Summary of Marine Mammal Observations During 2005 surveys

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SUMMARY OF MARINE MAMMAL OBSERVATIONS DURING 2005 SURVEYS

for

MWRA Harbor and Outfall Monitoring Project

submitted to

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1.0 Introduction

At least five endangered species of whales are known to visit or inhabit the Massachusetts and Cape Cod Bay area (EPA 1993): the right whale, humpback whale, finback whale, sei whale (rarely observed) and blue whale (rarely observed). Several non-endangered Marine Mammal species are also found: minke whales, harbor porpoise, several dolphin species, gray seals, and harbor seals.

Since 1995, Massachusetts Water Resources Authority (MWRA) has included marine mammal observers on monitoring surveys. The MWRA surveys are being conducted as part of the long-term Harbor and Outfall Monitoring Project designed to verify compliance with the discharge permit and to assess the potential environmental impact of treated sewage effluent discharge into Massachusetts Bay. These observers were included in response to a National Marine Fisheries Service (NMFS) request that MWRA provide observational data and set a positive example by using observers to minimize the chances of collision with a right whale. In addition to looking for right whales, observers conducted observations for other marine mammals. On surveys where observers were not present, the chief scientist and field crew documented any incidental sightings of marine mammals.

Marine mammal observers were present on 15 water quality surveys during 2005 (12 Nearfield and three Farfield surveys). Throughout the year, observers were present on all of the Nearfield water column surveys (n=12) to document the sightings of right whales in the Nearfield. Observers were present on three (WF051, WF052, and WF054) of the six Farfield water column surveys.

2.0 Background

A brief description of when marine mammals are expected to be found in Massachusetts and Cape Cod Bays is presented and discussed below.

The right whale (*Eubalaena glacialis*) is critically endangered. Based on historical sightings made, right whales can be expected to visit Massachusetts and Cape Cod Bays throughout the year (Brown *et al.* 2002), with peak abundance in February, March and early April (Hamilton and Mayo 1990). Over the past four decades, 72% of the catalogued population of right whales has visited Cape Cod Bay and Massachusetts Bay (Brown *et al.* 2002). For the period of 1978 through 1986, using photographed sightings of right whales collected from whale watch boats and research cruises, the total number of individually identified right whales in Cape Cod Bay ranged from a single animal in 1978 to 47 individuals in 1986 (Hamilton and Mayo 1990). Within the last five years, the use of the eastern portion of Stellwagen Bank/Wildcat Knoll by right whales has been noted during extended surveys by the Center for Coastal Studies (Brown *et al.* 2002).

The humpback whale (*Megaptera novaeangliae*) is an endangered species of whale known to feed within the Gulf of Maine in the spring, summer and fall (Waring *et al.* 1999). Historic records indicate that humpbacks have been documented on Stellwagen Bank from mid-April through November, with a peak abundance in May and June (CeTap 1982; NMFS 1991). However, distribution appears to correlate with prey densities (Waring *et al.* 1999). In 1992-1993, humpbacks were most abundant in offshore waters of Cultivator Shoals and the Northeast Peak of Georges Bank and less abundant in the nearshore areas (Langton *et al*. 1994). In 1996-1997, an increase in humpback whale sightings correlated with an abundance of sandlance (*Ammodytes dubius*) in the Stellwagen Bank area (Waring *et al.* 1999).

The finback whale (*Balaenoptera physalus*) is considered to be an endangered species and is the most abundant and frequently sighted of the endangered whales that visit Massachusetts and Cape Cod Bays

(EPA 1993). Finbacks are sighted year round in the Stellwagen Bank area with a peak abundance occurring between the spring and fall (Pett and McKay 1990).

The sei whale (*Balaenoptera borealis*) and blue whale (*Balaenoptera musculus*) are endangered species rarely sighted in Massachusetts and Cape Cod Bays (EPA 1993). Both blue and sei whales typically remain in deeper water (more than 100 meters) and further offshore (CeTap 1982). However, sightings of these species in coastal areas may correspond to changes in prey distribution (Payne *et al.* 1990, Wenzel *et al.* 1988).

The minke whale (*Balaenoptera acutorostrata*) is a non-endangered species typically seen in the Stellwagen Bank area during the spring, summer and fall (CeTap 1982; Pett and McKay 1990). During the winter, minke whale sightings in New England appear to decline dramatically (Waring *et al.* 1999).

The Atlantic white-sided dolphin (*Lagenorhynchus acutus*) is a species of dolphin found from central west Greenland to North Carolina (Waring *et al.* 1999). The Gulf of Maine stock of Atlantic white-sided dolphins is classified as strategic by the National Marine Fisheries Service (Waring *et al.* 1999). Sightings of these dolphins in the Stellwagen Bank and Cape Cod Bay areas are common in the spring and, to a lesser extent, the fall (Pett and McKay 1990).

The Atlantic pilot whale or long-finned pilot whale (*Globicephala melaena)* is the largest species of dolphin found in cool temperate waters off Labrador, Newfoundland, and in the St. Lawrence River with sporadic sightings as far south as Maryland and Virginia (Bulloch 1993). Pilot whales form schools of a few to many hundreds of individuals and are mainly found relatively close to shore. Pilot whale distribution and abundance appear to be linked to the topography of the sea floor and the abundance of their primary food source, squid (Harrison and Bryden 1989).

The gray seal (*Halichoerus grypus*) is a non-endangered species of pinniped found from Maine to Long Island Sound (Rough 1995). A small, year round breeding population is known to occur on outer Cape Cod and Nantucket Island (Waring *et al.* 1999). The majority of gray seal sightings in Cape Cod Bay and the Stellwagen Bank area occur during the winter and spring, although periodic sightings have been recorded in the summer (Center for Coastal studies unpublished data).

Harbor porpoises (*Phocoena phocoena*) of the Gulf of Maine/Bay of Fundy stock are classified as strategic by the National Marine Fisheries Service (Waring *et al.* 1999). Historic data indicate that harbor porpoises can be found in the Stellwagen Bank area and Cape Cod Bay from December through June (Pett and McKay 1990).

The harbor seal (*Phoca vitulina*) is a non-endangered species of pinniped commonly found in the near shore waters around New England (Katona *et al.* 1993). Harbor seals are most frequently seen in the Stellwagen Bank and Cape Cod Bay areas in the winter and early spring with sightings beginning in late September (Pett and McKay 1990).

