

**Appendix A.**  
**Chesapeake Bay National Estuarine Research Reserve in Maryland**  
**Accomplishments: 1990-2007**

## Appendix A. CBNERR-MD ACCOMPLISHMENTS: 1990-2007

Maryland's Chesapeake Bay National Estuarine Research Reserve (CBNERR-MD or the Reserve) has achieved significant accomplishments since the Reserve's designation in 1990. Following are selected accomplishments from 1990-2007.

### 3.1 Administration and Staffing

CBNERR-MD is managed through a cooperative approach involving the Maryland Department of Natural Resources (DNR), Harford County Parks and Recreation, and Harford County Chapter of the Izaak Walton League of America, Maryland-National Capital Park and Planning Commission (MNCPPC), Anne Arundel County Recreation and Parks. State support for the program has fluctuated over the past 16 years, but under the current administration, support for the program is moderately high.

#### Staffing

- State funds support 100 percent of two core Reserve staff positions—Reserve Manager and Education Coordinator.
- Federal funds support Research Coordinator, Stewardship Coordinator, and Coastal Training Program Coordinator.
- Since 1990, component staff numbers have grown from 5 to over 12 staff. Except for the Otter Point Creek site manager and maintenance, who receive a portion of their salaries from the federal grant, all positions listed below are paid for by local partners.
  - Otter Point Creek
    - § Site manager - Director of Anita C. Leight Estuary Center
    - § Full-time naturalist
    - § Two part-time secretaries
    - § Maintenance
  - Jug Bay
    - § MNCPPC in Prince George's County
      - Site manager - Director of Patuxent River Park
      - Two full-time naturalists
      - Maintenance
    - § Anne Arundel County
      - Site manager - Director of Jug Bay Wetlands Sanctuary
      - One full-time and two part-time naturalists
      - Secretary
      - Maintenance
  - Monie Bay
    - § Site manager – Manager of Deal Island Wildlife Management Area
- CBNERR-MD staff participate in national programs. All CBNERR-MD staff attend NERRS annual and sector meetings. The Education Coordinator and Research Coordinator participate in appropriate workgroups.
- Major administrative accomplishments since 1990 include:
  - Designation of Jug Bay and Otter Point Creek components in 1990.

- CBNERR-MD, in partnership with local site management and local government, has successfully integrated and merged the mission, goals and objectives from the National Estuarine Research Reserve System (NERRS) with the distinct state and local management direction and needs.
- Action plans and strategies were developed in 1999 with the assistance of an Advisory Committee, Reserve and site staff. Updates were completed in 2001, 2002, and 2003 and will be completed annually beginning in 2009.
- A socio-economic study was conducted for the Monie Bay component that identifies the current relationship between the Reserve and the local community and projects future directions for improving that relationship.

### **3.2 Research and Monitoring Program**

CBNERR-MD has conducted and provided a location for research to address important Maryland coastal issues.

- System Wide Monitoring Program -- CBNERR-MD participates fully in the NERR System-Wide Monitoring Program (SWMP).
  - Initiated SWMP with first data sondes installed in 1994/1995 at two sites in Jug Bay.
  - Reconfigured these sites at Jug Bay to capture data more consistently in 2002. In 2003 the program expanded to four sites, three at Jug Bay (Iron Pot Landing, Jackson Landing and Mataponi) and one at Otter Point Creek. By 2004 all sites (4 water quality and 1 weather) were operational and accurate. Telemetry was added during 2004 as well to two sites, with periodic telemetry at the two remaining sites during winter months. Tide gauges were added to two sites during 2004/2005,
  - Monthly nutrient and diel sampling are also collected as per the SWMP protocol.
  - Non-mandated additions to SWMP include:
    - § Added one additional weather station at Otter Point Creek during 2004 and made plans to add one at Monie Bay (not required). The uploading of SWMP weather and water quality data to a public website [www.eyesonthebay.net](http://www.eyesonthebay.net) where the data can be viewed seamlessly in near-real time along with DNR's over 40 other continuous water quality monitors that use the same technology.
    - § Added vented depth sondes (tide gauges) to two sites in 2004/5
    - § Upgraded two sondes with new dissolved oxygen technology in 2007
    - § Spatially intensive water quality mapping cruises conducted monthly in and around SWMP sites
    - § Bi-weekly discrete nutrient and water quality samples around SWMP sites for increased resolution
    - § 10 fixed discrete sites for Monie Bay beginning in 2006.

- Partnership with DNR's Tidewater Ecosystem Assessment (TEA). Shifted contract from UMCES to DNR to integrate with their Shallow Water Monitoring Program during 2003. The partnership with DNR TEA has not only dramatically improved CBNERR's SWMP effort but has better integrated CBNERR-MD with DNR and better connected DNR with NOAA and NERRS. TEA has maintained two technicians and low turn-over rate.
- Three of the SWMP stations were operational during Hurricane Isabel in 2003 and captured the impact of the tidal surge.
- Submerged Aquatic Vegetation Research–
  - In 2002 at Otter Point Creek, long-term SAV mapping and monitoring capable of tracking interannual changes was begun. This will help document the colonization and expansion of the non-native species, *Hydrilla verticillata*.
  - Other reserve efforts focus on improving the current science of SAV restoration by testing several questions, including the following:
    - § Identifying the most suitable species or collection of species for restoration
    - § Evaluating the success of monotypic versus mixed plantings
    - § Evaluating the success of greenhouse germinated plants (i.e., root bound) versus tank grown plants (i.e., bare-rooted or cuttings)
    - § Testing the efficiency and evaluating the success of planting methods (i.e., using a mechanized boat versus hand planting)
- Other Recent Water Quality and SAV Monitoring Efforts supported by CBNERR-MD.
  - An intern conducted tidal water quality sampling and SAV monitoring at six Otter Point Creek sites to determine the spatial variability of water quality, to provide pre- and post-restoration water quality data, and to see if water quality was a strong determinant influencing SAV populations at the six sites.
  - Preliminary SAV monitoring was conducted at Monie Bay on three dates to determine the dominant species of SAV and to document their location. Additional SAV ground truthing took place at Jug Bay and Otter Point Creek components.
  - Tidal water quality was monitored by volunteers using a redesigned program at Otter Point Creek. This builds on existing data in an effort to characterize this component for the site profile. The data were analyzed to determine if sites were statistically different from each other. Unique sites will be monitored permanently. Volunteers at Jug Bay Wetlands Sanctuary continued their water quality monitoring efforts.
  - “Grow Out” tanks for submerged aquatic vegetation were constructed at Otter Point Creek and at the Jug Bay Wetlands Sanctuary. These tanks provide nursery stock for restoration projects and offer opportunities for educational projects.

