Report on the 2018 Rapid Assessment Survey of Introduced, Cryptogenic, and Native Marine Species at New England Marinas: Massachusetts to Maine

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Credits

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Photo below courtesy of the U.S. Environmental Protection Agency Region 1 dive team.

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Introduction

Given New England's long maritime history, there are many well documented cases of marine introductions associated with international shipping. The European green crab *Carcinus maenas* was likely brought over in wooden ships (within rock ballast or on the hull) in the early 19th century (Carlton and Cohen 2003). The introduction in the 1950s of the green alga *Codium fragile* subsp. *fragile* is thought to be associated with shipping from Europe (Carlton and Scanlon 1985). The more recent introduction of the colonial tunicate *Didemnum vexillum* in the 1980s is likely due to shipping and subsequent local spread by recreational boats and movement of aquaculture gear (Dijkstra et al. 2007, Lambert 2009). As just one example of the impacts of introduced species, the spread of *C. f.* subsp. *fragile* in north Atlantic coastal waters has led to a decrease in diversity of native seaweeds (Scheibling et al. 2006, Dijkstra et al. 2017).

In the marine environment, the major vectors of species introductions include: international shipping (from ballast discharges or hitchhikers on ship hulls), followed by aquaculture, recreational boating, and the aquarium trade (Pappal 2010, Ojaveer et al. 2018). Marinas, with large areas of submerged artificial substrates, are hot spots for introduced species. The fouling community associated with artificial substrates in marinas is composed of attached organisms, such as marine algae and sessile (attached to one spot) marine invertebrates, as well as motile animals, such as crabs, shrimp, and fish that live and feed in this environment. These species are adapted to living on artificial hard surfaces and are therefore also well suited

Species Invasion Status: Terms and Clarification

The definitions of the terms "introduced" and "invasive" can vary depending on who is using them and in what context. For example, the biological definition of an invasive species may simply characterize the persistence and spread of a non-native species, while a policy definition may incorporate a measure of harm to native species or to people (Ruiz and Carlton 2003, ISAC 2006). The U.S. Department of the Interior Invasive Species Advisory Committee defines the term invasive species as "a non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human, animal, or plant health" (ISAC 2006). This definition distinguishes a species that is invasive from an introduced non-native species (other terms for "non-native" include alien, non-endemic, exotic, or non-indigenous) that is not yet thought to cause harm based on what is known about the species, acknowledging both that "harm" itself is not defined and that for many introduced species there are no qualitative, quantitative, or experimental impact data. The harm or impact of an introduced species is not always known, and a more conservative definition would conclude that all introduced species are likely to cause harm at some scale (Carlton 2002). Given this uncertainty, for the purposes of this report, all species identified by the survey as non-native will be referred to as "introduced." Species will be assigned the category "cryptogenic" if their status is unknown (i.e., "a species that is not demonstrably native or introduced" [Carlton 1996]).

to being transported by recreational and commercial vessels, either as hitchhikers attached to the hulls of ships or free-floating in the ballast water used to stabilize ships in trans-oceanic journeys (Pappal 2010).

As the world's population and economy continues to grow, along with the quantity of goods traversing the ocean, there is an increased likelihood of new species introductions. Warmer ocean temperatures due to climate change will likely result in an increase of successful introductions of species that previously could not survive in New England, in addition to range shifts of both native and introduced species (Stachowicz et al. 2002, Bellard et al. 2013, Colarusso et al. 2016, Ojaveer et al. 2018, Dijkstra et al. 2019). Management options in the marine environment are extremely limited, particularly once a species has spread beyond its initial point of introduction (Williams and Grosholz 2008, Giakoumi et al. 2019). Therefore, accurate information regarding new introductions, establishment, and distribution of marine species is critical for managers to take action and inform the public and concerned stakeholders.

A rapid assessment survey (RAS) is one successful method of detection and monitoring of native and invasive marine species (Pederson et al. 2005, Ojaveer et al. 2018). During such a survey, taxonomic experts sample sites throughout a region in a highly intensive effort to document all species encountered, including native, introduced, and cryptogenic species. The 2018 RAS, which focused on docks and marinas, was the sixth survey of its kind conducted in the New England region since the first survey in 2000. See Pederson et al. 2005 for the 2003 RAS survey, CZM 2013 for the 2010 RAS survey, and Wells et al. 2014 for the 2013 RAS survey (there were no publications for the 2000 and 2007 surveys). Goals of the survey were to: (1) identify native, introduced, and cryptogenic marine species, (2) expand on data collected in past surveys, (3) assess the introduction status and range expansions of documented introduced species, and (4) detect new introductions. This report presents the introduced, cryptogenic, and native species recorded during the 2018 survey and discusses general trends in surveys over time. The 2018 survey focused on the area from Buzzards Bay, Massachusetts, to Casco Bay, Maine. A separate RAS from Rhode Island to New York was conducted in August 2019 and will be reported elsewhere (Pederson et al. in prep).

The fouling community is made up of attached and free-swimming species, such as colonial tunicates, bryozoans, marine algae, and crustaceans including crabs, shrimp, and amphipods.

Methods

Eight sites in coastal Massachusetts, New Hampshire, and Maine were sampled during the 2018 RAS from July 23-25, 2018 (Table 1; Figure 1). Factors considered when selecting sites to monitor included: site inclusion in past surveys, permission for access, adequate access for the scientific team, consideration of travel logistics, and even distribution across the regions included in the survey. The sites were distributed from south to north as follows: two sites in the Buzzards Bay region in southern Massachusetts (Pope's Island Marina, Massachusetts Maritime Academy), three sites in the Massachusetts Bays region in northern Massachusetts (Sandwich Marina, Rowes Wharf, Hawthorne Cove Marina), one site in the Piscataqua region, New Hampshire (University of New Hampshire Marine Laboratory), and two sites in the Casco Bay Region, Maine (Port Harbor Marine, Brewer South Freeport Marine). 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 1.

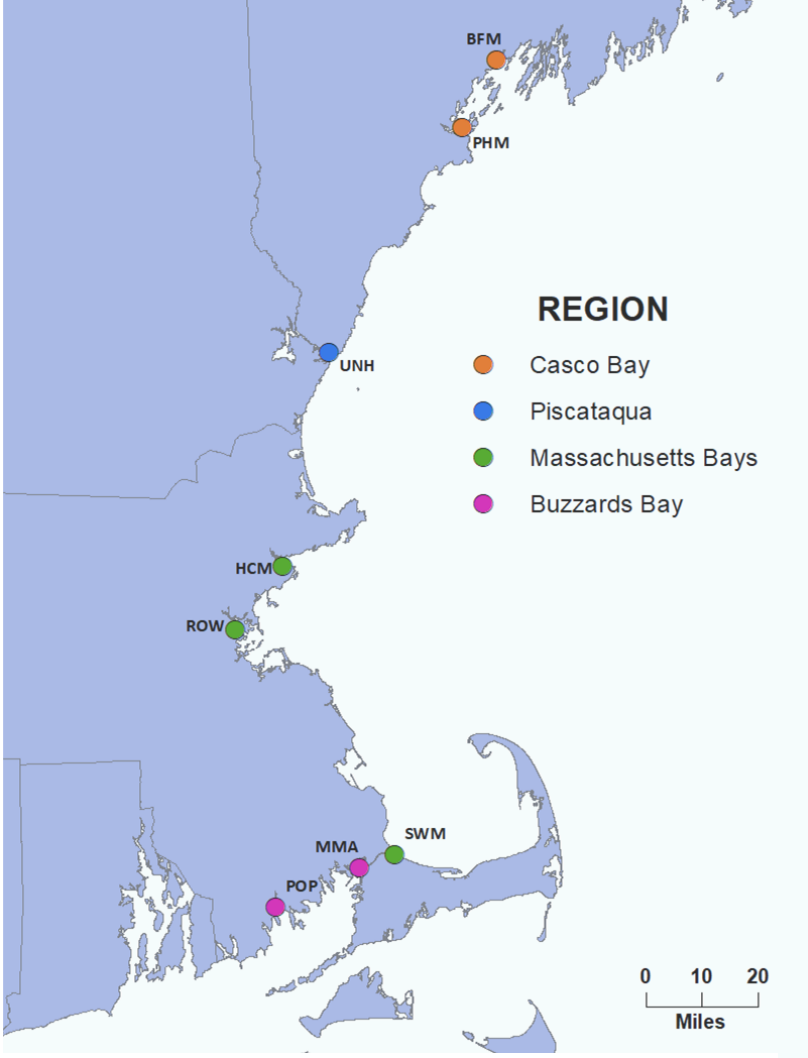


Figure 1: 2018 Rapid Assessment Survey sites within National Estuary Program regions.

