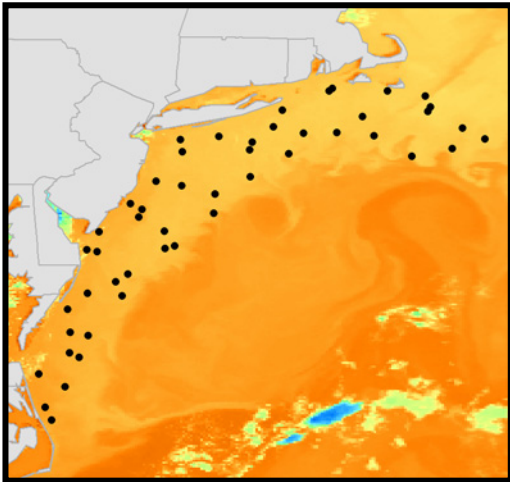

Cruise Report: Spring 2006 Survey of Ecological Conditions of the U.S. Middle Atlantic Bight

NOAA Ship Nancy Foster NF-06-06-NCCOS

(May 12 - May 21, 2006)



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NOAA Ship NANCY FOSTER Cruise NF-06-06-NCCOS
(May 12 - May 21, 2006)

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United States Department of
Commerce

National Oceanic and
Atmospheric Administration

National Ocean Service

Carlos M. Gutierrez
Secretary

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Administrator

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Preface

This cruise report is a summary of a field survey conducted in coastal-ocean waters of the Mid-Atlantic Bight from Nags Head, North Carolina to Cape Cod, Massachusetts and from approximately 1 nautical mile (nm) of shore seaward to the shelf break (100 m). The survey was conducted May 12 - May 21, 2006 on NOAA Ship NANCY FOSTER Cruise NF-06-06-NCCOS. Multiple indicators of ecological condition were sampled synoptically at each of 49 stations throughout the region using a random probabilistic sampling design. Samples were collected for the analysis of benthic community structure and composition; concentrations of chemical contaminants (metals, pesticides, PAHs, PCBs, PBDEs) in sediments and target demersal biota; nutrient and chlorophyll levels in the water column; and other basic habitat characteristics such as depth, salinity, temperature, dissolved oxygen, pH, sediment grain size, and organic carbon content. The overall purpose of the survey was to collect data to assess the status of ecological condition in coastal-ocean waters of the region, based on these various indicators, and to provide this information as a baseline for determining how environmental conditions may be changing with time. The results will be of value in helping to broaden our understanding of the status of ecological resources and their controlling factors, including impacts of potential ecosystem stressors, in such strategic coastal areas.

This was a multi-disciplinary partnership effort conducted by scientists from the following organizations:

- NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Environmental Health and Biomolecular Research (CCEHBR), Charleston, SC.
- U.S. Environmental Protection Agency (EPA), National Health and Environmental Effects Research Laboratory (NHEERL), Gulf Ecology Division (GED), Gulf Breeze, FL.
- U.S. Environmental Protection Agency (EPA), National Health and Environmental Effects Research Laboratory (NHEERL), Atlantic Ecology Division (AED), Narragansett, RI.
- NOAA, Office of Marine and Aviation Operations (OMAO), NOAA ship Nancy Foster.

Sampling activities also are being coordinated with bottom-trawl surveys of the NOAA National Marine Fisheries Service, Northeast Fisheries Science Center (NMFS/NEFSC) in Woods Hole, MA and Narragansett, RI to supplement collections of fish samples for the analysis of chemical-contaminant body burdens. Fish collected during the NMFS/NEFSC winter 2007 bottom-trawl survey will be provided for this purpose.

Additional copies of this cruise report can be obtained by contacting:

NOAA, Center for Coastal Environmental Health and Biomolecular Research, 219 Fort Johnson Road, Charleston, South Carolina, 29412, Telephone: 843/762-8511. Attention: Cynthia Cooksey.

1.0 Introduction

This survey is part of a series of studies being conducted by the National Oceanic and Atmospheric Administration (NOAA), U.S. Environmental Protection Agency (EPA), and partnering States to assess condition of aquatic resources throughout coastal-ocean waters of the U.S. using multiple indicators of ecological condition. The scope and design of these studies are similar to those used in the coastal component of EPA's Environmental Monitoring and Assessment Program (EMAP) and more recent National Coastal Assessment Program, which have focused mostly on estuaries and inland waters. The present work extends these prior efforts to coastal-ocean waters, approximately 1 nautical mile (nm) of shore seaward to the shelf break (100 m), throughout various coastal regions including sites in NOAA's National Marine Sanctuaries. Surveys of benthic fauna and other multiple indicators of ecological condition — including basic habitat characteristics such as depth, salinity, temperature, dissolved oxygen, pH, sediment grain size and organic content; nutrient and chlorophyll levels in the water column; chemical contaminants in sediments and biota — are conducted in these waters over a series of random stations using a probabilistic sampling design. Accordingly, the resulting data can be used to make estimates of the spatial extent of the region's health with respect to the various measured indicators, and to provide this information as a baseline for determining how environmental conditions may be changing with time. Where applicable the surveys also have included sites within sanctuaries in order to provide opportunities for comparing conditions within these protected areas to the surrounding coastal-ocean ecosystem. Thus far such efforts have included a survey of shelf waters along the U.S. west coast, from the Straits of Juan de Fuca, WA to Channel Islands, CA (summer 2003, NOAA Ship McARTHUR II Cruise AR-03-01-NC); a survey of shelf waters of the South Atlantic Bight from Cape Hatteras, NC to West Palm Beach, FL (summer 2004, NOAA Ship NANCY FOSTER Cruise NF-04-08-CL); and the present survey of shelf waters of the mid-Atlantic Bight (MAB) from Cape Hatteras to Cape Cod, MA.

The MAB is a component of the U.S. northeast continental shelf ecosystem, one of 10 recognized Large Marine Ecosystems (LMEs) within the U.S., and is a valuable reservoir of both living and mineral resources. In the present survey, sampling was conducted at 49 stations in shelf waters throughout the MAB, from approximately 1 nm of shore seaward to the shelf break at 100 m (Fig. 1), using multiple indicators and the random probabilistic sampling design of EMAP. The consistent and synoptic sampling of the different biological and environmental variables across these stations will provide an opportunity for learning more about the spatial patterns of these resources and processes controlling their distributions. As mentioned above, by incorporating a random probabilistic station design, the resulting data also can be used to make estimates of the spatial extent of the region's health with respect to the various measured indicators, and to provide this information as a baseline for determining how environmental conditions may be changing in the future. This is the first such baseline for the near-coastal (shelf) waters of the MAB region. The following report provides a brief summary of the scope and preliminary results of the supporting field work conducted May 12 - May 21, 2006 on NOAA Ship NANCY FOSTER Cruise NF-06-06-NCCOS.