- Wild Rice Research—Wild rice, *Zizania aquatica*, is an emergent species of particular interest to the Reserve. Over several years Reserve staff, volunteers from both the Jug Bay and Otter Point Creek components, and others have assisted Greg Kearns of Patuxent River Park in restoring this species and monitoring sora rails, who use this habitat. Restoration activities included fencing the wild rice and removing resident Canada geese to reduce grazing pressure. Beginning in 2003, interns have worked to create GIS data layers that can help document the location of the exclosures and the recovery of the plant associated with the exclosures. Aerial photography was also conducted to further document the areas being restored and the recovery of the plants.
- Aerial photography—A number of aerial photography efforts have been conducted by DNR and by the Reserve over the years. Future work will include interpreting these photos to map submerged and emergent plant communities. Efforts will include determining a hyperspectral signature for *Phragmites australis* and *Zizania aquatica*, and testing the use of new technology at measuring fluorescence in the water column. Partners for conducting overflights and GIS analysis include:
  - GIS group at DNR headed by Kevin Boone
  - Environmental Cooperative Science Center (ECSC) and Morgan State University conducted hyperspectral flyover at Monie in 2004
  - NOAA National Geodetic Survey
- Non-tidal loading study—The Reserve collaborated with other groups within DNR and the Harford County Department of Public Works to conduct a non-tidal loading study for the Bush River watershed. The goal of the study was to identify the primary point and non-point sources of sediments and nutrients to the river for use in targeting restoration and improving management efforts.
- Sediment Elevation—Research was initiated via the Center for Ecosystem Studies to examine the effects of vegetation type on sedimentation rates and marsh processes. Marta Ceroni and Ruhl Boumans were the Primary Investigators on this effort.
- Ongoing Fauna Studies—Staff, volunteers and interns continued their studies on fauna at the components, including birds, box turtles, snakes, salamanders and other amphibians.
  - Birds—
    - § Mist netting of birds is conducted to determine which species occur in Jug Bay and specifically, which species use the scrub shrub habitat.
    - § Sora rail studies have been conducted at Jug Bay.
  - Fish—At Otter Point Creek Fish are sampled through the fish seining program once a month from May through September. The goal is to collect baseline data to help develop a fish IBI (Index of Biological

Integrity) for tidal species which is a way to assess the overall health of the fish community.

- Herps—Reptiles and amphibians (herps) are good indicators of overall ecosystem health as they are sensitive to pollution and other ecological stressors.
  - § The Great Herp Search began at Jug Bay in 1989 and was initiated a few years later at Otter Point Creek. The Great Herp Search provides baseline population data to help determine the effects of land management practices on herp populations.
  - § The North American Amphibian Calling Surveys are conducted at Jug Bay and Otter Point Creek. The survey is particularly important because of the increasing amount of development and consequent land use change in the watersheds.
  - § Volunteers at Otter Point Creek have been trained in a protocol used at Jug Bay to monitor box turtles. Telemetry to monitor box turtle travels has been used since 1995. Now both Jug Bay and Otter point creek collect basic information about the box turtle populations and home ranges to see if urbanization is impacting the species.
- An annual Bioblitz was initiated in 2006 at Otter Point Creek and in 2007 at Jug Bay.
- CBNERR-MD has worked with numerous partners who conduct research in the Reserve including Morgan State University, University of Maryland, University of Pennsylvania, Towson State University, Aberdeen Proving Grounds, US Department of Agriculture, NOAA Mussel Watch, and NOAA National Geodetic Survey, to name a few. Examples of research conducted on the Reserve includes:
  - USDA scientist Walter Mulbry is investigating (2007) an algae based treatment process for treating manure liquids from dairies and swine operations at Jug Bay and Otter Point Creek to reduce nutrient runoff into the Chesapeake Bay.
  - NOAA's Mussel Watch sampled oysters near the Monie Bay component of the Chesapeake Bay National Research Reserve in Maryland in January 2007. Mussel Watch is a national program that monitors trends over time in metal and organic contaminant levels using bivalve molluscs as sentinel organisms. Measured contaminants include a suite of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides and trace elements.
  - Tom Jones of Salisbury University investigated nutrient inputs to Monie Bay.
  - Grace and Lucian Brush, Johns Hopkins University, studied nonpoint source pollution in freshwater wetlands.
  - Grace Brush, Johns Hopkins University, evaluated habitat alteration at Otter Point Creek.
  - Laura Murray, University of Maryland, compare vegetation and investigated nutrient dynamics at Monie Bay.

