

Final Evaluation Findings

Chesapeake Bay-Virginia National Estuarine Research Reserve

October 2014 to October 2021

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Summary of Findings

The Coastal Zone Management Act requires the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management to conduct periodic evaluations of the operation and management of each national estuarine reserve participating in the National Estuarine Research Reserve System. This evaluation examined the operation and management of the Chesapeake Bay National Estuarine Research Reserve in Virginia by the Virginia Institute of Marine Science in the College of William and Mary, the designated lead agency, for the period from October 2014 to October 2021. The evaluation focused on three target areas: program administration; resilience and sustainability; and habitat science and land management.

The findings in this evaluation document will be considered by the NOAA Office for Coastal Management in making future financial award decisions concerning the Chesapeake Bay National Estuarine Research Reserve in Virginia. The evaluation came to these conclusions:

Program Administration

Accomplishment: The Chesapeake Bay-Virginia Reserve staff have provided exceptional leadership in addressing coastal management issues and furthering advances in their sectors, serving on over 100 boards and committees and sharing their expertise at the global, national, regional, and local levels.

Accomplishment: The Chesapeake Bay-Virginia Reserve excels at training, supporting, and empowering the next generation of marine science leaders through early career development opportunities from high school to graduate students.

Necessary Action: The Chesapeake Bay-Virginia Reserve must have a published final management plan by September 30, 2022.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science to pursue the addition of three new positions identified in the reserve's management plan: a full-time resource conservation specialist, a part-time administrative support staff person, and a part-time communication specialist to expand its ability to implement high-quality programming and address regional needs. The reserve might consider looking at funding opportunities through the Infrastructure Investment and Jobs Act funding to support these positions.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to prioritize working on cross-sector integration and improving internal communication processes. The reserve is encouraged to consult with the office for assistance with meeting design and to seek assistance from an outside facilitator. The reserve could consider pursuing the development of a reserve system Science Collaborative grant and Infrastructure Investment and Jobs Act funding to further support specific cross-sector projects.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to apply for procurement acquisition and construction grant funding from the National Estuarine Research Reserve System to construct new office, laboratory, and dormitory space.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science to survey their fellows, interns, and staff mentors to document training and skill development needs and to identify gaps the reserve, institute, or partners could fill.

Programmatic

Accomplishment: The Chesapeake Bay-Virginia's new Environmental Data Center is improving access to, and management of, the reserve and partners' water quality and meteorological monitoring data and products. The data center also supports long-standing citizen science water quality monitoring and is making this data available to researchers and allowing citizen groups to analyze their data.

Accomplishment: The Chesapeake Bay-Virginia Reserve is a national leader in developing and implementing the National Estuarine Research Reserve System's System-wide Monitoring Program and Sentinel Site Program. Regionally and locally, the reserve's monitoring data is informing coastal decision-makers, business owners, and the general public.

Accomplishment: The Chesapeake Bay-Virginia Reserve reinvigorated the York River and Small Coastal Basin Roundtable, which is providing a platform for collaboration on water quality and conservation within the watershed.

Accomplishment: The Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science Marine Advisory Program are leaders in creating exceptional educational opportunities for university undergraduate and graduate students, pre-service teachers, and teachers to learn about communicating science and conducting outdoor science education. Two highlights are the Virginia Teachers Innovating and Designing Experiential Science (VATIDES) program and the Virginia Scientists and Educators Alliance (SEA) program.

Accomplishment: The Chesapeake Bay-Virginia Reserve provides students with life-altering learning opportunities, which have encouraged many students to consider a career in STEM.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve in its efforts to expand the scope of the Coastal Training Program to include serving the community through leadership and facilitation of partners around key areas such as the York River and Small Coastal Basin Roundtable and providing technical assistance.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to (a) investigate opportunities for integrating data around one geography such as Goodwin Islands and (b) complete habitat and change maps for all components. The reserve is encouraged to work with the National Estuarine Research Reserve System and the Office for Coastal Management's new Mid-Atlantic geospatial coordinator to further these efforts.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to expand its role in habitat restoration on reserve properties to test new technologies and adaptive management strategies to support habitat protection, mitigation, and creation in the Chesapeake Bay region and to share these results with decision-makers.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to pursue priority land acquisition projects in its management plan and consider the availability of upcoming federal funding.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science to continue to build on the Virginia Teachers Innovating and Designing Experiential Science (VATIDES) program to support and train pre-service teachers in outdoor science education and fieldwork.

Program Review Procedures

The Coastal Zone Management Act of 1972, as amended ([16 U.S.C. 1451 et. seq.](#)), requires that state coastal zone management programs (coastal programs) and national estuarine research reserves (research reserves) that are developed under the act and approved by the secretary of the Department of Commerce be evaluated periodically. Section 315 of the Coastal Zone Management Act and implementing regulations at 15 CFR 921, Subpart E, require that a research reserve be periodically evaluated with regard to 1) their operation and management, including education and interpretive activities; 2) the research being conducted within the research reserve; and 3) adherence to the requirements of Section 315(b)(2) of the Coastal Zone Management Act.

The National Oceanic and Atmospheric Administration (NOAA) evaluated the Chesapeake Bay National Estuarine Research Reserve in Virginia in fiscal year 2022. The evaluation team consisted of Carrie Hall, evaluation team lead; Rebecca Allee, evaluator; Tricia Hooper, site liaison; Matt Smith, U.S. Army Corps of Engineers Institute for Water Resources; and Rachel Stevens, Great Bay Reserve. The support of reserve staff members was crucial in conducting the evaluation, and this support is most gratefully acknowledged.

NOAA sent a notification of the scheduled evaluation to the director of the Virginia Institute of Marine Science, published a notice of “Intent to Evaluate” in the *Federal Register* on September 20, 2021, and notified members of Virginia’s congressional delegation. The reserve posted a notice of the public meeting and opportunity to comment in the *Daily Press* on Monday, September 6, 2021.

