Summary of marine mammal observations during 2010 surveys

Massachusetts Water Resources Authority
Environmental Quality Department
Report 2011-08

Citation

Wu, D. 2010. **Summary of marine mammal observations during 2010 surveys.** Boston: Massachusetts Water Resources Authority. Report 2011-08. 16p.

.

SUMMARY OF MARINE MAMMAL OBSERVATIONS DURING 2010 SURVEYS

Massachusetts Water Resources Authority
Charlestown Navy Yard
100 First Avenue
Boston, MA 02129

Prepared by
David Wu

Technical Report No: 2011-08

Acknowledgements

Marine mammal observers were individually contracted to assist Battelle in collecting the data contained in this report. The dedication and professionalism of David Silvia is appreciated.

Thanks and appreciation are also extended to the captains, crews, and scientific personnel of all the research vessels involved with the surveys of Boston Harbor and Massachusetts Bay.

Thanks to Matt Fitzpatrick of Battelle for compiling the mammal data.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction

At least five endangered species of whales are known to visit or inhabit the Massachusetts and Cape Cod Bay area (Environmental Protection Agency [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, pilot whales, harbor porpoises, Atlantic white-sided dolphins, white beaked dolphins, hooded seals, harp seals, 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 most, but not all, nearfield and farfield water quality surveys during 2010. Observers were not present on Boston Harbor surveys and bacteria surveys for shellfish water quality monitoring.

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, 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). Approximately 70% of the catalogued population of right whales have been reported to visit 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). 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 April through December (CeTap 1982; Geraci et al. 1989; NMFS 1991). However, distribution appears to correlate with prey densities (Waring *et al.* 1999). The amount of humpback whale use of the Stellwagen area varies periodically most likely based on the availability of sand lance as prey (Payne *et al.* 1986; Payne *et al.* 1990; Weinrich *et al.* 1997).

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 both endangered species (EPA 1993). The sei whale is uncommon but is regularly sighted (Schilling *et al.*1992), while the blue whale is 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, summer (Weinrich *et al.* 2001), 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

Figure 1 shows a map of MWRA sampling stations, nearfield and farfield. Marine mammal observations were performed during all daylight hours while transiting during nearfield water column surveys, and while the vessel was on-station for sampling operations. 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. Three survey vessels were used as observation platforms during the course of the year.

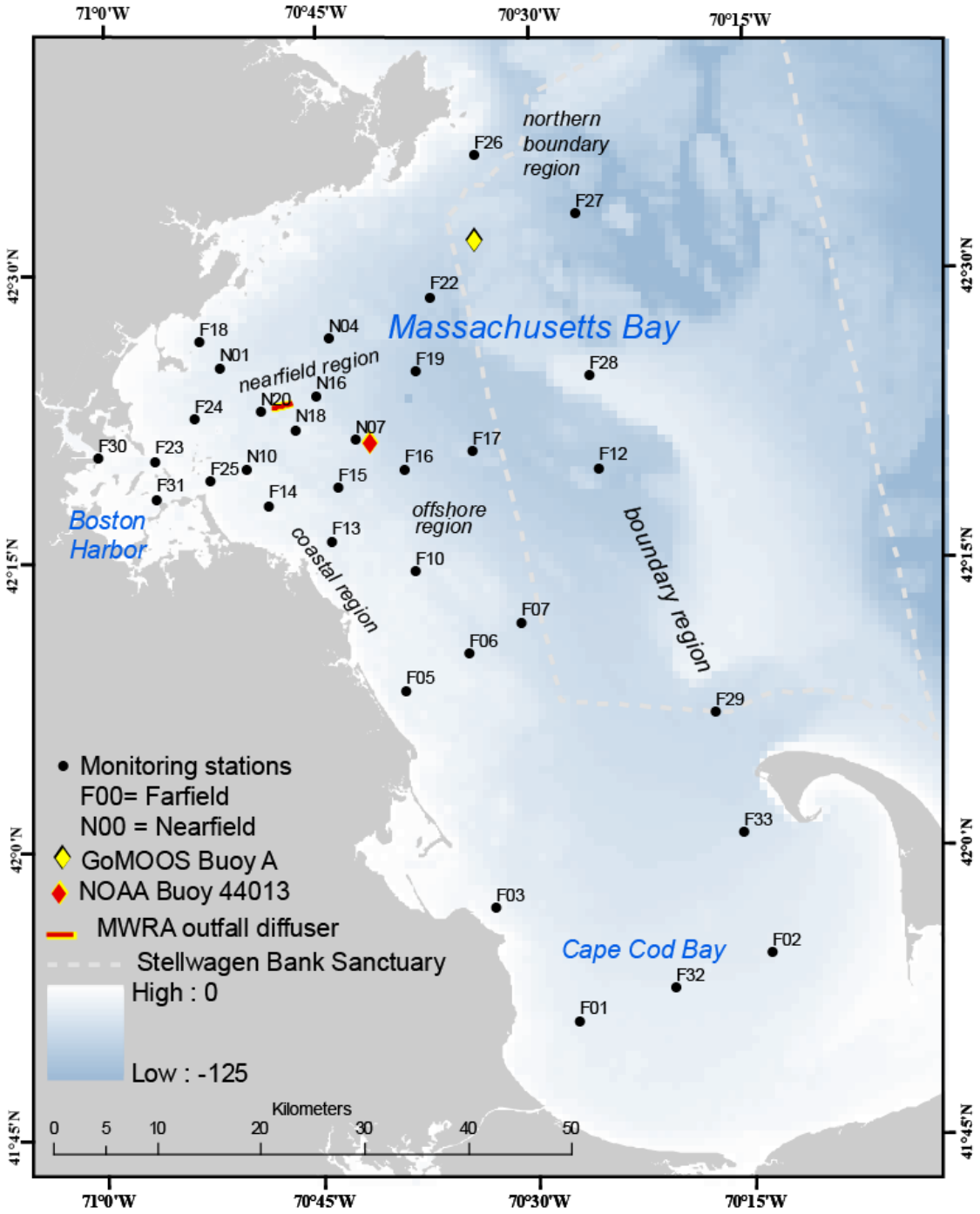

Figure 1. Location of Nearfield and Farfield Stations

The observer's eye-height above the sea surface was approximately 4 meters on the R/V *Tioga* and R/V *Andy Lynn VI* 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. The vessels R/V *Auk* and R/V *Tioga* were also used for surveys with onboard marine mammal observers.