2.0 Scientific Approach

Sampling was conducted May 12 - May 21, 2006 at each of 49 stations positioned randomly throughout shelf waters of the MAB (Fig. 1, Table 1). At each station, samples were collected for analysis of the following indicators (Table 2): (1) water quality characteristics including depth, salinity, dissolved oxygen (DO), temperature, total suspended solids, and chlorophyll and nutrient levels; (2) sediment characteristics including grain size (% silt-clay vs. coarser fraction) and total organic carbon (TOC) content; (3) pollutant exposure indicators including chemical contaminants (metals, pesticides, PCBs, PAHs, PBDEs) in sediments and fish tissue, low DO levels in the water column, and high TOC levels in sediment; and (4) biological indicators (diversity and abundance of benthic infaunal species, fish pathological anomalies).

Samples for the analysis of benthic infauna, sediment contaminants, % silt-clay, and TOC were collected with a 0.04-m² Young grab. Grab samples were deemed successful if >75% full with no major slumping. Two replicate grabs were collected at each station for infaunal analysis, sieved onboard through a 0.5-mm screen, and preserved in 10% buffered formalin with rose bengal stain. The upper 2-3 cm of sediment from 1-2 additional grabs also were taken at each station, combined into a single station composite, and then sub-sampled for the analysis of organic contaminants (PCBs, pesticides, PAHs), metals, PBDEs, TOC, and % silt-clay. These latter samples were kept frozen onboard the ship and later transferred to laboratories for subsequent analysis.

A Seabird 9/11 CTD unit, supplied by the NOAA ship NANCY FOSTER, was used to acquire vertical water column profiles of salinity, temperature, DO, and depth at each station. Continuous profiles of these parameters were recorded during both the descent and ascent. The Seabird 9/11 also was equipped with 12 Niskin bottles to acquire discrete water samples at three designated water depths: 1 m below sea surface, mid-water column, and 1 m off the seabed. These latter samples were processed for nutrients, total suspended solids, and chlorophyll.

Hook-and-line fishing methods (up to six fishing rods) were attempted at all 49 stations in an effort to capture bottom fish for inspection of external pathologies and for subsequent analysis of chemical contaminants in fish tissues. Target species included members of the families Bothidae (flatfish), Serranidae (seabass), Sparidae (scup), and Gadiformes (hake). The goal was to obtain five to six representative specimens (~20-30 cm total length) from up to three of these bottom-dwelling species at each of the sites.

3.0 Sampling Logistics and Scientific Parties

Sampling for the spring 2006 MAB shelf survey was conducted on NOAA ship NANCY FOSTER, Cruise NF-06-06-NCCOS, May 12 - May 21, 2006. The sampling area covered the continental shelf of the U.S. Mid-Atlantic Bight, from Nags Head, North Carolina to Cape Cod, Massachusetts. Samples were collected from the deck of the ship

around-the-clock. A summary of members of the scientific party and their affiliations is provided in Table 3.

Sampling activities also are being coordinated with bottom-trawl surveys of the NOAA National Marine Fisheries Service, Northeast Fisheries Science Center (NMFS/NEFSC) in Woods Hole, MA and Narragansett, RI to supplement collections of fish samples for the analysis of chemical-contaminant body burdens.

4.0 Preliminary Results

A total of 49 stations were sampled throughout the study region (Figure 1, Table 1). Of the original 50 target stations, Stations 16 and 46 both occurred off Cape Cod in waters hazardous to navigation and thus were deemed unsamplable. Stations 16 and 46 were replaced by alternate stations 90 and 98, respectively. Station 98 was a rocky, hard bottom site and only water samples were collected. Station 30, the 50th target station, could not be sampled due to vessel problems that exhausted the remaining sampling time on the last day of the cruise.

Water depths at the 49 stations averaged 22 m and ranged from 13 – 96 m. Bottom-water physical characteristics were highly variable across the region. Temperature ranged from 4.7°C to 19.6°C, salinity ranged from 13.2 psu to 36.0 psu, and DO ranged from 7.4 mg/L to 10.4 mg/L. Mean water quality measurements for depth, temperature, salinity and DO at each station are presented in Table 4. Water-column profiles (Appendix A) show the following general trends across most stations: decreasing water temperature with increasing depth; salinities that are highly variable within the top 10 m of water and then stabilize throughout the remainder of the water column; and relatively stable though slightly increasing DO levels with depth. Exceptions to these general trends are observed at stations near the shelf-break front, the boundary between cooler, less saline continental shelf waters and warmer, more saline continental slope waters. Specifically, the water-column profiles of stations 04, 05, 15, 29, 37, 39 and 44 show slugs of warmer, higher saline waters sandwiched between or overlying cooler, less saline waters. When all stations are plotted on sea surface temperature maps (Figure 2) it is clear that these seven stations are the stations that come close to the shelf-break front. Station 18, also located near the shelf-break front, has an opposite water-column profile, with the upper half of the water column being cooler and less saline than the underlying waters. A variety of bottom types were encountered among the various stations including hard rock, coarse sand, and fine silty sand.

Fishing was attempted at all 49 stations. However, no targeted species were collected. Alternatively, fish samples will be collected in February 2007 in cooperation with the NMFS/NEFSC winter 2007 bottom-trawl survey. The target species from this survey will be summer flounder (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), and windowpane flounder (*Scophthalmus aquosus*). Samples will be analyzed for presence of chemical contaminants in edible tissues (pending funding).

Data for other biological and abiotic environmental variables listed in Table 2 will be available once the processing of these samples has been completed.

5.0 Acknowledgements

Funding for this project is provided through NOAA/NOS/NCCOS/CCEHBR (field sampling supplies and equipment) and the EPA/NHEERL/GED (sample processing). All members of the field crew (Table 3) are commended for their high level of technical expertise, teamwork and dedication to getting the required sampling completed. Special appreciation also is extended to the officers and crew of the NOAA ship NANCY FOSTER for the superb job performed on NF-06-06-NCCOS. We also are grateful to the NMFS/NEFSC (Woods Hole and Narragansett labs) for their cooperation in providing fish for contaminant body-burden analysis from their bottom-trawl surveys.

