

Northeast Fisheries Science Center Reference Document 09-12

# Description of the 2008 Oceanographic Conditions on the Northeast U.S. Continental Shelf

by Maureen H. Taylor, Tamara Holzwarth-Davis, Cristina Bascuñán, and James P. Manning

August 2009

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#### Abstract

Hydrographic observations from 17 surveys that were conducted on the northeast continental shelf during 2008 are summarized. Contoured distributions of temperature, salinity, density stratification and anomalies are presented for six two-month time periods if coverage was sufficient. Average temperature/salinity values were calculated in five geographic regions over the northeast continental shelf: western Gulf of Maine (GOMW), eastern Gulf of Maine (GOME), Georges Bank (GBNK), northern Mid Atlantic Bight (MABN) and southern Mid Atlantic Bight (MABS).

Review of the computed regional average temperature data indicate that surface temperatures were predominately warmer than the reference values in all regions. The eastern Gulf of Maine exhibited slightly colder than expected bottom temperatures for all time periods for which data were available. Regional average salinities were mostly lower, but the largest (negative) anomalies were observed in the Mid-Atlantic Bight. There were localized areas of positive salinities anomalies observed during the year, but these tended to be associated with warm core rings or the variable position of the shelf/slope front. Warmer sea surface temperatures and lower salinities contributed to a higher degree of density stratification along the outer shelf region of the Mid Atlantic Bight during the 2008 summer. The volume of shelf water in the Mid Atlantic regions was high indicating that the shelf / slope front was located further offshore. The northeast climate experienced higher than normal precipitation and slightly warmer air temperatures during 2008.

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#### Introduction

The Northeast Fisheries Science Center (NEFSC) conducts multiple surveys off the northeast U.S. continental shelf each year in support of ecosystem research and management. Broad-scale sampling of the shelf (Cape Hatteras to the Gulf of Maine) occurs during the spring and fall bottom trawl surveys and ideally during four dedicated Ecosystem Monitoring (EcoMon) surveys. Coverage on other surveys varies depending on the specific objectives of the field program. During 2008 the Oceanography Branch supported 17 surveys representing 8 different NEFSC field programs. Surface and bottom temperature, salinity and anomaly distributions were displayed as plan-view contour plots where sufficient data were available. Estimates of the density stratification of the upper 50m of the water column were included. Regional average temperature and salinity and the corresponding anomalies were computed for the five different regions of the shelf shown in Figure 1 and for six time periods throughout the year. The volume of shelf water observed in the upper 100 meters in the Mid Atlantic Bight regions was calculated. The regional values are summarized in both tables and time series figures.

#### **Data and Methods**

The Oceanography Branch provides CTD (Conductivity, Temperature, and Depth) recording instruments to the NEFSC programs that request operational support (Taylor and Bascuñan, 2000). Training was provided prior to sailing in CTD deployment, maintenance, data acquisition and preliminary post processing procedures. All CTD data were processed on shore using Seabird Electronics software to produce 1-decibar averaged ASCII files. Salinity samples, typically taken twice daily at sea, were analyzed using a Guildline Autosal (salinometer) located at the Narragansett Laboratory. A salinity offset was applied to instrument data if the mean difference between the reference Autosal readings and the CTD values exceeded +/- 0.01. The data were quality controlled and converted to a standard 80-column ASCII formatted cruise file. These files were then loaded into ORACLE database tables and also posted in the NEFSC anonymous FTP account (ftp://ftp.nefsc.noaa.gov/pub/hydro). Hydrographic cruise reports were prepared for each survey and include cruise notes, a station distribution map, plan-view contour plots of the surface and bottom temperature, salinity, and anomalies (if station coverage was sufficient), and a table of regional average values and anomalies. CTD profile data can be retrieved from http://www.nefsc.noaa.gov/epd/ocean/MainPage/.

For this report, the processed 2008 CTD data were combined and sorted into two-month time bins. Regional average temperature and salinity were then calculated for the six time periods and for the five regions of the northeast continental shelf. Both the individual station and the regional temperature and salinity anomalies were computed using derived reference annual cycles that were updated by Mountain et al. (2004). Regional averages and anomalies were plotted against the calendar mid-date of all observations within each of the six time periods, if there were at least 10 observations. Regional values were also calculated for each individual cruise. The density stratification was computed using the density (sigma-t) difference between 50m and the surface value. If the station bottom depth was less than 50m, the difference was taken between the deepest observation and the surface. Annual cycles for density stratification (0-50m) were derived for each standard station of the MARMAP data set (Marine Resource Monitoring and Assessment Program, Sherman, 1980). Stratification Anomalies were then computed for each station using the same method that was used for temperature and salinity

(Mountain and Holzwarth, 1990). An observation is considered to be a "surface" value if it comes from the upper 5m of the water column while "bottom" observations must come within 10m of the station bottom depth. The anomaly value is the difference between the observed and the expected value for the particular station location and time of year.

The volume of shelf water for the upper 100 meters of the Mid Atlantic Bight regions is included in this report as an additional year-end product that will be included in future hydrographic atlas summaries. The shelf water volume calculations were made using the method described in Mountain (2004). Shelf water was defined as water having a salinity value < 34. The MARMAP hydrographic data were used as the reference for derived shelf water volume anomalies.

The data are presented chronologically in atlas form. The purpose of this document is to provide a descriptive overview of the hydrographic sampling that was conducted throughout the year and to depict the broad-scale oceanographic conditions that were observed. The atlas summary is intended to be a foundation for further research into observed hydrographic variability and its influence on the marine populations of the northeast continental shelf.

#### Results

The listing of NEFSC cruises that took place during 2008 is provided in Table 1. A total of 1831 CTD casts were collected, processed and archived during the year. Individual cruise reports can be viewed and downloaded from: http://www.nefsc.noaa.gov/HydroAtlas/. Station distributions for each two-month time period are shown in Figure 2. Full shelf coverage was poor during the May-June and November-December time periods. The spring EcoMon cruise was reduced from 16 to 4 sea-days and resulted in only minimal sampling and gear testing within the northern Mid Atlantic bight region (HB0804). Regional average surface and bottom temperature and salinity values are summarized in Tables 2 and 3 and are portrayed in Figures 3 and 4. Combining all of the hydrographic data from all cruises improved the spatial and temporal coverage within the regions and throughout the year. In some cases however, a simple average (not an area weighted mean) was determined because coverage within the area remained poor even after combining all observations. These values are indicated in the tables with a flag value of "1". The standard deviations are also listed (see Holzwarth and Mountain 1990 for further explanation of SDV1 and SDV2). Tables 1-5 of the Appendix contain the regional temperature and salinity values computed for each individual cruise that are also included in the cruise reports. Regional values computed from less than 10 observations for a given area were not included in Figures 3 and 4. Distributions of surface and bottom temperature, salinity, density stratification and anomalies are presented in Figures 5-16. Contour levels and color scaling for temperature and salinity are the same for all figures so that it would be easier to see the annual cycles. The scaling was changed for the water column stability of the upper 50 meters. No attempt was made to contour the hydrographic distributions for the May-June or November-December time periods. Shelf water volume and temperature/salinity characteristics for the upper 100 meters of the MAB regions are listed in Table 6 of the Appendix.

Shipboard environmental sensor data from the Albatross IV, Delaware II, and Henry Bigelow's Scientific Computing System (SCS) were documented and are available for download at: <u>http://www.nefsc.noaa.gov/epd/ocean/MainPage/AlongTrack.html</u>. The Albatross IV conducted its last survey in the late fall of 2008 and had successfully collected 22,924 hydrographic profiles since 1978.

#### Discussion

During the January–February time period, relatively low surface and bottom salinities were observed in the two regions of the Mid Atlantic Bight (MAB). Temperatures were also cooler along the shelf break extending approximately from  $39 - 40.5^{\circ}$ N. The shelf water volume anomaly was highest in the southern MAB and suggested that the shelf / slope front was located further offshore than what would be typical for this time period. A warm core ring was observed in satellite imagery impinging on the shelf in the vicinity of Great South Channel and along southeast Georges Bank and resulted in an area of relatively warm and saltier water. Conditions in the Gulf of Maine (GOM) during January – February were slightly cooler (~0.5°C) and slightly fresher (~0.2) than the expected conditions. Density stratification (0-50m) was minimal during this time period, although some evidence of higher stratification was observed at the mouth of the New York Bight area, and was associated with lower salinities.

The hydrographic data collected during the spring bottom trawl survey is captured in the March–April time period. Conditions remained relatively fresh and temperatures ranged between 1-2°C warmer in the MAB regions relative to the MARMAP reference values. Surface temperatures were also relatively warm in the western GOM. Observations suggest that bottom temperatures in the eastern GOM were slightly cooler than expected, while both temperature and salinities were near normal on Georges Bank. Density stratification remained fairly low during the late winter and early spring, although some localized areas of higher stability were observed in the western GOM and off the New Jersey coast. The reduced sampling during the May-June period impacted our ability to describe the onset and development of seasonal stratification as well as the latitudinal and cross shelf hydrographic gradients for the late spring.

