

2013

Report on the 2013 Rapid Assessment Survey of Marine Species at New England Bays and Harbors

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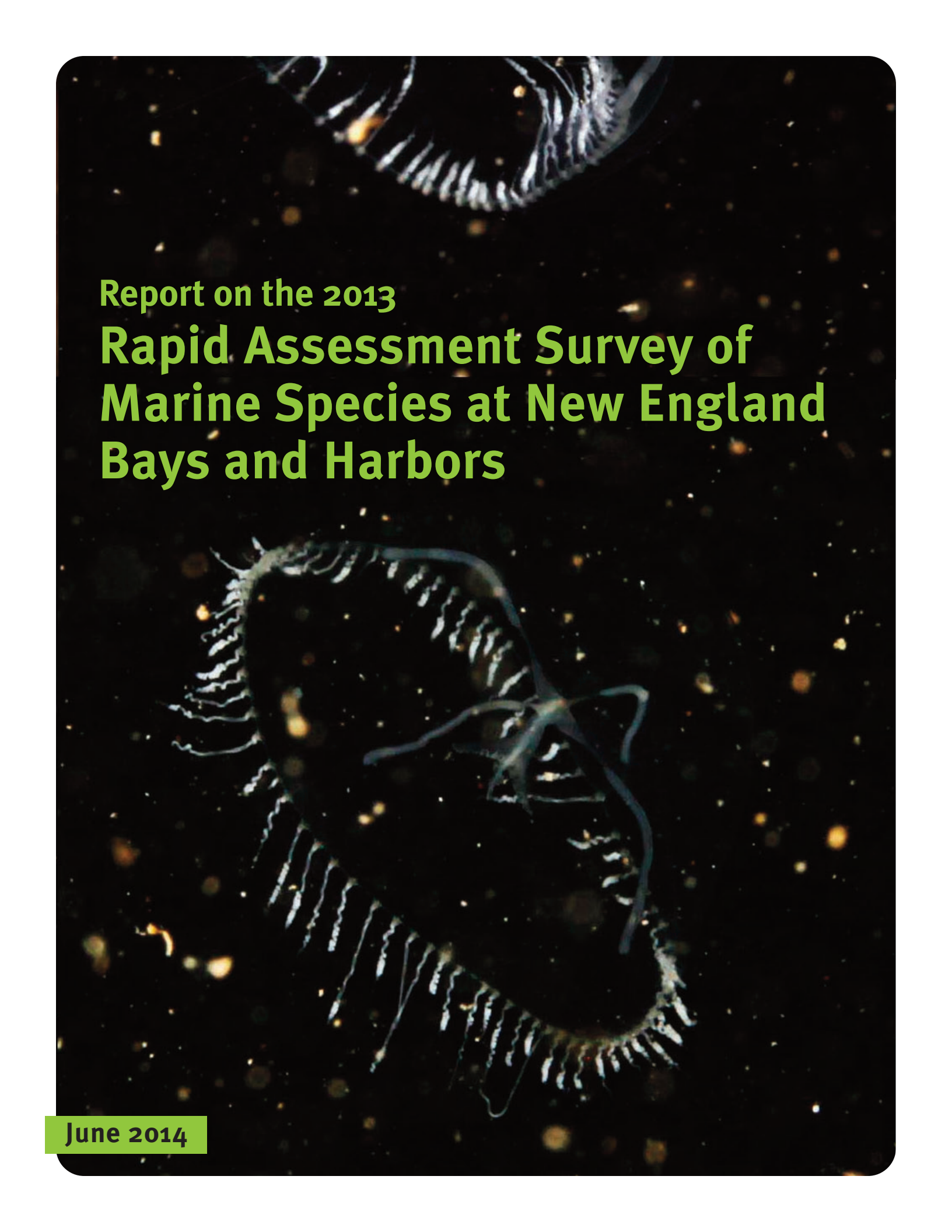
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Wells, Christopher D.; Pappal, Adrienne L.; Cao, Yuanguyu; and Carlton, James T., "Report on the 2013 Rapid Assessment Survey of Marine Species at New England Bays and Harbors" (2013). *Publications*. 208.
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A photograph of bioluminescent jellyfish in a dark ocean. The jellyfish are glowing with a bright, iridescent light, showing their internal structures and tentacles. The background is dark with many small, glowing particles, creating a starry effect.

**Report on the 2013
Rapid Assessment Survey of
Marine Species at New England
Bays and Harbors**

June 2014



CREDITS

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This report is a publication of the Massachusetts Office of Coastal Management (CZM) pursuant to the National Oceanic and Atmospheric Administration (NOAA). This publication is funded (in part) by a grant/cooperative agreement to CZM through NOAA NA13NOS4190040 and a grant to MIT Sea Grant through NOAA NA10OAR4170086. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies. This project has been financed, in part, by CZM; Massachusetts Bays Program; Casco Bay Estuary Partnership; Piscataqua Region Estuaries Partnership; the Rhode Island Bays, Rivers, and Watersheds Coordination Team; and the Massachusetts Institute of Technology Sea Grant College Program.

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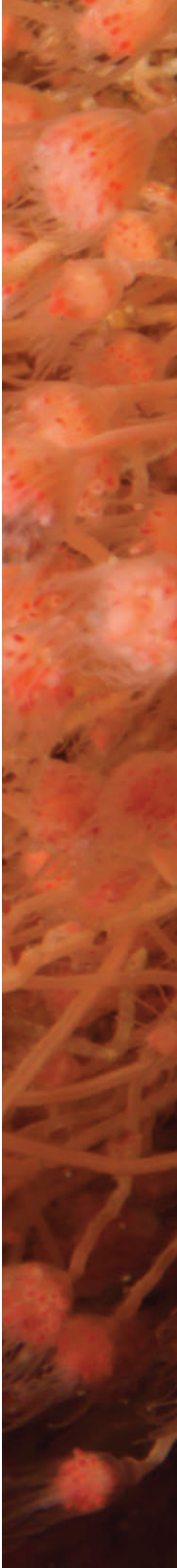
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PHOTOS: Adriaan Gittenberger, Gretchen Lambert, Linsey Haram, and Hans Hillewaert



ACKNOWLEDGMENTS



The New England Rapid Assessment Survey was a collaborative effort of many individuals. In addition to the authors of this paper, who were directly involved in the identification of the organisms, we thank those individuals that provided logistical support: Beverly Bayley-Smith, Casco Bay Estuary Partnership, Portland, Maine; Kevin Cute, Rhode Island Coastal Resources Management Council, Wakefield, Rhode Island; and Tracy Warncke, Buzzards Bay National Estuary Program, East Wareham, Massachusetts. We also would like to thank Larry Harris (University of New Hampshire) and David Murray (Brown University) for generous use of their laboratory facilities.

We are thankful for the willingness of the owners and operators of the various marinas who allowed access to their sites during the Rapid Assessment Survey: John Brewer, Brewer South Freeport Marine, South Freeport, Maine; Mike Soucy, Spring Point Marina, Portland, Maine; Noel Carlson, University of New Hampshire Coastal Marine Laboratory, New Castle, New Hampshire; Kevin Bailey, Hampton River Marina, Hampton, New Hampshire; Noah Flaherty, Brewer Hawthorne Cove Marina, Salem, Massachusetts; Ryan O'Connor, Rowes Wharf Marina, Boston, Massachusetts; Michael DiMeo, Green Harbor Marina, Marshfield, Massachusetts; Troy Lima, Sandwich Marina, Sandwich, Massachusetts; David Remsen, Marine Biological Laboratory, Woods Hole, Massachusetts; William Klimm, Massachusetts Maritime Academy, Buzzards Bay, Massachusetts; Debra Yuille, Pope's Island Marina, New Bedford, Massachusetts; Rich Picard, F.L. Tripp & Sons Marina, Westport, Massachusetts; Ray Mooney, Port Edgewood Marina, Cranston, Rhode Island; Ed Hughes, Allen Harbor Marina, North Kingstown, Rhode Island; Richard Masse, Fort Adams State Park, Newport, Rhode Island; and Anne Killeen, Point Judith Marina, Wakefield, Rhode Island.

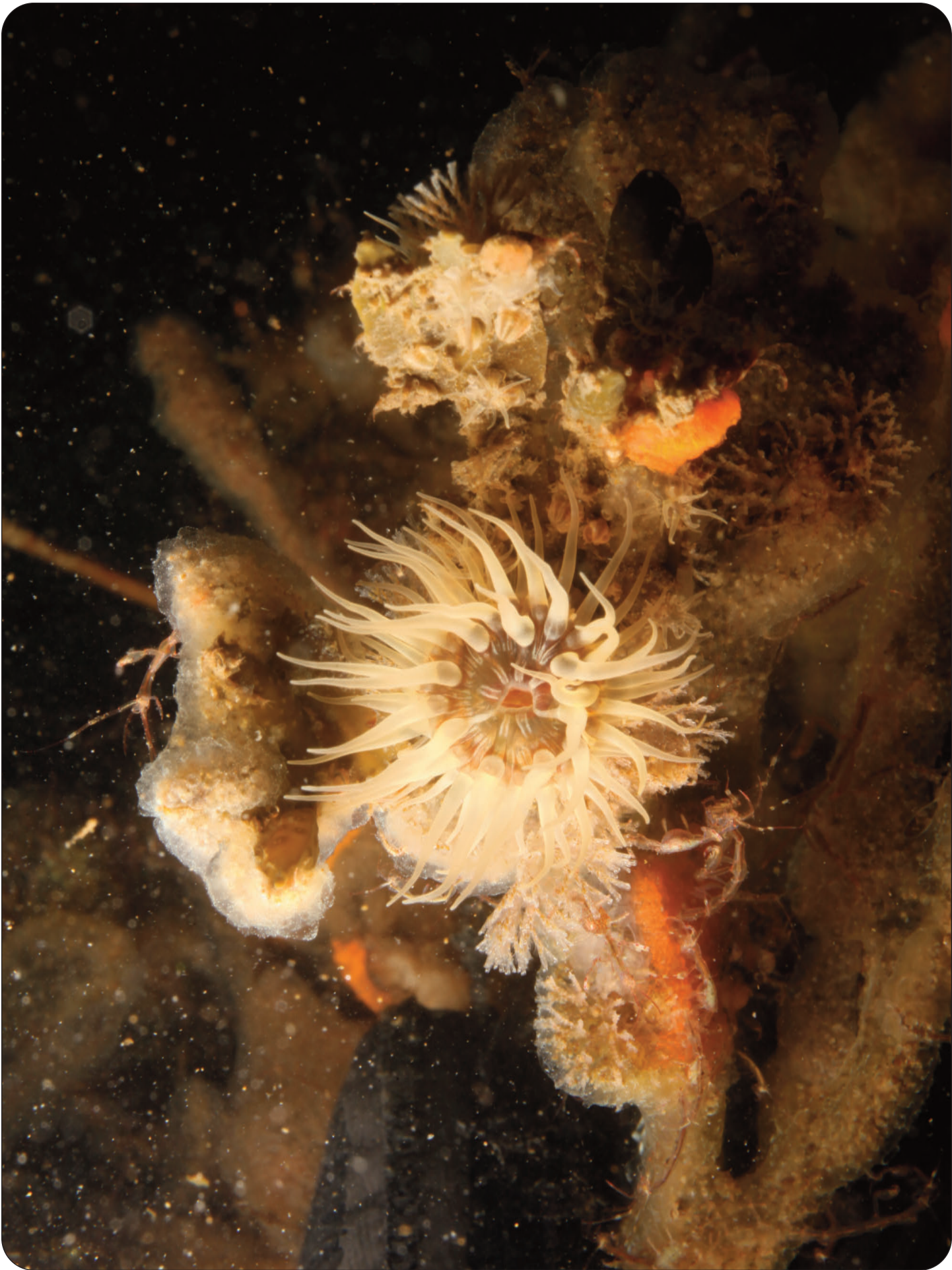
This study was supported by funding from the Casco Bay Estuary Partnership; the Massachusetts Bays National Estuary Program; the Massachusetts Institute of Technology Sea Grant College Program; the Massachusetts Office of Coastal Zone Management; the Piscataqua Region Estuaries Partnership; and the Rhode Island Bays, Rivers, and Watersheds Coordination Team.