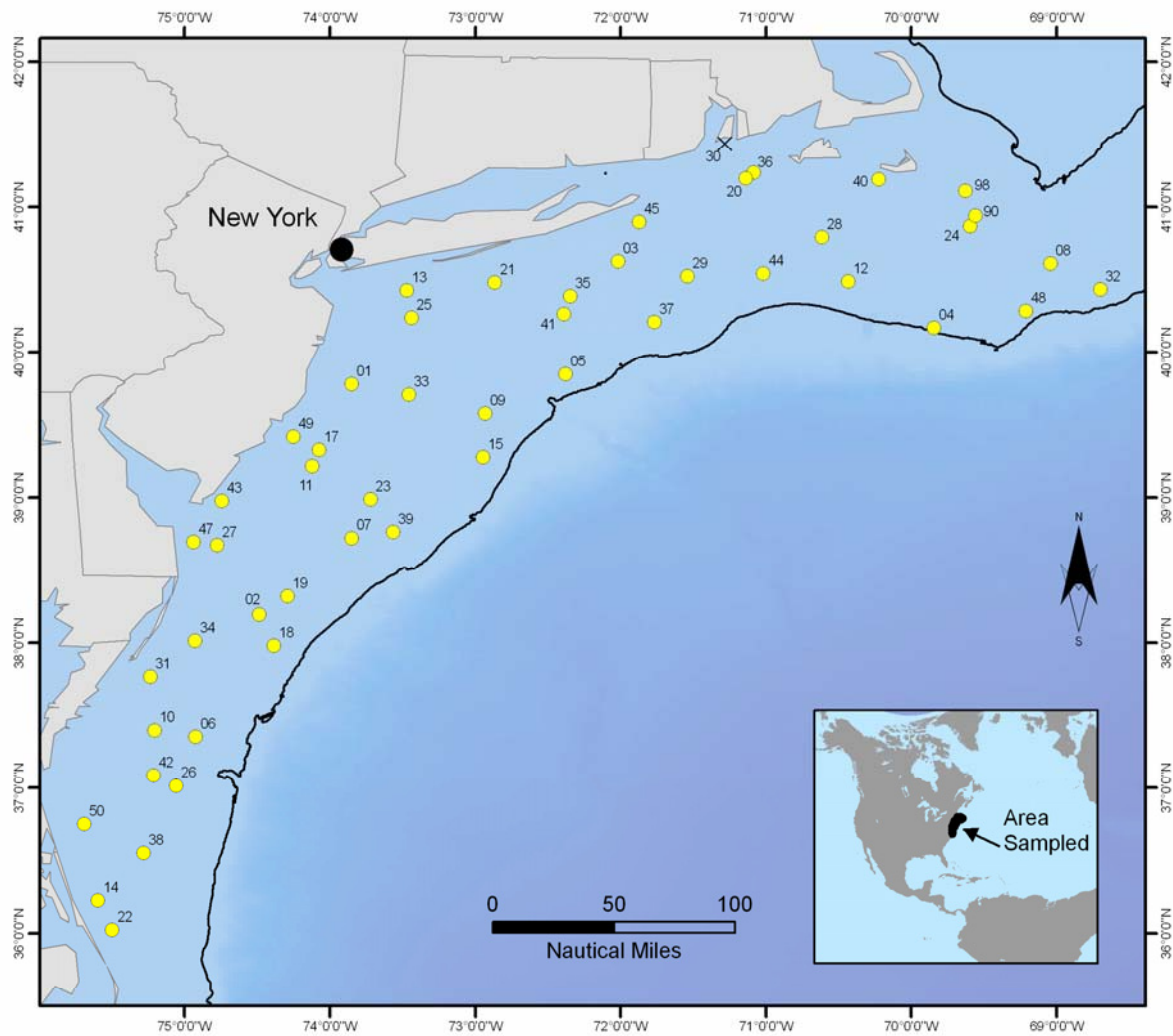


Figure 1. Overall study area and sampling sites for MAB 2006 survey of ecological conditions of the southeastern U.S. continental shelf (NOAA Ship Nancy Foster Cruise NF-06-06-NCCOS). Yellow circles indicate sampling stations, black line indicates 100 m shelf break.

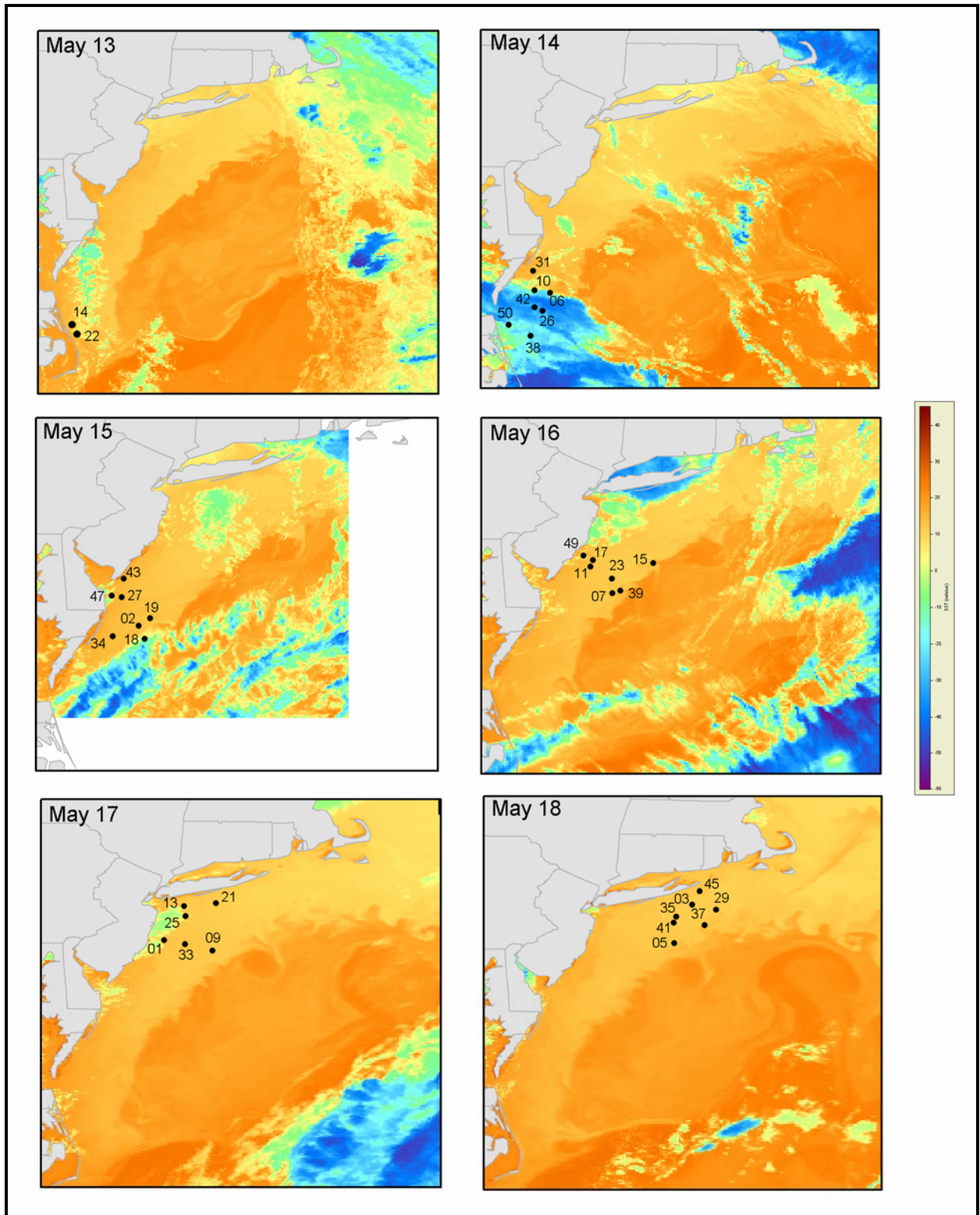


Figure 2. Sea surface temperatures (SST) and stations sampled by day, May 13 - 21. SST data courtesy of USDOC/NOAA/NESDIS/Coastwatch.