The "cold band" of remnant winter water can be seen in the bottom temperature distribution during July – August (Figure 11) in the northern Mid Atlantic Bight and surface salinities remained fairly low there. Regional surface temperatures were warm shelf wide. The co-occurrence of lower salinities and warmer surface temperatures resulted in an area of higher than expected density stratification extending from the mid-outer shelf south of Martha's Vineyard southwestward to just south of Hudson Shelf Canyon. Satellite imagery during July and August indicated numerous Gulf Stream meanders, streamers and at least two warm core rings. This likely contributed to the higher sea surface temperatures along the southern flank of Georges Bank. Warm core ring and meander activity continued to influence the outer shelf areas during the fall. The surface salinity anomaly distribution of Figure 15 shows two areas of higher surface salinity values that are associated with warm core rings; one located south of Great South Channel and another at the shelf break east of Delaware Bay. Regional surface salinities were near expected values and with the exception of the eastern GOM, surface temperatures remained relatively warm during the latter part of 2008. Density stratification had mostly broken down in the eastern GOM, Georges Bank, and the shelf area south of Block Island. The highest degree of stratification was observed along the mid - outer shelf from Hudson Shelf Canyon to an outer shelf area east of Delaware Bay and was associated with warmer surface temperatures. Another area of relatively high stratification was observed over Wilkinson Basin and was likely caused by the lower salinities observed there.

The Northeast Regional Climate Center (<u>http://www.nrcc.cornell.edu</u>) reports that the annual average northeast air temperatures were ~0.4°C warmer than their 1971-2001 baseline period. Precipitation was 6" above normal, while the states of Maine, Massachusetts, New Hampshire and Connecticut had over 12" above average rainfall. Out of 114 years of observations, 2008 ranked 111 in annual precipitation (114 being the wettest year). It is likely

that the lower than expected shelf water salinities observed in the MAB during 2008 (Appendix Table 6) were due in part to the above average rainfall in the New England states. However, the relatively high volume of shelf water observed throughout the year in the northern MAB, and for most of the year in the southern MAB was mainly due to a further offshore position of the shelf / slope front.

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Cruise/File	Program	Dates	Region(s)	#Casts
del0801.dat	Coop. Research	11 - 17 Jan	MAB	35
del0802.dat	EcoMon Survey	23 Jan - 07 Feb	MAB,GB,GOM	117
del0803.dat	Right Whale Habitat	17 Feb - 07 Mar	GOM	60
alb0801.dat	Spring Bottom Trawl	07 Mar - 03 May	MAB,GB,GOM	172
hb0802.dat	Gear Comparison	10 Mar - 23 Apr	MAB,GB,GOM	185
hb0803.dat	Gear Comparison	14 May - 07 Jun	SNE, MAB	53
hb0804.dat	EcoMon Gear Testing	09 - 13 Jun	Northern MAB	64
alb0802.dat	Gear Testing	05 - 15 May	GB, SNE	17
del0806.dat	Marine Mammal	06 May	GB	1
s10801.dat	Scallop Survey	22 Jun - 05 Aug	MAB, GB	148
hb0805.dat	Habitat Mapping	19 Jun - 20 Jul	MAB, GB	105
hb0806.dat	Benthic Habitat	15 - 25 Aug	GB	22
del0808.dat	EcoMon Survey	13 - 27 Aug	MAB,GB,GOM	170
alb0803.dat	Fall Bottom Trawl	03 Sep – 13 Nov	MAB,GB,GOM	104
hb0807.dat	Fall Trawl Calibration	04 Sep – 08 Nov	MAB,GB,GOM	285
del0809.dat	Hydro Acoustic	05 Sep - 09 Oct	GB,GOM	132
del0810.dat	EcoMon Survey	23 Oct – 10 Nov	MAB,GB,GOM	161

Table 1. Listing of 2008 NOAA NEFSC cruises supported by the Oceanography Branch.

Table 2. 2008 regional average surface and bottom temperature values computed from CTD data that were sorted into 6 two-month time periods for the five regions of the northeast continental shelf.