For some surveys, marine mammal observers were not present. The scientific crew on board the R/V *Merganser* and R/V *Aquamonitor* observed marine mammals while on these surveys. These vessels were used to conduct MWRA Boston Harbor surveys and some other nearfield, farfield, and *Alexandrium* rapid response surveys (Figure 2). Similar to the previous year, data from those surveys are included in this report.

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

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 different vessels (which vary the characteristics of the survey platform) were used during the year. Therefore it is not appropriate to use these opportunistic sightings to estimate animal abundance. The data provide useful qualitative information concerning seasonal patterns and relative abundance within the same study area.

During the 2010 monitoring year, the marine mammal observers, Battelle survey team members, and MWRA survey team members counted 33 individual whales. Included in the whale count are five right whales, nine humpback whales, eight minke whales, four finback whales, and seven unidentified whales (of which six were baleen whales). There was an unconfirmed sighting believed to be a minke whale which is included in Table 2, but not in any of the other tables or figures. Also counted were 112-117+ Atlantic white-sided dolphins, one pilot whale, 24 harbor porpoises, two unidentified porpoises, 84 harbor seals, one grey seal, and five unidentified seals. Whale sightings in 2010 were mostly in the Stellwagen Bank National Marine Sanctuary (14 whales) and Cape Cod Bay (also 14 whales). Four and one whales were sighted in the nearfield and farfield, respectively (Figure 3). The total number of whales (33) sighted during 2010 was less than 2009 (38-39 sightings). Tables 1 and 2 summarize all the sightings of whales by survey staff in 2010. Additionally, all other sighting of marine mammals such as pinnipeds and dolphins are also included in those tables. The geographic distribution of whale sightings is presented in Figure 3.

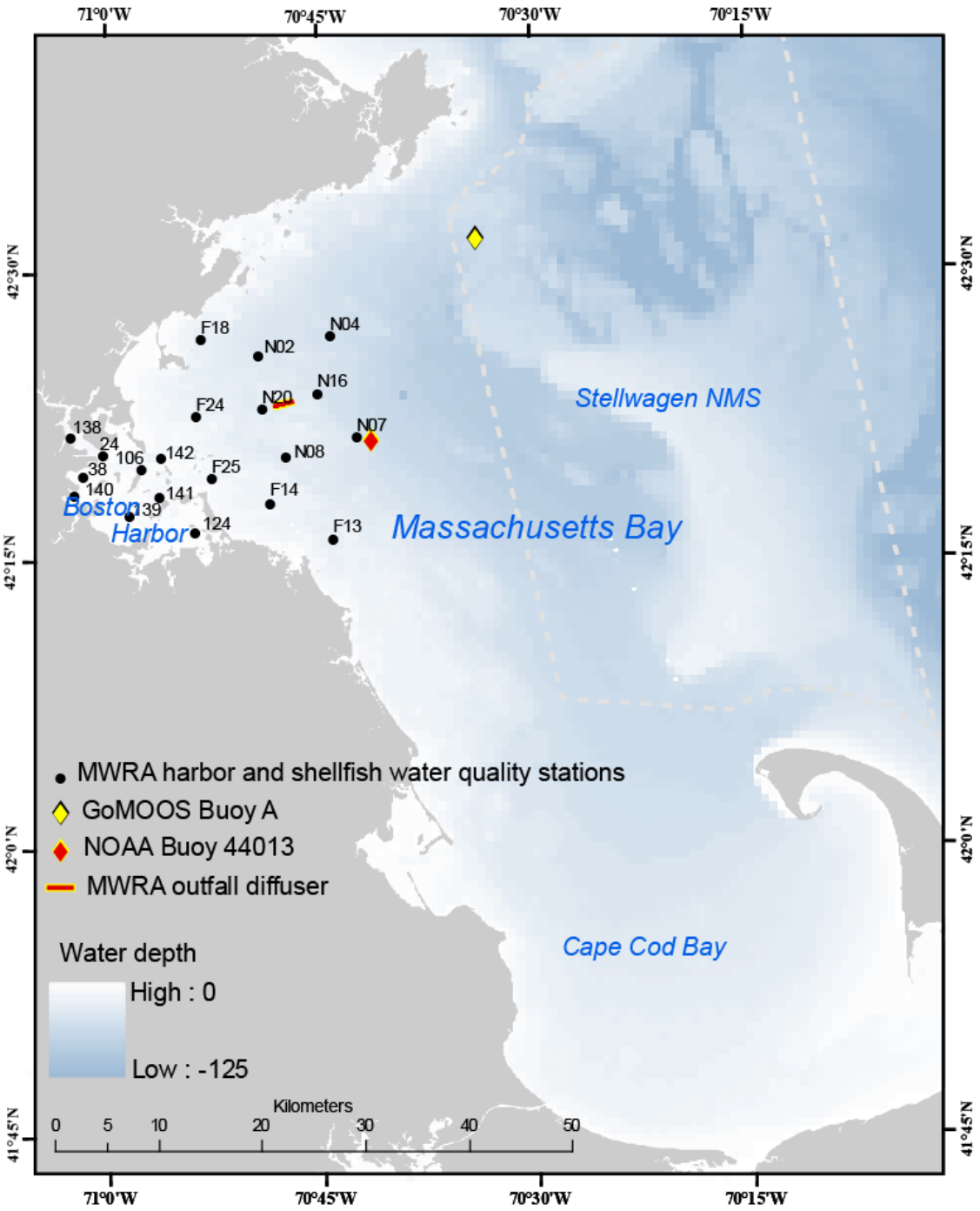

Figure 2. Location of MWRA Surveys for Division of Marine Fisheries Shellfish Water Monitoring

Table 1. Marine Mammal Sightings on 2010 MWRA Boston Harbor and Shellfish Water Quality Surveys.