3.0 Methods

Marine mammal observations were performed during all daylight hours while transiting during Nearfield water column surveys (Figure 1), and while the vessel was on-station for sampling operations. Additionally, marine mammal observers were present during three winter/spring Farfield surveys (Figure 2) during the 2005 survey year. During vessel transits, the observer continuously scanned the sea surface from directly ahead to 90 degrees abeam on either side of the vessel. Initial sightings were made by eye with confirmation and identification aided by binoculars. While on-station, the observer scanned 360 degrees around the vessel. The observer was typically positioned at the highest and most secure vantage point of the survey vessel. Weather conditions, safety of the observer, and limiting interference with the operation of the vessel and sampling team were all factors that influenced the position of the observer on board the vessel. Two survey vessels were used as observation platforms during the course of the year. The observer's eye-height above the sea surface was approximately 5 meters on the R/V *Tioga* and 2.5 meters aboard the R/V *Aquamonitor*. Observations were conducted 40 minutes out of every hour and were suspended when visibility was reduced to zero or when darkness occurred.

Several other vessels were also used to conduct surveys where marine mammal observers were not present, the scientific crew on board the R/V *Merganser*, F/V *Shanna Rose*, F/V *Key Largo*, F/V *Morning Light*, and F/V *First Light* observed marine mammals while on surveys. Many of these vessels were used to conduct MWRA Inner Harbor surveys. Unlike previous years, data from the Inner Harbor surveys are included in this report. Furthermore, the R/V *Merganser* conducted all Fecal Coliform Surveys in the Nearfield and Farfield areas (Figure 3).

Vessel track, station sequence, and number of stations varied among cruises, due to the constraints of weather, special survey requirements, or both.

