

Research Article

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Annotated checklist and community composition of introduced, cryptogenic, and native polychaetes in floating dock communities of New England, USA

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Abstract

This study presents the first comprehensive annotated checklist of polychaetes collected from floating dock communities across New England and adjacent New York areas, emphasizing the significance of rapid biodiversity assessment surveys in understanding marine biodiversity. With 61% of the identified species classified as cryptogenic, the research highlights the complexity of marine biogeography and the challenges of distinguishing between native and non-native species. The incorporation of DNA barcoding has significantly improved species identification and revealed the presence of cryptic species complexes. The study's findings illustrate the prevalence of tubicolous families (Spionidae, Serpulidae, Sabellidae, and Terebellidae) that are susceptible to anthropogenic dispersal mechanisms. It also addresses the challenge posed by the high proportion of cryptogenic species, calling for enhanced taxonomic and genetic analyses to resolve their origins and ecological roles. Despite the temporal variation in polychaete composition across years, the absence of distinct community assemblages suggests a level of resilience within floating dock communities. Our study advocates for the continuation and expansion of rapid assessment surveys, coupled with the integration of genetic methodologies, to provide a clearer picture of marine biodiversity.

Introduction

In recent years, coastal Rapid Assessment Surveys (RAS) have proven valuable to assess the current distribution of non-native species, to detect new introductions, and to assess changes in our knowledge of the distribution of native species. In the New England-New York region, these surveys began in 2000 focusing on sampling biofouling communities on floating docks in marinas (Pederson *et al.*, 2021). Seven surveys have been held, generally every two to three years, between 2000 and 2019, largely including sites from Maine to Connecticut (with New York being sampled as well in 2003 and 2019) (Pederson *et al.*, 2005, 2021; Mathieson *et al.*, 2008; McIntyre *et al.*, 2013; Wells *et al.*, 2014; Kennedy *et al.*, 2020). The success of these surveys has resulted in similar surveys being deployed in European waters (Arenas *et al.*, 2006; Ashton *et al.*, 2006; Nall *et al.*, 2015; O'Shaughnessy *et al.*, 2023) and elsewhere. This type of repeated targeted sampling across an extensive geographic region coupled with the participation of taxon-specific experts has proven to be a successful method for biomonitoring.

The polychaetous annelids (Polychaeta) are among the most diverse marine organisms and are integral components of marine ecosystems, often dominating benthic communities in terms of abundance and species richness (Rouse *et al.*, 2022). In addition, many commensal species have been implicated as introduced pests to commercially reared shellfish, thereby posing a threat to the global aquaculture trade (Simon and Sato-Okoshi, 2015; Davinack *et al.*, 2024; Martinelli *et al.*, 2024). However, identifying polychaetes poses significant challenges, even for expert polychaetologists. These difficulties stem in part from the increasing reports of cryptic species complexes and the constantly evolving taxonomy of these organisms, which can lead to uncertainty with regard to their status as native, introduced or cryptogenic species (Nygren, 2014; Darling and Carlton, 2018; Hutchings and Kupriyanova, 2018). A recent review by Darling and Carlton (2018), proposed the category of 'pseudocosmopolitan' for species whose perceived cosmopolitan status might be a misleading result of overly conservative taxonomic practices. This can be applied as a sub-category for cryptogenic species that are members of known species complexes that have yet to be resolved taxonomically and biogeographically. In one of the most recent rapid assessment surveys in New England, David and Krick (2019) incorporated DNA barcoding for the first time into the cataloging process that resulted in increased resolution of species diversity. These challenges underscore the importance of a comprehensive and nuanced approach to understanding polychaete diversity and distribution.

In this study, we present the first annotated checklist of polychaetes collected from floating dock communities in the New England – New York regions, which for centuries have had a long maritime history. Consequentially this has resulted in the potential historical movement



of marine species from other biogeographic regions. While previously published technical and peer-reviewed articles have summarized the findings of these surveys, granular details of the polychaete records were not previously assessed comprehensively and quantitatively. In addition, with the recent explosion in DNA barcoding, some previous identifications are no longer valid due to recent synonymizations. The polychaete checklist presented here is the product of almost 20 years of rapid biodiversity assessment surveys, reflecting a substantial effort in understanding marine biodiversity in New England. In addition to cataloguing these polychaetes, we delve into their biogeographic status, categorizing each species as native, introduced, or cryptogenic – the latter denoting species that cannot be definitively classified as either native or introduced (Carlton, 1996). Finally, we statistically analyse polychaete composition across different marinas and across different years. Altogether, this information is pivotal for understanding the changing dynamics of marine communities.

Materials and Methods

Description of study region and RAS protocol

Between 2000 and 2019, seven rapid assessment surveys were conducted at 56 marinas, largely along the New England coast (Figure 1). The names and GPS coordinates of the specific sites where at least one polychaete species was found (40 sites in total) are found in Table 1. These surveys were carried out in 2000, 2003, 2007, 2010, 2013, 2018 and 2019, with the 2019 survey specifically targeting Rhode Island and Connecticut (southern New England) and marinas in New York City (Brooklyn and Staten Island). Many of the marinas were sampled repeatedly across multiple years using the same methodology. The typical rapid assessment protocol involved sampling each marina for one hour by a team of taxonomists and research assistants. Over the past two decades, the number of workers has varied between 12–15 individuals with the sampling period occurring during summer months (either July or August). Sampling involved the scraping of material off docks and pilings and the amount can differ depending on the individual sampling. Team members sample broadly across any given marina, attempting to capture both protected sites in inner marina areas as well as more exposed outer sites. Biological material examined from these communities included mostly marine invertebrates and algae that were associated with subtidal structures such as submerged docks, pilings, ropes and buoys. While some organisms were identified on site, some groups such as polychaetes were stored alive in coolers with ice and transported to nearby university laboratories for further identification on the same day.

Identification of polychaetes was carried out using regional taxonomic keys to identify specimens to the species level. It should be noted that different polychaetologists were consulted on different surveys. For specimens that could not be identified to species level, these were stored in 99% ethanol for genetic barcoding, the results of which are available for the 2018 survey in David and Krick (2019). Distributional data collected were binary (presence/absence) and did not include relative abundance. In cases where multiple individuals of the same species were confirmed and recorded, some specimens were stored in 99% ethanol and archived as part of a community voucher at the Museum of Comparative Zoology at Harvard University.

Data mining

We first reviewed the original species inventory spreadsheets that were compiled for each survey since 2000, in addition to reviewing summaries of surveys that have been published in the grey

literature by the Massachusetts Office of Coastal Zone Management (McIntyre *et al.*, 2013; Wells *et al.*, 2014; Kennedy *et al.*, 2020). Historical records and species statuses were updated based on recent taxonomic revisions, DNA barcoding studies, updated biogeographical analyses and name/rank changes obtained from the World Register of Marine Species (WoRMS Editorial Board, 2024) database. Furthermore, specimen records from the Smithsonian Institution National Museum of Natural History invertebrate collections online database were examined. Based upon the literature cited for each species and upon our own biogeographic interpretations, we classified species as either Native (N), Introduced (I), Cryptogenic (C) or Unresolved cosmopolitan (U) (the latter referring to species that have been traditionally regarded as cosmopolitan in the literature but for which there are no studies to support this hypothesis). Finally, for each species we investigated whether common DNA barcodes were available for the species in the GenBank database, Barcode of Life Database (BoLD) and the DNA Databank of Japan (DDBJ). We tentatively assume that these deposited sequences were, in general, correctly identified, although these databases do not require indicating the expert taxonomists involved.

Statistical analyses

To assess the spatial and temporal differences in polychaete community composition across sites and across sampling years, we performed two separate Permutational Multivariate Analysis of Variance (PERMANOVA) tests using the scikit-bio library (<https://scikit.bio.org>) in Python ver. 3.0. The tests compared the Jaccard dissimilarity indices between samples from different years while permutations ($n = 999$) were used to assess the significance of the observed difference. To assess temporal variation in species composition, we also constructed a NMDS (Non-metric Multidimensional Scaling) plot to identify any distinct clustering of samples by year.

Results

Polychaete diversity analysis

From 2000–2019, 46 polychaete species were found associated with floating dock communities from 40 marinas. Of these, approximately 61% were cryptogenic, 35% were native and less than 4% were either introduced or an unresolved cosmopolitan (one species for each of those two categories). These species represent 16 of the 85 accepted polychaete families, with the most well represented being the Spionidae (14%) followed by Terebellidae (12%) (Figure 2). A PERMANOVA test found that there was no significant difference in polychaete composition across marinas (pseudo- $F = 1.11$, $P = 0.08$). While we did detect a significant difference in species composition across years sampled (pseudo- $F = 6.91$, $P = 0.001$) this was not reflected in the NMDS plot, which did not exhibit distinct clustering of samples (Figure 3).