Survey ID	Date/Time	Number	Mammal	Location	Sighting Comments	Observer Present
WQM2010 R/V *Merganser*	1/5/10 0848	1	Harbor seal	42.386763, -71.062829	500 yds from station 137	No
	1/5/10 1030	1	Harbor seal	42.305833, -71.0405	Station 140	No
PC102 R/V *Merganser*	2/3/10 1217	1	Harbor Seal	42.344305, -71.008849	100 yds from station 024	No
CSO2010 R/V *Merganser*	2/27/10 1000	1	Harbor seal	42.283477, -70.956082	100 yds from station 079	No
CSO2010 *Truck*	3/16/10 0900	1	Harbor seal	42.3535, -71.04967	Station 178	No
DMFADV R/V *Merganser*	3/17/10 0915	2	Finback whales	42.344, -70.699667	Near N07	No
	3/17/10 0915	2	Porpoises	42.344, -70.699667	Near N08	No
	3/17/10 0915	1	Pilot whale	42.344, -70.699667	Near N09	No
WQM2010 R/V *Merganser*	3/29/10 0845	1	Harbor seal	42.363333, -70.987333	Near station 130	No
PC104 R/V *Merganser*	4/1/10 0800	8	Harbor seals	42.318784, -70.922679	Off E side of Geroge's Island	No
	4/1/10 1057	1	Harbor porpoise	42.397667, -70.772	Between N04 and N20	No
PC107 R/V *Merganser*	7/2/10 0920	1	Minke whale	42.356, -70.706	Close to N07	No
WQM2010 R/V *Merganser*	8/5/10 1245	1	Grey seal	42.33925, -70.939467	Between stations 142 and 106	No
CSO2010 *Key Largo*	8/31/10 1156	1	Harbor seal	42.38492, -71.0331	Near station 027	No
WQM2010 R/V *Merganser*	9/14/10 0817	1	Seal	42.386763, -71.062829	Station 137	No
	9/14/10 1135	4	Seals	42.339167, -70.706167	Station 142	No
CSO2010 R/V *Merganser*	10/4/10 0813	1	Harbor seal	42.342667, -71.028667	Station 022	No
PC10A R/V *Merganser*	10/12/10 0950	10	Harbor porpoises	42.269333, -70.717	Between F13 and N07	No
CSO2010 *Key Largo*	10/14/10 0813	1	Harbor seal	42.3705, -70.9315	Station 014	No
WQM2010 R/V *Merganser*	10/20/10 0845	1	Harbor seal	42.376633, -71.046317	Between stations 014 and 015	No
	10/20/10 0943	1	Harbor seal	42.351567, -71.027117	Between stations 019 and 024	No
	10/20/10 0945	1	Harbor seal	42.34795, -71.0196	Near station 024	No
WQM2010 R/V *Merganser*	11/1/10 1015	1	Harbor seal	42.335317, -71.003467	Off Castle Island	No
CSO2010 R/V *Merganser*	11/10/10 0931	1	Harbor seal	42.375067, -71.046683	Between stations 014 and 015	No
	11/10/10 1137	1	Harbor seal	42.366833, -70.974133	Near Winthrop Marina	No
CSO2010 R/V *Merganser*	11/12/10 1039	1	Harbor seal	42.38735, -71.055267	At mouth of Island End	No
WQM2010 R/V *Merganser*	11/15/10 0805	1	Harbor seal	42.377533, -71.044	Between stations 014 and 015	No
	11/15/10 1014	1	Harbor seal	42.305933, -71.039983	Near station 140	No
PC10C R/V *Merganser*	12/10/10 0746	1	Harbor seal	42.3255, -70.945933	Off Nix's Mate	No
	12/10/10 0931	1	Harbor seal	42.2683333, -70.735	At F13	No
	12/10/10 1136	1	Harbor seal	42.4275, -70.8218333	At N02	No
	12/10/10 1206	1	Harbor seal	42.348133, -70.935933	Just E of DITP	No

Table 2. Marine Mammal Sightings on 2010 Nearfield and Farfield Surveys.

Survey ID	Date/Time	Number	Mammal	Location	Sighting Comments	Observer Present
WF/WN101 R/V *Tioga*	2/2/10 1330	1	Harbor seal	42.346333, -70.424133	At F12	Yes
	2/3/10 0725	1	Harbor seal	42.278667, -70.931	On Grape Island Rocks	Yes
	2/3/10 0740	2	Harbor seals	42.3155, -71.067667	On Toddy Rocks	Yes
	2/3/10 0750	1	Harbor seal	42.329167, -70.8405	On ice floe	Yes
	2/3/10 1600	1	Harbor porpoise	42.241167,-70.637667	At F10	Yes
WF/WN102 R/V *Tioga*	2/22/10 0945	1	Harbor seal	41.93235, -70.526183	Between F03 and F01	Yes
	2/22/10 1645	1	Harbor seal	42.485433, -70.649933	At F22	Yes
WN103 R/V *Aquamonitor*	3/19/10 0708	1	Harbor seal	42.257667, -70.93	In mooring area at Hewitt's Cove	Yes
	3/19/10 0730	8	Harbor seals	42.3155, -70.902167	Hauled out on the S side of George's Island	Yes
	3/19/10 0730	2	Harbor seal	42.3155, -70.902167	On Toddy Rocks, N of Hull	Yes
	3/19/10 0810	2	Harbor porpoises	42.368667, -70.846167	Between N10 and N01	Yes
	3/19/10 0922	1	Harbor seal	42.3835, -70.804333	Near N20	Yes
	3/19/10 1025	1	Harbor porpoise	42.389667, -70.706667	At N07	Yes
WF/WN104 R/V *Aquamonitor*	4/5/10 0945	1	Minke whale	42.4075, -70.6845		Yes
	4/5/10 1000	1	Harbor porpoise	42.4125, -70.636667		Yes
	4/5/10 1050	1	Harbor porpoise	42.496167, -70.6085		Yes
	4/5/10 1305	2	Finback whales	42.409167, -70.433833		Yes
	4/5/10 1300	1	Harbor porpoise	42.409167, -70.433833		Yes
	4/5/10 1320	1	Unidentified toothed whale	42.384167, -70.433167		Yes
	4/6/10 0808	1	Harbor porpoise	42.270167, -70.740833		Yes
	4/6/10 0835	1	Harbor seal	42.224, -70.705167		Yes
	4/6/10 0835	1	Harbor seal	42.224, -70.705167		Yes
	4/6/10 0913	1	Harbor seal	42.139833, -70.649167		Yes
	4/6/10 0955	1	Harbor porpoise	42.018167, -70.585167		Yes
	4/6/10 1035	1	Harbor seal	41.931167, -70.525333		Yes
	4/6/10 1105	1	Minke whale	41.8505, -70.453333		Yes
	4/6/10 1118	1	Minke whale	41.855, -70.4385		Yes
	4/6/10 1105	1	North Atlantic Right whale	41.870167, -70.374333		Yes
	4/6/10 1138	1	North Atlantic Right whale	41.873167, -70.358333		Yes
	4/6/10 1138	1	North Atlantic Right whale	41.873167, -70.358333		Yes
	4/6/10 1145	1	Minke whale	41.879167, -70.34		Yes
	4/6/10 1210	1	Unidentified baleen whale	41.894833, -70.281167		Yes
	4/6/10 1215	2	North Atlantic Right whales	41.898667, -70.269		Yes
	4/6/10 1215	1	Unidentified baleen whale	41.898667, -70.269		Yes
	4/6/10 1238	1	Harbor seal	41.903833, -70.2375		Yes
	4/6/10 1238	1	Unidentified baleen whale	41.903833, -70.2375		Yes
	4/6/10 1325	3	Humpback whales	42.0435, -70.272167		Yes
	4/6/10 1325	Small group	Atlantic white-sided dolphins	42.0435, -70.272167		Yes
	4/6/10 1325	Small group	Atlantic white-sided dolphins	42.0435, -70.272167		Yes

