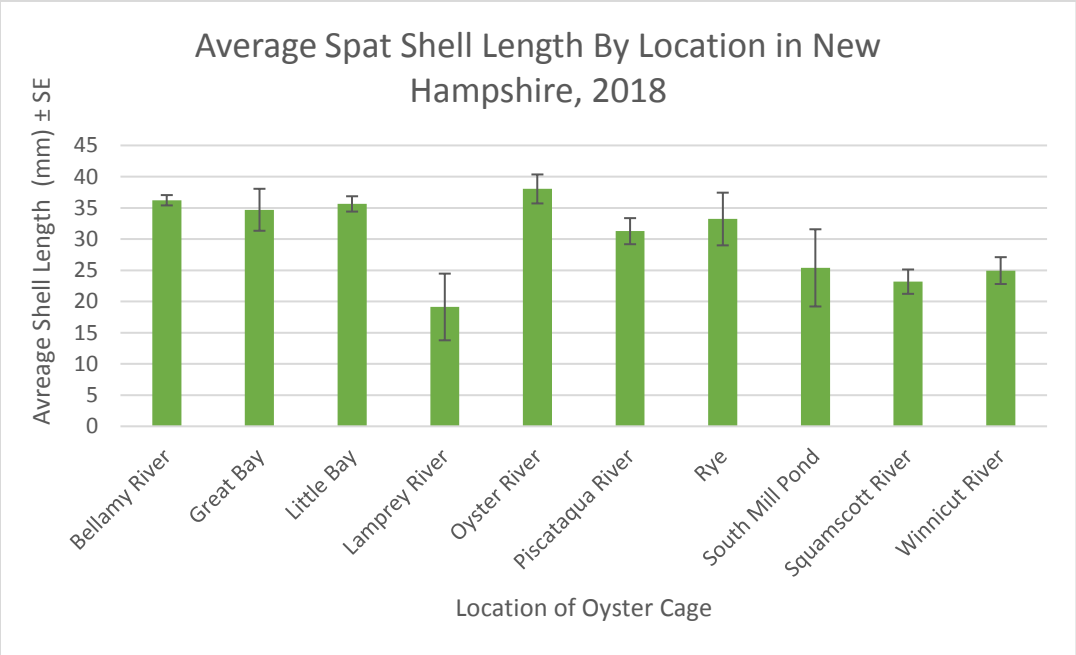

Figure 6. Average oyster spat shell length (used to measure growth) by location in New Hampshire, 2018 ± SE. Fastest growth occurred in the Oyster River with an average shell length of 38.03 mm and the slowest growth occurred in the Lamprey River with an average shell length of 19.11 mm.

Survival

Oyster Conservationists were given an estimated 27,122 oyster spat in July and returned an estimated total of 22,482 oyster spat in September with an overall 83% survival rate. This number is significantly higher than in previous years (2016 at 39% and 2017 at 64%) and can be attributed to the excellent growing conditions this summer in Great Bay with high concentrations of food and warm temperatures. The sites with highest survival occurred in the Bellamy River, Oyster River, and Little Bay. Sites with lowest survival were in the Lamprey River, Rye, and Squamscott River (Figure 7). Many of the sites experienced over 100% survival which can be attributed to wild spat settlement on oyster shells in the OC cages. Anecdotal evidence from oyster farmers in Little Bay suggests the native reefs in Great Bay Estuary were highly productive with high wild spat settlement (Personal Communication). Multiple sites in the Lamprey River experienced 100% mortality by the end of the season that could be due to predation or poor conditions (sedimentation, low salinity events, etc.).