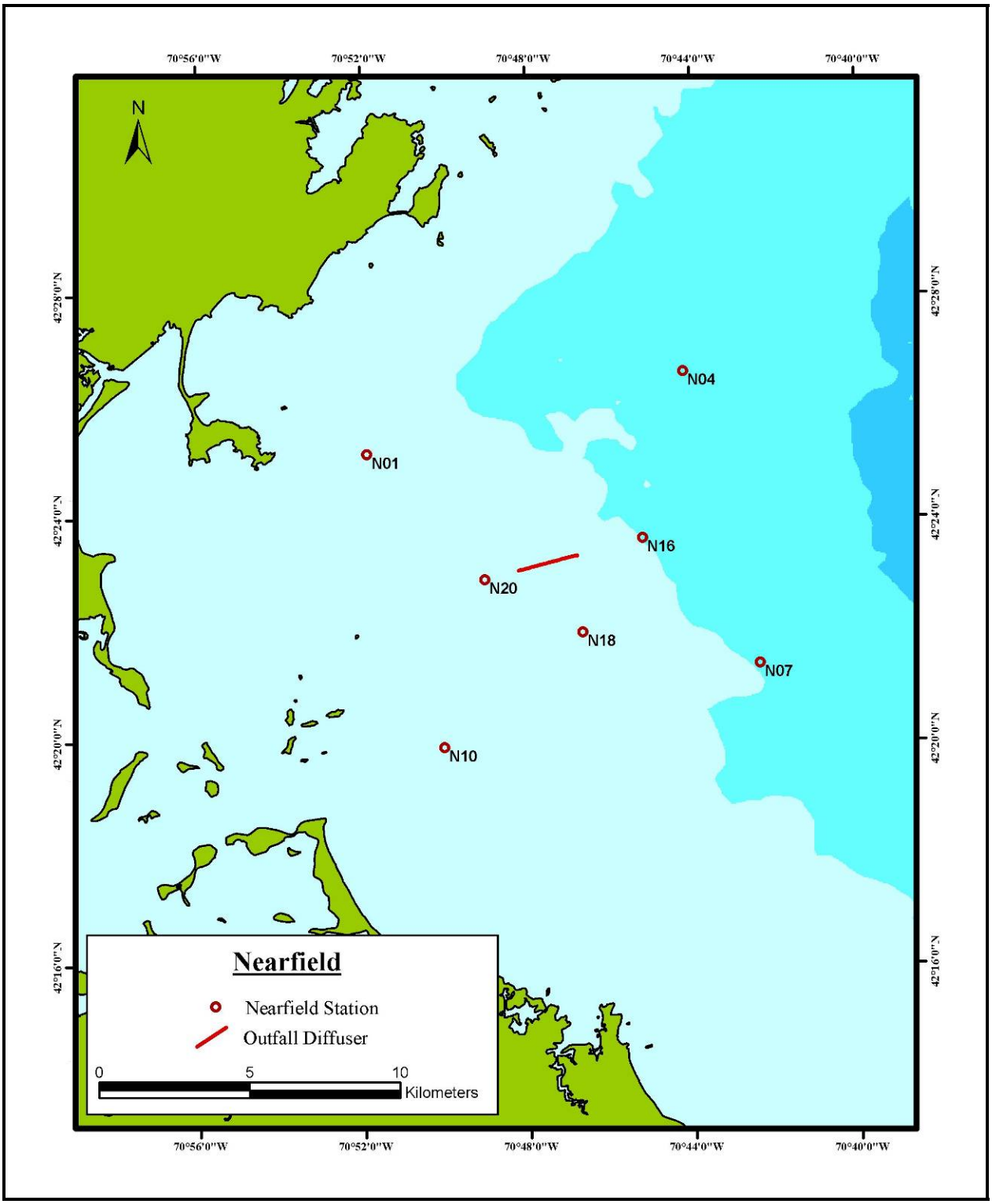

Figure 1. Location of Nearfield Stations

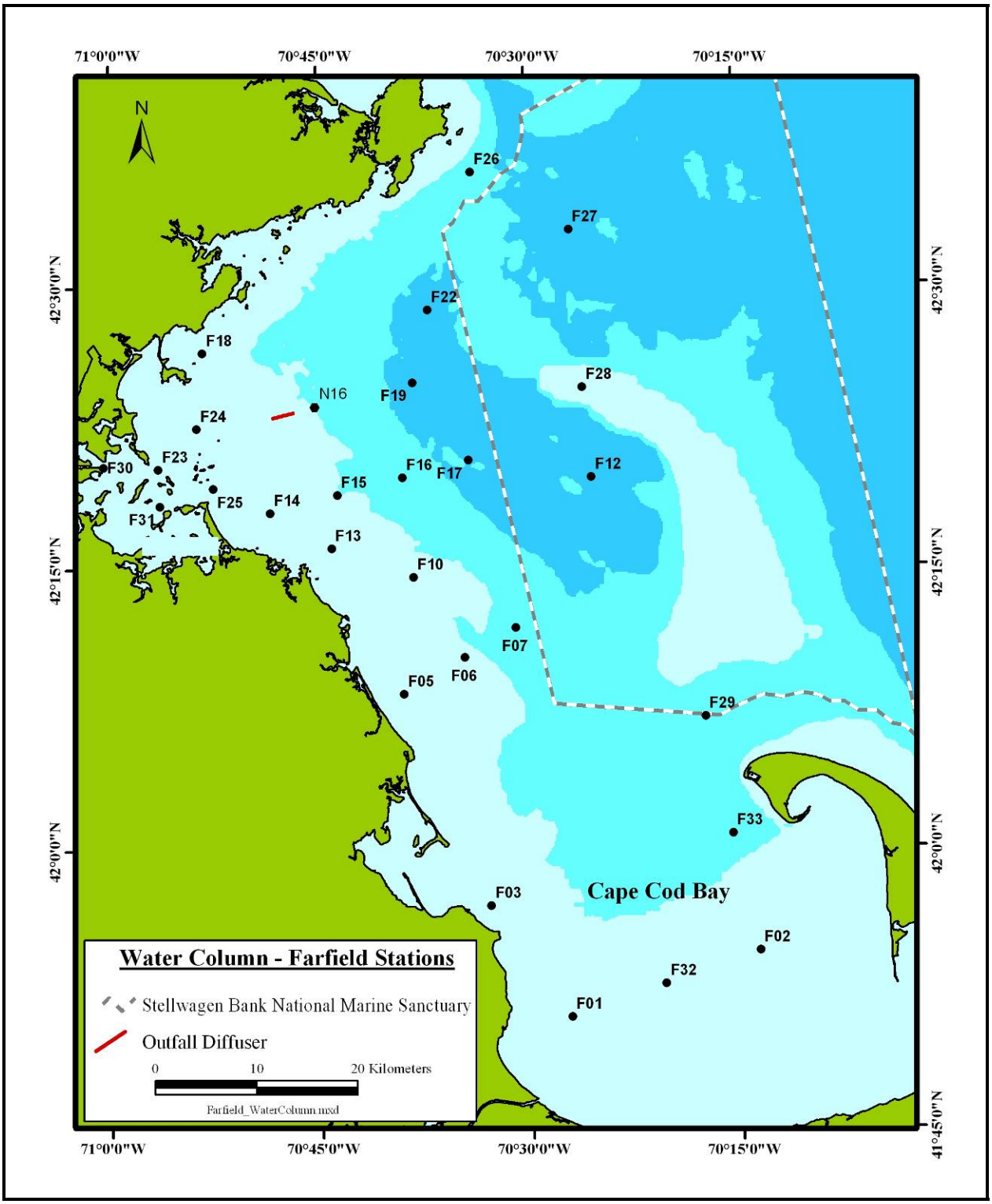

Figure 2. Location of Farfield Stations

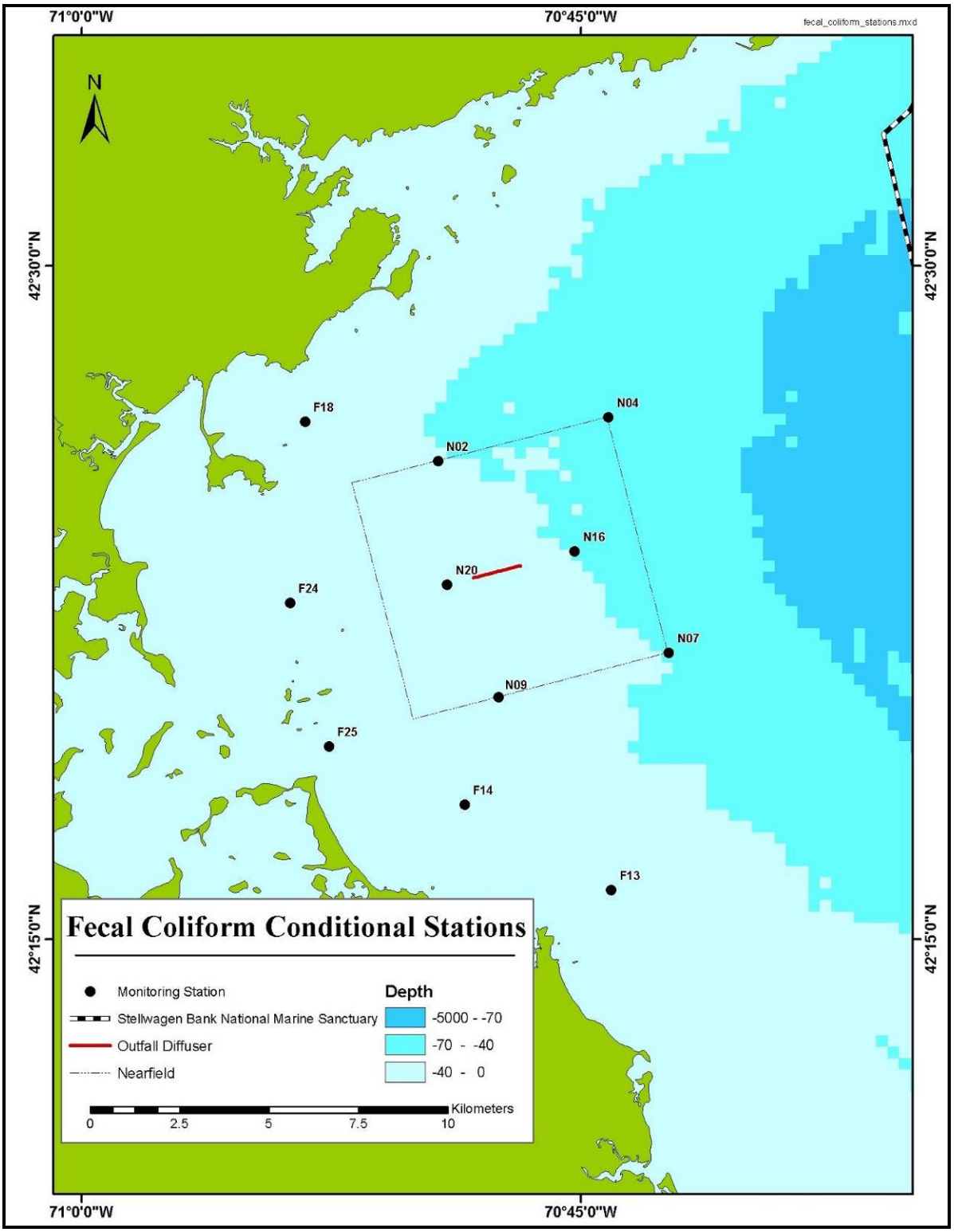

Figure 3. Location of Fecal Coliform/ Adverse Conditional Stations

4.0 Results

Observation of marine mammals on surveys designed and operated for the collection of water quality data places limitations and constraints on the method of observation and on the conclusions that may be drawn from the data. Standard line transect methodology is not possible on such surveys, and two different vessels (which vary the characteristics of the survey platform) were used during the year. Based on these factors, the ability to extrapolate from observation data to abundance estimates is severely limited and is not advisable. The utility of this data set is thus limited to documentation of the time, location and particulars for each individual occurrence of a sighting and provides useful qualitative information concerning seasonal patterns and relative abundance within the same study area.