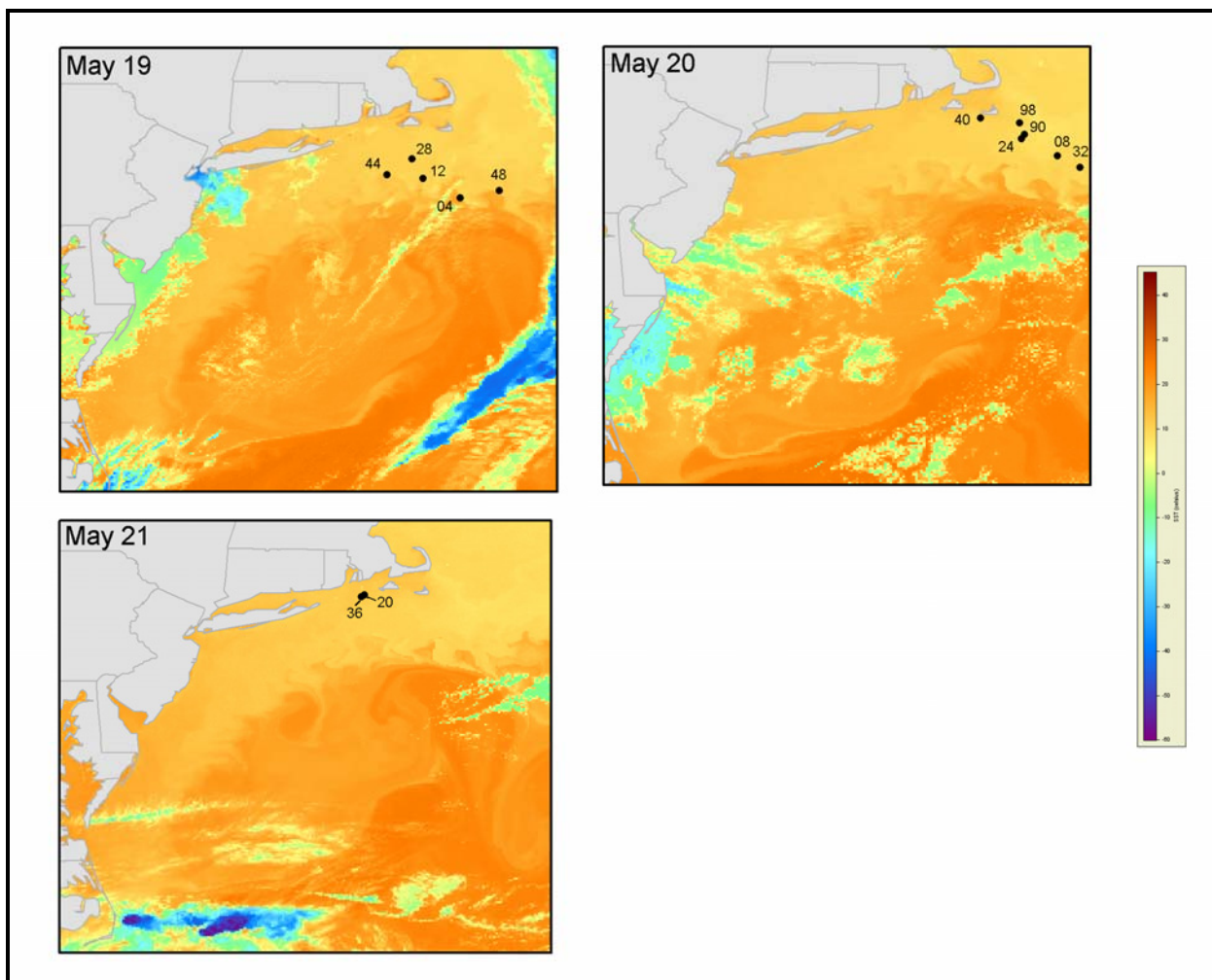


Figure 2. Continued.

Table 1. Locations of stations successfully sampled during the SAB 2004 survey of ecological conditions of the southeastern U.S. continental shelf.

Station ID	Latitude - Decimal Degrees	Longitude - Decimal Degrees	Station Depth (m)
MA06001	39.776233	-73.851945	26.0
MA06002	38.190407	-74.486817	42.0
MA06003	40.621980	-72.017077	55.4
MA06004	40.167088	-69.842480	98.3
MA06005	39.843450	-72.380105	75.0
MA06006	37.350552	-74.924692	39.6
MA06007	38.718668	-73.718655	48.8
MA06008	40.606713	-69.044848	71.0
MA06009	39.573712	-72.933070	62.0
MA06010	37.395983	-75.206850	28.1
MA06011	39.211000	-74.124180	24.0
MA06012	40.484228	-70.434203	70.0
MA06013	40.422640	-73.471575	24.8
MA06014	36.221567	-75.596483	26.3
MA06015	39.272112	-72.949640	70.0
MA06ALT90	40.935692	-69.553923	42.0
MA06017	39.324923	-74.075387	24.0
MA06018	37.968717	-74.388073	56.0
MA06019	38.314488	-74.294243	51.6
MA06020	41.232683	-71.086080	42.0
MA06021	40.476033	-72.866450	42.0
MA06022	36.020883	-75.498367	26.0
MA06023	38.984255	-73.723322	43.0
MA06024	40.865742	-69.596710	37.0
MA06025	40.234713	-73.441343	35.3
MA06026	37.011970	-75.057695	41.0
MA06027	38.668617	-74.779448	14.3
MA06028	40.788315	-70.616883	57.0
MA06029	40.521995	-71.541485	76.6
MA06031	37.764140	-75.237247	20.5
MA06032	40.430618	-68.699028	88.0
MA06033	39.702305	-73.457610	33.2
MA06034	38.007648	-74.929213	26.0
MA06035	40.382977	-72.346442	55.0
MA06036	41.194150	-71.139005	38.0
MA06037	40.205580	-71.770297	80.0
MA06038	36.547175	-75.284010	25.0
MA06039	38.759565	-73.566242	60.0
MA06040	41.184483	-70.226000	26.0
MA06041	40.261102	-72.390438	58.0
MA06042	37.081042	-75.213755	35.0
MA06043	38.974162	-74.746040	13.6
MA06044	40.539672	-71.019025	75.0
MA06045	40.892560	-71.873293	38.7
MA06ALT98	41.107847	-69.628018	31.2
MA06047	38.691598	-74.941145	17.6
MA06048	40.282282	-69.213077	92.2
MA06049	39.415743	-74.254705	16.0
MA06050	36.747858	-75.692603	20.5

Table 2. Summary of types of field samples collected at the 2006 Middle Atlantic Bight stations.