Survey ID	Date/Time	Number	Mammal	Location	Sighting Comments	Observer Present
WF/WN104 R/V *Aquamonitor*	4/6/10 1310	Hundreds	Atlantic white-sided dolphins	42.071167, -70.28		Yes
	4/6/10 1345	1	Unidentified baleen whale	42.105333, -70.286167		Yes
	4/6/10 1348	1	Harbor seal	42.114167, -70.289167		Yes
	4/6/10 1355	1	Humpback whale	42.116333, -70.291667		Yes
	4/6/10 1355	1	Harbor seal	42.116333, -70.291667		Yes
	4/6/10 1405	2	Humpback whales	42.136167, -70.311667		Yes
	4/6/10 1405	2	Atlantic white-sided dolphins	42.136167, -70.311667		Yes
	4/6/10 1405	1	Minke whale	42.136167, -70.311667		Yes
	4/6/10 1415	1	Humpback whale	42.146833, -70.32		Yes
	4/6/10 1422	1	Harbor porpoise	42.152167, -70.345		Yes
	4/6/10 1422	5	Atlantic white-sided dolphins	42.152167, -70.345		Yes
	4/6/10 1422	1	Minke whale	42.152167, -70.345		Yes
	4/6/10 1435	1	Harbor porpoise	42.164833, -70.391167		Yes
	4/6/10 1435	1	Humpback whale	42.164833, -70.391167		Yes
	4/6/10 1635	1	Harbor seal	42.277833, -70.737667		Yes
	4/6/10 1635	1	Harbor seal	42.277833, -70.737667		Yes
	4/7/10 1030	1	Harbor seal	42.356, -70.706167		Yes
	4/7/10 1230	6	Harbor seals	42.342, -70.929167		Yes
	4/7/10 1230	7	Harbor seals	42.314, -70.929833		Yes
AF101 R/V *Aquamonitor*	4/26/10 1235	2	Unidentified baleen whales	42.406967, -70.506983	Near AF6	Unknown
AF103 R/V *Aquamonitor*	5/21/10 1448	5-10	Atlantic white-sided dolphins	42.1679167, -70.592467		Unknown
WF/WN10B R/V *Aquamonitor*	8/9/10 1425	1	Minke whale		Unconfirmed; near F22	Yes
	8/10/10 1355	1	Harbor seal	42.339167, -70.9425	In transit between N16 and N07	Yes
	8/10/10 1025	1	Minke whale	42.394333, -70.753167		Yes
	8/11/10 1103	1	Humpback whale	42.163333, -70.400833	In transit to F29	Yes
	9/29/10 1012	1	Harbor seal	42.356167, -70.705667	At N07	Yes
WN10D R/V *Aquamonitor*	10/18/10 1345	6	Harbor seals	42.314333, -70.934333	On rocks S of George's Island	Yes
WF/WN10E R/V *Aquamonitor*	11/15/10 0730	1	Harbor seal	42.303833, -70.923667	In Hull Gut	Yes
WN10F R/V *Aquamonitor*	11/15/10 0950	2	Harbor porpoises	42.393833, -70.7535	At N16	Yes
	11/15/10 1230	1	Harbor seal	42.311333, -70.918667	On Toddy Rocks	Yes
	11/15/10 1240	1	Harbor seal	42.279833, -70.931167	On rocks E of Grape Island	Yes
	11/15/10 1250	1	Harbor seal	42.267667, -70.931333	On rock N of Grape Island	Yes

