

**An Updated Status Report on
Biological and Living Resources Monitoring
Databases Provided by the Chesapeake Bay
Program Data Center**

June 2000



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Introduction

The intent of this report is to summarize the recent status of “point data” databases currently provided by the Chesapeake Bay Program (CBP) Data Center. These databases contain biological and living resources monitoring data collected at stations (“points”) in Chesapeake Bay and associated tidal waters. The report is intended to be a reference for CBP staff and program partners in their efforts to 1) understand the frequently complex process of managing monitoring data collected by multiple laboratories, and 2) address CBP data management needs with respect to the Chesapeake Bay Information System (CIMS) and the *Strategy for Increasing Basin-wide Public Access to Chesapeake Bay Information* (adopted October 1996). It is hoped that this report will be used to identify areas where data management efforts and quality assurance resources are most needed by CBP partners.

Each section is structured to provide a 1-2 page overview of the condition of the monitoring data produced by each monitoring program. The monitoring programs were reviewed in five performance areas: a) laboratory data management practices, b) technical (analytical) quality of the data, c) data delivery with respect to overall contract/grant/MOA commitments (where applicable), d) data set availability and e) status of CIMS implementation.

This report is not intended to be a comprehensive review of the status of all biological and living resources monitoring programs in the Chesapeake Bay area. Rather, this report focuses on those data sets which were first identified as High Priority data sets by the CBP Living Resources Monitoring Workgroup of the Living Resources Subcommittee in 1995. Some of these data sets are also paid for by the program or used as state matches to obtain other monitoring funds from the program, hence they are a required deliverable to the program. Unlike the first version of this report in 1998, the 2000 report focuses solely on “point” data and does not address Living Resources Geographic Information System (GIS) managed data, e.g. submerged aquatic vegetation monitoring data, wetlands monitoring data, oyster bar monitoring data.

Table 1. Summary of Monitoring Program Performance from 1997 to 2000

Monitoring Program	Data Management	Data Quality	Deliverable Performance	Data Availability	CIMS Implementation
PLANKTON					
Maryland Phytoplankton Monitoring Program					
Virginia Phytoplankton and Picoplankton Monitoring Program					
Maryland Primary Production Monitoring Program		U			
Virginia Primary Production Monitoring Program		U			
Maryland Horizontal, Vertical and Potomac Horizontal Fluorescence Monitoring Program					
The Lower Virginia Chesapeake Bay Horizontal and Vertical Fluorescence Monitoring Program					
Upper Virginia Chesapeake Bay-Horizontal and Vertical Fluorescence Monitoring Program	NA		NA		
Maryland Microzooplankton Monitoring Program					
Virginia Microzooplankton Monitoring Program					
Maryland Mesozooplankton Monitoring Program					
Virginia Mesozooplankton Monitoring Program					
BENTHOS					
Maryland Benthic Monitoring Program					
Virginia Benthic Monitoring Program					
Virginia Benthic Sediment Imaging Program		U			
FISH AND BIRDS					
Maryland Fisheries-Independent Fish and Blue Crab Trawl Program			NA		
The Baywide Fisheries-Independent Winter Blue Crab Dredge Program			NA		
Maryland- Fisheries Independent Fish Seine Program			NA		
Virginia- Fisheries Independent Seine and Trawl Program			NA		
Bay Wide Waterfowl Concentration Surveys	NA	U	NA		

Legend Key

U Exellent Average Poor
 Status Unknown NA Not applicable

Plankton

The plankton represent a diverse group of organisms and plankton data sets are generated by an equally diverse set of monitoring programs. The plankton span multiple trophic levels from the microscopic primary producers (phytoplankton) through primary and secondary consumer (zooplankton) to decomposers (bacterioplankton). The plankton monitored by CBP partners range over seven orders of magnitude in size, from 0.2 microns (picophytoplankton) to greater than 2 meters (jellyfish). The large, diverse plankton community is currently monitored by ten separate programs in Maryland and Virginia. Some of the programs are funded directly by the Chesapeake Bay Program through the Living Resources or Monitoring subcommittees. Others are state programs that are used as state "matches" to obtain federally monitoring funds. Many of these programs have resolved fundamental data management problems since 1998, but new issues continue to emerge. The recent institution of split-sample comparisons and quality assurance procedures for plankton have confirmed suspected problems in some monitoring efforts and demonstrated the excellent quality and comparability of other monitoring efforts. Identified problems are now in various states of resolution. These QA/QC programs demonstrated the need to institute split sampling programs across all living resource monitoring programs.

Maryland Phytoplankton Monitoring Program

Principals:

Current principal investigator: Richard Lacouture, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Current data manager: Aime Imirie, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Program Manager:

Current Managers: Bruce Michael and Peter Tango, Maryland Department of Natural Resources, Tidewater Ecosystem Assessment.

Funding Vehicle:

Match Grant Program to the Maryland Mainstem Water Quality Monitoring Program. Academy of Natural Sciences is a Subcontractor.

Data Management Status:

The Academy of Natural Sciences (ANS) has generally produced high quality data sets with respect to data management practices. However, in last few years ANS lost data management staff and the Academy's ability to perform routine data reduction and reporting has suffered. ANS currently has limited resources to maintain their internal databases and existing data management software. On several occasions since 1998 the CBP Data Center staff has modified or developed new data processing applications for the Academy. The data documentation provided by the Academy has not been updated recently. While the situation is not yet critical, there may be problems in the future.

Data Quality Status:

Phytoplankton data from Maryland and Virginia can be combined for Bay-wide analysis with a few minor modification (See Appendix A or The 2000 Users Guide to Chesapeake Bay Program Biological and Living Resources Data for details). Maryland currently lacks a picoplankton monitoring program, however this does not affect bay-wide analysis of most phytoplankton groups.

Deliverable Performance:

Since 1997, the Academy has missed several delivery dates for phytoplankton data. Much of this may be attributed to the unrealistic expectations of the Monitoring Subcommittee's accelerated deliverable program instated in 1999. The overall data content quality has not appeared to have changed. A complete resubmission of the 1984-1999 plankton data set is planned. This update to CBP data holding will incorporate recommended data reporting changes and modifications based on the 1998 split sampling program. This re-submission should not be constituted as major corrections to erroneous data.

Data Availability:

Data from July 1984 through December 1999 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large scale relational database engine (i.e. Oracle or MS-SQL server). There are no current plans to establish a distributed CIMS Partner hosting arrangements. This is in part due to the lack

of data management resources at the Academy and a lack of attention on the part of Maryland DNR.

Best Recommendations:

- Maryland currently lacks a picoplankton monitoring program. The addition of this program would complete coordination with the Virginia Monitoring Program.
- In light of the lack of data management staff at the Academy, it is recommended that the Academy data serving responsibilities be incorporated to the work plan of the existing Maryland Department of Natural Resources CIMS MOA. If no arrangements with MDDNR can be established, the data should continue to be served at CBPO.
- Academy personnel need to be trained in writing data documentation compliant with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Virginia Phytoplankton and Picoplankton Monitoring Program

Principals:

Current principal investigator: Dr. Harold Marshall, Old Dominion University.

Current data manager: David Seaborn, Old Dominion University.

Program Manager:

Current manager: Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

EPA CBP funds, and State funding used as Match Grant Program to obtain funds for the Virginia Mainstem Water Quality Monitoring Program. Old Dominion University is a Subcontractor.

Data Management Status:

Prior to 1997, the Applied Marine Research Laboratory was responsible for data entry and processing of the phytoplankton data. As part of the resolution to a 1997 VADEQ vendor complaint, AMRL handed over most of its data management responsibilities to the monitoring program principal investigators in 1997. Since the hand over, the overall data management and data condition of the phytoplankton data has significantly improved. The ODU phytoplankton lab has worked with CBPO Data Center staff to produce good CIMS compliant data in a timely manner.

Data Quality Status:

Phytoplankton data from Maryland and Virginia can be combined for bay-wide analysis with a few minor modification (See Appendix A or The 2000 Users Guide to Chesapeake Bay Program Biological and Living Resources Data for details). It should be noted that the 1998 split sampling program, and the cross lab comparisons done as part of a NOAA *Pfiesteria* monitoring program between ODU, ANS and VIMS, showed that ODU has an inability to detect some organisms smaller than 1-2 microns. After extensive examination of individual laboratory microscopes and sample preparation techniques, there has been no apparent explanation for this discrepancy or a resolution. This issue will not affect bay-wide analysis of most phytoplankton groups.

Deliverable Performance:

Since 1997, there has been a marked improvement in the on-time delivery of data. The phytoplankton laboratory has not missed a data deliverable date in two years. This is in spite of the unrealistic expectations of the Monitoring Subcommittee's accelerated deliverable program. The overall data content quality has not appeared to have changed. A complete re-submission of the 1984-1999 plankton data set is planned. This update to CBP data holding will incorporate recommended data reporting changes and modifications based on the 1998 split sampling program. This re-submission should not be constituted as major corrections to erroneous data.

Data Availability:

Data from January 1985 through December 1999 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Related to the 1997 vendor complaint, funding was awarded to VADEQ/ODU for a full time Data Manager for Chesapeake Bay Program monitoring data. This individual was charged with resolving the existing internal ODU data management issues and with CIMS implementation for all of ODU's Bay Program Data. Furthermore, as part of the Virginia DEP CIMS MOA, ODU is obligated to serve as the CIMS site for the Living Resource and Water Quality monitoring data they collect from January 1, 1999 forward. ODU is anticipating having all 1999 plankton (Phytoplankton, Primary Production, Mesozooplankton, Microzooplankton and Fluorescence) data available as ASCII flat files and non CIMS compliant PC SAS data sets on their CIMS web site by the end of Calendar 2000. The establishment of a web enabled relational database for these data sets is planned for the 2001-2002 time frame. It is currently assumed that the CPBO program office will continue to serve data collected prior to 1999.

Best Recommendations:

- A formal CIMS MOA and data serving arrangement should be arranged with ODU independent of the VADEQ contractual obligations. An ODU MOA would insure continued data access if ODU's monitoring contract with DEQ was ever discontinued. Furthermore the CBPO Data Center staff should continue to work with the new AMRL data manager as ODU continues their CIMS implementation efforts.
- Since data management has been turned over to the laboratory, laboratory personnel need to be trained in writing data documentation which is in compliance with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Maryland Primary Production Monitoring Program

Data Generator:

Current principal investigator: Richard Lacouture, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Current data manager: Aime Imirie, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Program Manager:

Current Managers: Bruce Michael and Peter Tango, Maryland Department of Natural Resources, Tidewater Ecosystem Assessment.

Funding Vehicle:

State funds used in Match Grant Program to obtain funds for the Maryland Mainstem Water Quality Monitoring Program. Academy of Natural Sciences is a Subcontractor.