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Introduction

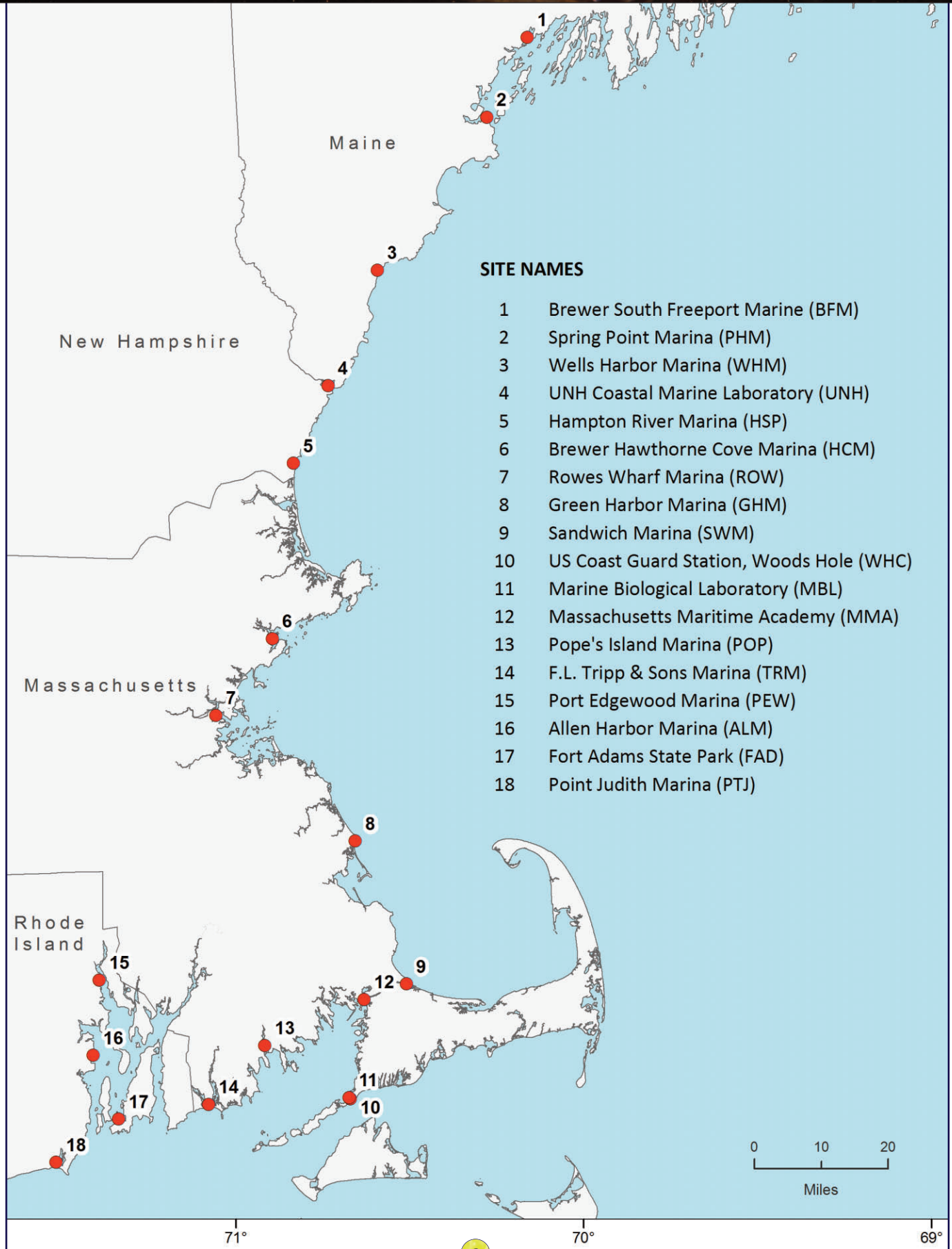


Introduced species (i.e., non-native species that have become established in a new location) have increasingly been recognized as a concern as they have become more prevalent in marine and terrestrial environments (Mooney and Cleland 2001; Simberloff et al. 2005). The ability of introduced species to alter population, community, and ecosystem structure and function, as well as cause significant economic damage is well documented (Carlton 1989, 1996b, 2000; Cohen and Carlton 1995; Cohen et al. 1995; Elton 1958; Meinesz et al. 1993; Occhipinti-Ambrogi and Sheppard 2007; Pimentel et al. 2005; Thresher 2000). The annual economic costs incurred from managing the approximately 50,000 introduced species in the United States alone are estimated to be over \$120 billion (Pimentel et al. 2005).

Having a monitoring network in place to track new introductions and distributional changes of introduced species is critical for effective management, as these efforts may be more successful when species are detected before they have the chance to become established. A rapid assessment survey is one such method for early detection of introduced species. With rapid assessment surveys, a team of taxonomic experts record and monitor marine species—providing a baseline inventory of native, introduced, and cryptogenic (i.e., unknown origin) species (as defined by Carlton 1996a)—and document range expansions of previously identified species.

Since 2000, five rapid assessment surveys have been conducted in New England. These surveys focus on recording species at marinas, which often are in close proximity to transportation vectors (i.e., recreational boats). Species are collected from floating docks and piers because these structures are accessible regardless of the tidal cycle. Another reason for sampling floating docks and other floating structures is that marine introduced species are often found to be more prevalent on artificial surfaces than natural surfaces (Glasby and Connell 2001; Paulay et al. 2002). The primary objectives of these surveys are to: (1) identify native, introduced, and cryptogenic marine species, (2) expand on data collected in past surveys, (3) assess the introduction status and range extensions of documented introduced species, and (4) detect new introductions. This report presents the introduced, cryptogenic, and native species recorded during the 2013 survey.

RAPID ASSESSMENT SURVEY: 2013 SAMPLING SITES



Methods

Eighteen sampling locations were chosen for the 2013 New England Rapid Assessment Survey (RAS) in coordination with National Estuary Programs and other partners. Factors involved in choosing sites were: adequate access for a team of 25 scientists, even distribution along the length of the shoreline to be examined, and consistency with sampling conducted during the previous five surveys (see map on page 2 for locations). The sites were distributed as follows: three sites in Maine, two sites in New Hampshire, four sites in northern Massachusetts (i.e., north of Cape Cod), five sites in southern Massachusetts (i.e., south of Cape Cod), and four sites in Rhode Island. Locations were marine with little freshwater influence, except at Port Edgewood Marina in Cranston, Rhode Island. For more detailed information on the sampling locations, including the sampling date and time, a brief description of the site, and the dominant biological community, see Appendix I.

Fouling communities were sampled on permanently installed floating docks and on associated subtidal structures, such as the floats supporting the docks,

ropes, wires, buoys, tires, and boat fenders. Motile animals associated with the fouling community, such as crabs, shrimps, and fishes, were documented and included in this report, but may be transient residents of the fouling community. Species observed on stationary piers, sea walls, rocky shores, pilings, and other nearby habitats were recorded, but are not included in the report. Other species that are difficult to identify without reproductive structures present (e.g., hydroids and certain algae species) were identified to genus.

The participants in the RAS included taxonomic experts familiar with native and introduced marine organisms, graduate and undergraduate students, and a support team to manage logistics. See Appendix II for details on the RAS survey team, including taxonomic expertise and affiliations. Sampling was carried out in early August to facilitate comparison between this RAS and prior surveys' efforts. Although the assemblages found within fouling communities vary from year to year because of environmental conditions, long-term monitoring helps to smooth out shorter-term variations to allow for analysis of trends through time.

Colpomenia peregrina

The macroscopic stage of the sea potato alga *Colpomenia peregrina* forms hollow brown sacks frequently found attached to other algae within the intertidal area and just below the tide line. *Colpomenia peregrina* was not found during the 2010 New England Rapid Assessment Survey, but was found at Sandwich Marina in Sandwich, Massachusetts, during the 2013 survey. It is becoming more and more common north of Cape Cod. *Colpomenia peregrina* was initially recorded in Nova Scotia in the 1960s (Bird and Edelstein 1978; Blackler 1964; Villard-Bohnsack 2002), followed by a collection in the early 1980s from Grand Barachois Lagoon in Newfoundland (Green et al. 2012). It has since spread southward from mid-coastal Maine to Massachusetts, initially found in 2011 (Green et al. 2012). *Colpomenia peregrina* is originally from the northwestern Pacific, but has been introduced to Europe and the west coast of North America (Boo et al. 2011). Care should be taken in identifying this alga as it is frequently confused with a similar native brown alga, *Leathesia marina*.



Colpomenia peregrina

At each location, sampling time was limited to one hour. Scientists atop the docks collected specimens from the vertical sides of the floats by hand or with paint scrapers and dip nets. The undersides of the floats were sampled by two snorkelers, except at the Woods Hole U.S. Coast Guard Floating Dock due to security precautions. Species were brought back to laboratories at the University of New Hampshire or Brown University for identification and verification. Collected specimens were either retained by investigators or archived within a community voucher deposited at the Museum of Comparative Zoology at Harvard University.

The status of invertebrates as native, introduced, cryptogenic, or summer transient was assessed by using the bioinvasion literature on individual species. For other species, the criteria summarized in Chapman and Carlton (1991, 1994) were applied, often combined with judgments assessing the extent of recent taxonomic and biogeographic work on a given species or a given group in general. The result is that the number of introduced species in New England remains underestimated (Carlton 2003, 2009); that is, an unknown number of species, here treated as either cryptogenic or native, are in fact introduced. No algal species are treated here as cryptogenic, but the same considerations apply.