Annotated checklist of polychaeta associated with floating dock communities

FAMILY CAPITELLIDAE

Capitella teleta Blake *et al.*, 2009

Synonymized names: *Capitella* sp. 1 [informal, 1976]

Status: Cryptogenic

Type Locality: New England region, USA

Barcodes available: Yes

Site Locations

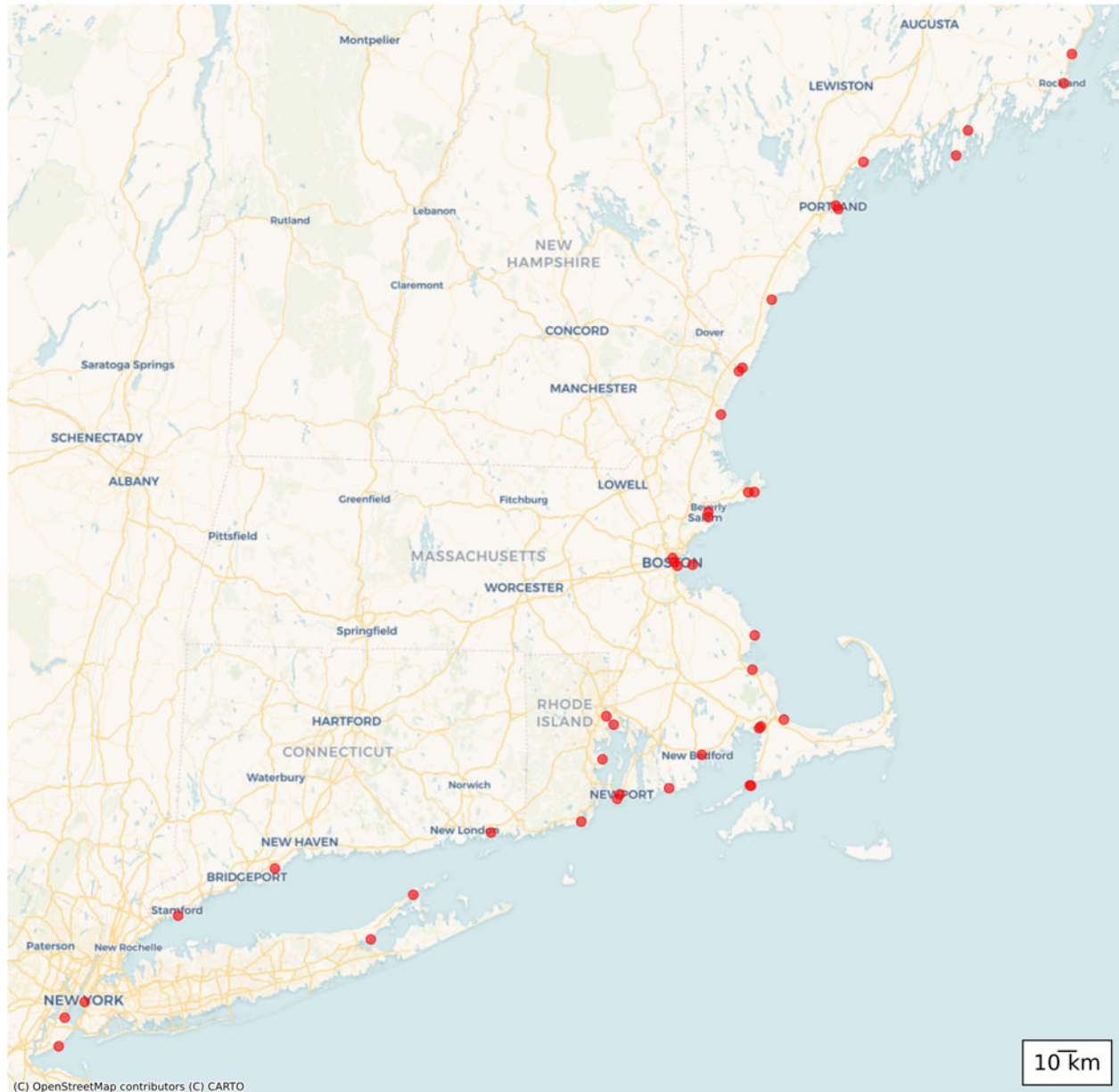


Figure 1. Sampling localities for polychaetes collected during rapid assessment surveys carried out between 2000 and 2019.

Notes: *Capitella teleta* is the species name given by Blake *et al.* (2009) to replace *Capitella* sp. 1, an opportunistic capitellid worm that had been cultured in laboratory experiments for decades. The species appears to have a wide distribution, with genetic confirmation of its presence in the Pacific and Atlantic – likely the result of transoceanic introductions (Tomioka *et al.*, 2016). Considering the long history of studies on *Capitella* sp. 1 along with the possibility of other potential cryptic species, pinpointing an exact geographic origin, i.e., the native range for the species is not possible to determine based on the current data.

FAMILY CIRRATULIDAE

Cirriformia grandis (Verrill, 1873)

Synonymized names: *Cirratulus grandis* Verrill, 1873, *Cirratulus tenuis* Verrill, 1873

Status: Native

Type Locality: 'New Haven to Vineyard Sound', southern New

England, USA

Barcodes available: No

Notes: *Cirriformia grandis* has been reported exclusively from the western Atlantic, with a distribution from the Gulf of Maine to the Gulf of Mexico (Kinner and Maurer, 1971).

Ctenodrilus serratus (Schmidt, 1857)

Synonymized names: *Ctenodrilus paradalis* Claparède, 1863, *Parthenope cirrata* [auct. lapsus, *cirrata* for *serrata*], *Parthenope serrata* Schmidt, 1857

Status: Introduced

Type Locality: Mediterranean Sea

Barcodes available: Yes

Notes: While *Ctenodrilus serratus* is reported to have a cosmopolitan distribution (Bellan, 2001; Glasby *et al.*, 2009), it is likely a global species complex interlaced with introduced populations (for example, Weidhase *et al.*, 2016). Westheide *et al.* (2003) demonstrated that *C. serratus* on both sides of the North Atlantic were genetically identical. Given the possibility of early dispersal in ships' sand ballast (Westheide *et al.*, 2003) along with its highly

Table 1. Floating dock marinas in New England and adjacent New York sites that were successfully sampled for polychaetes at rapid assessment surveys from 2000–2019

Site ID	Site name	Longitude	Latitude	State
WMM	Wayfarer's Marina	−69.0613	44.20948	ME
JEM	Journey's End Marina	−69.1021	44.10484	ME
DMC	Darling Marine Center dock	−69.5811	43.93508	ME
DMR	Maine Department of Marine Resources docks	−69.6408	43.84438	ME
BFM	Brewer South Freeport Maine	−70.1053	43.82094	ME
PYS	Portland Yacht Services	−70.2431	43.6623	ME
PHM	Port Harbor Maine	−70.2309	43.64958	ME
WHM	Wells Harbor Maine	−70.5635	43.32	ME
UNH	University of New Hampshire Coastal Marine Lab	−70.7105	43.07172	NH
HRM	Hampton River Marina/State Pier	−70.818	42.89974	NH
GSP	Gloucester State Pier	−70.6509	42.61422	MA
CAM	Cape Ann Marina	−70.6807	42.61303	MA
TSP	Tucks Point Marina	−70.6807	42.61303	MA
HCM	Hawthorne Cove Marina	−70.8817	45.5216	MA
CTM	Constitution Marina	−71.0595	42.37121	MA
ROW	Rowes Wharf	−71.0497	42.35722	MA
MDI	MWRA Deer Island	−70.96	42.34722	MA
BFT	Black Falcon Terminal	−71.035	42.34325	MA
GHM	Green Harbor Marina	−70.649	42.08499	MA
BRP	Brewer's Plymouth	−70.6598	41.95638	MA
PEW	Port Edgewood Marina	−71.3907	41.78235	MA
SWM	Sandwich Marina	−70.5024	41.77107	MA
BNM	Bourne Marina	−70.6177	41.74462	MA
MMA	Massachusetts Maritime Academy	−70.6262	41.73858	MA
POP	Pope's Island	−70.9126	41.6387	MA
ALH	Allen's Harbor	−71.4113	41.62131	MA
MBL	Marine Biological Laboratory	−70.6735	41.52443	MA
WHC	Woods Hole Coast Guard Station	−70.6673	41.52247	MA
TRM	Tripps Marina	−71.0769	41.51462	MA
NPS	Newport Shipyard	−71.3232	41.49008	RI
FAD	Fort Adams State Park	−71.3364	41.47402	RI
PTJ	Point Judith Marina	−71.5172	41.38772	RI
BYY	Brewer Yacht Yard at Mystic	−71.968	41.34668	CT
MYC	Milford Yacht Club	−73.0508	41.21165	CT
SHS	Stirling Harbor Shipyard	−72.3581	41.11228	CT
BYH	Brewer Yacht Haven Marine Center	−73.5345	41.03285	CT
ECM	East Creek Marina	−72.5702	40.94268	NY
SSS	South Street Seaport	−74.0024	40.70525	NY
SNC	Snug Harbor Cultural Center	−74.1017	40.6455	NY
GKS	Great Kills Park	−74.133	40.5369	NY

ME, Maine; NH, New Hampshire; MA, Massachusetts; RI, Rhode Island; CT, Connecticut; NY, New York.

patchy distribution in New England, we regard it as an introduced species. The species was found at only two sites in different years, once in 2007 at the Hawthorne Cove Marina in Salem, Massachusetts, and three years later in 2010 at Port Edgewood Marina in Cranston, Rhode Island. While found in 2010, the

record escaped reporting in McIntyre *et al.* (2013); there was no published report of the 2007 RAS, and we are thus first recording these records here. While Hansen *et al.* (1996) reported it from Long Island Sound, we find few published records of *Ctenodrilus serratus* for New England.

