2008 Boston Harbor Benthic Monitoring Report

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1. INTRODUCTION

The direct discharge of waste products into Boston Harbor for several decades had a profound impact on the sedimentary environment of the harbor, including degradation of the communities of organisms associated with the sediments. In 1985, in response to both the EPA mandate to institute secondary treatment and a Federal Court order to improve the condition of Boston Harbor, the newly created Massachusetts Water Resources Authority (MWRA) instituted a multifaceted approach to upgrading the sewage treatment system, including an upgrade in the treatment facility itself and construction of a new outfall pipe to carry the treated effluent to a diffuser system located 9.5 mi offshore in Massachusetts Bay.

Starting in 1991, the MWRA has conducted monitoring in Boston Harbor to evaluate changes to the system as contaminated discharges into the harbor were reduced. Summaries of the pollution abatement activities and the impact on the harbor can be found in several technical reports maintained on the MWRA's website: http://www.mwra.state.ma.us/harbor/enquad/trlist.html.

The purpose of this summary report is to present key findings from the 2008 sampling season, including several chemical parameters and the evaluation of the soft-bottom benthic community through sediment profile images (SPI) and taxonomic evaluation of grab samples. A comprehensive evaluation of the long-term sediment monitoring data collected since 1991 is provided in the 2007 harbor benthic monitoring report (Maciolek et al. 2008).

2. METHODS

Methods used to collect, analyze, and evaluate all sample types are consistent with those reported by Maciolek et al. (2008) for previous monitoring years. SPI samples were collected in triplicate at 60 reconnaissance stations (Figure 1). Nine stations were sampled for grain size composition, total organic carbon (TOC), the sewage tracer *Clostridium perfringens*, sediment chemistry, and benthic infauna. Sediment data (i.e., individual replicate and station mean values) were evaluated on a station- and harbor-wide basis to assess spatial and temporal trends, if any, among the data. The harbor-wide data were also evaluated in context of the four discharge periods established by Taylor (2006). For benthic community and sediment chemical evaluations, the periods were offset by plus one year to allow for a lag in response time, as follows:

- Period I – including data from 1991 and 1992
- Period II – including data from 1993 to 1998
- Period III – including data from 1999 to 2001
- Period IV – including data from 2002 to 2008

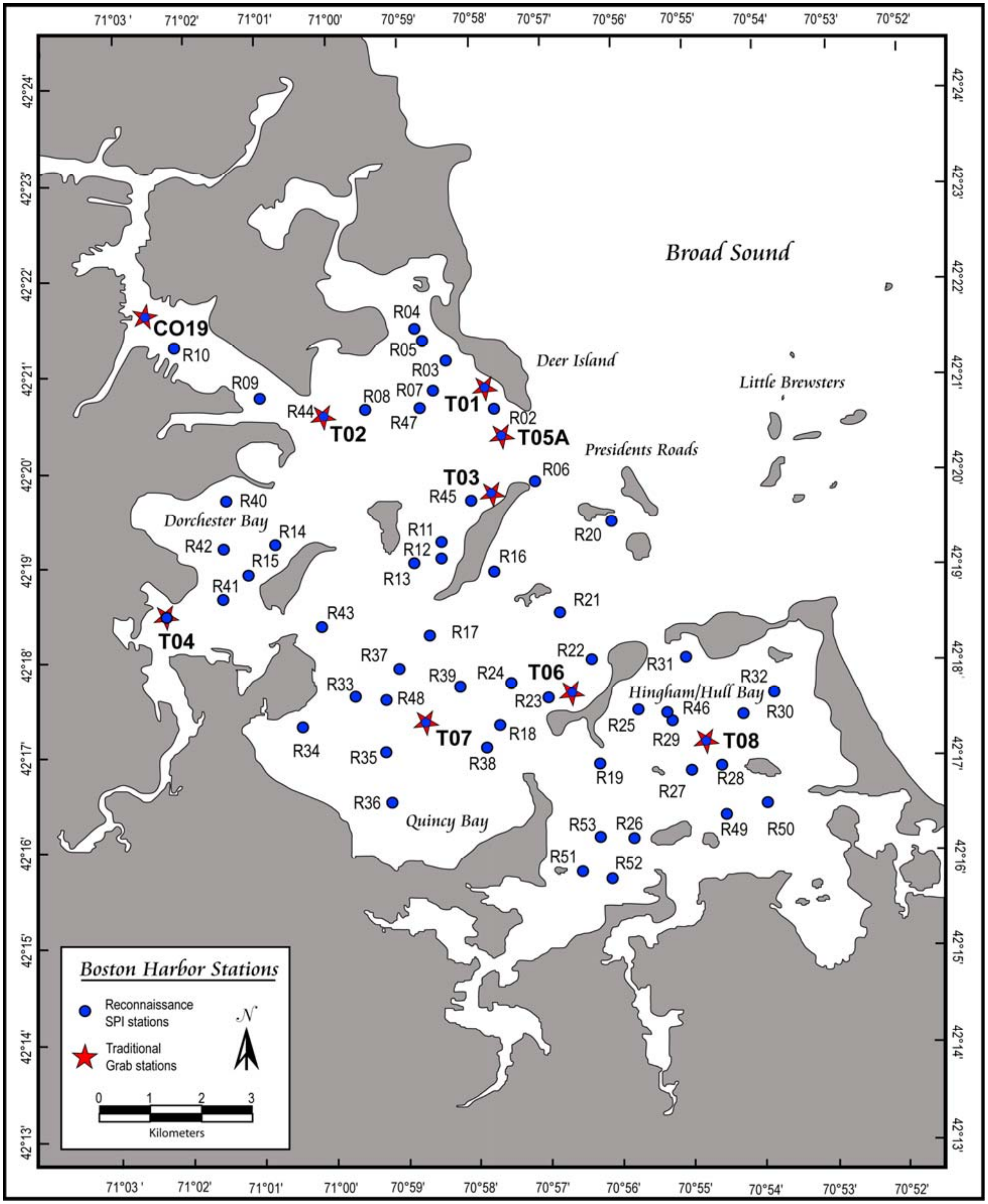


Figure 1. Locations of benthic stations in Boston Harbor sampled in August 2008. All stations were sampled by SPI and those denoted by star symbols were also sampled by grab.

3. RESULTS

3.1 2008 Sediment Chemistry

Grain Size. Results for 2008 were consistent with grain-size data from the larger monitoring period (1991–2007; Maciolek et al. 2008). Surface sediments in Boston Harbor include a wide range of sediment types, including coarse- and fine-grained sediments (Figure 2). Harbor stations T01, T05A, and T08 generally have coarse-grained sediments; stations T04 and CO19 have fine-grained (silty) sediment; and stations T02, T03, T06, and T07 were comprised of sediments with roughly equal parts coarse- and fine-grained material (Figure B1-1 in Maciolek et al. 2008).

Grain-size composition has changed significantly over time at stations T02 (Figure 3) and T07, as evidenced by a significant increase in percent fines. Temporal changes in sediment environments at the other harbor stations have been difficult to discern because of the high variability among the data over time.

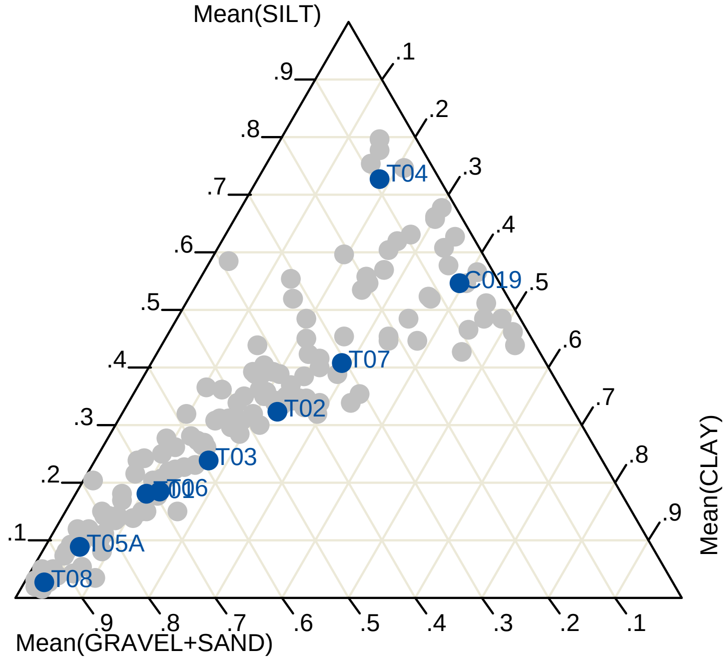


Figure 2. Distribution of percentages of gravel+sand, silt, and clay in surface sediment at Boston Harbor, 1991–2008. (Gray symbols represent 1991–2007 station mean values; blue symbols represent the 2008 station mean values, labeled with the station number).