Table 1: 2018 Rapid Assessment Survey sites from south to north.

Abbreviation	Site Name	Location
POP	Pope's Island Marina	New Bedford, MA
MMA	Massachusetts Maritime Academy	Buzzards Bay, MA
SWM	Sandwich Marina	Sandwich, MA
ROW	Rowes Wharf	Boston, MA
HCM	Hawthorne Cove Marina	Salem, MA
UNH	UNH Coastal Marine Laboratory	Newcastle, NH
PHM	Port Harbor Marine	South Portland, ME
BFM	Brewer South Freeport Marine	South Freeport, ME

Scientists collect samples for identification at Rowes Wharf Marina in Boston, MA.

The participants in the RAS included taxonomic experts familiar with native and introduced marine organisms, graduate students, a dive team, and a support team to manage logistics. See Appendix 2 for details on the RAS survey team, including taxonomic expertise and affiliations.

Marine invertebrates and algae within the fouling community were sampled by the team on permanently installed floating docks and on associated subtidal structures such as the submerged pilings supporting the docks, ropes, wires, buoys, tires, and boat fenders. While fish were not the target of the survey, identifications of fish found associated with the fouling community were included in keeping with past reports for informational purposes. Pelagic organisms such as jellyfish and unattached marine algae were not included in the report.

At each location, sampling time was limited to one hour, consistent with past surveys. Scientists sampled the vertical sides of the floats by hand, with paint scrapers or dip nets to capture motile animals such as shrimp and amphipods, with a goal to obtain as representative a sample of the fouling community as possible within the time constraint. The undersides of the floats and associated structures including nearby pilings were sampled by the dive team at all sites except for Pope's Island Marina, Hawthorne Cove Marina, and Brewer South Freeport Marine due to logistical constraints. Preliminary identifications were made on site for easily identifiable and common taxa when possible, with most of the biological material collected and stored in coolers with ice for further identification.

Water quality data were collected at each site including temperature, salinity, and dissolved oxygen with an underwater Sonde (YSI Model 85). Parameters were measured every meter starting at the surface with a final reading just above the bottom. Water clarity and bottom depth were measured with a secchi disk. See Appendix 3 for water quality data.

Species that were not positively identified in the field were brought back to the Harris Laboratory at the University of New Hampshire (UNH) in Durham, New Hampshire, for identification and verification. A collection of specimens

U.S. Environmental Protection Agency (EPA) diver collects samples underneath the docks at Massachusetts Maritime Academy in Buzzards Bay, MA. (*Photo: EPA dive team*)

The water quality team collects secchi depth at Massachusetts Maritime Academy, Buzzards Bay, MA.

representing the community sampled at each site was preserved in alcohol and archived at the Museum of Comparative Zoology at Harvard University. Bryozoan specimens were collected and archived at the North Carolina Museum of Natural History. Algae specimens were pressed and archived at the UNH herbarium, as well as online at www.macroalgae.org.

All data from the scientific team were combined for this report and checked against original individual observations. Duplicate observations and unverified identifications were deleted from the final dataset as part of quality control review. Identifications were considered verified if they were identified by a taxonomic expert for that particular biological group, if they were a commonly observed species that a general taxonomist could identify, or if they were identified by multiple general taxonomists. Organisms were excluded from the report if they could not be identified at least to the genus level. All animal scientific names were verified and updated if needed to currently accepted names using the World Register of Marine Species (WoRMS) catalog (www.marinespecies.org) and the Integrated Taxonomic Information System (ITIS) database (www.itis.gov). Algae species names were verified and updated if needed using the AlgaeBase database (www.algaebase.org).

The status of species as native, introduced, or cryptogenic can change based on new evidence from biogeographic surveys, taxonomic work, or genetic sequencing. Invasion status for the species listed in this report was determined by the taxonomic experts on the team based on review of literature and best professional judgment from multiple lines of evidence. The number of introduced marine species in New England (and in these surveys) is likely underestimated given that there are an unknown number of species otherwise identified as native that may have been introduced and established well before they were documented in the natural history literature starting in the 19th century.

Scientists identifying specimens collected during the RAS at the Larry Harris Lab, University of New Hampshire, Durham, NH.

Results and Discussion

This section covers the following topic areas: 2018 observations, comparison of the 2018 survey with previous surveys, and strengths and limitations of the RAS.

Observations from the 2018 Survey

During the 2018 RAS, a total of 170 taxa were identified to the species level, of which 123 were native, 20 were cryptogenic, and 27 were introduced (Figure 2). Eighteen additional taxa were conservatively assigned unknown status as they were identified to the genus level only. No new introduced species were observed during the 2018 Rapid Assessment Survey.

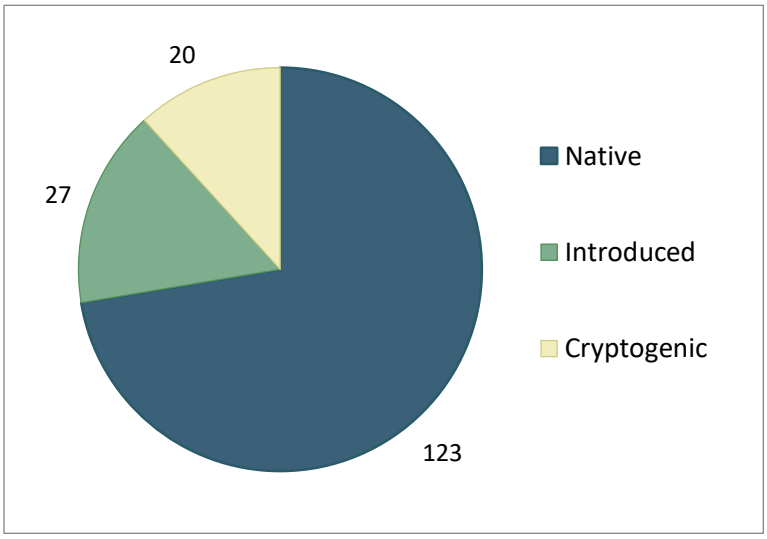


Figure 2: Number of native, cryptogenic, and introduced species found during the 2018 Rapid Assessment Survey.

Massachusetts Maritime Academy in Buzzards Bay, Massachusetts, had the highest number of introduced species (18; Table 2). The UNH Coastal Laboratory in Newcastle, New Hampshire, had the highest number of native species (52; Table 2). The Massachusetts Bays Region (MassBays; northern Massachusetts) had the lowest average number of native species (39; Table 2) and the Casco Bay Region (southern Maine) had the lowest number of introduced species (12; Table 2). The most frequently observed introduced invertebrate species in 2018 were *Botrylloides violaceus*, *Botryllus schlosseri* (in part, see Table 3 footnote), *Caprella mutica,* and *Styela clava* (observed at all eight sites), followed by *Ascidiella aspersa*, *Ciona intestinalis*, *Didemnum vexillum,* and *Tricellaria inopinata* (observed at seven out of eight sites). The most frequently observed introduced marine algae were *Dasysiphonia japonica* (observed at five out of eight sites) and *Grateloupia turuturu* (observed at four out of eight sites). For a complete list of the 27 introduced species found by state in the 2018 RAS see Table 3. For a complete list of all taxa identified by site see Appendix 4.