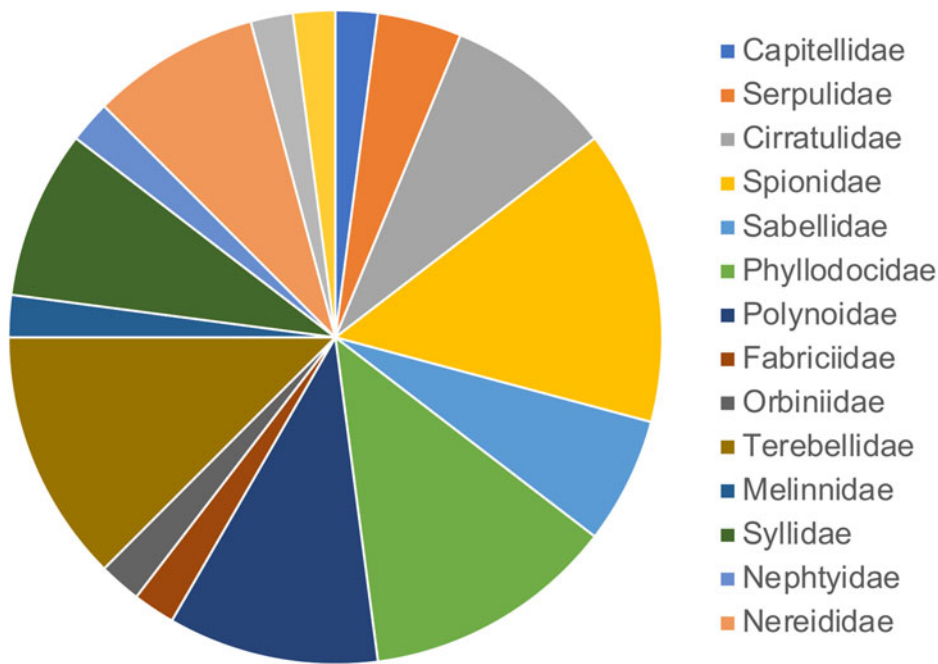


Figure 2. Proportion of polychaete families represented in the New England Rapid Assessment Surveys (2000–2019).

Dodecaceria concharum Örsted, 1843

Synonymized names: *Dodecaceria caulleryi* Dehorne, 1933, *Heterocirrus graviera* McIntosh, 1911, *Nereis sextentaculata* Delle Chiaje, 1828, *Terebella ostreae* Dalyell, 1853, *Zeppelinina medio-pigmentata* Gilland, 1979

Status: Cryptogenic

Type Locality: Denmark

Barcodes available: Yes

Notes: Similar to the closely related *Ctenodrilus serratus*, *D. concharum* has had a relatively problematic taxonomic history compounded by a lack of genetic data (Gibson, 2015).

Tharyx acutus Webster and Benedict, 1887

Synonymized names: none

Status: Native

Type Locality: Maine

Barcodes available: Yes

Notes: Based on the distributional reports, descriptions, and revisions of the genus *Tharyx* by Hilbig and Blake (2000), Blake (2015), and Blake and Göransson (2015), *T. acutus* appears to be restricted to the northeastern United States.

FAMILY FABRICIIDAE

Fabricia stellaris (Müller, 1774)

Synonymized names: *Amphicora fabricia* (Müller, 1776), *Amphicora fabricii* [auct. misspelling], *Amphicora sabella* Ehrenberg, 1836, *Fabricia affinis* Leuckart, 1849, *Fabricia amphicora* Quatrefages, 1866, *Fabricia leidy* Verrill, 1873, *Fabricia sabella* (Ehrenberg, 1836), *Novafabricia bilobata* Martin & Giangrande, 1991, *Othonia fabricii* (Johnston, 1835), *Tubularia fabricia* Müller, 1776, *Tubularia stellaris* Müller, 1774

Status: Cryptogenic

Type Locality: Denmark

Notes: The majority of reports are from the Arctic and North Atlantic region (Davoult *et al.*, 1999; Christie *et al.*, 2003) with additional reports from the Caribbean Sea and the Mediterranean Sea (Davoult *et al.*, 1999; Miloslavich *et al.*, 2010). There are currently no biogeographic or population genetic studies available for this species.

FAMILY HESIONIDAE

Oxydromus obscurus (Verrill, 1873)

Synonymized names: *Ophiodromus obscurus* (Verrill, 1873), *Podarke obscura* Verrill, 1873

Status: Native

Type Locality: Massachusetts, USA

Barcodes available: Yes

Notes: The distribution of *Oxydromus obscurus* is largely restricted to the northeastern and northwestern Atlantic and Gulf of Mexico (Bellan, 2001; Felder and Camp, 2009). Lana (1984) reported the species from Paraná in Brazil, while Fauchald (1977) recorded the species from Panama, although a review by Rizzo and Salazar-Vallejo (2014) considers these identifications questionable. The species was also recently reported from Egypt (Abdelnaby, 2019), although this report is highly dubious because of an inadequate description.

FAMILY MELINNIDAE

Melinna cristata (Sars, 1851)

Synonymized names: *Sabellides cristata* Sars, 1851

Status: Cryptogenic

Type Locality: Norway

Barcodes available: Yes

Notes: *Melinna cristata* is found throughout the Atlantic Ocean, including north, east, mid, and south Atlantic (Gunton *et al.*, 2023). While some barcodes do exist for the species, a large-scale phylogeographic study is needed to better understand the status of the species in New England.

FAMILY NEREIDIDAE

Alitta virens (Sars, 1835)

Synonymized names: *Neanthes virens* (Sars, 1835), *Nereis (Alitta) virens* Sars, 1835, *Nereis (Neanthes) paucidentata* Treadwell, 1939, *Nereis (Neanthes) varia* Treadwell, 1941, *Nereis (Neanthes) virens* Sars, 1835, *Nereis virens* Sars, 1835, *Nereis yankiana* Quatrefages, 1866

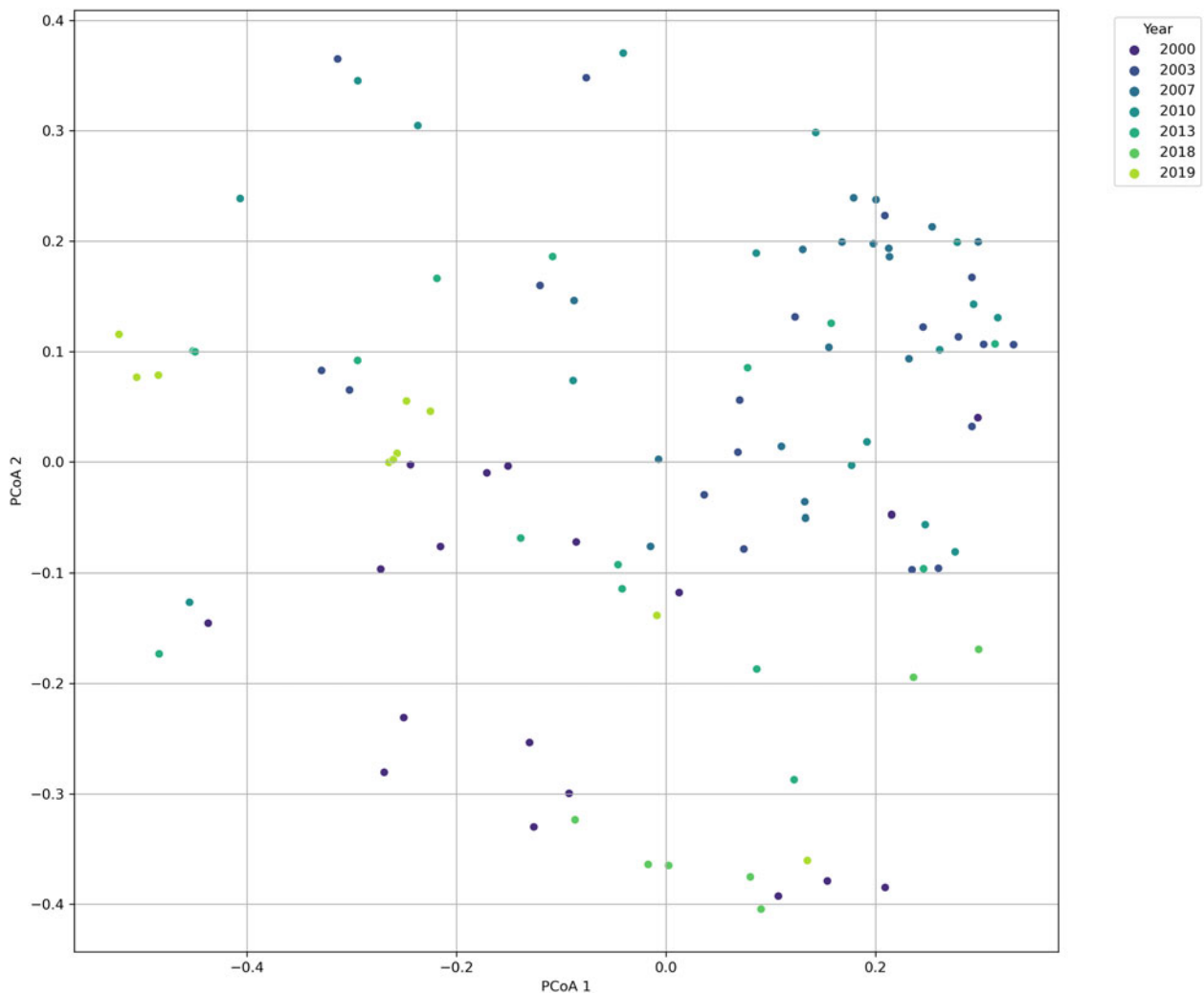


Figure 3. Non-metric multidimensional scaling (NMDS) plot of polychaete species composition based on Jaccard dissimilarity indices. Each point represents the species composition of a sample, with the colour indicating the year of collection. The proximity of points suggests the similarity in species composition, with closer points indicating more similar communities. The axes, PCoA 1 and PCoA 2, represent the two dimensions explaining the most variation in the dataset.