The evaluation process included a review of relevant documents and a survey of stakeholders, which helped identify target areas for the evaluation: program administration, coastal resiliency, water quality, and habitat management. A virtual site visit was conducted and the evaluation team held meetings with staff members and group discussions with stakeholders and program staff members about the target areas. In addition, a public meeting was held virtually on Wednesday, October 20, 2021, at 5:00 p.m., to provide an opportunity for members of the public to express their opinions about the implementation of the program. Stakeholders and members of the public were also given the opportunity to provide written comments. A summary of the written comments received and the NOAA Office for Coastal Management’s responses are included in Appendix A. NOAA then developed draft evaluation findings, which were provided to the Virginia Institute of Marine Science for review, and the department’s comments were considered in drafting the final evaluation findings.

Final evaluation findings for the national estuarine research reserves highlight each reserve’s accomplishments in the target areas and include recommendations, which are of two types.

Necessary Actions address programmatic requirements of implementing regulations of the Coastal Zone Management Act. These must be carried out by the dates specified. Failure to address necessary actions may result in a future finding of non-adherence and the invoking of interim sanctions, as specified in the Coastal Zone Management Act §312(c).

Recommendations are actions that the office believes would improve the program but which are not mandatory. The state is expected to have considered the recommendations by the time of the next evaluation or dates specified.

Evaluation Findings

Program Administration

Overview

Reserve staff are well respected in the region. They are described by partners as dedicated and committed, passionate, smart, highly qualified, brilliant, approachable, enthusiastic, creative, and professional. Partners praised staff for their openness to new collaborations and flexibility in addressing stakeholder problems.

The reserve undertook a reorganization when the long-term research coordinator retired. The reserve hired a new research coordinator from within the Virginia Institute of Marine Science who serves as the associate director and supervises the Coastal Training, Stewardship, and Education Program coordinators. Previously, the four sector coordinators reported to the program manager. In a concurrent effort, the reserve reassigned office space, reorganized its laboratory facilities to better meet program needs, and established the Environmental Data Center.

Staffing

The reserve's draft 2022-2026 management plan identifies three key programmatic staff needs going forward: a part-time administrative support staff person, a part-time communication specialist, and a full-time resource conservation specialist. A part-time administrative support staff person and a part-time communication specialist could help alleviate the workload of each sector. In particular, additional staffing could help the reserve apply for and manage additional external funding to support all of the additional reserve staff outside of the core positions that NOAA funds. Reserve staff manage a significant number of grants beyond their annual NOAA operations award, 18 at the time of the site visit. Additional staff support could also assist with ensuring timely and accurate reporting and addressing numerous other clerical and procurement tasks that sectors could use assistance with.

As discussed further in the findings, a full-time resource conservation specialist would allow the reserve to expand its investment in making significant contributions to restoration and habitat management in the region. There is a great need in the Chesapeake region to better understand the impacts of climate change on habitat and the potential of restoration and green infrastructure to help the region adapt. The addition of a resource conservation specialist would build the reserve's habitat management and restoration capacity, and allow the reserve to better leverage existing research, stewardship, training, and education initiatives to help communities in the Chesapeake region build resilience.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science to pursue the addition of three new positions identified in the reserve's management plan: a full-time resource conservation

specialist, a part-time administrative support staff person, and a part-time communication specialist to expand its ability to implement high-quality programming and address regional needs. The reserve might consider looking at funding opportunities through the Infrastructure Investment and Jobs Act funding to support these positions.

Management Plan

The previous evaluation findings (2016) contained a necessary action requiring the reserve to “submit a draft management plan to the NOAA Office for Coastal Management by June 30, 2016.” The reserve did not meet this deadline but did complete the action in 2020, and since then has made significant progress. The reserve is in the process of obtaining NOAA approval of the final management plan. A notice of opportunity for public comment on the draft revised management plan was posted in the *Federal Register* on March 1, 2022. Comments were closed on March 31 and NOAA is taking comments under consideration when approving the management plan. The reserve and NOAA are on track to complete and publish the final management plan notice in the *Federal Register* by September 30, 2022.

Necessary Action: The Chesapeake Bay-Virginia Reserve must have a published final management plan by September 30, 2022.

Cross-Sector Integration

Reserve staff members work well together and are engaged in some projects that cross sectors. However, there is an opportunity to both improve communication across sectors and leadership and strategically increase cross-sector integration to maximize the reserve’s impact in addressing priority coastal issues. As a follow-up from the October 2021 evaluation, in April 2022 the Office for Coastal Management worked with the reserve to survey staff and facilitate a meeting to identify processes to improve communication and decision-making around planning and implementation of cross-sector projects.

The reserve is encouraged to build upon this effort to determine whether the new communication and decision-making processes are working or need to be further improved. The Office for Coastal Management can provide technical assistance, to include consultation on meeting objectives, design and activities in support of this effort, and the reserve is encouraged to seek assistance from an outside facilitator. In addition to ongoing communication methods, some reserves use an annual retreat to focus on cross-sector integration opportunities. The reserve should continue to focus on opportunities to deepen cross-sector integration across current portfolios and could consider new opportunities to jump-start this effort, such as developing a cross-sector project for funding under the NERRS Science Collaborative and the Infrastructure Investment and Jobs Act. The reserve may also wish to use its strategic thinking time to consider the impacts of COVID-19 on programming and what changes the reserve should build on, or adapt, as in-person engagement resumes with more regularity.

The reserve could consider reaching out to other reserves that continually strive to implement processes to improve cross-sector integration. The Kachemak Bay Reserve prioritized and

undertook efforts to improve cross-sector integration, including setting a target to have “80% of grant proposals submitted annually include significant elements of integration between two or more sectors,” for which they met their goal and improved by over 40 percent. The reserve staff continue to set aside time to work together to develop cross-sector projects. Great Bay, North Carolina, and Guana Tolomato Matanzas are reserves that also focus on cross-sector collaboration.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to prioritize working on cross-sector integration and improving internal communication processes. The reserve is encouraged to consult with the office for assistance with meeting design and to seek assistance from an outside facilitator. The reserve could consider pursuing the development of a reserve system Science Collaborative grant and Infrastructure Investment and Jobs Act funding to further support specific cross-sector projects.