Table 2: Number of native, introduced, and cryptogenic species found at each site and averaged by region. The sites are listed from south to north and are abbreviated as follows: Pope's Island Marina (POP), Massachusetts Maritime Academy (MMA), Sandwich Marina (SWM), Rowes Wharf (ROW), Hawthorne Cove Marina (HCM), UNH Coastal Marine Laboratory (UNH), Port Harbor Marine (PHM), and Brewer South Freeport Marine (BFM).

Site, Location	Native	Introduced	Cryptogenic	Total
POP, New Bedford, MA	38	13	4	55
MMA, Buzzards Bay, MA	43	18	10	71
Buzzards Bay Region	41	16	7	64
SWM, Sandwich, MA	34	16	8	58
ROW, Boston, MA	42	13	11	66
HCM, Salem, MA	40	14	10	64
MassBays Region	39	14	10	63
UNH, Newcastle, NH	52	15	10	77
Piscataqua Region	52	15	10	77
PHM, South Portland, ME	47	13	9	69
BFM, South Freeport, ME	45	11	12	68
Casco Bay Region	46	12	11	69

Table 3: List by state of introduced species identified during the 2018 Rapid Assessment Survey. Massachusetts is split between sites south and north of Cape Cod. Species are grouped by phylum.

Species (Common Name)	MA (S)	MA (N)	NH	ME
Chlorophyta (green algae)				
Codium fragile subsp. *fragile* (Green Fleece)	x		x	
Phaeophyceae (brown algae)				
Colpomenia peregrina (Sea Potato)	x			
Rhodophyta (red algae)				
Dasysiphonia japonica (Siphoned Feather Weed)	x	x	x	x
Grateloupia turuturu (Devil's Tongue Weed)	x	x		
Lomentaria clavellosa (Club Bead-Weed)			x	
Lomentaria orcadensis (Orkney Weed)			x	
Pyropia yezoensis (Open Sea Nori)		x		
Arthropoda (shrimps, crabs, and relatives)				
Caprella mutica (Japanese Skeleton Shrimp)	x	x	x	x
Carcinus maenas (European Green Crab)	x	x	x	
Chthamalus fragilis (Little Gray Barnacle)[1]	x			
Hemigrapsus sanguineus (Asian Shore Crab)	x	x		
Ianiropsis serricaudis (Isopod)	x			
Palaemon macrodactylus (Asian Shrimp)	x			
Praunus flexuosus (Bent Opossum Shrimp)		x		x
Bryozoa (colonial bryozoan animals)				
Bugula neritina (Purple Bushy Bryozoan)	x	x		

Bugulina simplex (Fan Bugula)	x	x		
Membranipora membranacea (Lacy Crust Bryozoan)		x	x	x
Tricellaria inopinata (Unexpected Bryozoan)	x	x	x	x
Chordata (tunicates)				
Ascidiella aspersa (European Sea Squirt)	x	x	x	x
Botrylloides violaceus (Sheath Tunicate)	x	x	x	x
Botryllus schlosseri (Golden Star Tunicate)[2]	x	x	x	x
Ciona intestinalis (Sea Vase)[3]	x	x	x	x
Didemnum vexillum ("Mystery" Colonial Tunicate)	x	x	x	x
Styela canopus (Rough Tunicate)	x	x		
Styela clava (Club Tunicate)	x	x	x	x
Cnidaria (anemones, hydroids, and relatives)				
Diadumene lineata (Orange-Striped Anemone)	x	x		x
Mollusca (snails, bivalves, and relatives)				
Ostrea edulis (European Oyster)		x	x	x

[1]*Chthamalus fragilis* is a native barnacle originally restricted to Chesapeake Bay and south until it appeared in southern New England in the 1890s (Carlton et al. 2011).

[2]*Botryllus schlosseri* is now held to be largely native, with some metapopulations derived from Europe, which can only be distinguished genetically (Yund et al. 2015).

[3]*Ciona intestinalis,* previously categorized as cryptogenic, is now considered to be introduced in New England (Hudson et al. 2019).

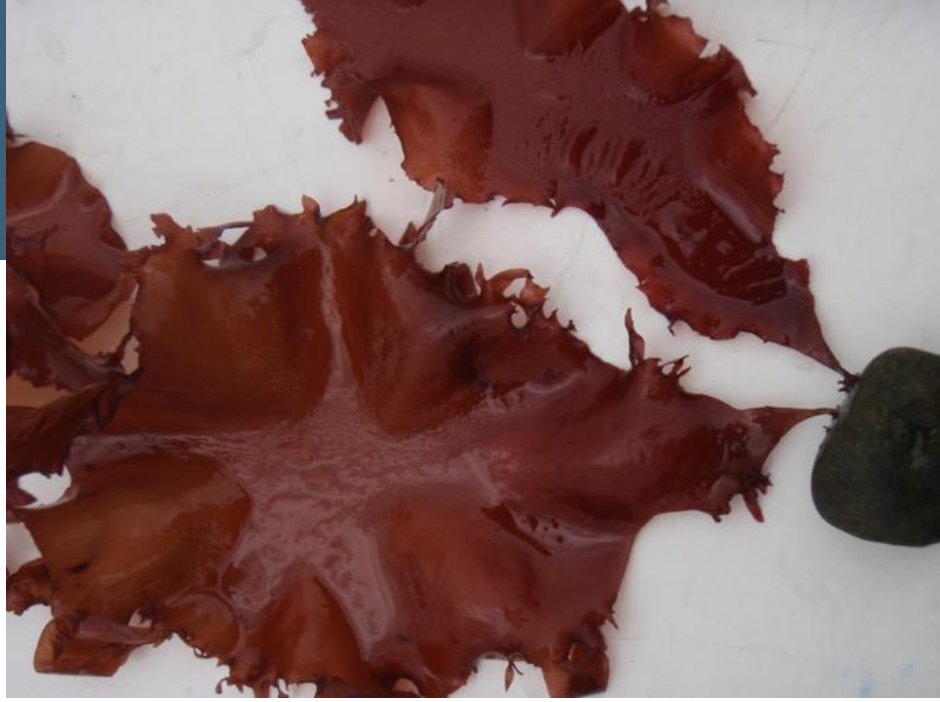
Comparison with Previous Surveys

The total number of introduced species observed has been relatively steady over time since the original survey in 2000: 31 species on average, ranging from a minimum of 25 species observed in the 2007 RAS to a maximum of 39 species observed in the 2013 RAS (Table 4). The sea anemone *Sagartia elegans*, which was found only in Hawthorne Cove Marina in 2000 to 2010, has not been observed in the 2013 and 2018 Rapid Assessment Surveys and other survey efforts and likely failed to sustain a population after environmental conditions at the location had changed (Wells and Harris 2019). In 2013, several summer transient species not commonly found in New England, such as the Florida grass shrimp *Palaemon floridanus* detected at that time in Woods Hole, were observed. In 2018, no summer transients were observed.

Table 4: Number of introduced species found during the past six New England Rapid Assessment Surveys.