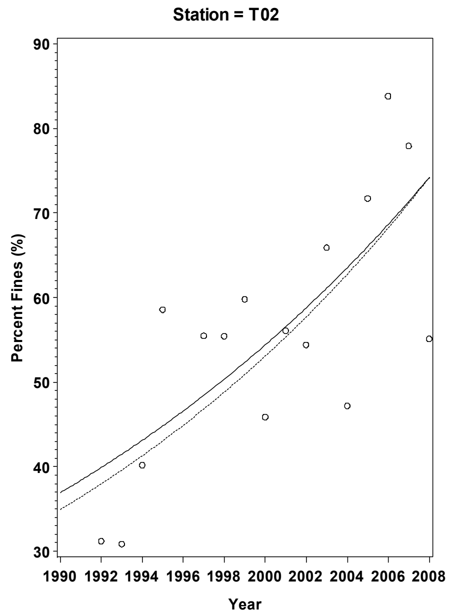


Figure 3. Increasing trends in percent fines in surface sediment at station T02, 1992–2008 (outlier years 1991 and 1996 excluded).

Total Organic Carbon. Results for 2008 were consistent with data from the larger monitoring period (1991–2007; Maciolek et al. 2008). Fine-grained sediments (e.g., station T04) typically had higher TOC compared with coarse-grained sediments (e.g., stations T05A and T08) (Figure 4A, B). Station T04, located in a depositional area considered to be a focus area for accumulation of sediment and contaminants entering Boston Harbor (Wallace et al. 1991; Stolzenbach and Adams 1998), consistently had the highest TOC (mean = 4.4%) relative to other harbor stations (Figure 4A). The lowest TOC content was measured at stations T08 and T05A (mean values <0.8%, Figure 4A).

TOC content in 2008 was among the lowest levels measured in recent years at many of the harbor stations (Figure 4A). TOC decreased significantly over time at stations T01, T03, and T06[1] (representative station T01 shown in Figure 5). TOC content and variability also appears to be decreasing harbor-wide over the four discharge periods (Figure 6), albeit the decrease in mean concentrations is not significant.

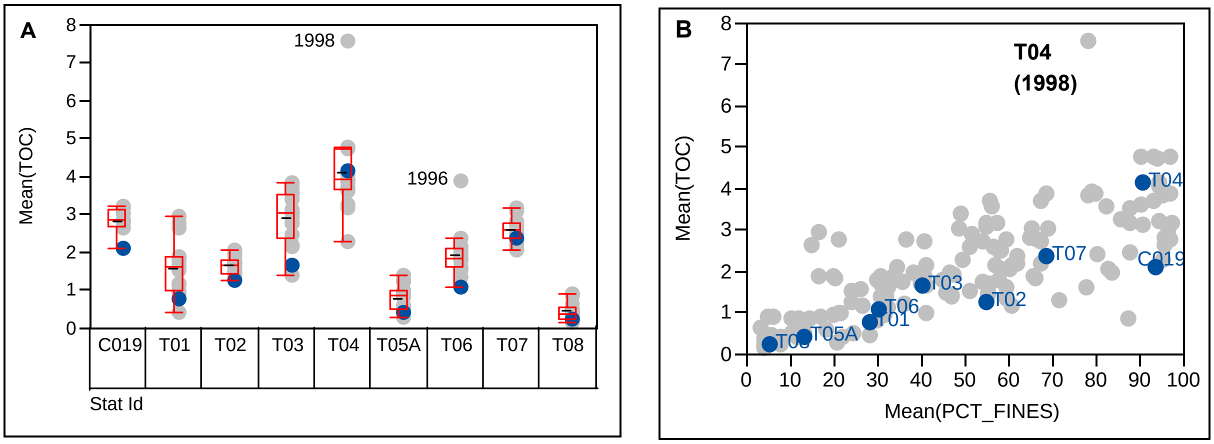


Figure 4. Distribution of TOC, by station (A) and in correspondence with percent fines (B), in surface sediment in Boston Harbor, 1991–2008. Gray symbols represent 1991–2007 station mean values; blue symbols represent 2008 station mean values.

[1] The significance of the decrease at T06 is influenced by the very low TOC content measured in 2008.

Clostridium perfringens. There was a significant difference in the abundances of *C. perfringens* (normalized to percent fines) over time at many of the harbor stations. That is, abundances decreased significantly over time at stations T02, T05A, T06, and T08 and increased significantly over time at station CO19. Abundances also decreased at station T01 (Figure 5), although the decrease was not significant at the 95% level of confidence (p = 0.08). The largest harbor-wide decrease in abundances of *C. perfringens* (normalized to percent fines) occurred between Periods I and III (Figure 6), and a statistical analysis indicates that harbor-wide abundances from the Period III and IV discharge periods were significantly lower than those measured in Periods I and II (p = <0.001).

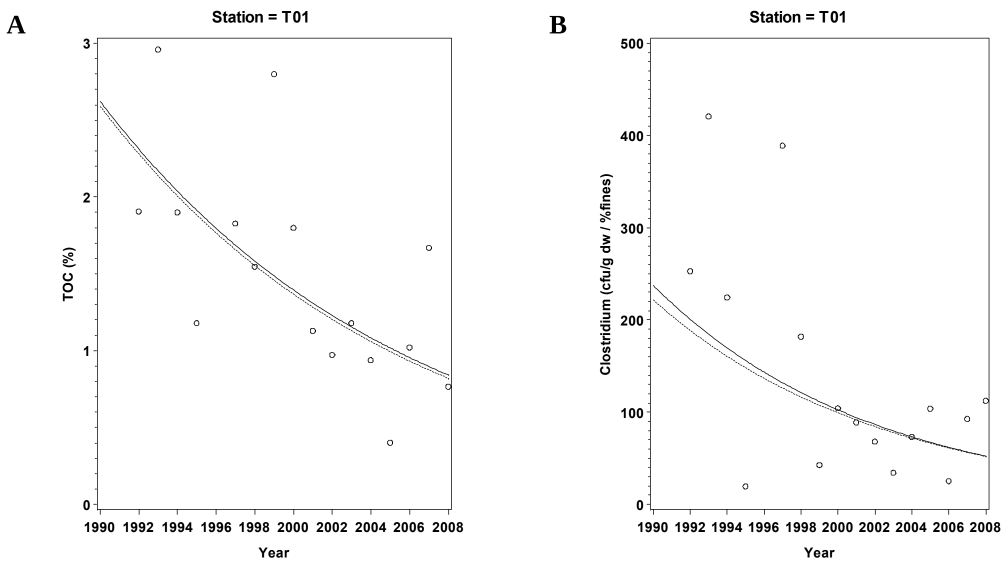


Figure 5. Decreasing trends in (A) TOC (*p* = 0.08) and (B) *C. perfringens* (normalized to percent fines, *p* <0.05) at station T01 from 1992 to 2008 (outlier years 1991 and 1996 excluded).

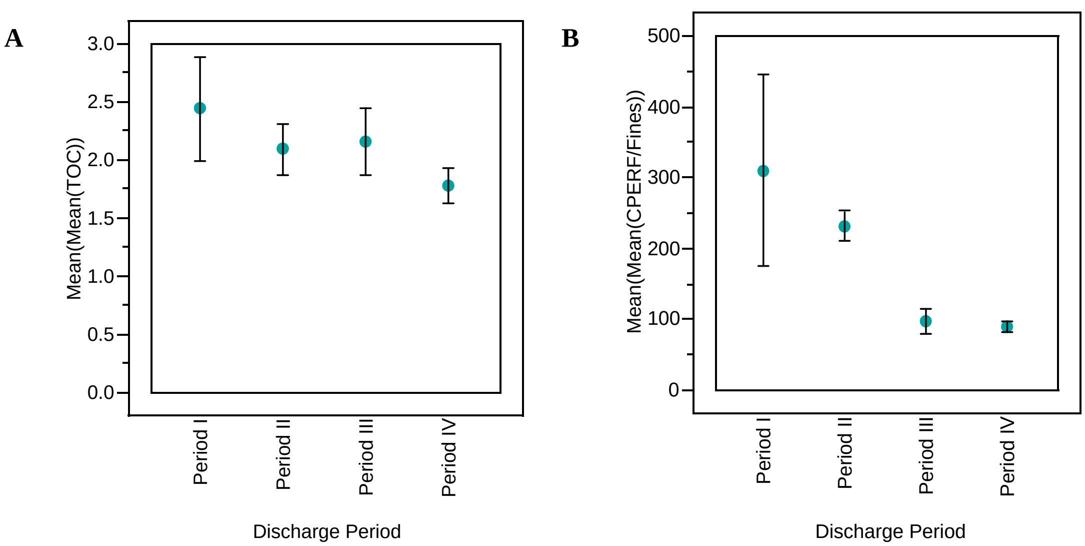


Figure 6. Trends in harbor-wide TOC (*p* = 0.36) and *C. perfringens* (normalized to percent fines, *p* < 0.001) from 1992 to 2008. Symbols represent the harbor-wide mean and vertical bars represent the standard error around the mean (outlier years 1991 and 1996 and station CO19 excluded).