Region         CD         #obs         Temp         Anomaly         SDV1         SDV2         Flag         #obs         Temp         Anomaly         SDV2         Flag           GOMW         40         50         4.79         -0.56         0.19         0.44         0         46         6.29         0.22         0.17         0.56         0         0           GOME         38         17         4.46         -0.55         0.24         1.13         1         13         7.12         -0.41         0.28         1.40         1           GBNK         33         39         6.07         0.40         0.18         1.28         0         26         6.04         -0.05         0.22         0.92         0           MABN         26         23         6.41         -0.32         0.26         1.35         0         17         6.76         -0.52         0.31         1.88         0           MABS         17         46         8.69         0.54         0.19         1.84         1         41         8.86         0.84         0.21         1.75         1           GOMW         105         94         6.33         0.77         0.16<
GOMW         40         50         4.79         -0.56         0.19         0.44         0         46         6.29         0.22         0.17         0.56         0           GOME         38         17         4.46         -0.55         0.24         1.13         1         13         7.12         -0.41         0.28         1.40         1           GBNK         33         39         6.07         0.40         0.18         1.28         0         26         6.04         -0.05         0.22         0.92         0           MABN         26         23         6.41         -0.32         0.26         1.35         0         17         6.76         -0.52         0.31         1.88         0           MABS         17         46         8.69         0.54         0.19         1.84         1         41         8.86         0.84         0.21         1.75         1           GOMW         105         94         6.33         0.77         0.16         1.45         1         92         5.78         0.43         0.13         1.32         1           GOME         105         37         4.86         0.15         0.17         <
GOMW       40       50       4.79       -0.56       0.19       0.44       0       46       6.29       0.22       0.17       0.56       0         GOME       38       17       4.46       -0.55       0.24       1.13       1       13       7.12       -0.41       0.28       1.40       1         GBNK       33       39       6.07       0.40       0.18       1.28       0       26       6.04       -0.05       0.22       0.92       0         MABN       26       23       6.41       -0.32       0.26       1.35       0       17       6.76       -0.52       0.31       1.88       0         MABS       17       46       8.69       0.54       0.19       1.84       1       41       8.86       0.84       0.21       1.75       1         MABS       17       46       8.69       0.54       0.19       1.84       1       41       8.86       0.84       0.21       1.75       1         GOMW       105       94       6.33       0.77       0.16       1.45       1       92       5.78       0.43       0.13       1.32       1 <th< td=""></th<>
GOME       38       17       4.46       -0.55       0.24       1.13       1       13       7.12       -0.41       0.28       1.40       1         GBNK       33       39       6.07       0.40       0.18       1.28       0       26       6.04       -0.05       0.22       0.92       0         MABN       26       23       6.41       -0.32       0.26       1.35       0       17       6.76       -0.52       0.31       1.88       0         MABS       17       46       8.69       0.54       0.19       1.84       1       41       8.86       0.84       0.21       1.75       1         GOMW       105       94       6.33       0.77       0.16       1.45       1       92       5.78       0.43       0.13       1.32       1         GOMW       105       94       6.33       0.77       0.16       1.45       1       92       5.78       0.43       0.13       1.32       1         GOME       105       37       4.86       0.15       0.17       0.74       0       36       6.10       -0.40       0.17       0.78       0       GB <t< td=""></t<>
GBNK       33       39       6.07       0.40       0.18       1.28       0       26       6.04       -0.05       0.22       0.92       0         MABN       26       23       6.41       -0.32       0.26       1.35       0       17       6.76       -0.52       0.31       1.88       0         MABS       17       46       8.69       0.54       0.19       1.84       1       41       8.86       0.84       0.21       1.75       1         March-April         GOMW       105       94       6.33       0.77       0.16       1.45       1       92       5.78       0.43       0.13       1.32       1         GOME       105       37       4.86       0.15       0.17       0.74       0       36       6.10       -0.40       0.17       0.78       0         GB       100       56       5.23       0.07       0.14       0.80       0       49       5.59       0.10       0.17       0.91       0         MABN       84       56       5.70       0.97       0.19       0.94       0       53       6.84       1.17       0.22 <th< td=""></th<>
MABN         26         23         6.41         -0.32         0.26         1.35         0         17         6.76         -0.52         0.31         1.88         0           MABS         17         46         8.69         0.54         0.19         1.84         1         41         8.86         0.84         0.21         1.75         1           GOMW         105         94         6.33         0.77         0.16         1.45         1         92         5.78         0.43         0.13         1.32         1           GOME         105         37         4.86         0.15         0.17         0.74         0         36         6.10         -0.40         0.17         0.78         0           GB         100         56         5.23         0.07         0.14         0.80         0         49         5.59         0.10         0.17         0.91         0           MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1
MABS         17         46         8.69         0.54         0.19         1.84         1         41         8.86         0.84         0.21         1.75         1           GOMW         105         94         6.33         0.77         0.16         1.45         1         92         5.78         0.43         0.13         1.32         1           GOME         105         37         4.86         0.15         0.17         0.74         0         36         6.10         -0.40         0.17         0.78         0           GB         100         56         5.23         0.07         0.14         0.80         0         49         5.59         0.10         0.17         0.91         0           MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1.13         0         73         8.84         2.89         0.18         1.37         0
GOMW         105         94         6.33         0.77         0.16         1.45         1         92         5.78         0.43         0.13         1.32         1           GOME         105         37         4.86         0.15         0.17         0.74         0         36         6.10         -0.40         0.17         0.78         0           GB         100         56         5.23         0.07         0.14         0.80         0         49         5.59         0.10         0.17         0.91         0           MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1.13         0         73         8.84         2.89         0.18         1.37         0
GOMW         105         94         6.33         0.77         0.16         1.45         1         92         5.78         0.43         0.13         1.32         1           GOME         105         37         4.86         0.15         0.17         0.74         0         36         6.10         -0.40         0.17         0.78         0           GB         100         56         5.23         0.07         0.14         0.80         0         49         5.59         0.10         0.17         0.91         0           MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1.13         0         73         8.84         2.89         0.18         1.37         0
GOME         105         37         4.86         0.15         0.17         0.74         0         36         6.10         -0.40         0.17         0.78         0           GB         100         56         5.23         0.07         0.14         0.80         0         49         5.59         0.10         0.17         0.91         0           MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1.13         0         73         8.84         2.89         0.18         1.37         0
GB         100         56         5.23         0.07         0.14         0.80         0         49         5.59         0.10         0.17         0.91         0           MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1.13         0         73         8.84         2.89         0.18         1.37         0           May-June
MABN         84         56         5.70         0.97         0.19         0.94         0         53         6.84         1.17         0.22         1.51         0           MABS         77         80         8.03         2.00         0.15         1.13         0         73         8.84         2.89         0.18         1.37         0           May-June
MABS 77 80 8.03 2.00 0.15 1.13 0 73 8.84 2.89 0.18 1.37 0 May-June
May-June
GOMW         131         28         8.07         0.80         0.20         3.68         1         28         5.77         0.39         0.18         5.57         1
GOME
GBNK         136         23         7.64         0.55         0.22         4.05         1         23         7.10         0.95         0.22         6.13         1
MABN         158         116         15.09         1.32         0.11         1.71         1         105         9.15         1.59         0.12         2.73         1
MABS         178         111         22.03         1.47         0.12         1.12         1         111         9.91         -0.37         0.13         2.14         1
July-August
GOMW         235         33         18.16         1.66         0.20         2.06         0         25         6.75         0.11         0.18         2.31         0
GOME         235         36         15.10         1.09         0.23         2.52         0         31         7.81         -1.01         0.26         2.45         0
GBNK         224         96         17.68         2.12         0.14         2.47         0         90         11.17         -0.21         0.15         2.58         0
MABN         217         42         21.83         2.29         0.21         2.14         0         38         9.21         -0.45         0.23         2.13         0
MABS         214         84         23.73         0.49         0.16         1.80         0         75         12.20         0.50         0.18         3.35         0
September-October
GOMW         285         99         13.89         0.92         0.13         0.97         0         95         7.22         0.11         0.11         1.15         0
GOME         287         77         12.56         -0.07         0.15         1.03         0         72         8.07         -0.44         0.16         1.45         0
GBNK         280         83         15.74         0.60         0.13         1.03         0         74         12.87         0.04         0.19         1.86         0
MABN         274         79         18.47         0.84         0.18         1.14         0         71         12.35         0.00         0.21         2.53         0
MABS         260         90         22.02         0.36         0.14         1.28         0         83         14.54         0.25         0.17         2.80         0
November-December
GOMW         312         55         10.96         0.52         0.17         0.73         0         51         7.08         -0.20         0.16         1.08         0
GOME         313         13         11.39         0.17         0.28         2.16         1         10         7.92         -0.67         0.31         3.28         1
GBNK         313         38         13.22         0.66         0.17         1.23         0         31         12.79         1.01         0.22         1.33         0
MABN         310         20         14.93         0.58         0.32         2.76         1         10         13.34         -0.29         0.43         1.74         1
MABS 307 25 15.62 -0.67 0.27 0.48 1 23 15.35 0.04 0.29 0.83 1

"Region", the geographic region of the northeast continental shelf: "CD", the calendar mid-date of all the stations within a region and for a time period: "#obs", the number of observations included in each average: "Temp", the areal average temperature: "Anomaly", the areal average temperature anomalies: "SDV1", the standard deviation associated with the average temperature anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived: "Flag", a value of "1" indicates that a true areal average could not be calculated due to poor station coverage. The areal averages listed were derived from a simple average of the observations within the region.

			S	URFAC	E				F	<b>JOTTON</b>	Л		
Region	CD	#obs	Salt	Anomaly	SDV1	SDV2	Flag	#obs	Salt	Anomaly	SDV1	SDV2	Flag
						Janua	iry-Fel	oruary					
GOMW	40	50	32.92	-0.15	0.13	0.24	0	46	33.59	-0.01	0.1	0.22	0
GOME	38	17	32.63	-0.22	0.17	0.58	1	13	34.31	-0.07	0.13	0.57	1
GBNK	33	39	32.91	-0.02	0.11	0.44	0	26	32.97	-0.11	0.13	0.3	0
MABN	26	23	32.49	-0.61	0.18	0.64	0	17	32.81	-0.78	0.19	0.59	0
MABS	17	46	32.71	-0.91	0.15	0.57	1	41	33.08	-0.55	0.13	0.43	1
	'					Ma	rch-A	oril					
GOMW	105	94	32.33	-0.12	0.1	0.45	1	92	33.35	-0.03	0.08	0.47	1
GOME	105	37	32.41	-0.07	0.13	0.22	0	36	33.75	-0.14	0.1	0.29	0
GBNK	100	56	32.83	-0.14	0.08	0.25	0	49	33.07	-0.19	0.1	0.32	0
MABN	84	56	32.27	-0.62	0.12	0.88	0	52	32.98	-0.5	0.13	0.56	0
MABS	77	80	32.39	-0.61	0.11	1.37	0	73	32.94	-0.51	0.11	1.52	0
2010	1					M	ay-Jur	1e	~~~~				
GOMW	131	28	32.19	-0.21	0.13	1.77	1	28	33.05	-0.03	0.1	1.77	1
GOME	1		00.74	0.40	0.40				~~ ~~	0.00	0.40		
GBNK	136	23	32.74	-0.13	0.12	1.9	1	23	32.83	-0.08	0.12	1.94	1
MABN	158	116	31.55	-0.47	0.09	0.81	1	105	32.66	-0.32	80.0	0.87	1
MABS	1/8	111	30.51	-1.29	0.1	0.61	1	111	32.97	0.01	80.0	0.44	1
0000	225	22	24 74	0.25	0.10	Jui	y-Aug	ust I of	22.04	0.05	0.11	0.00	0
GOMIN	235	33	31.71	-0.35	0.12	0.52	0	25	33.24	-0.25	0.11	0.26	0
GOIVIE	235	36	32.32	-0.13	0.17	0.22	0	31	33.93	0.02	0.16	0.2	0
GBINK	224	90	32.49	-0.17	0.08	0.34	0	90	32.84	-0.12	0.09	0.22	0
	218	41	31.00	-0.00	0.13	1.40	0	30	33.04	-0.33	0.13	0.54	0
MABS	214	84	31.75	-0.07	0.13	1.12	nbor C	/5	33.57	0.49	0.11	0.74	0
COMW	285	00	32.06	.0 35	0.00	Septen 0.20	D-19df		23 51	.0 13	0.07	0.28	0
GOME	200	99 77	32.00	-0.33	0.05	0.25	0	72	33.01	-0.13	0.07	0.20	0
GRNK	207	83	32.52	-0.27	0.08	0.20	0	74	32 92	-0.20	0.03	0.30	0
MARN	200	78	32.02	-0.03	0.00	0.41	0	70	32.82	· -0.10	0.11	0.52	0
MARS	260	88	32.02	0.17	0.12	1.05	0	82	33.15	-0.0	0.12	0.85	0
WIADO	200	00	52.47	0.20	0.11	Novem	ber-De	cember	00.10	-0.04	0.1	0.00	0
GOMW	312	55	32.39	-0.31	0.11	0.22	0	51	33.39	-0.23	0.1	0.21	0
GOME	313	13	32.16	-0.43	0.19	0.67	1	10	34.37	-0.16	0.15	0.64	1
GBNK	313	38	32.62	-0.13	0.1	0.54	0	31	33.03	-0.01	0.13	0.34	0
MABN	310	20	33.56	0.27	0.19	1.19	1	10	33.71	0.03	0.25	0.72	1
MABS	307	25	32.75	-0.03	0.21	0.47	1	23	33.02	-0.27	0.18	0.3	1
GOMW GOME GBNK MABN MABS GOMW GOME GBNK MABN MABS	233 235 224 218 214 285 287 280 274 260 312 313 313 310 307	33 36 96 41 84 99 77 83 78 88 55 13 38 20 25	31.71 32.32 32.49 31.68 31.75 32.06 32.32 32.62 32.82 32.82 32.47 32.39 32.16 32.62 33.56 32.75	-0.33 -0.13 -0.17 -0.68 -0.07 -0.35 -0.27 -0.09 0.17 0.28 -0.31 -0.43 -0.43 -0.13 0.27 -0.03	0.12 0.17 0.08 0.13 0.13 0.09 0.11 0.08 0.12 0.11 0.11 0.19 0.21	0.32 0.22 0.34 0.61 1.12 <b>Septen</b> 0.29 0.26 0.41 0.61 1.05 <b>Novemi</b> 0.22 0.67 0.54 1.19 0.47	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1	23 31 90 38 75 72 74 70 82 <b>cember</b> 51 10 31 10 23	33.24 33.93 32.84 33.04 33.57 33.51 34 32.92 32.87 33.15 33.39 34.37 33.03 33.71 33.02	-0.23 0.02 -0.12 -0.33 0.49 -0.13 -0.26 -0.13 -0.6 -0.04 -0.23 -0.16 -0.23 -0.16 -0.01 0.03 20.27	0.11 0.16 0.09 0.13 0.11 0.07 0.09 0.11 0.12 0.1 0.1 0.15 0.13 0.25 0.18	0.20 0.22 0.54 0.74 0.28 0.38 0.32 0.52 0.85 0.21 0.64 0.34 0.72 0.3	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1