Data Management Status:

The Academy of Natural Sciences (ANS) has generally produced high quality data sets with respect to data management practices. However, in last few years ANS has lost data management staff and the Academy's ability to perform routine data reduction and reporting has suffered. ANS currently has limited resources to maintain their internal databases and existing data management software. On several occasions since 1998 the CBP Data Center staff has modified or developed new data processing applications for the Academy. The data documentation provided by the Academy has not been updated recently. While the situation is not yet critical, there may be problems in the future.

Data Quality Status:

The actual analytical quality of both the Maryland and Virginia C14 Production data is unknown. There is currently no split sampling program or documented quality assurance data on record for either the Maryland or Virginia programs. The Bay Program's modelers and investigators in the research community currently do not include the existing bay-wide C14 Monitoring data citing issues with production measurement techniques. Furthermore recent split sampling exercises involving the measurement of chlorophyll and fluorescence have indicated that the ANS's chemical laboratory protocols and procedures leave room for improvement. There maybe nothing wrong with the analytical quality of data from this lab but we have no grounds to make any assessments. It should be noted that there was a partial re-submission of the primary production data in 1995 due an analytical problem in the calculation chlorophyll a (a related parameter in the data set).

Deliverable Performance:

Since 1997, the Academy has missed several delivery dates for primary data. Much of this may be attributed to the unrealistic expectations of the Monitoring Subcommittee's accelerated deliverable program instated in 1999. The overall data content quality has not appeared to have changed.

Data Availability:

Data from July 1984 through December 1999 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large scale relational database engine (i.e. Oracle or MS-SQL server). There are no current plans to establish a distributed CIMS Partner hosting arrangements. This is in part due to the lack of data management resources at the Academy and a lack of attention on the part of Maryland DNR.

Best Recommendations:

- The Maryland and Virginia programs badly needs to have a split sampling/quality assurance program instated. The Bay Program should either change the programs so they start generating C14 data the modelers and research community can use or terminate the programs. It is not cost effective to collect and manage unused or unable monitoring data.
- In light of the lack of data management staff at the Academy, it is recommended that the Academy data serving responsibilities be incorporated to the work plan of the existing Maryland Department of Natural Resources CIMS MOA. If no arrangements with MDDNR can be established, the data should continue to be served at CBPO.
- Academy personnel need to be trained in writing data documentation compliant with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Virginia Primary Production Monitoring Program

Data Generator:

Current principal investigator: Dr. Kneeland Nesieus, Old Dominion University.
Current data manger: None On Record.

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

EPA CBP funds, and State funds used in Match Grant Program to obtain funds for the Virginia Mainstem Water Quality Monitoring Program. Old Dominion University is a Subcontractor.

Data Management Status:

Prior to 1997, the Applied Marine Research Laboratory was responsible for data entry and processing of the phytoplankton data. As part of the resolution to a 1997 VADEQ vendor complaint, AMRL handed over most of its data management responsibilities to the monitoring program principal investigators in 1997. Since that time, Dr Nesius and his staff have submitted data directly to the Bay program. Data submissions have been in CIMS compliant formats and free of obvious data reporting problems. While this lab does seem to be somewhat transient. They seem to maintain acceptable levels of routine data reduction and reporting. Data documentation provided by ODU with this data set is extremely weak.

Data Quality Status:

The actual analytical quality of both the Maryland and Virginia C14 Production data is unknown. There is currently no split sampling program or documented quality assurance data on record for either the Maryland or Virginia programs. The Bay Program's modelers and investigators in the research community currently do not include the existing bay-wide C14 Monitoring data citing issues with production measurement techniques. Neither the Living Resources Data Manager nor the Bay Program QA Officer have conducted a site visit of the C14 lab nor a review of any analytical procedures used by Dr. Nesieus 's staff. There maybe nothing wrong with the analytical quality of data from this lab but we have no grounds to make any assessments.

Deliverable Performance:

Since 1997, there has been a marked improvement in the on-time delivery of data. The primary production laboratory has not missed a data deliverable date in two years. This lab seemed to be unaffected by the accelerated deliverable program instated in 1999. The overall data content quality has not appeared to have changed, however recent questions about data analytical quality in other Living Resources Monitoring Programs raises questions about this program.

Data Availability:

Data from January 1989 through December 1999 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Related to

the 1997 vendor complaint, funding was awarded to VADEQ/ODU for a full time data manager for Bay Program monitoring data. This individual was charged with resolving the existing internal ODU data management issues and with CIMS implementation for all of ODU's Bay Program Data. Furthermore, as part of the Virginia DEP CIMS MOA, ODU is obligated to serve as the CIMS site for the Living Resource and Water Quality monitoring data they collect from January 1, 1999 forward. ODU is anticipating having all 1999 plankton (Phytoplankton, Primary Production, Mesozooplankton, Microzooplankton and Fluorescence) data available as ASCII flat files and non CIMS compliant PC SAS data sets on their CIMS web site by the end of Calendar 2000. The establishment of a web enabled relational database for these data sets is planned for the 2001-2002 time frame. It is currently assumed that the CPBO program office will continue to serve data collected prior to 1999.

Best Recommendations:

- This program badly needs to have a split sampling/quality assurance program instated. The Bay program should either change this program so it starts generating C14 data the modelers and research community can use or terminate this program. It is not cost effective to collect and manage unused or unable monitoring data.
- A formal CIMS MOA and data serving arrangement should be arranged with ODU independent of the VADEQ contractual obligations. An ODU MOA would insure continued data access if ODU's monitoring contract with DEQ was ever discontinued. Furthermore the CBPO Data Center staff should continue to work with the new AMRL data manager as ODU continues their CIMS implementation efforts.
- Since data management has been turned over to the laboratory, laboratory personnel need to be trained in writing data documentation which is in compliance with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Maryland Horizontal, Vertical and Potomac Horizontal Fluorescence Monitoring Program

Data Generator:

Current principal investigator: Richard Lacouture, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Current data manager: Aime Imirie, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Program Manager:

Bruce Michael and Peter Tango, Maryland Department of Natural Resources, Tidewater Ecosystem Assessment.

Funding Vehicle:

Mainstem and Tidal Tributary Horizontal and Vertical Fluorescence Monitoring is State funding used in Match Grant Program to obtain funds for the Maryland Mainstem Water Quality Monitoring Program. The Potomac Horizontal Monitoring Program is EPA funded. Academy of Natural Sciences is a Subcontractor.

Data Management Status:

The Academy of Natural Sciences (ANS) has generally produced high quality data sets with respect to data management practices. However, in last few years ANS has lost data management staff and the Academy's ability to perform routine data reduction and reporting has suffered. ANS currently has limited resources to maintain their internal databases and existing data management software. On several occasions since 1998 the CBP Data Center staff has modified or developed new data processing applications for the Academy. The data documentation provided by the Academy has not been updated recently. While the situation is not yet critical, there may be problems in the future.

Data Quality Status:

In June of 1999, significant irregularities between comparison of water quality chlorophyll and fluorescence chlorophyll values were brought to the attention of the Living Resources Data Manager. After some examination of the data the difference were attributed to the discovery of an equipment biases between vertical and horizontal sampling gear. The gear differences require that separate calibration regression be used to calculate chlorophyll values for each the vertical and horizontal data. Previously all chlorophyll data was estimated from regression based on vertical profile data. Further, work was also done to standardize monitoring protocols and data calibration procedures among the states. It was found that ANS was performing a single instrument calibration for each 3 day cruise instead of daily instrument calibrations for chlorophyll. The end result of this QA effort will be that ANS will be correcting the entire Horizontal Fluorescence record for the July 1984 to December 1999 time period.

Deliverable Performance:

Since 1997, the Academy has missed several delivery dates for fluorescence data. Much of this may be attributed to the unrealistic expectations of the Monitoring Subcommittee's accelerated deliverable program instated in 1999. The overall data content quality has not appeared to have changed. The Academy also currently feels that they are unable to perform the data correction and resubmission's required to correct the horizontal fluorescence data.

Data Availability:

Data from July 1984 through December 1999 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide

accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is in need of migration to a large scale relational database engine (i.e. Oracle or MS-SQL server). There are no current plans to establish a distributed CIMS Partner hosting arrangements. This is in part due to the lack of data management resources at the Academy and a lack of attention on the part of Maryland DNR.

Best Recommendations:

- ANS should correct the regressions for the horizontal fluorescence and resubmit the data before the CBP database is migrated into SQL Server. First priority should be given to data collected from 1991 to present. (The fluorescence monitoring program in Virginia did not begin until 1991.) By correcting the data from this time period first, we can restore our complete mainstem horizontal fluorescence record.
- In light of the lack of data management staff at the Academy, it is recommended that the Academy data serving responsibilities be incorporated to the work plan of the existing Maryland Department of Natural Resources CIMS MOA. If no arrangements with MDDNR can be established, the data should continue to be served at CBPO.
- Academy personnel need to be trained in writing data documentation compliant with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

The Lower Virginia Chesapeake Bay Horizontal and Vertical Fluorescence Monitoring Program

Data Generator:

Current principal investigator: Dr. Dan Dauer, Old Dominion University.
Current data manager: Susan Daughton of the Applied Marine Research Laboratory.

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

Directly Federally funded through grant to the Virginia Mainstem Water Quality Monitoring Program. Old Dominion University is a Subcontractor.

Data Management Status:

Prior to 1997, the Applied Marine Research Laboratory had never delivered any of this data to the Bay Program. As part of the resolution to a 1997 VADEQ vendor complaint, AMRL delivered all past due monitoring data as is. Since the initial lump sum data delivery and subsequent data cleanup, the overall data management and data condition of the fluorescence data has significantly improved. Data deliverables arrive in the grant specified format and on time. The ODU water quality lab has worked with well CBPO Data Center staff to produce good CIMS compliant data in a timely manner. The data documentation provided with the fluorescence data is better than what is provided with other ODU data sets, but is not in the living resources monitoring data documentation or FGDC data documentation format.

Data Quality Status:

While in the initial submissions of this data were found to have serious analytical problems with the estimation of fluorescence chlorophyll and approximately 30% of all original data collected were removed due to these analytical problems. The data submitted since 1998 seems to be free of these previous problems. This program has participated in an informal quality assurance program in conjunction with the water quality chlorophyll split-sampling program. Further more work has been done over the last year to standardize monitoring and data calibration procedures among the states. There is currently no fluorescence monitoring in the tributaries in Virginia and this lack should be addressed.

Deliverable Performance:

Since 1997, there has been a marked improvement in the on-time delivery of data. The water quality laboratory has generally been early with data deliverable date over the two years. Despite the initial QA problems associated with the initial submission of this data, the staff as ODU has always been responsive and shown a genuine interest in correcting the data and producing the best data set possible. This has been a good monitoring program as of late.