Status: Cryptogenic (Pseudocosmopolitan)

Type Locality: Norway

Barcodes available: Yes

Notes: David and Krick (2019) classified *A. virens* from New England as pseudocosmopolitan, owing to the fact that it is part of a species complex and morphologically indistinguishable from its sibling species, *A. brandti* and *A. grandis* (Villalobos-Guerrero and Bakken, 2018).

Hediste diversicolor (Müller, 1776)

Synonymized names: *Neanthes diversicolor* (Müller, 1776), *Nereis* (*Hediste*) *diversicolor* Müller, 1776, *Nereis* (*Nereis*) *diversicolor* Müller, 1776, *Nereis brevimanus* Johnston, 1840, *Nereis depressa* Frey & Leuckart, 1847, *Nereis diversicolor* Müller, 1776, *Nereis sarsii* Rathke, 1843, *Nereis versicolor* [misspelling for *diversicolor*], *Nereis viridis* Johnston, 1840

Status: Cryptogenic

Type Locality: North Sea

Barcodes available: Yes

Notes: *Hediste diversicolor* is a well-known environmental indicator species that is increasingly used to detect emerging contaminants (Catalano et al., 2012; Moltedo et al., 2019; Silva et al., 2020). The worm is one of the more ubiquitous polychaetes found throughout marinas in the New England region, usually buried within mudpacks on fouling communities (David and Krick,

2019). It has an ampho-Atlantic distribution, with other reports outside of this area being dubious due to the species' problematic taxonomic history (Scaps, 2002). A phylogeographic study by Virgilio et al. (2009) recovered three cryptic lineages for *H. diversicolor*, indicating that multiple species may be present in different geographical regions. Unfortunately, the western Atlantic was not included in that study but is an area ripe for future investigation.

Nereis pelagica Linnaeus, 1758

Synonymized names: *Heteronereis arctica* Örsted, 1843, *Heteronereis assimilis* Örsted, 1843, *Heteronereis grandifolia* (Rathke, 1843), *Heteronereis migratoria* Quatrefages, 1866, *Nereilepas fusca* Örsted, 1843, *Nereis* (*Lycoris*) *pelagica* Linnaeus, 1758, *Nereis* (*Nereis*) *pelagica* Linnaeus, 1758, *Nereis bowerbankii* Quatrefages, 1866, *Nereis delagica* [auct. misspelling for *pelagica*], *Nereis deneticulata* Stimpson, 1853, *Nereis ferruginea* Gunnerus, 1770, *Nereis fimbriata* Müller, 1776, *Nereis fulgens* Dalyell, 1853, *Nereis grandifolia* Rathke, 1843, *Nereis renalis* Johnston, 1840, *Nereis reynaudi* Quatrefages, 1866, *Nereis subulicola* Leach in Johnston, 1865, *Nereis verrucosa* Müller, 1776

Status: Cryptogenic

Type Locality: Western Europe

Barcodes available: Yes

Notes: Bakken and Wilson (2005) in their phylogeny of the

Nereididae reported *Nereis pelagica* as a cosmopolitan species. However, in light of the large number of cryptic complexes currently being uncovered in this group, a species complex may be involved.

***Platynereis dumerilii* (Audouin & Milne Edwards, 1833)**

Synonymized names: *Eunereis africana* Treadwell, 1943, *Heteronereis fucicola* Örsted, 1843, *Heteronereis maculata* Bobretzky, 1868, *Heteronereis malmgreni* Claparède, 1868, *Iphineris fucicola* (Örsted, 1843), *Leontis dumerili* (Audouin & Milne Edwards, 1833), *Leptonereis maculata* Treadwell, 1928, *Mastigonereis quadridentata* Schmarda, 1861, *Mastigonereis striata* Schmarda, 1861, *Nereilepas variabilis* Örsted, 1843, *Nereis* (*Platynereis*) *dumerilii* Audouin & Milne Edwards, 1833, *Nereis* (*Platynereis*) *dumerilii striata* (Schmarda, 1861), *Nereis* (*Platynereis*) *striata* (Schmarda, 1861), *Nereis alacris* Verrill, 1879, *Nereis antillensis* McIntosh, 1885, *Nereis dumerilii* Audouin & Milne Edwards, 1833, *Nereis glasiovi* Hansen, 1882, *Nereis peritonealis* Claparède, 1868, *Nereis taurica* Grube, 1850, *Nereis zostericola* Örsted, 1843, *Platynereis dumerili* [auct. misspelling], *Platynereis jucunda* Kinberg, 1865, *Platynereis striata* (Schmarda, 1861), *Uncinereis lutea* Treadwell, 1928, *Uncinereis trimaculosa* Treadwell, 1940

Status: Cryptogenic (Pseudocosmopolitan)

Type Locality: La Rochelle, France

Barcodes available: Yes

Notes: *Platynereis dumerilii* is a well-known animal model used in a variety of molecular studies (Zantke *et al.*, 2014). However, the species itself consists of at least 10 divergent lineages (Teixeira *et al.*, 2022), which challenges its former cosmopolitan designation, but also makes it extremely difficult to determine which areas, if any, it has been introduced to. For example, a study by Kara *et al.* (2020) used molecular data to show that *P. dumerilii*, despite being reported from South Africa in the past, is actually absent from the region. Instead, a new *Platynereis* species was discovered and described, and a second potential species remains unresolved.

FAMILY NEPHTYIDAE

***Nephtys incisa* Malmgren, 1865**

Synonymized names: *Nephtys incisa* Malmgren, 1865, *Nephtys incisa bilobata* Heinen, 1911, *Nephtys lawrencii* McIntosh, 1900

Status: Cryptogenic

Type Locality: Sweden

Barcodes available: Yes

Notes: *Nephtys incisa* has a reported amphi-Atlantic distribution (Hayward and Ryland, 1990; Dauvin *et al.*, 2003; Trott, 2004). Currently, there are no morphogenetic or biogeographic studies on the species to determine its status in the New England region.

FAMILY ORBINIIDAE

***Leitoscoloplos robustus* (Verrill, 1873)**

Synonymized names: *Anthostoma robustum* Verrill, 1873, *Haploscoloplos robustus* (Verrill, 1873), *Haploscoloplos tortugaensis* Monro, 1933, *Haploscoloplos bustorus* (Eisig, 1914), *Scoloplos bustorus* Eisig, 1914, *Scoloplos robustus* (Verrill, 1873), *Scoloplos rufa* Treadwell, 1941

Status: Native

Type Locality: New England region, USA

Barcodes available: Yes

Notes: The species is largely restricted to the northeastern United States (Trott, 2004), with Miloslavich *et al.* (2010) reporting additional records from the Caribbean Sea (see Table S5 in

Miloslavich *et al.*, 2010). Furthermore, Blake (2021) has also reported the distribution of this species from eastern Canada to Florida.

FAMILY PHYLLODOCIDAE

***Eulalia viridis* (Linnaeus, 1767)**

Synonymized names: *Eracia virens* (Ehlers, 1864), *Eulalia* (*Eumida*) *microceros* Claparède, 1868, *Eulalia annulate* Verrill, 1873, *Eulalia brevisetis* Saint-Joseph, 1899, *Eulalia virens* Ehlers, 1864, *Eumidia vivida* Verrill, 1873, *Nereis viridis* Linnaeus, 1767, *Phyllodoce gervillei* Audouin & Milne Edwards, 1833, *Pterocirrus microceros* (Claparède, 1868)

Status: Cryptogenic (Pseudocosmopolitan)

Type Locality: Western Europe

Barcodes available: Yes

Notes: *Eulalia viridis* was discovered to be part of a cryptic complex by Bonse *et al.* (1996), who separated the species into *E. viridis* sensu-stricto, found in Sweden, Denmark, and Germany, and *E. clavigera* found in France and England. Using DNA barcoding, David and Krick (2019) identified the species found on the New England coast as belonging to *E. viridis*. However, a recent study by Teixeira *et al.* (2023) using three different molecular markers recovered six distinct lineages within this complex. Because none of the individuals sequenced were from the western Atlantic, the clade identity and status of *E. viridis* in New England remain unknown at this time.

***Phyllodoce arenae* Webster, 1879**

Synonymized names: *Anaitides arenae* (Webster, 1879)

Status: Native

Type Locality: New Jersey, USA

Barcodes available: No

Notes: *Phyllodoce arenae* has an exclusively western Atlantic distribution from Maine to the Gulf of Mexico (Pettibone, 1963; Felder and Camp, 2009), with one noted report from the southern Caribbean in Trinidad and Tobago (Gobin, 1990).