During the 2005 monitoring year, 31-33 individual whales, 16-21 harbor porpoise, one unidentified porpoise, and a small pod of Atlantic white-sided dolphins were directly observed by the marine mammal observers, Battelle survey team members, and MWRA survey team members. Included in these sightings were five humpback whales, one finback whale, seventeen minke whales, and eight to ten instances of unidentifiable whales (possibly two minke whales). Whale sightings in 2005 were concentrated mainly in Massachusetts Bay (Figures 1, 2, and 3) and of the whales sighted, four whales were sighted in the vicinity of the Nearfield area. The total number of whales (32) sighted during 2005 was greater than during several previous years (2004, 11 sightings; 2003, 15 sightings; 2002, 16 to 19 sightings; and 2001, 20 sightings), and less than sightings during the years of 2000, (53+ sightings) and 1999, (59 sightings) (Short *et al.* 2005). Similar to 2003, right whales were not observed during 2005 water column surveys. It should also be noted that whales were observed on other types of surveys in addition to the water column surveys. Both the Benthic Farfield and Nearfield (BN/BF) survey and the Stellwagen Bank survey, which was conducted for the Stellwagen Bank National Marine Sanctionary (SW), are included in the observations in Table 1, as well as the Rapid Response *Alexandrium* Surveys conducted in both Massachusetts and Cape Cod Bays and the Boston Harbor surveys conducted by MWRA. In addition to the whales, 76 harbor seals were also sighted during the year. All sightings recorded by a dedicated marine mammal observer or other survey personnel are summarized in Table 1. Whale sighting distribution is presented in Figure 4. The second column in Table 1 provides the figure location and corresponds to a circle on Figure 4.

Table 1. Marine Mammal Observer Sightings During MWRA 2005 Water Quality Monitoring Program

Survey ID	Figure Location[1]	Date\Time	Number	Mammal	Location	Sighting Comments	Observer Present
PC051 F/V *Shanna Rose*		01/26/05		No sightings[2]			No
PC052 F/V *Shanna Rose*		02/14/05		No sightings			No
WF051/WN051 R/V *Tioga*		02/01/05 0735	1	Harbor seal	42°18.75'N/070°55.13'W	Hauled out on rocks SE side of George's Island.	Yes
		02/01/05 1525	1	Unidentified Odontocete	41°54.22'N/070°14.58'W		Yes
		02/02/05		No sightings			Yes
		02/07/05 1535	Sm Group	Atlantic white-sided dolphins	42°04.23'N/070°31.26'W		Yes
WF052/WN052 R/V *Tioga*		02/23/05		No sightings			Yes
		02/26/05 0750	1	Harbor seal	42°19.18'N/070°53.58'W	Hauled out on Toddy Rocks, North shore of Hull	Yes
		02/26/05 1036	1	Harbor seal	42°12.84'N/070°30.27'W	Observed between station F07 & F12.	Yes
		02/27/05 1715	1	Harbor seal	42°19.80'N/070°56.11'W	Hauled out on rock.	Yes
		02/27/05 1725	4	Harbor seals	42°18.67'N/070°65.65'W	Hauled out on rocks.	Yes

Table 1. Marine Mammal Observer Sightings During MWRA 2005 Water Quality Monitoring Program

Survey ID	Figure Location[1]	Date\Time	Number	Mammal	Location	Sighting Comments	Observer Present
BHWQM R/V *Merganser*		03/16/05 0910	1	Harbor porpoise		Inner Harbor-off Coast Guard Station	No
		03/16/05 0920	1	Harbor porpoise		Inner Harbor-off Logan Airport	No
PC053 R/V *Merganser*		03/21/05		No sightings			No
WN053 R/V *Aquamonitor*	1	03/17/05 1200	1	Unidentified Baleen whale (possibly a minke)	42°21.30'N/070°47.00'W		Yes
CSORWM R/V *Merganser*		03/29/05 1026	1	Harbor seal	42°20.56'N/071°08.66'W		
WN054/WF054 R/V *Aquamonitor*		04/04/05 1030	1	Harbor porpoise	42°56.62'N/070°14.32'W		Yes
		04/04/05 1330	22	Harbor seals	42°59.31'N/070°38.85'W	Hauled out on rocks at "Bug Light".	Yes
		04/05/05		No sightings			Yes
		04/06/05 0830	1	Harbor Porpoise	42°20.49'N/070°00.34'W	Observed while at station F30.	Yes
		04/06/05 0855	1	Harbor seal	42°20.35'N/070°56.50'W	Observed while at station F23.	Yes
		04/06/05 0910	1	Harbor seal	42°20.63'N/070°56.23'W	Sighting 200° from vessel.	Yes
		04/06/05 0910	1	Harbor seal	42°20.63'N/070°56.23'W	Sighting 270° from vessel.	Yes
		04/06/05 1420	5	Harbor seals	42°18.90'N/070°54.78'W	Hauled out on Toddy Rocks, North end of Hull.	Yes
		04/06/05 1620	11	Harbor seals	42°19.22'N/070°55.12'W	Hauled out on rocks, South end of George's Island.	Yes
		04/06/05 1620	7	Harbor seals	42°19.22'N/070°55.12'W	Hauled on rocks, North end of Hull.	Yes
		04/07/05		No sightings			Yes
PA051 (PC054) *F/V First Light*		04/13/05		No sightings			No
BHWQM R/V *Merganser*		04/22/05 0906	2	Harbor porpoises	42°20.59'N/071°00.48'W		
	2	04/22/05 0915	1	Juvenile Humpback whale		Inner Harbor-Reserved Channel, Castle Island	No
WN056 R/V *Aquamonitor*		05/13/05		No sightings			Yes
PC055 R/V *Merganser*		05/05/05 0903	1	Harbor seal	42°18.00'N/070°48.50'W		No
PC056 R/V *Merganser*		06/13/05		No sightings			No
AF055 R/V *Aquamonitor*	3	06/09/05 1329	1	Unidentified Baleen whale	42°00.75'N/070°15.55'W	North of Station F33	No
WF057/WN057 R/V *Aquamonitor*		06/13/05		No sightings			No
		06/14/05		No sightings			Yes
		06/17/05		No sightings			Yes
		06/18/05		No sightings			No
AF057 R/V *Aquamonitor*	4	06/28/05 1301	1	Unidentified Baleen whale	42°28.79'N/070°16.36'W		No
	5	06/28/05 1459	1	Unidentified Baleen whale	42°19.73'N/070°36.57'W		No
PC057 R/V *Merganser*		07/05/05		No sightings			No
AF058 R/V *Aquamonitor*		07/06/05 1128	1	Seal	Observed while at station F02.		No
WN059 R/V *Aquamonitor*		07/18/05		No sightings			Yes