Data Availability:

Data from January 1991 through December 1999 are available from the CBPO CIMS web page through an on-line searchable relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Related to the 1997

vendor complaint, funding was awarded to VADEQ/ODU for a full time data manager for Bay Program monitoring data. This individual was charged with resolving the existing internal ODU data management issues and with CIMS implementation for all of ODU's Bay Program Data. Furthermore, as part of the Virginia DEP CIMS MOA, ODU is obligated to serve as the CIMS site for the Living Resource and Water Quality monitoring data they collect from January 1, 1999 forward. ODU is anticipating having all 1999 plankton (Phytoplankton, Primary Production, Mesozooplankton, Microzooplankton and Fluorescence) data available as ASCII flat files and non CIMS compliant PC SAS data sets on their CIMS web site by the end of Calendar 2000. The establishment of a web enabled relational database for these data sets is planned for the 2001-2002 time frame. It is currently assumed that the CPBO program office will continue to serve data collected prior to 1999.

Best Recommendations:

- Establish fluorescence monitoring in the tributaries in Virginia.
- A formal CIMS MOA and data serving arrangement should be arranged with ODU independent of the VADEQ contractual obligations. An ODU MOA would insure continued data access if ODU's monitoring contract with DEQ was ever discontinued. Furthermore the CBPO Data Center staff should continue to work with the new AMRL data manager as ODU continues their CIMS implementation efforts.
- Since data management has been turned over to the laboratory, laboratory personnel need to be trained in writing data documentation which is in compliance with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Upper Virginia Chesapeake Bay-Horizontal and Vertical Fluorescence Monitoring Program

Data Generator:

Current Contact: Dr. Larry Haas, Virginia Institute of Marine Sciences

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

PROGRAM WAS DISCONTINUED IN DECEMBER 1995. Federally funded through grant to the Virginia Mainstem Water Quality Monitoring Program. The Virginia Institute of Marine Sciences was a Subcontractor.

Data Management Status:

This is a terminal data set. The data record stops in December 1995 when the Virginia Institute of Marine Sciences lost its Chesapeake Bay Program water quality monitoring contract. The CBP Living Resources Data Manager examined the datasets in September 1995 and found problems with duplicate records, but these issues were later resolved. Sample collection and analysis information was provided by VIMS after the termination of their monitoring contract, so CBP staff could write accurate data documentation.

Data Quality Status:

The VIMS Horizontal fluorescence program measured sampling locations with LORAN-C (1991 - June 1995) or GPS (after July 1995) each time a fluorescence measurement was made. Vertical fluorescence monitoring took place at standard CBP stations, so the standard latitudes and longitudes are used with each profile. The records in regards to chlorophyll regression and calculation procedures are unavailable at this time.

Deliverable Performance:

Not Applicable

Data Availability:

Data from January 1991 through December 1995 are available from the CBPO CIMS web page through an on-line searchable relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Due to the loss of the VIMS monitoring contract the long-term responsibility for serving this data should lie with CBPO.

Best Recommendations:

Not Applicable

Maryland Microzooplankton Monitoring Program

Data Generator:

Current Principal Investigator: Ms. Stella Sellner, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Current data manager: Aime Imirie, Academy of Natural Sciences, Benedict Estuarine Research Laboratory.

Program Manager:

Bruce Michael and Peter Tango, Maryland Department of Natural Resources Tidewater Ecosystem Assessment.

Funding Vehicle:

Federal funds from the Maryland Mainstem Water Quality Monitoring Program. Academy of Natural Sciences is a Subcontractor.

Data Management Status:

The Academy of Natural Sciences (ANS) has generally produced high quality data sets with respect to data management practices. However, in last few years ANS has lost data management staff and the Academy's ability to perform routine data reduction and reporting has suffered. ANS currently has limited resources to maintain their internal databases and existing data management software. On several occasions since 1998 the CBP Data Center staff has modified or developed new data processing applications for the Academy. The data documentation provided by the Academy has not been updated recently. While the situation is not yet critical, there may be problems in the future.

Data Quality Status:

The 1998-1999 microzooplankton split sampling program demonstrated the high quality of the ANS data (level of taxonomic identification, raw count numbers, quality assurance, etc). The Study also demonstrated the direct comparability of the Maryland and Virginia counts for two important taxonomic groups: copepod nauplii and rotifers. In 1998, ANS added a whole water component to their existing collection and counting protocol for a number of stations during the spring and summer. This step allows them to collect and count the microzooplankton taxa less than 44 micron in size, and makes their Microzooplankton results more comparable to those of Virginia at these sites. The Maryland program could be further improved by instituting whole water sampling for all stations and seasons. There are still procedural differences between Maryland and Virginia microzooplankton sample analysis methods that prevent direct comparisons, and ANS is presently resolving these by lumping their species data to match a ODU group category. Specifically, ANS is lumping its counts for ciliate species >20 micron in order to match the ODU ciliate count which are made only on ciliates > 20 micron. The microzooplankton data from Maryland and Virginia can be combined for bay-wide analysis for two groups: the copepod nauplii and the rotifers (See Appendix B or the 2000 Users Guide to Chesapeake Bay Program Biological and Living Resources Data for details). ANS can also calculate species-specific abundances and diversity indices for Maryland.

Deliverable Performance:

Since 1997, the Academy has missed several delivery dates for phytoplankton data. Much of this may be attributed to the unrealistic expectations of the Monitoring Subcommittee's accelerated deliverable program instated in 1999. The overall data content quality has not appeared to have changed. However, none of the whole water sample counts instituted in 1998 have been delivered to the Bay Program, due to lack of resources at ANS.

Data Availability:

Data from July 1984 through December 1999 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large scale relational database engine (i.e. Oracle or MS-SQL server). There are no current plans to establish a distributed CIMS Partner hosting arrangements. This is in part due to the lack of data management resources at the Academy and a lack of attention on the part of Maryland DNR.

Best Recommendations:

- The Academy needs to allot some resources to process and deliver the whole water count data to the CBPO Data Center.
- In light of the lack of data management staff at the Academy, it is recommended that the Academy data serving responsibilities be incorporated to the work plan of the existing Maryland Department of Natural Resources CIMS MOA. If no arrangements with MDDNR can be established, the data should continue to be served at CBPO.
- Academy personnel need to be trained in writing data documentation compliant with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Virginia Microzooplankton Monitoring Program

Data Generator:

Current principal investigator: Dr. Kent Carpenter, Old Dominion University.
Current data manager: Mike Lane

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

Federal funds from the Virginia Mainstem Water Quality Monitoring Program. Old Dominion University is a Subcontractor.

Data Management Status:

Prior to 1997, the Applied Marine Research Laboratory was responsible for data entry and processing of the phytoplankton data. As part of the resolution to a 1997 VADEQ vendor complaint, AMRL handed over most of its data management responsibilities to the monitoring program principal investigators in 1997. Since the hand over, the overall data management and data condition of the microzooplankton data has significantly improved. The ODU Microzooplankton lab has worked with well CBPO data center staff to produce good CIMS compliant data in a timely manner. It should be noted that the new AMRL Data Manager has done extensive work designing a new data management system for this laboratory.

Data Quality Status:

The 1998-1999 Split Sample Study demonstrated the direct comparability of the Maryland and Virginia counts for two important taxonomic groups: copepod nauplii and rotifers. Procedural differences still preclude direct comparability of species or taxa counts or counts for other taxonomic groups such as the ciliates. Specifically, ODU does not identify and enumerate microzooplankton to the genus and species level. Also, ODU does not count microzooplankton less than 20 micron in size while ANS does. Microzooplankton <20 micron are primarily ciliates, therefore Maryland and Virginia total ciliate counts are not comparable. To make their data directly comparable to the ANS whole water counts, ODU should begin to 1) identify to lower taxonomic levels and 2) count ciliates and other protozooplankton <20 microns. The ODU Principal Investigator states that this additional work is not possible based on the current funding level. Microzooplankton data from Maryland and Virginia can be combined for bay-wide analysis for two groups: the copepod nauplii and the rotifers (See Appendix B or the 2000 Users Guide to Chesapeake Bay Program Biological and Living Resources Data for details).

Deliverable Performance:

Since 1997, there has been a marked improvement in the on-time delivery of data. The microzooplankton laboratory has missed two data deliverable dates over the current review period. The overall data content quality has not appeared to have changed.

Data Availability:

Data from January 1993 through December 1999 are available from the CBPO CIMS web page through an on-line searchable relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Related to the 1997 vendor complaint, funding was awarded to VADEQ/ODU for a full time data manager for Bay Program monitoring data. This individual was charged with resolving the existing internal ODU data management issues and with CIMS implementation for all of ODU's Bay Program Data. Furthermore, as part of the Virginia DEP CIMS MOA, ODU is obligated to serve as the CIMS site for the Living Resource and Water Quality monitoring data they collect from January 1, 1999 forward. ODU is anticipating having all 1999 plankton (Phytoplankton, Primary Production, Mesozooplankton, Microzooplankton and Fluorescence) data available as ASCII flat files and non CIMS compliant PC SAS data sets on their CIMS web site by the end of Calendar 2000. The establishment of a web enabled relational database for these data sets is planned for the 2001-2002 time frame. It is currently assumed that the CPBO program office will continue to serve data collected prior to 1999.

Best Recommendations:

- This program needs to start doing taxonomic identifications down to the genus and species level since the current information from the program is of limited use.
- A formal CIMS MOA and data serving arrangement should be arranged with ODU independent of the VADEQ contractual obligations. An ODU MOA would insure continued data access if ODU's monitoring contract with DEQ was ever discontinued. Furthermore the CBPO Data Center staff should continue to work with the new AMRL data manager as ODU continues their CIMS implementation efforts.
- Since data management has been turned over to the laboratory, laboratory personnel need to be trained in writing data documentation which is in compliance with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Maryland Mesozooplankton Monitoring Program

Data Generator:

Current principal investigators: William Burton of Versar Incorporated, and Dr. Fred Jacobs of Post, Buckley, Schuh and Jerigan, Inc.
Interim data manager: Craig Bruce.

Program Manager:

Bruce Michaels and Peter Tango, Maryland Department of Natural Resources Tidewater Administration.

Funding Vehicle:

Federal funds from CBP Living Resources Subcommittee, state funds (Patuxent River), and funding from the Maryland Mainstem Water Quality Monitoring Program. Versar is a Subcontractor.