- Humaira Khan, University of Maryland, studied nutrient and metal accumulation in a freshwater tidal marsh at Jug Bay.
  - Michael Kearney, University of Maryland, mapped marsh loss at Jug Bay.
  - Marilyn Fogel, Carnegie Institute of Washington, investigated stable isotopic and molecular changes in plant biochemicals during decomposition.
  - Greg Pasternack and Bill Hilgartner, Johns Hopkins University, studied marsh development at Otter Point Creek.
  - Jennifer Zelenke and J.C. Cornwell, University of Maryland, evaluated long term retention of nutrients in tidal marshes at Jug Bay.
  - Ben Alder studied the use of habitat types by black ducks (*Anas rubripes*) and widgeon ducks (*Anas Americana*) at Monie Bay. He investigated differences in behavioral characteristics of these ducks in different habitat types. He also analyzed food depletion over the wintering period for the two types of ducks, looking especially at the availability of submerged aquatic vegetation (SAV).
- The Jug Bay Wetlands Sanctuary Scientific Advisory Committee, which was established in 1985, continues to be active to the present with three original members still on the committee.
  - Jug Bay Wetlands Sanctuary staff developed a field guide to the reptiles and amphibians found at this component (2001).
  - CBNERR-MD participates in the NERRS Graduate Research Fellowship (GRF) Program. Since the program began in 1997, it has supported 9 students who have conducted research relevant to coastal decision-making in the CBNERR-MD components.
    - Jude Apple, University of Maryland, Center for Environmental Science, examined the effects of anthropogenic nutrient loading on bacterioplankton community metabolism and phylogeny of estuarine waters at Monie Bay.
    - Kitty Fielding, University of Maryland, Center For Environmental Science, the effects of different nutrient loadings on phytoplankton biomass and composition in the three contrasting tributaries of Monie Bay.
    - Jill Rooth, University of Maryland, Center for Environmental Science, studied the impact of phragmites at Monie Bay.
    - Jeremy Testa, University of Maryland, Center for Environmental Science, examined effects of tidal marshes on metabolism along a tidal continuum.
    - Todd Chadwell, University of Maryland, Center for Environmental Science, Appalachian Laboratory, conducted research at Otter Point Creek on the colonizing mechanisms and rates of invasion by hydrilla (*Hydrilla verticillata*), a nonnative species, and the interactions between hydrilla and the native wild celery (*Vallisneria americana*).

- Karen Phemister, University of Maryland, College Park, examined the effects of tidal infiltration on hydrodynamics and nutrient cycling in the marsh at Jug Bay (2003-2004).
  - Lauren McChesney, University of Maryland, Center for Environmental Science, Appalachian Laboratory, studied competitive abilities of *Hydrilla verticillata* and *Vallisneria Americana* along a nutrient gradient.
  - Ben Fertig, University of Maryland, Center For Environmental Science, Horn Point Laboratory, establishing a link between  $\delta^{15}\text{N}$  in *Crassostrea virginica* tissues to land use: spatial analysis and modeling approaches (2006-2007).
  - Michael Castellano, University of Pennsylvania, using soil properties as a framework for understanding nutrient transport and transformation at the terrestrial-aquatic estuarine interface (2007-2008).
- The Cooperative Institute for Coastal Estuarine Environmental Technology (CICEET) also funded several research projects tied to CBNERR-MD. A few examples include:
    - Mark Trice at DNR, in conjunction with the University of Maryland, developed a real-time, geographic information system (GIS)-based interface called DATAVIEW to provide mapping and visualization of point data during collection of water quality data with existing DATAFLOW equipment. This will make it possible to conduct targeted, adaptive, sampling while in the field. CICEET funds projects throughout the US. For more information go to: [www.ciceet.unh.edu/](http://www.ciceet.unh.edu/)
    - Allen Davis of the University of Maryland examined how different soil mixtures affect the filtering capacity of areas to handle stormwater runoff.
    - Charles Sarabun et al. of Johns Hopkins University developed a comprehensive and rapid capability to detect, map and localize groundwater inflow into rivers and estuaries in the hopes of better managing contaminant inputs into coastal waters.
    - Roger Newell and colleagues from the University of Maryland have been studying the impact of bivalves on SAV restoration in estuaries and are developing a model to enable coastal managers to predict the effects of bivalves on SAV distribution in estuaries.
    - Robert Costanza and Roelof Boumans at the University of Maryland conducted a three year project to use sediment elevation tables (SET) to develop a standardize method for obtaining, analyzing and interpreting changes in wetland elevation nationally.

### **3.3 Education Program**

Reserve and site staff work cooperatively to deliver a wide array of educational programs for teachers, students and the public. Science concepts and research methods are taught by providing authentic hands-on learning experiences to hundreds of students annually.



- Wetlands and Wildlife Field Day—Developed and implemented Wetlands and Wildlife Field Day at Monie Bay for all 4th grade students in Somerset County. This has been an annual event. Some of those children are now in high school and have returned to assist with the program.
- Maryland State Department of Education Ocean and Environmental Literacy Initiative—The Maryland Ocean Literacy Initiative will address the use and incorporation of the Ocean Literacy Essential Principles and Fundamental Concepts into formal education by implementing an ocean sciences course in two Somerset County high schools. The Initiative will provide high quality ocean science materials for this course, provide lab supplies necessary to implement the program and provide high quality professional development for teachers. In addition, the project will increase ocean and estuarine literacy among teachers and students by providing opportunities for coursework, field experiences, and internships. CBNERR-MD provided funding for this project in 2007.
- MD Green Schools—CBNERR-MD has provided support for this project annually in recent years. In addition, Reserve staff participated in the review of Green School applications and assisted with an awards ceremony for 14 schools and the first ever Green Center award given to the Lathrop E. Smith Center in Montgomery County.
- Environmental Heroes
  - Bob Finton, former Education Coordinator, received NOAA's Environmental Hero Award posthumously in 2006, and the Otter Point Creek Finton Laboratory with a Focus on Fun was dedicated in his memory.
  - Tara Whittle and Morgan Angus, two volunteers from the Jug Bay Wetlands Sanctuary, were honored in 2003 with NOAA's Environmental Heroes Awards for their research on turtles and salamanders and for their assistance with the Reserve's Estuary LIVE internet broadcast in 2002.
- Research Interns—CBNERR-MD has hired undergraduate and graduate, and post-graduate research interns to assist with projects. In the process, interns gain invaluable experience and knowledge about estuarine science and the Reserve in particular.
- Intern Education—Over 20 National Aquarium in Baltimore staff/volunteers and summer interns came to Monie Bay for 3-5 days during July 2005 for on-the-ground estuarine science experiences.
- A wide variety of education activities targeting K-12 students and teachers have been conducted at the Reserve components since 1990—far too many to list. A few examples of education activities are included here:
  - Hosted a one hour segment of Estuaries Live (2002), an internet broadcast targeted to school children. The focus was on sora rail research and life history and box turtle studies at Jug Bay. Also, conducted activities at the

Department of Commerce for children on the same day in celebration of Estuaries Day.