***Phyllodoce groenlandica* Örsted, 1842**

Synonymized names: *Anaitides groenlandica* (Örsted, 1842), *Phyllodoce* (*Anaitides*) *groenlandica* Örsted, 1842, *Phyllodoce arctica* Hansen, 1882, *Phyllodoce luetkeni* Malmgren, 1867

Status: Native

Type Locality: Greenland

Barcodes available: Yes

Notes: *Phyllodoce groenlandica* is noted as an Arctic-boreal species (Nygren *et al.*, 2009) ranging south to the Gulf of Maine (Verrill, 1874) and Long Island Sound (Verrill, 1875) and thence to North Carolina (Pettibone, 1963). It should be noted that Magalhães *et al.* (2022) remarked on the morphological similarities of a large number of species of *Phyllodoce*, indicating that misidentification could be a possibility. Interestingly, David and Krick (2019), using DNA barcoding, were only able to recover *Phyllodoce maculata* and *Phyllodoce mucosa* from the 2018 rapid assessment survey. While *P. groenlandica* is reported from piling fouling communities (Pettibone, 1963), it may be largely sub-littoral in the studied region, where it has been reported primarily in dredged samples (Verrill, 1874, 1875). Alternatively, records of this species in earlier RAS samples (for example, in the year 2003) may represent a misidentification of *P. maculata*, *P. mucosa*, or both. A targeted revision of *Phyllodoce* in this region would help clarify the diversity of this genus in the Northwest Atlantic.

***Phyllodoce maculata* (Linnaeus, 1767)**

Synonymized names: *Anaitides maculata* (Linnaeus, 1767), *Nereis maculata* Linnaeus, 1767, *Phyllodoce* (*Anaitides*) *maculata*

(Linnaeus, 1767), *Phyllodoce pulchella* Malmgren, 1867, *Phyllodoce rinki* Malmgren, 1867, *Phyllodoce teres* Malmgren, 1865

Status: Cryptogenic

Type Locality: Western Europe

Barcodes available: Yes

Notes: This species has been reported from the North Atlantic from Scandinavia to Iceland, Greenland, and Hudson Bay south to Rhode Island (Pettibone, 1963) south to New Jersey (Kennish, 2001), as well as in the North Pacific from Japan, Alaska, and British Columbia (Pettibone, 1963). Additional records are from West Africa (Pettibone, 1963) and the Mediterranean (Bakalem et al., 2020). A species complex may be involved. Due to confusion with *Phyllodoce mucosa* (Pleijel, 1993), the full extent of the range of *P. maculata* is unknown (David and Krick, 2019).

Phyllodoce mucosa Örsted, 1843

Synonymized names: *Anaitides mucosa* (Örsted, 1843),

Phyllodoce (Anaitides) mucosa Örsted, 1843

Status: Cryptogenic

Type Locality: Western Europe

Barcodes available: Yes

Notes: Like many of the phyllococids reported in the New England rapid assessment surveys, *P. mucosa* is another species with an ampho-Atlantic distribution. In addition, since this species is often easily confused with *P. maculata*, the full extent of its range is unknown. Both *P. mucosa* and *P. maculata* were found together at one site in Maine.

FAMILY POLYNOIDAE

Eunoe nodosa (Sars, 1861)

Synonymized names: *Antinoe zetlandica* Lankester, 1866, *Eunoe islandica* Hansen, 1878, *Harmothoe (Eunoe) nodosa* (Sars, 1861),

Harmothoe nodosa (Sars, 1861), *Lepidonotus pharetratus* Johnston, 1865, *Polynoe (Eunoe) islandica* Hansen, 1878, *Polynoe foraminifera* Hansen, 1882, *Polynoe nodosa* Sars, 1861, *Polynoe spinulosa* Hansen, 1882

Status: Cryptogenic

Type Locality: Norway

Barcodes available: Yes

Notes: *Eunoe nodosa* has an ampho-Atlantic distribution (Dauvin et al., 2003; Trott, 2004), with its status on the New England coast pending a detailed taxonomic study on the species.

Harmothoe extenuata (Grube, 1840)

Synonymized names: *Evarnella triannulata* (Moore, 1910), *Harmothoe plumosa* (Grube, 1840), *Harmothoe sarniensis* Lankester, 1866, *Hermadion extenuata* (Grube, 1840), *Lagisca ehlersi* Malmgren, 1867, *Lagisca ehlersi pontica* Czerniavsky, 1882, *Lagisca extenuata* (Grube, 1840), *Lagisca propinqua* Malmgren, 1867, *Lepidonotus dumetosus* Quatrefages, 1866, *Lepidonotus leachii* Quatrefages, 1866, *Polynoe extenuata* Grube, 1840, *Polynoe plumosa* Grube, 1840

Status: Cryptogenic

Type Locality: Mediterranean Sea

Barcodes available: Yes

Notes: *Harmothoe extenuata* was recorded in four rapid assessment surveys dating as far back as 2007. Barnich and Fiege (2009), in a review of the genus *Harmothoe*, noted that the species has a primarily northeastern Atlantic distribution, with other reports being 'doubtful due to confusion with other species.' This implies that the species may have been inaccurately identified in other regions where it has been reported. Considering that the collections at the Smithsonian Institution National Museum of Natural History house more than 900 lots

of *H. extenuata*, many of which have been sampled from the New England region with dates going back to the 1870s and positively identified by both Addison Verrill and Marian Pettibone, this conclusion seems highly unlikely. Instead, we argue that further studies reconciling these vouchers with the most current descriptions, together with genetic studies, will be required to determine the species' status in New England and whether multiple lineages may be involved. As a consequence, we designated the species as cryptogenic for the U.S. Atlantic coast.

Harmothoe imbricata (Linnaeus, 1767)

Synonymized names: *Aphrodita cirrata* Müller, 1776, *Aphrodita imbricata* Linnaeus, 1767, *Aphrodita lepidota* Pallas, 1766, *Aphrodita plana* Gmelin in Linnaeus, 1788, *Aphrodita varians* Dalyell, 1853, *Aphrodita violacea* Strom, 1768, *Harmothoe hartmanae* Pettibone, 1948, *Harmothoe imbricata incerta* (Bobretzky, 1881), *Harmothoe levis* Treadwell, 1937, *Harmothoe maxillospinosa* de Saint-Joseph, 1888, *Harmothoe unicolor* Baird, 1865, *Lepidonote cirrata* Örsted, 1843, *Polynoe (Harmothoe) imbricata* (Linnaeus, 1767), *Polynoe complanata* Quatrefages, 1866, *Polynoe incerta* Bobretzky, 1881

Status: Cryptogenic

Type Locality: Western Europe

Barcodes available: Yes

Notes: *Harmothoe imbricata* is a morphologically diverse species that exhibits remarkable color polymorphisms (Nygren et al., 2011). The most detailed description of the species from the New England region can be found in Pettibone (1963). *Harmothoe imbricata* is also a frequent resident of floating dock communities in New England, found at almost every marina throughout the rapid assessment surveys, and usually associated with tunicate and mussel aggregations (David and Krick, 2019). A recent population genetic study by David and Cahill (2020) using the COI genetic marker uncovered high levels of genetic diversity across the species' known range, indicating that it might be part of a potential cryptic complex.

Lepidonotus squamatus (Linnaeus, 1758)

Synonymized names: *Aphrodita armadillo* Bosc, 1802, *Aphrodita longirostra* Bruguière, 1789, *Aphrodita pedunculata* Pennant, 1777, *Aphrodita punctata* Müller, 1771, *Aphrodita squamata* Linnaeus, 1758, *Lepidonote armadillo* (Bosc, 1802) sensu Leidy, 1855, *Lepidonote punctata* Örsted, 1843, *Lepidonotus granularis* Leach in Johnston, 1865, *Lepidonotus verrucosus* Leach in Johnston, 1865, *Polynoe scutellata* Risso, 1826, *Polynoe dasypus* Quatrefages, 1866, *Polynoe inflata* Castelnau, 1842, *Polynoe punctata* Castelnau, 1842, *Polynoe squamata* (Linnaeus, 1758)

Status: Cryptogenic (Pseudocosmopolitan)

Type Locality: Western Europe

Barcodes available: Yes

Notes: *Lepidonotus squamatus*, like *H. imbricata*, is morphologically diverse but also genetically diverse. A large-scale study by Carr et al. (2011) found that the species exhibited an unusually high level of genetic divergence, particularly between specimens from the Atlantic and Pacific basins. This indicates that it is likely a 'pseudo-cosmopolitan' species as defined by Darling and Carlton (2018) and proposed by David and Krick (2019). As a consequence, here we designate the species as being cryptogenic until more detailed morphogenetic studies can properly clarify the specimens from New England.

FAMILY SABELLIDAE

Parasabella microphthalma (Verrill, 1873)

Synonymized names: *Demonax microphthalma* (Verrill, 1873),

Sabella microphthalma Verrill, 1873**Status:** Native**Type Locality:** Vineyard Sound, Massachusetts**Barcodes available:** Yes

Notes: The distribution of *P. microphthalma* is almost exclusive to the western Atlantic with at least one report of the species as far south as the Gulf of Mexico (Felder and Camp, 2009).

Potamilla neglecta (Sars, 1851)

Synonymized names: *Aspeira modesta* Bush, 1905, *Sabella breviberbis* Langerhans, 1881, *Sabella neglecta* Sars, 1851

Status: Cryptogenic**Type Locality:** Norway**Barcodes available:** Yes

Notes: *Potamilla neglecta* has been reported from both Atlantic and Pacific basins (Imajima, 1961; Trott, 2004; Mark *et al.*, 2010) with little or no genetic information available for the species.