Year	Sites Sampled	Geographic Range of Survey	Introduced Species
2000	34	Narragansett Bay (RI) to Gloucester (MA)	34
2003	20	Staten Island (NY) to Portland (ME)	31
2007	17	Buzzards Bay (MA) to Rockland (ME)	25
2010	20	Narragansett Bay (RI) to Cape Elizabeth (ME)	32
2013	18	Narragansett Bay (RI) to South Freeport (ME)	39
2018	8	New Bedford (MA) to South Freeport (ME)	27

***Grateloupia turuturu* has expanded northward in range over time since its introduction to New England waters.**



In general, trends for introduced algae were similar to past surveys, but some range expansions were documented in the 2018 RAS. *Dasysiphonia japonica* was observed for the first time at both Port Harbor Marine (Portland, ME) and Brewer South Freeport Marine (South Freeport, ME), continuing its northward expansion (Mathieson et al. 2016). *Colpomenia peregrina* continues to be an uncommon species in the RAS, but was observed for the first time at Massachusetts Maritime Academy (Buzzards Bay, MA), the southernmost site where it has been observed by the Rapid Assessment Surveys. The southward range expansion of *C. peregrina* has been documented by other studies, and it is now found to occur as far south as Rhode Island (Green-Gavrielidis et al. 2019). *Grateloupia turuturu*, first observed in Massachusetts at Rowes Wharf, Boston, by the 2007 RAS continued to be observed at Rowes Wharf in the 2010 and 2013 surveys (Mathieson et al. 2008a, CZM 2013, Wells et al. 2014, Mathieson et al. 2016). In the 2018 survey, *G. turuturu* was observed for the first time at Hawthorne Cove Marina (Salem, MA). While this was the first observation of *G. turuturu* north of Boston during a RAS, it has been recorded north of Boston by other monitoring efforts before 2018 and can now be found as far north as the Damariscotta River estuary (Capistrant-Fossa and Brawley 2019).

While it is difficult to compare across surveys given the variations in geographic range and number of sites covered, general trends over time can be discerned for each of the eight sites sampled in 2018 (Table 5; Figure 3). The number of introduced species observed per site has generally increased over time, however for many sites, the highest numbers of introduced species were observed in 2013 (Figure 3). The 2013 RAS also had the highest number of new introduced species (9) observed at the eight sites sampled in 2018.

Footer photos on pages 9 and 10 courtesy of the U.S. Environmental Protection Agency Region 1 dive team.

Table 5: Past survey information for each site sampled in 2018. An x indicates that the site was sampled. The sites are listed from south to north and are abbreviated as follows: Pope's Island Marina (POP), Massachusetts Maritime Academy (MMA), Sandwich Marina (SWM), Rowes Wharf (ROW), Hawthorne Cove Marina (HCM), UNH Coastal Marine Laboratory (UNH), Port Harbor Marine (PHM), and Brewer South Freeport Marine (BFM).

	POP	MMA	SWM	ROW	HCM	UNH	PHM	BFM
2000		x	x	x	x			
2003		x		x	x	x	x	x
2007		x	x	x	x		x	x
2010	x	x	x	x	x	x	x	x
2013	x	x	x	x	x	x	x	x
2018	x	x	x	x	x	x	x	x

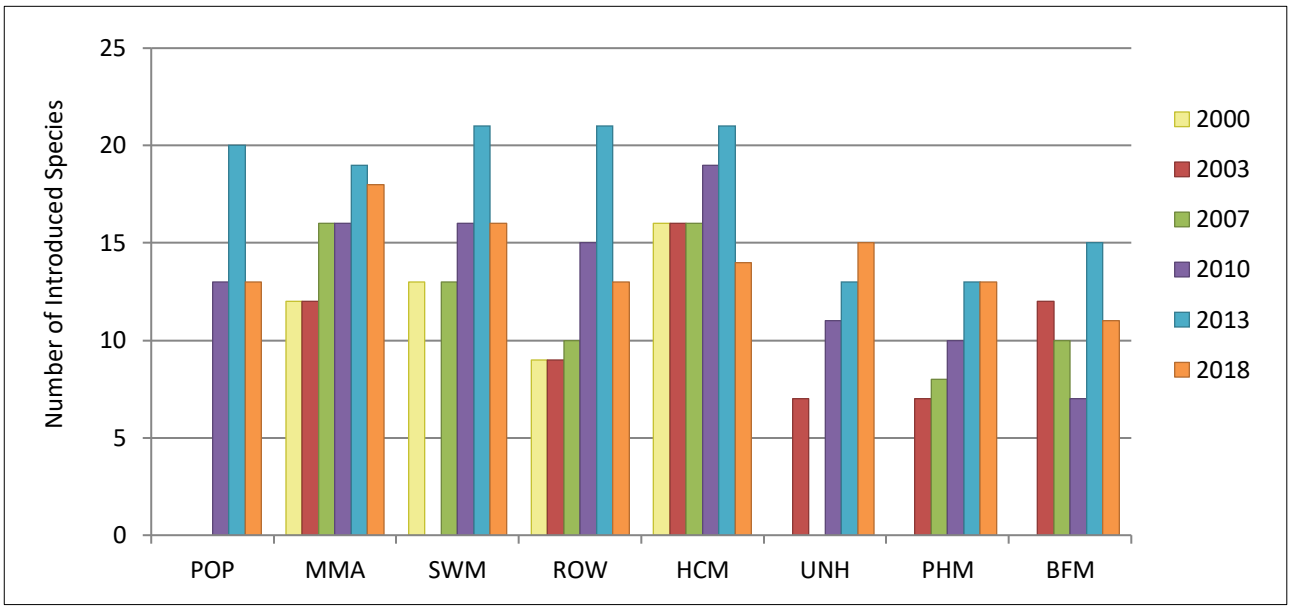


Figure 3: Number of introduced species observed over time at the eight sites sampled in 2018. Sites are listed from south to north and abbreviated as follows: Pope's Island Marina (POP), Massachusetts Maritime Academy (MMA), Sandwich Marina (SWM), Rowes Wharf. (ROW), Hawthorne Cove Marina (HCM), UNH Coastal Marine Laboratory (UNH), Port Harbor Marine (PHM), and Brewer South Freeport Marine (BFM). POP was not sampled prior to 2010. SWM was not sampled in 2003. UNH was not sampled in 2000 and 2007. PHM and BHM were not sampled in 2000.

Overall, the following introduced species were the most frequently observed across surveys: *B. violaceus, B. schlosseri, Carcinus maenas, C. mutica, S. clava, A. aspersa, Membranipora membranacea, D. vexillum, Diadumene lineata*, and *Hemigrapsus sanguineus*. *Didemnum vexillum* has been more frequently observed over time from zero sites in 2000 to seven out of eight sites in 2018. Similarly, *T. inopinata*, first documented in the 2013 RAS, was found at four out of eight sites in 2013 and most recently found at seven out of eight sites in 2018. *Diplosoma listerianum* has fluctuated in observations over time. It was not documented at any sites in 2018, while in 2013 it was documented at all eight sites.

Some species have shown potentially declining trends over time: *Palaemon elegans* was found at three out of eight sites in 2013 and was not observed in 2018 (other shrimp species observed in 2018 were limited to Pope's Island Marina). *Membranipora membranacea* was observed at more than 75% of the sites from 2000 to 2010, but at only four out of eight sites in 2018.

Strengths and Limitations of Rapid Assessment Surveys

A strength of rapid assessment surveys is the capacity to assemble a consistent team of taxonomic experts that provide accurate species identifications. However, it is important to keep in mind the limitations of these types of surveys. Given the logistics and funding constraints of assembling a team of taxonomic experts and the time needed to identify species sampled, the data collected represent a small snapshot in time and space. For example, the 2018 RAS was the first survey of the northern New England region in five years, and the week-long effort resulted in eight hours of field time sampling species at eight marinas.

Each survey has varied in geographic ranges and numbers of sites visited depending on funding levels, regional priorities of funders or experts involved, time conflicts of scientists and organizers, and availability and location of laboratory facilities. The 2003 RAS sampled 20 sites from New York City Harbor, New York, to Casco Bay, Maine, while the most recent 2018 RAS sampled eight sites from southern Massachusetts to Casco Bay, Maine. While the core taxonomic team has remained the same, there are some taxonomic groups that may have been underrepresented in a given year depending on the composition of the team and how many field assistants were helping each expert. For example, sponges have generally been underrepresented as the team has not had an expert specifically focused on sponge collection (although many members of the team have some knowledge of sponge identification).