Water temperature, salinity, and dissolved oxygen were collected through the use of two underwater sondes (YSI30 and YSI85, YSI Inc., South Burlington,

VT). For the results of the hydrographical data, see Appendix III.

Results

During the RAS, a total of 289 taxa were identified, of which 218 were native, 27 were cryptogenic, 39 were introduced, and five were either summer transient species or their establishment was unknown (Figure 1). Hawthorne Cove Marina in Salem, Massachusetts, had the highest percentage of introduced species (32%). Port Edgewood Marina in Cranston, Rhode Island, had the highest percentage of native species (82%). Complete lists of introduced, cryptogenic, and native taxa are provided at the end of the document. Table 1 provides the average number of native, cryptogenic, and introduced species found within each state (i.e., the total number of native, cryptogenic, and introduced species found at each site within a state, divided by the number of survey sites within that state). Native taxa compose similar percentages of total taxa in all states (69-70%), except for northern Massachusetts where they represent a relatively low percentage (62%). The percentage of cryptogenic taxa was highest in northern Massachusetts (12%) and lowest in southern Massachusetts (7%). Introduced taxa compose similar percentages of total taxa in all states (19-21%), except for northern Massachusetts (25%). For a complete list of the introduced species found within each state see Table 2.

The hair alga
Cladophora sericea (green)
is a native species.



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Figure 1: Total number of native, cryptogenic, introduced, and summer transient species found during the 2013 Rapid Assessment Survey.

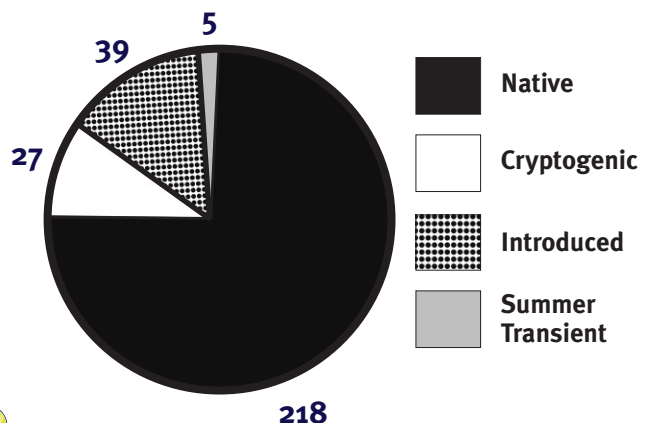


Table 1: Average number of native, cryptogenic, and introduced species found within each state with standard error rounded to the nearest whole number. Massachusetts is split between sites north and south of Cape Cod.

SPECIES TYPE	SPECIES AVERAGE BY STATE				
	ME	NH	MA (N)	MA (S)	RI
Native	53 ± 1	53 ± 7	49 ± 5	58 ± 2	52 ± 7
Cryptogenic	8 ± 2	8 ± 1	10 ± 1	6 ± 1	6 ± 1
Introduced	14 ± 1	15 ± 2	20 ± 1	18 ± 1	16 ± 4
Total	76 ± 3	76 ± 7	80 ± 6	83 ± 4	74 ± 10

Melita palmata

The males of the European palmed gammarid *Melita palmata* have a distinct paddle-like leg, which makes the animal very easy to distinguish from other *Melita* species. During the 2013 Rapid Assessment Survey, only one individual was found at a single site: Rows Wharf in Boston, Massachusetts. Although it has been introduced to the southeast coast of South America, *Melita palmata* has never been recorded in New England, and it is unknown whether there is an established population. No additional specimens were found on a return trip to Rows Wharf looking specifically for this species.



Melita palmata

Table 2: List by state of introduced species identified during the 2013 Rapid Assessment Survey. Massachusetts is split between sites north and south of Cape Cod. Those species marked with an asterisk (*) are either summer transient species or their establishment is unknown.

SPECIES (COMMON NAME)	ME	NH	MA (N)	MA (S)	RI
Chlorophyta (green algae)					
<i>Codium fragile</i> subsp. <i>fragile</i> (dead man's fingers)			X	X	X
Heterokontophyta (brown algae)					
<i>Colpomenia peregrina</i> (sea potato)			X		
<i>Melanosiphon intestinalis</i> (dark sea tubes)	X				
Rhodophyta (red algae)					
<i>Bonnemaisonia hamifera</i> (hooked red weed)	X			X	
<i>Gracilaria vermiculophylla</i> (wormleaf)				X	X
<i>Grateloupia turuturu</i> (Devil's tongue weed)			X	X	X
<i>Heterosiphonia japonica</i> (siphoned feather weed)		X		X	X
<i>Lomentaria clavellosa</i> (club bead-weed)		X	X	X	X
<i>Lomentaria orcadensis</i> (Orkney weed)			X		
<i>Neosiphonia harveyi</i> (doughball weed)	X	X	X	X	X
<i>Pyropia yezoensis</i> (open sea nori)			X		X
Annelida (ringed worms)					
<i>Neodexiospira brasiliensis</i> (Brazilian spiral tubeworm)				X	X
Arthropoda (crabs, shrimp, and relatives)					
* <i>Amphibalanus amphitrite</i> (striped barnacle)				X	
<i>Caprella mutica</i> (Japanese skeleton shrimp)	X	X	X	X	X
<i>Carcinus maenas</i> (European green crab)	X	X	X	X	X
<i>Hemigrapsus sanguineus</i> (Asian shore crab)	X	X	X	X	X
<i>Ianiropsis serricaudis</i> (isopod)		X	X	X	X
* <i>Melita palmata</i> (palmed gammarid)			X		
<i>Microdeutopus gryllotalpa</i> (tube builder)	X	X		X	
<i>Palaemon elegans</i> (European rock pool shrimp)	X	X	X		
* <i>Palaemon floridanus</i> (Florida grass shrimp)				X	
<i>Palaemon macrodactylus</i> (oriental grass prawn)					X
<i>Praunus flexuosus</i> (bent opossum shrimp)	X	X	X		
* <i>Stenothoe valida</i> (gammarid amphipod)	X	X		X	
Bryozoa (bryozoans)					
<i>Bugula neritina</i> (purple bugula)			X	X	X
<i>Bugula simplex</i> (fan bugula)	X	X	X	X	X
<i>Bugula stolonifera</i> (stolonized bugula)	X				X
<i>Conopeum seurati</i> (encrusting bryozoan)			X		
<i>Membranipora membranacea</i> (lacy crust bryozoan)	X	X	X	X	
<i>Tricellaria inopinata</i> (unexpected bryozoan)		X	X	X	X
Chordata (tunicates and vertebrates)					
<i>Ascidella aspersa</i> (European tunicate)	X		X	X	X
<i>Botrylloides violaceus</i> (sheath tunicate)	X	X	X	X	X
<i>Botryllus schlosseri</i> (star tunicate)	X	X	X	X	X
<i>Botryllus</i> sp. (colonial tunicate)			X	X	X
<i>Didemnum vexillum</i> (pancake batter tunicate)	X	X	X	X	X

Table 2 continued

SPECIES (COMMON NAME)	ME	NH	MA (N)	MA (S)	RI
<i>Diplosoma listerianum</i> (gelatinous tunicate)	X	X	X	X	X
<i>Styela canopus</i> (rough tunicate)				X	X
<i>Styela clava</i> (club tunicate)	X		X	X	X
Cnidaria (anemones, hydroids, and relatives)					
<i>Aiptasiogeton eruptaurantia</i> (pink-spotted sea anemone)					X
* <i>Clytia linearis</i> (hydroid)			X	X	X
<i>Diadumene lineata</i> (orange striped anemone)	X		X	X	X
<i>Hydrodendron</i> sp. (hydroid)				X	
Mollusca (snails and bivalves)					
<i>Littorina littorea</i> (common periwinkle)	X	X	X		
<i>Ostrea edulis</i> (European oyster)	X	X	X	X	X
Total Species	22	20	30	32	29

Six introduced species were found for the first time in 2013: *Aiptasiogeton eruptaurantia*, *Colpomenia peregrina*, *Hydrodendron* sp., *Neodexiospira brasiliensis*, *Palaemon macrodactylus*, and *Tricellaria inopinata*. Several species found on prior surveys expanded in range, some explosively (e.g., *Heterosiphonia japonica* and *Palaemon elegans*).

Tricellaria inopinata

Tricellaria inopinata, commonly known as the unexpected bryozoan, has been described as having a “crunchy” feeling when compared to other branching bryozoans, but it cannot be identified with complete certainty without a dissecting microscope on a high power. *Tricellaria inopinata* was originally found in Eel Pond in 2010 (Johnson et al. 2012) and has quickly spread north as far as Gloucester (Wells and Pappal, personal observation) and south to Rhode Island. During the 2013 Rapid Assessment Survey, it was found at nine of 18 sites from Salem, Massachusetts, to Newport, Rhode Island (see Table 5 for more details). *Tricellaria inopinata* is thought to be native to the western Pacific and has been introduced to Europe, Australia, New Zealand, and the West Coast of the United States.



Tricellaria inopinata

Summary

Introduced species represented a large component of the total fouling community from Maine to Rhode Island (up to 31%). The number of introduced species has steadily been increasing within New England waters; during the 2010 New England RAS, 29 introduced species were found (McIntyre et al. 2013) in contrast to the 39 detected during the 2013 survey (Table 3) (care should be taken when comparing the results of this survey and previous surveys as effort has varied greatly). The total number of introduced species recorded is far lower than similar surveys carried out in California (Cohen et al. 2005; Boyd et al. 2002; Lambert and Lambert 1998, 2003), Australia (Hewitt et al. 2004), and Hawaii (Coles et al. 1999), but is on par with results of similar surveys in the Pacific Northwest, Eastern Atlantic, and New England (Arenas et al. 2006; Cohen et al. 1998, 2001; Mathieson et al. 2008; Mills et al. 2000; Pederson et al. 2005).

There were distinct southern United States biota identified at several of the sites during the 2013 RAS, including the striped barnacle *Amphibalanus amphitrite*, the pink-spotted anemone *Aiptasiogeton eruptaurantia*, and the Florida grass shrimp *Palaemon floridanus*. Both *A. amphitrite* and *P. floridanus* are summer transient species that will likely not survive the New England winter; *A. amphitrite* is the only species of the three with a history of summer appearances in New England (Carlton, personal observation). Although *A. eruptaurantia* does not have a long history of presence in southern New England, it has been observed at Point Judith Marina in Rhode Island since the summer of 2011 (Hobbs, personal observation) and is now considered an established introduced species. Also present during this RAS were several hydroids more commonly found in warmer waters: *Pennaria disticha*, *Schizotracha tenella*, *Eudendrium glomeratum*, and *Hydrodendron* sp. While the first three of these hydroids have been documented in New England previously, they are being found more frequently. The two previous winters, which were warm



The docks at Wells Harbor Marina.

for New England, could have facilitated the increase in warm-water species (Wells, personal observation). These animals were likely transported to New England by coastal recreational and commercial vessels via ballast water or hull fouling. Future warming due to climate change may enhance the establishment of these and other warm-water species.