Data Management Status:

The quality of Versar data management has varied over time but is currently acceptable. Earlier databases containing data collected between 1984-1990 have been somewhat problematic. In 1999, the CBP Data Center modified in-house data processing applications for Versar to create Bay Program data deliverables. Data documentation provided by Versar has been improving over time but is not compliant with the Federal Geospatial Meta Data Standards. It is currently not a requirement in the contract between MDDNR and Versar. Versar staff is trained in the FGDC standard and generates data documentation in that format for other contractual work they do. The data documentation released with final data sets is still rewritten into a standard format by the CBP Living Resources Data Manager.

Data Quality Status:

Maryland and Virginia mesozooplankton data prior to 2000 cannot be combined for bay-wide analysis without serious caveats and limitations due to state differences in laboratory analysis methods (see Appendix C for details). Maryland and Virginia are presently resolving these procedural differences. In 1998, Versar modified its laboratory methods to improve counts of large, rare species. An improvement in diversity measures was observed in the 1998-1999 split sample study. Disparities were observed between Maryland and Virginia species lists in the split sample results. These differences are being resolved with better coordination of species identification references and side-by-side comparisons. It is the opinion of the authors that most of the issues related to data comparability appear to be Virginia issues and should not be construed as data quality problems with the Maryland data.

Deliverable Performance:

Over the last two year, the on-time delivery of zooplankton data from Versar under the accelerated data deliverable program has not been good. However, as the data becomes available, it is made available to data analysts on request prior to the delivery date. Data deliverables now average 60 days late.

Data Availability:

Data from July 1984 through July 1999 are available from the CBP Data Center CIMS web page through an on-line searchable relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as in standard Living Resources data documentation format. The data documentation released with final data sets is rewritten into standard formats by the CBP Living Resources Data Manager. Data are accompanied by a 2000 Living Resources Data Users Guide. The CBP relational database housing this data set is not currently in need of migration to a large scale relational database engine(i.e. Oracle or MS-SQL server) .

CIMS Implementation:

The data base is currently on a CBPO server, and depending on the outcome of the VERSAR CIMS MOA implementation for benthos, the mesozooplankton may also be served by the data generator. A decision from VERSAR as to their desire to serve zooplankton data will probably not be made until 2002.

Best Recommendations:

- There are major procedural differences in the methodology for Mesozooplankton determination between Maryland and Virginia which must be resolved. These changes will have to occur before the data can be used in any type of bay-wide assessments or Indicator development.
- VERSAR Corporation has signed a CIMS MOA for their benthic monitoring program in October 1999. However, work on MOA implementation halted due to a change in lead investigator. It is hoped that work on this MOA will resume later this year or in 2001. After the benthic implementation Versar Corporation had always intended to review the costs and benefits of CIMS partnership and determine if they wished to go forward with a similar arrangement for the zooplankton program.
- Get generation of FGDC complaint meta data into the contract with Versar as a data deliverable.

Virginia Mesozooplankton Monitoring Program

Data Generator:

Current principal investigator: Dr. Kent Carpenter, Old Dominion University.
Current data manager: George Mateja

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

Federal funds from CBP Living Resources Subcommittee and through the Virginia Mainstem Water Quality Monitoring Program. Old Dominion University is a Subcontractor.

Data Management Status:

The overall data management and condition of the last three mesozooplankton data deliverables (data sets and documentation) was less than optimal. Prior to 1997, the Applied Marine Research Laboratory was responsible for data entry and processing of the mesozooplankton data. In 1997, the Principal Investigators of the ODU monitoring programs assumed data management responsibilities as part of the resolution of a 1997 VADEQ vendor complaint. The ODU mesozooplankton program is presently working with CBPO Data Center staff to produce good quality, CIMS compliant data in a timely manner. The new AMRL data manager has done extensive work designing a new data management system for this laboratory. However, the laboratory is still not delivering error free data sets on time at the same level presently carried out by the ODU Phytoplankton, Fluorescence and Benthic monitoring programs.

Data Quality Status:

Maryland and Virginia mesozooplankton data prior to 2000 cannot be combined for bay-wide analysis without serious caveats and limitations due to state differences in laboratory analysis methods (see Appendix C for details). Maryland and Virginia are presently resolving these procedural differences. A 1998-1999 split sampling study indicated the ODU splits counted with the laboratory's long-standing "Coefficient of Variation Stabilization Method" had significantly lower counts (abundances), higher variances, and lower diversity measures (species richness, Margalef Diversity Index) than the Maryland splits. These disparities were found to be reflected in the actual monitoring results (see Appendix C). Disparities were also observed between Maryland and Virginia species lists in the split samples. The ODU mesozooplankton program attempted to resolve the discrepancies in 1998 with additional, smaller mesh sieves that passively filtered the water leaving the CVS apparatus. Some improvement was observed but many ODU species and taxa counts were still significantly lower than the equivalent Maryland counts (e.g. *Eurytemora affinis* copepodites, *Acartia tonsa* copepodites, total cladocera, total copepods, polychaetes). ODU will be switching to the Hensen-Stempel pipette method used by Versar, Inc. in the near future to ensure forward comparability between the states. Although trends calculated on pre-2000 data will probably be comparable to trends calculated on post-1999 data, Virginia's mesozooplankton status characterizations of its tidal waters for the two periods will not be directly comparable. For example, the food availability index for larval striped bass in tidal fresh/oligohaline spawning reaches will probably improve significantly with the new laboratory protocol. The feasibility of using [correction factors] to make the pre-2000 Virginia and Maryland data comparable is being explored but does not look promising. The species list differences observed in the split sample study are being resolved with better coordination of species identification references and side-by-side comparisons.

Deliverable Performance:

There has been no real change in the on-time performance of ODU mesozooplankton deliverables since 1997 under the accelerated data deliverable program. On four occasions the

laboratory has sent data files to the CBP Data Center by the deliverable date, but then sends a "corrected data set" afterwards.

Data Availability:

Data from January 1985 through December 1999 are available from the CBPO CIMS web page through an on-line searchable relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard Living Resources data documentation format. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager. Data are accompanied by the 2000 Living Resources Data Users Guide.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Related to the 1997 vendor complaint, funding was awarded to VADEQ/ODU for a full time data manager for Bay Program monitoring data. This individual was charged with resolving the existing internal ODU data management issues and with CIMS implementation for all of ODU's Bay Program Data. Furthermore, as part of the Virginia DEP CIMS MOA, ODU is obligated to serve as the CIMS site for the Living Resource and Water Quality monitoring data they collect from January 1, 1999 forward. ODU is anticipating having all 1999 plankton (Phytoplankton, Primary Production, Mesozooplankton, Microzooplankton and Fluorescence) data available as ASCII flat files and non CIMS compliant PC SAS data sets on their CIMS web site by the end of Calendar 2000. The establishment of a web enabled relational database for these data sets is planned for the 2001-2002 time frame. It is currently assumed that the CPBO program office will continue to serve data collected prior to 1999.

Best Recommendations:

- There are numerous, serious data quality questions regarding pre-2000 data generated with the CVS laboratory procedure. There are also unresolved questions concerning the experience and training of younger staff in making taxonomic identifications. Laboratory procedures should be changed and performance tracked in order to ensure Maryland-Virginia comparability in the data.
- A formal CIMS MOA and data serving arrangement should be arranged with ODU independent of the VADEQ contractual obligations. An ODU MOA would insure continued data access if ODU's monitoring contract with DEQ was ever discontinued. Furthermore the CBPO Data Center staff should continue to work with the new AMRL data manager as ODU continues their CIMS implementation efforts.
- Since data management has been turned over to the laboratory, laboratory personnel need to be trained in writing data documentation which is in compliance with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Benthos

Benthic biota have well defined indicators that are used to assess community health. These indicators have proven their worth in numerous habitat and toxics targeting exercises. From a programmatic standpoint, the benthic monitoring programs are "Match Programs". This means that they are the state funded programs which are considered to be the states contributions to the EPA funded Water Quality Monitoring Program. This match status has caused some problems over the years because the states view these programs as their own and not part of the collaborative Bay program effort. In turn there have been long term problems in maintaining bay wide program coordination and data deliverable schedules.

Maryland Benthic Monitoring Program

Data Generator:

Current principal investigator: Roberto Llanso, Versar Incorporated.

Current data manager: Unavailable

Program Manager:

Bruce Michaels and Renee Karrh, Maryland Department of Natural Resources Tidewater Administration.

Funding Vehicle:

Match Grant Program to the Maryland Mainstem Water Quality Monitoring Program.

Versar, Incorporated is a Subcontractor.

Data Management Status:

The quality of Versar benthic data management has varied over time but is currently acceptable. Data sets of data collected between 1984-1995 have been somewhat problematic. In 1998, the CBP Data Center modified in-house data processing applications for Versar to create Bay Program data deliverables. Data documentation provided by Versar has been improving over time but is not compliant with the Federal Geospatial Meta Data Standards. It is currently not a requirement in the contract between MDDNR and Versar. Versar staff is trained in the FGDC standard and generates data documentation in that format for other contractual work they do. The data documentation released with final data sets is still rewritten into a standard format by the CBP Living Resources Data Manager.

Data Quality Status:

The Bay Program has no formal quality assurance program arranged between the Maryland and Virginia monitoring programs. However, on their own initiative the individual laboratories involved in the monitoring programs have instituted an informal program for quality assurance. Within this program, samples are routinely recounted, samples are exchanged between labs for cross comparisons and staff are exchanged for training purposes. It would be desirable if the Bay Program could obtain documentation on the existing quality assurance program for verification purposes.

Deliverable Performance:

Since 1997 Versar benthic data deliverables have been late on all deliverable occasions. However, past program performance may not reflect future performance. The program changed principal investigators October of 1999 and data managers in early 2000. On a positive note, the new PI has shown a receptive attitude toward working with CBP data staff and a constructive working relationship is being established. There are outstanding issues relating to the historic data. Many of the problems documented in the 1998 State of the Databases Report are unresolved. It is doubtful, with the change in Principal investigators, that these data gaps and analytical quality problems will be addressed in the historic data.

Data Availability:

Data from July 1984 through December 1998 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

VERSAR Corporation signed a CIMS MOA in 1999. As part of this MOA the benthic monitoring data would be served on a VERSAR web site. There were serious issues with the work plan including: 1) data was to be served as PC SAS data sets-a non CIMS compliant format, 2) they were unwilling to commit to using the established Living Resources relational database design to serve their data on the web and , 3) there were no plans to implement searchable relational database for the data. All of these issues were tabled when all work on Versar' s CIMS implementation halted after the change in program PI in October of 1999.

Best Recommendations:

- While VERSAR Corporation has signed a CIMS MOA, their participation in this initiative halted after the change in program PI in October of 1999. The new lead investigator had proceeded cautiously because he is unsure of what his program, is now committed to do. Additionally the new PI inherited a large number of unfinished CBPO and EPA work. It is our recommendation that the Program let the MOA rest until 2001, by then Dr. Llanso will have firmly established control of the program and can be educated on what CIMS is about. Then we need to go back and renegotiate what Versar is doing as part of their CIMS-MOA and be sure their work is going to integrate with the rest of the CIMS network.