Table 1. Marine Mammal Observer Sightings During MWRA 2005 Water Quality Monitoring Program

Survey ID	Figure Location[1]	Date\Time	Number	Mammal	Location	Sighting Comments	Observer Present
BF051/BN051 R/V *Aquamonitor*	6	08/04/05 0950	15	Minke Whales	South of FF06	Observed swimming in groups of 2-3.	No
PC058 R/V *Merganser*		08/09/05		No sightings			No
WF05B/WN05B/ SW051 R/V *Aquamonitor*	7	08/16/05 1539	3-5	Unidentified Baleen whales	Station F28	Three whales were observed feeding.	No
	8	08/17/05 0930	1	Unidentified Baleen whale	42°23.17'N/070°44.54'W		Yes
	9	08/19/05 1053	1	Minke whale	Station F29		No
WN05C R/V *Aquamonitor*		09/02/05		No sightings			Yes
PC059 R/V *Merganser*		09/02/05		No sightings			No
WN05D R/V *Aquamonitor*	10	09/28/05 1111	3	Humpback whales	42°23.34'N/070°42.36'W	One whale identified as Polevault, a 4-year old animal.	Yes
PC05A R/V *Merganser*	11	09/19/05 1057	1	Unidentified Baleen whale (possibly a minke)	42°23.64'N/070°45.20'W		No
BHWQM R/V *Merganser*		10/11/05 0957	1	Harbor seal	42°20.59'N/071°00.48'W		No
WF05E/WN05E/ SW052 R/V *Aquamonitor*		10/19/05 0730	3	Harbor seals		Seals spotted on rocks off of George's Island.	No
	12	10/19/05 1520	1	Humpback whale	42°19.80'N/070°25.40'W	Station F12	No
	13	10/19/05 1600	1	Finback whale	42°17.00'N/070°21.00'W	Station SW1	No
	14	10/20/05 1020	1	Minke whale	42°23.64'N/070°45.23'W		Yes
		10/21/05 0730	6	Harbor seals		Seals spotted on rocks off of George's Island.	No
		10/21/05 0945	10-15	Harbor porpoises	42°20.75'N/070°34.23'W	Spotted while in transit to station F17.	No
PC05B F/V *Shanna Rose*		10/18/05		No sightings			No
CSORWM F/V *Key Largo*		10/28/05 0900	1	Harbor seal		Off Deer Island Dock	No
CSORWM F/V *Key Largo*		11/04/05 0754	1	Harbor seal	42°20.59'N/071°00.48'W		No
WN05F R/V *Aquamonitor*		11/14/05		No sightings			Yes
CSORWM R/V *Merganser*		11/15/05 0821	1	Harbor seal	42°20.10'N/070°58.89'W		No
BHWQM R/V *Merganser*		11/29/05 1011	1	Harbor seal	42°19.30'N/077°01.28'W		No
CSORWM R/V *Merganser*		12/01/05 0828	2	Harbor seals	Off Hyatt Hotel/East Boston		No
PC05C F/V *Morning Light*		12/05/05		No sightings			No
CSORWM R/V *Merganser*		12/14/05 0916	1	Harbor seal	42°17.13'N/071°02.36'W		No
CSORWM R/V *Merganser*		12/20/05 0930	1	Harbor seal	Off Tug & Towing Docks/East Boston		No
		12/20/05 0940	2	Harbor seals	42°22.90'N/071°02.70'W		No
PC05D F/V *Shanna Rose*		12/28/05		No sightings			No

[1] This number refers to the numbers in Figure 4, which identify the location of where the whale(s) were observed.

[2] "No sightings" means that the marine mammal observer, Battelle survey team members, or MWRA survey team members did not see any animals on that day.