All surveys were conducted in the late summer, which is the peak growth season for many species, but undercounts species that peak in abundance in the spring or fall.

Didemnum vexillum **(picture from Rowes Wharf) continues to be more frequently observed over time and was observed at 7 out of 8 sites during the 2018 RAS.**

Similarly, there is year to year variability in weather patterns and water temperature preceding the surveys, leading to different species assemblages depending on conditions prior to the survey (e.g., an unseasonably cold spring).

In general, due to the variations in taxonomic expertise, geographic range, and number of sites sampled, total species observed have varied widely—from 349 taxa identified in 2003 to 170 in 2018. Lastly, these surveys are focused on floating docks (and rocky intertidal for 2010 only) and are not representative of all the types of coastal habitats (and the species found within each habitat type) in New England.

Conclusion

Introduced species are one of the major threats to marine biodiversity, along with overfishing, habitat loss, pollution, and warming due to climate change (Costello et al. 2010). As new introductions in the marine environment continue, there remains a strong need to understand what species are being introduced, whether they establish and spread, and what impacts they have on native ecosystems, public health, and livelihoods. Rapid assessment surveys have added significantly to our understanding of marine species (native and introduced) in New England and beyond.

While no new introduced species were documented in the 2018 RAS, several established introduced species were observed more frequently and in a wider geographic range than past surveys. For example, the colonial attached invertebrates *Didemnum vexillum* and *Tricellaria inopinata* were observed more frequently, and the ranges for the algae *Colpomenia peregrina* and *Grateloupia turuturu* expanded. The total number of introduced species observed during each survey has remained relatively stable (less than a quarter of all species observed for each survey); however, when looking at trends over time at individual sites, the number of introduced species has generally increased since the first observations at a site. Despite this increase, it is important to note that the majority of species documented in the 2018 RAS, as well as in past surveys, were native species.

These surveys are the only ones of their kind in New England and have led to the documentation of several new introduced species and range expansions of established introduced species. Since these surveys also document native and cryptogenic species, they provide a record of fouling community species assemblages over time. As marine environmental conditions change due to climate change and other anthropogenic impacts, these surveys are an increasingly important record to document ecological response. In August 2019, a complementary rapid assessment survey was conducted in southern New England (New York City Harbor, NY, through Narragansett Bay, RI), and sites in New York and Connecticut were surveyed for the first time since the 2003 RAS (Pederson et al. in prep). These results and those from future surveys will continue to inform managers and the public on changes in species distributions and new introductions in coastal waters.

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Appendix 1: Site Descriptions

Descriptions of the eight sites sampled during the 2018 Rapid Assessment Survey are listed below from south to north. Descriptions include summaries of species identified and any site-specific observations of note.

Pope's Island Marina (POP)

New Bedford, Massachusetts

July 23, 2018, 8:05 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. The fouling community was dominated by solitary and colonial tunicates and bushy bryozoans. This location was the only site where shrimp species were observed (one adult *Palaemon macrodactylus* and abundant small palaemonid shrimp). POP was not sampled by the dive team.

Scientists check the undersides of buoys at Pope's Island Marina, New Bedford, MA.

Massachusetts Maritime Academy (MMA)

Buzzards Bay, Massachusetts

July 23, 2018, 10:07 AM

The Massachusetts Maritime Academy is located at the southern end of the Cape Cod Canal and features one permanent floating dock of approximately 70 meters. Several large vessels are docked nearby, including the 160-meter-long TS Kennedy. The floating docks are located on the Buzzards Bay end of the Cape Cod Canal. The fouling community was dominated by solitary and colonial tunicates, and red and green algae.

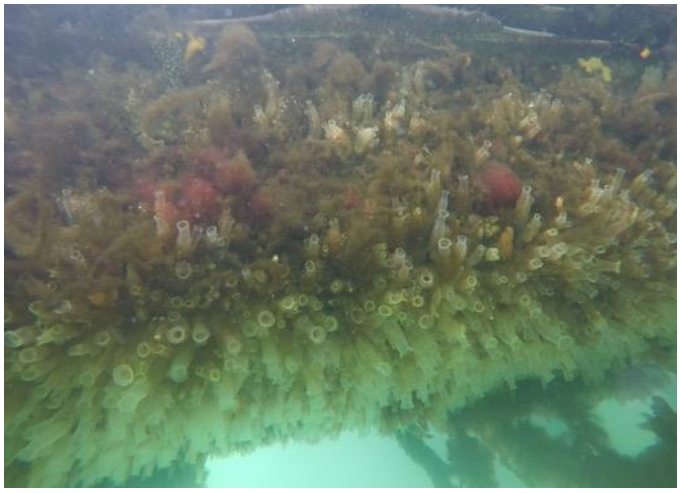
The RAS Team sampling at Massachusetts Maritime Academy.

Sandwich Marina (SWM)

Sandwich, Massachusetts

July 23, 2018, 12:50 PM

Sandwich Marina is an important site for monitoring the northerly progression of introduced species via the Cape Cod Canal. The marina, operated by the Town of Sandwich, features 164 slips for recreation ships and 42 commercial slips. The fouling community was dominated by solitary and colonial tunicates. An old lobster trap found off the docks with wood trim contained the cryptogenic wood-boring isopod *Limnoria lignorum*, as well as unidentified shipworms



The solitary tunicate *Ciona intestinalis* was abundant underneath docks at Sandwich Marina. (*Photo: EPA dive team*)

The Marina at Rowes Wharf (ROW)

Boston, Massachusetts

July 24, 2018, 9:55 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. The fouling community was dominated by a mixture of *Mytilus edulis/trossulus* blue mussels and colonial and solitary tunicates.

The RAS team in action at Rowes Wharf, Boston, MA.

Hawthorne Cove Marina (HCM)

Salem, Massachusetts

July 24, 2018, 12:55 PM

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. The fouling community was dominated by a mixture of *Mytilus edulis/trossulus* blue mussels, *Obelia* hydroids, tunicates, and the sugar kelp *Saccharina latissima*. HCM was not sampled by the dive team.

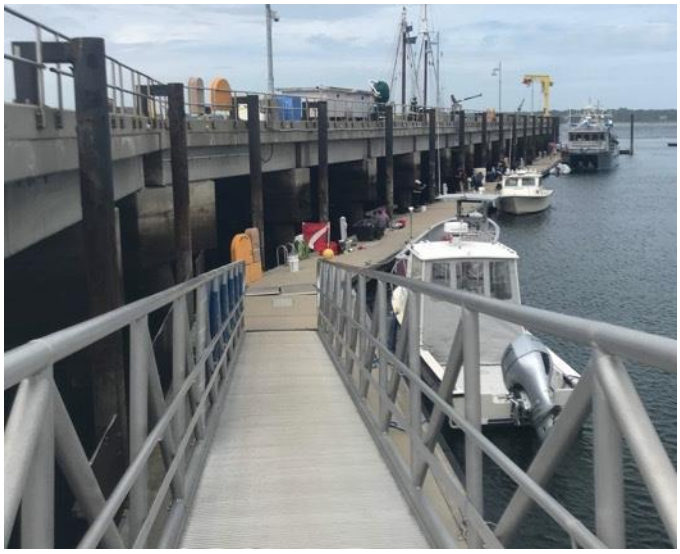
Hawthorne Cove Marina, Salem, MA.

University of New Hampshire Coastal Marine Lab (UNH)

New Castle, New Hampshire

July 25, 2018, 3:25 PM

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, with floating docks, that provides berthing space for the UNH fleet of research vessels. The floating dock was dominated by the blue mussels *Mytilus edulis/trossulus*, solitary and colonial tunicates, frilled sea anemone *Metridium senile*, and the sugar kelp *Saccharina latissima*.



University of New Hampshire Coastal Marine Lab, New Castle, NH.