Parameters	# of Replicates	Container	Sample Size	Preservation
Infauna	2	1000 ml Polypropylene jar	All material retained on 0.5mm sieve	10% Buffered Formalin in the field
Metal Contaminants	1 (composited sediment)	250 HDPE jar	2/3 full	frozen
Organic Contaminants	1 (composited sediment)	500 ml I-Chem glass jar	2/3 full	frozen
TOC	1 (composited sediment)	125 ml Polypropylene jar	2/3 full	frozen
% Silt/Clay & % Moisture	1 (composited sediment)	500 ml HDPE jar	2/3 full	frozen
Total Suspended Solids	3 (water column - surface, mid, bottom)	47 mm preweighed filter pads	TSS retained on filter pad	frozen
Nutrients	3 (water column - surface, mid, bottom)	60 ml HDPE containers	2/3 full	frozen
Chlorophyll a	3 (water column - surface, mid, bottom)	25 mm filter pads	cells retained on pad	frozen
Fish Tissue	None collected*			

* - Fish samples will be collected during the NMFS Winter Trawl Survey.

Table 3. Scientific crew for MAB 2006 survey of ecological conditions of the U.S. Middle Atlantic Bight continental shelf. * - indicates Chief Scientist.

Name	Affiliation
JD Dubick *	NOAA/NOS/NCCOS/CCEHBR
George Craven*	USEPA/Gulf Ecology Division
Don Cobb	USEPA/ Atlantic Ecology Division
Anna Greene	NOAA/NOS/NCCOS/CCEHBR
Tom Heitmuller	USGS/NWRC
Kellee James	NOAA/NOS/NCCOS/CCEHBR
Stephanie Rexing	NOAA/NOS/NCCOS/CCEHBR
Eileen Roy	NOAA/NOS/NCCOS/CCEHBR
Jon Serbst	USEPA/Atlantic Ecology Division

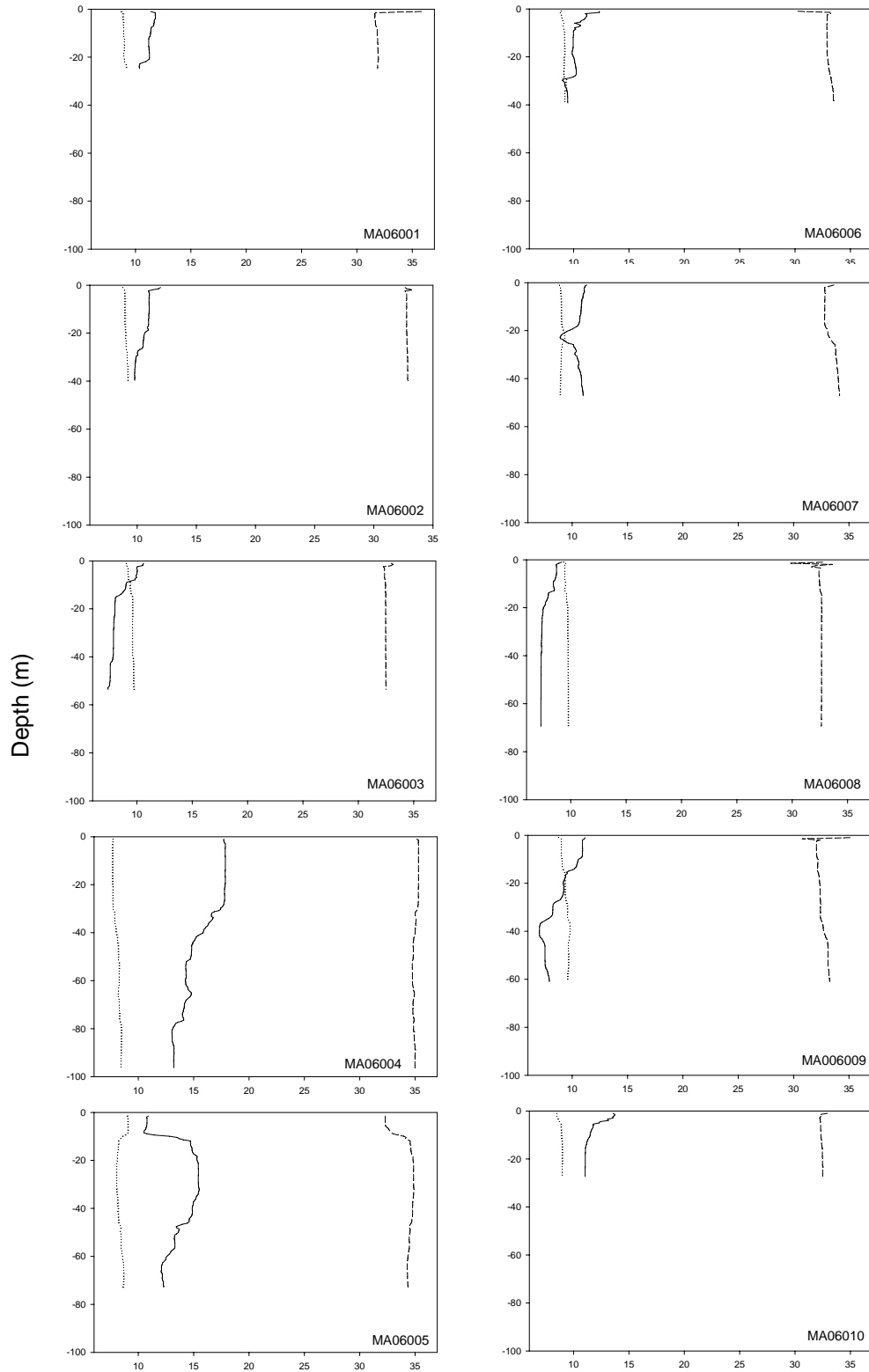
Table 4. Water quality measurements as measured with a SeaBird CTD during the MAB2006 survey of ecological conditions of the mid-Atlantic Bight U.S. continental shelf.