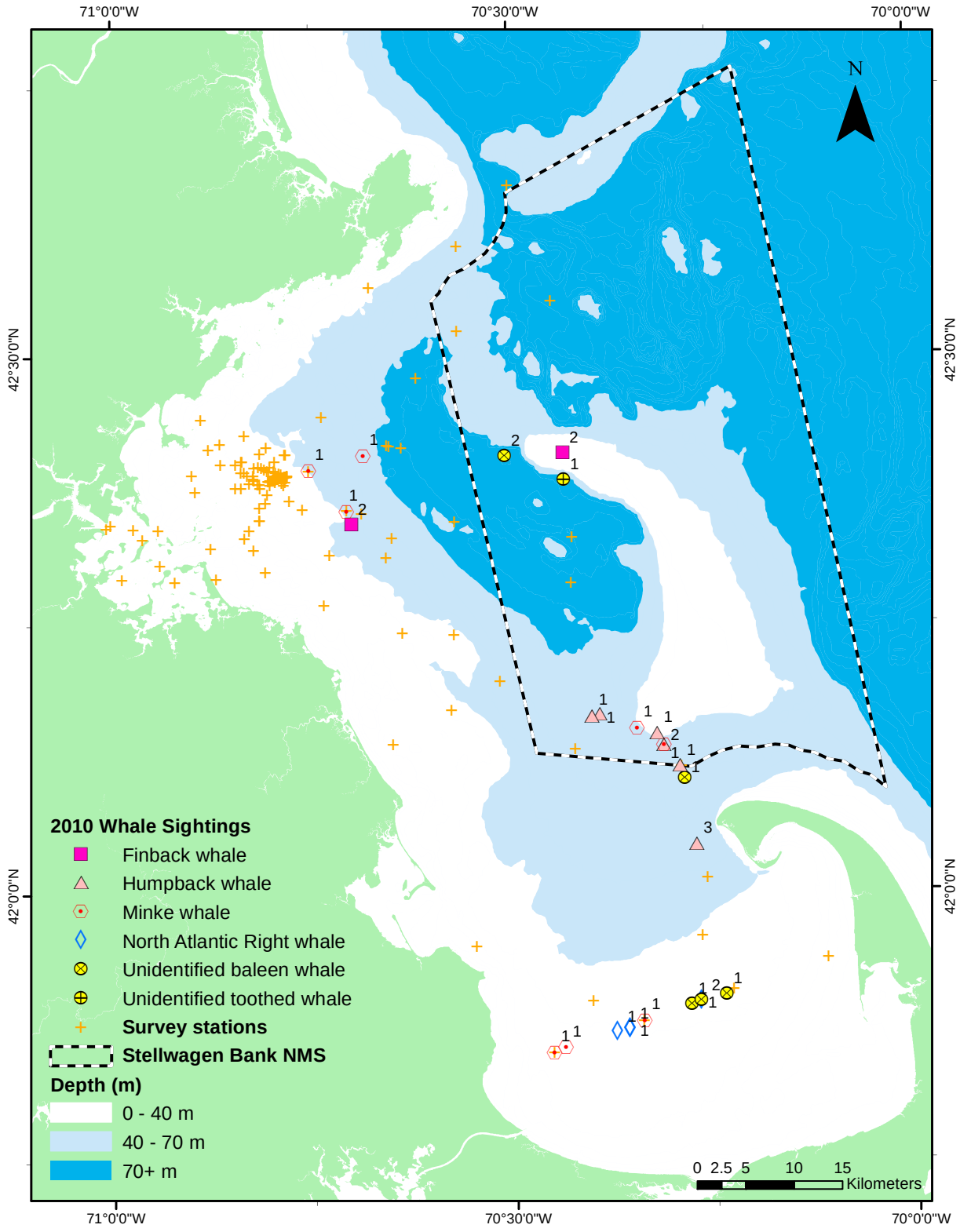

Figure 3. Approximate Locations of Whale Sightings during 2010 Surveys

Note: The data displayed in this figure come from Tables 1 and 2 of this report.

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), therefore, observations are descriptive, not a statistically robust population census.

During 2010, 90 pinnipeds were sighted. 84 of these were harbor seals, one was a grey seal, and five were seals of an unidentified species. These sightings were a decrease from 2009 when 153 pinnipeds were reported. The 2010 sighting numbers are more in line with 2007 which had 96 pinniped sightings. Both 2010 and 2007 had a smaller number of sightings than 2009 and 2008 which had 153 and 142, respectively. For comparison, the numbers for 2006 to 2001 were 136, 76, 303, 105, 138, and 138, respectively. Furthermore, in years prior to 2001, only 20 to 60 pinniped sightings were made throughout the survey area. Most observations of pinnipeds are when the vessel is transiting to and from the survey area; the pinnipeds were typically resting upon rocks.

112-143+ Atlantic white-sided dolphins were seen in 2010. This is a very rough estimate since two sightings were of "small groups" of dolphins and one was described in the survey report as "hundreds." So it is safe to say that the 2010 count was much higher than officially recorded and that it surpassed 2003 as the year with the great number of Atlantic white-sided dolphin sightings. Additionally, 24 harbor porpoises were seen along with two unidentified porpoises. To put these numbers into a historical context, in 2009, 6-7 Atlantic white-sided dolphins were seen. In 2008 one Atlantic white-sided dolphin and eight porpoises were sighted. In 2007, about 19-26 dolphins were sighted, similar to 2006 (24-31 dolphins), 2004 (27+ dolphins), and 1998 (32 dolphins). However, 2007 had an increase in dolphin sightings compared to both 2005, when a small pod was observed, 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.

Since 1998, the Provincetown Center for Coastal Studies (PCCS) has conducted systematic surveys of Cape Cod Bay and adjacent waters from January through mid-May. In 2010, through photographic identification, 163 different right whales were identified. This number is in line with the 187, 148, and 161 unique individuals sighted in 2009 through 2007, respectively. Half the individuals sighted in 2007 were seen again in the 2008 surveys, and 61% of the individuals seen in 2008 were spotted in 2009. From 2007 to 2010 at least 45% of the known right whale population has been sighted annually in the Cape Cod Bay area. These observations suggest that the Cape Cod Bay area is an important habitat for right whales (Stamieszkin *et al*., 2010, Leeney *et al*., 2008, Leeney *et al.*, 2009).

6.0 Summary of Whale Sightings 1998 through 2010

For the past 15 years, MWRA has collected and reported on the yearly sightings of marine mammals made during program surveys. The same methods have been used to collect whale sighting data over the years, but other factors such as vessels 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 twelve years (1998 through 2010). 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. Data for Boston Harbor collected by MWRA was not available prior to 2005; therefore, the data are not included in this comparison.

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

- Nearfield (NF; all nearfield stations),
- Stellwagen Bank National Marine Sanctuary (SBNMS; SW1, SW2, SW3, and SW4; stations F12, F27, F28, and F29),
- Cape Cod Bay (CCB; F01, F02, F03, F32, and F33), and
- Farfield (FF; F05, F06, F07, F10, F13, F14, F15, F16, F17, F18, F19, F22, F23, F24, F25, F30, and F31).

During 2010, approximately 24 survey days were spent in Massachusetts and Cape Cod Bays. The Nearfield area was visited at least 12 times during 2010 with a total of seven stations sampled on each survey. The Stellwagen Bank, Cape Cod Bay, and Farfield areas were surveyed at least six times during the year. Each survey day consisted of at least eight hours of vessel time (approximately 192 hours/year for all the surveys). Additionally, there were three full day rapid response surveys that examined an *Alexandrium fundyense* bloom in Massachusetts Bay.

During the MWRA surveys from 1998 to 2010, 418-430+ whales of at least four identified species and unidentified species were seen over the past twelve years (Table 3). The highest number of whales (59) was sighted in 1999, due in part to 24-27 finback whales being observed on Stellwagen Bank. There was one humpback whale spotted in Boston Harbor in 2005 which accounts for the one whale discrepancy in the total number of whales sighted between the figure cited above (418-430+) and the numbers in Table 3 (total of 417-429+), which are for areas outside of the harbor.