3.2 2008 Sediment Profile Imaging

From 1992 to 2008, there were large changes in organic inputs to the harbor related to upgrades and relocation of outfalls; these changes led to improvements in benthic habitat quality for infauna. There were increases in deeper, bioturbating species, which likely increased trophic complexity. An inner-to-outer harbor gradient remains the prominent factor in controlling benthic habitat quality.

Overall, sediments in 2008 were similar to those in 2007 and other years. Estimated successional stage (SS) and the organism-sediment index (OSI) trended up and the aRPD layer depth trended deeper. Biogenic structures also appeared to increase in 2008 relative to 2007. For the first time in the monitoring program, eel grass colonized station R08 on Deer Island Flats (Figure 7). Physical processes remained prominent in structuring surface sediments in 2008. Microalgal mats, which were observed at 18% of stations in 2007, were not observed in 2008. Only station CO19 may have had a microalgal mat.

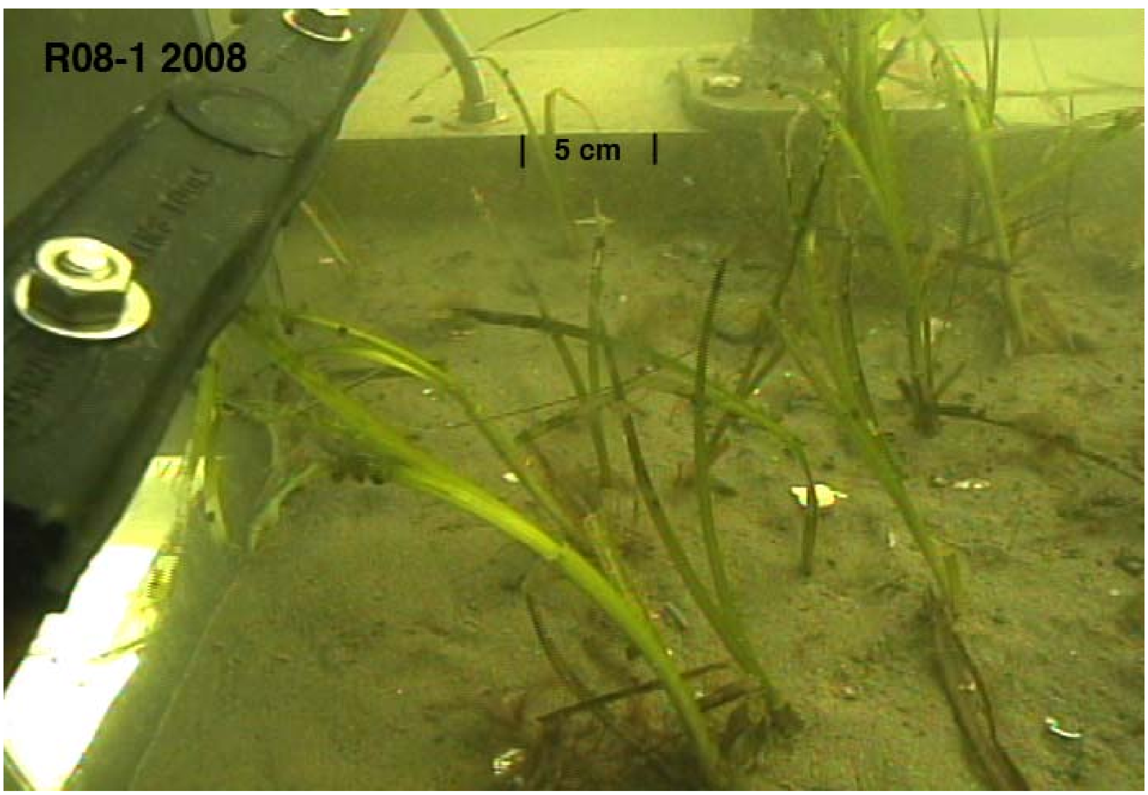


Figure 7. Eel grass bed at station R08.

In 2008, *Ampelisca* spp. tubes appeared at mat densities at 10 stations, and at less-than-mat densities at 25 stations. Overall, this represents the third consecutive year for an increase in tube mats over 2005, when no station had mat densities (Figure 8). Over the 16 years of SPI monitoring (1993–2008), station R21 had amphipod mats in all years except 2005 and R20 had mats in all years except 2005 and 2006. The percentage of stations with *Ampelisca* spp. tubes increased from 43% in 2007 to 58% in 2008 (Figure 9). Mats persisted the longest in the outer harbor and southern harbor regions. Mats have never been common in the inner harbor areas.

In 2008, 15 stations had enhanced levels of bioturbation that appeared to be related to the presence of the amphipod *Leptocheirus pinguis* (Figure 10). Several stations had what appeared to be larger *Ampelisca*-like tubes that were about 0.5 cm wide (Figure 11). Typically, *Ampelisca* spp. tubes are about 0.3 cm wide.

The occurrence of epifaunal organisms in 2008 appeared to be lower than in 2007, with most being hermit crabs. Small fish were seen at two stations: R08 in an eel grass bed and R13 over a soft-sediment bottom.

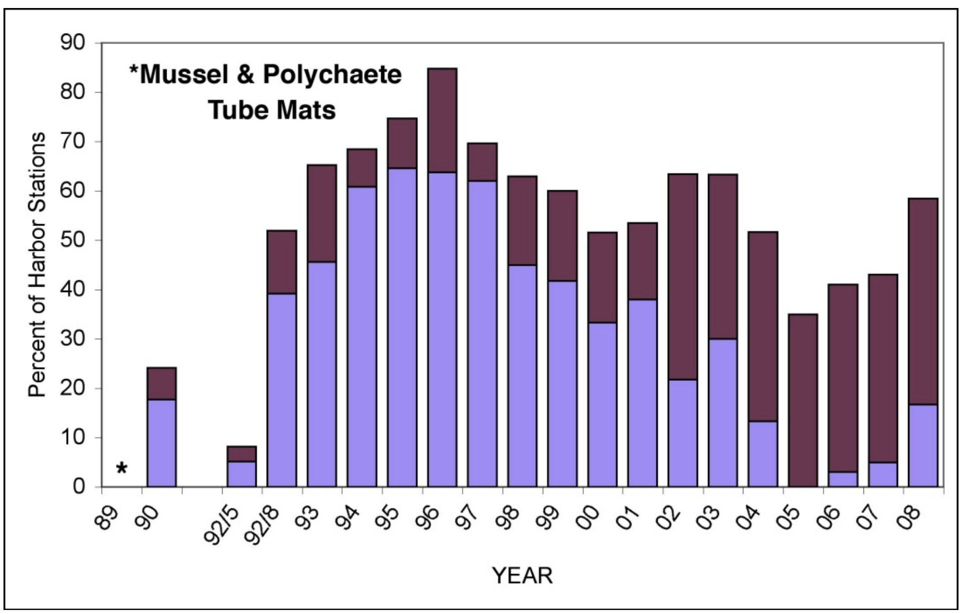


Figure 8. Histogram of *Ampelisca* spp. tubes present at harbor stations. Percent of stations with mats densities of tubes are in blue.