Communications

In 2019, reserve staff drafted a communications plan to increase the reserve’s visibility and to improve the efficacy of external communications with the public and partners. Virginia Institute of Marine Science staff engaged in communication efforts also contributed to the plan. The plan is designed to be adaptive and provides a situation analysis, including current challenges faced; details on target audiences, as well as audience-specific goals and strategies that will achieve them; best practices for program communication, including key messages and talking points; an inventory of assets and existing opportunities to leverage; and an outline of priority efforts moving forward. The reserve will be continuing to implement the ideas in the draft plan and to refine and finalize the plan in 2022.

The reserve is encouraged to look at opportunities to use the reserve logo and other branding across properties in alignment with the new communications plan. The different ownership and management models at each site component mean it is not possible to develop consistent access and allowable use messaging across reserve properties. Instead rules and signage will need to be customized for each component.

Facilities

The reserve has identified a number of opportunities for improving facilities in its draft 2022-2026 management plan, including installation of a new living shoreline protection system at Gloucester Point, a laboratory and field support facility, a dormitory, and additional public access trails and interpretation. The proposed projects are all important to enhancing the reserve. With the creation of the new Machicomoco State Park bordering the reserve and a new manager at York River State Park interested in working with the reserve to improve public access, the reserve is well positioned to work with its partners to enhance public access.

The reserve has a need for new office space and laboratory facilities as some facilities are aged, at or beyond capacity, and substandard. For example, one of two modular buildings, is a research lab purchased in 1995 with a 10-year life expectancy that sits across campus from the

reserve's main facilities. The modular lab is slated for removal when construction begins on the institute's new fisheries building. The other aged modular unit provides lab and field associated staff offices adjacent to the reserve's main Catlett-Burruss Research and Education Laboratory. The reserve would greatly benefit from a new facility that incorporates both laboratory and office space to better serve its current and future needs.

Gloucester Point is a relatively small town, and the availability and affordability of housing for visiting researchers, teachers, and students is currently challenging for the reserve and the institute. A new dorm facility would enable the reserve to provide affordable housing for interns, fellows, students, researchers, and volunteers with programs such as AmeriCorps. A dorm facility could also allow the reserve to host participants of multi-day training and education programs.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to apply for procurement acquisition and construction grant funding from the National Estuarine Research Reserve System to construct new office, laboratory, and dormitory space.

National to Local Leadership

Reserve leadership and staff are leaders in their fields and have made an impact locally, regionally, nationally, and globally. A selection of these efforts are highlighted in the findings. Reserve staff serve on over 100 boards and committees that serve national to local audiences.

The reserve's contributions to the National Estuarine Research Reserve System is exceptional, with the reserve providing leadership in activities across sectors. Examples of these efforts include:

- Hosting the 2016 national system's annual conference. The 2016 conference set a new, high bar for future hosts.
- The Coastal Training Program coordinator is a leader in the Diversity, Equity, Inclusion, and Justice workgroup and moving the national system forward.
- The education coordinator serves on the Teachers on the Estuary (TOTE) committee, Education Steering Committee, Sentinel Site workgroup, and also on the NOAA Education Council. At the start of the COVID-19 pandemic, the education coordinator provided valuable assistance to education coordinators in the system who struggled to transition to virtual learning. In 2020, the coordinator assisted with planning the virtual annual meeting.
- The reserve is a national leader in water quality monitoring and has helped lead the development of the national system's Sentinel Site Program.
- The stewardship coordinator serves as co-chair of the Sentinel Site Application Module One (SAM-1) workgroup, and the research coordinator has been very active in developing a submerged aquatic vegetation module for SAM.
- The reserve director served as co-chair of the NOAA/National Estuarine Research Reserve System National Focus Growth Strategy Workgroup in 2016.

- The reserve director was the only reserve manager to serve on the National Estuarine Research Reserve Blue Ribbon Review Panel in 2015.

Accomplishment: The Chesapeake Bay-Virginia Reserve staff have provided exceptional leadership in addressing coastal management issues and furthering advances in their sectors, serving on over 100 boards and committees and sharing their expertise at the global, national, regional, and local levels.

Diversity, Equity, Inclusion, and Accessibility

The reserve has undertaken a number of efforts to improve diversity, equity, and inclusion in its processes and programming.

- The reserve and institute began hosting a Camp Launch in 2020. The camp is a two-week STEM camp for high school students of high ability from low socioeconomic backgrounds that provides students with hands-on science content and activities in a university environment. The program provides an opportunity for students to see themselves in a STEM career.
- To make programs affordable for any school, the reserve offers free and low cost education programs.
- The education program partners with the local Boys and Girls Club to provide transportation for summer camp programs so as to enhance participation from rural and low-income regions.
- The education coordinator served on a Virginia Department of Education state committee tasked with incorporating environmental justice in the state's education and providing equitable experiences for all students.
- With South Slough Reserve, the reserve co-hosted a Hollings Scholar to look across the reserve system at how reserves are engaging with tribes and best practices. The project results are informing NOAA's work.
- The Coastal Training Program coordinator, outside of work at the reserve, completed a research report, "Nuestro Océano y La Costa," looking at Latino attitudes and experiences with the ocean and coast with recommendations for further engagement in coastal and ocean issues.
- The reserve worked with local rural communities, hosting a Coastal Farming Challenges workshop looking at saltwater intrusion.
- The reserve is improving its hiring and recruitment practices, including writing job descriptions to apply to a diverse applicant pool and using diverse interview panels.
- The reserve has partnered with the Fairfield Foundation to interpret local history, including the culture of tribes and enslaved populations that lived in the area.