Table 3. Whale Sightings by Area, Species, and Year.

Area	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total Sightings
Right Whale Observations														
SBNMS	2	1			2					1	1	1		**8**
FF	1													**1**
CCB	1	1		7			3		1		12		5	**30**
NF														
Totals	**4**	**2**		**7**	**2**		**3**		**1**	**1**	**13**	**1**	**5**	**39**
Humpback Whale Observations														
SBNMS	4	12	29+	1	2-5			1	24-27	6	8	8	6	**101-107+**
FF				3	4			3	2-3	1				**13-14**
CCB					1	2			5		2		3	**13**
NF	1											2		**3**
Totals	**5**	**12**	**29+**	**4**	**7-10**	**2**		**4**	**31-35**	**7**	**10**	**10**	**9**	**130-137+**
Finback Whale Observations														
SBNMS		27	4		1			1	7		1		2	**43**
FF					1		2			1	1			**5**
CCB							1		2					**3**
NF					1	1					3		2	**7**
Totals		**27**	**4**		**3**	**1**	**3**	**1**	**9**	**1**	**5**		**4**	**58**
Minke Whale Observations														
SBNMS	3		1					1	6+	3		3	2	**19+**
FF	1	3		3		1			1		1	3	1	**14**
CCB			1					15					3	**19**
NF	2	1	1	1	1	5	2	1		1	3	4	2	**24**
Totals	**6**	**4**	**3**	**4**	**1**	**6**	**2**	**17**	**7+**	**4**	**4**	**10**	**8**	**76+**
Unidentified Whale Observations														
SBNMS	5	7	5-6	1	1	2	1	4-6	4+	1	7-8	13-14	4	**55-60+**
FF	1	2	1	1	2			1		2		1		**11**
CCB	1	4	11	3		2		1	1	1	4	3	3	**34**
NF	5+	1				2	2	3			1			**14+**
Totals	**12+**	**14**	**17-18**	**5**	**3**	**6**	**3**	**9-11**	**5+**	**4**	**12-13**	**17-18**	**7**	**114-119+**
Year Totals	**27+**	**59**	**53-54+**	**20**	**16-19**	**15**	**11**	**31-33**	**53-57+**	**17**	**44-45**	**38-39**	**33**	**417-429+**

Note: Blank cell denotes no whales observed.

Over half of the overall sightings (54% of the 417-429+) were made within the boundary of Stellwagen Bank (Figures 4 and 5). The area with the second highest whale sightings from 1998 to 2010 was Cape Cod Bay (24% of the 417-429+). Cape Cod Bay had the highest number of right whale sightings (30 out of 39), with the highest concentration of sightings occurring in April 2008 when ten were noted. Five right whales were seen in Cape Cod Bay in April 2010. An additional 11% of whales were sighted just outside Stellwagen Bank western boundary (listed as Farfield). The Nearfield area, which lies over and around the outfall, had just over 12% of the total whale sightings, with minke whales being the dominant species, followed by unidentified whale species.

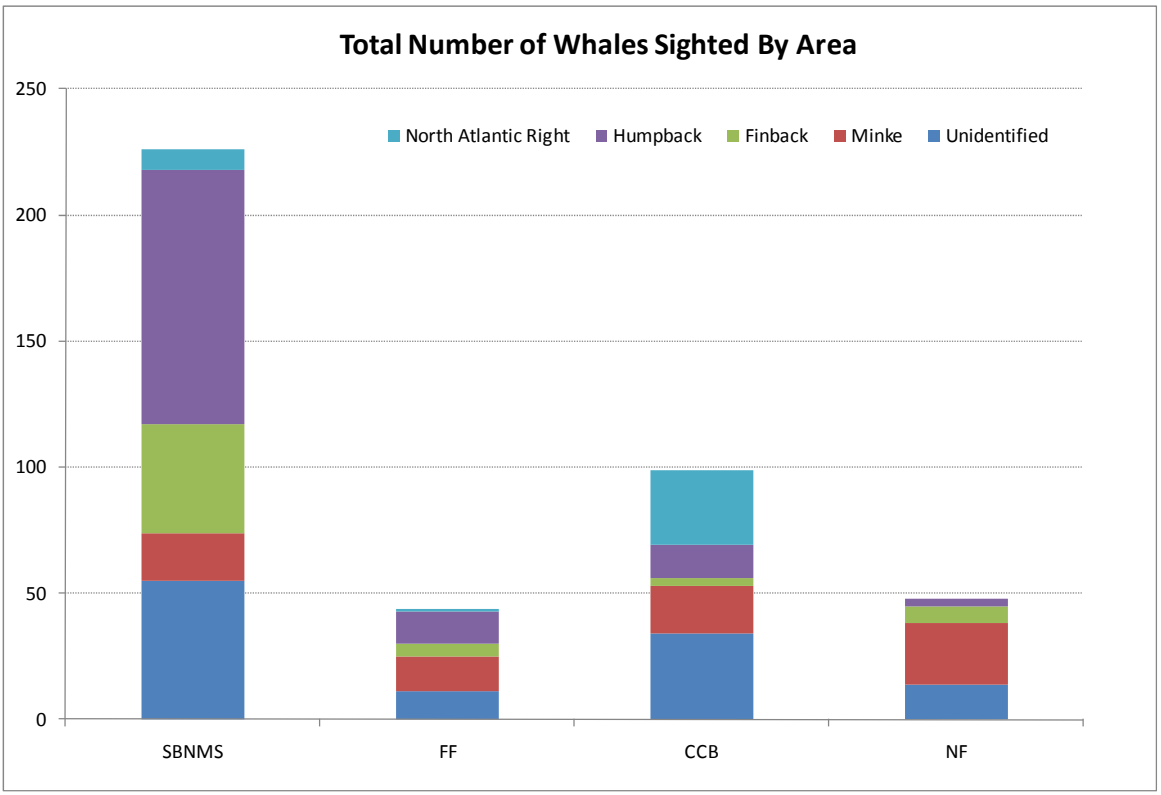

Figure 4. Distribution of Sightings by Species and Area, 1998-2010.