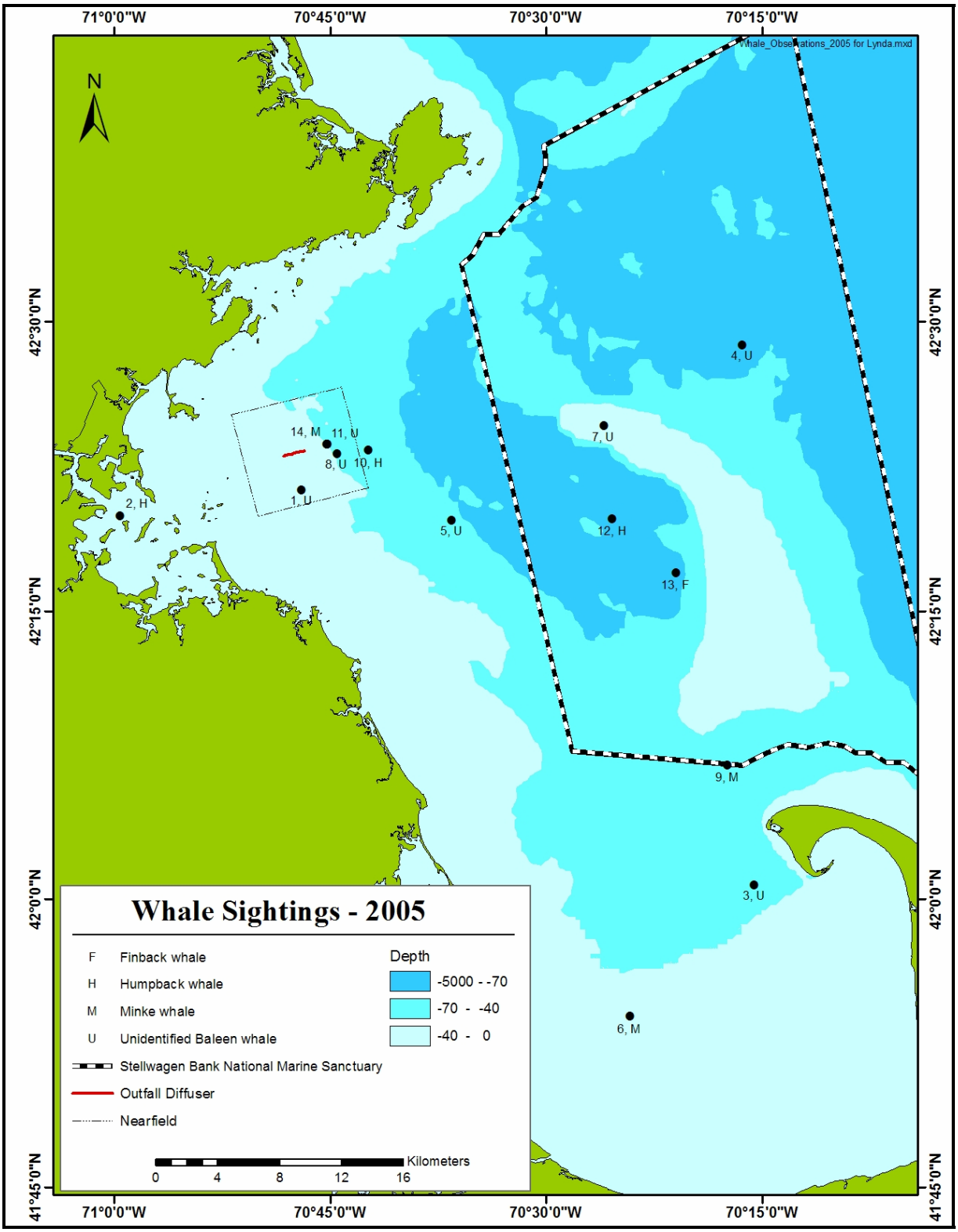

Figure 4. Approximate Locations of Whale Sightings during 2005 MWRA Water Quality Surveys

Note: The data displayed in this figure come from Table 1 of this report. Numbers in the Figure corresponds to numbers in column 2 of Table 1.

5.0 Discussion

Unlike statistically based programs or programs that are specifically designed to search for whales, the MWRA sightings are opportunistic and do not follow dedicated and systematic line transect methodology (as mentioned in Section 4.0). However, some generalizations can be made.

Of the 32-34 whales sighted on the surveys, six whales were sighted by a dedicated observer, which were less than 2004 (n=7), 2003 (n=13); however 2005 dedicated observer sightings were equal to 2002 (n=6). Furthermore, 2005 sightings were less than 1998-2001 years (n = between 16 and 31). During 2005, more than 76 pinnipeds were sighted; a considerable decrease in number compared to sightings that occurred in 2004 when 303 were observed, however, only 105 were noted in 2003, and 138 pinnipeds were noted in 2001 and 2002 each year. Furthermore, in years prior to 2001, only 20 to 60 pinniped sightings were made throughout the survey area.

A small group of dolphins were sighted in 2005, which is slightly less than 2004 when approximately 27+ dolphins were sighted, and 2002 when 10-13 dolphins were sighted. For the years 1999, 2000, 2001, and 2003, dolphin sightings averaged between 50 and 112+, with 2003 recording the highest number of dolphins ever sighted for these surveys. However, 1998 had only 32 dolphins sighted, which is only slighter higher than the number of sightings in 2004.

Whale Center of New England sighting records for the season show that whales observed in Massachusetts Bay and Stellwagen Bank increased somewhat from the sparse summer sightings in 2003 and 2004. Numerous fin whales and a steady aggregation of 10-20 humpback whales were seen starting in mid-July, with numbers sometimes increasing well beyond that mark. Target prey seemed to be both small fish, including sand lance (*Ammodytes* spp.) and an unidentified plankton prey. Also notable was the late July to mid-August presence of numerous sei whales and North Atlantic right whales. At least three mother-calf right whale pairs and several other adult animals appeared to be feeding on a dense layer of *Calanus finmarchicus* in the middle of the water column. These sightings were concentrated around the northern end of Stellwagen, but also extended to the waters west, east, and north of the northern portion of the Bank. The presence of the right whales led to a “dynamic area management” action by the National Marine Fisheries Service to reduce the threat of whale entanglement from Stellwagen to the shoreline of Massachusetts, including many of the MWRA monitoring sites (full details can be found at http://www.nero.noaa.gov/whaletrp/). As was the case for each year since 2001, humpback and fin whales were also numerous relatively close to shore west and northwest of Stellwagen during the second half of the field season. At times up to 25-30 humpbacks, and approximately an equal number of fin whales, were seen feeding (apparently on some kind of plankton) often within five miles of the end of the outfall tunnel. Whales were seen in this area starting in late August and continuing through October. These sightings represent a higher level of use than any other such fall plankton feeding aggregation documented. The Whale Center’s sightings database comes from a variety of platforms, including whale watch boats operating out of Provincetown, Boston, and Gloucester, MA, and a dedicated research vessel operating out of Gloucester, MA. Their sightings are generally a result of dedicated searches with some survey effort as well (Mason Weinrich, Director of the Whale Center of New England, January 2006).

Over the last eight years, the Center for Coastal Studies has conducted systematic surveys of Cape Cod Bay from January through mid-May. In 2005, right whales were present in the Cape Cod Bay Critical Habitat area for at least 86 days between January 30, 2005 and April 26, 2005 (Jaquet *et al.* 2005). A total of 264 right whale sightings were recorded from aerial surveys and research cruises, of which 249 were photographed. Of those 249 photographed sightings, 192 were in Cape Cod Bay representing 45 unique individuals, and 57 were in an area east of the Cape, representing another 45 individuals. The

number of right whales identified in Cape Cod Bay and adjacent waters in 2005 is a minimum estimate because a small portion of the sightings have not yet been matched to or confirmed to match an individual in the catalogue. Large aggregations of whales in the northeastern part of the bay (near Provincetown) that were frequently observed in previous years were not observed in 2005. Most of the whales were sighted in the southern and central part of the Bay, a region that corresponded to the area of highest zooplankton concentration (from CCS sampling) during the month of April (Jaquet *et al* 2005).

This past April, while MWRA was conducting their Harbor Cruise, a juvenile Humpback whale was observed in Boston Harbor, the data from this sighting is included in this report. The New England Aquarium also reported that "The whale was originally observed in the Hull Gut area, apparently feeding heavily before breaching repeatedly for more than 45 minutes. On Wednesday morning, the whale was spotted in the Reserve Channel by Boston Harbor Police, and several workers at Boston Tow. By the time Officer Johnston and crew arrived, the whale had vanished. Not to be deterred, and enjoying the abundant sunshine, the group boated around the inner and outer harbor for several hours, only to return and find the whale right where they started, outside the Reserve Channel" (New England Aquarium, News & Events).