The number of species documented during the 2013 RAS is only a small portion of the known flora and fauna of New England. For example, of the approximately 500 algae species found within New England (Mathieson, personal communication), 90 algae species were found. Rapid assessments are limited by time, seasonality of fouling species, and number of habitats evaluated (Mathieson et al. 2008; Pederson et al. 2005). While not intended to be complete surveys of a site's biota, the RAS effectively and economically identifies presence/absence of species, finds newly introduced species, and detects range expansions.

Surveys like the RAS are critical for providing a baseline inventory of native, cryptogenic, and introduced species, and continued monitoring of at-risk habitats is a valuable asset for monitoring new introductions and range expansions. The data collected during the New England surveys can help managers prevent and control future invasions as well as aid in the creation of legislation for controlling and eradicating introduced species. Future surveys will continue to build on this wealth of knowledge and help promote understanding of invasion processes and the ecology of New England's coastal habitats.

Table 3: Number of introduced species found on the past five New England Rapid Assessment Surveys.

YEAR	SITES	SURVEY RANGE	SPECIES
2000	34	Gloucester (MA) to Narragansett Bay (RI)	32
2003	20	Portland (ME) to Staten Island (NY)	29
2007	17	Rockland (ME) to Buzzards Bay (MA)	26
2010	20	Cape Elizabeth (ME) to Narragansett Bay (RI)	29

Introduced Shrimps: *Palaemon elegans* and *P. macrodactylus*

The European rock shrimp *Palaemon elegans* can be easily identified by its distinctive blue and yellow claws as well as prominent blue and yellow striping and spotting on its carapace. *Palaemon elegans* was first documented in New England during the 2010 New England Rapid Assessment Survey at a single site: Hawthorne Cove Marina in Salem, Massachusetts (McIntyre et al. 2013). It has since rapidly spread as far north as Portland, Maine, and as far south as Provincetown, Massachusetts. It is expected to continue to spread both north and south.

The oriental grass prawn *P. macrodactylus* is native to the western Pacific, but has been introduced across Europe and the southeastern coast of South America. *Palaemon macrodactylus* is easily confused with other shrimp such as the native marsh grass shrimp *Palaemonetes vulgaris*. A faint white stripe down the center of the top of the carapace has been suggested as an identifying characteristic of *P. macrodactylus*, but this character can also be present in *Palaemonetes vulgaris*. The only definite way to identify this species is by looking at the rostrum (i.e., the forward extension of the carapace in front of the eyes) with a magnifying glass (for large individuals) or under a dissecting microscope. *Palaemon macrodactylus* was originally collected in 2001 within the estuary system of New York City (Warkentine and Rachlin 2010), and was found at one site during this survey: Fort Adams in Rhode Island.



Palaemon elegans

Palaemon macrodactylus

Appendix I: Site Descriptions

Brewer South Freeport Marine (BFM), South Freeport, Maine | August 4, 2013, 1:30 PM

Brewer South Freeport Marine is a relatively large marina located on the banks of the Harraseeket River on the edge of Casco Bay. It historically served as a shipbuilding port and now provides service to both recreational craft and commercial lobstermen. The marina provides over 100 slips and 15 moorings with dockside depths of approximately four meters. During the RAS, a total of 80 species were identified at BFM, of which 55 were native, nine cryptogenic, 15 introduced, and one a summer transient species. The dominant species at BFM were a mixture of the blue mussel *Mytilus edulis* or *M. trossulus* (unable to identify to species without genetic analysis), the frilled sea anemone *Metridium senile*, and the introduced sheath tunicate *Botrylloides violaceus*.

Spring Point Marina (PHM), Portland, Maine | August 4, 2013, 10:30 AM

Spring Point Marina, formerly known as Port Harbor Marine, is the largest full-service marina in Maine. Spring Point Marina is located at the entrance of Portland Harbor and the mouth of the Fore River. The marina was originally the site of the South Portland Shipyard, which built Liberty Ships during World War II. Floats were low in the water and heavily fouled. During the RAS, a total of 76 species were identified at PHM, of which 53 were native, 10 were cryptogenic, and 13 were introduced. The dominant species at PHM were a mixture of the blue mussels *M. edulis/trossulus* and large, heavily fouled blades of the sugar kelp *Saccharina latissima*. The frilled sea anemone *M. senile* and the bent opossum shrimp *Praunus flexuosus* were abundant on the underside of the docks.

Wells Harbor Marina (WHM), Wells, Maine | August 4, 2013, 8:15 AM

Wells Harbor Marina is located at the mouth of the Webhannet River. Nearby salt marsh and beach areas provide nursery habitats for estuary-dependent species. During the RAS, a total of 71 species were identified at WHM, of which 52 were native, four cryptogenic, 14 introduced, and one a summer transient species. The dominant species at WHM were a mixture of the blue mussels *M. edulis/trossulus* and the hydroid *Ectopleura larynx*.

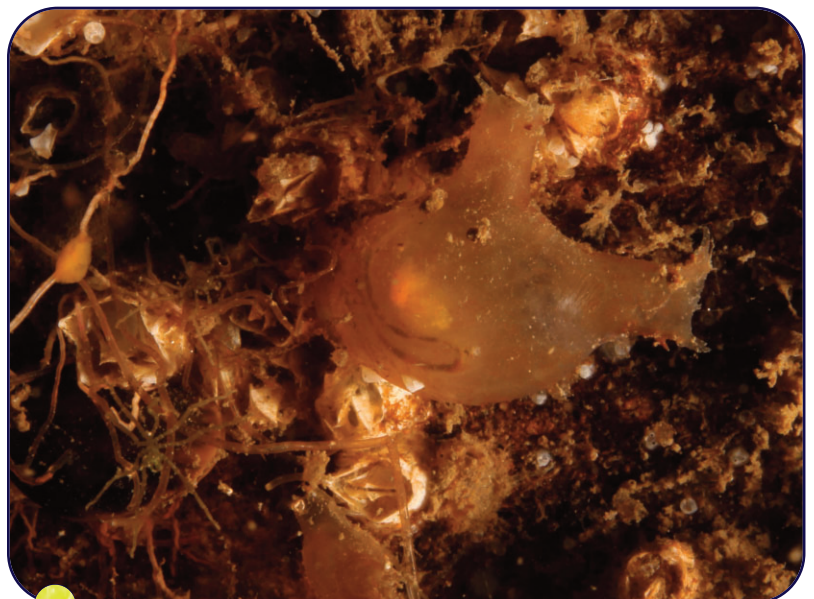
University of New Hampshire Coastal Marine Lab Floating Dock (UNH), New Castle, New Hampshire | August 5, 2013, 7:30 AM

The UNH floating dock is located at the mouth of Portsmouth Harbor adjacent to the historic Fort Constitution. The marine laboratory provides faculty and students with access to the Gulf of Maine and includes facilities with running seawater and a 100-meter research pier that provides berthing space for the UNH fleet of research vessels. Underneath the pier and adjacent to the floating dock there are experimental enclosures used for marine research. Floats holding the dock up are attached farther in and are deep and were therefore difficult to sample without the aid of divers. During the RAS, a total of 82 species were identified at the UNH floating dock, of which 59 were native, nine cryptogenic, 13 introduced, and one a summer transient species. The floating dock was dominated by the blue mussels *M. edulis/trossulus*, dead remains of the hydroid *E. larynx*, and large individuals of the frilled sea anemone *M. senile*. There was an abundant population of the medusa (i.e., jellyfish) life stage of the hydroid *Clytia hemisphaerica* found at this site.

Hampton River Marina (HSP), Hampton, New Hampshire | August 5, 2013, 9:30 AM

Hampton River Marina is located at the mouth of the Piscataqua River Estuary. The marina features 144 boat slips. The bottom is littered with bivalve shells; most appear to be sourced from the fouling community. The area is highly developed and supports a large amount of tourism. During the RAS, a total of 69 species were identified at HSP, including 46 native species, seven cryptogenic species, and 16 introduced species. The floating docks were dominated by the blue mussel *M. edulis/trossulus* and a mixture of introduced colonial and solitary tunicates. There was an orange-ringed color morph of the cryptogenic sea vase tunicate *Ciona intestinalis* found at this site.

The native orange sea grape tunicate *Molgula citrina* was only found north of Cape Cod.



Brewer Hawthorne Cove Marina (HCM), Salem, Massachusetts | August 5, 2013, 12:15 PM

Brewer Hawthorne Cove Marina, part of the historic Salem shipping port, is a private marina with 110 slips located on the northern shore of Salem Harbor. Depth ranges from 1-4 meters. During the RAS, a total of 68 species were identified at HCM, including 38 native species, eight cryptogenic species, 21 introduced species, and one summer transient species. This site had the highest percentage of introduced species (32%). Float fouling communities were dominated by tunicates and branching bryozoans on the vertical surfaces and mussels on the horizontal surfaces. Hawthorne Cove Marina is the only location where the anemone *Sagartia elegans* has been reported in the Western Atlantic, but this species disappeared after the winter of 2010-2011 (Wells 2013).



The introduced bryozoan *Bugula neritina* hosts a bacterium that produces a chemical that may have anti-cancer properties.

The Marina at Rowes Wharf (ROW), Boston, Massachusetts | August 6, 2013, 9:30 AM

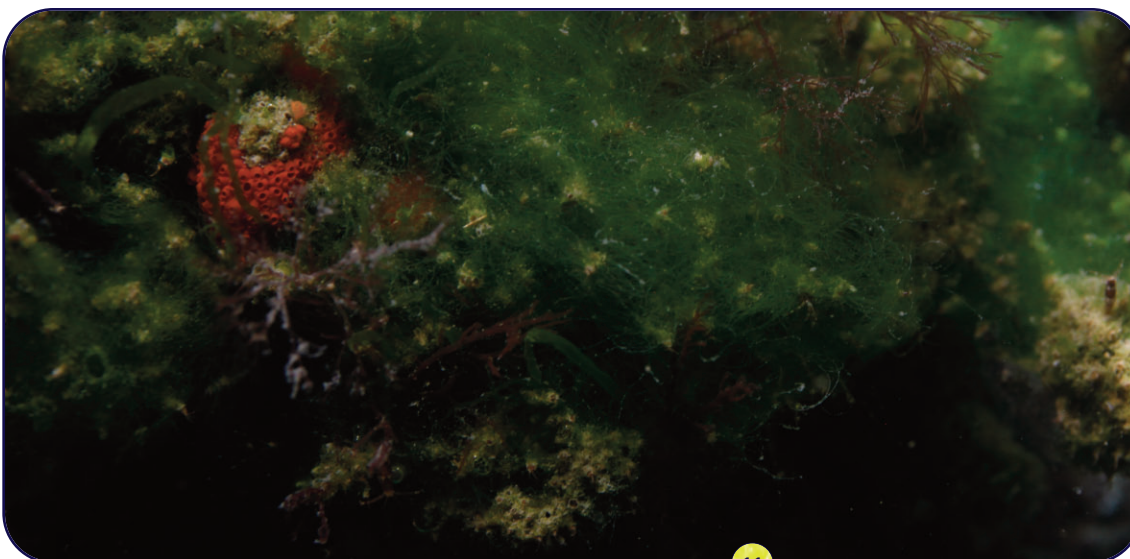
The Marina at Rowes Wharf is located along the highly developed waterfront of Boston's inner harbor and is part of the Rowes Wharf luxury hotel and condominium complex. It has 38 slips that can accommodate mega yachts. During the RAS, a total of 91 species were identified at ROW including 57 native species, 12 cryptogenic species, 21 introduced species, and one summer transient species. The floating docks had a light covering of the blue mussels *M. edulis/trossulus* and a mixture of introduced colonial and solitary tunicates as well as encrusting sponges. One individual of the introduced amphipod *Melita palmata* was found at ROW (see text box on page 5).