Station ID	Depth (m)	Mean Temperature (°C)	Mean Salinity (PSU)	Mean Dissolved Oxygen (mg/L)
MA06001	12.9	11.3	31.9	9.0
MA06002	20.3	10.6	32.8	9.0
MA06003	27.3	8.3	32.5	9.5
MA06004	48.6	15.5	35.0	8.1
MA06005	37.2	13.7	34.4	8.4
MA06006	20.1	10.0	33.0	9.1
MA06007	24.1	10.5	33.4	9.0
MA06008	35.2	7.6	32.6	9.7
MA06009	31.0	8.7	32.6	9.4
MA06010	14.1	11.6	32.4	8.9
MA06011	11.9	11.0	32.2	9.0
MA06012	34.7	7.6	32.6	9.7
MA06013	12.4	10.4	31.2	9.2
MA06014	13.6	12.4	31.9	8.7
MA06015	34.5	16.0	35.0	8.0
MA06ALT90	20.3	7.7	32.3	9.7
MA06017	12.4	11.4	32.2	8.9
MA06018	28.0	12.2	34.3	8.7
MA06019	25.8	10.7	33.2	9.0
MA06020	21.6	9.1	32.1	9.4
MA06021	21.8	9.1	32.0	9.4
MA06022	13.4	12.5	32.0	8.7
MA06023	21.3	9.4	32.8	9.3
MA06024	18.9	8.3	32.3	9.5
MA06025	17.4	10.2	32.0	9.2
MA06026	19.6	10.7	32.8	9.0
MA06027	7.2	13.5	31.4	8.6
MA06028	28.0	7.7	32.5	9.7
MA06029	37.5	6.6	32.7	9.9
MA06031	10.2	13.7	31.4	8.5
MA06032	42.7	7.8	33.0	9.6
MA06033	16.6	10.0	32.1	9.2
MA06034	12.9	12.7	32.1	8.7
MA06035	27.0	7.7	32.4	9.7
MA06036	18.4	9.2	32.2	9.4
MA06037	39.4	12.3	34.1	8.7
MA06038	12.9	11.5	32.3	8.9
MA06039	30.5	15.6	35.2	8.0
MA06040	12.2	10.0	32.1	9.2
MA06041	28.5	7.9	32.4	9.6
MA06042	17.6	11.6	32.5	8.9
MA06043	6.9	13.6	30.6	8.6
MA06044	37.7	12.8	34.3	8.5
MA06045	18.9	9.4	31.9	9.3
MA06ALT98	15.1	8.8	32.1	9.5
MA06047	9.2	14.2	30.9	8.5
MA06048	45.9	7.9	33.0	9.6
MA06049	8.2	13.7	30.0	8.6
MA06050	10.2	13.7	31.3	8.5

Appendix A
Water Column Profiles:
Temperature, Dissolved Oxygen, and Salinity

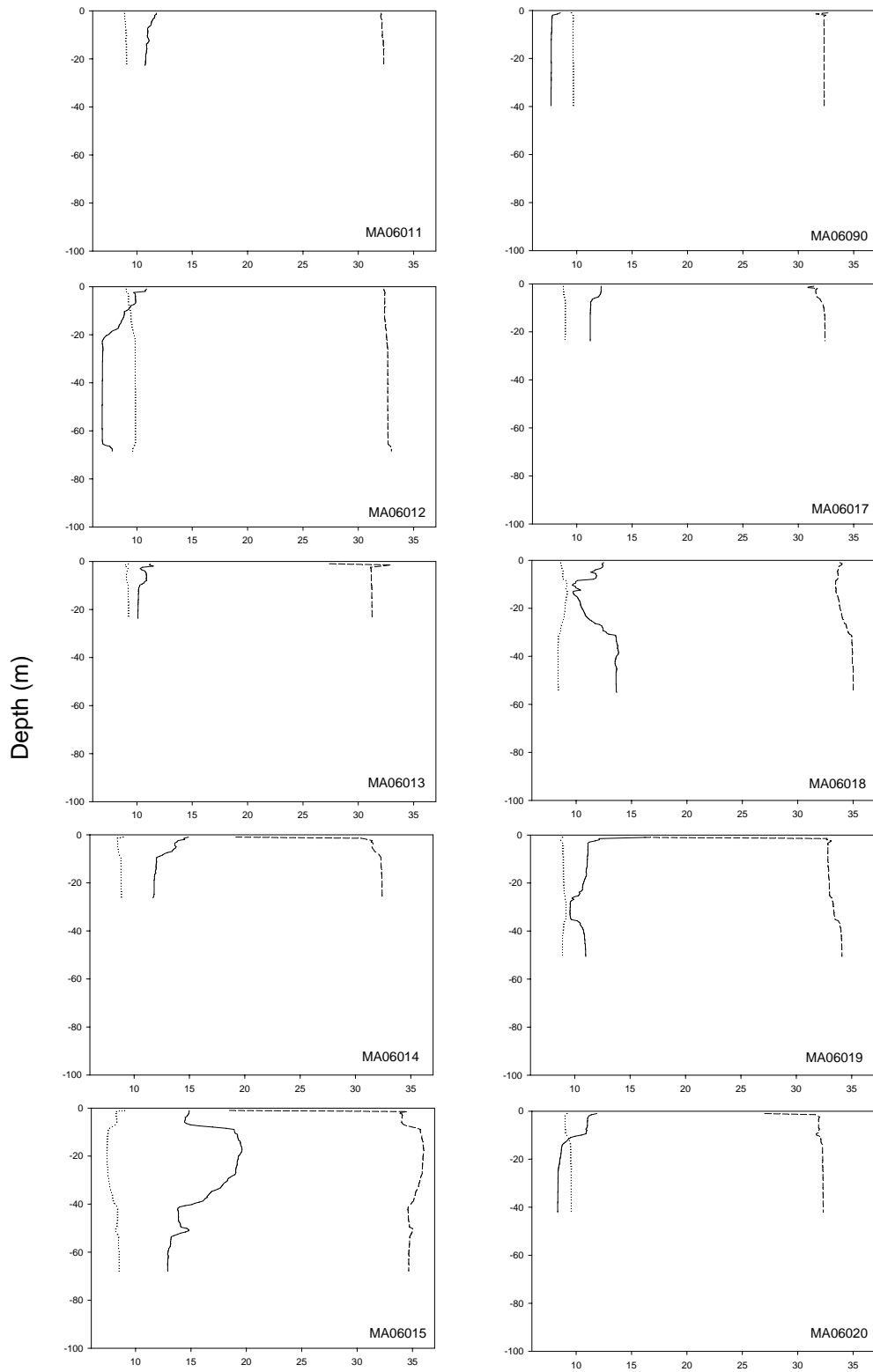
Appendix A. Water column profiles of temperature, dissolved oxygen, and salinity collected at all 49 stations with a Seabird CTD.

