

An overview of the invertebrate communities living in the soft-bottom sediments of the upper Narragansett Bay.

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6/23/2008

The objective of this article is to provide a summary of the invertebrate communities present in the soft-bottom sediments at four stations in the upper Narragansett Bay. Understanding the complex interaction of factors underlying the dynamics of the benthic macrofaunal communities of Narragansett Bay is important for a number of reasons. For example, benthic fauna are a primary food source for many of the finfish species that support Rhode Island's recreational and commercial fishing industries (Meng et al. 2001; Collette and Klein-MacPhee 2002).

The data presented here were collected and processed by the Marine Ecosystems Research Laboratory (MERL) at the URI Graduate School of Oceanography (GSO) as part of the Upper Narragansett Bay Benthic Study. This program is ongoing and has sampled the sediment (benthic) communities of the upper Narragansett Bay since 2000. Stations were located (1) off Conimicut Point at the mouth of the Providence River, (2) in Mt. Hope Bay off the Brayton Point power station, (3) at the mouth of Greenwich Bay, and (4) off the northern tip of Jamestown (Figure 1). Methods have remained the same since this sampling program began. Replicate sediment cores were hand collected by scuba divers, samples were sieved through stacked 300 and 500 μm mesh screens and all of the organisms retained on the screens were identified to the lowest possible identification level (LPIL; typically to species) and counted. All four stations were sampled in early June of 2000-2002, 2004 and 2006 and sediment cores were also collected at the North Jamestown station in June of 2005, 2007 and 2008. The samples from 2006 in Mt. Hope Bay and 2008 north of Jamestown have not yet been processed. While the samples from 2007 north of Jamestown have been processed,

these data have not yet been incorporated into the database and will not be included here.

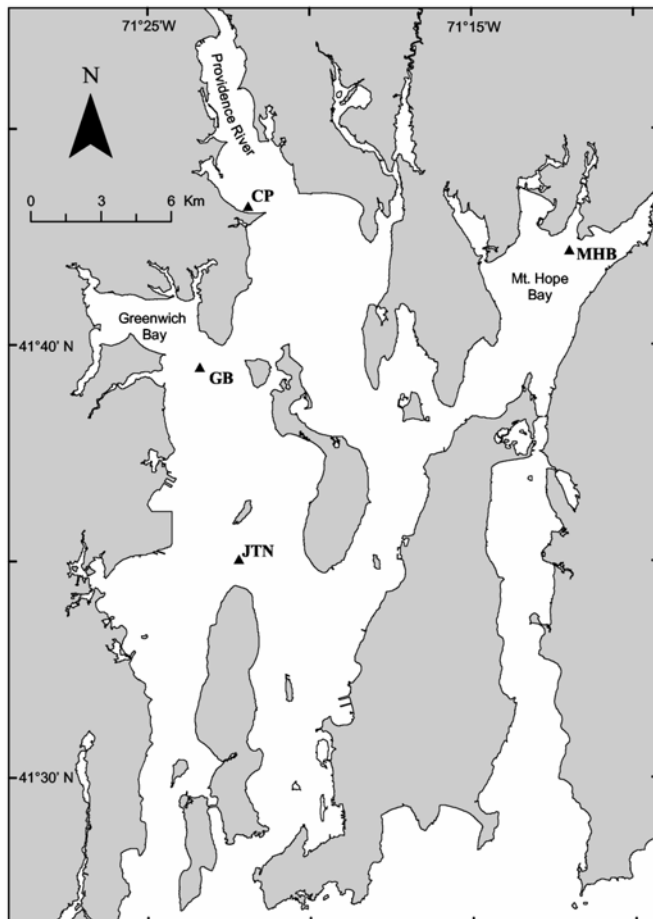


Figure 1: Benthic sampling stations in Narragansett Bay, Rhode Island, CP: Conimicut Point; MHB: Mt. Hope Bay; GB: Greenwich Bay; JTN: North Jamestown.