Green Harbor Marina (GHM), Marshfield, Massachusetts | August 6, 2013, 12:45 PM

Green Harbor Marina is located on the eastern side of Green Harbor located on the South Shore of Massachusetts. Green Harbor Marina has approximately 135 slips. pontoons were composed of polystyrene foam. During the RAS, a total of 71 species were identified at GHM, including 45 native species, seven cryptogenic species, 18 introduced species, and one summer transient species. The fouling community was dominated by solitary and colonial tunicates and branching bryozoans. The blue mussels *Mytilus edulis/trossulus* and barnacles were rare.

Sandwich Marina (SWM), Sandwich, Massachusetts | August 8, 2013, 8:30 AM

Sandwich Marina is an important site for monitoring the northerly progression of introduced species via the Cape Cod Canal. The marina features 164 slips for recreation ships and 42 commercial slips. During the RAS, a total of 90 species were found at SWM, including 57 native species, 11 cryptogenic species, 21 introduced species, and one summer transient species. The fouling community was dominated by solitary and colonial tunicates.



The native hair alga *Cladophora sericea* was very common at Hawthorne Cove Marina where it forms dense clumps on the floats just beneath the surface.

US Coast Guard Station Floating Dock (WHC), Woods Hole, Massachusetts | August 8, 2013, 1:45 PM

The Woods Hole Coast Guard Station has been in existence since 1857. The station is located on a highly developed shoreline on the Vineyard Sound side of Cape Cod. This site was surveyed for 30 minutes per the request of the Coast Guard; divers were not allowed in the water for security reasons and therefore organisms found deep on the vertical surfaces and on the horizontal surfaces are likely underrepresented. During the RAS, a total of 79 species were found at WHC, including 55 native species, four cryptogenic species, 18 introduced species, and two summer transient species. The fouling community was dominated by solitary and colonial tunicates growing over the abundant common jingle shell *Anomia simplex*. One specimen of the Florida grass shrimp *Palaemon floridanus* was collected at the docks amongst the marsh grass shrimp *Palaemonetes vulgaris*. *Palaemon floridanus* has only been documented as far north as Fort Pierce, Florida, prior to this record and is unlikely to survive the winter.

Marine Biological Laboratory Floating Dock (MBL), Woods Hole, Massachusetts | August 8, 2013, 2:30 PM

The Marine Biological Laboratory floating dock is located on the southwestern shore of Eel Pond, an embayment in Woods Hole, Massachusetts. During the RAS, a total of 70 species were identified at MBL, including 51 native species, three cryptogenic species, 15 introduced species, and one summer transient species. The fouling community was dominated by solitary and colonial tunicates as well as the blue mussels *M. edulis/trossulus* and branching bryozoans.

Massachusetts Maritime Academy Floating Dock (MMA), Buzzards Bay, Massachusetts | August 8, 2013, 10:15 AM

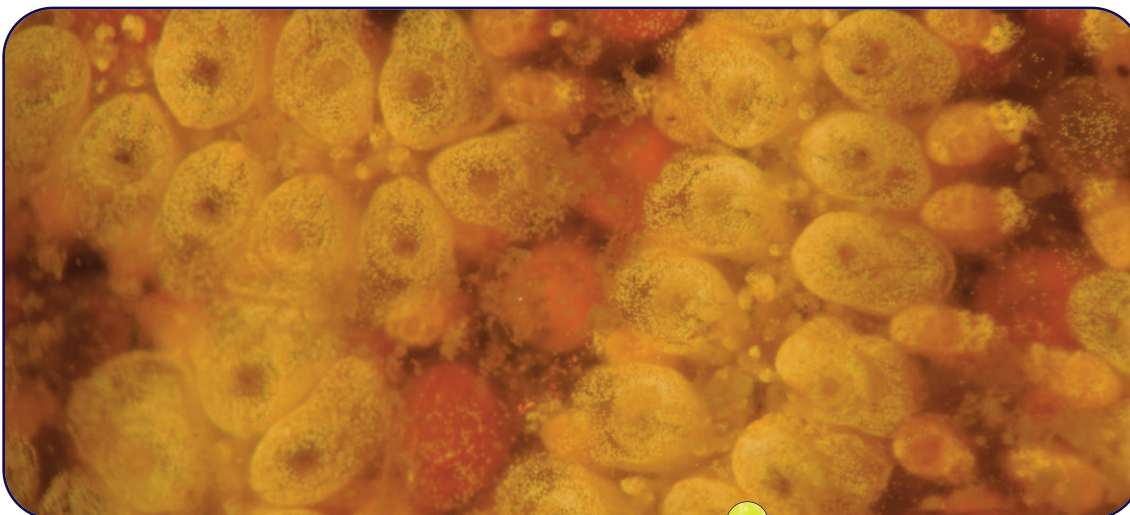
The Massachusetts Maritime Academy is located at the southern end of the Cape Cod Canal. The MMA features one permanent floating dock of approximately 70 meters. Several large vessels are docked nearby, including the 160-meter-long USTS *Kennedy*. The floating docks are located on the Buzzards Bay end of the Cape Cod Canal. During the RAS, a total of 90 species were identified at MMA, including 61 native species, nine cryptogenic species, 19 introduced species, and one summer transient species. There was a patchy base of the blue mussels *M. edulis/trossulus* and colonial and solitary tunicates. The hydroid *E. larynx* was very common at this site.

Pope's Island Marina (POP), New Bedford, Massachusetts | August 9, 2013, 8:15 AM

Pope's Island Marina is a public boat facility with 198 boat slips located on the south side of Pope's Island in the upper region of New Bedford Harbor. The marina was opened in 1993 with assistance from the Massachusetts Department of Conservation and Recreation and is currently maintained and operated by the New Bedford Harbor Development Commission. During the RAS, a total of 88 species were identified at POP, including 59 native species, seven cryptogenic species, 20 introduced species, and two summer transient species. The fouling community was dominated by the tube-building worm *Hydroides dianthus* and the encrusting bryozoan *Schizoporella variabilis*. On the last set of slips at POP, a grouping of the striped barnacle *Amphibalanus amphitrite* was found. *Amphibalanus amphitrite* is an introduced barnacle normally found much farther south and will likely not survive the winter.

F.L. Tripp & Sons Marina (TRM), Westport, Massachusetts | August 9, 2013, 10:30 AM

Tripp's Marina is located on the Westport River between Rhode Island Sound and Buzzards Bay and features 178 slips. The floating pontoons at TRM are made of polystyrene foam. During the RAS, a total of 90 species were identified at TRM, including 62 native species, eight cryptogenic species, 18 introduced species, and two summer transient species. The fouling community was dominated by introduced colonial tunicates, such as the sheath tunicate *Botrylloides violaceus*, the star tunicate *Botryllus schlosseri*, and the pancake batter tunicate *Didemnum vexillum*.



Close-up photograph of the sheath tunicate *Botrylloides violaceus*. The lighter orange circles are the individual animals living within a shared tunic. The darker orange circles are developing embryos, nearly the same size as their parents.



The hydromedusan jellyfish *Clytia hemisphaerica* was only found at the University of New Hampshire Coastal Marine Laboratory floating docks where it was highly abundant.

Port Edgewood Marina (PEW), Cranston, Rhode Island | August 7, 2013, 1:45 PM

Port Edgewood Marina is located in the northern region of Providence Harbor adjacent to a large industrial park. The marina includes three large, wooden floats and 160 seasonal and transient boat slips. This site had the lowest average salinity of any site sampled during the 2013 RAS. During the RAS, a total of 50 species were identified at PEW, including 41 native species, four cryptogenic species, four introduced species, and one summer transient species. Port Edgewood Marina had a heavy freshwater influence and hosted a significantly different community of organisms, as indicated by the presence of the American oyster *Crassostrea virginica*. This site had the highest percentage of native species (82%). The fouling community was dominated by the orange striped anemone *Diadumene lineata* and the ivory barnacle *Amphibalanus eburneus*. Two individuals of a rare green color morph of the ghost anemone *D. leucolena* were found at PEW.

Allen Harbor Marina (ALM), North Kingstown, Rhode Island | August 7, 2013, 10:45 AM

Allen Harbor Marina is located on the western side of Narragansett Bay on the corner of the former Quonset-Davisville Naval Base. The marina features a wooden dock system with 80 moorings and 66 slips and is surrounded by heavily industrialized lands. Allen Harbor features polystyrene foam pontoons. During the RAS, a total of 64 species were identified at ALM, including 40 native species, nine cryptogenic species, 14 introduced species, and one summer transient species. The fouling community was dominated by solitary and colonial tunicates. Sponges, specifically of the genera *Halichondria* and *Haliclona*, were relatively common at ALM.

Fort Adams State Park Floating Dock (FAD), Newport, Rhode Island | August 9, 2013, 10:30 AM

Fort Adams State Park is located at the mouth of Newport Harbor facing the East Passage of Narragansett Bay. Construction of the fort began in 1824 and was completed 30 years later. The fort was deeded to the state of Rhode Island in 1966 and has since become a major public access point into Narragansett Bay and a recreational attraction. The 105-acre park includes a small, semi-enclosed marina at the southern-most point. During the RAS, a total of 89 species were found at FAD, including 60 native species, five cryptogenic species, 23 introduced species, and one summer transient species. The base of the fouling community was composed of the blue mussels *M. edulis/trossulus*, commonly with branching bryozoans *Bugula* spp. and the sea lettuce *Ulva lactuca*. The bryozoan *Tricellaria inopinata* was collected at FAD; this is the southernmost record for this species and the first for Rhode Island.

