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2004 Great Bay Water Quality (DataSonde) Monitoring Program

A Final Report to

The New Hampshire Estuaries Project

Submitted by

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Table of Contents

Introduction	2
Project Goals and Objectives	2
Methods	2
Results and Discussion	3
Conclusions and Recommendations	4
References	4
Appendix 1 (Meta-Data)	5
Appendix 2 (Data CD)	Inside Back Cover

Introduction

In situ water quality assessment has become an important source of data for monitoring, research and management activities in estuaries nationwide. As part of the National Estuarine Research Reserve System, the Great Bay System-Wide Monitoring Program (SWMP) produces *in situ* water quality data for four sites in and around Great Bay. This project extends the SWMP program to include year-round *in situ* data for a station at the University of New Hampshire Coastal Marine Lab pier at the mouth of the Piscataqua River and summer data for a station in the Salmon Falls (SF) River. This suite of stations provides a comprehensive *in situ* sampling array that monitors the major rivers and open estuary locations within the Great Bay estuarine system.

Project Goals and Objectives

UNH completed this project under contract to the NH Estuaries Project (Project ID #04-M-2; CE-991711-06 and CE-991711-08). The project goals and objectives per the contract were to:

- (1) support *in situ* water quality monitoring for the April – December sampling season at the Lamprey River (LR), Squamscott River (SQ), Oyster River (OR), Great Bay (GB) and Coastal Marine Lab (CML) sites; and
- (2) fund the deployment of *in situ* water quality monitoring at the Salmon Falls (SF) for July, August and September.

The final work product was agreed to be a series of Excel data files containing monthly data records for each of these sites along with appropriate meta-data for these data.

Methods

The methods for this project followed the procedures prescribed by the National Estuarine Research Reserve Central Data Management Office (CDMO) and detailed in Small et al. (2003).

Briefly, YSI 660 DataSondes are programmed to obtain measurements of specific conductivity, salinity, dissolved oxygen, percent saturation, pH, temperature, water level, and turbidity every half-hour. The instruments are deployed continuously during ice-free seasons, except for brief periods when they are removed for cleaning, maintenance and recalibration. Pre and post-deployment calibrations are performed using the diagnostics menu of the YSI Ecowatch program and QA/QC

procedures developed by NERR Research Coordinators and YSI engineers. VWR conductivity and pH standards are used for calibration. YSI formazin is used to calibrate turbidity probes.

DataSondes are deployed approximately one meter from the bottom and recovered for data download every 2-4 weeks depending upon the time of years. Files are first examined and graphed using Ecowatch software. Missing and/or anomalous data are noted. Files are then transferred to a Macintosh computer and opened in Excel software and edited. Missing data due to routine YSI maintenance and probe failure or communication errors are inserted into the spreadsheet. Edited files are merged to contain one full month of data. Files are verified by means of CDMO Excel macros. The CDMO cdmomac3.xls macro allows the user to automatically format column widths to the correct number decimal places based on the YSI sensor specifications. It also allows the user to QA/QC each data logger generated file for missing data points, fill all cells that do not contain data with periods, and find all data points that fall outside the range of what the datalogger is designed to measure (outliers). The CDMO import.xls macro will allow PC users with 30-minute data to automatically create a monthly Excel file from a two-week deployment and insert periods for missing data. Edited files are merged to contain one full month of data. In addition, in November 1999 a graphing capability was added to this macro allowing users to produce single parameter and missing point graphs on a monthly basis. All files are graphed in Excel and examined in order that anomalous data points can be identified and removed.

Results and Discussion

Data for the DataSondes deployed as part of the NERRS SWMP program have been submitted and accepted by the NERRS CDMO. So as not to create potentially different data sets (CDMO potentially modifies the data that are submitted to them), the data and all associated meta-data for the GB, LR, SQ and OR sites are available at <http://cdmo.baruch.sc.edu/home.html> and by following the links to: (a) NERR Data; (b) NERR Data and Associated Metadata; (c) NERR SWMP Water Quality Data; and (d) Great Bay (GRB).