- Completed and printed “Ecology of an Estuary: Chesapeake Bay,” which is a guide for middle school teachers.
  - Organized and developed the Otter Point Creek Environmental Survey, a program for 7th grade students. This program exposes students to real world field monitoring and laboratory experiences and then asks them to make conclusions to predict outcomes and environmental impacts.
  - Developed and conducted “Chem Craze,” a four day program to teach students about the importance of physics and chemistry in learning about estuaries.
  - Developed and presented a series of activities for teachers to assist them in teaching the chemistry and physics of the Chesapeake Bay.
  - Developed and implemented a SAV monitoring program for high school students at Otter Point Creek..
  - Developed “A Blast from the Past,” a summer program in which students learn of the ways people lived around the Bay by conducting a fake archaeological excavation. A version of this program for educators was presented at the annual conference of the Maryland Association for Environmental and Outdoor Education.
  - Made special presentations with a focus on water chemistry, physics and SAV at a wide variety of events including:
    - § Water Fest in Prince Georges County to three groups of 200 students each with local media on hand to record the program
    - § Dolphin Day at Sandy Point State Park for elementary school students; the Maryland State Fair
    - § Wade-In at the Chesapeake Bay Environmental Center
  - Developed education programming for the new wet lab in 2007.
- A variety of large public education events have been held. Recent events include NOAA Restoration Day (2007 @ Jug Bay), Patuxent Sojourn event (2007@t Jug Bay), Wade-In (hands-on activities provided annually at event at Otter Point Creek).

### **3.4 Coastal Training Program (CTP)**

The CNBERR-MD Coastal Training Program aims to facilitate informed and improved decision-making by making relevant and cutting-edge estuarine research relevant, meaningful, and accessible to managers and stakeholders through targeted workshops. Following are some accomplishments of the Reserve’s CTP.

- In 2007, CBNERR-MD’s Coastal Training Program will be fully implemented and has received NOAA program approval. Program approval required development, submission and approval of CTP planning documents. The primary CTP target audiences include municipal and county elected and appointed officials and their staff. CTP will initially focus in the counties near the Reserve components, but will look to the future possibility of all coastal counties. The primary topic area will be

helping local governments plan for and respond to 1) population growth and development; and 2) climate change/subsidence/inundation.

- CBNERR-MD has partnered with DNR's Monitoring and Non-tidal Assessment Division to help host a Noon Seminar Series on Thursdays from September to June. The audience ranges from 20-30 people and consists of natural resource managers, representatives from environmental groups, and citizens.
- The Reserve has hosted three Coastal Decision-makers Workshops per year. These workshops provide technical information, tools and networking opportunities to coastal resource professionals. Example workshops are listed below:
  - Sea Level Rise in Chesapeake Bay. Assessing the impacts of Sea Level Rise in Chesapeake Bay was held in two locations. University of Maryland Eastern Shore & Harford Community College. (1996)
  - Personal Watercraft, Fact, Fiction and the Future on Chesapeake Bay. Highlighted information, scientific studies and general concerns about the use of personal watercraft. (2001)
  - Rain Gardens: A Series of three workshops (2002):
    - § From Rainbows to Rain Garden
    - § Rain Gardens Concept and Design
    - § Maintenance for Rain Gardens
  - Submerged Aquatic Vegetation Restoration. Held in conjunction with the SAV Task Group of the Chesapeake Bay Program, this workshop brought together researchers and managers to learn about the latest tools and techniques for restoring SAV. Presenters included Chuck Nieder from the Hudson River NERR on his bathymetry work and Mike Smart with the US Army Corps of Engineers, Environmental Research and Development Center. (2003)
  - Reducing Nitrogen Pollution from Septic Systems. Co-sponsored by the Tributary Strategies Development Workgroup, this workshop focused on the impact of septic systems on water quality and providing information on the implementation of alternatives to conventional systems. (2003)
  - Research Conference at Jug Bay. Nineteen presentations were delivered to county planning and zoning officials, staff from the Health Department and Public Works, land managers and others. Research covered a range of topics, including box turtles, mosquitoes, waterfowl populations, Lyme's disease, sedimentation, hydrology, West Nile virus and SAV restoration. All research was being conducted in the Jug Bay area of the Patuxent River. (2003)
  - Hurricane Isabel in Perspective: Developing an understanding how storm events impact Chesapeake Bay. (2004)
  - Mid Atlantic Agricultural Ammonia Forum: The role of ammonia in the nitrogen cycle, its impact on air and water quality and the emerging science on agricultural ammonia emissions. (2004)
  - Well and Septics Forum: Addressing Issues on the Eastern Shore, (2005)
  - Managing Visitor Use. (2006)

- Living Shoreline Summit in Virginia. (2006)
- Living Shoreline Summit on Lower Eastern Shore of Maryland. (2007)
- Sassafras Bayscaping Workshop. (2007)
- Other Coastal Decision Maker Workshop topics have included:
  - § Impact of Phragmites on the mid-Atlantic
  - § Submerged Aquatic Vegetation Restoration
  - § Beneficial Use of Dredged Materials
  - § Green Development
  - § Bush River Forum as part of the Watershed Restoration Action Strategy (WRAS) developed by Harford County
  - § State of the Sassafras River: Past, Present, and Future
  - § Ongoing Research in Jug Bay

### **3.5 Stewardship and Volunteer Programs**

- CBNERR-MD has protected over 3,600 acres in perpetuity through Memoranda of Understanding and conservation easements at the three reserve components—Otter Point Creek (Harford County), Jug Bay (Prince George’s and Anne Arundel Counties) and Monie Bay (Somerset County). This Management Plan proposes to increase that number to over 4,900 acres.
- Established the Friends of Otter Point Creek in 1997 (later evolved into the current Otter Point Creek Alliance) to support the activities and interests of this component.
- The Friends of Jug Bay (associated with Jug Bay Wetlands Sanctuary) was established in 1986 and remains extraordinarily active today.
- Hold Otter Point Creek Annual Marsh Cleanup Day at Bosely Conservancy annually in March.
- Volunteer Monitoring: Citizens, scout troops and school groups assist with efforts to assess ecosystem health within the Reserve by monitoring a variety of biotic and abiotic parameters. Volunteer highlights in recent years include:
  - Revised and printed the “Jug Bay Volunteer Guide.” Developed and printed a “Volunteer Guide for Otter Point Creek.”
  - Grasses to the Masses workshops, held in conjunction with the Chesapeake Bay Foundation, trained volunteers to grow submerged aquatic vegetation at home and then plant the SAV as part of a restoration effort. They became partners in a monitoring program. Water stargrass and wild celery were the species grown and planted.
  - Citizens participated in efforts to restore wild rice at Jug Bay. Working with staff at Patuxent River Park, they repaired and installed fences and planted seeds.
  - Volunteers helped maintain the SAV grow out tanks and helped propagate plants in the greenhouse. They also assisted with restoration and research activities.