Legend
- None
+ Present
MAT

		Taylor Periods																		
		I	II	II	II	II	II	II	II	III	III	IVa	IVa	IVa	IVa	IVb	IVb	IVb	IVb
		1990	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CHARLES RIVER	C019	.	.	.	.	.	.	.	.	.	.	.	.	.	-	-	-	-	-
	R09	-	.	-	MAT	-	MAT	MAT	MAT	MAT	+	MAT	+	+	+	-	-	-	-
	R10	-	.	-	-	-	-	+	-	MAT	-	-	-	-	-	-	-	-	-
DORCHESTER BAY	R14	.	.	-	MAT	MAT	MAT	MAT	MAT	-	-	MAT	-	+	-	-	+	-	-
	R15	.	.	+	-	MAT	+	-	-	-	-	-	-	-	+	-	-	-	-
	R40	-	.	-	-	+	+	-	+	-	-	+	+	-	+	+	-	-	+
	R41	-	.	-	MAT	MAT	MAT	MAT	+	-	+	+	MAT	+	+	-	-	-	+
	R42	-	.	-	-	-	-	-	-	-	-	-	+	-	+	+	+	-	-
	R43	-	.	+	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-
	T04	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QUINCY BAY	R18	.	.	MAT	MAT	-	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	+	+	+	+	MAT
	R33	-	.	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+
	R34	-	.	-	-	-	+	-	-	-	-	.	-	-	-	-	-	-	-
	R35	-	.	-	-	MAT	-	-	-	-	-	.	-	-	-	+	-	-	-
	R36	-	.	-	-	-	-	-	-	-	-	.	-	-	-	-	-	-	-
	R37	+	.	+	-	MAT	-	+	+	+	-	-	+	+	+	-	-	-	+
	R38	+	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	+	MAT	+	-	+	+	+
	R39	-	.	MAT	MAT	MAT	MAT	+	MAT	+	MAT	+	MAT	-	-	-	+	-	+
	R48	-	.	.	.	-	-	-	+	-	+	+	+	+	+	-	-	-	-
	T07	.	+	+	-	MAT	MAT	-	-	-	-	+	-	+	-	-	+	-	+
DEER ISLAND FLATS	R02	.	.	MAT	MAT	+	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	-	+	+	MAT	MAT
	R03	.	.	+	MAT	MAT	MAT	MAT	MAT	+	+	+	+	MAT	-	-	-	+	+
	R04	.	.	-	MAT	MAT	+	-	-	-	-	MAT	-	-	-	-	-	-	-
	R05	.	.	-	MAT	MAT	+	-	MAT	+	+	+	+	+	+	-	-	-	+
	R07	.	.	-	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	+	-	-	+	+
	R47	.	.	.	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	-	+	+	MAT
	T01	.	-	-	-	-	+	-	-	-	-	-	+	-	-	+	-	-	-
	R08	-	.	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
OFF LONG ISLAND	R11	.	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	-	-	-	+	+
	R12	.	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	-	-	-	-	+
	R13	.	.	+	MAT	+	+	-	-	-	-	MAT	-	-	-	-	-	-	-
	R16	+	.	MAT	+	MAT	MAT	MAT	MAT	MAT	MAT	+	-	+	-	+	-	+	+
	R17	+	.	MAT	MAT	MAT	+	MAT	MAT	MAT	MAT	-	+	-	-	+	-	+	-
	R45	.	.	.	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	+	+	+	+	MAT
	T03	+	MAT	-	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	+	+	MAT
	R06	.	.	MAT	+	-	-	-	-	-	-	+	-	+	+	-	-	-	-
PRESIDENT ROADS	R44	.	.	.	.	MAT	-	-	MAT	-	+	MAT	+	+	-	-	-	-	-
	T02	-	-	+	MAT	MAT	+	MAT	+	+	MAT	+	-	+	+	-	-	+	+
	T05a	.	-	.	-	MAT	MAT	MAT	-	-	-	MAT	-	MAT	MAT	+	-	+	+
NANTASKET ROADS	R21	+	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	MAT	MAT
	R22	-	.	MAT	MAT	MAT	+	MAT	MAT	MAT	MAT	MAT	+	+	-	+	+	-	-
	R23	-	.	MAT	MAT	MAT	MAT	MAT	+	+	MAT	MAT	+	+	+	+	-	+	+
	R24	+	.	MAT	MAT	MAT	MAT	+	MAT	MAT	MAT	MAT	+	+	-	-	+	+	MAT
	T06	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	MAT	-	-	+	+
	R20	+	.	MAT	MAT	MAT	MAT	MAT	-	MAT	MAT	MAT	MAT	MAT	MAT	+	+	MAT	MAT
HINGHAM BAY	R19	.	.	+	+	-	MAT	-	-	+	-	-	-	+	+	-	-	-	-
	R25	.	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	-	-	MAT	-	-	-	-	-
	R26	-	.	MAT	-	+	MAT	+	+	+	-	-	-	-	-	-	-	-	+
	R27	-	-	+	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	+	-	+	+	+
	R28	-	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	MAT	+	+	+	+
	R29	-	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	+	+	+
	R30	.	+	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	MAT	+	+	MAT	+	MAT
	R31	+	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	-	+	-	+
	R32	.	+	+	MAT	-	MAT	-	+	+	-	MAT	-	-	+	-	-	-	+
	R46	+	.	.	.	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	MAT	+	+	+	+
	R49	.	.	.	.	-	MAT	-	+	-	-	-	+	-	+	-	+	-	-
	R50	+	.	.	.	MAT	MAT	MAT	MAT	+	MAT	-	+	+	-	+	+	+	+
	R51	-	.	.	.	+	MAT	-	+	+	-	-	-	-	-	-	+	+	-
	R52	+	.	.	.	-	MAT	-	-	-	-	-	-	-	-	-	-	-	-
	R53	-	.	.	.	+	MAT	-	-	-	+	-	+	-	-	-	-	-	-
	T08	.	MAT	MAT	+	MAT	-	MAT	-	+	-	MAT	+	+	+	+	+	+	MAT

Figure 9. Pattern of *Ampelisca* spp. occurrence through time for all harbor stations.

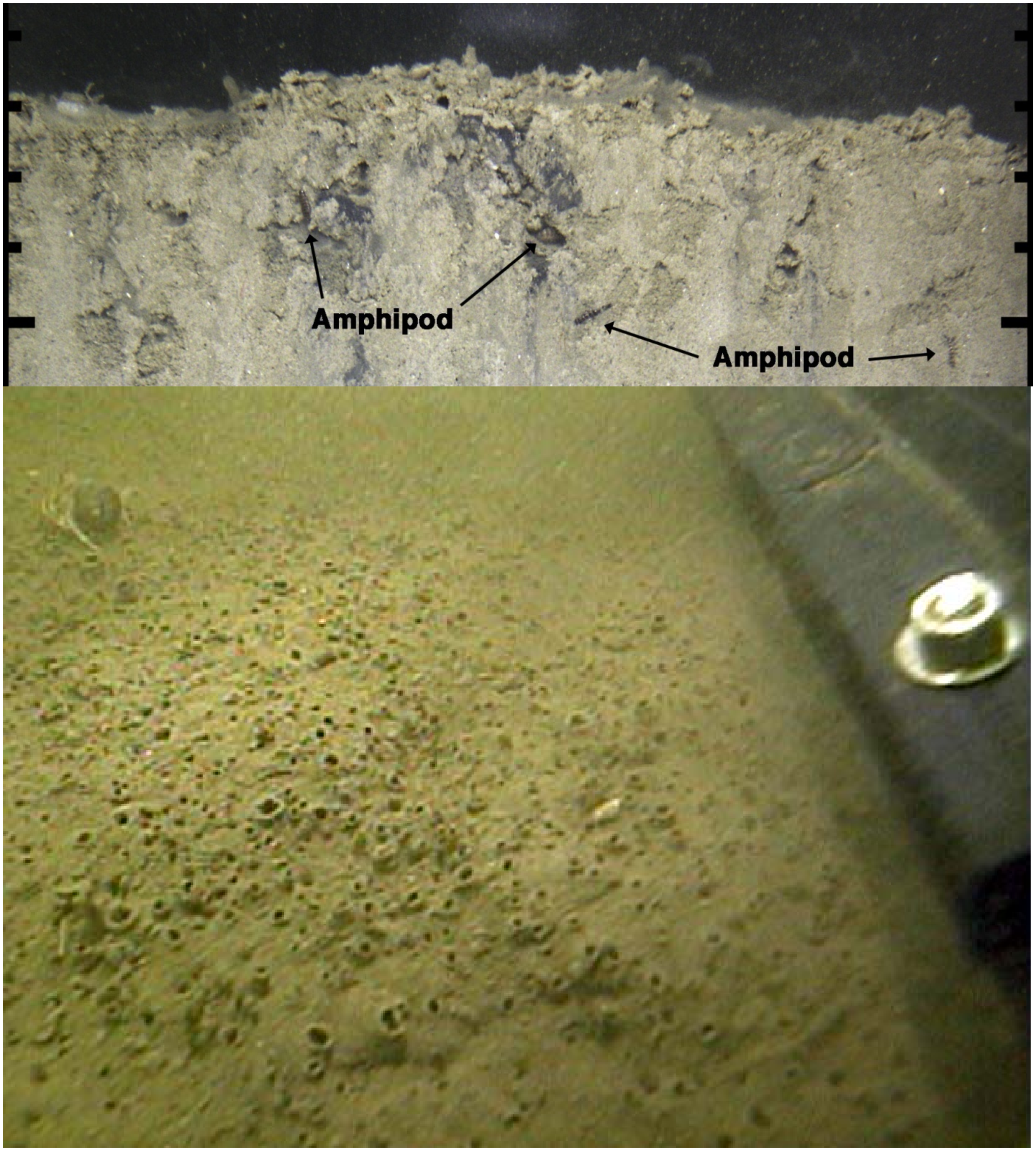


Figure 10. Bioturbation by *Leptocheirus pinguis* in 2008 at station R46 (SPI image) and R07 (surface image). Tubes of *Ampelisca* spp. are at the sediment surface. Scale is in cm units.