Point Judith Marina (PTJ), Wakefield, Rhode Island | August 7, 2013, 8:30 AM

The Point Judith Marina is located on the southern end of Narragansett Bay within the sheltered enclosure of Point Judith Pond. The marina features a large system of floating docks and wooden pilings. During the RAS, a total of 94 species were identified at PTJ, including 66 native species, seven cryptogenic species, and 21 introduced species; PTJ had the most documented species during the 2013 RAS. The fouling community was dominated by solitary and colonial tunicates and the bryozoans *Bugula* spp., with patchy clumps of the blue mussels *M. edulis/trossulus*. The pink-spotted anemone *Aiptasiogeton eruptaurantia* was found at PTJ; this species is normally found much farther to the south, but has established a population over the last several years (Hobbs, personal observation).

Appendix II: Rapid Assessment Survey Participants

The field team for the 2013 RAS included marine scientists with varying specialties.

Participant Name	Specialty/Role	Affiliation
Yuanguy Cao	Algal taxonomy	University of New Hampshire
James T. Carlton	General taxonomy	Williams College-Mystic Seaport
Zara Currimjee	Lab and field assistance	Williams College-Mystic Seaport
Kevin Cute	Logistics	Rhode Island Coastal Resource Management Council
Jennifer Dijkstra	Ascidian taxonomy	University of New Hampshire
Sara K. Edquist	Worm taxonomy	University of New Hampshire
Megan Flenniken	Lab and field assistance	Stony Brook University
Adriaan Gittenberger	General taxonomy, photography	GiMaRIS (Netherlands)
Seth Goodnight	Algal taxonomy	University of New Hampshire
Sara P. Grady	General taxonomy, dockmaster	Massachusetts Bays Program/ North and South Rivers Watershed Association
Lindsay A. Green	Algal taxonomy	University of New Hampshire
Larry G. Harris	General taxonomy	University of New Hampshire
Leslie H. Harris	Worm taxonomy	Natural History Museum of Los Angeles
Niels-Viggo Hobbs	Peracarid taxonomy	University of Rhode Island
Gretchen Lambert	Ascidian taxonomy, photography	University of Washington
Antonio C. Marques	Medusazoan taxonomy	Universidade de São Paulo (Brazil)
Arthur C. Mathieson	Algal taxonomy	University of New Hampshire
Megan I. McCuller	Lab and field assistance	University of New Hampshire
Kristin Osborne	Lab and field assistance	University of Massachusetts, Boston
Adrienne L. Pappal	Co-Organizer and logistics	Massachusetts Office of Coastal Zone Management
Judith A. Pederson	General taxonomy	Massachusetts Institute of Technology Sea Grant
Macarena Ros	Caprellid taxonomy	Universidad de Sevilla (Spain)
Jan P. Smith	Co-Organizer and logistics	Massachusetts Office of Coastal Zone Management
Lauren M. Stefaniak	Ascidian taxonomy	University of Connecticut
Alexandra Stevens	Lab and field assistance	Williams College-Mystic Seaport
Christopher D. Wells	Anthozoan taxonomy and logistics	University of New Hampshire/Massachusetts Office of Coastal Zone Management

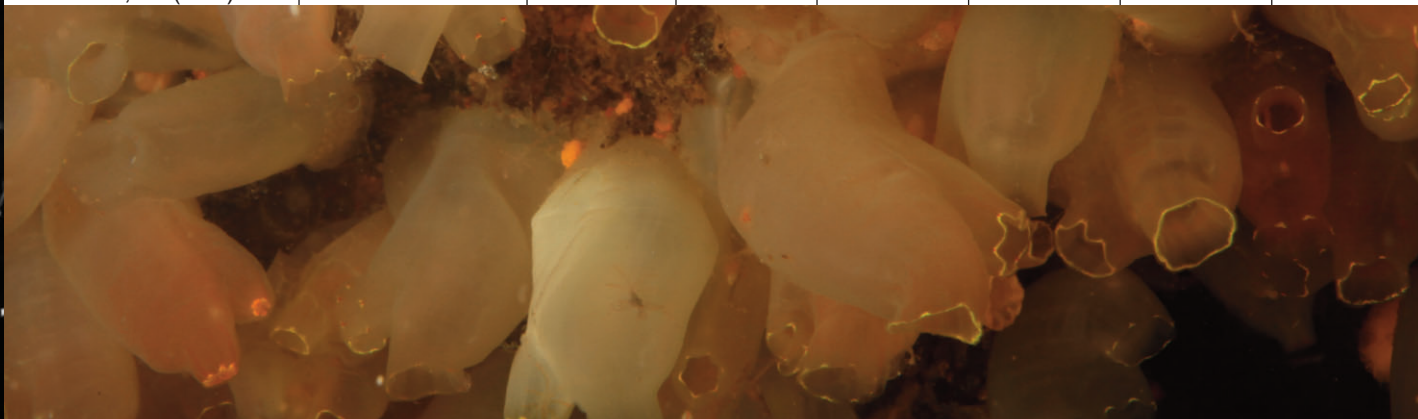


An exceptional color morph of the star tunicate *Botryllus schlosseri* was found at Massachusetts Maritime Academy.

Appendix III: Hydrographic Data

Surface-water temperatures showed a north-south pattern, with coldest temperatures in Maine (18.2 ± 3.6 °C) and New Hampshire (17.1 ± 0.8 °C) and highest temperatures in southern Massachusetts (i.e., south of Cape Cod, 23.2 ± 1.2 °C). Bottom-water temperature followed a similar pattern with coldest temperatures in Maine (16.9 ± 2.7 °C) and New Hampshire (16.5 ± 1.2 °C) and warmest temperatures in southern Massachusetts (22.8 ± 0.9 °C). Surface and bottom-water salinities were similar across states with no inherent pattern (27.8-30.3 ppt and 28.9-30.3 ppt respectively). Surface-water dissolved oxygen was highest in Maine (7.71 ± 0.67 mg/L) and decreased southerly, with dissolved oxygen lowest in southern Massachusetts (5.84 ± 1.14 mg/L) and Rhode Island (6.09 ± 0.72 mg/L). Bottom-water dissolved oxygen followed a similar pattern to surface-water dissolved oxygen, although it was much more variable. Bottom-water dissolved oxygen was highest in Maine (7.22 ± 0.93 mg/L) and lowest in Rhode Island (5.30 ± 2.08 mg/L). For depth, temperature, salinity, and oxygen concentration for each site, see table below.

LOCATION	MAXIMUM DEPTH (m)	SURFACE TEMP (°C)	BOTTOM TEMP (°C)	SURFACE SALINITY (ppt)	BOTTOM SALINITY (ppt)	SURFACE OXYGEN (mg/L)	BOTTOM OXYGEN (mg/L)
S. Freeport, ME (BFM)	5.3	21.1	18.6	28.8	28.9	7.56	7.26
Portland, ME (PHM)	4.5	19.5	16.7	24.5	28.1	7.13	7.16
Wells, ME (WHM)	5	14.2	14	30.2	30.1	8.81	8.29
New Castle, NH (UNH)	5.5	17.3	17.2	27.9	27.9	7.25	7.1
Hampton, NH (HSP)	3.8	16.8	16.8	29.3	29.8	6.57	7.87
Salem, MA (HCM)	4.5	15.8	14	30.1	30.3	7.1	6.89
Boston, MA (ROW)	6	19.6	17.9	28.5	29.5	5.81	6.43
Marshfield, MA (GHM)	4.5	21.3	20.2	29.1	29.5	7.02	6.32
Sandwich, MA (SWM)	3.5	19.4	18.6	29	30	6.06	5.97
Woods Hole, MA (WHC)	3.8	24.4	23.2	30.4	30.6	5.56	5.11
Woods Hole, MA (MBL)	2.5	24.8	23.8	30.4	30.4	6.46	6.68
Buzzards Bay, MA	5.3	22.1	22	29.9	29.8	6.34	6.22
New Bedford, MA (POP)	4	23.9	23.7	30.1	30.2	4.4	4.96
Westport, MA (TRM)	2.5	22.2	22.1	30.8	30.8	6.6	6.45
Cranston, RI (PEW)	2	23.7	22.7	25.2	26	nd	nd
N. Kingstown, RI (ALM)	4.5	23.5	21.9	28.6	29.3	5.43	3.64
Newport, RI (FAD)	3	20	19.2	30.3	30.6	5.98	5.75
Wakefield, RI (PTJ)	4.3	20.6	20.5	30.4	30.5	6.86	7.2



The cryptogenic sea vase tunicate *Ciona intestinalis* formed dense aggregations at Hampton River Marina.

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Any hard substratum left hanging near the dock will soon be colonized by tunicates and other fouling organisms.





Scientists sampled the fouling community no matter what the weather.

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Lists of Introduced, Cryptogenic, and Native Species

The following tables contain the species found during the 2013 Rapid Assessment Survey, excluding species that could not be identified to genus or lower. Within the tables, the sampling sites have been abbreviated as follows: Brewer South Freeport Marine (BFM), Spring Point Marina (PHM), Wells Harbor Marina (WHM), UNH Coastal Marine Laboratory Floating Dock (UNH), Hampton River Marina (HSP), Brewer Hawthorne Cove Marina (HCM), Rowes Wharf Marina (ROW), Green Harbor Marina (GHM), Sandwich Marina (SWM), Woods Hole US Coast Guard Floating Dock (WHC), Marine Biological Laboratory Floating Dock (MBL), Massachusetts Maritime Academy Floating Dock (MMA), Pope's Island Marina (POP), F.L. Tripp & Sons Marina (TRM), Port Edgewood Marina (PEW), Allen Harbor Marina (ALM), Fort Adams State Park Floating Dock (FAD), and Point Judith Marina (PTJ). Sites are listed from northeast to southwest following the coast.

Introduced Species Identified During the 2013 Rapid Assessment Survey by Sampling Site

Species marked with an asterisk (*) are likely summer transient species or their establishment status is unknown.