The reserve is encouraged to continue to look for opportunities to support addressing diversity, equity, inclusion, and accessibility. Potential opportunities discussed during the virtual site visit include:

- Developing internship opportunities for community college students to reach students of different academic abilities and those not necessarily interested in graduate work. This could include developing a stewardship internship(s) opportunity.

- Developing a fellow or internship focused on diversity, equity, inclusion, and accessibility.
- Providing training opportunities both internal to the university and external on diversity, equity, inclusion, and accessibility issues.

Next Generation

The reserve is committed to training and empowering the next generation of marine science leaders through early career development opportunities. Research, education, and environmental communication opportunities are provided to high school, undergraduate, and graduate students through federal and local programs. The reserve tries to reach local students through multiple events and opportunities as students continue through their K-12 education and beyond. For example, students might participate in a school field trip one year, summer camp the next, visit the reserve with their family, and later become an intern or fellow at the reserve.

The evaluation team had the opportunity to engage with a number of the reserve's interns and fellows. They praised the support they received from staff and highlighted the positive impact their experiences had on their future schooling and career choices. As one fellow stated, "My internship had a huge positive impact on me and my career and academic goals." The interns and fellows shared their experiences.

- A Hollings Scholar discussed their experience working on a community monitoring project. The scholar cited the value of being able to do fieldwork and independent research, combined with opportunities to communicate the results. The scholar created a lesson plan and an ESRI Story Map and guide for future students, participated in the training of K-12 teachers, and helped to lead summer camps. The scholar is now working in the field of citizen science and cited their experience working at the reserve as helping determine career direction.
- A fellow discussed how key the reserve's data sets and assistance of staff were in having a successful project and overcoming challenges.
- An intern discussed how they started at the reserve as a camper when they were 12 and that "it has changed my life." They were excited to be able to come back and volunteer at the camp when they were 16. They designed and implemented a senior project and presented the results with the education coordinator serving as a mentor. The intern is now working at the reserve leading teacher workshops and field trips and will soon graduate from college.
- A conservation intern started volunteering as a senior and working at the reserve every other day assisting the Coastal Training Program coordinator with event planning and social media management before being hired as an intern. They cited the breadth of experience gained and how it helped with their college science classes.
- A Margaret A. Davidson (MAD) Fellow discussed how even before becoming a fellow, they turned to the reserve for data and resources to help with their graduate research. They valued the opportunity to develop a lesson plan for high school students. They greatly appreciated that they were able to work with all four reserve sectors. They were excited to build their confidence in communicating their science and received strong

support from the education coordinator. They also appreciated the opportunity to connect with people in the region and nationally in the NERRS. The experience led them to want to continue to pursue research and to teach and mentor.

Accomplishment: The Chesapeake Bay, Virginia Reserve excels at training, supporting, and empowering the next generation of marine science leaders through early career development opportunities from high school to graduate students.

The evaluation team identified opportunities the reserve may wish to pursue based on the evaluation site visit discussions:

- Conduct a survey of fellows, interns, and staff mentors for training needs, particularly short classes and certificates for specific skills to identify any gaps that the reserve or partners could fill. Evaluation participants noted that they would have been interested in training in coding and GIS as this is moving from a specialized to foundational skill. They identified a potential certificate in fieldwork as valuable in future job searches or schooling.
- The reserve could explore providing interns and fellows with more opportunities through the National Estuarine Research Reserve System to interact and conduct projects across multiple reserves.
- The reserve might consider providing volunteer opportunities for younger students if allowed by the university system.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science to survey their fellows, interns, and staff mentors to document training and skill development needs and to identify gaps the reserve, institute, or partners could fill.

Water Quality

The reserve's water quality monitoring, assessments, and data management and dissemination are fundamental to Chesapeake Bay restoration efforts, help support the local economy, and improve public safety. The reserve operates a robust System-wide Monitoring Program and supplemental local and regional water quality monitoring stations that attract researchers to the reserve. Over the evaluation period, at least 33 graduate-level theses and dissertations and 43 peer-reviewed manuscripts used reserve data sets.

Environmental Data Center

In 2020, the reserve established an Environmental Data Center to improve access to, and management of, the reserve and partners' water quality and meteorological monitoring data and products. The data center currently maintains two water quality monitoring databases and associated web applications: the Virginia Estuarine and Coastal Observing System (<http://vecos.vims.edu/>) and the Chesapeake Monitoring Cooperative Data Explorer (<https://cmc.vims.edu/>). The observing system contains more than 174 million water quality measurements. The data explorer features a full-scale data management platform that

centralizes resulting data from disparate citizen science monitoring efforts located across the Chesapeake Bay watershed, and currently contains more than 430,000 water quality and 3,600 benthic sample measurements. The reserve has funding to support the data center for the next six years, including funding for an additional position. The reserve is working with modelers at the institute to add more real-time advisory related tools.

The Chesapeake Monitoring Cooperative Data Explorer provides nontraditional partners, nonprofits, civic associations, and local governments an opportunity to upload and store data in an easy-to-navigate system and to make the data available to scientists and resource managers. The data center provides tools for citizen groups, allowing them to construct basic visualizations of their data. A representative of the Alliance for the Chesapeake Bay praised the reserve for developing an easy-to-use platform for citizen scientists.

Accomplishment: The Chesapeake Bay-Virginia's new Environmental Data Center is improving access to, and management of, the reserve and partners' water quality and meteorological monitoring data and products. The data center also supports long-standing citizen science water quality monitoring and is making this data available to researchers and allowing citizen groups to analyze their data.

The evaluation team and stakeholders identified a number of potential opportunities the reserve may wish to consider regarding the Environmental Data Center:

- Develop a long-term strategic plan for the water quality program and data center that addresses how the reserve's efforts are integrated and complement each other, and that considers the role of each sector.
- Continue to expand the data visualization and analysis tools in the data center to reach a variety of audiences and support management decisions.
- Pursue opportunities to work with modelers at the institute.
- Develop and offer training on how to use these tools.
- Look for opportunities to connect to other data sources and more qualitative water quality data.
- Support and pursue partnerships with other community-based groups to get data out to the general public.