FAMILY: SABELLARIIDAE

Sabellaria vulgaris Verrill, 1873

Synonymized names: *Sabellaria falcigera* Johansson, 1927, *Sabellaria floridensis stephensoni* Hartman, 1949, *Sabellaria varians* Webster, 1879, *Sabellaria vulgaris beaufortensis* Hartman, 1944, *Sabellaria vulgaris vulgaris* Verrill, 1873

Status: Native**Type Locality:** Massachusetts, USA**Barcodes available:** Yes

Notes: This species has been reported from the northeastern United States to the Gulf of Mexico (Curtis, 1975; Felder and Camp, 2009).

FAMILY SERPULIDAE

Circeis spirillum (Linnaeus, 1758)

Synonymized names: *Dexiospira spirillum* (Linnaeus, 1758), *Janua (Dexiospira) spirillum* (Linnaeus, 1758), *Janua (Dexiospira) spirillum lucida* (Montagu, 1803), *Serpula cornea* Adams, 1800, *Serpula lucida* Montagu, 1803, *Serpula sinistorsa* Montagu, 1803, *Serpula spirillum* Linnaeus, 1758, *Spirillum pellucidum* Oken, 1815, *Spirorbis comptus* Bush, 1905, *Spirorbis cornea* (Adams, 1800), *Spirorbis fewkesii* Bush in Sumner, Osburn & Cole, 1913, *Spirorbis lucida* (Montagu, 1803), *Spirorbis reflexa* Adams in Morch, 1863, *Spirorbis spirillum* (Linnaeus, 1758)

Status: Cryptogenic**Type Locality:** Europe**Barcodes available:** Yes

Notes: Very little is known about the biogeography of *C. spirillum*.

Hydroides dianthus (Verrill, 1873)

Synonymized names: *Eupomatus dianthus* (Verrill, 1873), *Serpula dianthus* Verrill, 1873, *Serpula dianthus citrina* Verrill, 1873

Status: Native**Type Locality:** Connecticut, USA**Barcodes available:** Yes

Notes: *Hydroides dianthus* is a well-known fouling polychaete in the New England region and has an almost cosmopolitan distribution (Sun *et al.*, 2017). A previous study by Sun *et al.* (2017) found that populations of *H. dianthus* from the Mediterranean had higher levels of haplotype diversity compared to populations from the eastern United States, arguing that the former may be the native range for this worm. However, several factors elevate genetic diversity in a region (e.g., multiple introductions) or

reduce it (e.g., historical bottlenecks, sampling bias). In fact, a large portion of the eastern United States (e.g., Maine, Georgia, and the Carolinas) were not sampled in the Sun *et al.* (2017) study. Therefore, until a more comprehensive population genetic study is performed that adequately samples its eastern US range, we retain its native status in this region.

Janua heterostropha (Montagu, 1803)

Synonymized names: *Bushiella (Jugaria) granulata* (Linnaeus, 1767), *Janua (Dexiospira) pagenstecheri* (Quatrefages, 1866), *Janua (Dexiospira) pusilloides* (Bush, 1905), *Janua pagenstecheri* (Quatrefages, 1866), *Jugaria granulata* (Linnaeus, 1767), *Laeospira granulata* (Linnaeus, 1767), *Mera pusilla* Saint-Joseph, 1894, *Serpula granulata* Linnaeus, 1767, *Serpula heterostropha* Montagu, 1803, *Serpula minuta* Montagu, 1803, *Serpula sulcata* Adams, 1797, *Spirorbis (Dexiospira) pusilloides* (Bush, 1905), *Spirorbis (Janua) epichysis* Bailey, 1969, *Spirorbis (Janua) gnomonicus* Bailey, 1969, *Spirorbis affinis* Levinsen, 1883, *Spirorbis epichysis* Bailey, 1970, *Spirorbis fabricii* Malmgren, 1867, *Spirorbis granulata* (Linnaeus, 1767), *Spirorbis granulatus* (Linnaeus, 1767), *Spirorbis pagenstecheri* Quatrefages, 1866, *Spirorbis pagenstecheri incoloris* Gee, 1964, *Spirorbis pusilloides* Bush, 1905, *Spirorbis sulcata* Adams in Morch, 1863

Status: Cryptogenic**Type Locality:** England**Barcodes available:** No

Notes: *Janua heterostropha*, like *H. dianthus*, is a well-known fouling serpulid reported under this and other names from all oceans of the world (Knight-Jones *et al.*, 1975), doubtless in large part as a result of introductions via historical and contemporary shipping. Knight-Jones *et al.* (1975) suggested a European origin based on this species' breadth of physiological and ecological adaptations of this species to the climate of the Northeast Atlantic Ocean. However, in the absence of genetic data, and given the probability of a cryptic species complex, we conservatively treat it as cryptogenic here.

FAMILY SPIONIDAE

Dipolydora socialis (Schmarda, 1861)

Synonymized names: *Leucodore socialis* Schmarda, 1861, *Polydora socialis* (Schmarda, 1861)

Status: Unresolved cosmopolitan species**Type Locality:** Chile**Barcodes available:** Yes

Notes: *Dipolydora socialis* is assumed to have a cosmopolitan distribution because of its occurrence in multiple oceanic basins across the globe (see David *et al.*, 2021 and references therein); it falls into the 'unresolved cosmopolitan' category of Darling and Carlton (2018). *Dipolydora socialis* is frequently found associated with encrusting organisms such as sponges and coralline algae. In addition, the species has also been found associated with boring polychaetes that burrow into the shells of commercially reared shellfish such as oysters and abalone. As a consequence, it is possible that through vectors such as shipping and the aquaculture trade, the species has been able to disperse to multiple biogeographic regions. It should also be noted that many of the reports of *D. socialis* have not been accompanied by thorough taxonomic investigations, and considering the lack of genetic data available (Radashevsky *et al.*, 2023) especially from the type localities of this species, the possibility of the existence of a cryptic complex cannot be ruled out.

Polydora aggregata Blake, 1969**Synonymized names:** none**Status:** Native

Type Locality: Maine, USA

Barcodes available: No

Notes: Adults of *Polydora aggregata* were first described by Blake (1971), preceded by his description of its larvae (Blake, 1969). It ranges from northern New England (its type locality) to the Gulf of Mexico (Blake, 1971). Five specimens from Limfjord, Denmark, collected in 1981 and identified by Mary Petersen as *Polydora cf. aggregata*, on deposit at the Smithsonian Institution's National Museum of Natural History (USNM 71444), require re-examination.

***Polydora colonia* Moore, 1907**

Synonymized names: *Polydora ancistra* Jones, 1962, *Polydora hoplura inhaca* Day, 1957

Status: Cryptogenic

Type Locality: Massachusetts, USA

Barcodes available: Yes

Notes: *Polydora colonia* is exclusively a sponge borer and does not appear to exhibit any host-specificity (David and Williams, 2012; Gouillieux *et al.*, 2022). The species is morphologically similar to another exclusive sponge borer, *Polydora spongicola*, but a study by McGrail (2023) found that both species were genetically distinct, with *P. colonia* possessing species-specific posterior recurved 'boat' hooks that *P. spongicola* lacked. There is a limited amount of genetic data available for this species on the GenBank database. Historical reports of the species have largely been confined to the east coast of the United States. Day (1967) reported the species from South Africa, but a revision of his work currently underway in light of modern integrative taxonomic methods has yet to report this species in the region (see Simon *et al.*, 2022). The species was described on the New England coast by Blake (1971) and has been frequently reported from various sites along the western Atlantic. However, due to gaps in our understanding of this species' biogeography, David and Williams (2012) categorized *P. colonia* as cryptogenic for the region, and we reiterate that status here.

***Polydora cornuta* Bosc, 1802**

Synonymized names: *Polydora amaricola* Hartman, 1936, *Polydora ligni* Webster, 1879, *Polydora littorea* Verrill, 1881, *Spio caudatus* Lamarck, 1818

Status: Cryptogenic

Type Locality: South Carolina, USA

Barcodes available: Yes

Notes: *Polydora cornuta* is the type species for the genus *Polydora* (Blake, 1971). The species has a reported cosmopolitan distribution and is arguably the most widely distributed polydorid, being found within mudpacks on fouling communities and within the crevices of molluscs (Radashevsky, 2005). The species was reported throughout New England as far back as 1884 (Webster and Benedict, 1884) and was at one point considered native to the region, prior to Rice *et al.*'s (2008) discovery of reproductively isolated cohorts. *Polydora cornuta* remains an unresolved species complex, but despite the genetic divergence, Radashevsky (2005), using an extensive morphological dataset, concluded that there were insufficient taxonomically informative differences to warrant an assignment of unique species status to any of the isolated populations. While found as early as 1802 on the U.S. Atlantic coast, shipping from Europe and eventually from around the world, has touched the South Carolina coast since the 1500s. Nevertheless, it is regarded as introduced to the Pacific coast from British Columbia to California, initially with the extensive transport of Atlantic oysters (*Crassostrea virginica*) to the Eastern Pacific commencing in the 1870s (Cohen and Carlton, 1995).