- Conducted workshops for citizens to grow various species of tidal, freshwater submerged aquatic vegetation and then hosted planting days.
  - Developed a fish monitoring program at Otter Point Creek which includes protocol from the Department of Natural Resources and coordinated program with Jug Bay. Data collected is used by biologists to assess fish populations in the Bush River.
  - Organized Amphibian Calling Surveys and training for volunteers at Jug Bay and Otter Point Creek. These surveys provide information to a national database that tracks amphibian populations.
  - Using protocol from Jug Bay, developed the Herp Search program to identify and count amphibians and reptiles at Otter Point Creek.
  - Initiated a Water Quality Monitoring Program for volunteers at Otter Point Creek in 1997 with a complete revision and reconfiguration of the sites sampled in 2002.
  - Worked with site staff at Monie Bay to initiate plans for a volunteer program at this component. Identified and contacted key citizens to assist with implementation.
- Volunteer Appreciation Events are held annually at Jug Bay Wetlands Sanctuary and at Otter Point Creek.

### **3.6 Special Programs**

CBNERR-MD and CBNERR-VA have developed a formal relationship with the Tianjin Palaeocoastal and Wetland National Nature Reserve (TPWNR) in the People's Republic of China (PCR) as part of a US-PRC agreement. The goal of the relationship is includes 1) exchange of data, documentation, and research materials; 2) exchange of scholars, researchers, administrators, and students; and 3) coordination of activities such as joint research, lectures, seminars, workshops and symposia.

### **3.7 Land Acquisition and Boundary Expansion**

In order to protect the natural integrity of the ecosystems within the Reserve components and to manage these lands and waters for long-term research, monitoring and education activities, land must be acquired. Since 1990, 32 acres have been acquired at Otter Point Creek and 890 acres at Jug Bay Wetlands Sanctuary for inclusion in the Reserve. An additional 455 acres already owned by the Maryland National Capital Park and Planning Commission will also be included in the Reserve with the acceptance of this management plan.

### **3.8 Enhancement of Facilities and Site Infrastructure**

Adequate facilities and equipment allow the reserve to implement its research, education, stewardship, and coastal training programs and to fully participate in NERRS national priorities. Through support from NOAA and other sources, CBNERR-MD has added important facilities to the Otter Point Creek and Jug Bay components since 1990.

- Otter Point Creek
  - Grand opening of the Anita C. Leight Estuary Center at Otter Point Creek was held in September 1996. It was constructed through cooperation between Harford County, DNR and NOAA. The Center serves as the key facility for that component and for the Reserve as a whole.
  - Exhibits at the Anita C. Leight Estuary Center were completed in the spring of 2003. Exhibits highlight the importance of change in the Chesapeake Bay ecosystem, especially with regard to the impact of human activities.
  - The purchase of the Hirschauer property in Harford County was completed. This property abuts Leight Park and assures protection for the Estuary Center from development, adds approximately 860 linear feet of shoreline and a pier to the component and provides additional access to Otter Point Creek for activities.
  - Boardwalks have been added.
  
- Jug Bay
  - The McCann Wetlands Study Center at Jug Bay Wetlands Sanctuary was dedicated in 1993. It was constructed through cooperation of Anne Arundel County, DNR and NOAA.
  - New interactive exhibits were installed at the McCann Wetland Study Center (Jug Bay Wetlands Sanctuary) in 1999.
  - The wet lab for estuarine education programs at Jug Bay (Patuxent River Park) was completed and outfitted in 2007.
  - Boardwalks have been added.
  
- Reserve-wide
  - A traveling exhibit about the Reserve was created for the Coastal Zone '03 conference in Baltimore. Basic information about the components and about the Reserve's activities were presented.

# **ACCOMPLISHMENTS AS DESCRIBED IN 312 EVALUATION FINDINGS**

## **PRIOR TO SEPTEMBER 1993**

Unavailable

## **SEPTEMBER 1993 THROUGH OCTOBER 1997**

1. In response to the previous evaluation final findings, the CBNERR-MD was able to hire a full-time education coordinator and a half-time research coordinator during this review period using Federal funds.
2. During this review period, the CBNERR-MD and the Otter Point Creek component successfully completed the construction and opening of the Anita C. Leight Estuary Center.
3. The CBNERR-MD made great strides in developing an education plan and program. A number of projects have been conducted with each of the components, including an educators workshop, wetlands field trips for fourth grade students, and the Reserve's brochure.
4. The research coordinator has been instrumental in assisting in the development of the system-wide monitoring program, the graduate research fellowship program, and hosting the annual research coordinators' meeting. He also hosted a CBNERR-MD researchers meeting to expand knowledge of the resources and research activities in the Reserve.
5. During this review period, the CBNERR-MD printed the volunteer guide developed during the last review period, in cooperation with the Jug Bay Wetlands Sanctuary. This excellent guide has been nationally recognized, and is used successfully by all volunteers at the component to assist the 10,000 annual visitors.

## **NOVEMBER 1997 THROUGH NOVEMBER 2002**

During the review period from November 1997 through November 2002, activities at the MD CBNERR have resulted in many significant accomplishments. These accomplishments are directly attributable to the actions of the core staff members of the MD CBNERR. In addition to the accomplishments listed below, the daily activity of staff requires coordination with a large number of groups and individuals, response to professional queries, interaction with other research reserves, support for international work, and direct involvement in national studies in support of the overall Research Reserve System. It is noteworthy that each MD CBNERR site is unique with its own set of related issues: Otter Point Creek is impacted by development; Patuxent River Park and Jug Bay are a "main stem" of protected areas within areas of development and mixed use;

and Monie Bay is pristine. Programs in each reflect their unique characteristics. The details of the most noteworthy of these accomplishments are listed below.