Additional Data Monitoring and Dissemination Efforts

The reserve works with the local aquaculture industry to support the use of water quality data in informing management decisions. For example, the reserve worked with Bevans Oyster Co. and Cowart Seafood Corporation to place a water quality station at their water intake. The data from this station led the company to realize the importance of pH, salinity, and chlorophyll to larval survival. The company monitors fluctuations closely and is able to use the data to adaptively manage its systems. The region's oyster industry is now benefiting from this greater understanding of water quality impacts on larval survival. A representative of the seafood corporation stated they are "truly benefitting our hatchery and industry and allowing us to produce more products."

The reserve's water quality data is used by the Virginia Department of Environmental Quality to inform the development of the state's *Water Quality Assessment Integrated Report* that is submitted to the U.S. Environmental Protection Agency pursuant to Section 305(b) and 303(d) of the Clean Water Act. Reserve waters are all listed as impaired waters. The department relies on reserve data to conduct its analysis. The department also cited the Virginia Estuarine and Coastal Observing System as a very helpful resource for conducting its work.

NOAA's Chesapeake Bay Office provides funding to the reserve to maintain the Chesapeake Bay Interpretive Buoy System. The office described the reserve as "essential for maintaining the system." In the past few years, this partnership has grown as NOAA increasingly relies on the reserve to troubleshoot and conduct repairs and to do deployments and recoveries. The buoy system monitors surface conditions and water quality and the data is used by the NOAA National Weather Service to inform marine forecasts, the NOAA National Centers for Coastal Ocean Science for monitoring vibrio, and anglers and boaters for safety and fishing. The data from the buoy system is available to the public on a website and apps.

Accomplishment: The Chesapeake Bay-Virginia Reserve is a national leader in developing and implementing the National Estuarine Research Reserve System's System-wide Monitoring Program and Sentinel Site Program. Regionally and locally, the reserve's monitoring data is informing coastal decision-makers, business owners, and the general public.

The evaluation team and stakeholders identified a number of potential opportunities the reserve may wish to consider:

- Look at additional opportunities to engage the public in citizen science, building on the reserve's current success in this area.
- Provide additional support to hatchery efforts in addressing real-time water quality changes during larval development.
- Expand work on understanding carbon source and fate, including extending sampling sites further up into tributaries and reference sites.
- Explore new opportunities for multi-reserve research efforts within the national system's working groups.

Fostering Resilience through Training, Service, and Engagement

In the initial years of the evaluation period, the Coastal Training Program focused on providing training to state and local government officials and other audiences. With the hiring of a new coordinator mid-way through the evaluation period, the program has expanded its delivery mechanisms to include more community engagement, technical assistance, and additional forms of capacity building. In addition, the program has incorporated more social science into its work and offerings. The shift in the coordinator's role and incorporation of more social science into training and other activities mirrors changes in the national system.

The Coastal Training Program coordinator took the lead in reinvigorating the York River and Small Coastal Basin Roundtable, which provides a forum for information sharing and

collaboration among water quality and conservation-minded stakeholders within the York River Mobjack Bay and Piankatank River watershed areas. The coordinator facilitates the roundtable, and partners in the region are excited about the group's potential. The roundtable allows NOAA to better connect with local community members. Through the workgroup, NOAA worked with partners to endorse a shoreline monitoring framework. The roundtable has developed a resources page for identifying priority restoration sites, developed restoration site-selection criteria to prioritize projects, developed a restoration workshop, and coordinated efforts to develop shoreline and habitat restoration site design plans for a selected site. The roundtable is also drawing on the expertise of other reserve staff; for example, the education coordinator serves as an advisor on the education committee. The roundtable received a Science Collaborative grant in October 2021 to implement a project, "State of the York: A Holistic Synthesis of Placed-based Data for Informed Decision-making and Outreach."

Accomplishment: The Chesapeake Bay-Virginia Reserve reinvigorated the York River and Small Coastal Basin Roundtable, which is providing a platform for collaboration on water quality and conservation within the watershed.

The coordinator worked with the Chesapeake Bay Sentinel Site Cooperative to develop and host a coastal farming/woodlot workshop on sea level rise impacts, including salinization of agricultural fields. This is an area of interest across the Chesapeake Bay region, and there is currently relatively little programming about this issue. The reserve is exploring a community of practice to continue the conversations. The NOAA Office for Coastal Management encourages the reserve in its efforts to address the needs of this new audience and to explore opportunities to work with other reserves in the Chesapeake Bay region on this issue.

The Coastal Training Program's expansion into serving in a stakeholder convening role and engaging with different communities is appreciated by the reserve's partners and is enabling the reserve to better integrate its science into decision-making. The expansion of the Coastal Training Program's role is setting the reserve up to have an even more impactful role in the region. There are a number of additional opportunities the reserve should consider. The reserve is encouraged to look for opportunities to further incorporate the reserve's research and monitoring into training programs and outreach. For example, the reserve could host a water quality summit highlighting water quality data and emerging issues such as PFAS and microplastics. The reserve is well positioned to support the state in the implementation of the *Virginia Coastal Resilience Master Plan*, with each sector being able to contribute. The reserve could also expand its work with the farming community and potentially work with other reserves in the region to work with this new audience. The program can also expand support of regional restoration efforts, helping coordinate stakeholders, and bringing the latest reserve research and monitoring data to stakeholders in the region.

In 2020, with the impacts of COVID-19, the Coastal Training Program successfully pivoted to new delivery mechanisms and broadened its audience through virtual settings. The coordinator also led "COVID on the Coast," a virtual best practices space for stakeholders to discuss and

share lessons learned about learning through a virtual environment
(<https://padlet.com/ctpcoordinatorcbtnerr/covidonthecoast>).

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve in its efforts to expand the scope of the Coastal Training Program to include serving the community through leadership and facilitation of partners around key areas such as the York River and Small Coastal Basin Roundtable and providing technical assistance.