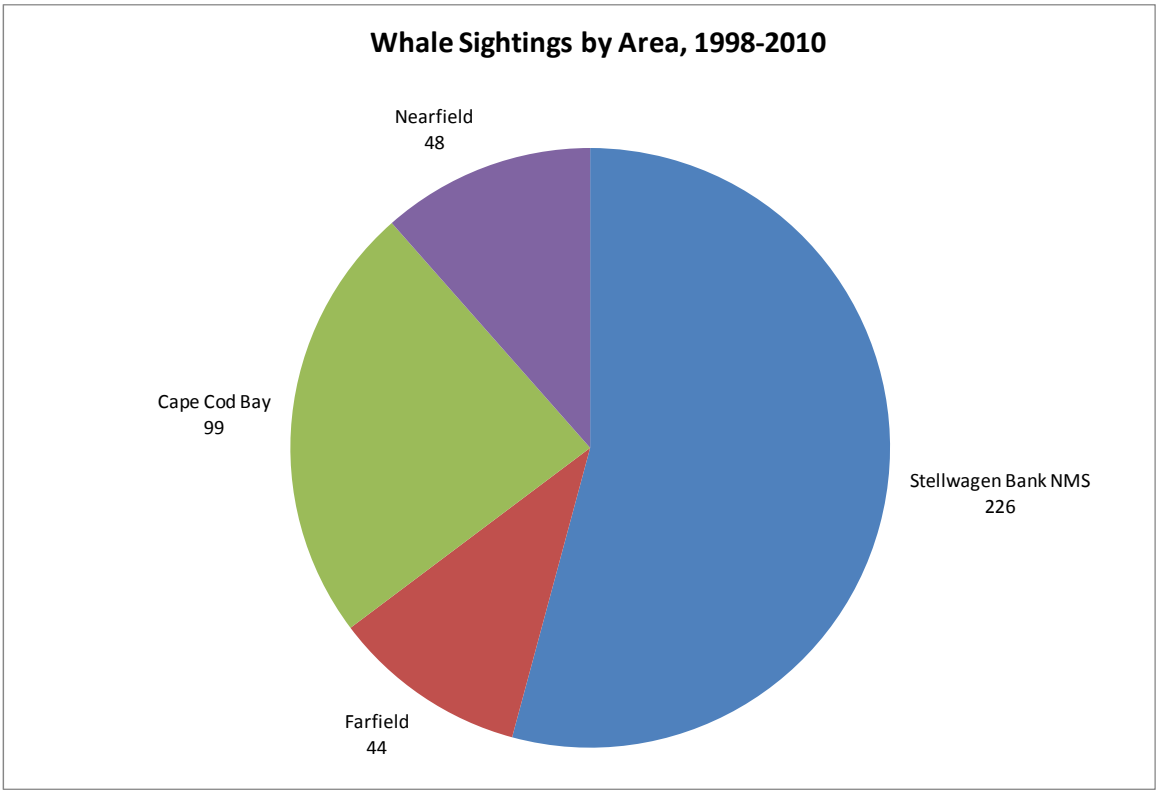

Figure 5. Total Sightings of Whales by Area, 1998-2010.

The most abundant identified whale species noted during the surveys was the humpback whale (130) (Figure 6). The total number of humpback whales represents 31% of the sightings of all whales throughout all of the areas over the years. Furthermore, 78% of humpback whale sightings occurred in the area of Stellwagen Bank. The second most abundant identified whales were the minke and the finback whales, with 18% and 14% of the total sightings, respectively. It should be noted that 27% of the whales sighted from 1998 to 2010 were of unidentified species.

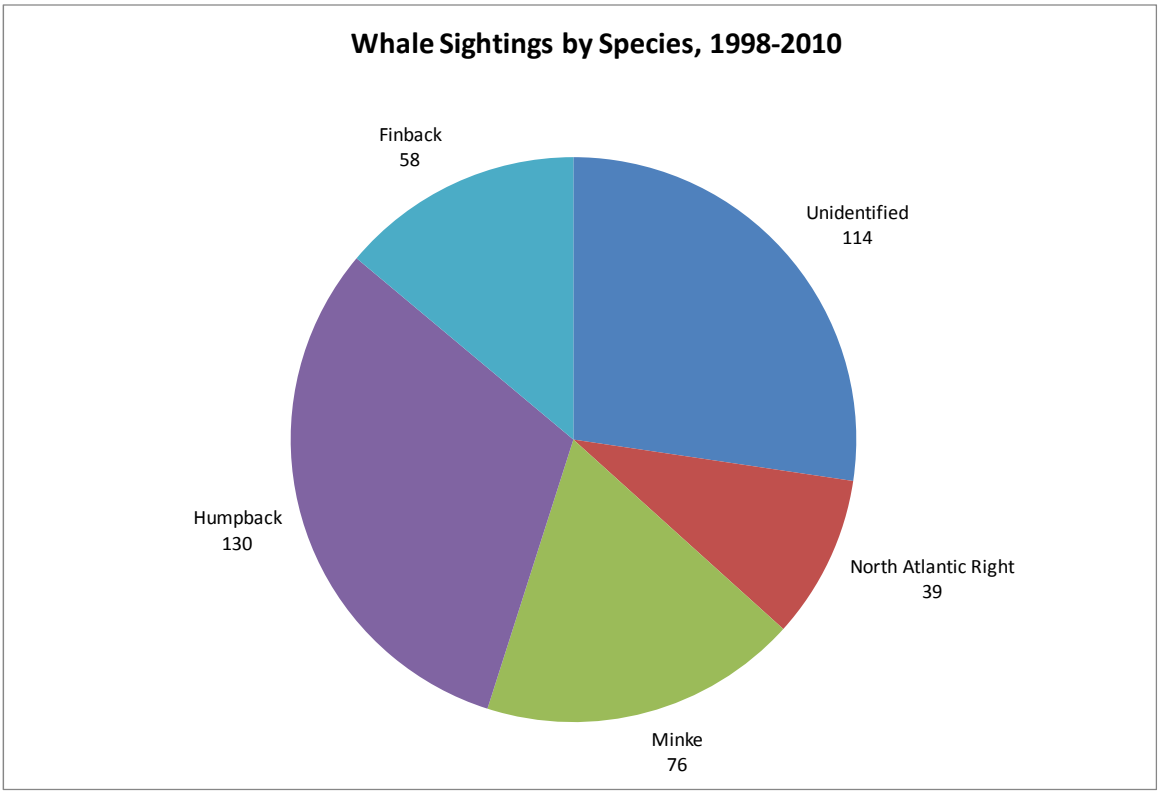

Figure 6. Distribution of Whale Sightings by Species, 1998-2010.