## **A) Research Program**

### **1) System Wide Monitoring Program.**

The Research Coordinator was hired in January of 2002 and has spent the recent past getting the MD CBNERR research program back on track. In the past the System Wide Monitoring Program (SWMP) data from Maryland have been patchy, and a first priority has been to get SWMP up and running with the submission of timely and accurate data. At the time of the evaluation site visit, the locations of the data loggers were being reconfigured and two additional sites were being identified. Up until the time of the review, the Chesapeake Bay Lab handled SWMP data. In the future the Maryland Department of Natural Resources (DNR) will maintain the system, keep the data loggers in the water until weather dictates otherwise, and put the data on-line. There is interest in connecting the water quality data collected through SWMP and volunteer efforts to submerged aquatic vegetation restoration research. Collecting baseline data at all of the sites through volunteer monitoring and visiting researchers is also important to the MD CBNERR. This research includes sediment surveys, biological monitoring, and increased spatial range for water quality monitoring. The Research Coordinator is working with local institutions and the ERD Graduate Research Fellows Program to attract investigators interested in issues relevant to local resource management and is making every effort to integrate the research happening at the Reserve into the education and volunteer activities at all of the sites. In addition, the Research Coordinator shares an interest in restoration with the Virginia CBNERR Research Coordinator, and the two have talked about potential opportunities to work together.

Currently, research is done throughout the Reserve by CICEET investigators, volunteers, Graduate Research Fellows, site naturalists and biologists, and local scientists and students. The MD CBNERR has developed and funded a site specific research program which allows the components to conduct individual research projects which include: wild rice restoration; Sora rail migration patterns; submerged aquatic vegetation studies; the use of marshes by black ducks; and studies of several different species of biota.

### **2) Submerged Aquatic Vegetation**

Research activities at the Otter Point Creek Component have begun to focus on studying factors influencing submerged aquatic vegetation (SAV) distribution in the area and how diversity affects restoration success. In the summer of 2001, three species of SAV [wild celery (*Vallisneria americana*), redhead grass (*Potamogeton perfoliatus*) and water stargrass (*Heteranthera dubia*)] were placed at eight sites in and around Otter Point Creek to determine how environmental conditions affect species growth and survival. The research has been continued to look at how light attenuation affects different SAV species growth and survival. During 2002, nine floating trays of five SAV species were deployed at three different depths to identify optimal planting depths for each species. Through funding by the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), the MD CBNERR has benefitted from additional research. A



study by the University of Maryland funded through CICEET has focused on the impact of bivalves on SAV restoration in estuaries. The intent is to develop a model to enable coastal managers to predict the effects of bivalves on SAV distribution in estuaries.

### **3) Wild Rice Study**

An interesting collaboration between the Patuxent River Park, Jug Bay Wetlands Sanctuary and the Maryland Reserve has led to the restoration of native wild rice stands in the wetlands of the Jug Bay Component. Initiated and led by a naturalist at Patuxent River Park, this successful project has become a leader in wild rice restoration. The U.S. Geologic Survey, the U.S. Army Corps of Engineers, and the Anacostia Watershed Society have sought advice on implementing similar projects on the Anacostia and Potomac Rivers.

The Reserve has supported this effort for over six years. In 2002 funds were used to pay research assistants to install fencing, plant rice seed, monitor rice growth, and collect seed at the end of the growing season. Work was also carried out with the Friends of Jug Bay, who received a grant from the Chesapeake Bay Trust to purchase wire and metal posts, to support the project. Staff and volunteers from Jug Bay and students from the Key School were involved, and an educational component was added to introduce students, volunteers, and staff to the value of wild rice in the Jug Bay ecosystem.

The project began with the installation of wire fencing in long sections where wild rice had historically been in evidence. The purpose of the wire, aside from delineating the project area, was to prevent grazing by resident geese so that the rice could regenerate on its own. Enclosures of varying sizes were also constructed to support seed collection for re-seeding efforts. Late in the season additional wire fencing was required to reduce the enclosure sizes to prevent goose entry. Seed collected the previous year as part of a Boy Scout Eagle project was planted in late April to allow for natural seeding to take place in the late summer. Transplanting small rice seedlings, from 2 to 4 inches up to 3 feet was also carried out to determine the best method of initiating plant growth in the natural setting. In late summer, seed was collected from mature plants and kept in river water and placed in refrigerated storage to simulate the cold period needed to stimulate germination for next year's planting.

The collection of seed is critical to the restoration of wild rice to the estuary. As much as 90% of all rice is consumed by the fall migration of birds and the diminished wild rice stands are impacted by the loss of regenerating seed. Consequently, migrating populations of birds are driven to other areas or to alternative food sources. For this reason collection bags are placed over rice "panicles" or seed heads to collect the rice seed. In 2002 over 60 gallons of seed, which will allow for the planting of some 20 acres of wetlands, were collected.

### **B) Education Program.**

#### **1) General Program**

The education program springs from, supports and is closely tied to the Departmental education effort. In the current organizational structure the Education Coordinator is placed in the Education, Bay Policy and Growth Management area of DNR.

Nevertheless, the activities are very much directed toward the MD CBNERR program needs as it supports generic DNR activities (DNR Summit of Education Outreach) and

the need to address emerging controversies. The Education Coordinator identifies four roles: support the existing programs at the sites such as the Jug Bay “Teen Adventure” program; develop MD CBNERR programs at the State level to share with the components and with other Reserves; support the parent partner DNR programs and “fly the CBNERR flag” at activities like the Volvo Ocean Race activities, the State Fair and on wetlands days; and, support the larger Reserve System with program support like “Estuary Live.”

Reserve staff have worked together with component site staff to develop and implement summer programs for teens, a 7 grade pontoon boat program, the “Chem Craze” program with an emphasis on the physics and chemistry of water; SAV plantings with the Chesapeake Bay Foundation, and the 9th Annual Wetland and Wildlife Field Day at Monie Bay. Coastal Decision Maker Workshops covered the following topics: Rain Gardens, Submerged Aquatic Vegetation Restoration, the Impact of Phragmites, and the Beneficial Use of Dredged Materials. The education programs focus on teachers, students and public programs. Public decision makers were targeted by the Decision Maker Workshops. Bringing together the research happening at the components and using the volunteer networks that exist at some of the sites, component staff are in a perfect position to actualize site education program integration.