Figure 11. Larger-than-usual amphipod tubes, Station T08, replicate 2. Scale is in cm units.

The aRPD layer depth deepened in 2008, likely related to an increase in oxic voids and bioturbation by amphipods (Figure 12).

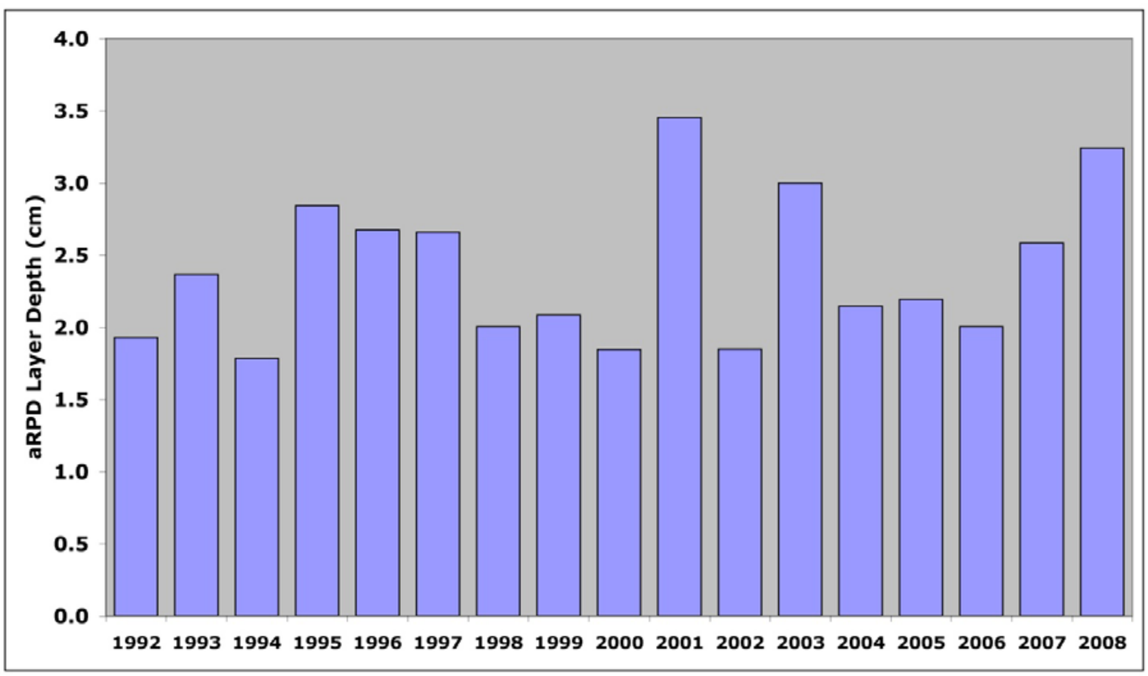


Figure 12. Average aRPD layer depth at Boston Harbor stations by year.

3.3 2008 Soft-Bottom Benthic Infaunal Communities

Harbor-wide results. Twenty-seven benthic grab samples were collected from Boston Harbor stations in August 2008; benthic community parameters were calculated for each of the samples (Appendix A) as in previous years (Maciolek et al. 2008). Samples collected from the eight traditional grab stations in the harbor indicated a large increase in abundance compared with 2007 (Figure 13). This increase was due primarily to increases in the density of two species, the polychaete *Polydora cornuta* and the amphipod *Leptocheirus pinguis*. The total abundance of species of the amphipod genus *Ampelisca* was only slightly higher than in 2007 (Figure 14, but see section 3.2); this taxon was most common at stations T03 and T05A as in past years, but still at greatly reduced densities compared with 2003–2004.

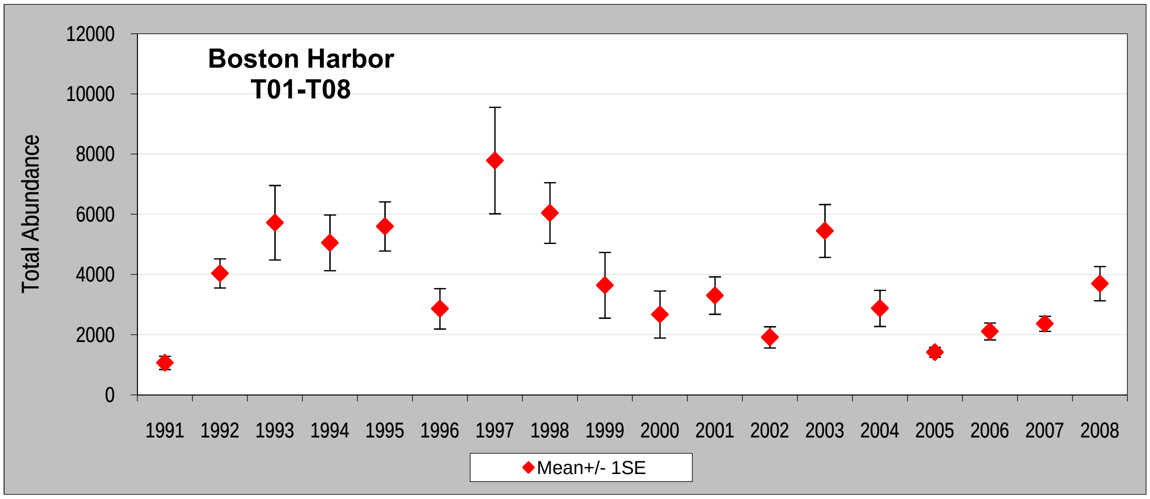


Figure 13. Mean total abundance for eight Boston Harbor stations in August 1991–2008.

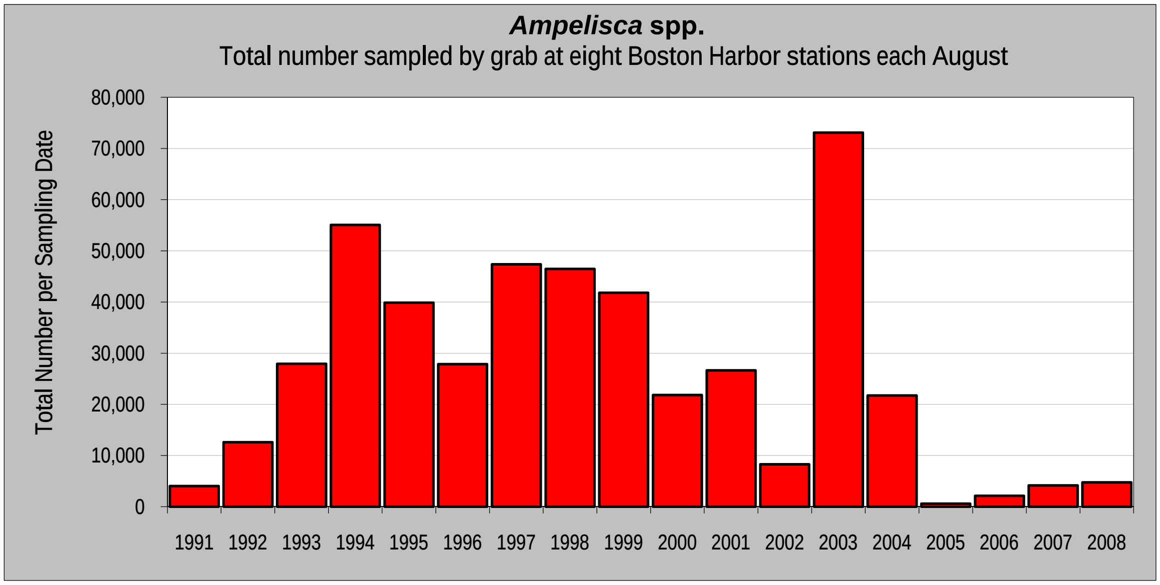


Figure 14. Total number of *Ampelisca* at Boston Harbor stations in August 1991–2008.

Mean species richness in 2008 was the highest recorded in the program to date, and much higher than in 2007 (Figure 15), having increased at all stations except stations T05A and T08 and with only a minor increase at station T04. Mean species richness in 2008 (52.1 ± 3.4 taxa) was similar to that recorded in 2003 (51.0 ± 3.5 taxa).