7.0 References

Brown MW, O Nichols, MK Marx, and JN Ciano. 2002. Surveillance monitoring and management of North Atlantic right whales (*Eubalaena glacialis*) in Cape Cod Bay, Massachusetts: 2002. Final report to Division of Marine Fisheries, Commonwealth of Massachusetts, and Massachusetts Environmental Trust, September, 2002. 28 pp.

Bulloch DK. 1993. The Whale-Watcher's Handbook: A Field Guide to the Whales, Dolphins, and Porpoises of North America. Lyons & Burford, New York, NY. 114 pp.

CeTAP. 1982. A Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf. Final Report of the Cetacean and Turtle Assessment Program, University of Rhode Island, Kingston, RI. U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC. Contract AA551-CT-48. 450 pp.

Environmental Protection Agency. 1993. Assessment of Potential Impact of the MWRA Outfall on Endangered Species. Boston, MA: U.S. Environmental Protection Agency.

Geraci, J.R., Anderson, D.M., Timperi, R.J., Early, G.A., Prescott, J.H., and Mayo, C.A. 1989. Humpback whales (Megaptera novaeangliae) fatally poisoned by dinoflagellate toxin. J. Fish. Res. Bd. Canada 46: 1895-1898.

Hamilton PK, CA Mayo. 1990. Population characteristics of right whales, *Eubalaena glacialis*, in Cape Cod Bay and Massachusetts Bay, 1978-1986. In: Hammond, P.S. et al. (eds.), Individual Recognition and Estimation of Cetacean population Parameters. Report of the International Whaling Commission Special Issue 12:203-208.

Harrison R, MM Bryden. 1989. Whales, Dolphins and Porpoises. Weldon Owen Pty Limited, McMahons Point, Australia. 240 pp.

Jaquet, N., C.A. Mayo, D. Osterberg, O.C. Nichols, M.K. Marx, and C.L. Browning. 2006. Surveillance, monitoring and management of North Atlantic right whales in Cape Cod Bay and adjacent waters – 2006. Final report submitted to the Division of Marine Fisheries, Commonwealth of Massachusetts. November 2006.

Jaquet N., Mayo C., Osterberg D., Browning C. L. and Marx M. K. 2007. Surveillance, Monitoring and Management of North Atlantic Right Whales in Cape Cod Bay and Adjacent Waters - 2007. Final report submitted to the Division of Marine Fisheries, Commonwealth of Massachusetts. October 2007:112pp, retrieved from http://www.coastalstudies.org/what-we-do/right-whales/rwreports.htm

Katona SK, V Rough, DT Richardson. 1993. A Field Guide to Whales, Porpoises, and Seals from Cape Cod to Newfoundland. Smithsonian Institution Press. Washington, DC. 316 pp.

Langton RW, JB Pierce, JA Gibson. 1994. Selected Living Resources, Habitat Conditions, and Human Perturbations of the Gulf of Maine. NOAA Tech. Memo NMFS-NE-106; 70 pp.

Leeney RH, K Stamieszkin, N Jaquet, CA Mayo, D Osterberg, and MK Marx. 2008. Surveillance, Monitoring and Management of North Atlantic Right Whales in Cape Cod Bay and Adjacent Waters – 2008. October 2008; 186pp, retrieved from http://www.coastalstudies.org/what-we-do/right-whales/rwreports.htm

Leeney RH, K Stamieszkin, CA Mayo, and MK Marx. 2009. Surveillance, Monitoring and Management of North Atlantic Right Whales in Cape Cod Bay and Adjacent Waters – 2009. November 2009; 324pp, retrieved from http://www.coastalstudies.org/what-we-do/right-whales/rwreports.htm

NMFS (National Marine Fisheries Service). 1991. Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*). Report prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Springs, MD. 105 pp.

Payne, PM, Nicolas, J.R., O'Brien, L., and Powers, K.D. 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. Fish. Bull. U.S.: 271-277.

Payne PM, DN Wiley, SB Young, S Pittman, PJ Clapham, JW Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fishery Bulletin 88:687-696.

Pett, S, CJ McKay. 1990. Technical report on the resources and uses of Stellwagen Bank. In: The Resources and Uses of Stellwagen Bank. J.H. Archer (ed.). Urban Harbors Institute, University of Massachusetts, Boston. 66pp.

Rough V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report prepared for the U.S. Marine Mammal Commission. Contract No. T10155615. NTIS No. PB95-191391.

Schilling, M.R., Seipt, I., Weinrich, M.T., Frohock, S.E., Kuhlberg, A.K., and Clapham, P.J. 1992. Behavior of individually identified sei whales (*Balaenoptera borealis*) during an episodic influx into the southern Gulf of Maine in 1986. Fishery Bulletin 90: 749-755.

Short, LM, Schaub E. 2006. Summary of marine mammal observations during 2005 surveys. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2005-03. 18 p.

Short, LM, Michelin D. 2007. Summary of marine mammal observations during 2007 surveys. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2007-01. 19p.

Stamieszkin K, L Ganley, CA Mayo, RH Leeney, and MK Marx. 2010. Surveillance, Monitoring and Management of North Atlantic Right Whales in Cape Cod Bay and Adjacent Waters – 2010. November 2010; 31pp, retrieved from http://www.coastalstudies.org/what-we-do/right-whales/rwreports.htm

Waring GT, DJ Lalka, PJ Clapham, S Swartz, MC Rossman, TVN Cole, KD Bisack , LJ Hansen. 1999. U.S. Atlantic marine mammal stock assessments-1998. NOAA Technical memorandum NMFS-NE-116.

Wenzel, F, DK Matilla, PJ Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Mar. Mamm. Sci. 4(2):172-175.

Weinrich, M., M. Martin, R. Griffiths, J. Bove, and M. Schilling. 1997. A shift in distribution of humpback whales, (*Megaptera novaeangliae*) in response to prey in the southern Gulf of Maine. Fishery Bulletin 95: 826-836.

Weinrich, M.T., C.R. Belt, and D. Morin. 2001. Behavior and ecology of the Atlantic white-sided dolphin (*Lagenorhynchus acutus*) in coastal New England waters. Marine Mammal Science 17: 231-248.

Massachusetts Water Resources Authority
Charlestown Navy Yard
100 First Avenue
Boston, MA 02129
(617) 242-6000
http://www.mwra.state.ma.us