Table 3. 2008 regional average surface and bottom salinity values computed from CTD data that were sorted into 6 two-month time periods for the five regions of the northeast continental shelf.

"Region", the geographic region of the northeast continental shelf: "CD", the calendar mid-date of all the stations within a region and for a time period: "#obs", the number of observations included in each average: "Salt", the areal average salinity: "Anomaly", the areal average salinity anomalies: "SDV1", the standard deviation associated with the average salinity anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived: "Flag", a value of "1" indicates that a true areal average could not be calculated due to poor station coverage. The areal averages listed were derived from a simple average of the observations within the region.



Figure 1. Region designations for the northeast continental shelf (MAB = Mid Atlantic Bight, GBNK = Georges Bank, GOM = Gulf of Maine).



Figure 2. 2008 station distributions for each two-month time bin.



Figure 3. Time Series of the 2008 regional surface (left) and bottom (right) temperatures and anomalies (temperature values = blue circles, temperature anomalies = grey bars).



Figure 4. Time series of the 2008 regional surface (left) and bottom (right) salinities and anomalies (salinity values = blue circles, salinity anomalies = grey bars).



Figure 5. Surface and bottom temperature (left) and salinity (right) distributions during January - February 2008.



Figure 6. Surface and bottom temperature anomaly (left) and salinity anomaly (right) distributions during January - February 2008.



Figure 7. Density stratification (left) and stratification anomaly (right) during January - February 2008. The units are  $kg/m^3$ .



Figure 8. Surface and bottom temperature (left) and salinity (right) distributions during March - April 2008.



Figure 9. Surface and bottom temperature anomaly (left) and salinity anomaly (right) distributions during March - April 2008.



Figure 10. Density stratification (left) and stratification anomaly (right) during March - April 2008. The units are  $kg/m^3$ .



Figure 11. Surface and bottom temperature (left) and salinity (right) distributions during July - August 2008.



Figure 12. Surface and bottom temperature anomaly (left) and salinity anomaly (right) distributions during July - August 2008.



Figure 13. Density stratification (left) and stratification anomaly (right) during July - August 2008. The units are  $kg/m^3$ .



Figure 14. Surface and bottom temperature (left) and salinity (right) distributions during September - October 2008.



Figure 15. Surface and bottom temperature anomaly (left) and salinity anomaly (right) distributions during September - October 2008.



Figure 16. Density stratification (left) and stratification anomaly (right) during September - October 2008. The units are  $kg/m^3$ .

## Appendix

Appendix Table 1. 2008 regional average temperature and salinity values for individual cruises that sampled within the western Gulf of Maine.