***Polydora websteri* Hartman in Loosanoff and Engle, 1943**

Synonymized names: none

Status: Cryptogenic

Type Locality: Connecticut, USA

Barcodes available: Yes

Notes: Globally, *Polydora websteri* is an economically important and genetically homogenous species (Rice *et al.*, 2018; Rodewald *et al.*, 2021; Davinack *et al.*, 2024). It is an obligate shell borer where it is responsible for burrowing into the shells of commercially reared shellfish on every continent except Antarctica (Radashevsky *et al.*, 2006; Read, 2010; Sato-Okoshi *et al.*, 2013; Waser *et al.*, 2020; Rodewald *et al.*, 2021; Davinack *et al.*, 2024). The species' global genetic homogeneity has been attributed to repeated introductions as a result of the aquaculture trade (Rodewald *et al.*, 2021). *Polydora websteri* was once regarded as native to the New England region, but a study by Rice *et al.* (2018) focusing on the COI marker found that populations from Asia had the highest genetic diversity, indicating that this region could be the actual native range for *P. websteri*. However, it should be noted that genetic diversity can be elevated in a population if multiple introductions are occurring from different regions (Roman and Darling, 2007), while such diversity can be greatly reduced in another region as a result of historical bottlenecks. Therefore, we classify the species here as cryptogenic until a more comprehensive study incorporating additional markers and population genetic analyses can further clarify the issue.

***Spio setosa* Verrill, 1873**

Synonymized names: *Spio robusta* Verrill, 1873

Status: Native

Type Locality: Massachusetts (Vineyard Sound), USA

Barcodes available: Yes

Notes: *Spio setosa* is arguably one of the most well-studied spionids ecologically. Its feeding behavior has been reported by Bock and Miller (1997) and Dauer (2000), its reproduction and larval development by Simon (1967), its growth rates by Hentschel and Herrick (2005), and its bioturbative contributions to its intertidal habitat by Waldbusser *et al.* (2004). Based on the most recent description by Maciolek (1990), the species can easily be distinguished from other members of the genus *Spio* and is therefore unlikely to be part of a cryptic complex. Based on all of the historic and current occurrence reports, along with location information on every *S. setosa* voucher from the Smithsonian Institution National Museum of Natural History, the species' range appears to be exclusive to the western Atlantic indicating that it might be endemic to this region.

***Streblospio benedicti* Webster, 1879**

Synonymized names: *Streblospio lutincola* Hartman, 1936

Status: Native

Type Locality: New Jersey, USA

Barcodes available: Yes

Notes: *Streblospio benedicti* has a relatively widespread distribution, being reported as introduced to the Pacific coasts of the United States and to several regions in western Europe (Pernet and McArthur, 2006). A genetic study by Mahon *et al.* (2009) confirmed *S. benedicti* as a distinct species, undoing a previous synonymization with *Streblospio shrubsolii* (Buchanan, 1890) (Foster, 1971) and reiterating the native status of the species in the western Atlantic.

FAMILY SYLLIDAE

***Myrianida prolifera* (Müller, 1788)**

Synonymized names: *Autolytus agassizii* Quatrefages, 1866, *Autolytus ehbiensis* Saint Joseph, 1887, *Autolytus hesperidum*

Claparède, 1868, *Autolytus prolifer* (Müller, 1788), *Autolytus prolifera* (Müller, 1788), *Crithida prolifera* (Müller, 1788), *Nereis prolifera* Müller, 1788

Status: Cryptogenic

Type Locality: Norway

Barcodes available: Yes

Notes: *Myrianida prolifera* has been reported throughout the western and eastern Atlantic, Mediterranean Sea, and Arctic Oceans (Holly, 1938; Trott, 2004; Musco and Giangrande, 2005). Aside from a single *M. prolifera* barcode generated as a result of a redescription of another syllid (Nygren and Pleijel, 2010), there are no genetic data available for the species and very little identified material available in national collections. Further studies are needed to determine the status of this species in the New England region.

Proceraea prismatica (Müller, 1776)

Synonymized names: *Amytis prismatica* (Müller, 1776), *Autolytus (Proceraea) trilineatus* Berkeley & Berkeley, 1945, *Autolytus incertus* Malmgren, 1867, *Autolytus longosetosus* (Örsted, 1843), *Autolytus prismaticus* (Müller, 1776), *Autolytus trilineatus* Berkeley & Berkeley, 1945, *Nereis prismatica* Müller, 1776, *Nereisyllis prismatica* (Müller, 1776), *Polybostrichus longosetosus* Örsted, 1843, *Polybostrichus longosetus* [auct.], *Proceraea gracilis* [auct. misspelling]

Status: Native

Type Locality: Greenland (Arctic Ocean)

Barcodes available: Yes

Notes: *Proceraea prismatica* appears to have a very restricted range in the Arctic Ocean (Pettibone, 1963; Jørgensen and Gulliksen, 2001). Early reports from the eastern Atlantic were considered rare, isolated, or dubious by Hamond (2002). Very little is known about the worm's distribution in other regions where it has been reported, including the western Atlantic and the north Pacific. In New England, *P. prismatica* was recorded in only one survey (2000) at five marinas – three in the Gulf of Maine, one in New Hampshire, and one in Boston, Massachusetts.

Considering the latitudinal consistency, it is likely that these records may represent a part of its natural boreal and sub-boreal distribution.

Salvatoria clavata (Claparède, 1863)

Synonymized names: *Brania clavata* (Claparède, 1863), *Grubea clavata* (Claparède, 1863), *Grubea dolichopoda* Webster, 1879, *Grubea fusifera* Quatrefages, 1866, *Grubea websteri* Verrill, 1882, *Grubeosyllis clavata* (Claparède, 1863), *Pseudobrania clavata* (Claparède, 1863), *Salvatoria dolichopoda* (Marenzeller, 1874), *Syllis clavata* Claparède, 1863

Status: Cryptogenic

Type Locality: Normandy, France

Barcodes available: Yes

Notes: *Salvatoria clavata* was reported as the most dominant polychaete associated with marinas on the Iberian Peninsula and was regarded as an 'opportunistic' syllid in that study since it thrived in areas of environmental stress (Fernandez-Romero *et al.*, 2019). In contrast, on the New England coast, the species was only reported in one survey in 2000 at two sites (Woods Hole Coast Guard Station and the Marine Biological Laboratory, both in Woods Hole, Massachusetts) and has not appeared in any subsequent survey. The species has been reported worldwide (San Martín, 2003; Nascimento *et al.*, 2021). However, with only a single 18S rRNA sequence available on GenBank and no population genetic or biogeographic information available, it is impossible to determine its introduced status in any of these regions. To further complicate matters, San Martín (2003) noticed variation within taxonomically informative traits, indicative of a potential cryptic species complex.

Syllis gracilis Grube, 1840

Synonymized names: *Syllis (Syllis) gracilis* Grube, 1840, *Syllis (Syllis) longissima* Gravier, 1900, *Syllis brachycirris* Grube, 1857, *Syllis buchholziana* Grube, 1877, *Syllis longissima* Gravier, 1900, *Syllis mixosetosa* Bobretzky, 1870, *Syllis navicellidens* Czerniavsky, 1881, *Syllis nigrovittata* Czerniavsky, 1881, *Syllis nigro-vittata* Czerniavsky, 1881, *Syllis palifica* Ehlers, 1901, *Syllis quadridentata* Czerniavsky, 1881, *Syllis vancaurica* Grube, 1867

Status: Cryptogenic (Pseudocosmopolitan)

Type Locality: Gulf of Naples

Barcodes available: Yes

Notes: *Syllis gracilis* is an unresolved species complex and arguably one of the most difficult ones that has yet to be resolved. A complex of two lineages was first discovered using allozymes by Maltagliati *et al.* (2000). Since then, it has been shown that the species exhibits a remarkably high level of phenotypic plasticity in various regions (Langeneck *et al.*, 2020), which ultimately nullifies general taxonomic keys. Furthermore, even more divergent lineages have been discovered that do not correspond to morphotypes (Alvarez-Campos *et al.*, 2017). Finally, different species delineation tests have yielded conflicting results (Langeneck *et al.*, 2020). This species can best be thought of as pseudocosmopolitan and is regarded as cryptogenic here.

FAMILY TERESELLIDAE

Amphitrite cirrata Müller, 1776

Synonymized names: *Amphitrite cirrata* (Müller, 1776), *Amphitrite palmata* Moore, 1906, *Amphitrite radiata* Moore, 1908, *Nereis cirrosa* Linnaeus, 1767, *Sabella cirrata* (Müller, 1776), *Spio cirrata* König [pre-Linnaean], *Terebella cirrata* (Müller, 1776), *Terebella cirrhata* [auct. misspelling], *Terebella montagui* Quatrefages, 1866, *Teredo arenaria* Forsskål, 1775

Status: Cryptogenic

Type Locality: Scandinavia (exact location unknown)

Barcodes available: Yes

Notes: The location of the type material for *A. cirrata* is unknown but is believed to have originated from the Scandinavian region (Norway, Denmark, or Iceland). While this species has an extensive distribution with reports from the Mediterranean and the Pacific Ocean, and Africa, there are no molecular data to support these reports. Furthermore, Jirkov (2020) did not find the species in any of the Mediterranean or Pacific locations where it was reported. Jirkov (2020) also cast doubt on Day's (1967) report from the Cape of Good Hope and Senegal along with Hartman's (1969) description of the species from California. David and Krick (2019) used COI sequence data to report the species for the first time in rapid assessment surveys from New England (referred to as *Amphitrite cf. cirrata*), specifically at marinas located in Maine, Massachusetts, and New Hampshire. However, considering the lack of molecular data from many of the aforementioned regions, along with its challenging taxonomy (Hutchings and Kupriyanova, 2018; Jirkov, 2020), we categorize this species as cryptogenic to the New England coast.