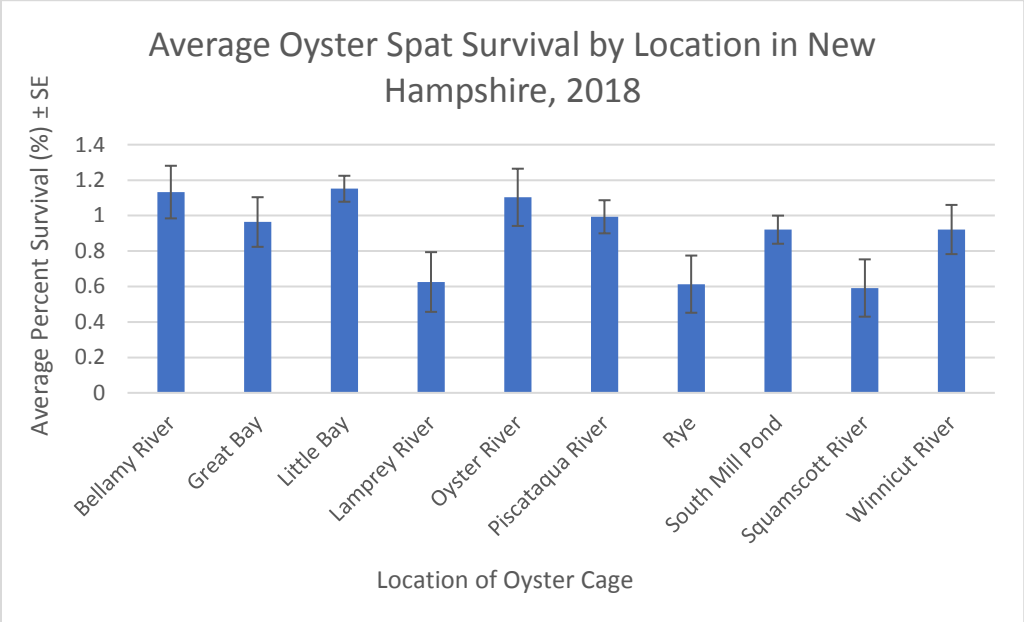

Figure 7. Average oyster survival by location in New Hampshire, 2018. Highest average survival occurred at sites in Little Bay (115% survival) and the lowest average survival occurred at sites in the Squamscott River (59% survival). Survival over 100% can be attributed to settlement of wild spat in the OC cages.

Maine Oyster Conservationist Program

TNC purchased oyster seed (<1" in size) from Basket Island Oysters, ME for the Maine OC Program. Each cage distributed to the 9 volunteers contained a bait bag with clam shell and another bait bag with approximately ½ cup (approx. 100 oysters) of the purchased oyster seed. Volunteers cared for their cage and collected data on growth twice during the 8-week season. Dates and methods for data collection were the same as the NH OC Program.

The overall average shell length (mm) for ME was 23.42 mm ± 0.7 mm (mean ± standard error). Sites in the Piscataqua River had the highest average shell growth (26.8 mm) followed by the cage at the Shoals Marine

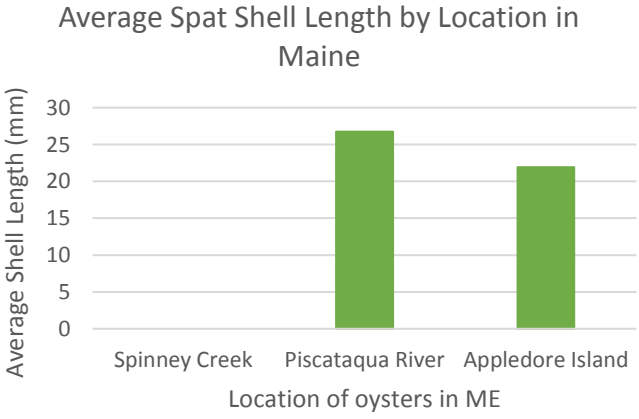

Figure 8. Average oyster seed shell length by location in Maine for Maine Oyster Conservationists. Fastest growth occurred at sites in the Piscataqua River with average shell length of 26.8 mm.

Lab on Appledore Island (21.9 mm) (Figure 8). The site at Spinney Creek experienced 100% mortality due to oyster drills (holes from oyster drill predation were visible on all dead spat at the end of the season). The largest spat was recorded at 41mm in the Piscataqua River.