## **2) “Estuary Live.”**

“Estuary Live” showcased live interactive events over the internet at estuaries in North Carolina, Louisiana, Oregon, Washington, South Carolina, Florida, New Jersey, and Maryland. The live events were supplemented with videotape presentations from U.S. EPA National Estuary Programs in Florida, Alabama, California, Massachusetts, and Texas. Naturalists from two of the MD CBNERR components were involved in the production, inviting local high school students and volunteers to have “air time” and reinforcing the connectivity between components. A naturalist from Jug Bay Wetlands Sanctuary also helped to lead activities at the Department of Commerce where 150 students and several NOAA and EPA officials gathered to watch the Maryland portion of Estuary Live. The MD CBNERR Education Coordinator organized the event and was a superb host for the production, making “Estuary Live” a success for the MD CBNERR and also for the national system by developing an informative and entertaining program that was watched by children and teachers across the country and by key administrative supporters in Washington, D.C.

## **C) Volunteer Programs**

Hiring a volunteer coordinator was one of the suggested actions from the previous evaluation of the MD CBNERR. This done, much of the coordinator’s work is in coordinating protocols for volunteer monitoring across sites, training volunteers, encouraging and assisting in the development of programs at the component sites, and connecting the sites with State efforts and resources that can be obtained through NOAA and other funding sources.

Volunteer management is mostly a site specific endeavor, and the education, research, and public outreach programs at the sites rely heavily on volunteers. The concept of “mentoring” as opposed to “managing” is the primary approach to voluntary involvement. Yet, volunteer coordination is very time consuming. Active volunteers feel

that the Reserve is “a place where I belong” and the act of volunteering is its own reward - “I get to be a part of what’s going on.”

There is a local benefit to the research that has occurred at Otter Point Creek and volunteers are a big part of the effort, along with supporting other elements of the component’s operations.

There are around 40 individuals who are extremely active and some 20 to 30 who are less active participating in one event each year. Volunteer recognition programs occur at Otter Point Creek and Jug Bay. Site and Reserve staff also offer several professional development opportunities for volunteers.

#### **D) Tie to the Maryland Coastal Management Program.**

The CBNERR is organizationally in the DNR’s Coastal Zone Management Division, which also houses the Maryland Coastal Zone Management Program and the Maryland Coastal Bays National Estuaries Program. With this close tie to coastal management a number of activities carried out through the CBNERR were of mutual benefit. This is especially true for Coastal Decision Maker Workshops which focused on:

- The Impact of Phragmites on the Mid-Atlantic;
- Bio-retention of Storm Water and Rain Gardens (a series of three workshops in partnership with Prince Georges County targeting land managers, professional landscapers, and community leaders);
- Submerged Aquatic Vegetation Restoration;
- The Beneficial Use of Dredged Materials;
- Green Development; and,
- The Bush River Forum on Water Quality in Harford County.

MD CBNERR also coordinated the education program for the Volvo Ocean Race stopover in Maryland, the only North American stop. This international sailing event brought visitors to the stopover sites of Baltimore, where the competitors stopped first to refit their vessels for the next leg of the race, and Annapolis, where the competitors prepared for the start of the next leg to France. Both sites had visitors in the hundreds of thousands as the messages of the Reserve and Coastal Management were presented.

#### **E) Site Specific Accomplishments**

##### **1) Otter Point Creek**

The Otter Point Creek Component is heavily impacted and influenced by a rapidly developing watershed. The Component sits at the tidal interface of the Bush River and the Winters Run tributary which contributes the majority of freshwater flow to the system. Urbanization within the Winters Run watershed has the potential to bring increased loads of sediment and nutrients to the Component. In addition to the strong influence of the upstream area, Otter Point Creek is also impacted tidally from downstream sources of pollution. There are two wastewater treatment plants that discharge directly into the tidal Bush River and thus have the ability to impact water quality in the Otter Point Creek area through tidal transport of the discharge.

The Component has developed an effective level of programming and services and land acquisition has expanded the area under the Reserve’s control. The purchase of the Hirschauer property in Harford County abutting the Otter Point Creek component of the reserve has been a major accomplishment. The area surrounding the Otter Point Creek site is heavily developed and without this protection, the anthropogenic pressures

affecting the resources at Otter Creek Point probably would have increased. The Anita C. Leight Estuary Center was opened in September 1996 and currently houses offices for a full time naturalist, park manager, receptionist, and Reserve staff. Public programs are routinely filled to capacity. The Center supports education programs for Harford County Schools such as the 7 Grade to High School monitoring program th as well as other school based programming. The Research program supports masters and PhD research activities and there are paid and non-paid interns involved in the Center's ongoing research activities. The volunteer program is central to the ongoing operation of the Center and provides support for research, center programming, and other needs. A manual provides "job descriptions" for voluntary support which defines different voluntary opportunities and the expectations of the job from the standpoint of the volunteer as well as the Center. According to Center staff the program "could not run without the volunteers." The program maintains a strong relationship with Hartford County Parks and Recreation and is a central part of its natural area programming. Exhibits about the Chesapeake Bay, its geology and the interactions of people with the Bay throughout history will open in the spring. The exhibits also highlight the importance of research in understanding the dynamics of the Bay ecosystem.

## **2) Patuxent River Park**

The Jug Bay Component is jointly managed by the Jug Bay Wetlands Sanctuary and Patuxent River Park and represents a large tidal freshwater ecosystem along the tidal Patuxent River. Patuxent River Park (PRP) evolved from the designation of the Patuxent River as a Maryland Scenic River, a State program which challenged local governments to develop a master plan to support the designation. The Prince Georges County Master Plan for the River essentially defines a linear park along the River's edge. Significant programming includes "kids day in the country" with country cooking, hay rides, and other activities. A significant amount of programming is directed toward education activities. PRP also has 3 boat ramps, fishing areas, interpretive, hiking, biking, and horse trails, wildlife viewpoints, boat rentals and programs conducted from pontoon boats. It enjoys partnerships with DNR, Program Open Space, the Rural Legacy Program, CBNERR, and a number of other agencies and organizations. NOAA funding has been used for a Jug Bay interpretive sign, development of a nature study area, an interpretive trail with interpretive signs, an osprey exhibit which provides real time coverage of an active osprey nest, and funding for a wild rice study. The partnership with CBNERR has been exceptional over the past three years - directly attributable to the staff of the program and their capabilities.