For the CML site, DataSondes were successfully deployed as follows:

Site/Sonde	deploy date	time	retrieve date	time
CML	1/1/2004	0000	2/19/2004	1030
CML	2/19/2004	1500	4/8/2004	1530
CML	4/8/2004	1600	5/10/2004	1230
CML	5/10/2004	1300	6/3/2004	1030
CML	6/3/2004	1200	6/25/2004	1500
CML	6/25/2004	1430	7/26/2004	1430
CML	7/26/2004	1500	8/25/2004	1400
CML	8/25/2004	1500	9/20/2004	1530
CML	9/20/2004	1630	10/19/2004	1430
CML	10/19/2004	1500	12/3/2004	0800
CML	12/2/2004	1600	12/11/2004	0500

For the SF site, DataSondes were successfully deployed as follows:

Site/Sonde	deploy date	time	retrieve date	time
SF	7/30/2004	1330	8/17/2004	1330
SF	8/17/2004	1400	9/13/2004	1330
SF	9/13/2004	1330	10/14/2004	1330
SF	10/14/2004	1400	11/10/2004	1000

The CD included with this report contains the following information for the CML and SF DataSonde deployments: (a) raw data files; (b) edited data files (these are the files that should be used and distributed); and (c) meta-data, calibration and deployment files.

Conclusions and Recommendations

The *in situ* water quality monitoring program provides important data on basic water quality parameters in the Great Bay estuary. The CML site at the mouth of the Piscataqua River provides particularly critical information on the marine 'end-member' for the Great Bay system necessary for modeling and other integrative studies. The SF site provides important information on water quality during the critical summer period when dissolved oxygen levels may potentially decrease. When combined with the NERRS SWMP DataSonde program, these instruments provide comprehensive coverage of the Great Bay estuary.

References

Small, Tamara D., Ashly D. Norman, Danna D. Swain, Jesse Friedmann and Dwayne E. Porter. (2003) CDMO NERR SWMP DATA MANAGEMENT MANUAL Version 5.0 (December 2003). NOAA National Estuarine Research Reserve, Centralized Data Management Office, Georgetown, SC.

2004 Water Quality (DataSonde) Monitoring Program Meta-Data (Appendix 1)

Research Methods

Datasondes are programmed to obtain measurements of specific conductivity, salinity, dissolved oxygen, percent saturation, pH, temperature, water level, and turbidity every half-hour. The instruments are deployed continuously during ice-free seasons, except for brief periods when they are removed for cleaning, maintenance and recalibration. Pre and post-deployment calibrations are performed using the diagnostics menu of the YSI Ecowatch program and QA/QC procedures developed by NERR Research Coordinators and YSI engineers. VWR conductivity and pH standards are used for calibration. YSI formazin is used to calibrate turbidity probes.

YSI 6600 datasondes are deployed approximately one meter from the bottom and recovered for data download every 2-4 weeks depending upon the time of years. Files are first examined and graphed using Ecowatch software. Missing and/or anomalous data are noted. Files are then transferred to a Macintosh computer and opened in Excel software and edited. Missing data due to routine YSI maintenance and probe failure or communication errors are inserted into the spreadsheet. Edited files are merged to contain one full month of data. Files are verified by means of CDMO Excel macros. The CDMO cdmomac3.xls macro will allow the user to automatically format column widths to the correct number decimal places based on the YSI sensor specifications. It also allows the user to QA/QC each data logger generated file for missing data points, fill all cells that do not contain data with periods, and find all data points that fall outside the range of what the datalogger is designed to measure (outliers). The CDMO import.xls macro will allow PC users with 30-minute data to automatically create a monthly Excel file from a two-week deployment and insert periods for missing data. Edited files are merged to contain one full month of data. In addition, in November 1999 a graphing capability was added to this macro allowing users to produce single parameter and missing point graphs on a monthly basis. All files are graphed in Excel and examined in order that anomalous data points can be identified.

Missing or Anomalous Data CML 2004

Suspect Data:

- pH data from 1/9 1730 to 2/19 1500 appears to be aberrant. It is quite a bit higher than readings at the end of previous and the beginning of the subsequent deployments. The probe appeared to have malfunctioned, though it's pre and post calibration checks were both correct. The data were retained but are suspect.
- During the 1/9 to 2/19 deployment, the oxygen values drift upward, as is sometimes typical. Values over 120% should probably be considered suspect, but were retained.
- The drop in salinity at the beginning of April resulted from the following rainfall amounts.
 - 04/01/2004 23.9 mm
 - 04/02/2004 47.0 mm
 - 04/03/2004 20.1 mm
- DO data from 4/8 1600 to 5/9 1230 is abnormally high and should be considered suspect. At this site,

DO values over 120 are usually out of acceptable range. The data were retained.