—— Temperature ($^{\circ}$ C) Dissolved Oxygen (mg/L) ---- Salinity (psu)

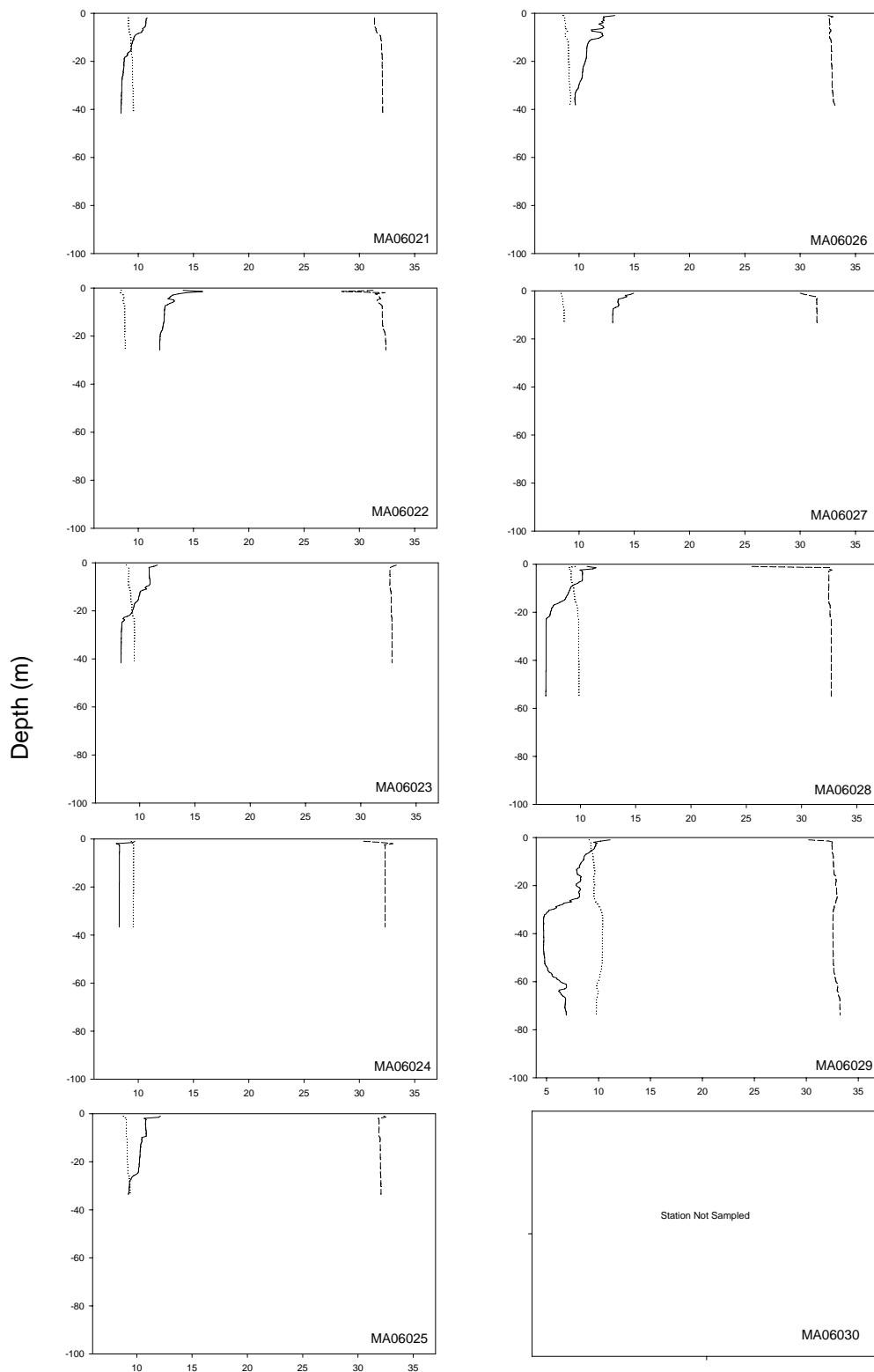
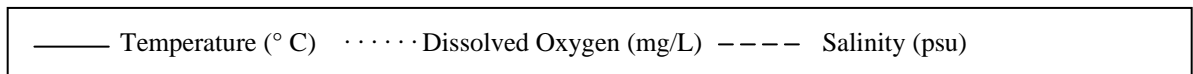