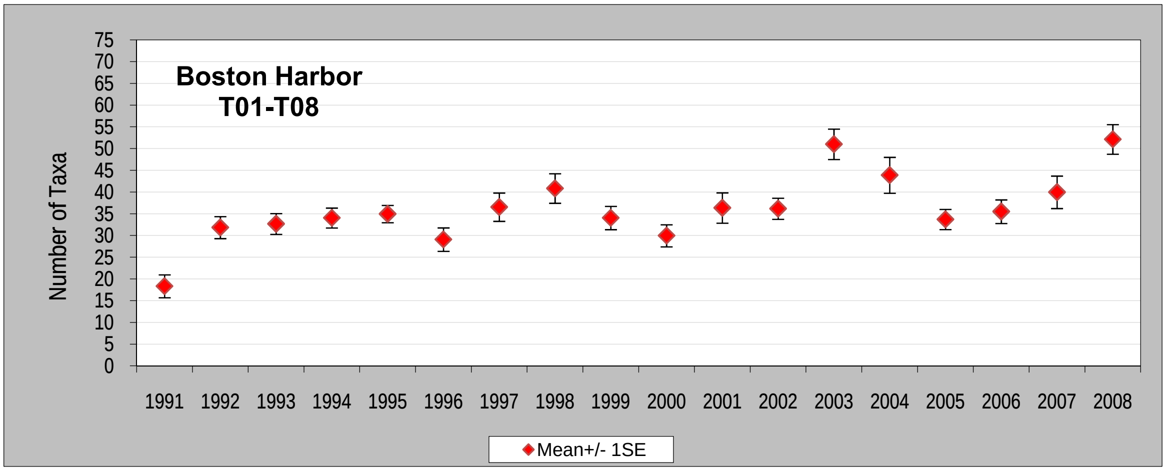


Figure 15. Mean species richness for eight Boston Harbor stations in August 1991–2008.

The numerically dominant species in the harbor were somewhat different in 2008 compared with 2007 (Table 1). *Nephtys cornuta*, the small polychaete that dominated most stations since 2005, continued to decline from its 2006 peak abundance. Another polychaete, *Polydora cornuta*, which has been common in the harbor throughout the monitoring period, increased in abundance and was the top numerical dominant at four of eight stations (Figure 16, Table 1).

Table 1. Dominant taxa at eight grab stations in Boston Harbor in August 2009.

Taxon	Total Abundance	Comparison with 2007	Stations where top dominant in 2008
Polydora cornuta	29, 646	nearly 3.5 x 2007 density	T01, T02, T06, T07
Leptocheirus pinguis	10,363	more than 2 x 2007 density	
Nephtys cornuta	5,543	~50% of 2007 abundance	
Ampelisca abdita/vadorum /spp.	4,769	~15% increase	T05A
Tubificoides apectinatus	4,381	no change	
Limnodriloides medioporus	3,670	~16% decrease	
Streblospio benedicti	3,606	not among top dominants in 2007	T04
Prionospio steenstrupi	2,796	not among top dominants in 2007	
Scoletoma hebes	2,394	not among top dominants in 2007	
Aricidea catherinae	2,262	~30% decrease	T03

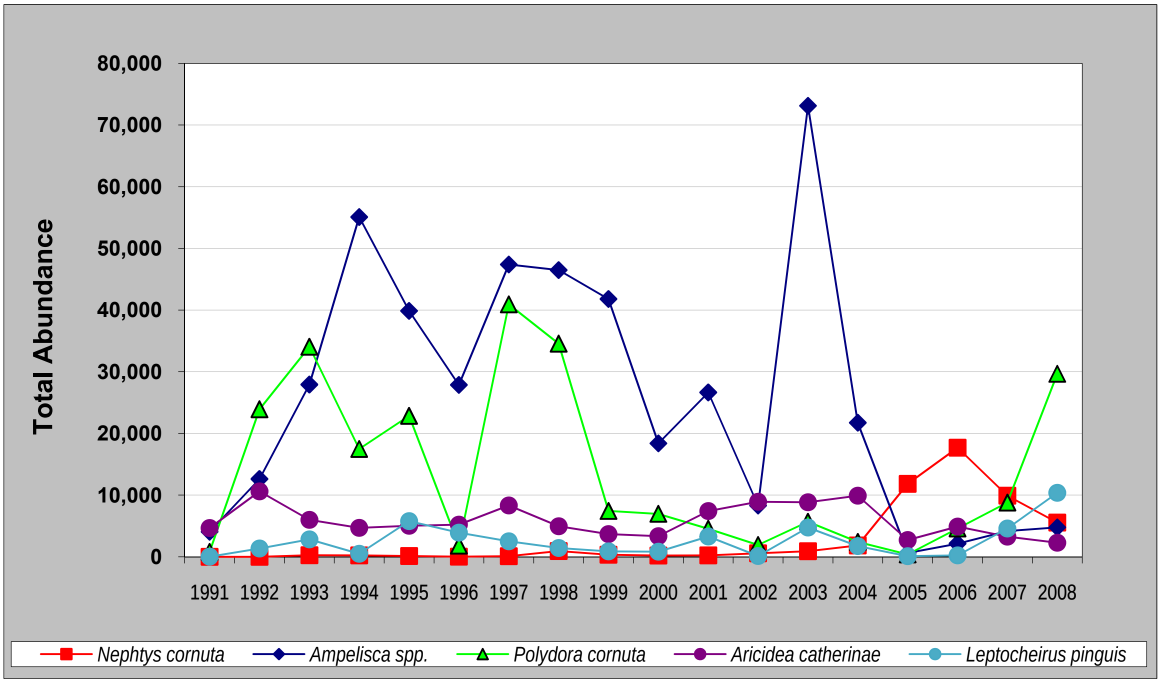
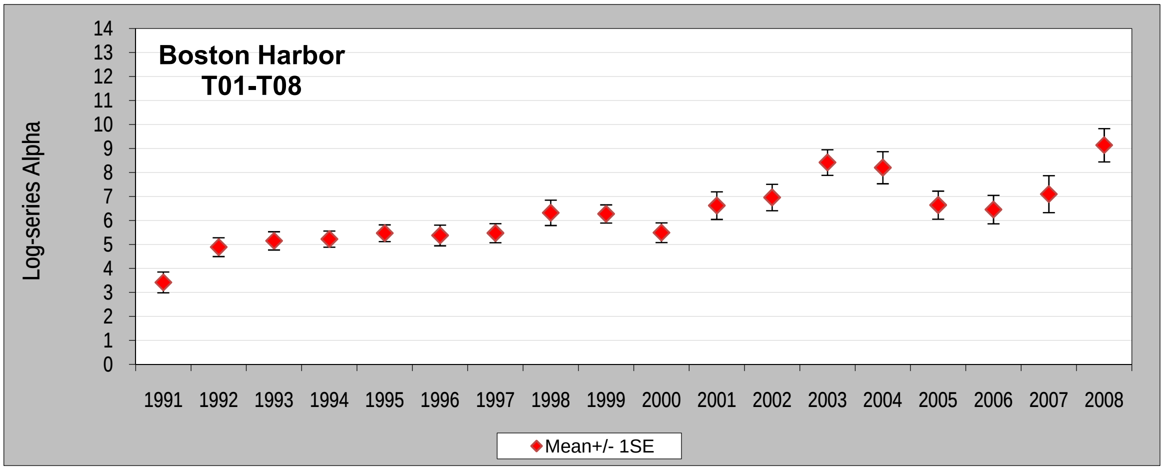


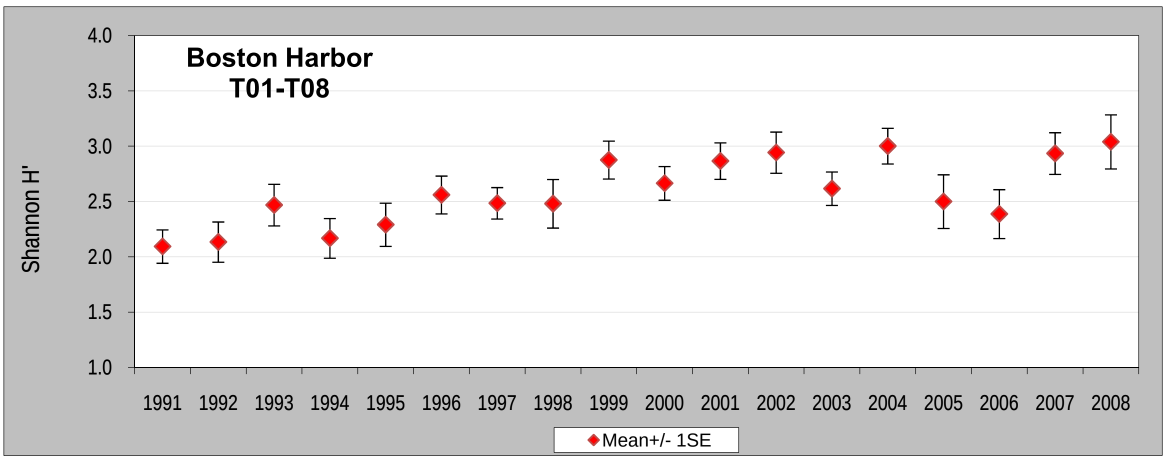
Figure 16. Annual density of five common species in Boston Harbor for the period 1991–2008.

