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Scope of Work

Technical Support for Assessing the Ecological Health of Little Pond and Establishing a Current Baseline following MEP Procedures

for: Town of Falmouth Water Quality Management Committee

October 2, 2021

Overview

Eelgrass is a fundamentally important species in the ecology of shallow coastal systems, providing both habitat structure and sediment stabilization. Mapping of the eelgrass beds within the Little Pond System was conducted for comparison to historic records (DEP Eelgrass Mapping Program, C. Costello). Temporal trends in the distribution of eelgrass beds are used by the MEP to assess the stability of the habitat and to determine trends potentially related to water quality. Eelgrass beds can decrease within embayments in response to a variety of causes, but throughout almost all of the embayments within southeastern Massachusetts, the primary cause appears to be related to increases in embayment nitrogen levels. Within the Little Pond System, temporal changes in eelgrass distribution provides a strong basis for evaluating recent increases (nitrogen loading) or decreases (increased flushing-new inlet) in nutrient enrichment.

In areas that do not support eelgrass beds, benthic animal indicators were used to assess the level of habitat health from "healthy" (low organic matter loading, high D.O.) to "highly stressed" (high organic matter loading-low D.O.). The basic concept is that certain species or species assemblages reflect the quality of their habitat. Benthic animal species from sediment samples were identified and the environments ranked based upon the fraction of healthy, transitional, and stressed indicator species. The analysis is based upon life-history information on the species and a wide variety of field studies within southeastern Massachusetts waters, including the Wild Harbor oil spill, benthic population studies in Buzzards Bay (Woods Hole Oceanographic Institution) and New Bedford (SMAST), and more recently the Woods Hole Oceanographic Institution Nantucket Harbor Study (Howes *et al.* 1997). These data are coupled with the level of diversity (H') and evenness (E) of the benthic community and the total number of individuals to determine the infaunal habitat quality.

The project will be overseen by Dr. Brian Howes Director, Coastal Systems Program SMAST-UMass Dartmouth. Where applicable the methods and protocols will follow the previous Massachusetts Estuaries Project work on Little Pond to ensure comparability. The overall purpose is to update the baseline conditions in Little Pond as regards nitrogen enrichment and gauging ecological restoration to meet the USEPA/MassDEP TMDL.

Task 1. Repeat MEP Benthic Infauna Analysis.

Quantitative sediment sampling will be conducted at the 8 MEP locations throughout the Little Pond System (Figure 1). Three samples will be collected at each location with two sorted and identified to the lowest possible taxon, typically genus or species. The third sample will be sorted if the first two samples show large differences. In all areas and particularly those that do not support eelgrass beds, benthic animal indicators can be used to assess the level of habitat health from healthy (low organic matter loading, high D.O.) to highly stressed (high organic matter loading-low D.O.). The basic concept is that certain species or species assemblages reflect the quality of the habitat in which they live. Benthic animal species from sediment samples are identified and ranked as to their association with nutrient related stresses, such as organic matter loading, anoxia, and dissolved sulfide. The analysis is based upon life-history information and animal-sediment relationships (Rhoads and Germano 1986). Assemblages are classified as representative of healthy conditions, transitional, or stressed conditions. Both the distribution of species and the overall population density are taken into account, as well as the general diversity and evenness of the community. It should be noted that, given the absence of eelgrass coverage throughout much of the Little Pond System over the past two decades, habitat impairment may still be occurring as the effects of watershed sewering gradually impact the pond. However, to the extent that it can still support healthy infaunal communities, the benthic infaunal analysis is important for determining the level of impairment (moderately impaired→significantly impaired→severely degraded). This assessment is also important for updating the current baseline conditions within the pond found by the MEP studies in 2003.

Analysis of the evenness and diversity of the benthic animal communities will also be used to support the density data and the natural history information described above. The evenness statistic can range from 0-1 (one being most even), while the diversity index does not have a theoretical upper limit. The highest quality habitat areas found in the MEP, as shown by the oxygen and chlorophyll records and eelgrass coverage, have the highest diversity (generally >3) and evenness (~0.7). The converse is also true, with poorest habitat quality found where diversity is <1 and evenness is <0.5.

As in the MEP, samples will be collected in late October to early November (2021). Samples will be collected using a Young modified Van Veen Grab (25cm x 25 cm), sieved in the field and placed in buffered formalin until sorting and identification at which time the formalin is replaced with ethanol. Formalin waste will be disposed following UMD safety procedures and a certified hazardous waste company.

Task 2, Macroalgae and Eelgrass Mapping.

The distribution of macroalgae accumulations and eelgrass will be mapped using an underwater video array coupled to a d-GPS. This visual survey will be conducted by collecting underwater video recordings of the bottom of Little Pond. Cameras are synced with GPS and recording at five frames per second. Each frame represents approximately 0.25 m2 and the collected video is reviewed frame-by-frame for macroalgal accumulation and eelgrass coverage. A map is produced from the visual records coupled to spatial information, which will be presented in the Tech Memo.

Task 3, Update baseline TN levels and temporal trends from Falmouth Pondwatch Program.
TN data collected by Falmouth Pondwatch since the MEP (with MEP as starting point) will be analyzed for the levels of TN at the sentinel station over the past 20 years. The goal is to determine changes in TN in time-series. The time-series record will be presented in the summary Tech Memo (Task 5).

Task 4, Assess temperature increase over past 30 years of Pondwatch.
As part of the Pondwatch Program surface and bottom water temperatures have been collected at three open water stations in Little Pond over the past three decades. This data will be compiled and analyzed to determine if temperatures have varied due to a change in thermal absorption of the pond itself or changes in climate over this period. The time-series record will be presented in the summary Tech Memo (Task 5).

Task 5, Reporting.
A brief Technical Memorandum will be provided covering the results of the Data Report and containing macroalgae and eelgrass mapping results. It will also provide updated TN and temperature results and discussion of temporal changes. In addition the results will be presented at a meeting of the Water Quality Management Committee or other mutually agreed upon venue.

Deliverables

- Data report in Excel format containing infauna community results, any observations and station locations.
- A brief Technical Memorandum covering the results of the Data Report and containing macroalgae and eelgrass mapping results, updated TN and temperature results and discussion of temporal changes.
- A meeting (zoom)to discuss the monitoring results and associated assessment of the pond.

Little Pond Habitat Baseline Update 2021

Task	Description	Cost
1	Repeat MEP Benthic Infauna Analysis (8 sites)	$12,500
2	Macroalgal and Eelgrass Survey (video/d-GPS)	$ 2,500
3	Update baseline TN and assess for temporal trends	$ 2,000
4	Assess temperature increase over past 30 years of Pondwatch	$500
5	Summary Tech Memo	$2,000
TOTAL		$19,500

There will be one billing, when the Technical Memo is complete.

Figure 1. Aerial photograph of the Little Pond system showing location of benthic infaunal sampling stations occupied by the SMAST/MassDEP Massachusetts Estuaries Project in fall 2002 (red symbol).