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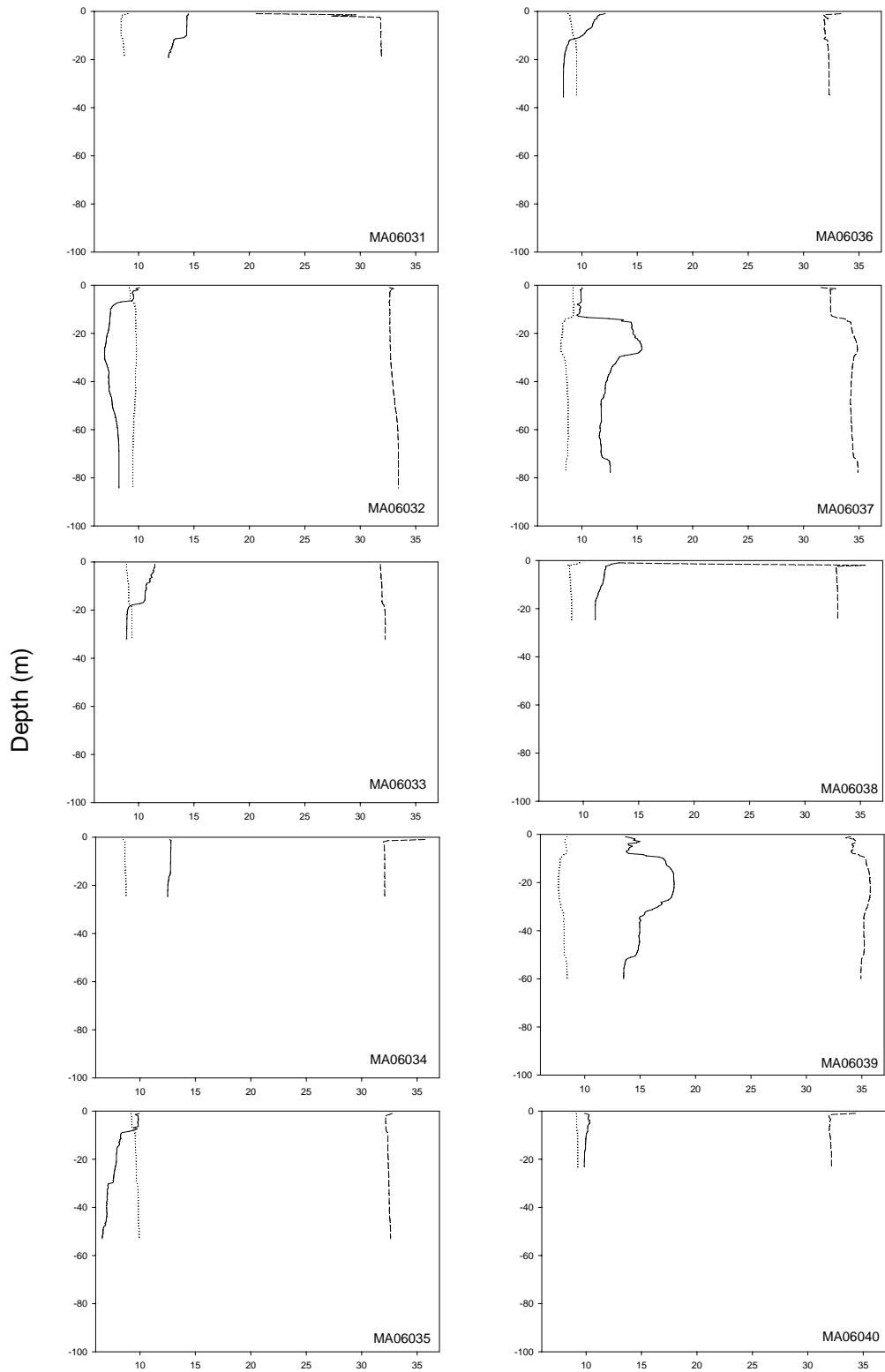
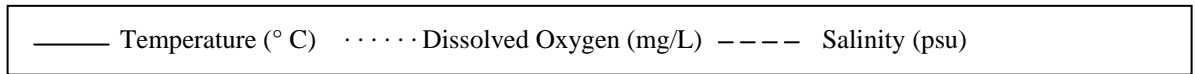
—— Temperature ($^{\circ}$ C) Dissolved Oxygen (mg/L) ---- Salinity (psu)



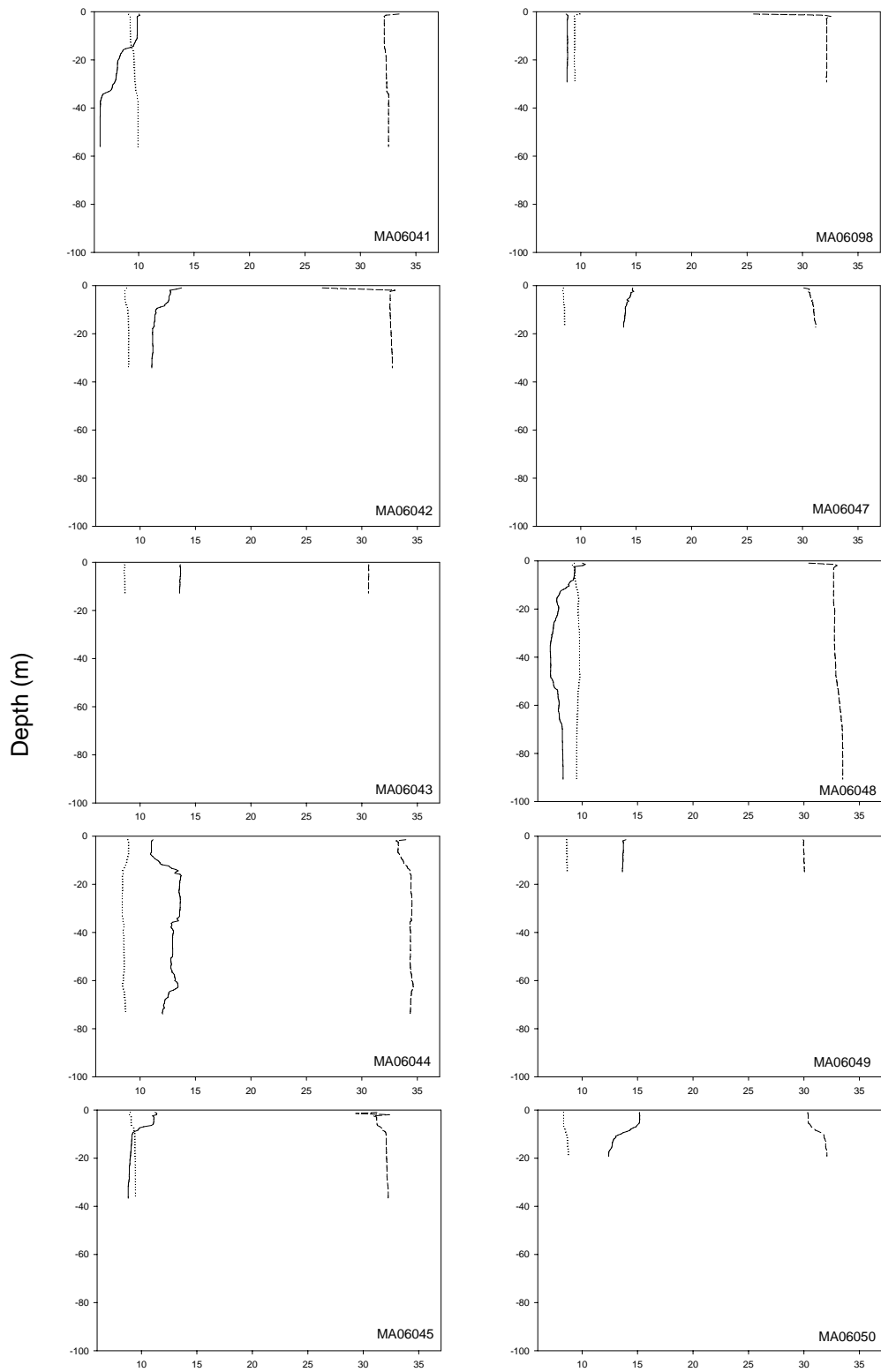
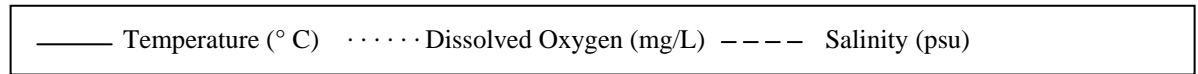
Appendix A continued.



Appendix A continued.



Appendix A continued.



United States Department of Commerce

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Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret.)
Under Secretary of Commerce for Oceans and Atmospheres

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