Virginia Benthic Monitoring Program

Data Generator:

Current principal investigators: Dr. Daniel Dauer, Old Dominion University.
Current data manager is Anthony Rodi.

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

A Match Grant Program to the Virginia Mainstem Water Quality Monitoring Program. Old Dominion University is a Subcontractor.

Data Management Status:

The ODU benthic data has generally been of good quality with few problems. Data are submitted as comma delimited ASCII files and processed into normalized format at the Bay Program office. The ODU benthic lab has worked with CBPO Data Center staff to produce good CIMS compliant data in a timely manner. It should be noted that this is another laboratory where the new AMRL data manager has designing a new data management system for the laboratory.

Data Quality Status:

The Bay Program has no formal quality assurance program arranged between the Maryland and Virginia monitoring programs. However, on their own initiative the individual laboratories involved in the monitoring programs have instituted an informal program for quality assurance. Within this program, samples are routinely recounted, samples are exchanged between labs for cross comparisons and staff are exchanged for training purposes. It would be desirable if the Bay Program could obtain documentation on the existing quality assurance program for verification purposes.

Deliverable Performance:

Since 1997, the ODU has generally be early with their annual data deliverables. The overall data content quality has not appeared to have changed. This monitoring program continues to deliver data in good condition on time.

Data Availability:

Data from January 1985 through December 1998 are available from the CBPO CIMS web page through an on-line relational database and as comma delimited ASCII files. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard living resources data documentation format. A 2000 Living Resources Data Users Guide accompanies the data. The data documentation released with final data sets was written into standard formats by the CBP Living Resources Data Manager.

CIMS Implementation:

The Bay Program relational database housing this data set is not currently in need of migration to a large-scale relational database engine (i.e. Oracle or MS-SQL server). Related to the 1997 vendor complaint, funding was awarded to VADEQ/ODU for a full time data manager for Bay Program monitoring data. This individual was charged with resolving the existing internal ODU data management issues and with CIMS implementation for all of ODU's Bay Program Data. Furthermore, as part of the Virginia DEP CIMS MOA, ODU is obligated to serve as the CIMS site for the Living Resource and Water Quality monitoring data they collect from January 1, 1999 forward. ODU is anticipating having all 1999 plankton (Phytoplankton, Primary Production, Mesozooplankton, Microzooplankton and Fluorescence) data available as ASCII flat files and non CIMS compliant PC SAS data sets on their CIMS web site by the end of Calendar 2000. The

establishment of a web enabled relational database for these data sets is planned for the 2001-2002 time frame. It is currently assumed that the CPBO program office will continue to serve data collected prior to 1999.

Best Recommendations:

- A formal CIMS MOA and data serving arrangement should be arranged with ODU independent of the VADEQ contractual obligations. An ODU MOA would insure continued data access if ODU's monitoring contract with DEQ was ever discontinued. Furthermore the CBPO Data Center staff should continue to work with the new AMRL data manager as ODU continues their CIMS implementation efforts.
- Since data management has been turned over to the laboratory, laboratory personnel need to be trained in writing data documentation which is in compliance with the Federal Geospatial Meta Data Standards. This training has not occurred to date. The data documentation currently being released with final data sets was written by the CBP Living Resources Data Manager and reviewed by the PI's.

Virginia Benthic Sediment Imaging Program

Data Generator:

Current principal investigators: Dr. Robert Diaz, Virginia Institute of Marine Sciences.
Current data manager is Randy Cutter.

Program Manager:

Frederick Hoffman, Virginia Department of Environmental Protection.

Funding Vehicle:

A Match Grant Program to the Virginia Mainstem Water Quality Monitoring Program. The Virginia Institute of Marine Sciences is a subcontractor to Old Dominion University. Old Dominion University is a Subcontractor to VADEQ.

Data Management Status:

The management of the benthic data is the responsibility of the data generator. The quality and content of this data are mixed. Data are submitted as photographic interpretations (in Excel spread sheets) and photographic images (in TIFF and JPG files). Data entry errors are common in the interpretation of photo images. Frequently we receive images without their corresponding interpretation or image interpretation data without the corresponding image. The image interpretation data undergoes an intensive manual processing by the Living Resources Data Manager to a format which can be loaded into the benthic database at the Bay Program. The data documentation provided by the VIMS data generator is sufficient for Bay Program use, but not in compliance with the Federal Geospatial Meta Data Standards.

Data Quality Status:

There is no quality assurance program for this program. However, the Bay Program has never set any QA standards or reporting requirements (ie parameters for image analysis, number of images per station, image quality and format) for this program.

Deliverable Performance:

This monitoring program has never submitted a data deliverable on time. Deliverables on average arrive three month late. There are many data management problems (mentioned above). In each of the three years of this program, the annual data deliverables have been subject to multiple data deliverable re-submissions (both interpretations and photo images).

Data Availability:

Photo interpretation of images from January 1996 through 1998 are available from the CBPO CIMS web page through an on-line searchable relational database and as comma delimited ASCII files. The camera images are available by request only. Data documentation is available as FGDC Compliant or NBII Compliant metadata records as well as a standard Living Resources data documentation format. The data documentation released with final data sets is rewritten into standard formats by the CBP Living Resources Data Manager. Data are accompanied by a 2000 Living Resources Data Users guide.

CIMS Implementation:

The bay program relational database housing this data set is not currently in need of migration to a large scale relational database engine(i.e. Oracle or MS-SQL server). It should be noted that we have never had any data requests for this information. The data base is currently on a CBPO server, and there are no plans to change the hosting arrangements for this data as part of the ODU obligations under the VADEQ CIMS MOA.

Best Recommendations:

- An assessment needs to be made on the utility of this program's data from the perspective of the new Basin-wide monitoring strategy.
- The QA and data management issues need to be resolved.

Fish and Birds

The following group of monitoring programs represent programs which are not "Chesapeake Bay Program" monitoring programs. The following programs monitor species which are of great importance to the public as well as the Chesapeake Bay ecosystem. These monitoring programs are funded and run by individual states or Federal Agencies. While the Chesapeake Bay Program does not financially support the acquisition of these data sets, access to the data and their associated information have been deemed an important information need for Bay Program.

Maryland Fisheries-Independent Fish and Blue Crab Trawl Program

Data Generator:

Maryland Department of Natural Resources-Fisheries Division.

Program Manager:

Harley Spear, Maryland Department of Natural Resources Fisheries Service. Brenda Davis is current data manager.

Funding Vehicle:

Program funded by the Maryland Department of Natural Resources.

Data Management Status:

All data is currently collected and managed by staff at the MD DNR Matapeake fisheries lab. The quality of the data is inconsistent. Data from 1988-1992 has numerous data entry errors which are currently being addressed. The Matapeake lab has been very willing to cooperate with the current CBP Living Resources data management effort, and has worked to "clean up" these data sets.

Data Quality Status:

Many of the previous data quality issues with this data set were resolved when the trawl data was loaded into the current relational database. A final corrected submission of the 1988-1992 data and the 1999 data are expected in summer of 2000.

Deliverable Performance:

Not Applicable

Data Availability:

Data from 1993-1998 data was loaded into a relational database at the CBPO Data Center and placed on an internet data server. The 1988 to 1992 data is still being reworked by DNR for correction of data entry and other data management errors.

CIMS Implementation:

All available data is being served from the NOAA Chesapeake Bay Program web page through an on-line searchable relational. There is currently no data documentation to accompany this data in any format. The staff of the NOAA Chesapeake Bay program office is currently working on generating data documentation to released with this data. This data is accompanied by a 2000 Living Resources Data Users guide. The relational database housing this data set is not currently in need of migration to a large scale relational database engine(i.e. Oracle or MS-SQL server) .

Best Recommendations:

- Due to political issues within DNR, it would be best to enable the DNR Fisheries division to establish and run their own CIMS server and or establish their own data site on the CBPO CIMS server. This may require CBPO funding for personal, personnel training, computer software and computer hardware if an independent server were established.

The Baywide Fisheries-Independent Winter Blue Crab Dredge Program

Data Generator:

Maryland Department of Natural Resources and the Virginia Institute of Marine Resources

Program Manager:

MARYLAND: Harley Spear, Maryland Department of Natural Resources Fisheries Service. Glen Davis is the Maryland data manager.

VIRGINIA: Marcel Montane, Virginia Institute of Marine Sciences. Mike Seebo is the Virginia data manager.

Funding Vehicle:

Program funded by the National Oceanic and Atmospheric Administrations Chesapeake Bay Program Office with matching funds from the states of Maryland and Virginia. Complete funding of this project is expected to be provided by the states by 2003.

Data Management Status:

All data for the winter dredge survey collected in both Virginia and Maryland, are managed as a single data set at the Matapeake Laboratory. The Matapeake Laboratory has done a less than optimal job managing the Virginia portion of the data.

Data Quality Status:

The cleanup and loading of the winter dredge data into the current relational database was performed by the CBP-Living Resources Data Manager. There are known sampling site position problems in the data set due to the use of Loran-C for sighting stations in the early years of the survey.

Deliverable Performance:

Not Applicable

Data Availability:

Data from 1990 through 1998 were delivered as part of an annual deliverable to the NOAA Chesapeake Bay Program Office. Data has subsequently been processed by the CBP Living Resources Data Manager and loaded into a relational database on the CBP CIMS server. The NOAA Chesapeake Bay Program Office has taken on the responsibility for the serving and maintenance of this database.

CIMS Implementation:

The NOAA Chesapeake Bay Program Office planning to continue to be responsible for the serving of this database. NOAA is looking as this activity to be their in-kind contribution to the maintenance of the winter dredge survey after they cease providing financial support for this survey.

Best Recommendations:

- Provide training to staff at the NOAA Chesapeake Bay program office in relational database maintenance and FGDC meta data documentation so they can continue to serve this data as a full CIMS partner with out the assistance of the Living Resources Data Manager.
- It might be better to turn the data compilation responsibilities for this survey over to the NOAA Chesapeake Bay Program Office or the Virginia Institute of Marine Sciences. Maryland has demonstrated that they may not be the best candidate for the job.

Maryland- Fisheries Independent Fish Seine Program

Data Generator:

Maryland Department of Natural Resources

Program Manager:

Harley Speir, Maryland Department of Natural Resources Fisheries Service. Eric Durell is current data manager.

Funding Vehicle:

Program funded by the Maryland Department of Natural Resources.