Habitat Science and Monitoring

Overview

The reserve is a leader in habitat science locally, regionally, nationally, and globally and is valued for its technical advisory service. This strength is supported by a strong relationship with the reserve's state partner, the Virginia Institute of Marine Science. The reserve's habitat research and monitoring focuses on seagrasses, emergent wetlands, and the marsh-upland transgression zone.

Monitoring

All four of the reserve components are operational sentinel sites, with required infrastructure, monitoring, and analyses elements. The comprehensive infrastructure includes more than 45 sediment elevation tables (SETs) with associated feldspar marker plots, groundwater monitoring wells, and the boardwalks needed to access them. High-resolution tide gauges are maintained at Catlett Islands, Taskinas Creek, and Sweet Hall Marsh, while Goodwin Islands makes use of data from a nearby NOAA Center for Operational Oceanographic Products and Services-maintained long-term gauge.

Emergent wetland vegetation is monitored using fixed transects at each reserve component to assess plant diversity along a salinity gradient and in response to sea level rise. Three of the four reserve components have biomonitoring transects that extend into the forest upland to monitor marsh transgression in response to rising sea levels. Submerged aquatic vegetation is monitored using fixed transects at Goodwin Islands and Gloucester Point. Monitoring quantifies inter-annual variability in shoot density and distribution and looks for any correlation with water quality parameters. The reserve is a participant in SeagrassNET and monitors seagrass beds adjacent to Assateague Island National Seashore in partnership with the National Park Service's Northeast Coastal and Barrier Network.

Reserve components serve as reference sites to evaluate restoration project success and are areas to trial and demonstrate restoration and adaptation techniques. Several studies that pilot habitat adaptation or mitigation strategies to sea level rise have taken place at the reserve, including thin-layer placement, seagrass seeding, and nutrient reduction.

A habitat map for the Goodwin Islands was recently approved by the national system's Habitat and Change review committee, and a map for the Catlett Island component is in progress. Reserve staff have developed capacity and expertise with uncrewed aerial system (UAS) technology that has potential to support future deliverables for other component sites. These maps support the spatial location of research projects and are the foundation for tracking change over time.

The reserve is encouraged to explore opportunities for additional support for completing the habitat maps and to look at opportunities for using more efficient mapping techniques. There may be opportunities to partner with students at William and Mary's Center for Geospatial

Analysis to support creation and evaluation of reserve system's habitat mapping and change products. The reserve is also encouraged to work with the Office for Coastal Management as it is increasing its geospatial capacity and has recently created a new Mid-Atlantic geospatial coordinator position.

The reserve has exceptional water quality monitoring data that is archived comprehensively. With the new Environmental Data Center and expansion of monitoring and completion of the habitat map for Goodwin Islands, there is an opportunity to bring together and integrate data around one geography such as Goodwin Islands as a valuable tool for future research. The reserve could include human dimensions data, such as qualitative data for water quality and potentially verbal and photo data from tribes and others, to provide context. The reserve will be collecting this data for the next two years as part of a Science Collaborative grant-funded project, "State of the York." Integration of multiple data sets will be a labor intensive process and require significant resources. The national system is just beginning to look at setting standards, and reserve staff do not want to get far ahead of the national system. The reserve is encouraged to work with the national system and the Office for Coastal Management's new Mid-Atlantic geospatial coordinator to further investigate the potential of this type of project.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to (a) investigate opportunities for integrating data around one geography such as Goodwin Islands and (b) complete habitat and change maps for all components. The reserve is encouraged to work with the National Estuarine Research Reserve System and the Office for Coastal Management's new Mid-Atlantic geospatial coordinator to further these efforts.

The reserve was a founding member of the Chesapeake Bay Sentinel Site Cooperative. Reserve staff are members of the cooperative's management team, SET workgroup, and Education and Outreach workgroup. The cooperative uses reserve research and data along with other work in the region to understand how marshes are responding to sea level rise. The reserve advanced the idea of a two-day Marsh Resilience Summit and helped create a successful summit with 200 participants from 125 agencies. The reserve also assisted with bringing the cooperative together after the summit to talk about next steps for the collaborative. The reserve has also brought its knowledge and national connections to members, for example, presenting its work on conducting marsh rapid assessments at 10 sites in the bay, which was based on work done by the Narragansett Bay Reserve. The reserve has helped the cooperative address member and regional needs, for example conducting a SET 101 Workshop for members and interested parties.

Research

The reserve's four components are used as study sites for multiple interdisciplinary and collaborative research projects. Examples include a U.S. Geological Survey study that used field measurements to correct LiDAR, a Smithsonian Environmental Research Center study to collect intertidal methane emissions with remotely sensed data, and a multi-institution study to assess spatial variation in subsidence across Chesapeake Bay.

The value of the reserve's high-quality long-term environmental data sets was noted by a number of partners as a large draw for outside investigators to conduct research there. The high standards for data quality control and assurance supports trust in the data. The reserve's location within the institute has also centered it as a research hub in the region.

Research at the reserve is supported by a strong relationship with institute investigators and the Center for Coastal Resources Management on campus. Collaborations include partnering with reserve staff on multiple grants and working with outreach and training programs at the reserve. The center also regularly accesses monitoring data collected and managed by the reserve.

Reserve staff provide extensive logistical support to outside research projects taking place on component sites or using long-term data streams. Researchers cited the ease of working with reserve staff members and their enthusiasm and support. The reserve also serves as a popular site for student field trips.

Research at the reserve informs management of natural resources in the Chesapeake Bay. In a research project highlighted during the evaluation, a researcher from the institute discussed their work at Goodwin Islands and the natural resource management implications. Their research showed that the ecosystems just inland of the saltwater marshes were the most vulnerable to sea level rise, leading decision-makers in the region to realize that they needed to focus on preserving lands that will become marsh in the future. Another researcher discussed their work and how reserve lands are keeping up with sea level rise, but eelgrasses are threatened by increases in water temperature. The reserve has partnered to work on a project in Broad Bay looking at varieties of eelgrass resistant to temperature. The reserve selected a site at Goodwin Islands for comparison and is doing water quality and sediment transfer monitoring.