Port Harbor Marine (PHM)

Portland, Maine

July 25, 2018, 12:45 PM

Port Harbor Marine, also called Spring Point Marina, is the largest full-service marina in Maine with 250 boat slips. PHM 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. The community was dominated by a mixture of heavily fouled blades of the sugar kelp *Saccharina latissima*, solitary and colonial tunicates, and the frilled anemone *Metridium senile*.

The anemone *Metridium senile* (pictured under the microscope) was a common native member of the fouling community at Port Harbor Marine, Portland, ME.

Brewer South Freeport Marine (BFM)

South Freeport, Maine

July 25, 2018, 9:55 AM

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 lobsterman. The marina provides over 100 slips and 15 moorings. The dominant species were solitary and colonial tunicates, the frilled sea anemone *Metridium senile*, and blue mussels *Mytilus edulis/trossulus*. BFM was not sampled by the dive team.

Brewer South Freeport Marine, South Freeport, ME.

Appendix 2: Participants

Name	Specialty/Role	Affiliation
Carolina Bastidas	General taxonomy	Massachusetts Institute of Technology Sea Grant
Jean Brochi	Diver	U.S. Environmental Protection Agency
James Carlton	General taxonomy	Williams College-Mystic Seaport
Phil Colarusso	Diver	U.S. Environmental Protection Agency
Andrew David	Polychaete worm taxonomy	Clarkson University
Jennifer Dijkstra	Ascidian taxonomy	University of New Hampshire
Sean Duffey	Lab and field assistance, water quality	Massachusetts Office of Coastal Zone Management
Brent England	Diver	U.S. Environmental Protection Agency
Jennifer Gibson	Lab and field assistance, water quality	University of New Hampshire
Sara Grady	General taxonomy, dock master	Massachusetts Bays National Estuary Partnership, North South Rivers Watershed Association
Lindsay Green-Gavrielidis	Algal taxonomy	University of Rhode Island (former), Salve Regina University (current)
Larry Harris	General taxonomy	University of New Hampshire
Niels-Viggo Hobbs	Crustacean taxonomy	University of Rhode Island
Cristina Kennedy	Co-organizer and logistics	Massachusetts Office of Coastal Zone Management
Alec Mauk	Algal taxonomy	University of Rhode Island
Megan McCuller	Bryozoan taxonomy	North Carolina Museum of Natural History
Chris Neefus	Algal taxonomy	University of New Hampshire
Eric Nelson	Diver	U.S. Environmental Protection Agency
Brandon O'Brien	Algal taxonomy	University of New Hampshire
Kristin Osborne	Ascidian taxonomy, community voucher	Massachusetts Maritime Academy
Adrienne Pappal	Co-organizer and logistics	Massachusetts Office of Coastal Zone Management
Judy Pederson	General taxonomy	Massachusetts Institute of Technology Sea Grant
Chuck Protzmann	Diver	U.S. Environmental Protection Agency
Jaclyn Robidoux	Algal taxonomy	University of New Hampshire
Matt Tyler	Algal taxonomy	University of New Hampshire
Kaitlin Van Volkom	General taxonomy, community voucher	University of New Hampshire

Appendix 3: Water Quality Data

Location (Abbreviation)	Date	Time	Time of Next Low Tide (Station)	Secchi Depth (m)	Bottom Depth (m)	Surface Temp (°C)	Bottom Temp (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/L)	Bottom Oxygen (mg/L)
Pope's Island Marina (POP)	7/23/2018	8:11am	1:20pm (Woods Hole, MA)	2.3	3.0	24.4	24.3	31.4	31.2	NR	NR
Massachusetts Maritime Academy (MMA)	7/23/2018	10:10am	1:20pm (Woods Hole, MA)	2.5	4.6	22.7	22.4	31.1	30.5	6.80	4.40
Sandwich Marina (SWM)	7/23/2018	12:50pm	1:20pm (Woods Hole, MA)	4.2	4.2	16.3	11.9	30.9	30.8	8.00	0.35
The Marina at Rowes Wharf (ROW)	7/24/2018	9:30am	3:41pm (Boston, MA)	2.7	5.6	22.7	19.0	26.8	29.8	6.90	4.00
Safe Harbor Hawthorne Cove (HCM)	7/24/2018	1:00pm	3:41pm (Boston, MA)	2.1	2.8	24.0	21.9	30.1	30.5	7.90	5.50
Brewer South Freeport Marine (BFM)	7/25/2018	10:05am	4:29pm (Portland, ME)	1.3	4.5	20.1	19.4	29.1	30.5	6.10	4.00
Port Harbor Marine (PHM)	7/25/2018	12:55pm	4:29pm (Portland, ME)	3.0	4.1	19.0	16.3	29.8	30.5	7.00	6.20
UNH Coastal Marine Laboratory (UNH)	7/25/2018	3:40pm	4:30pm (Portsmouth, NH)	3.7	4.0	17.5	17.5	30.4	30.5	7.80	8.30

Appendix 4: All Species Observed (Native, Cryptogenic, and Introduced)

The following tables contain all species identified during the 2018 Rapid Assessment Survey, excluding species that could not be identified to genus or lower. The sites are listed from south to north and are abbreviated as follows: Pope's Island Marina (POP), Massachusetts Maritime Academy (MMA), Sandwich Marina (SWM), Rowes Wharf Marina (ROW), Hawthorne Cove Marina (HCM), UNH Coastal Marine Laboratory (UNH), Port Harbor Marine (PHM), and Brewer South Freeport Marine (BFM). Species are grouped by phylum or class. Scientific names and taxonomic authority (including formatting) are taken from www.algaebase.org for algae and www.marinespecies.org for animals.

Introduced Species Identified During the 2018 Rapid Assessment Survey by Sampling Site.

Scientific Name and Taxonomic Authority	POP	MMA	SWM	ROW	HCM	UNH	PHM	BFM
Chlorophyta (green algae)								
Codium fragile subsp. *fragile* (Suringar) Hariot 1889	x	x				x		
Phaeophyceae (brown algae)								
Colpomenia peregrina Sauvageau 1927		x						
Rhodophyta (red algae)								
Dasysiphonia japonica (Yendo) H.-S. Kim 2012		x	x			x	x	x
Grateloupia turuturu Yamada 1941	x	x		x	x			
Lomentaria clavellosa (Lightfoot ex Turner) Gaillon 1828						x		
Lomentaria orcadensis (Harvey) Collins in W.R. Taylor 1937						x		
Pyropia yezoensis (Ueda) M.S. Hwang and H.G. Choi 2011			x					
Arthropoda (shrimps, crabs, and relatives)								
Caprella mutica Schurin, 1935	x	x	x	x	x	x	x	x
Carcinus maenas (Linnaeus, 1758)	x	x		x	x	x		
Chthamalus fragilis Darwin, 1854[1]		x						
Hemigrapsus sanguineus (De Haan, 1835 [in De Haan, 1833-1850])	x	x	x		x			
Ianiropsis serricaudis Gurjanova, 1936		x						
Palaemon macrodactylus Rathbun, 1902	x							
Praunus flexuosus (Müller, 1776)					x		x	x

Scientific Name and Taxonomic Authority	POP	MMA	SWM	ROW	HCM	UNH	PHM	BFM
Bryozoa (colonial bryozoan animals)								
Bugula neritina (Linnaeus, 1758)	x	x	x					
Bugulina simplex (Hincks, 1886)	x		x					
Membranipora membranacea (Linnaeus, 1767)			x		x	x	x	
Tricellaria inopinata d'Hondt & Occhipinti Ambrogi, 1985		x	x	x	x	x	x	x
Chordata (tunicates and vertebrates)								
Ascidiella aspersa (Müller, 1776)		x	x	x	x	x	x	x
Botrylloides violaceus Oka, 1927	x	x	x	x	x	x	x	x
Botryllus schlosseri (Pallas, 1766)[2]	x	x	x	x	x	x	x	x
Ciona intestinalis (Linnaeus, 1767)[3]		x	x	x	x	x	x	x
Didemnum vexillum Kott, 2002	x	x	x	x	x	x	x	
Styela canopus (Savigny, 1816)		x	x	x				
Styela clava Herdman, 1881	x	x	x	x	x	x	x	x
Cnidaria (anemones, hydroids, and relatives)								
Diadumene lineata (Verrill, 1869)	x		x	x			x	x
Mollusca (snails, bivalves, and relatives)								
Ostrea edulis Linnaeus, 1758				x	x	x	x	x

[1]*Chthamalus fragilis* is a native barnacle originally with a range restricted to Chesapeake Bay and south until it appeared in southern New England in the 1890s (Carlton et al. 2011).