Mean diversity as measured by Fisher's log-series *alpha* and Shannon's H′ increased between 2007 and 2008 (Figure 17), although the difference was not reflected by the Shannon index (3.04 in 2008 vs. 2.93 in 2007) as clearly as by Fisher's *alpha* (9.13 in 2008 vs. 7.10 in 2007). Evenness (J′) was a little lower in 2008 (0.53 ± 0.4 in 20008 vs. 0.56 ± 0.02 in 2007) (Figure 17).

T01. Changes over time in Boston Harbor are exemplified by the changes seen at T01, in the northern part of the harbor near Deer Island Flats (see Figure 1 for location). Community diversity, as represented by the rarefaction curves in Figure 18, increased after the divergence of the discharge from the habor in September 2000. Only years 2002–2004 had higher diversity than 2008.

Multivariate analysis indicated that the years 2006–2008 were very different from all other years at T01 (Figure 19A): the increase in numbers of *Nephtys cornuta*, as well as *Limnodriloides medioporus* and *Tharyx* spp., accounted for this difference (Figure19B). Similarly, the years before the divergence of the discharge (1991–2000), differ from the years immediately after the divergence (2001–2005) due to higher abundances of *Streblospio benedicti* in the earlier years, and higher abundances of species associated with cleaner, sandier sediments (e.g., *Exogone hebes* and *Leptocheirus pinguis*) in later years (Figure 19A, B).





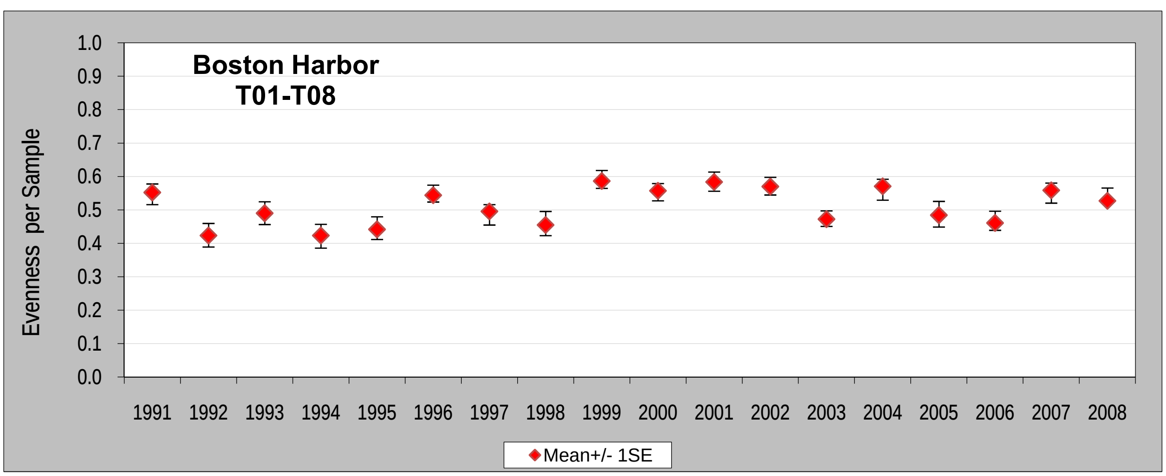


Figure 17. Mean species diversity and evenness for eight Boston Harbor stations in August 1991–2008.

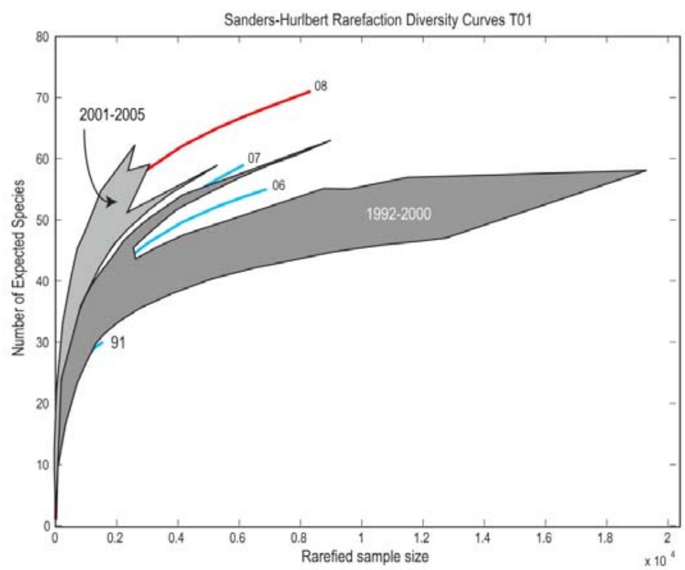


Figure 18. Rarefaction curves for station T01 off Deer Island flats in Boston Harbor, 1991–2008. All samples pooled within each year.

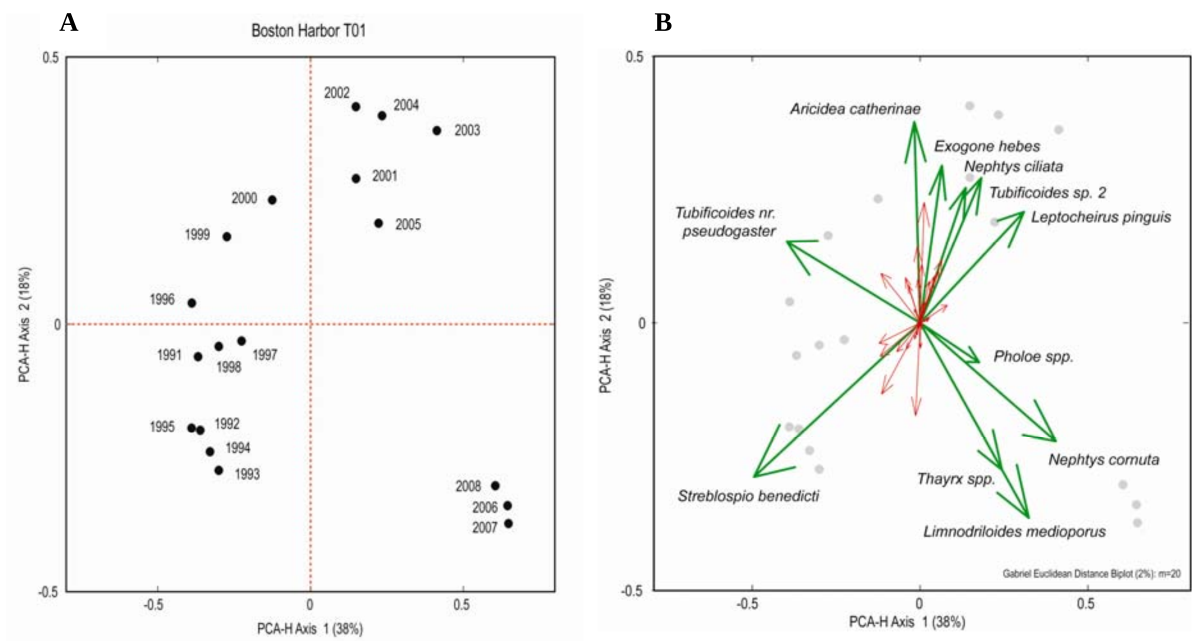


Figure 19. PCAH analyis for station T01 off Deer Island flats in Boston Harbor, 1991–2008. (A) metric scaling of annual samples, (B) Euclidean distance biplot showing the species responsible for at least 2% of the CNESS (*m* = 20) variation.

C019. This station was originally sampled in 1989 as part of the Sediment-Water Exchange (SWEX) study (Gallagher and Keay 1998). At that time, 94–96 % of the fauna was comprised of *Streblospio benedicti* and a cirratulid identified as *Chaetozone setosa*; only a few individuals of four additional taxa were identified from the samples (oligochaetes, *Polydora* sp., *Mya arenaria*, and *Pectinaria gouldii*).