The reserve participated in an eight-reserve Science Collaborative project to test the use of thin-layer placement across diverse marsh plant communities, entitled "Thin-Layer Sediment Placement: Evaluating an Adaptation Strategy to Enhance Coastal Marsh Resilience." The team assessed the impact of elevation, sediment type, and layer thickness on the success of this marsh adaptation technique. Greenhouse experiments exploring the effect of sediment texture and the addition of biochar as a soil amendment complemented these field studies. A Hollings Scholar developed an ESRI Story and lesson plan based on the project (<https://www.arcgis.com/apps/MapSeries/index.html?appid=3e39b76e7e834717b333d7e579373ecb>).

A representative of the NOAA Chesapeake Bay Office also highlighted their work with the reserve concerning resilience and habitat restoration. The Chesapeake Bay Program has a goal of restoring 185,000 acres of submerged aquatic vegetation. As part of this effort, NOAA has been working with the reserve to develop 25 sentinel sites across the bay and is relying on submerged aquatic vegetation research at the reserve to guide future research and

management activities. Since the evaluation site visit, NOAA has selected the Middle Peninsula as a Habitat Focus Area and will be focusing its programs and investments to address fish and shellfish productivity, restoring shorelines, and building capacity for restoration. The effort will heavily rely on partners like the reserve and York River and Small Coastal Basin Roundtable, local governments, U.S. Department of Defense, U.S. Fish and Wildlife, The Nature Conservancy, and other partners.

During the evaluation, additional science and monitoring opportunities were discussed that the reserve may wish to consider:

- Expanding the reserve's technical advisory services to support rapid vulnerability assessments of identified critical habitats and associated engineering and dredge projects.
- Pursue increasing the amount of vegetation monitoring data submitted to the Central Data Management Office, especially for emergent marshes. National system approved protocols are followed to monitor submerged and emergent wetland communities. The quality of local quality assurance and quality control of these data is exceptional.
- Expand the current emergent marsh research and monitoring network and collect additional metrics to assess sediment and biomass dynamics in emergent marshes. This data could be used to inform forecasting models such as the Marsh Equilibrium Model, enhancing the application of adaptive management approaches in the area.

Stewardship

Land management takes place in cooperation with the Virginia Department of Conservation and Recreation and a private landowner, the Tacoma Hunting and Fishing Club. Activities include boundary maintenance, public access, and natural resource management. Department of Conservation and Recreation Park Rangers, Department of Wildlife Resources Conservation Police, and Marine Resources Commission Marine Police provide law and regulation enforcement capabilities. Public access is allowed at the Goodwin Islands, Catlett Islands, and Taskinas Creek, where the public can engage in wildlife viewing, waterfowl hunting, and fishing. Taskinas Creek is within York River State Park and has more diverse public uses, including biking and equestrian trails. Sweet Hall Marsh is privately owned and general public access is not permitted, but fishing and crabbing are allowed in the surrounding waters. Recreation infrastructure includes kayak launches, boardwalks, and 18 waterfowl hunting blinds.

Chesapeake Bay habitats are sensitive and vulnerable to impacts from stressors such as climate change, pollution, and land use. The reserve's habitat Sentinel Site Monitoring Program, and related research studies, are increasing understanding of how stressors impact habitat and informing the development and implementation of mitigation strategies to enhance habitat resilience. The stewardship and Coastal Training Program coordinators are planning on partnering to work with a Hollings Intern on public access. The project will include working with the Virginia Coastal Program and contribute to the State of the York Report.

Natural resource management plans have been created for each site component, and target species management plans, such as for the diamondback terrapin, are in place. The

management plans are nearing the end of their intended 10-year life span. The reserve is encouraged to explore opportunities to work with Virginia Department of Conservation and Recreation staff to update existing natural resource plans. Updates should incorporate future ecological condition states and adaptive management planning where possible. Plan updates would also provide the opportunity to incorporate enhanced study and conservation of archaeological resources. The diamondback terrapin management plan and implementation of key strategies has been very successful. As resources are available, the reserve could consider developing species-specific management plans and actions for additional species of concern. The evaluation team also heard from partners an interest in completing natural resource surveys in understudied areas of the reserve, such as the forest upland areas at Taskinas Creek and Sweet Hall Marsh, and an interest in implementing shorebird and secretive marsh bird surveys at each component site. The reserve could also look for opportunities to increase and diversify funding to support natural resource management and monitoring visitor use.

Staff capacity is a challenge across the reserve, including the stewardship sector. The stewardship sector is responsible for resource management and restoration at the reserve's four component sites, for research and monitoring of tidal wetland habitats, providing technical assistance to landowners and natural resource professionals, supporting external research on reserve lands, and for participation in national system initiatives, including several workgroups and the Habitat Mapping and Change program. The stewardship sector is also responsible for the reserve's GIS program and emergency response activities and is involved in several NERRS Science Collaborative projects and regional committees such as the Chesapeake Bay Sentinel Site Cooperative.

Additional staff capacity, through the addition of a conservation specialist, would allow the stewardship coordinator to have more time for high value activities, including grant writing; research, data synthesis of reserve monitoring data, and writing papers or other outreach activities to share results; partnering in more depth with researchers doing work of high interest to the reserve; and as discussed in the next section, expanding the reserve's leadership and participation in applied habitat restoration research.

The reserve is also encouraged to look at other opportunities for supporting stewardship at the reserve. The reserve could benefit from creating a stewardship coordination group to discuss, plan for, and address natural resource issues of shared interest. This group could potentially sit under the umbrella of the York River and Small Coastal Basin Roundtable, as the *Phragmites* workgroup had done in the past. The reserve could explore additional opportunities for expanding capacity as well, through fellows, a management-focused post-doctoral researcher to write up manuscripts, science-writer contractors to produce other types of outreach products, or partnerships within the institute or nonprofits.