6.0 Summary of Whale Sightings 1998 through 2005

For the past 11 years, MWRA has collected and reported on the yearly sightings of whales made during program surveys. The same methods have been used to collect whale sighting data over the years, but other factors such as platforms used, areas surveyed and time at each site prevent the data from being used for quantitative statements regarding whale populations in Massachusetts and Cape Cod Bays. The most consistent aspect of the program is that stations were surveyed around the same time of the year for approximately the same number of days. The following text provides a summary and comparison of the MWRA whale sighting data over the last eight years (1998 through 2005). Data prior to 1998 have not been included in this report due to possible differences in data collection methods, changes in survey teams, and variations in time spent in each area. However, during 2005, observations were made in the Inner Harbor by MWRA and the data are also included in the comparison.

For this comparison, the whale sightings were grouped into five areas:

- Nearfield (NF; all nearfield stations),
- Stellwagen Bank National Marine Sanctuary (SBNMS; stations F12, F27, F28, and F29),
- Cape Cod Bay (CCB; stations F01, F02, F03, F32, and F33),
- Farfield (FF; all stations not in other areas), and
- Inner Harbor (IH; MWRA harbor stations).

During 2005, at least 70 survey days were spent in Massachusetts and Cape Cod Bays throughout the year. The Nearfield area was visited at least 12 times during 2005 with a total of seven stations sampled. The survey normally was for one day with vessel time exceeding eight hours per day (approximately 96 hours/year). In previous years, the Nearfield area was visited at least 17 times with 21 stations sampled during the survey. The remaining areas are visited during six or more surveys covering 1 to 3 days in an area, depending on the vessel track and weather.

During these MWRA surveys, more than 233 whales of at least four identified species were seen over the past eight years (Table 2). The highest number of whales (59) was sighted in 1999, due in part to 27 finback whales being observed on Stellwagen Bank. In the following year (2000), more than 29 humpback whales were noted on Stellwagen Bank bringing the total number of whales sighted in the year to more than 53. The lowest number of whales (11) was sighted in 2004; the cause of fewer sightings

could be due to fewer survey days and decrease in survey time in the four areas. In 2005, 32-34 whales were observed, which is an increase from 2004 and the third highest number of whales observed in a single year.

Table 2. Sightings by Area, Species, and Year

Area	1998	1999	2000	2001	2002	2003	2004	2005	Total Sightings
Right Whale Observations									
SBNMS	2	1			2				**5**
FF	1								**1**
CCB	1	1		7			3		**12**
NF									
IH									
Totals	**4**	**2**		**7**	**2**		**3**		**18**
Humpback Whale Observations									
SBNMS	4	12	29+	1	2-5			1	**49+**
FF				3	4			3	**10**
CCB					1	2			**3**
NF	1								**1**
IH								1	**1**
Totals	**5**	**12**	**29+**	**4**	**7-10**	**2**		**5**	**64+**
Finback Whale Observations									
SBNMS		27	4		1			1	**33**
FF					1		2		**3**
CCB							1		**1**
NF					1	1			**2**
IH									
Totals		**27**	**4**		**3**	**1**	**3**	**1**	**39**
Minke Whale Observations									
SBNMS	3		1					1	**5**
FF	1	3		3		1			**8**
CCB			1					15	**16**
NF	2	1	1	1	1	5	2	1	**14**
IH									
Totals	**6**	**4**	**3**	**4**	**1**	**6**	**2**	**17**	**43**
Unidentified Whale Observations									
SBNMS	5	7	5-6	1	1	2	1	4-6	**26+**
FF	1	2	1	1	2			1	**8**
CCB	1	4	11	3		2		1	**22**
NF	5+	1				2	2	3	**13+**
IH									
Totals	**12+**	**14**	**17-18**	**5**	**3**	**6**	**3**	**9-11**	**69+**
Year Totals	**27+**	**59**	**53-54+**	**20**	**16-19**	**15**	**11**	**32-34**	**233+**

Blank cell denotes no whales observed.

Half of the overall sightings (50% of the 233) were made within the boundary of Stellwagen Bank (Figures 5 and 6). The area with the second highest whale sightings from 1998 to 2005 was Cape Cod Bay (23% of the 233), which has the highest number of right whale sightings. An additional 13% were sighted just outside its western boundary (listed as Farfield). The Nearfield area, which lies over and around the outfall, also had only 13% of the total whale sightings, with minke whales being the dominant species. An interesting caveat of the Nearfield sightings is that this area receives the most concentrated effort towards observations of whales relative to the other 3 areas (excluding the Inner Harbor). The

Inner Harbor, for which data was not previously available, had 4% of the 233 sightings, with a juvenile humpback whale observed in Boston Harbor.