			Surface	1					Bottom				
Cruise	CD	#obs	Temp	Anomaly	SDV1	SDV2	Flag	#obs	Temp	Anomaly	SDV1	SDV2	Flag
DEL0802	36	21	4.95	-0.55	0.23	0.50	0	17	6.25	0.18	0.22	0.51	0
DEL0803	57	44	4.39	-0.37	0.16	0.31	1	45	6.39	0.15	0.14	0.62	1
HB0802	111	16	6.13	0.95	0.27	1.38	1	16	5.49	0.52	0.23	1.77	1
ALB0801	119	31	7.29	1.32	0.19	1.26	1	30	5.75	0.53	0.17	1.95	1
ALB0802	126	4	6.79	0.19	0.59	1.46	1	4	5.95	1.06	0.59	1.64	1
HB0803	152	8	10.13	0.51	0.36	2.25	1	8	6.22	-0.26	0.29	3.89	1
DEL0808	238	25	18.29	1.73	0.21	1.42	0	17	6.79	0.03	0.19	1.18	0
DEL0809	270	63	15.79	0.87	0.13	1.11	1	61	7.13	0.16	0.12	1.52	1
HB0807	299	40	12.51	0.80	0.18	0.90	0	38	7.18	-0.02	0.15	1.33	0
ALB0803	308	33	11.80	0.93	0.20	1.80	1	33	7.33	-0.24	0.17	2.31	1
DEI 0810	312	22	10 99	0.55	0.23	0.63	0	18	7 10	_0.10	0.20	0.70	0
DELCOTO	012	22	10.55	0.55	0.25	0.05	0	10	7.10	-0.13	0.20	0.70	0
DELOGIO	012	22	Surface	0.55	0.23	0.05	0	10	Bottom	-0.13	0.20	0.70	0
Cruise	CD	#obs	Surface Salt	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salt	Anomaly	SDV1	SDV2	Flag
Cruise	CD 36	#obs	Surface Salt	Anomaly -0.13	0.23 SDV1	0.03 SDV2	Flag	#obs	Bottom Salt	Anomaly	SDV1	SDV2	Flag
Cruise DEL0802 DEL0803	CD 36 57	#obs	Surface Salt 32.95 32.91	Anomaly -0.13 -0.14	0.23 SDV1 0.15 0.11	0.00 SDV2 0.30 0.15	Flag 0	#obs 17 45	Bottom Salt 33.58 33.71	0.02 -0.08	0.20 SDV1 0.13 0.07	0.24 0.22	Flag 0 1
Cruise DEL0802 DEL0803 HB0802	CD 36 57 111	#obs 21 44 16	Surface Salt 32.95 32.91 32.53	-0.13 -0.14 -0.08	0.23 SDV1 0.15 0.11 0.16	0.03 SDV2 0.30 0.15 0.44	Flag 0 1	#obs 17 45 16	Bottom Salt 33.58 33.71 33.31	Anomaly 0.02 -0.08 -0.04	0.20 SDV1 0.13 0.07 0.14	0.24 0.22 0.61	Flag 0 1
Cruise DEL0802 DEL0803 HB0802 ALB0801	CD 36 57 111 119	#obs 21 44 16 31	Surface Salt 32.95 32.91 32.53 32.12	-0.13 -0.14 -0.08 -0.25	0.23 SDV1 0.15 0.11 0.16 0.13	0.03 SDV2 0.30 0.15 0.44 0.64	Flag 0 1 1 1	#obs 17 45 16 30	Bottom Salt 33.58 33.71 33.31 33.38	Anomaly 0.02 -0.08 -0.04 0.03	0.13 0.13 0.07 0.14 0.10	0.24 0.22 0.61 1.63	Flag 0 1 1 1
Cruise DEL0802 DEL0803 HB0802 ALB0801 ALB0802	CD 36 57 111 119 126	#obs 21 44 16 31 4	Surface Salt 32.95 32.91 32.53 32.12 32.80	-0.13 -0.14 -0.08 -0.25 -0.15	0.23 SDV1 0.15 0.11 0.16 0.13 0.31	0.03 SDV2 0.30 0.15 0.44 0.64 0.17	Flag 0 1 1 1 1	#obs 17 45 16 30 4	Bottom Salt 33.58 33.71 33.31 33.38 32.87	Anomaly 0.02 -0.08 -0.04 0.03 -0.10	0.20 SDV1 0.13 0.07 0.14 0.10 0.28	0.70 SDV2 0.24 0.22 0.61 1.63 0.20	Flag 0 1 1 1 1
Cruise DEL0802 DEL0803 HB0802 ALB0801 ALB0802 HB0803	CD 36 57 111 119 126 152	#obs 21 44 16 31 4 8	Surface Salt 32.95 32.91 32.53 32.12 32.80 32.44	-0.13 -0.14 -0.08 -0.25 -0.15 -0.07	0.23 SDV1 0.15 0.11 0.16 0.13 0.31 0.22	0.00 SDV2 0.30 0.15 0.44 0.64 0.17 1.85	Flag 0 1 1 1 1 1	#obs 17 45 16 30 4 8	Bottom Salt 33.58 33.71 33.31 33.38 32.87 32.96	Anomaly 0.02 -0.08 -0.04 0.03 -0.10 -0.13	0.20 SDV1 0.13 0.07 0.14 0.10 0.28 0.17	0.70 SDV2 0.24 0.22 0.61 1.63 0.20 1.67	Flag 0 1 1 1 1 1
Cruise DEL0802 DEL0803 HB0802 ALB0801 ALB0802 HB0803 DEL0808	CD 36 57 111 119 126 152 238	#obs 21 44 16 31 4 8 25	32.95 32.91 32.53 32.12 32.80 32.44 31.68	-0.13 -0.14 -0.08 -0.25 -0.15 -0.07 -0.40	0.23 SDV1 0.15 0.11 0.16 0.13 0.31 0.22 0.13	0.00 SDV2 0.30 0.15 0.44 0.64 0.17 1.85 0.35	Flag 0 1 1 1 1 1 0	#obs 17 45 16 30 4 8 17	Bottom Salt 33.58 33.71 33.31 33.38 32.87 32.96 33.29	0.02 -0.08 -0.04 0.03 -0.10 -0.13 -0.25	0.20 SDV1 0.13 0.07 0.14 0.10 0.28 0.17 0.11	0.70 SDV2 0.24 0.22 0.61 1.63 0.20 1.67 0.25	Flag 0 1 1 1 1 1 0
Cruise DEL0802 DEL0803 HB0802 ALB0801 ALB0802 HB0803 DEL0808 DEL0809	CD 36 57 111 119 126 152 238 270	#obs 21 44 16 31 4 8 25 63	32.95 32.91 32.53 32.12 32.80 32.44 31.68 31.93	-0.13 -0.14 -0.08 -0.25 -0.15 -0.07 -0.40 -0.25	0.23 SDV1 0.15 0.11 0.16 0.13 0.31 0.22 0.13 0.08	0.30 0.15 0.44 0.64 0.17 1.85 0.35 0.35	Flag 0 1 1 1 1 1 0 1	#obs 17 45 16 30 4 8 17 61	Bottom Salt 33.58 33.71 33.31 33.38 32.87 32.96 33.29 33.77	0.02 -0.08 -0.04 0.03 -0.10 -0.13 -0.25 0.02	0.20 SDV1 0.13 0.07 0.14 0.10 0.28 0.17 0.11 0.07	0.70 SDV2 0.24 0.22 0.61 1.63 0.20 1.67 0.25 0.30	Flag 0 1 1 1 1 1 0 1
Cruise DEL0802 DEL0803 HB0802 ALB0801 ALB0802 HB0803 DEL0808 DEL0809 HB0807	CD 36 57 111 119 126 152 238 270 299	#obs 21 44 16 31 4 8 25 63 40	32.95 32.91 32.53 32.12 32.80 32.44 31.68 31.93 32.29	-0.13 -0.14 -0.08 -0.25 -0.15 -0.07 -0.40 -0.25 -0.31	0.23 SDV1 0.15 0.11 0.16 0.13 0.31 0.22 0.13 0.08 0.11	0.30 0.15 0.44 0.64 0.17 1.85 0.35 0.35 0.22	Flag 0 1 1 1 1 1 0 1 0	#obs           17           45           16           30           4           8           17           61           38	Bottom Salt 33.58 33.71 33.31 33.38 32.87 32.96 33.29 33.77 33.46	0.02 -0.08 -0.04 0.03 -0.10 -0.13 -0.25 0.02 -0.17	0.20 SDV1 0.13 0.07 0.14 0.10 0.28 0.17 0.11 0.07 0.09	0.70 SDV2 0.24 0.22 0.61 1.63 0.20 1.67 0.25 0.30 0.30	Flag 0 1 1 1 1 1 0 1 0
Cruise DEL0802 DEL0803 HB0802 ALB0801 ALB0802 HB0803 DEL0808 DEL0809 HB0807 ALB0803	CD 36 57 111 119 126 152 238 270 299 308	#obs 21 44 16 31 4 8 25 63 40 33	32.95 32.91 32.53 32.12 32.80 32.44 31.68 31.93 32.29 32.11	-0.13 -0.14 -0.08 -0.25 -0.15 -0.07 -0.40 -0.25 -0.31 -0.42	0.23 SDV1 0.15 0.11 0.16 0.13 0.31 0.22 0.13 0.08 0.11 0.13	0.30 0.15 0.44 0.64 0.17 1.85 0.35 0.35 0.22 0.85	Flag 0 1 1 1 1 1 0 1 0 1	#obs           17           45           16           30           4           8           17           61           38           33	Bottom Salt 33.58 33.71 33.31 33.38 32.87 32.96 33.29 33.77 33.46 33.01	0.02 -0.08 -0.04 0.03 -0.10 -0.13 -0.25 0.02 -0.17 -0.12	0.20 SDV1 0.13 0.07 0.14 0.10 0.28 0.17 0.11 0.07 0.09 0.10	0.70 SDV2 0.24 0.22 0.61 1.63 0.20 1.67 0.25 0.30 0.30 0.74	Flag 0 1 1 1 1 1 0 1 0 1

Gulf of Maine West

Appendix Table 2. 2008 regional average temperature and salinity values for individual cruises that sampled within the eastern Gulf of Maine.

			Surface						Bottom				
Cruise	CD	#obs	Temp	Anomaly	SDV1	SDV2	Flag	#obs	Temp	Anomaly	SDV1	SDV2	Flag
DEL0802	36	14	4.59	-0.44	0.27	1.09	1	l 10	7.10	-0.40	0.32	1.08	1
DEL0803	60	8	3.92	-0.58	0.33	0.84	1	8	7.36	-0.20	0.34	1.55	1
ALB0801	104	12	4.86	0.07	0.29	2.19	1	11	6.58	-0.77	0.29	3.24	1
HB0802	109	20	5.02	0.22	0.21	0.74	0	20	5.93	-0.20	0.22	0.88	0
HB0803	153	6	9.73	0.98	0.38	4.27	1	6	6.89	-1.01	0.38	7.43	1
HB0805	199	7	18.92	6.44	0.36	5.95	1	7	6.78	-4.05	0.34	7.69	1
HB0806	233	10	17.36	3.17	0.30	1.69	1	10	9.35	-2.89	0.29	3.78	1
DEL0808	237	15	15.08	0.66	0.25	1.24	0	12	7.79	-0.44	0.27	1.29	0
DEL0809	264	46	16.16	0.65	0.15	1.51	1	46	8.43	-0.72	0.14	2.20	1
ALB0803	292	7	12.26	-0.26	0.37	4.39	1	7	7.81	-0.17	0.36	5.61	1
HB0807	295	27	11.89	-0.26	0.18	0.91	0	24	8.24	-0.72	0.20	1.56	0
DEL0810	313	13	11.39	0.17	0.28	1.46	1	10	7.92	-0.67	0.31	1.57	1
			Surface						Bottom				
Cruise	CD	#obs	Salt	Anomaly	SDV1	SDV2	Flag	#obs	Salt	Anomaly	SDV1	SDV2	Flag
DEL0802	36	14	32.65	-0.18	0.19	0.59	1	10	34.34	-0.08	0.15	0.51	1
DEL0803	60	8	32.58	-0.28	0.21	0.37	1	8	34.25	0.02	0.16	0.55	1
ALB0801	104	12	32.55	-0.06	0.19	1.07	1	11	34.28	-0.09	0.15	2.69	1
HB0802	109	20	32.38	-0.08	0.16	0.20	0	20	33.57	-0.13	0.13	0.36	0
HB0803	153	6	32.57	-0.33	0.23	3.46	1	6	33.11	0.13	0.23	3.14	1
HB0805	199	10	32.23	-0.33	0.22	1.61	1		33.30	0.12	0.21	1.51	1
HB0806	233	10	32.10	-0.40	0.17	0.25	1	10	32.67	-0.02	0.17	0.18	1
DEL0808	237	15	32.32	-0.10	0.18	0.15	0	12	34.10	-0.01	0.17	0.24	0
DELU809	264	46	32.19	-0.22	0.09	0.45	1	46	34.15	-0.11	0.08	0.41	1
	292	27	32.55	-0.19	0.24	2.00	1	24	34.38	-0.27	0.17	1.81	0
	290	21	32.34	-0.20	0.14	0.34	U	24	33.82	-0.22	0.11	0.44	U
ALB0801 HB0802 HB0803 HB0805 HB0806 DEL0808 DEL0809 ALB0803 HB0807	104 109 153 199 233 237 264 292 295	12 20 6 7 10 15 46 7 27	32.55 32.38 32.57 32.23 32.10 32.32 32.19 32.55 32.34	-0.06 -0.08 -0.33 -0.33 -0.40 -0.10 -0.22 -0.19 -0.26	0.19 0.16 0.23 0.22 0.17 0.18 0.09 0.24 0.14	1.07 0.20 3.46 1.61 0.25 0.15 0.45 2.06 0.34	1 0 1 1 0 1 0	11 20 6 7 10 12 46 7 24	34.28 33.57 33.11 33.30 32.67 34.10 34.15 34.38 33.82	-0.09 -0.13 0.13 0.12 -0.02 -0.01 -0.11 -0.27 -0.22	0.15 0.13 0.23 0.21 0.17 0.17 0.08 0.17 0.11	2.69 0.36 3.14 1.51 0.18 0.24 0.41 1.81 0.44	1 0 1 1 0 1 1 0