[2]*Botryllus schlosseri* is now held to be largely native, with some metapopulations derived from Europe, which can only be distinguished genetically (Yund et al. 2015).

[3]*Ciona intestinalis,* previously categorized as cryptogenic, is now considered to be introduced in New England (Hudson et al. 2019).

Cryptogenic and Unknown Status Species Identified During the 2018 Rapid Assessment Survey by Sampling Site.

Organisms marked with an asterisk (*) were not identified to the species level and biogeographic status could not be determined.

Scientific Name and Taxonomic Authority	POP	MMA	SWM	ROW	HCM	UNH	PHM	BFM
Chlorophyta (green algae)								
Cladophora sericea (Hudson) Kützing 1843		x	x	x	x		x	
Ulva lactuca/U. australis Linnaeus 1753/Areschoug 1854*[1]			x	x	x	x	x	x
Ulva spp. (tubular)*	x	x	x	x	x	x	x	x
Ochrophyta (diatoms and brown algae)								
Licmophora sp.*						x		
Rhodophyta (red algae)								
Gracilaria tikvahiae/Agarophyton vermiculophyllum McLachlan 1979/(Ohmi) Gurgel, J.N. Norris & Fredericq 2018*[2]	x							
Pyropia spp.*					x		x	
Annelida (polychaete worms)								
Amphitrite cirrata Müller, 1776				x	x	x	x	x
Dipolydora socialis (Schmarda, 1861)				x				x
Harmothoe imbricata (Linnaeus, 1767)	x	x	x	x		x		
Lepidonotus squamatus (Linnaeus, 1758)[3]	x	x	x	x	x	x	x	x
Neoamphitrite figulus (Dalyell, 1853)				x	x	x	x	x
Phyllodoce maculata (Linnaeus, 1767)	x					x		x
Phyllodoce mucosa (Orsted, 1843)								x
Arthropoda (shrimps, crabs, and relatives)								
Caprella penantis Leach, 1814		x						
Limnoria lignorum Rathke, 1799			x	x				
Monocorophium acherusicum Costa, 1853		x						
Palaemon spp.*	x							
Bryozoa (colonial bryozoan animals)								
Cryptosula pallasiana (Moll, 1803)	x		x	x	x	x	x	
Electra pilosa (Linnaeus, 1767)		x	x		x	x	x	x
Nolella sp.*								x
Schizoporella sp.* [4]		x						

Scientific Name and Taxonomic Authority	POP	MMA	SWM	ROW	HCM	UNH	PHM	BFM
Cercozoa (some amoebas and relatives)								
Gromia sp.*						x	x	
Chordata (tunicates and vertebrates)								
Molgula provisionalis Van Name, 1945					x			
Cnidaria (anemones, hydroids, and relatives)								
Obelia longissima (Pallas, 1766)		x		x	x		x	x
Obelia spp.*	x		x		x			x
Entoprocta ("nodding head" sessile animals)								
Barentsia sp.*								x
Mollusca (snails, bivalves, and relatives)								
Catriona gymnota (Couthouy, 1838)						x		x
Facelina bostoniensis (Couthouy, 1838)								x
Porifera (sponges)								
Halichondria bowerbanki Burton, 1930		x		x	x			x
Leucosolenia botryoides (Ellis & Solander, 1786)		x	x	x	x	x	x	x
Sycon ciliatum (Fabricius, 1780)		x	x			x	x	

[1]Could not be identified to species level, specimen is either *Ulva lactuca* (cryptogenic) or *U. australis* (introduced).

[2]Could not be identified to species level, specimen is either *Gracilaria tikvahiae* (native) or *Agarophyton vermiculophyllum* (introduced).

[3]*Lepidonotus squamatus* is identified as "pseudo-cosmopolitan" by David and Krick 2019 or "species that were traditionally considered cosmopolitan as a consequence of overly conservative taxonomy but are now under more rigorous scrutiny due to the discovery of geographically distinct genetic lineages."

[4]*Schizoporella* sp. specimen is potentially a native species from the southern U.S. Atlantic coast, but identification to the species level has not been confirmed at the time of publication.

Native Species Identified During the 2018 Rapid Assessment Survey by Sampling Site.

Organisms marked with an asterisk (*) are polychaete worm species that were identified as native in past rapid assessment surveys, but identified as "pseudo-cosmopolitan" by David and Krick 2019 or "species that were traditionally considered cosmopolitan as a consequence of overly conservative taxonomy but are now under more rigorous scrutiny due to the discovery of geographically distinct genetic lineages."

Scientific Name and Taxonomic Authority	POP	MMA	SWM	ROW	HCM	UNH	PHM	BFM
Chlorophyta (green algae)								
Acrosiphonia arcta (Dillwyn) Gain 1912					x			x
Bryopsis plumosa (Hudson) C. Agardh 1823	x	x	x		x			x
Chaetomorpha ligustica (Kützing) Kützing 1849		x	x		x			x
Chaetomorpha linum (O.F. Müller) Kützing 1845		x		x		x	x	x
Chaetomorpha melagonium (F. Weber & D. Mohr) Kützing 1845							x	
Chaetomorpha picquotiana Montagne ex Kützing 1849							x	
Cladophora albida (Nees) Kützing 1843	x	x		x	x		x	x
Cladophora rupestris (Linnaeus) Kützing 1842				x	x			
Rhizoclonium tortuosum (Dillwyn) Kützing 1845					x			
Spongomorpha aeruginosa (Linnaeus) Hoek 1963					x		x	
Ulva compressa Linnaeus 1753							x	
Ulva rigida C. Agardh 1823	x	x	x		x			
Phaeophyceae (brown algae)								
Ascophyllum nodosum (Linnaeus) Le Jolis 1863			x		x	x	x	x
Chordaria flagelliformis (O.F. Müller) C. Agardh 1817							x	x
Elachista fucicola (Velley) Areschoug 1842				x	x			
Fucus vesiculosus Linnaeus 1753	x		x	x	x	x	x	x
Leathesia marina (Lyngbye) Decaisne 1842		x						
Punctaria latifolia Greville 1830						x	x	
Saccharina latissima (Linnaeus) C.E. Lane, C. Mayes, Druehl & G.W. Saunders 2006			x	x	x	x	x	x
Sargassum filipendula C. Agardh 1824	x	x						
Scytosiphon lomentaria (Lyngbye) Link 1833							x	