- Throughout the 2004 database for CML DO levels exceeding 120% should be regarded with skepticism.
- From 6/25 1430 to approximately 7/2 the depth sensor recorded data indicating that the sonde had been placed in a higher portion of the deployment tube. Evidently that was corrected and it began recording more typical depth data. The data were retained.
- Dissolved oxygen data from 6/25 1430 to 7/26 1430 is out of range (high) and all values over 120% should be considered suspect. Pre and post calibration values for the DO probe were accurate. (100% and 109% in saturated air).
- DO data drifts downward from approximately 8/4 until the end of the deployment on 8/25. Downward drift is often caused by fouling, however the post deployment DO calibration for this instrument was 100% before cleaning. Data are suspect but were retained.
- Significant rainfall occurred during the last part of August resulting in a decrease in salinity.
- Dissolved oxygen data from 8/25 until 9/20 are somewhat higher than what would be expected. Any values over 120% should be considered suspect.
- Oxygen values rise to abnormal levels shortly after the beginning of the 10/19 deployment. These are aberrant data and should be suspect if over 120%.
- There are no data from 12/11/04 until the end of the month because the instrument unexpectedly ceased recording for no apparent reason.

Deleted Data:

- During the beginning of the deployment which began on 2/19, the oxygen probe returned good data for the first few days, then apparently malfunctioned. The post calibration DO% reading was -24.2.
- DO data from 2/28 1830 to 4/8 1530 (ranging from -50 to 500) were aberrant, probably due to equipment failure, and were deleted.
- No turbidity data 4/2 0700 to 4/8 1530 because the data was mostly negative to -51.1. Data were deleted.
- During the period 6/25 1430 and 6/28 1900 salinity and specific conductivity values were aberrant (low) and were deleted. This occurred during part of the period when the sonde appeared to be misplaced in its tube.
- Between 6/30 and 7/2 some salinity and specific conductivity data were out of range and deleted. These correspond to the depth data which indicates the sonde may have been temporarily out of the water.
- Turbidity data above 100 were considered out of range and deleted.
- The following dissolved oxygen data was out of range and deleted (5/16/04, 8:00:00)

- The following specific conductivity data were out of range and deleted (12/2/04, 20:30:00; 12/2/04, 21:00:00)

Missing or Anomalous SF Data 2004

Suspect Data:

- Between 8/13 and 8/17 approximately 82.5 mm of rain fell. This could account for the dramatic reduction in salinity and specific conductivity values during that period. The data were retained.
- Depth levels abruptly drop on 8/27 until the end of the deployment on 9/13. When the sonde was re-deployed, it was discovered that it had been dragged (probably by a boat) to a shallower position. The depth data returns to normal at the beginning of the 9/13 deployment.
- Heavy rain fell on 8/21 to 8/22, resulting in a drop in salinity.
- From 9/9 to 9/10 almost 50 mm of rain fell which resulted in a decrease in salinity during that time.
- More heavy rain fell on 9/19 causing a drop in salinity, pH and water temperature.
- Salinity values drop 10/16 to 10/19 and 11/5 to 11/7 due to rain events during those periods.

Deleted Data:

- The following turbidity data were out of range and deleted

Date	Time	Turb
8/7/04	15:00:00	295.1
8/7/04	17:00:00	418.7
8/14/04	6:00:00	1223.7
8/17/04	2:30:00	1371.6
8/27/04	3:30:00	914.7
8/30/04	11:00:00	141.8
9/7/04	3:00:00	139.7
9/9/04	3:30:00	121.2
9/19/04	7:00:00	290.9
10/5/04	10:30:00	596.2
10/12/04	7:00:00	2086.2
10/29/04	13:00:40	415.7
11/9/04	13:00:40	534.1

- The following pH data were out of range and deleted.

Date	Time	pH
8/23/04	18:00:00	5.98
8/23/04	18:30:00	5.99
8/27/04	17:00:00	5.66
8/27/04	16:30:00	5.03
9/1/04	9:30:00	5.65
9/2/04	9:30:00	5.97

9/2/04	10:00:00	5.8
9/3/04	10:00:00	4.97
9/3/04	10:30:00	4.56
9/4/04	10:30:00	4.88
9/4/04	11:00:00	4.78
9/4/04	10:00:00	5.43
9/12/04	16:30:00	5.6
9/12/04	17:00:00	5.52
9/12/04	17:30:00	5.62
9/12/04	18:00:00	5.18
8/28/04	15:30:00	8.98
8/28/04	16:00:00	8.22

- From 8/17 1400 to 8/21 1730 dissolved oxygen data were out of range and deleted. The values were as low as 44.5% and inconsistent with the range during the previous deployment. Since DO levels returned to a more normal range during 8/17 to 9/13 deployment, the out of range data may have resulted from temporary fouling or interference by algae or some other substance.
- The following DO% and DO mg/l was out of range and deleted.

8/28/04	15:30:00	191.2	14.85
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