Data Management Status:

This data set has suffered because it has had multiple data managers. Transitions between data managers has never been orderly and the database has not been maintained. Additionally, the work of past data manager was not well documented and each subsequent data manager proceeded to start over from scratch. The data set was sent out in Fall of 1997 to a private consultant for professional data cleanup. The contractor processed data set was then loaded into the current relational database.

Data Quality Status:

This long term survey has gone through a few program and sampling protocol changes over time. It needs to be remembered that this survey it targeted primary at assessing strip bass. Further over time the scope of which species were being monitor and the variety of measurements taken has varied over time. The resulting data set has a number of serious caveats which need to be documented.

Deliverable Performance:

Not Applicable

Data Availability:

Data from 1958 through 1998 was provided to the Bay program during the summer of 1999. Data has been subsequently processed by the CBP Living Resources Data Manager and loaded into a relational database on the CBP CIMS server. It is hoped that some day DNR could take over the responsibility for database maintenance.

CIMS Implementation:

Data from 1958 through 1998 is available from the NOAA Chesapeake Bay Program web page through an on-line searchable relational. There is currently no data documentation to accompany this data in any format. The staff of the NOAA Chesapeake Bay program office is currently working on generating data documentation to released with this data. This Data is accompanied by a 2000 Living Resources Data Users guide. The relational database housing this data set is not currently in need of migration to a large scale relational database engine(i.e. Oracle or MS-SQL server) .

Best Recommendations:

- Due to political issues within DNR, it would be best to enable the DNR Fisheries division to establish and run their own CIMS server and or establish their own data site on the CBPO CIMS server. This may require CBPO funding for personal, personnel training, computer software and computer hardware if an independent server were established.

Virginia- Fisheries Independent Seine and Trawl Program

Data Generator:

Herb Austin, Virginia Institute of Marine Sciences. Chris Bonzek is current data manager for the Trawl Study. Robert Harris is current data manager for the Seine Study.

Program Manager:

Virginia Marine Fisheries Commission.

Funding Vehicle:

Program funded by the Virginia Marine Fisheries Commission.

Data Management Status:

The Virginia fisheries data has had the benefit of having a long term commitment to data management. They have invested in retaining high caliber data management staff, and their ability to routinely produce data and report monitoring results for managers and the research community has reaped the benefits of this commitment.

Data Quality Status:

Data content and quality are considered to be quite good.

Deliverable Performance:

These programs are prime examples of how a good monitoring program should be run and a model of how the CIMS process should work. The only place where there is room for improvement is in the area of documentation. There is data documentation currently being released with final data sets, it is written by the VIMS data managers and reviewed by the PI's. VIMS does not currently provide FGDC complaint meta data documentation for the data in their databases.

Data Availability:

The Fisheries Division of the Virginia Institute of Marine Science has instated it own WWW server and is continuing to serve their Seine and Trawl data holdings on the Internet. The raw data are available from an online relational data base on the world wide web. Data are also available from VIMS by request. Enhancements to their Internet offerings-(Juvenile indices and Summary statistics) are being added as time and resources allow.

CIMS Implementation:

Access database has been placed on world wide web server and web interface has been implemented. However due to the size of these databases they should be migrated into large scale database engine such as MS-SQL Server or Oracle . As part of the initial set of this CIMS site a SQL Server License was purchased for VIMS. VIMS staff has not had the time to perform the migration to date.

Best Recommendations:

- Provide continued technical support and software support as required.
- The only missing piece to these databases at this point is FGDC Meta Data records for the data . There is a need to get the VIMS fishery data managers metadata training.

Bay Wide Waterfowl Concentration Surveys

Data Generator:

US Fish and Wildlife Service. Current data manager: Doug Forsell.

Program Manager:

US Fish and Wildlife Service

Funding Vehicle:

US Fish and Wildlife Service, Individual States in the Northeast Flyway, EPA Chesapeake Bay Program has contributed funding for the aerial survey periodically

Data Management Status:

This data base is composed of data from a number of surveys including the Chesapeake Bay Breeding Bird Survey, the Chesapeake Bay Mid-winter Water Fowl Survey, and other assorted state surveys. Data are known to be housed in a combination of Atlas Pro, Microsoft Excel and/or MapInfo databases. This data set is currently being held at the Annapolis, U.S. Fish and Wildlife Service office.

Data Quality Status:

Status Unknown.

Deliverable Performance:

There have been problems consistently conducting the Mid-Winter water fowl survey. Fish and Wildlife has been unable to conduct this survey over the last few years for reasons ranging from: being unable to schedule the survey during the bird migration period, weather restraints on flying the survey, to lack of funding. The breeding bird survey has been conducted on a more regular basis. The real problem has been access to useful data derived from these surveys.

Data Availability:

Data is available by request only from the PI at Fish and Wildlife Service. When data requests are filled only bay-wide or regional annual summary numbers and graphics have been provided. Fish and Wildlife feels they are not legally able to release the underlying database with actual latitudes and longitudes of bird sightings.

CIMS Implementation:

None At this time. : The legal releases for public data distribution need to be obtained by the Bay Program or Fish and Wildlife before any CIMS distribution plans can be made.

Best Recommendations:

- Start negotiations with high level USFWLS personnel release the waterfowl survey data to bay program staff. These negotiations will involve also obtaining data releases from individual states in addition to Fish and Wildlife. Additionally we may have to agree to certain restrictions on the data we have for in-house use and for public release.

Appendices: Split Sampling Program Reports

APPENDIX A

A Review Of Split Sample Results Regarding Phytoplankton Composition And Abundance In Samples Examined By Old Dominion University And The Academy Of Natural Science Estuarine Research Center

by

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and

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Prepared for the

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January/February 1999

Participants and Purpose:

David Seaborn and Harold Marshall, Old Dominion University (ODU).
Richard Lacouture and Ann Marie Hartsig, Academy of Natural Science Estuarine Research Center (ANS).

The above participants met at the Phytoplankton Analysis Laboratory at Old Dominion University, Norfolk, Virginia on November 12, 1998. Both ANS and ODU representatives provided water samples that were previously examined in the Split Sampling study by the two laboratories. Sub-samples from these were then prepared for microscope analysis. Samples selected were those where differences in cell counts had been identified in the study. Side by side examinations of water samples by the participants were conducted. Results of the re-examination of these samples by those assembled are given below.

Differences Associated with Different Magnification Effects.

1. The identification of species above the cell size of 8 microns showed only minor taxonomic problems between the two laboratories. Little disagreement involving species categories or species identification was present. Identification questions were centered on only a few very small taxa (see #2 following).

RESOLUTION: None needed. The two laboratories will continue to work together on questions in the interpretation of species taxonomy in the future, as they have in the past.

2. Cells less than 8 microns in size. Several samples indicated the presence of 1 or 2 small algae, less than 6 microns in size, that were given different interpretations regarding their identity as either a diatom, a green cell (*Chlorella* sp.), or a cell placed in a general unidentified category of cells 3-5 microns in size. Microscopic analysis indicated some of these cells could be included in either one of these categories.

RESOLUTION: Differences in making calls of this type, of a very small cell with so few taxonomic features with light microscopy, is not uncommon. In an effort to resolve this particular question, ODU can conduct examinations of samples containing these cells with scanning electron microscopy which would clarify these identifications.

However, it should be noted that the present monitoring program does not support SEM analysis of cells within these small size categories, or where questionable identifications may be present. This is one reason a certain amount of lumping of cells into broader groups is often used for different levels of taxonomy, if essential identification characteristics are not discernable with light microscopy. In most cases, this lumping is found in cells belonging to one taxonomic category (e.g. pennate diatoms <10 microns in size), but it may also occur in mixed taxonomic categories (as in B-2 described below).

There are restraints that are imposed on monitoring phytoplankton populations as to the degree of species identification that can be expected. It should be understood that not every species can be identified using light microscopy alone.

COMMENT: There are some differences in the counting techniques between ODU and ANS regarding what concentrations and magnifications are used. Both ODU and ANS identify taxa at 312x and 500x magnifications. In addition, ODU scans the entire sample at a lower magnification (125x) for species that were not noted at the other levels. The approaches vary slightly, but have mutual goals and overall a similar basis for species identification. There are also similar approaches used in the "lumping" of cells, within many of the specific taxonomic categories (e.g.

pennate diatoms < 10 microns). Both of these laboratory approaches are well established in both programs, each with an extensive historical data base.

Taxonomic Evaluations

1. There is a difference in the nomenclature used by the two laboratories for species within the cyanobacteria genera *Merismopedia* (ODU) and *Agmenellum* (ANS). These genera are considered synonymous.

RESOLUTION: To be discussed within the two laboratories. Either one genus should be selected for use, or the taxonomic code numbers for similar species should be matched.

COMMENT: Both of the type species and genera for these two designations were established the same year (1839). The genus *Merismopedia* is used by Geitler (1932), Desikachary (1959), and in the revision of the cyanobacteria by Komarek and Anagnostidis (1986). We recommend this usage also.

2. The inclusion (lumping) of more than one generic group in the "small microflagellates" category was discussed. ANS counts all small flagellated cells noted within this size category, whereas, ODU will include small unidentifiable flagellated cells only if they contain an autotrophic (phytoplankton) characteristic. These differences result in higher counts in this category from ANS. The question raised is the lack of comparability in the counts in this group by the two labs, because past ANS records of this group would (may) include both heterotrophic and autotrophic cells.

Also, in the data sheets used in the comparison review, ANS included several different taxonomic categories under the heading of these microflagellates (ANS separates these groups in their individual station listing of species). In contrast, ODU had separate listing for these other categories, in addition to the microflagellate category. This difference in the listings in this category increased the differences noted between the two labs regarding cell concentrations in this category.

RESOLUTION: Both ANS and ODU agree this category should not be included in the counts for the Bay Monitoring Program analysis for the Baywide indicators. However, both ODU and ANS will continue using their individual protocols for recording cells in this category.

3. *Microcystis* and the autotrophic picoplankton cell counts were discussed. The majority of the picoplankton cells are also cyanobacteria. Cells within these groups may be similar in appearance. Differences occur in many of the samples where Maryland's *Microcystis* cell counts are higher than ODU. During side by side comparisons of *Microcystis* colonies by personnel from the two labs, there were no differences in their identification. A possible variable in these counts is that ODU records the concentrations of the autotrophic picoplankton cells under a separate classification listing. These include clutches of cells that may not be identified as *Microcystis* by ODU under that category. ANS indicates they count small bluegreen spheres as *Microcystis* only when there is a colonial assemblage of cells. Both labs have the opinion that they have been calling the *Microcystis* colonies in the same way.

RESOLUTION: The laboratories concur on how they identify *Microcystis*. However, in the presence of these past differences in cell counts for *Microcystis*, it is not recommended to use cyanophyte densities as a Baywide indicator.