Gulf of Maine East

					C	George	es Ba	nk					
			Surface						Bottom				
Cruise	CD	#obs	Temp	Anomaly	SDV1	SDV2	Flag	#obs	Temp	Anomaly	SDV1	SDV2	Flag
DEL0802	33	39	6.07	0.40	0.18	1.28	0	26	6.04	-0.05	0.22	0.92	0
ALB0801	99	20	5.25	-0.12	0.25	0.89	0	17	5.28	0.10	0.24	2.40	1
HB0802	100	36	5.23	0.18	0.18	0.70	0	32	5.59	0.09	0.21	0.97	0
ALB0802	127	14	6.91	0.53	0.29	0.66	1	14	6.74	1.21	0.29	0.72	1
HB0803	153	8	8.88	0.57	0.35	2.41	1	8	7.66	0.47	0.34	4.15	1
HB0805	199	10	16.68	4.38	0.29	4.78	1	10	10.61	-0.79	0.28	5.04	1
S10801	211	42	16.88	2.16	0.17	3.07	1	41	10.36	-0.12	0.17	3.30	1
HB0806	234	12	16.68	1.67	0.27	1.33	1	12	11.19	-2.71	0.26	3.15	1
DEL0808	234	32	17.03	1.00	0.19	1.58	0	27	13.53	0.39	0.19	2.76	1
DEL0809	266	24	16.20	0.88	0.19	0.98	1	24	12.17	-1.75	0.19	2.23	1
HB0807	282	56	15.58	0.60	0.15	1.07	0	49	12.98	0.32	0.20	1.91	0
ALB0803	302	10	13.72	0.29	0.39	2.76	1	8	13.16	1.68	0.40	4.06	1
DEL0810	312	32	13.27	0.61	0.19	1.34	0	25	12.66	0.81	0.26	1.14	0
			Surface						Bottom				
Cruise	CD	#obs	Salt	Anomaly	SDV1	SDV2	Flag	#obs	Salt	Anomaly	SDV1	SDV2	Flag
DEL0802	33	39	32.91	-0.02	0.11	0.44	0	26	32.97	-0.11	0.13	0.30	0
ALB0801	99	20	32.80	-0.15	0.15	0.33	0	17	33.07	-0.06	0.14	2.09	1
HB0802	100	36	32.83	-0.14	0.10	0.21	0	32	33.07	-0.19	0.12	0.32	0
ALB0802	127	14	32.80	-0.12	0.16	0.08	1	14	32.82	-0.13	0.15	0.09	1
HB0803	153	8	32.59	-0.17	0.21	1.98	1	8	32.81	0.00	0.20	1.81	1
HB0805	199	10	32.30	-0.30	0.17	1.31	1	10	32.63	-0.09	0.17	0.98	1
S10801	211	42	32.51	-0.01	0.09	1.06	1	41	32.73	-0.11	0.09	0.78	1
HB0806	234	12	32.23	-0.27	0.16	0.19	1	12	32.55	-0.04	0.16	0.11	1
DEL0808	234	32	32.48	-0.17	0.11	0.26	0	27	32.63	-0.13	0.11	0.66	1
DEL0809	266	24	32.22	-0.30	0.12	0.18	1	24	32.57	-0.08	0.11	0.14	1
HB0807	282	56	32.65	-0.07	0.09	0.51	0	49	32.96	-0.11	0.12	0.39	0
ALB0803	302	10	32.47	-0.29	0.22	1.44	1	8	32.81	-0.02	0.22	1.45	1
DEL0810	312	32	32.61	-0.13	0.12	0.63	0	25	33.00	-0.03	0.15	0.35	0

Appendix Table 3. 2008 regional average temperature and salinity values for individual cruises that sampled within the Georges Bank area.

Appendix Table 4. 2008 regional average temperature and salinity values for individual cruises that sampled within the northern Mid Atlantic Bight.