Geologically speaking Narragansett Bay is a sedimentary environment (McMaster 1960) and soft-bottom (mud, silt, sand) communities dominate in the upper Bay. Studies of soft-bottom communities typically focus on either the macrofauna, which are organisms that are retained on a sieve having a mesh size of 300 μm or

greater; or they focus on the meiofauna, which are organisms that pass through sieves with a mesh size of 300 µm (Frithsen 1989). This article will focus on the macrofauna of Narragansett Bay, the majority of which were polychaete worms and also included various crustaceans, bivalves, and gastropods.

The following table (Table 1) shows the most abundant species identified in the sediment communities at each of the four stations during each year of sampling. The polychaete worm, *Mediomastus ambiseta*, was a ubiquitous member of the benthic community throughout the upper bay region. Other important members of the soft-bottom community were the bivalve *Nucula annulata* and the tube building amphipod *Ampelisca* (LPIL). *N. annulata* was consistently one of the top two species present at the station north of Jamestown and *Ampelisca*, while present in the top five during at least one year at all stations, was one of the dominant species at the Mt. Hope Bay station during all years of sampling. The total abundance of individuals was highest at the Conimicut Point station during the 2004 sampling at over 220,000 organisms per square meter (Table 2). The lowest total abundance observed over the course of this time series, 24,637 individuals per square meter, also occurred at the Conimicut Point station in 2001.

Table 1: The top five most abundant members of the macrofaunal communities at each station during each year of sampling. Fauna are listed in order of decreasing abundance, with the species located in column number 1 having the highest abundance of each row. Repeated species are colored the same to highlight dominance and general categories are coded as follows: (◆) Polychaete; (■) Gastropod; (◆) Bivalve; and (+) Crustacean.

Rank	1	2	3	4	5	
Conimicut Point	2000	◆Mediomastus ambiseta	◆Polydora ligni	■ Crepidula (LPIL)	◆Streblospio benedicti	◆Capitella capitata
	2001	◆Polydora ligni	◆Mediomastus ambiseta	+ Ampelisca (LPIL)	■ Crepidula (LPIL)	◆Streblospio benedicti
	2002	◆Mediomastus ambiseta	◆Capitella capitata	+ Ampelisca (LPIL)	Nemertinea (LPIL)	◆Polydora ligni
	2004	◆Tharyx acutus	◆Polydora ligni	◆Periploma papyratium	Oligochaeta (LPIL)	◆Streblospio benedicti
	2006	◆Streblospio benedicti	◆Mediomastus ambiseta	◆Polydora ligni	Oligochaeta (LPIL)	■ Crepidula (LPIL)
Greenwich Bay	2000	◆Mediomastus ambiseta	◆Brania wellfleetensis	◆Streblospio benedicti	◆Gemma gemma	◆Syllides longocirrata
	2001	◆Mediomastus ambiseta	+ Ampelisca (LPIL)	■ Crepidula (LPIL)	◆Tharyx acutus	◆Aricidea catherinae
	2002	◆Tharyx acutus	◆Gemma gemma	◆Mediomastus ambiseta	◆Capitella capitata	◆Eusyllis blomstrandii
	2004	◆Tharyx acutus	◆Clinocardium ciliatum	◆Syllides setosa	◆Gemma gemma	◆Polygordius (LPIL)
	2006	◆Polygordius (LPIL)	■ Crepidula (LPIL)	◆Streblospio benedicti	◆Gemma gemma	Oligochaeta (LPIL)
North Jamestown	2000	◆Nucula annulata	◆Mediomastus ambiseta	◆Nephtys incisa	◆Aricidea catherinae	◆Tharyx acutus
	2001	◆Mediomastus ambiseta	◆Nucula annulata	◆Polycirrus medusa	◆Maldanidae (LPIL)	◆Nephtys incisa
	2002	◆Mediomastus ambiseta	◆Nucula annulata	+ Ampelisca (LPIL)	Nemertinea (LPIL)	◆Aricidea catherinae
	2004	◆Nucula annulata	◆Mediomastus ambiseta	◆Polycirrus medusa	◆Harmothoe imbricata	◆Aricidea catherinae
	2005	◆Mediomastus ambiseta	◆Nucula annulata	◆Mulinia lateralis	◆Polycirrus medusa	◆Aricidea catherinae
	2006	◆Mediomastus ambiseta	◆Nucula annulata	■ Acteocina canaliculata	■ Turbonilla elegantula	◆Mya arenaria
Mt. Hope Bay	2000	◆Mytilus edulis	◆Mediomastus ambiseta	◆Nucula annulata	+ Ampelisca (LPIL)	◆Exogone dispar
	2001	◆Mediomastus ambiseta	+ Ampelisca (LPIL)	◆Nucula annulata	◆Tharyx acutus	◆Polydora ligni
	2002	◆Mediomastus ambiseta	+ Ampelisca (LPIL)	◆Capitella capitata	◆Tharyx acutus	◆Spiochaetopterus oculatus