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Rhodophyta (red algae)								
Agardhiella subulata (C. Agardh) Kraft & M.J. Wynne 1979	x	x				x		
Aglaothamnion halliae (Collins) Aponte, D.L. Ballantine & J.N. Norris 1997		x	x					
Antithamnion cruciatum (C. Agardh) Nägeli 1847						x		x
Callithamnion corymbosum (Smith) Lyngbye 1819								x
Ceramium deslongchampsii Chauvin ex Duby 1830	x			x				
Ceramium diaphanum (Lightfoot) Roth 1806							x	
Ceramium virgatum Roth 1797		x	x	x	x	x	x	x
Champia farlowii M.K. Griffith, C.W. Schneider & C.E. Lane 2017	x	x						
Chondrus crispus Stackhouse 1797		x		x	x	x	x	x
Cystoclonium purpureum (Hudson) Batters 1902			x					
Dasya baillouviana (S.G. Gmelin) Montagne 1841						x		
Gaillona rosea (=*Aglaothamnion roseum*) (Roth) Athanasiadis 2016	x							
Grinnellia americana (C. Agardh) Harvey 1853	x	x	x					
Mastocarpus stellatus (Stackhouse) Guiry 1984				x		x		
Melanothamnus (=*Neosiphonia*) *harveyi* (Bailey) Díaz-Tapia & Maggs 2017[1]	x	x	x		x		x	x
Palmaria palmata (Linnaeus) F. Weber & D. Mohr 1805						x	x	
Phycodrys rubens (Linnaeus) Batters 1902						x		
Phyllophora pseudoceranoides (S.G. Gmelin) Newroth & A.R.A. Taylor ex P.S. Dixon & L.M. Irvine 1977			x					
Polysiphonia denudata (Dillwyn) Greville ex Harvey in Hooker 1833	x	x		x				x
Polysiphonia elongata (Hudson) Sprengel 1827			x					
Polysiphonia fibrillosa (Dillwyn) Sprengel 1827								x
Polysiphonia schneideri B. Stuercke & D.W. Freshwater 2010		x						
Polysiphonia stricta (Mertens ex Dillwyn) Greville 1824				x	x		x	
Porphyra purpurea (Roth) C. Agardh 1824			x		x			
Porphyra sp.							x	
Porphyra umbilicalis Kützing 1843					x	x	x	x

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Pterothamnion plumula (J. Ellis) Nägeli in Nägeli & Cramer 1855						x		
Rhodomela confervoides (Hudson) P.C. Silva 1952				x	x			
Spermothamnion repens (Dillwyn) Magnus 1873		x	x					
Vertebrata (= *Polysiphonia*) *fucoides* (Hudson) Kuntze 1891						x		x
Vertebrata (= *Polysiphonia*) *nigra* (Hudson) Díaz-Tapia & Maggs 2017		x						
Annelida (polychaete worms)								
Alitta virens (M. Sars, 1835)*			x	x		x	x	x
Circeis spirillum (Linnaeus, 1758)				x				x
Eulalia viridis (Linnaeus, 1767)*		x		x	x	x	x	x
Hydroides dianthus (Verrill, 1873)	x			x				
Polydora cornuta Bosc, 1802				x	x	x	x	x
Syllis gracilis Grube, 1840*				x		x		
Arthropoda (shrimps, crabs, and relatives)								
Amphibalanus eburneus (Gould, 1841)	x							
Amphibalanus improvisus (Darwin, 1854)				x				
Ampithoe longimana Smith, 1873	x		x					
Ampithoe rubricata (Montagu, 1808)	x							
Ampithoe valida Smith, 1873	x							
Anoplodactylus lentus Wilson, 1878						x		
Balanus crenatus Bruguière, 1789	x	x	x	x	x	x	x	x
Cancer borealis Stimpson, 1859						x		
Cancer irroratus Say, 1817				x		x		
Corophium sp.						x	x	
Dyspanopeus sayi (Smith, 1869)		x			x			
Globosolembos smithi (Holmes, 1905)			x					
Hyale sp.		x	x					
Idotea balthica (Pallas, 1772)	x	x			x	x	x	x
Idotea metallica Bosc, 1802	x							

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Jassa marmorata Holmes, 1905	x		x	x	x	x	x	x
Libinia emarginata Leach, 1815	x			x		x		
Libinia sp.		x						
Palaemon intermedius (Stimpson, 1860)	x							
Panopeus herbstii H. Milne Edwards, 1834	x							
Phoxichilidium femoratum (Rathke, 1799)		x				x	x	
Semibalanus balanoides (Linnaeus, 1767)	x	x		x	x	x	x	x
Tanystylum orbiculare Wilson, 1878		x						
Bryozoa (colonial bryozoan animals)								
Alcyonidium adustum Winston & Hayward, 2012					x			
Amathia dichotoma (Verrill, 1873)	x							
Amathia sp.	x	x			x	x	x	x
Amathia tertia (Winston & Hayward, 2012)				x	x			
Bugulina stolonifera (Ryland, 1960)[2]	x	x	x	x	x		x	x
Celleporella hyalina (Linnaeus, 1767)					x	x	x	x
Conopeum sp.	x		x	x				
Cribrilina annulata (O. Fabricius, 1780)								x
Crisularia turrita (Desor, 1848)	x	x	x	x		x	x	x
Schizoporella variabilis (Leidy, 1855)	x							
Scruparia ambigua (d'Orbigny, 1841)		x						
Chordata (tunicates and vertebrates)								
Aplidium constellatum (Verrill, 1871)		x						
Aplidium glabrum (Verrill, 1871)		x	x					
Aplidium pallidum (Verrill, 1871)		x	x					
Molgula citrina Alder & Hancock, 1848	x		x		x	x	x	x
Molgula manhattensis (De Kay, 1843)	x	x						x
Pholis gunnellus (Linnaeus, 1758)		x						

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Cnidaria (anemones, hydroids, and relatives)								
Diadumene leucolena (Verrill, 1866)		x	x					
Ectopleura crocea (Agassiz, 1862)		x		x		x	x	x
Edwardsiella lineata (Verrill in Baird, 1873)		x	x					
Eudendrium ramosum (Linnaeus, 1758)						x		
Metridium senile (Linnaeus, 1761)		x	x	x	x	x	x	x
Obelia geniculata (Linnaeus, 1758)	x			x	x	x	x	
Echinodermata (sea stars, urchins, and relatives)								
Ophiopholis aculeata (Linnaeus, 1767)			x			x		
Strongylocentrotus droebachiensis (O.F. Müller, 1776)						x		
Mollusca (snails, bivalves, and relatives)								
Anomia simplex d'Orbigny, 1853							x	
Astyris lunata (Say, 1826)		x				x		
Coryphella verrucosa (M. Sars, 1829)						x		
Costoanachis avara (Say, 1822)	x							
Crepidula fornicata (Linnaeus, 1758)	x	x	x	x	x	x	x	x
Crepidula plana Say, 1822				x	x	x	x	
Dendronotus frondosus (Ascanius, 1774)						x	x	x
Doto coronata (Gmelin, 1791)					x	x		
Eubranchus olivaceus (O'Donoghue, 1922)				x		x		x
Heteranomia squamula (Linnaeus, 1758)						x		x
Hiatella arctica (Linnaeus, 1767)			x	x	x	x	x	x
Lacuna vincta (Montagu, 1803)		x		x	x	x	x	x
Modiolus modiolus (Linnaeus, 1758)			x				x	x
Mya arenaria Linnaeus, 1758								x
Mytilus edulis/M. trossulus Linnaeus, 1758/Gould, 1850[3]	x	x	x	x	x	x	x	x
Onchidoris bilamellata (Linnaeus, 1767)						x	x	x
Tergipes tergipes (Forsskål in Niebuhr, 1775)				x		x	x	x
Urosalpinx cinerea (Say, 1822)				x				

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Nemertea (ribbon worms)								
Zygonemertes virescens (Verrill, 1879)		x						
Platyhelminthes (flatworms)								
Notoplana atomata (O.F. Müller, 1776)							x	
Porifera (sponges)								
Chalinula loosanoffi (Hartman, 1958)	x	x	x	x	x	x	x	
Clathria prolifera (Ellis & Solander, 1786)	x			x				
Halichondria panicea (Pallas, 1766)	x			x			x	
Cliona sp.	x							

[1]*Melanothamnus harveyi*, previously categorized as introduced, is now considered to be native in New England (Savoie and Saunders 2015).

[2]*Bugulina stolonifera*, previously categorized as introduced, is now considered to be native in New England (McCann et al. 2019).

[3]*Mytilus edulis* and *M. trossulus* are morphologically similar and require genetic analysis for identification to species level.