			Surface						Bottom				
Cruise	CD	#obs	Temp	Anomaly	SDV1	SDV2	Flag	#obs	Temp	Anomaly	SDV1	SDV2	Flag
DEL 0802	26	21	6.37	-0.29	0.28	1.21	0	<b>I</b> 16	6 72	-0.51	0.33	1.95	0
AL B0801	83	39	5 71	1 1 1	0.25	0.90	õ	37	5.90	1 69	0.21	1 48	1
HB0802	89	19	5 72	0.89	0.33	0.95	õ	18	6 74	0.79	0.35	1 79	ò
HB0803	145	33	11.36	0.04	0.21	0.95	1	33	8.42	2.02	0.22	1.72	1
HB0804	163	62	16.52	2.12	0.16	0.98	1	51	8.85	1.15	0.18	1.57	1
HB0805	172	17	18.90	1.33	0.29	3.28	1	17	12.01	2.25	0.31	3.38	1
S10801	195	16	21.30	2.55	0.31	2.79	1	16	8.55	0.74	0.31	3.37	1
DEL0808	230	26	22.17	2.12	0.26	1.81	0	22	9.73	-0.60	0.28	2.15	0
HB0807	268	46	19.32	1.03	0.21	1.23	0	42	11.93	-0.30	0.24	2.86	0
ALB0803	285	12	17.85	1.26	0.38	2.30	1	9	16.42	2.29	0.45	3.43	1
DEL0810	306	41	14.57	-0.03	0.24	1.40	0	30	13.82	0.45	0.28	1.26	0
			Surface						Bottom				
Cruise	CD	#obs	Surface Salt	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salt	Anomaly	SDV1	SDV2	Flag
Cruise	CD	#obs	Surface Salt	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salt	Anomaly	SDV1	SDV2	Flag
Cruise DEL0802	CD 26	#obs 21	Surface Salt 32.49	Anomaly	SDV1 0.19	SDV2	Flag 0	#obs	Bottom Salt 32.80	Anomaly	SDV1 0.19	SDV2	Flag 0
Cruise DEL0802 ALB0801	CD 26 83	#obs 21 39	Surface Salt 32.49 32.22	Anomaly -0.60 -0.61	SDV1 0.19 0.16	SDV2 0.64 1.04	Flag 0 0	#obs 16 36	Bottom Salt 32.80 32.27	Anomaly -0.80 -0.63	SDV1 0.19 0.13	SDV2 0.61 1.40	Flag 0 1
Cruise DEL0802 ALB0801 HB0802	CD 26 83 89	#obs 21 39 19	Surface Salt 32.49 32.22 32.34	Anomaly -0.60 -0.61 -0.60	SDV1 0.19 0.16 0.21	SDV2 0.64 1.04 0.58	Flag 0 0 0	#obs 16 36 18	Bottom Salt 32.80 32.27 33.04	Anomaly -0.80 -0.63 -0.56	SDV1 0.19 0.13 0.21	SDV2 0.61 1.40 0.48	Flag 0 1 0
Cruise DEL0802 ALB0801 HB0802 HB0803	CD 26 83 89 145	#obs 21 39 19 33	Surface Salt 32.49 32.22 32.34 31.37	Anomaly -0.60 -0.61 -0.60 -0.29	SDV1 0.19 0.16 0.21 0.15	SDV2 0.64 1.04 0.58 0.84	Flag 0 0 1	#obs 16 36 18 33	Bottom Salt 32.80 32.27 33.04 32.20	Anomaly -0.80 -0.63 -0.56 -0.62	SDV1 0.19 0.13 0.21 0.13	SDV2 0.61 1.40 0.48 0.78	Flag 0 1 0 1
Cruise DEL0802 ALB0801 HB0802 HB0803 HB0804	CD 26 83 89 145 163	#obs 21 39 19 33 62	Surface Salt 32.49 32.22 32.34 31.37 31.87	Anomaly -0.60 -0.61 -0.60 -0.29 -0.64	SDV1 0.19 0.16 0.21 0.15 0.11	SDV2 0.64 1.04 0.58 0.84 0.36	Flag 0 0 1 1	#obs 16 36 18 33 51	Bottom Salt 32.80 32.27 33.04 32.20 33.33	Anomaly -0.80 -0.63 -0.56 -0.62 0.10	SDV1 0.19 0.13 0.21 0.13 0.11	SDV2 0.61 1.40 0.48 0.78 0.58	Flag 0 1 0 1 1
Cruise DEL0802 ALB0801 HB0802 HB0803 HB0804 HB0805	CD 26 83 89 145 163 172	#obs 21 39 19 33 62 17	Surface Salt 32.49 32.22 32.34 31.37 31.87 30.59	Anomaly -0.60 -0.61 -0.60 -0.29 -0.64 -0.26	SDV1 0.19 0.16 0.21 0.15 0.11 0.32	SDV2 0.64 1.04 0.58 0.84 0.36 0.97	Flag 0 0 1 1 1	#obs 16 36 18 33 51 17	Bottom Salt 32.80 32.27 33.04 32.20 33.33 31.58	Anomaly -0.80 -0.63 -0.56 -0.62 0.10 -1.00	SDV1 0.19 0.13 0.21 0.13 0.11 0.22	SDV2 0.61 1.40 0.48 0.78 0.58 0.74	Flag 0 1 0 1 1
Cruise DEL0802 ALB0801 HB0802 HB0803 HB0804 HB0805 S10801	CD 26 83 89 145 163 172 195	#obs 21 39 19 33 62 17 15	Surface Salt 32.49 32.22 32.34 31.37 31.87 30.59 31.22	Anomaly -0.60 -0.61 -0.60 -0.29 -0.64 -0.26 -0.71	SDV1 0.19 0.16 0.21 0.15 0.11 0.32 0.21	SDV2 0.64 1.04 0.58 0.84 0.36 0.97 1.67	Flag 0 0 1 1 1 1	#obs 16 36 18 33 51 17 16	Bottom Salt 32.80 32.27 33.04 32.20 33.33 31.58 32.96	Anomaly -0.80 -0.63 -0.56 -0.62 0.10 -1.00 -0.05	SDV1 0.19 0.13 0.21 0.13 0.11 0.22 0.19	SDV2 0.61 1.40 0.48 0.78 0.58 0.74 1.23	Flag 0 1 1 1 1
Cruise DEL0802 ALB0801 HB0802 HB0803 HB0804 HB0805 S10801 DEL0808	CD 26 83 89 145 163 172 195 230	#obs 21 39 19 33 62 17 15 26	Surface Salt 32.49 32.22 32.34 31.37 31.87 30.59 31.22 31.83	Anomaly -0.60 -0.61 -0.60 -0.29 -0.64 -0.26 -0.71 -0.57	SDV1 0.19 0.16 0.21 0.15 0.11 0.32 0.21 0.17	SDV2 0.64 1.04 0.58 0.84 0.36 0.97 1.67 0.53	Flag 0 0 1 1 1 1 0	#obs 16 36 18 33 51 17 16 22	Bottom Salt 32.80 32.27 33.04 32.20 33.33 31.58 32.96 32.98	Anomaly -0.80 -0.63 -0.56 -0.62 0.10 -1.00 -0.05 -0.42	SDV1 0.19 0.13 0.21 0.13 0.11 0.22 0.19 0.17	SDV2 0.61 1.40 0.48 0.78 0.58 0.74 1.23 0.57	Flag 0 1 1 1 1 1
Cruise DEL0802 ALB0801 HB0802 HB0803 HB0804 HB0805 S10801 DEL0808 HB0807	CD 26 83 89 145 163 172 195 230 268	#obs 21 39 19 33 62 17 15 26 46	Surface Salt 32.49 32.22 32.34 31.37 31.87 30.59 31.22 31.83 32.80	Anomaly -0.60 -0.61 -0.60 -0.29 -0.64 -0.26 -0.71 -0.57 0.21	SDV1 0.19 0.16 0.21 0.15 0.11 0.32 0.21 0.17 0.14	SDV2 0.64 1.04 0.58 0.84 0.36 0.97 1.67 0.53 0.65	Flag 0 0 1 1 1 1 0 0	#obs 16 36 18 33 51 17 16 22 42	Bottom Salt 32.80 32.27 33.04 32.20 33.33 31.58 32.96 32.98 32.79	Anomaly -0.80 -0.63 -0.62 0.10 -1.00 -0.05 -0.42 -0.64	SDV1 0.19 0.13 0.21 0.13 0.11 0.22 0.19 0.17 0.14	SDV2 0.61 1.40 0.48 0.78 0.58 0.74 1.23 0.57 0.46	Flag 0 1 1 1 1 1 0 0
Cruise DEL0802 ALB0801 HB0802 HB0803 HB0804 HB0805 S10801 DEL0808 HB0807 ALB0803	CD 26 83 89 145 163 172 195 230 268 285	#obs 21 39 19 33 62 17 15 26 46 12	Surface Salt 32.49 32.22 32.34 31.37 31.87 30.59 31.22 31.83 32.80 32.32	Anomaly -0.60 -0.61 -0.60 -0.29 -0.64 -0.26 -0.71 -0.57 0.21 0.04	SDV1 0.19 0.16 0.21 0.15 0.11 0.32 0.21 0.17 0.14 0.28	SDV2 0.64 1.04 0.58 0.84 0.36 0.97 1.67 0.53 0.65 1.29	Flag 0 0 1 1 1 1 0 0	#obs 16 36 18 33 51 17 16 22 42 9 9	Bottom Salt 32.80 32.27 33.04 32.20 33.33 31.58 32.96 32.98 32.79 31.83	Anomaly -0.80 -0.63 -0.56 -0.62 0.10 -1.00 -0.05 -0.42 -0.64 -1.07	SDV1 0.19 0.13 0.21 0.13 0.11 0.22 0.19 0.17 0.14 0.28	SDV2 0.61 1.40 0.48 0.78 0.58 0.74 1.23 0.57 0.46 1.28	Flag 0 1 1 1 1 1 0 0

Northern Mid Atlantic Bight

Appendix Table 5. 2008 regional average temperature and salinity values for individual cruises that sampled within the southern Mid Atlantic Bight.