SPECIES (COMMON NAME)	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Chlorophyta (green algae)																		
<i>Codium fragile</i> subsp. <i>fragile</i> (dead man's fingers)						x				x		x	x	x		x	x	x
Heterokontophyta (brown algae)																		
<i>Colpomenia peregrina</i> (sea potato)									x									
<i>Melanosiphon intestinalis</i> (dark sea tubes)			x															
Rhodophyta (red algae)																		
<i>Bonnemaisonia hamifera</i> (hooked red weed)			x											x				
<i>Gracilaria vermiculophylla</i> (wormleaf)													x		x	x		
<i>Grateloupia turuturu</i> (Devil's tongue weed)							x		x	x			x	x		x	x	x
<i>Heterosiphonia japonica</i> (siphoned feather weed)				x								x		x			x	
<i>Lomentaria clavellosa</i> (club bead-weed)					x	x			x					x			x	
<i>Lomentaria orcadensis</i> (Orkney weed)									x									
<i>Neosiphonia harveyi</i> (doughball weed)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
<i>Pyropia yezoensis</i> (open sea nori)						x												x
Annelida (ringed worms)																		
<i>Neodexiospira brasiliensis</i> (Brazilian spiral tubeworm)														x			x	x
Arthropoda (crabs, shrimp, and relatives)																		
* <i>Amphibalanus amphitrite</i> (striped barnacle)													x					
<i>Caprella mutica</i> (Japanese skeleton shrimp)	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
<i>Carcinus maenas</i> (European green crab)	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
<i>Hemigrapsus sanguineus</i> (Asian shore crab)	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
<i>Ianiropsis serricaudis</i> (isopod)					x	x	x	x	x	x	x	x	x	x			x	x
* <i>Melita palmata</i> (palmed gammarid)							x											
<i>Microdeutopus gryllotalpa</i> (tube builder)	x			x								x		x				
<i>Palaemon elegans</i> (European rock pool shrimp)		x	x		x	x		x	x									
* <i>Palaemon floridanus</i> (Florida grass shrimp)										x								
<i>Palaemon macrodactylus</i> (oriental grass prawn)																	x	
<i>Praunus flexuosus</i> (bent opossum shrimp)	x	x	x		x	x		x	x									
* <i>Stenothoe valida</i> (gammarid amphipod)	x		x	x										x				
Bryozoa (bryozoans)																		
<i>Bugula neritina</i> (purple bugula)						x	x		x	x	x		x				x	x
<i>Bugula simplex</i> (fan bugula)	x			x	x	x	x	x	x	x	x	x	x			x	x	x
<i>Bugula stolonifera</i> (stolonized bugula)	x																	x
<i>Conopeum seurati</i> (encrusting bryozoan)							x											
<i>Membranipora membranacea</i> (lacy crust bryozoan)		x	x	x	x		x		x				x					
<i>Tricellaria inopinata</i> (unexpected bryozoan)					x	x	x	x	x	x	x	x					x	
Chordata (tunicates and vertebrates)																		
<i>Asciidiella aspersa</i> (European tunicate)	x	x				x	x	x	x	x	x	x	x				x	x
<i>Botrylloides violaceus</i> (sheath tunicate)	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
<i>Botryllus schlosseri</i> (star tunicate)	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
<i>Botryllus</i> sp. (colonial tunicate)							x	x		x	x	x	x			x		
<i>Didemnum vexillum</i> (pancake batter tunicate)	x		x	x		x	x	x	x	x	x	x	x	x			x	x
<i>Diplosoma listerianum</i> (gelatinous tunicate)	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x
<i>Styela canopus</i> (rough tunicate)										x		x		x			x	x
<i>Styela clava</i> (club tunicate)		x				x	x	x	x	x	x	x	x	x		x	x	x

Introduced Species *continued*

SPECIES (COMMON NAME)	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Cnidaria (anemones, hydroids, and relatives)																		
<i>Aiptasiogeton eruptaurantia</i> (pink-spotted sea anemone)																		x
* <i>Clytia linearis</i> (hydroid)						x		x	x	x	x	x	x	x	x	x	x	x
<i>Diadumene lineata</i> (orange striped anemone)		x				x	x	x	x			x	x	x	x	x	x	x
<i>Hydrodendron</i> sp. (hydroid)													x					
Mollusca (snails and bivalves)																		
<i>Littorina littorea</i> (common periwinkle)	x			x	x		x											
<i>Ostrea edulis</i> (European oyster)	x	x	x	x	x	x	x	x					x				x	

Cryptogenic Species Identified During the 2013 Rapid Assessment Survey by Sampling Site

SPECIES (COMMON NAME)	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Annelida (ringed worms)																		
<i>Capitella teleta</i> (telete worm)				x														
<i>Lepidonotus</i> sp. (scale worm)						x	x							x				
<i>Perkinsiana</i> sp. ¹ (sabellid worm)																	x	
<i>Polycirrus</i> sp. (terebellid worm)											x							
Arthropoda (shrimp, crabs, and relatives)																		
<i>Caprella penantis</i> (caprellid amphipod)												x						
<i>Microdeutopus anomalous</i> (amphipod)									x									
<i>Tanais dulongii</i> (tanaid)							x					x						
Bryozoa (bryozoans)																		
<i>Bowerbankia imbricata</i> (tiled moss hydroid)							x						x	x		x		
<i>Cryptosula pallasiana</i> (orange crust bryozoan)	x	x		x	x		x		x	x		x	x		x	x	x	
Cercozoa (some amoebas and relatives)																		
<i>Gromia oviformis</i> (rhizopod)									x									
Chordata (tunicates and vertebrates)																		
<i>Ciona intestinalis</i> (sea vase tunicate)	x	x		x	x	x	x		x	x	x	x					x	x
Cnidaria (anemones, hydroids, and relatives)																		
<i>Bougainvillia muscus</i> (sticky moss hydroid)	x	x			x				x			x						
<i>Clava multicornis</i> (club hydroid)		x	x						x									
<i>Clytia gracilis</i> (hydroid)									x	x	x		x	x		x		x
<i>Clytia hemisphaerica</i> (hydroid)				x														
<i>Dynamena pumila</i> (sea oak hydroid)	x	x							x			x						
<i>Ectopleura crocea</i> (pink-hearted hydroid)	x					x	x											
<i>Ectopleura larynx</i> (ringed tubularian)	x	x	x	x	x	x	x	x	x			x		x				x
<i>Gonothyrea loveni</i> (Hydroid)													x	x		x		
<i>Hydractinia</i> sp. (snail fur hydroid)				x	x		x								x			
<i>Laomedea calceolifera</i> (hydroid)						x		x								x		
<i>Obelia dichotoma</i> (sea thread hydroid)	x	x		x	x	x	x	x	x				x	x	x	x	x	x
<i>Obelia longissima</i> (bushy wine-glass hydroid)		x				x	x							x		x		x
<i>Pennaria disticha</i> (Christmas tree hydroid)												x						
Mollusca (snails, bivalves, and relatives)																		
<i>Tenellia adspersa</i> (miniature aeolis)													x					
Porifera (sponges)																		
<i>Halichondria</i> sp. (sponge)	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
<i>Haliciona</i> sp. (sponge)	x	x	x	x			x	x	x		x					x		x

¹This species has been tentatively identified as *Perkinsiana* sp., but the specimens collected may be an undescribed (i.e., new) species.

Native Species Identified During the 2013 Rapid Assessment Survey by Sampling Site

SPECIES	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Chlorophyta (green algae)																		
<i>Acrosiphonia arcta</i>	x																	
<i>Acrosiphonia spinescens</i>												x	x					x
<i>Blidingia minima</i>	x		x	x		x	x	x	x					x	x		x	
<i>Bryopsis hypnoides</i>													x	x			x	
<i>Bryopsis plumosa</i>						x		x	x	x	x		x			x		x
<i>Caposiphon fulvescens</i>		x						x							x			
<i>Chaetomorpha ligustica</i>	x		x	x		x	x		x				x					
SPECIES																		
Chlorophyta (green algae)																		
<i>Chaetomorpha linum</i>												x						x
<i>Chaetomorpha picquotiana</i>			x				x			x	x							
<i>Cladophora albida</i>							x				x		x		x			
<i>Cladophora sericea</i>	x				x	x	x	x	x	x		x						x
<i>Percursaria percursa</i>	x		x															
<i>Pseudoclonium submarinum</i>												x			x			
<i>Rhizoclonium riparium</i>	x														x			
<i>Ulva compressa</i>	x		x			x												x
<i>Ulva flexuosa</i> subsp. <i>flexuosa</i>					x								x	x		x		
<i>Ulva flexuosa</i> subsp. <i>paradoxa</i>									x									
<i>Ulva intestinalis</i>	x	x			x		x		x			x	x					x
<i>Ulva lactuca</i>	x	x	x	x	x	x	x		x	x	x			x	x		x	x
<i>Ulva linza</i>		x		x	x	x	x											x
<i>Ulva prolifera</i>	x		x					x						x			x	
<i>Ulvaria obscura</i>		x		x										x				
<i>Urospora penicilliformis</i>						x			x									
Cyanobacteria (blue-green algae)																		
<i>Lyngbya confervoides</i>	x							x			x		x	x	x	x		x
<i>Spirulina major</i>	x																	
Heterokontophyta (brown algae)																		
<i>Ascophyllum nodosum</i>	x	x	x	x				x	x			x		x				x
<i>Berkeleya rutilans</i>		x	x	x	x													
<i>Chordaria flagelliformis</i>					x													
<i>Desmarestia aculeata</i>				x														
<i>Ectocarpus fasciculatus</i>		x		x														
<i>Ectocarpus siliculosus</i>	x		x										x					x
<i>Elachista fucicola</i>									x									
<i>Fragilaria</i> sp.		x	x		x													
<i>Fucus spiralis</i>	x		x	x	x							x						
<i>Fucus vesiculosus</i>	x	x	x	x	x	x	x	x	x		x			x				x
<i>Fucus vesiculosus</i> ecad <i>volubilis</i>														x				
<i>Hinckesia granulosa</i>							x											x
<i>Isthmia nervosa</i>		x	x	x	x													
<i>Melosira nummuloides</i>			x						x									
<i>Microspongium gelatinosum</i> ¹							x											
<i>Petalonia fascia</i>		x							x									
<i>Protectocarpus speciosus</i>							x											
<i>Ralfsia verrucosa</i>			x															
<i>Saccharina latissima</i>	x	x		x			x		x									
<i>Saccharina longicuris</i>		x																
<i>Sargassum filipendula</i>										x	x	x	x					x
<i>Sphacelaria cirrosa</i>											x							
Rhodophyta (red algae)																		
<i>Acrochaetium secundatum</i>							x			x								
<i>Agardhiella subulata</i>									x	x	x	x	x	x	x	x	x	x
<i>Aglaothamnion halliae</i> ¹										x			x					
<i>Antithamnion hubbsii</i>											x							x
<i>Antithamnion plumula</i>				x														