Table 2: The total abundance of individuals greater than 500 μm in size at each of the four upper Narragansett Bay benthic stations during each year of sampling. Numbers represent an average of up to 15 replicate cores normalized to the core area. In 2005 only the North Jamestown station was sampled and the 2006 samples collected in Mt. Hope Bay have not yet been analyzed.

Year	Total Abundance (number/m ²)			
	Conimicut Point	Greenwich Bay	North Jamestown	Mt. Hope Bay
2000	38,194	26,768	49,311	91,714
2001	24,637	39,205	52,697	77,246
2002	94,773	73,845	51,541	80,950
2004	221,747	109,830	49,119	108,790
2005	No Data	No Data	89,994	No Data
2006	77,386	107,783	41,189	TBA

The manner in which species abundances and composition varied at the four stations, both spatially (between stations) and temporally (between years) was assessed in conjunction with a number of monitoring data sets available from various sources in order to determine the important factors structuring the macrobenthic communities in these areas of the upper Narragansett Bay. These additional data sets included potential stressors that were both natural (eg. sea surface temperature, salinity, food availability, predator abundance) and anthropogenic (human induced, eg. concentration of heavy metals, concentration of organic pollutants, incidence of low bottom water dissolved oxygen or hypoxia). This analysis has resulted in the following conclusions:

- Variability in the benthic communities between stations was primarily the result of the overall north to south pollution gradient in the bay, with the concentrations of sediment contaminants and the effects of eutrophication decreasing southward with distance from the bay's urban centers.
- The Conimicut Point and Mt. Hope Bay stations, located at the mouths of the Providence and Taunton Rivers, respectively, were characterized by benthic communities that persist in an early stage of species succession and are dominated by a few, highly abundant, opportunistic species. This was true to a lesser extent at the Greenwich Bay station, while the benthic assemblage mid-bay, at a station north of Jamestown, was more characteristic of a late-stage, equilibrium community.

- Fauna at the Conimicut Point station were exposed to severe summertime hypoxia and it was likely that this community relied heavily on an influx of stress-tolerant recruits (juveniles) to re-populate following large-scale mortality events.
- While hypoxic events also occurred in Mt. Hope Bay, they tended to be shorter in duration and intensity when compared to events in the Providence River. The degradation of the benthic community at the mouth of the Taunton River was more likely the result stress caused by sediment pollution. The Taunton River has a long history of industrialization and analysis of sediments at the stations revealed elevated levels of heavy metals and organic pollutants.
- Benthic abundance and species composition has remained remarkably consistent over time at the mid-bay station north of Jamestown and was suggestive of a diverse and stable community.
- Inter-annual variability in species abundance and reproductive success of benthic fauna at each station appear to be related to the magnitude of both the winter-spring phytoplankton bloom, which provides the primary food source for these organism, and predation pressure by benthic feeding fish such as winter flounder and scup.

Acknowledgements:

Special thanks to Greg Ellis, Malcolm McFarland, Kris Joppe-Mercure, Jason Graff, Felicia Olmeta & Felipe Paredes for aid in the analysis of benthic samples and to Eric Klos, Robert Sand, Chris Melrose, Brennan Phillips, Jason Krumholz & Mark Gustafson for their diving support. Funding was provided by grants from the U.S. Environmental Protection Agency and the RI Department of Environmental Management.

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