Discussion

As a citizen science community engagement program, a major goal of the Oyster Conservationist Program is to create environmental stewards that advocate or act for the protection and preservation of the environment and wildlife. This program successfully met that goal this summer with 89 Oyster Conservationist sites and almost 300 volunteers of different backgrounds and ages that engaged with the program. Volunteers in the OC Program also collected important data regarding oyster growth and survival that contributes to the 10+ years' worth of data already collected that can be analyzed spatially and temporally for long term trends. The Oyster Conservationist Program successfully supplemented oyster reef restoration by directly contributing live oysters to Great Bay. As a result of the OC Program, almost 250,000 oysters have been placed into Great Bay to begin contributing those important ecosystem services to people and wildlife since 2006 (Figure 9).

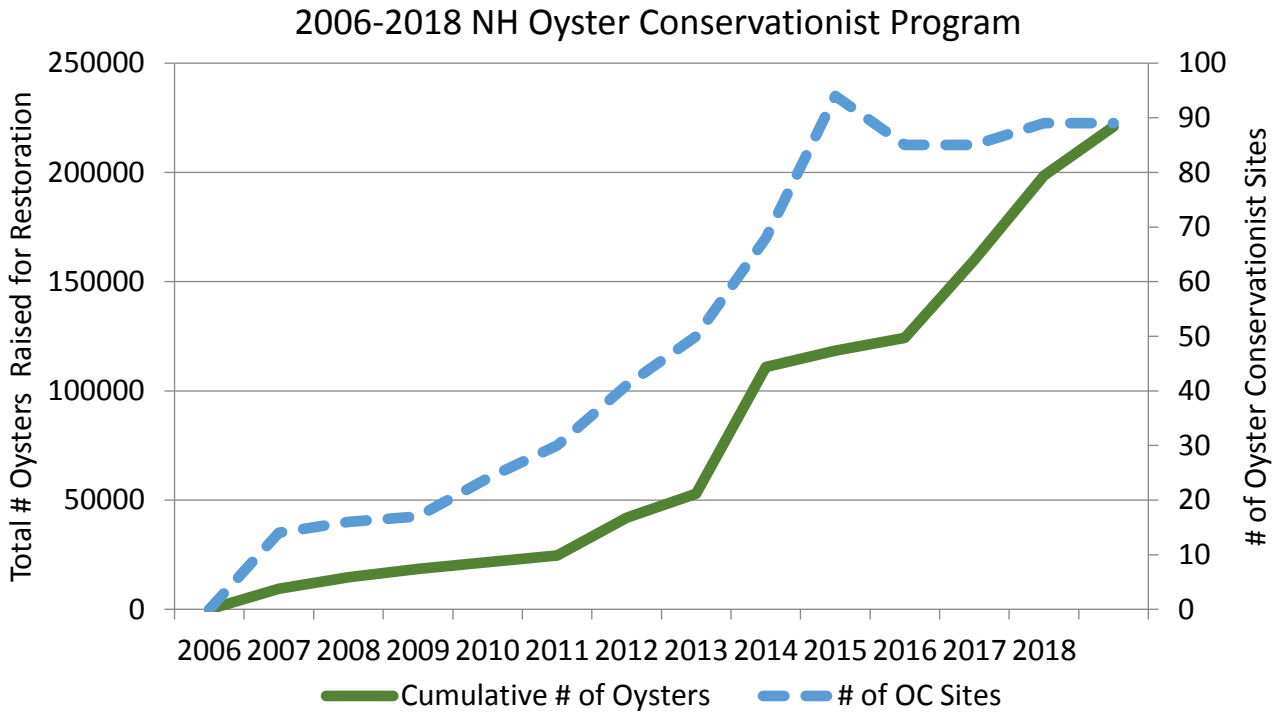

Figure 9. Cumulative number of oysters grown (solid green line) and the number of OC sites each year (dotted blue line) in the Oyster Conservationist Program in New Hampshire. In 2018 there were 89 sites that grew 22,482 oysters for reef restoration. Overall, the OC Program has grown 220,980 oysters since 2006.

The important benefits that the OC Program provides to Great Bay (community engagement, oyster production for reef restoration, and data collection) makes this program a valuable contribution to improving the overall health of this important estuarine ecosystem.

Thank you & Acknowledgements

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Works Cited

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