Native Species *continued*

SPECIES	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Rhodophyta (red algae)																		
<i>Antithamnionella floccosa</i>					x					x								
<i>Callithamnion corymbosum</i>										x								
<i>Ceramium deslongchampsii</i>	x	x			x		x	x			x		x	x	x	x		
<i>Ceramium virgatum</i>	x	x	x		x	x	x		x	x		x			x		x	x
<i>Champia parvula</i>										x		x		x			x	x
<i>Chondria capillaris</i>				x						x				x				x
<i>Chondrus crispus</i>	x	x	x		x	x	x		x			x		x			x	
<i>Cystoclonium purpureum</i>			x															
<i>Dasya baillouviana</i>								x	x		x			x				
<i>Erythrotrichia carnea</i>			x		x									x			x	x
<i>Gracilaria tikvahiae</i>													x					
<i>Grinnellia americana</i>									x	x		x						x
<i>Hypnea musciformis</i>														x				
<i>Lomentaria divaricata</i>										x		x	x	x			x	x
<i>Mastocarpus stellatus</i>	x						x		x								x	
<i>Palmaria palmata</i>		x		x														
<i>Polysiphonia elongata</i>				x	x													
<i>Polysiphonia flexicaulis</i>			x					x										
<i>Polysiphonia fucoides</i>	x			x	x			x										
<i>Polysiphonia nigra</i>				x														
<i>Polysiphonia schneideri</i>							x		x	x	x	x	x	x		x	x	x
<i>Polysiphonia stricta</i>			x	x	x	x	x		x								x	
<i>Porphyra purpurea</i>		x		x	x	x	x		x					x				
<i>Porphyra umbilicalis</i>	x		x															
<i>Spermothamnion repens</i>			x					x			x		x	x				x
<i>Spyridia filamentosa</i>								x			x	x	x	x				x
<i>Stylonema alsidii</i>						x								x				
<i>Titanoderma pustulatum</i>	x		x						x	x	x	x		x				
<i>Vertebrata lanosa</i>	x		x															
Annelida (ringed worms)																		
<i>Alitta virens</i>	x		x	x		x		x		x	x	x		x				
<i>Amphitrite ornata</i>	x									x	x	x	x				x	
<i>Cirriformia grandis</i>								x					x					
<i>Dodecacera concharum</i>																	x	
<i>Eulalia viridis</i>				x		x												
<i>Eumida sanguinea</i>							x											
<i>Harmothoe extenuata</i>		x		x		x	x	x	x		x						x	x
<i>Harmothoe imbricata</i>	x	x	x	x	x		x	x	x			x					x	x
<i>Harmothoe spinulosa</i>												x						
<i>Hydroides dianthus</i>									x	x	x	x	x	x	x	x	x	x
<i>Lepidonotus squamatus</i>	x	x	x	x	x		x	x	x	x	x	x					x	x
<i>Neanthes succinea</i>	x							x	x			x	x	x	x	x	x	x
<i>Neomphitrite figulus</i>	x	x		x			x	x										x
<i>Nereis pelagica</i>	x		x	x	x			x					x					x
<i>Oxydromus obscurus</i>								x		x	x	x	x	x	x	x	x	x
<i>Parasabella microphthalma</i>										x	x		x	x			x	x
<i>Pista palmata</i>										x	x							
<i>Platynereis dumerilii</i>													x				x	
<i>Polydora cornuta</i>	x	x					x		x						x	x	x	
<i>Polydora websteri</i>																	x	
<i>Syllis gracilis</i>											x			x				
<i>Terebella verrilli</i>											x			x				x
Arthropoda (shrimp, crabs, and relatives)																		
<i>Amphibalanus eburneus</i>							x	x		x	x		x		x	x		
<i>Amphibalanus improvisus</i>						x	x						x	x	x	x	x	x
<i>Ampithoe longimana</i>													x	x			x	x
<i>Ampithoe rubricata</i>															x		x	
<i>Ampithoe valida</i>							x		x			x	x			x	x	x

Native Species *continued*

SPECIES	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Arthropoda (shrimp, crabs, and relatives)																		
<i>Anurida maritima</i>								x							x	x		
<i>Apocorophium acutum</i>												x	x				x	
<i>Balanus crenatus</i>	x	x	x	x	x	x	x	x	x				x				x	
<i>Callinectes sapidus</i>										x			x	x	x			
<i>Cancer borealis</i>				x													x	
<i>Cymadusa compta</i>														x				x
<i>Dyspanopeus sayi</i>										x		x	x	x				x
<i>Elasmopus levis</i>										x	x		x	x		x	x	x
<i>Eurypanopeus depressus</i>													x			x		
<i>Gammarus mucronatus</i>							x	x	x					x		x	x	x
<i>Globosolembos smithi</i>		x											x		x		x	
<i>Idotea balthica</i>	x				x			x				x		x			x	x
<i>Idotea phosphorea</i>			x	x	x	x								x				
<i>Jaera marina</i>												x						
<i>Jassa marmorata</i>	x	x	x	x	x	x	x	x	x	x		x	x	x			x	x
<i>Libinia dubia</i>									x			x		x				
<i>Libinia emarginata</i>									x	x				x				x
<i>Limnoria lignorum</i>		x														x		
<i>Melita nitida</i>															x	x		
<i>Monocorophium acherusicum</i>	x				x					x								
<i>Monocorophium insidiosum</i>				x	x	x	x	x	x	x	x				x	x		x
<i>Palaemonetes pugio</i>	x														x	x		
<i>Palaemonetes vulgaris</i>									x	x	x		x	x	x	x	x	x
<i>Panopeus herbstii</i>									x	x	x	x	x	x	x		x	x
<i>Paracaprella tenuis</i>		x												x				
<i>Phoxichilidium femoratum</i>				x														
<i>Ptilohyale plumulosus</i>							x					x	x	x				
<i>Semibalanus balanoides</i>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
<i>Stenothoe minuta</i>													x					
Bryozoa (bryozoans)																		
<i>Amathia dichotoma</i>														x				
<i>Bowerbankia gracilis</i>		x		x	x	x	x	x		x		x		x	x			
<i>Bowerbankia tertia</i>							x						x					
<i>Bugula turrata</i>	x	x		x	x	x			x	x	x	x	x					x
<i>Celleporella hyalina</i>			x	x	x		x		x									
<i>Electra pilosa</i>		x	x	x	x			x	x								x	
<i>Microporella</i> sp.				x	x													
<i>Schizoporella variabilis</i>					x		x			x		x	x		x	x		x
<i>Scrupocellaria scabra</i>	x				x	x				x	x	x						
Chordata (tunicates and vertebrates)																		
<i>Aplidium constellatum</i>											x	x						x
<i>Aplidium glabrum</i>									x	x	x	x		x				
<i>Aplidium pallidum</i>											x							
<i>Fundulus heteroclitus</i>							x	x										
<i>Molgula citrina</i>		x	x	x	x	x			x									
<i>Molgula manhattensis</i>							x	x			x		x	x	x	x	x	x
<i>Molgula provisionalis</i>				x		x												
<i>Myoxocephalus</i> sp.		x																
<i>Osmerus mordax</i>								x										
<i>Perophora viridis</i>														x				
<i>Pholis gunnellus</i>	x					x												
<i>Pungitius pungitius</i>		x														x		
<i>Tautoga onitis</i>													x				x	x
<i>Tautoglabrus adspersus</i>			x	x	x	x	x	x	x			x	x			x	x	x

Native Species *continued*

SPECIES	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Cnidaria (anemones, hydroids, and relatives)																		
<i>Astrangia poculata</i>									x	x	x	x	x				x	x
<i>Aurelia</i> sp.		x						x				x						x
<i>Cyanea capillata</i>																		x
<i>Diadumene leucolena</i>							x		x	x		x	x	x	x		x	x
<i>Edwardsiella lineata</i>						x		x	x		x	x		x	x	x	x	x
<i>Eudendrium album</i>												x						
<i>Eudendrium glomeratum</i>																		x
<i>Halopteris tenella</i>										x				x				
<i>Metridium senile</i>	x	x	x	x	x	x	x	x	x	x		x	x	x		x	x	x
<i>Obelia geniculata</i>	x			x														
<i>Tubularia indivisa</i>				x			x											
Ctenophora (comb jellies)																		
<i>Mnemiopsis leidyi</i>				x					x		x	x		x	x	x		x
Echinodermata (sea stars, urchins, and relatives)																		
<i>Arbacia punctulata</i>											x							x
<i>Asterias forbesi</i>								x			x	x						
<i>Asterias rubens</i>	x		x	x			x	x										
<i>Strongylocentrotus droebachiensis</i>				x														
Entoprocta (nodding heads)																		
<i>Barentsia laxa</i>															x			
Mollusca (snails, bivalves, and relatives)																		
<i>Aeolidia papillosa</i>	x	x																
<i>Anadara transversa</i>										x								
<i>Anomia simplex</i>	x	x	x	x	x		x	x	x	x		x					x	x
<i>Astyris lunata</i>							x							x			x	x
<i>Corambe obscura</i>		x													x			
<i>Costoanachis</i> sp.			x															
<i>Crassostrea virginica</i>															x			
<i>Cratena pílata</i>														x				
<i>Crepidula fornicata</i>	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
<i>Crepidula plana</i>	x	x	x			x	x		x			x	x	x		x	x	x
<i>Cuthona gymnota</i>			x	x														
<i>Dendronotus frondosus</i>		x																
<i>Eubranchus exiguus</i>		x	x															
<i>Facelina bostoniensis</i>	x		x	x														
<i>Geukensia demissa</i>															x	x		
<i>Heteranomia squamula</i>			x	x	x					x	x	x		x				
<i>Hiatella arctica</i>	x	x	x	x			x											
<i>Lacuna vincta</i>		x		x														
<i>Lunarca ovalis</i>										x	x							
<i>Modiolus modiolus</i>				x						x								
<i>Mya arenaria</i>	x														x	x		
<i>Mytilus edulis/trossulus</i> ²	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
<i>Onchidoris bilamellata</i>				x														
<i>Onchidoris muricata</i>		x																
<i>Placida dendritica</i>									x									
<i>Polycerella emertoni</i>												x	x					
<i>Urosalpinx cinerea</i>										x	x		x					
Nemertea (ribbon worms)																		
<i>Cyanophthalma cordiceps</i>		x																
<i>Lineus arenicola</i>							x											
<i>Lineus ruber</i>							x					x				x		
<i>Ramphogordius sanguineus</i>	x																	
<i>Tenuilineus bicolor</i>			x															
<i>Zygonemertes virescens</i>											x							

Native Species *continued*

SPECIES	BFM	PHM	WHM	UNH	HSP	HCM	ROW	GHM	SWM	WHC	MBL	MMA	POP	TRM	PEW	ALM	FAD	PTJ
Platyhelminthes (flatworms)																		
<i>Euplana gracilis</i>															x	x		
<i>Notoplana atomata</i>				x	x													
<i>Pleioplana atomata</i>		x	x															
<i>Stylochus ellipticus</i>															x	x	x	
Porifera (sponges)																		
<i>Clathria prolifera</i>							x					x	x					x
<i>Ciona</i> sp.							x				x	x	x					
<i>Leucosolenia</i> sp.	x	x			x	x		x	x	x	x		x				x	x
<i>Sycon ciliatum</i>									x	x		x	x					x

¹The identifications of *Microspongiium gelatinosum* and *Aglaothamnion balliae* are tentative.

²It is unclear at this time which species was found during the Rapid Assessment Survey as they are morphologically similar and may require genetic analysis for identification.