Generally, the research program is opportunistic and predicated on the interests of staff and must tie to education or have an educational component. The use of volunteers is a high priority in any effort.

## **3) Jug Bay Wetlands Sanctuary**

While the Patuxent River watershed is urbanized, there are extensive vegetative buffers around the Jug Bay Component, possibly reducing the effects of land use impacts on the system. Water quality at the site is driven in part by the vast freshwater marshes which have the capacity to further reduce contaminants and aid in biological processing at the

site. Additionally, water quality is heavily influenced by the rapid movement of water and tidal flux associated with the mainstream of the Patuxent River, and is also influenced by a large wastewater treatment plant which discharges treated effluent into Western Branch, a tidal tributary of the Patuxent River. Research and education are top priorities at Jug Bay Wetlands Sanctuary. Staff and volunteers are greatly involved in many projects, ongoing herpetological research into migratory and reproductive behaviors of native turtle populations, over 10 years of volunteer water quality monitoring, tidal fish sampling, and monitoring of waterfowl populations. Volunteer support also plays a strong role in component activities, and volunteers are given an annual Volunteer Appreciation Day, offered professional development opportunities and rewarded with various special activities.

#### **4) Monie Bay and Wetlands and Wildlife Field Day**

Monie Bay is part of the Deal Island State Wildlife Management Area in the Department of Natural Resources. It represents a large tidal saltwater marsh ecosystem on Maryland's Eastern Shore and is a relatively undeveloped watershed with limited agricultural activities occurring outside the management area. Water quality at the site is driven in part by tidal flow from the Chesapeake Bay mainstream as well as vast tidal saltwater marshes and creeks that make up the watershed. The site is composed of three main tidal tributaries, Little Monie Creek, Monie Creek, and Little Creek, which range in salinity from mesohaline to oligohaline. In addition to their range in salinity, they also range in the amount of development (specifically agriculture) that impacts each creek. Monie Creek is the largest of the three and has a large freshwater input as well as high agricultural input. Little Monie Creek is slightly smaller with less freshwater input causing salinities to be higher at 10-12ppt and has moderate agricultural input. Little Creek is the smallest of the three and has less freshwater inflow and increased tidal influence with salinities ranging from 12-13 ppt and no agricultural or development impacts within the watershed. This collection of three different tributaries under one management regime lends itself well to research.

Comparison studies on the effects of agricultural runoff on water quality have been conducted here by Graduate Research Fellows. The proximity of University of Maryland Eastern Shore and its Fish and Wildlife Co-op program provides opportunities for partnership. Students of this program can assist in research, outreach and educational activities at Monie Bay. The Wetlands Wildlife Field Day is a successful field trip for all 4 graders in the county. Ten years of experience and thrilled teachers and students have made this event a central point for Monie Bay education and volunteers and staff from all of the component sites participated in this year's field trip. Monie Bay is interested in starting a volunteer group and increasing educational and outreach opportunities while maintaining a focus on estuarine research.

#### **F) MD CBNERR Administration**

The MD CBNERR is administered by the Maryland Department of Natural Resources' Chesapeake and Coastal Watershed Service's Coastal Zone Management Office. Central administration of the three components which make up the State partnership of the MD CBNERR can be equated to the National Estuarine Research Division's partnership with the NERR sites throughout the nation. During the review period the MD CBNERR has

built a strong foundation of association with the three component sites, provided support to program development, and nurtured a collective energy at the central DNR office which has spread to each of the sites. Full staffing of the central core has led to the accomplishments noted above at the state level, has fostered community partnerships through the reserve components, and has assured administrative accomplishment and project completion. It is necessary that this core be maintained to retain the level of service needed to meet the basic program requirements, to make maximum use of Federal funding, and to address program opportunities in the future.

## **DECEMBER 2002 THROUGH NOVEMBER 2005**

### **Operations and Management**

- **Staffing:** The staff members of the Reserve are dedicated and highly respected professionals who, despite significant challenges during this evaluation period, are responsible for the achievements and successes as outlined in these findings.
- **Coordination and Partnerships:** The Reserve has strengthened the partnership and mutual interaction among the three sites with quarterly site manager meetings, annual retreats, intern and volunteer exchanges, and multi-component projects. The Reserve sites benefit from the strong partnerships of friends groups and volunteers.

### **Research and Monitoring**

- **Research Activities:** In response to previous evaluation findings, the Reserve has identified specific focal research issue areas, and the staff members have integrated those research areas across all three site components and across the research, education, and stewardship programs at the Reserve. The Reserve has expanded the network of scientists interested in conducting research in the Reserve and has significantly increased the involvement of interns and student researchers through the Graduate Research Fellows program, the Environmental Cooperative Science Center partners, and the Cooperative Institute for Coastal and Estuarine Environmental Technology.
- **Monitoring:** The Reserve's SWMP has made significant improvements since the last evaluation, now conforms to all systemwide protocols, and has been enhanced to provide elements beyond requirements for the program. Data collection, accuracy, and timely submission to the CDMO have significantly improved.

### **Stewardship and Resource Management**

- **Stewardship:** The stewardship activities at the Reserve are an excellent integration of research and education. The restoration strategies are solidly based on science but give the staff and volunteers involved a strong sense of ownership and responsibility. With the lengthy absence of an education coordinator, the Stewardship Coordinator, in conjunction with the Research Coordinator and the site component managers, has provided an educational experience in all stewardship activities and has assisted with educational and public programming at the individual component sites.
- **Volunteer Program and Coordination:** The Reserve benefits greatly from very active "friends" organizations and a dedicated corps of volunteers. It recognizes the importance of appreciation events for the volunteers and friends to honor their commitment of time and energy to the Reserve and its natural resources.