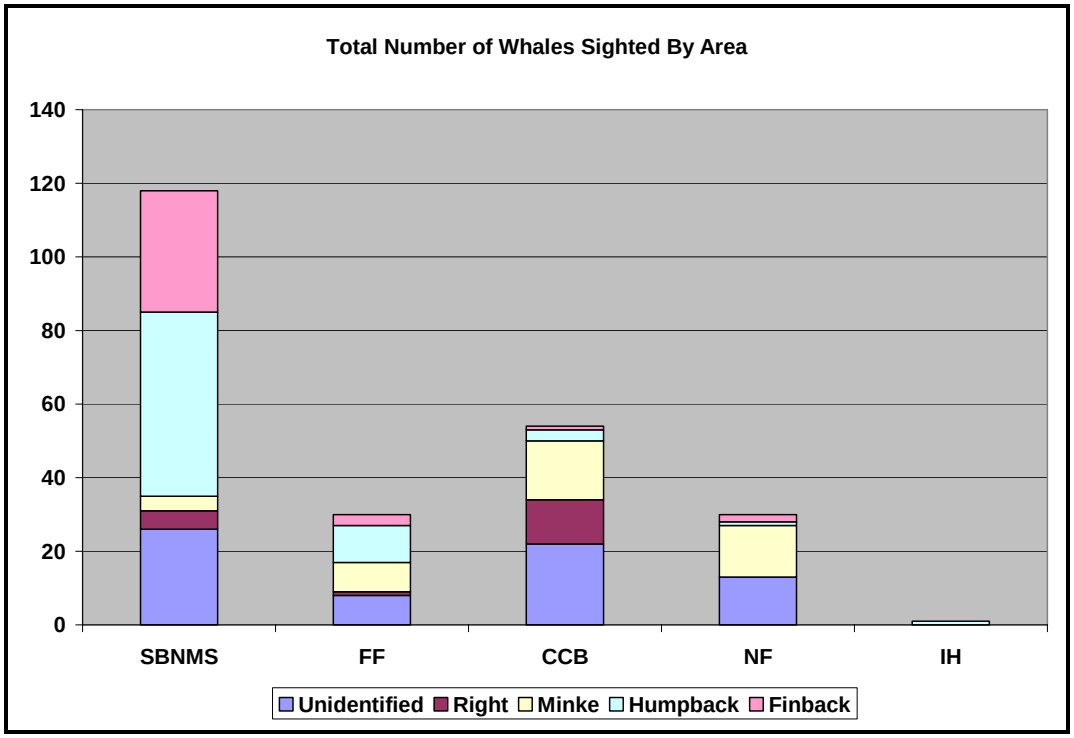

Figure 5. Distribution of Sightings by Species and Area, 1998-2005

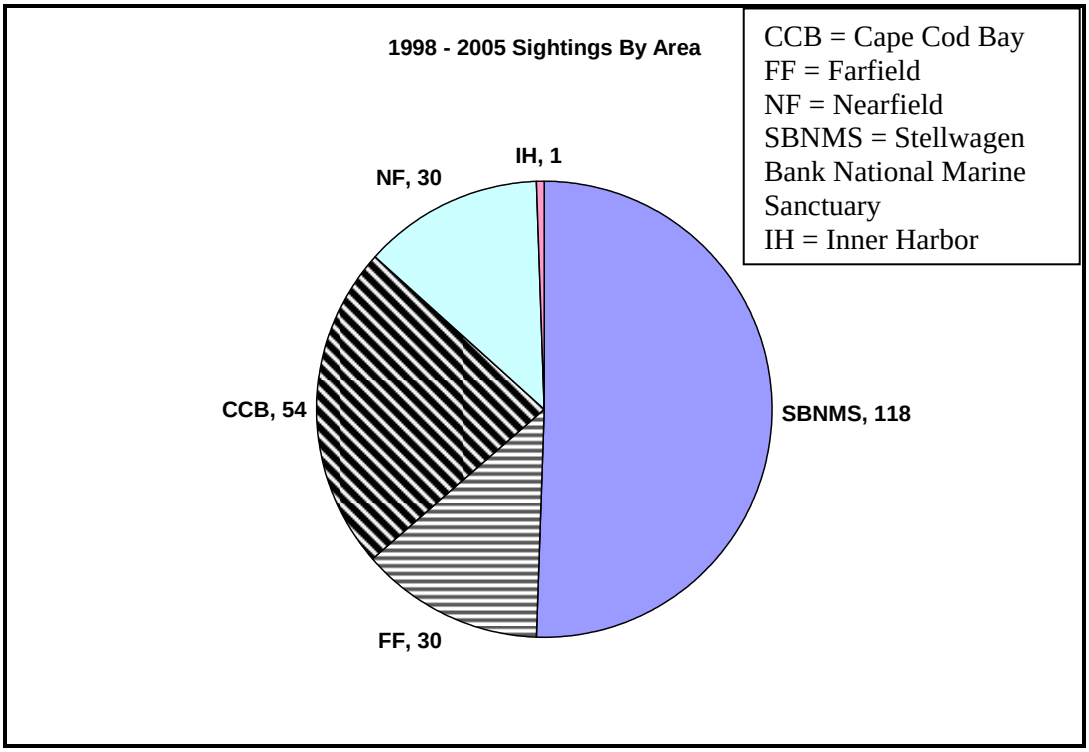

Figure 6. Total Sightings of Whales by Area, 1998-2005

The most abundant identified whale species noted during the surveys was the humpback whale (though even more were unidentified) (Figure 7). The second most abundant identified whale was the minke whale with 18% of the sightings. The total humpback (64) and minke whale (43) sightings on Stellwagen Bank represent 50% of the sightings for these whales and 46% of the sightings of all whales throughout all of the areas over the years.

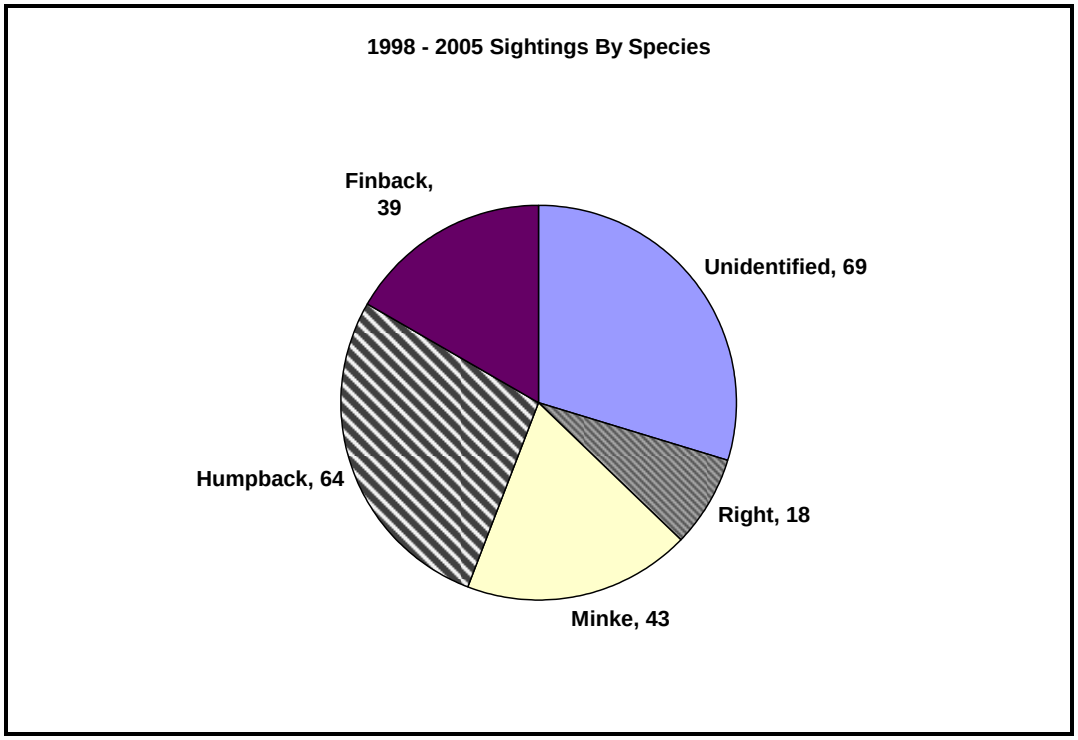

Figure 7. Distribution of Sightings within the Four Identified and Unidentified Species Categories

Cape Cod Bay had the highest number of right whale sightings (12 out of 18), with the highest concentration of sightings occurring in February 2001 when seven were noted in Cape Cod Bay. With the exception of the humpback and finback whales noted on Stellwagen Bank, the minke whale in the Nearfield area was the only other whale species consistently sighted in an area each year under the MWRA program.

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