		5	Surface						Bottom				
Cruise	CD	#obs	Temp	Anomaly	SDV1	SDV2	Flag	#obs	Temp	Anomaly	SDV1	SDV2	Flag
DEI 0801	14	32	9.63	0.44	0.23	2.10	1	27	9.61	0.68	0.27	1.96	1
DEL0802	24	14	6.55	0.75	0.32	1.12	1	14	7.43	1.14	0.34	1.22	1
ALB0801	76	27	7.90	2.59	0.26	0.86	1	23	8.16	3.40	0.30	1.29	1
HB0802	78	58	8.05	1.99	0.17	1.13	ò	51	8.81	2.87	0.21	1.34	0
HB0805	179	72	21.05	0.99	0.15	1.55	1	68	10.33	-1.93	0.17	1.53	1
S10801	181	77	23.14	2.02	0.15	1.00	1	76	9.32	1.56	0.16	1.39	1
DEL0808	229	47	24.29	0.28	0.21	1.32	0	42	13.77	-1.24	0.21	3.81	1
ALB0803	254	9	22.30	0.65	0.36	1.27	1	5	16.33	1.01	0.61	2.65	1
HB0807	255	75	22.74	0.44	0.16	1.38	0	70	14.31	0.22	0.19	2.91	0
DEL0810	306	41	15.46	-0.54	0.23	0.49	1	36	14.67	0.07	0.27	0.81	1
					0.20								
			Surface		0.20		-		Bottom				
Cruise	CD	#obs	Surface Salt	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salt	Anomaly	SDV1	SDV2	Flag
Cruise DEL0801	CD 14	#obs	Surface Salt 33.09	Anomaly -0.82	SDV1 0.17	SDV2 0.50	Flag	#obs	Bottom Salt 33.28	Anomaly -0.53	SDV1 0.16	SDV2 0.39	Flag 1
Cruise DEL0801 DEL0802	CD 14 24	#obs 32 14	Surface Salt 33.09 31.83	Anomaly -0.82 -1.10	SDV1 0.17 0.27	SDV2 0.50 0.68	Flag 1 1	#obs 27 14	Bottom Salt 33.28 32.71	Anomaly -0.53 -0.58	SDV1 0.16 0.22	SDV2 0.39 0.50	Flag 1 1
Cruise DEL0801 DEL0802 ALB0801	CD 14 24 76	#obs 32 14 27	Surface Salt 33.09 31.83 31.49	Anomaly -0.82 -1.10 -1.23	SDV1 0.17 0.27 0.21	SDV2 0.50 0.68 1.80	Flag 1 1 1	#obs 27 14 23	Bottom Salt 33.28 32.71 31.81	Anomaly -0.53 -0.58 -1.08	SDV1 0.16 0.22 0.19	SDV2 0.39 0.50 1.64	Flag 1 1 1
Cruise DEL0801 DEL0802 ALB0801 HB0802	CD 14 24 76 78	#obs 32 14 27 58	Surface Salt 33.09 31.83 31.49 32.52	Anomaly -0.82 -1.10 -1.23 -0.50	SDV1 0.17 0.27 0.21 0.13	SDV2 0.50 0.68 1.80 0.82	Flag 1 1 1 0	#obs 27 14 23 51	Bottom Salt 33.28 32.71 31.81 33.07	Anomaly -0.53 -0.58 -1.08 -0.43	SDV1 0.16 0.22 0.19 0.13	SDV2 0.39 0.50 1.64 0.80	Flag 1 1 1 0
Cruise DEL0801 DEL0802 ALB0801 HB0802 HB0805	CD 14 24 76 78 179	#obs 32 14 27 58 72	Surface Salt 33.09 31.83 31.49 32.52 30.54	Anomaly -0.82 -1.10 -1.23 -0.50 -1.06	SDV1 0.17 0.27 0.21 0.13 0.13	SDV2 0.50 0.68 1.80 0.82 0.46	Flag 1 1 1 0 1	#obs 27 14 23 51 68	Bottom Salt 33.28 32.71 31.81 33.07 32.54	Anomaly -0.53 -0.58 -1.08 -0.43 -0.11	SDV1 0.16 0.22 0.19 0.13 0.10	SDV2 0.39 0.50 1.64 0.80 0.34	Flag 1 1 1 0 1
Cruise DEL0801 DEL0802 ALB0801 HB0802 HB0805 S10801	CD 14 24 76 78 179 181	#obs 32 14 27 58 72 77	Surface Salt 33.09 31.83 31.49 32.52 30.54 30.73	Anomaly -0.82 -1.10 -1.23 -0.50 -1.06 -1.39	SDV1 0.17 0.27 0.21 0.13 0.13 0.11	SDV2 0.50 0.68 1.80 0.82 0.46 0.67	Flag 1 1 1 0 1 1	#obs 27 14 23 51 68 76	Bottom Salt 33.28 32.71 31.81 33.07 32.54 33.54	Anomaly -0.53 -0.58 -1.08 -0.43 -0.11 0.17	SDV1 0.16 0.22 0.19 0.13 0.10 0.09	SDV2 0.39 0.50 1.64 0.80 0.34 0.51	Flag 1 1 0 1 1
Cruise DEL0801 DEL0802 ALB0801 HB0802 HB0805 S10801 DEL0808	CD 14 24 76 78 179 181 229	#obs 32 14 27 58 72 77 47	Surface Salt 33.09 31.83 31.49 32.52 30.54 30.73 32.03	Anomaly -0.82 -1.10 -1.23 -0.50 -1.06 -1.39 0.18	SDV1 0.17 0.27 0.21 0.13 0.13 0.11 0.16	SDV2 0.50 0.68 1.80 0.82 0.46 0.67 1.10	Flag 1 1 1 0 1 1 0	#obs 27 14 23 51 68 76 42	Bottom Salt 33.28 32.71 31.81 33.07 32.54 33.54 33.33	Anomaly -0.53 -0.58 -1.08 -0.43 -0.11 0.17 0.59	SDV1 0.16 0.22 0.19 0.13 0.10 0.09 0.14	SDV2 0.39 0.50 1.64 0.80 0.34 0.51 0.81	Flag 1 1 0 1 1 1
Cruise DEL0801 DEL0802 ALB0801 HB0802 HB0805 S10801 DEL0808 ALB0803	CD 14 24 76 78 179 181 229 254	#obs 32 14 27 58 72 77 47 5	Surface Salt 33.09 31.83 31.49 32.52 30.54 30.73 32.03 31.63	Anomaly -0.82 -1.10 -1.23 -0.50 -1.06 -1.39 0.18 -0.42	SDV1 0.17 0.27 0.21 0.13 0.13 0.11 0.16 0.48	SDV2 0.50 0.68 1.80 0.82 0.46 0.67 1.10 1.10	Flag 1 1 1 0 1 1 0 1	#obs 27 14 23 51 68 76 42 4	Bottom Salt 33.28 32.71 31.81 33.07 32.54 33.54 33.33 31.82	Anomaly -0.53 -0.58 -1.08 -0.43 -0.11 0.17 0.59 -0.88	SDV1 0.16 0.22 0.19 0.13 0.10 0.09 0.14 0.41	SDV2 0.39 0.50 1.64 0.80 0.34 0.51 0.81 1.06	Flag 1 1 1 0 1 1 1 1
Cruise DEL0801 DEL0802 ALB0801 HB0802 HB0805 S10801 DEL0808 ALB0803 HB0807	CD 14 24 76 78 179 181 229 254 255	#obs 32 14 27 58 72 77 47 5 75	Surface Salt 33.09 31.83 31.49 32.52 30.54 30.73 32.03 31.63 32.42	Anomaly -0.82 -1.10 -1.23 -0.50 -1.06 -1.39 0.18 -0.42 0.33	SDV1 0.17 0.27 0.21 0.13 0.13 0.11 0.16 0.48 0.12	SDV2 0.50 0.68 1.80 0.82 0.46 0.67 1.10 1.10 1.03	Flag 1 1 1 1 1 1 0 1 0	#obs 27 14 23 51 68 76 42 4 70	Bottom Salt 33.28 32.71 31.81 33.07 32.54 33.54 33.33 31.82 33.11	Anomaly -0.53 -0.58 -1.08 -0.43 -0.11 0.17 0.59 -0.88 -0.03	SDV1 0.16 0.22 0.19 0.13 0.10 0.09 0.14 0.41 0.11	SDV2 0.39 0.50 1.64 0.80 0.34 0.51 0.81 1.06 0.82	Flag 1 1 1 1 1 1 1 0

Southern Mid Atlantic Bight

Appendix Table 6. Temperature, salinity and shelf water volume calculations of the upper 100 meters for cruises conducted in the Mid Atlantic Bight regions during 2008 (CD = calendar day, SHW = shelf water, volume units = cubic kilometers).

CD	Temp	Temp.	Salt	Salt	SHW	SHW	SHW	SHW	SHW	SHW Vol.
	_	Anomaly		Anomaly	Temp	T. Anom	Salt	S. Anom	Volume	Anomaly
						MABN				
26	7.09	-0.25	32.89	-0.69	6.74	0.55	32.77	-0.37	2345.13	426.87
82	6.58	1.08	32.89	-0.46	5.91	1.50	32.63	-0.42	2170.25	87.29
88	5.94	0.28	32.77	-0.55	5.80	1.19	32.72	-0.31	2416.59	348.33
197	11.45	-0.76	32.41	-0.90	11.45	-0.26	32.41	-0.37	2502.79	548.87
229	12.85	-0.80	32.98	-0.46	12.49	-0.73	32.72	-0.08	2226.34	355.07
267	15.31	0.46	33.32	-0.29	14.33	-0.10	32.80	-0.08	1889.80	298.05
305	14.71	0.10	33.44	-0.27	14.32	0.26	33.02	0.03	1927.09	560.07
						MABS				
14	9.49	-0.60	33.15	-1.07	9.15	1.67	33.02	-0.10	2787.79	1611.05
76	8.79	0.88	33.20	-0.74	8.00	2.67	32.70	-0.68	2184.96	825.63
77	8.70	0.79	33.33	-0.60	8.02	2.65	32.93	-0.44	2270.74	903.75
228	16.45	0.56	33.54	0.25	15.27	0.23	32.60	-0.05	1888.69	-426.80
254	16.69	0.27	33.52	0.07	16.02	-0.08	32.69	-0.19	2020.19	-159.56
305	14.95	-0.14	33.30	-0.58	15.00	-0.44	32.91	-0.14	2325.93	619.00

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