Over the past five years of sampling (2004–2008), a total of 48 taxa have been recorded from this station, with the 2008 samples yielding 27 species. In 2008, as in the four preceding years, the fauna at C019 was dominated by *Nephtys cornuta* (Figure 20), but because of increased abundances of other species, including *Polydora cornuta, Chaetozone vivipara, S. benedicti, M. arenaria*, and *Prionospio steenstrupi, N. cornuta* did not dominate the fauna to the same extent as in previous years.

The increase in number of taxa and reduced importance of *N. cornuta* in 2008 are reflected in the diversity values (Figure 21), which were higher in 2008 than in the previous three years.These values were similar to those recorded in 2004, before the population irruption of *N. cornuta*.

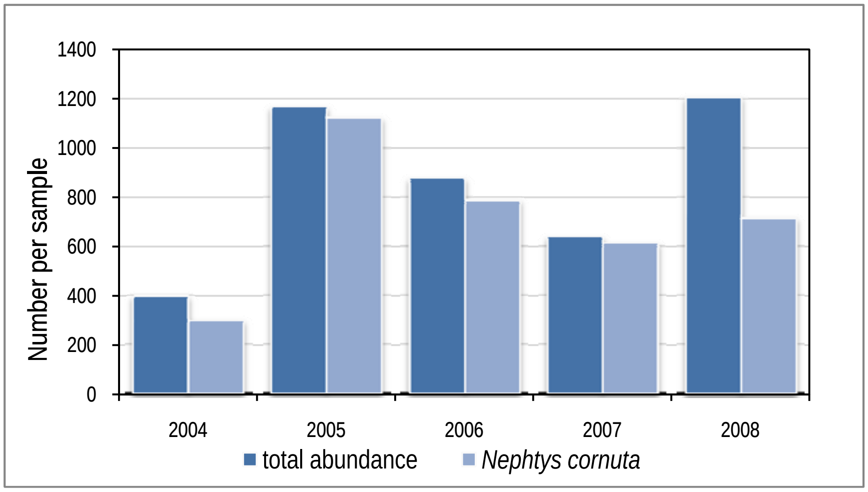


Figure 20. Total abundance and density of *Nephtys cornuta* at station C019.

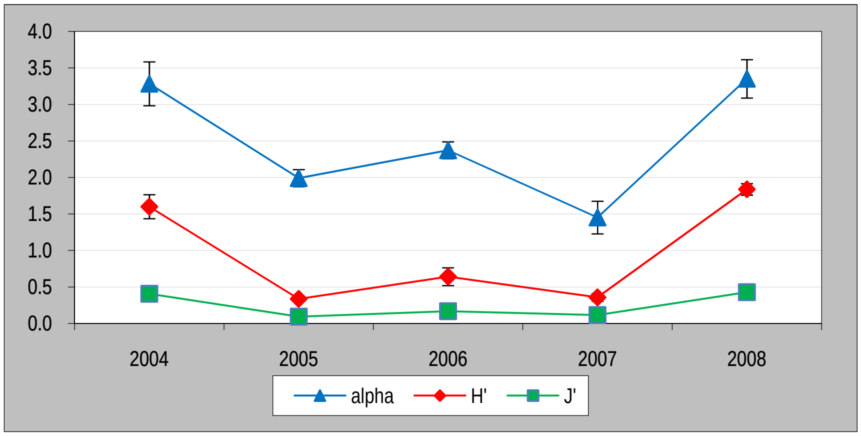


Figure 21. Benthic community diversity parameters at station C019.

Trends over time. Benthic community parameters for the harbor overall were summarized for Taylor (2006) time periods, offset by one year to allow for any lag time in the response of benthic populations to decreased pollutant loads (Table 2). Periods II and III appear the most similar for all parameters. Fisher's *alpha* shows a steady increase through all time periods, whereas the mean values of other parameters appear identical or decline between subsequent periods (e.g., number of species, periods II and III; Shannon diversity, periods III and IV), reflecting the increase and decline of amphipod populations, and, in the last two or three years, the irruption of *Nephtys cornuta*.

Table 2. Benthic community characteristics of Boston Harbor traditional stations summarized by discharge time periods defined by Taylor (2006).

Parameter	Period			
	I before Dec. 1991	**II** Dec 1991–mid-1998	**III** mid-1998–Sep. 2000	**IV** after Sep. 2000 (after outfall diversion)
Groupings offset by one year	**n= 48 (1991–1992)**	**n = 144 (1993–1998)**	**n= 70 (1999–2001)**	**n = 168 (2002–2008)**
Number of Species	25.1 ± 14.25	34.7 ± 13.6	33.5 ±14.2	41.8 ± 17.1
H′	2.11 ± 0.81	2.41 ± 0.90	2.80 ±0.78	2.77 ± 1.00
log-series *alpha*	4.14 ± 2.13	5.50 ± 2.00	6.13 ± 2.24	7.56 ± 3.19
Rarefaction curves	1991 lowest	low	intermediate	highest
Fauna	highest abundances of opportunistic species such as *Streblospio benedicti* and *Polydora cornuta*	declining abundances of opportunistic species, some amphipod species numerous	fewer opportunists, more oligochaetes, some amphipod species numerous	some species from Massachusetts Bay, rise and decline of amphipods, irruption of opportunistic polychaete *Nephtys cornuta*

4. CONCLUSION

Results obtained for biology and chemistry samples collected in Boston Harbor in 2008 were consistent with trends seen previously in the long-term monitoring data (Maciolek et al. 2008). The cyclic nature of population densities of, for example, ampeliscid amphipods and small polychaetes is typical of a near-coastal environment where physical as well as some level of contaminant stress is present. It is probable that the harbor benthos will continue to evidence episodic irruptions and declines of populations of amphipods and other species as has been documented over the past several years. However, the decrease in carbon loading and levels of *Clostridium perfringens* at several locations in the harbor, plus the concomitant increase in community parameters such as species richness and Fisher's *alpha*, as well as the deepening of the aRPD layer, all point towards a cleaner and healthier benthic environment brought about by minimizing wastewater impacts to Boston Harbor.

5. REFERENCES

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APPENDIX A

2008 Infaunal Community Parameters

Table A1. Benthic community parameters for all samples collected in August 2008.

Station	Replicate	Total Abundance	No. Species	H' (base 2)	J'	Log-series *alpha*
T01	1	3401	57	3.16	0.54	9.75
	2	1847	52	3.77	0.66	9.95
	3	3131	53	3.50	0.61	9.07
	Mean ± SD	2793.0±830.3	54.0±2.6	3.5±0.3	0.6±0.1	9.6±0.5
T02	1	8582	59	1.78	0.30	8.54
	2	9094	53	1.86	0.32	7.47
	3	12620	62	1.86	0.31	8.50
	Mean ± SD	10,098.7±2198.5	58.0±4.6	1.8±0.04	0.3±0.01	8.2±0.6
T03	1	3544	64	3.92	0.65	11.10
	2	4471	65	3.91	0.65	10.80
	3	3969	66	3.85	0.64	11.26
	Mean ± SD	3994.7±464.0	65.0±1.0	3.9±0.04	0.65±0.01	11.1±0.2
T04	1	1492	15	0.55	0.14	2.32
	2	779	9	0.52	0.16	1.43
	3	1423	15	0.48	0.12	2.34
	Mean ± SD	1231.2±393.2	13.0±3.5	0.5±0.04	0.1±0.02	2.0±0.5
T05A	1	3970	68	3.70	0.61	11.66
	2	4315	67	3.98	0.66	11.27
	3	3481	62	3.86	0.65	10.72
	Mean ± SD	3922.0±419.1	65.6±3.2	3.8±0.14	0.6±0.03	11.2±0.5
T06	1	2747	51	4.02	0.71	8.91
	2	2683	57	4.05	0.69	10.25
	3	3579	55	3.46	0.60	9.23
	Mean ± SD	3003.0±499.9	54.3±3.1	3.8±0.3	0.7±0.1	9.5±0.7
T07	1	3568	44	3.06	0.56	7.07
	2	3086	51	3.02	0.53	8.69
	3	3631	44	2.84	0.52	7.05
	Mean ± SD	3428.3±298.1	46.3±4.0	3.0±0.1	0.5±0.02	7.6±0.9
T08	1	1472	71	3.87	0.63	15.72
	2	787	52	3.90	0.68	12.67
	3	1109	59	4.03	0.69	13.44
	Mean ± SD	1122.7±342.7	60.1±9.6	3.9±0.1	0.7±0.03	13.9±1.6
CO19	1	1433	19	1.76	0.41	3.10
	2	1064	18	1.99	0.48	3.08
	3	1126	22	1.76	0.39	3.88
	Mean ± SD	1207.7±197.6	19.7±2.1	1.84±0.14	0.43±0.04	3.35±0.46

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