4. Maryland category #221 Blue Green Trichomes. The split samples indicated high concentrations of these trichomes reported by ANS in the Maryland samples, but that they were not reported by ODU in their examination of these samples. The original split water samples in

which these were reported by ANS were re-examined at this time. These cells were not found in either the original Maryland or the ODU sample sets.

Comment: ANS believes there are optical resolution differences in the microscopes used by ODU and ANS that would explain the differences in counts of the thin filamentous cyanobacteria (1-2 um) and the interpretation differences in the identification of the small diatoms or chlorophyte cells. However, at ODU, in the search for these filamentous cells, 3 different Zeiss inverted plankton microscopes were used with the same negative results, with one microscope having higher magnification capabilities than that used at ANS.

RESOLUTION: Unresolved at this time, but further cell comparisons in this category are recommended. ANS indicated when these cells are noted again, they will provide samples to ODU. In addition, ANS has also invited an ODU representative to their lab to examine these at their facilities using their microscopes.

Cell Count Differences Associated With Laboratory Protocols

1. Counts associated with cyanobacteria trichomes. ANS provides mean cell counts for the cells in a cyanobacterium trichome. ODU records each trichome as 1 trichome, without cell number. This produces higher cell counts for the filamentous cyanobacteria in the Maryland data. For instance, this value may represent 35-40 cells per trichome for a particular cyanophyte, and be reported as such by Maryland, whereas, Virginia would record this as a single unit (trichome).

RESOLUTION: ANS will indicate the mean cell counts per trichome they have used for the filamentous cyanobacteria to ODU (Michael Lane, AMRL) . These cell values may be used to revise the past ODU Bay data set records for these species, and be used in future data entry by ODU.

2. Species Diversity. A comparison of the split samples indicated ODU includes a greater amount of species identified (44%) than ANS. Within the split samples analyzed, the range of taxa identified was 10 to 47 for ANS, and 20 to 68 for ODU. There are two differences in the protocols used. One is in the sub-samples taken by the 2 labs to analyze, and the other is that ODU uses a 3rd level of lower magnification to scan the field for cells that are not included in the other magnification counts.

RESOLUTION: A third level of magnification (125x magnification scan) would increase the number of species recorded in the ANS analysis.

3. Autotrophic picoplankton analysis. This category represents one of the most important components and indicators of water quality in the Chesapeake Bay plankton community. Virginia has a long term data set for this category, yet it is lacking in the Maryland program. The incorporation of this component in the ANS analysis data set would be a valuable asset in the interpretation of health status and trends in the Bay estuarine system.

RESOLUTION: It is recommended that the analysis for the autotrophic picoplankton component be included in the Maryland plankton monitoring program.

Taxa Where Counts And Identifications Are Comparable For Indicator Purposes

Comparable results were found among the following taxonomic categories in both laboratories and which can be used for Chesapeake Bay-wide indicator purposes:

Diatom biomass
Dinoflagellate biomass
Cyanobacteria biomass*
Chlorophyll a
Productivity

This does not mean the other taxonomic categories identified by both laboratories are not comparable, only that these categories mentioned above are considered to be the most useful in the development of a phytoplankton indicator system. ODU and ANS will examine the analysis results provided by this set in each of the salinity regimes, and make decisions if additional categories would be necessary.

*After changes are made regarding cell counts/trichomes in the ODU data set.

Taxon Categories Not Considered Comparable Or Useful For Indicator Purposes

The following categories are not considered comparable for Bay wide analysis purposes:

Autotrophic Picoplankton *
Small microflagellates **
Cyanobacteria cell concentrations**

* conducted only in Virginia

** different protocols used by the 2 labs

Conclusions and Summary

1. The joint examination of the previously collected split samples took place by representatives of the two laboratories. Side by side comparisons were made of various taxa and their identifications.
2. Although there were a few differences in several calls of the very small taxa, there were suggestions as to how these differences would be resolved in future analyses by the two laboratories. There were no major differences noted in any of the other taxonomic categories examined. For instance, there were very close comparisons within the samples for diatoms and dinoflagellates.
3. Based on our discussions and the review of the data sets, ODU and ANS have made recommendations as to which components within the phytoplankton data set would be most suitable, and comparable across the Bay, for incorporation in the bio-indicator analysis program, in addition to those we do not recommend.
4. In addition, in order to provide closer, and continued agreement in phytoplankton identification between the two laboratories, it is recommended that: 1. Future discourse on matters of species identification between the two laboratories (ODU and ANS) be incorporated as an annual component of the Bay Monitoring Program, and this would include regular visitations by

personnel to both laboratories; and 2. When needed, additional SEM analysis, or other protocols be incorporated to clarify any questions regarding the identification of major species within the Bay ecosystem.

5. The two laboratories (ODU and ANS) express their appreciation for the support of this project. The project was a worthwhile activity and the results of this interaction will enhance conformity in the analysis of the phytoplankton community within the Bay ecosystem.

ADDENDUM

February 1999

Introduction

At the conclusion of the initial review of the split sample analysis between the two laboratories in November 1998, it was recommended by the participants that Old Dominion University (ODU) representatives meet at the Academy of Natural Sciences (ANS) to continue this review process. Scanning electron microscopy (SEM) examination was also suggested.

On February 4, 1999, the two ODU representatives traveled to the ANS laboratory to work with the ANS representatives to continue the split samples analysis. ODU also brought with them one of their laboratory microscopes.

Participants

David Seaborn and Harold Marshall, Old Dominion University
Richard Lacouture and Anne-Marie Hartsig, Academy of Natural Sciences.

Specific questions to be resolved were as follows:

Item 1. Clarify the status of the small size cells less than 6 microns in size. It was suggested that these cells be examined with SEM, and with the samples and microscopes at the ANS laboratory.

Item 2. Can the small #221 Blue Green Trichome category be identified with microscopes used in the different laboratories. Is there an optical resolution problem to be considered.

Results

Item 1. ODU conducted SEM analysis of the plankton samples originally examined in this study. The SEM micrographs indicated the size and occurrence of small centric diatoms, with cell diameters of 4 to 5 microns, and the presence of spherical, soft-bodied cells approximately 2 to 3 microns in size. These results indicated the presence of two categories of cells in the samples. The smaller soft-bodied cell could be classified as either a chlorophyte (e.g. *Chlorella* sp.) or placed in a size category of cells. Distinctions between these two groups were reviewed at this time with light microscopy.

Item 2. These Blue Green Trichomes were observed and identified with microscopes from both laboratories. Optical resolution using the different microscopes was not an issue. The characteristics of these cells were reviewed and both groups agreed these cells should continue to be in the Blue Green trichome category. Its species identification will require further study.

Further Activities

1. The ODU and ANS participants believe this past experience was very worthwhile and we plan to continue sample review and exchange practice this summer (1999). We will compare at least one set of water samples for phytoplankton at two mainstem stations, CB5.2 and CB6.1.

2. The two laboratories will continue to work closely on any future events related to the phytoplankton dynamics in the Bay, in addition to questions of species identifications, etc.

Recommendations

1. ODU and ANS recommend the continuation and financial support of future annual exchange visits by the laboratory participants to both the ODU and ANS phytoplankton laboratories.

APPENDIX B

ANS/ODU Microzooplankton Split Sampling Meeting-Data Review Report

by

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March 1999

The microzooplankton component of the MD Water Quality Monitoring Program began in 1985. VA added microzooplankton to their program in 1991. At that time, the differences in methodology between the 2 programs were discussed and preliminary data were examined. It was evident from the onset that there were some major differences in sampling and counting techniques. Recently, the importance of compatibility of data from both programs to establish Bay wide indicators has been discussed. It is from these discussions and a prior split sampling meeting that the need to make the programs more comparable has become a priority.

Purpose

The purpose of the meeting was to assemble the microzooplankton taxonomists from both ANSERC and ODU to review the results of the Z score analysis Elgin Perry had run on the original split sample counts, discuss the differences in collection and counting techniques between the MD and VA programs and, using the Z scores, reexamine samples which showed the greatest differences between the 2 labs. Listed below are the concerns, results of discussion, conclusions and recommendations that came from this meeting, held on January 20-22, 1999.

Concerns

1. ODU netting of samples leads to possible breakage of fragile ciliates. ODU did a series of counts comparing whole water and netted samples. From a 2 liter water sample, 50ml of sample were removed for a whole water count. The remaining sample was handled in the usual way with the larger organisms caught on a 73 μ m mesh net and the water passing through subsampled and a count done for the smaller organisms. The 2 methods compared well for ciliates.

Conclusion- Methods compared well for ciliates which occurred in large numbers but greater discrepancies existed for those organisms found in low numbers. Netting is not a problem once samples have been fixed.

2. Discrepancies in grouping of organisms.

The following is a table which lists the differences between MD and VA in defining various taxonomic groups of microzooplankton:

Group	ODU	ANSERC
Copepod nauplii	all, length <200 μ m	all
Rotifers	all, length <200 μ m	all
Sarcodinids	all	all
Tintinnids	all >20 μ m in width, length doesn't matter	all in mesohaline all > 44 μ m in other salinity zones
Non loric ciliates	all > 20 μ m in width, less than 200 μ m in length	all in mesohaline all > 44 μ m in others salinity zones
Barnacle nauplii all	< 200 μ m in length	none
Polychaete larvae	all < 200 μ m in length	none
Pelecypod larvae	all < 200 μ m in length (In other category)	all
Gastropod larvae	all < 200 μ m in length(In other category)	all
Cladocerans	all < 200 μ m in length	none

ODU uses the classical definition of microzooplankton being zooplankton 20-200 μm in size. ANSERC also counts the non-loricate ciliates and tintinnids that are less than 20 μm in size. ANSERC considers barnacle nauplii, polychaete larvae and cladocerans to be mesozooplankton and does not count any organisms within these groups. These organisms are enumerated in the MD mesozooplankton program. ODU size cutoffs for tintinnids and non-loricate ciliates are based on widths while ANSERC's size categories are based on length. Example- A ciliate that is 15 μm wide and 60 μm long is not counted by ODU. ANSERC counts it and puts it into a size category of 50-99 μm in length.

Conclusion- Using current techniques, rotifers and copepod nauplii are the only groups that compare well between the 2 labs. Sarcodinids are too low in numbers to use. Ciliates and tintinnids cannot be used because of differences in counting techniques (based on size).

Recommendation- ODU adopts ANSERC's method of enumerating all ciliates and does not drop any ciliates from counts that are less than 20 μm in width.

3. Calculating densities of organisms in subsamples using large multipliers. Both counting techniques use multipliers to convert the number of organisms counted in the subsample (raw count) to the number of organisms per ml (standardized count). Some of the multipliers are quite large and a low number of organisms seen in a subsample may appear to represent a very high density.

Recommendation- Have Elgin review this to determine the error involved in these methods.