Loimia sp.

Status: Cryptogenic

Notes: A *Loimia* species in our RAS samples (for example, from 2000 and 2003) has long been presented in Atlantic coast literature as *Loimia medusa* (Savigny, 1822), a tropical species with a type locality of the Gulf of Suez. *Loimia 'medusa'* (Savigny, 1822) has been reported from many habitats worldwide in the Atlantic, Pacific, and Indian Oceans, and doubtless represents a species complex, perhaps including introduced tropical or subtropical

populations. Our biofouling *Loimia* from the cold waters of New England represents an as-yet to be resolved species.

Neoamphitrite figulus (Dalyell, 1853)

Synonymized names: *Amphitrite figulus* (Dalyell, 1853), *Amphitrite johnstoni* Malmgren, 1866, *Amphitrite nana* Claparède, 1870, *Amphitrite stimpsoni* Meyer, 1912, *Terebella elongata* Quatrefages, 1866, *Terebella figulus* Dalyell, 1853

Status: Cryptogenic

Type Locality: United Kingdom

Barcodes available: Yes

Notes: *Neoamphitrite figulus* has been reported in both the eastern and western Atlantic in addition to the North Sea and the Mediterranean (Hartmann-Schröder, 1996; Brunel *et al.*, 1998; Bellan, 2001). The species is a well-known epibiont of the European oyster (*Ostrea edulis*) (Smyth and Roberts, 2010), which has had a long history of translocation to various parts of the world for oyster cultivation (Haydar and Wolff, 2011). As a consequence, it is difficult to determine the true native range for *N. figulus*, especially considering that there is a paucity of genetic data available for this species.

***Nicolea* sp.**

Status: Native

Notes: While the European terebellid *Nicolea zostericola* Ørsted, 1844, has been long reported from the Northwestern Atlantic Ocean, including New England (e.g., Sebens, 1986, from a subtidal rock wall in Nahant, Massachusetts), and while Lopez *et al.* (2014) considered it a possible cryptogenic species in Long Island Sound, de Matos Nogueira (2008, a paper overlooked by Lopez *et al.*, 2014) suggested that records of this species likely represent native taxa, including *N. cetrata* (now *Pista cetrata*), *N. simplex*, or *N. lazowasemi* (incorrectly originally spelled as *lazo-wasemi*). Reported in the RAS 2000, 2007, and 2013 surveys, we have not had access to these specimens to re-determine the species.

Pista palmata (Verrill, 1873)

Synonymized names: *Scionopsis palmata* Verrill, 1873

Status: Native

Type Locality: Vineyard Sound, Massachusetts, USA

Barcodes available: Yes

Notes: *Pista palmata* has a restricted distribution in the western Atlantic. The majority of occurrences of the species are between the New England region, Gulf of Mexico and the Caribbean (Hartman, 1951, 1959; Felder and Camp, 2009; Miloslavich *et al.*, 2010).

Terebella verrilli Holthe, 1986

Synonymized names: *Lepraea rubra* Verrill, 1873, *Terebella rubra* (Verrill, 1873)

Status: Native

Type Locality: Vineyard Sound, Massachusetts, USA

Barcodes available: No

Notes: According to de Matos Nogueira (2008), who examined *T. verrilli* specimens from both the western Atlantic, including the type locality, and the Mexican-Caribbean, there is ample morphological variation in specimens. Coupled with similar findings from previous reports, this suggests that a species complex could be present within what is likely a group native to the Northwest Atlantic Ocean.

Discussion

The current study presents the first annotated checklist of polychaetes from floating dock communities in New England and adjacent New York areas, marking a significant advancement in our understanding of marine biodiversity in marina

environments. These Rapid Assessment Surveys allow for the detection of trends and anomalies, the latter being an important feature as they are often associated with the appearance of a non-indigenous species as a result of translocation or range expansion of southern fauna. The predominance of cryptogenic species (61%) in our study highlights a critical challenge in marine biodiversity studies – the difficulty in determining the native status of many species. This is particularly relevant for polychaetes, which have complex life histories and exhibit high levels of cryptic diversity (Nygren, 2014), complicating efforts to categorize them as native or non-native. The high proportion of cryptogenic species also echoes the findings of previous studies, emphasizing the need for comprehensive taxonomic and genetic analyses to unravel the origins of these species (Darling and Carlton, 2018; David and Krick, 2019). Equally problematic is that many of the polychaetes on this checklist have been the subject of various ecological and physiological experimental research, with some, such as *P. dumerili*, serving as important laboratory model systems despite their taxonomy being unresolved. The apparently low number of introduced species in the current data set (we report only one, *Ctenodrilus serratus*) should not be taken to mean that non-native polychaetes are rare in New England, but, rather, may reflect that a large number of species are currently categorized as cryptogenic, the majority of which likely arrived long before any biosecurity efforts (such as the control of ballast water) were in place.

The vast majority of the polychaete families recovered was tubicolous (e.g., Spionidae, Serpulidae, Terebellidae, Sabellidae) which is not surprising considering that this ecological niche easily lends itself to anthropogenic-mediated transport mechanisms. For example, the adults of spionids, sabellids and terebellids live within mud-tubes of varying strength that can be found lodged among a variety of fouling organisms (such as mussels, barnacles, sponges, and algae) that commonly attach themselves to vessels. Members of the *Polydora*-complex that parasitize commercially reared shellfish are a prime example of species that can quickly spread across multiple biogeographic regions by hitchhiking on imported oysters, as well as burrowing into calcareous substrates (such as barnacles and oysters) on vessels (Williams *et al.*, 2017). Serpulids are unique due to their ability to create and reside within calcium carbonate tubes that can encrust on the hulls of ships, oysters, and hard structures that can be translocated from one region to the next (Bastida-Zavala *et al.*, 2017). Pettengill *et al.* (2007) using microsatellite loci to assess the genetic connectivity of the serpulid *Hydroides elegans* found that its dispersal across multiple global regions was likely the result of biofouling on ships.

The current checklist consists of several species that are part of cryptic complexes making it difficult to determine the species' true range, that in turn also makes it difficult to determine their origin. The most problematic species are those that have historically been referred to as 'cosmopolitan'. In developing this checklist, we adopted Hutchings and Kupriyanova's (2018) null hypothesis of assuming that these species have a narrower range than reported in the literature. The only exception was for species whose populations have been assessed genetically and whose biogeography has been resolved.

Our findings also revealed no significant difference in polychaete composition across marinas but did show a significant difference across years sampled. As expert polychaete taxonomists were involved over the years, we believe that these differences are largely not related to different workers being involved over time, although there are possible exceptions (as noted below). This temporal variation underscores the dynamic nature of floating dock communities, which can be influenced by a variety of factors including changes in environmental conditions, marina

management practices, and species dispersal events. The lack of distinct clustering in the NMDS plot suggests that while composition varies over time, these changes are not leading to the formation of distinct community assemblages by year. This could indicate a high degree of community resilience or reflect the influence of similar environmental and anthropogenic pressures across the study period.

The application of DNA barcoding in the identification process of the Rapid Assessment Survey, as initiated by David and Krick (2019) has proven to be invaluable in increasing the resolution of species diversity. For example, the phyllocid *Phyllococe groenlandica*, which has been reported on the New England coast for more than a century including during earlier surveys, was not recovered in the 2018 survey, but the morphologically similar *P. maculata* and *P. mucosa* were. This brings up the question of whether *P. groenlandica* had been misidentified during past biomonitoring surveys and opens the door for a revision of New England phyllococids. As taxonomy continues to evolve with the integration of genetic data, future surveys should incorporate these methodologies including eDNA surveys to ensure accurate species identification and status determination.

Limitations and Future Directions

One limitation of the rapid assessment survey is the reliance on presence/absence data, which does not account for the relative abundance of species. This built-in limitation is intentional as it allows for broader explorations, and can quickly detect anomalies and changes in species composition. Additionally, while our study has made significant strides in cataloguing polychaete diversity in the New England region, the high number of cryptogenic species identified points to the need for further taxonomic and biogeographic research to clarify the origins of many species. Unfortunately, due to a dearth of taxonomic specialists (Kholia and Fraser-Jenkins, 2011; McClain, 2011), the rate at which regional taxonomic revisions are occurring cannot keep pace with the speed of biotic changes. This disconnect can have severe consequences on biomonitoring surveys, which in turn can hamper conservation and management efforts. Finally, while DNA barcoding has invigorated the science of taxonomy, as Hutchings and Kupriyanova (2018) state, 'not all sequences are created equal.' Voucher-linked sequence data are good, voucher linked-sequence data from the type locality are even better, and barcodes obtained from type material are the gold-standard. Therefore, prudent mining of sequence data, regardless of which database they are pulled from, is a critical but often overlooked step in the barcoding workflow.

In conclusion, our findings provide not only a baseline for future research but also a framework for ongoing monitoring efforts aimed at understanding the integrity of marine ecosystems in the New England region. By highlighting the importance of these surveys and the complexities of polychaete taxonomy and biogeography, this study contributes to the broader understanding of marine biodiversity and the scale of non-native biodiversity in a rapidly changing marine environment.

Data. The data that support the findings of this study are available from the corresponding author, [A. D.], upon reasonable request.

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