4. Differences in magnification used by the 2 labs when examining smaller organisms. When doing whole water counts, ANSERC uses a magnification of 312.5X while ODU uses 200X as their highest magnification for their groups 2 and 3 which are predominately made up of the smallest organisms counted.

Recommendation- For ODU to be able to accurately count the smaller ciliates less than 20 μm in width, they begin to use the same magnification as ANSERC.

5. Preservative differences. ODU uses Lugol's which stains darkly and shrinks soft bodied organisms but is necessary to preserve fragile ciliates. ANSERC uses formalin for net samples and Lugol's for whole water samples. Rotifers are easier to identify using formalin than Lugol's. This became apparent in one comparison count in which a ciliate fixed in Lugol's was identified as a rotifer because its internal structures could not be seen.

Recommendation- ODU look into using a narcotizing agent such as neosynefrin prior to fixation in Lugol's to relax rotifers. The effect of this on fragile ciliates would have to be carefully evaluated. Cross checking between the 2 labs when there is a questionable organism would eliminate some of the potential identification problems.

6. Degree of identification and method of grouping organisms. ODU doesn't speciate organisms, using only very broad categories. ANSERC takes rotifers and tintinnids to lowest possible level of identification. ANSERC categorizes ciliates based on size and general groupings.

Recommendation- Currently, ODU groups all their non-loricate ciliates as oligotrichs. This is not necessarily accurate as not all non-loricate ciliates are in this group. In their data sets, ODU should not use this group name. It should be changed to non-loricate ciliates.

7. Data dictionaries do not define exactly what is being counted and included in the data sets (such as ciliates >20 μm in width).

Recommendation- Both labs should review and edit their data dictionaries and make them more specific in regards to what is included in the data sets. It should be suggested to Jackie Johnson that somewhere in the documentation that is on the web, the differences between the labs regarding the counting techniques and grouping of the organisms in the counts be specified.

8. Continuation of comparison of counts between the 2 labs. The statistics that Elgin Perry ran on the split samples were invaluable for the comparison of the 2 counting techniques. The split sampling and meetings to compare results also proved to be very helpful in trying to make the monitoring data more comparable.

Recommendation- Split sampling between the labs be done annually and the results be compared with Elgin's guidance. There should also be a continuation of "ongoing technical collaboration" between the labs along with an annual meeting to discuss results. The idea of a formal basic training program for new microzooplankton taxonomists coming into the monitoring program along with the writing of a guide to microzooplankton in the Chesapeake Bay (which could ultimately be put on the web) were also proposed and needs to be discussed further.

Summary of Counting Differences Based on Z Scores and Actual Percent Differences

The following comments and tables summarize statistical and [arithmetic] comparisons of the microzooplankton split samples. In the table at the end of the discussion, the actual Z scores are reported. A Z score less than -2 or greater than 2 indicates a difference between the labs. Note- The comparison split samples taken from MWT5.1 in June has been omitted from discussion because of a discrepancy in sampling dates between the replicate samples sent to ODU.

1. Copepod nauplii- Z scores indicated no significant difference between the labs for this group of organisms.

2. Rotifers- Two major disagreements

MCB2.1- This appeared to be a taxonomic problem in which a ciliate was counted as a rotifer because it was difficult to identify after being fixed with Lugol's. When these were removed from ODU counts, the densities were ANSERC=85/liter and ODU=114/liter (rather than 1994 /liter). Need to rerun with corrected data.

MET5.1 in May- Samples examined for id problems and none could be found. There may have been a sampling problem, such as patchiness of the organisms, when the split samples were taken.

3. Tintinnids- Over half the samples had significant differences between the labs. Samples were rechecked for identification and 2 differences became obvious. There is a genus of tintinnid called *Tintinnidium* which is difficult to identify and may have been overlooked in ODU samples. Small tintinnids which are less than 20 μ m in width would not be counted by ODU, and this probably led to most of the differences between the labs.

Recommendation- When there is a question in identification of a dominant organism, cross checking between labs should be done. ODU should drop their cutoff of 20 μ m for the width of the tintinnids and include all of these organisms in their counts.

4. Sarcodinids- Sarcodinids usually occur in very low numbers. They can also be extremely difficult to identify in samples with debris. The sample taken at XEA6596 in June was reexamined because of extremely high numbers of sarcodinids found by ODU. When the subsamples were examined, the sarcodinids could not be found.

Recommendation- Sarcodinids should not be included when analyzing results of split sampling.

5. Non-loricate Ciliates- This group had the most discrepancies. Two major differences were found. ODU does not count the non-loricate ciliates less than 20 μ m in **width**. ANSERC counts all ciliates, grouping them by **length**. As mentioned previously, a ciliate which is 15 μ m wide by 60 μ m in length would be counted by ANSERC and not by ODU. There is no way to remove these from the ANSERC counts since they are not grouped by width. Because of drawings made when the count was done, we were able to do this for MET5.1 in May. ANSERC removed the ciliates less than 20 μ m in width from the final count. The ANSERC density was 1700 (instead of 9800)/liter and the ODU density was 1800/liter. The second difference was due to the presence of the photosynthetic ciliate *Myrionecta* (or *Mesodinium*) *rubra* which can occur in very high numbers. ANSERC counts them and puts them in a separate category and ODU excludes them from their data sets. ANSERC only identified the obvious ones that were in side view and put the questionable ones in the ciliate category. ODU didn't report any.

Recommendation-ODU counts all ciliates regardless of size as well as *Myrionecta*. This would allow ciliates to be used as a Baywide indicator.

Overall Recommendation-For current Baywide comparisons, copepod nauplii and rotifers should be used. It is important to revise the counting protocol of the labs so that ciliates can be used as a Baywide indicator in the future.

ANS/ODU Microzooplankton Split Sampling Results

Z Scores

Statistical significance of split samples between ANS and ODU
Values greater than 2 or less than -2 indicate a difference between labs

STATION	MONTH	NAUPLII	ROTIFERS	TINTINNIDS	CILIATES	SARCODIN.
MCB5.2	MARCH	-0.57	-1.79	14.37	2.10	*
MET5.2	MARCH	1.68	-0.58	3.67	-1.86	0.36
MCB5.2	APRIL	0.69	-0.81	-6.06	-1.09	0.81
MET5.1	APRIL	-0.77	-1.44	1.20	-4.05	1.63
MCB2.1	MAY	1.89	-13.34	-1.10	27.87	*
MCB3.3C	MAY	-0.15	-1.82	8.66	36.60	*
MET5.1	MAY	0.51	6.10	6.06	37.02	6.41
MLE2.2	MAY	1.98	0.62	-3.12	48.52	*
MCB4.3C	JUNE	2.00	-1.02	18.45	62.84	*
PXT0402	JUNE	0.92	-2.48	3.17	4.52	4.62
XEA6596	JUNE	0.74	-3.36	-3.00	-26.71	-10.80

(*) INDICATES NOT PRESENT IN SAMPLE

ANS/ODU Microzooplankton Split Sampling Results

% DIFFERENCE BETWEEN SAMPLES

STATION	MONTH	NAUPLII	ROTIFERS	TINTINNIDS	CILIATES
MCB5.2	MARCH	29.82	24.26	47.12	12.05
MET5.2	MARCH	26.25	36.00	69.16	10.26
MCB5.2	APRIL	28.82	18.16	23.42	5.82
MET5.1	APRIL	11.93	36.76	30.79	11.15
MCB2.1	MAY	25.95	95.68	9.12	52.03
MCB3.3C	MAY	3.76	36.25	43.90	95.65
MET5.1	MAY	8.00	39.70	24.99	81.63
MLE2.2	MAY	21.64	16.62	35.46	99.20
MCB4.3C	JUNE	20.51	57.30	71.85	76.19
PXT0402	JUNE	14.52	25.33	25.41	27.44
XEA6596	JUNE	21.60	28.27	20.85	82.16

APPENDIX C

DRAFT-Mesozooplankton Split Sampling Report- Executive Summary

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Split Sampling Study for the Maryland and Virginia Mesozooplankton Monitoring Programs

Draft Final Report, May 2000

Executive Summary

The Maryland and Virginia mesozooplankton monitoring programs implemented modifications to their respective laboratory counting protocols in 1998 in order to better estimate species richness in Maryland and to eliminate laboratory sieving losses of smaller mesozooplankton taxa and life stages in Virginia. A 1998 - 1999 Mesozooplankton Split Sample Study indicates the desired outcomes of the modifications were only partially accomplished. The "new" Versar counting method (Maryland program) has improved Versar's ability to measure species richness, an important Bay-wide indicator, and the "new" ODU counting method (Virginia program) has increased ODU's taxa counts per sample. However, comparisons of twenty split sample counts show that the "new" ODU method produces significantly lower total counts than the Versar method. The method consistently counts less of certain taxa, particularly the immature (copepodite) life stage of calanoid copepods, a common and frequently dominant taxonomic group. The study determined that counts produced with the "new" ODU method have variances that are higher than counts produced with the Versar method, hence the ODU estimates of precision are lower. Furthermore, the number of taxa identified per sample was on average lower in the ODU counts. Since results produced by the modified laboratory methods of the two programs are still not directly comparable, a single method needs to be selected and implemented in order to meet the information needs of the Chesapeake Bay Program. Backward comparability with the pre-1998 Chesapeake Bay Program mesozooplankton data could be lost for many mesozooplankton taxa, but Maryland and Virginia results will become comparable and the CBP monitoring programs should be able to calculate and use multiple, bay-wide mesozooplankton indicators.

Four taxa showed no significant differences *on average* between the "old" and "new" ODU split sample counts, although their sample variances were at times large. ODU counts of these taxa were also generally comparable to Versar counts. These taxa are: adult *Eurytemora affinis* (frequent common calanoid copepod species in tidal freshwaters), adult *Acartia* spp. (dominant calanoid copepod genus in mesohaline/polyhaline salinities), Podonidae (mesohaline/polyhaline cladoceran family), and possibly *Bosmina longirostris* (seasonally dominant cladoceran in freshwater). These four taxa may eventually prove to be useful for long-term trends in Virginia.

The Split Sample Study identified other problems that need to be resolved. There appears to be within laboratory and between laboratory differences in taxonomic identification that should be reconciled with side-by-side comparisons and the assembly of a photographic or archival specimen collection for Chesapeake Bay mesozooplankton. Quality assurance procedures should be maintained in each laboratory to ensure adequate taxonomic training of new technical staff. Quality assurance (repeated) counts for each laboratory should be regularly submitted to the states, the Chesapeake Bay Program or their designees for independent analysis. Regular site visits between the two states' technical staffs should be carried out to ensure comparable interstate taxonomy. A split sample study should be done annually for at least the next few years to ensure interstate count comparability.