Resilience and Sustainability through Habitat Restoration and Protection

In addition to water quality assessments and observing networks, habitat and restoration science is a backbone element of the reserve's activities. However, there is an opportunity to expand this purview to explore opportunities to test new technologies and adaptive management strategies on reserve lands in support of habitat protection, mitigation, and creation. This expansion of scope is especially relevant in the context of climate change and its impacts, including sea level rise and warming waters. The addition of habitat restoration projects would involve additional staff experience in project planning, permitting, and implementation. Projects located on reserve lands could be used to demonstrate best management practices and restoration and adaptation science to other natural resource professionals and local decision-makers.

The Infrastructure Investment and Jobs Act, passed in November 2021, will be providing funding across the next five years to strengthen physical and natural infrastructure, including coastal habitats. The region will have increased opportunities to restore coastal habitats, and the reserve is well positioned to inform and participate in restoration projects. The reserve could capitalize on its partnerships with the institute's Center for Coastal Resources Management and Marine Advisory Program, the Virginia Coastal Zone Management Program, and others to implement habitat restoration projects on reserve lands and to share lessons learned throughout the region.

The reserve may also be able to apply for federal funding to complete land acquisition projects that are priorities in the reserve's management plan. The reserve could consider identifying nonprofit partners such as The Nature Conservancy or Trust for Public Land to move projects forward in a time frame that matches the rapid pace of real estate transactions.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to expand its role in habitat restoration on reserve properties to test new technologies and adaptive management strategies to support habitat protection, mitigation, and creation in the Chesapeake Bay region and to share these results with decision-makers.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay-Virginia Reserve to pursue priority land acquisition projects in its management plan and consider the availability of upcoming federal funding.

The reserve may wish to consider the following as it builds its capabilities in habitat restoration:

- Pursuing opportunities for staff development in the process of project planning, permitting, and implementation. Several projects that advance nearshore resilience through climate-adaptive and nature-based restoration have been implemented in Maryland and Delaware, so there may be opportunities for Chesapeake Bay-Virginia staff to gain "lessons learned" from these geographies.

- Looking for opportunities to get site-specific restoration and adaptation project designs and permitting in place so “shovel ready” projects can be strategically prepared for funding opportunities that may arise.
- Exploring the beneficial use of sediments from Back Creek at Goodwin Islands as part of an Army Corps of Engineering project currently being planned.
- The potential of using sediment from dredging projects planned for Cedarbush and Timberneck Creek for thin-layer placement in degraded marshes at Catlett Island.
- Looking for opportunities to partner with, and leverage assets of, the institute's Center for Coastal Resources Management. By exploring efficiencies and opportunities for shared programming, the reserve could potentially provide sites for the center to expand current demonstration projects beyond the Carl Hershner Teaching Marsh. Partnering could also extend the reach of the reserve’s expertise in habitat science by reaching center audiences such as the Pamunkey Indian Tribe, with whom the center recently worked to prepare a shoreline management plan.
- Exploring opportunities to streamline the permitting process.

Resilience and Sustainability through Education and Outreach

The education program strives to increase awareness and understanding of the estuary through formal and informal programs for students, teachers, and the local community. The education program translates science into products and programs for its audiences and is building environmental literacy and resilience for coastal communities. The education program also supports the state by serving in state organizations, councils, and boards. The education program has reached more than 450 educators and 1,700 members of the public through outreach activities in the last three years.

The education program conducted a market analysis and needs assessment in 2020 focused on teacher professional development needs across the state. Based on the results, priority areas were identified including hands-on inquiry field experiences, professional development for teachers on estuary and ocean science, and the use of locally relevant scientific data. The findings are being used to guide topics and directions for future Teachers on the Estuary (TOTE) workshops, as well as to understand teachers’ attitudes and self-efficacy with experiential learning.

The coordinator works closely with the institute’s education program, and in 2019 they partnered on a TOTE workshop, allowing for more staff support for a class of 16 teachers. These efforts align with the national system’s increased focus on educating teachers, an area of potential growth and positive impact. The education program has also expanded its efforts to work with graduate students and to provide informal education opportunities.

In 2017, the reserve received two-year funding to create the Virginia Scientists and Educators Alliance (SEA) program. This is a very popular program with students and institute staff that gives students the opportunity to work with researchers and teachers to develop K-12 lesson

plans based on their research. The lesson plans are then reviewed by teachers and tested with students. The final lesson plans are published at William and Mary (https://scholarworks.wm.edu/vasea_lessonplans/) and receive DOI [Digital Object Identifier] numbers. The lesson plans can be added to students' Google Scholar profiles. At the time of the site visit, 44 lesson plans had been published by 42 students. The institute and the evaluation team received positive feedback from students, who value the opportunity to hone their communication skills and ability to translate science for the public. The institute also sees great value in the program, and when the original Bay Watershed Education and Training (B-WET) grant expired, the institute stepped up to fund the program. The reserve modeled the program on a similar program piloted by the North Carolina Reserve and has since shared the program's impacts at a national reserve system conference. The program has been adopted in Oregon, and Florida is considering adopting the program as well.

An area of growth for the education program has been an increase in efforts to reach teachers and pre-service teachers (student teachers who are enrolled in a teacher education program and working toward teacher certification), and participate in the development of state-level education requirements. The education coordinator is working towards a PhD and is serving as an adjunct professor, teaching a class for future science teachers.

The reserve partnered with the Virginia Institute of Marine Science Marine Advisory Program to train 132 pre-service teachers in conducting outdoor science education and fieldwork. The program, Virginia Teachers Innovating and Designing Experiential Science (VATIDES), draws students from James Madison University, Virginia Wesleyan University, Virginia Commonwealth University, and the William and Mary School of Education. In Virginia, students are required to complete Meaningful Watershed Educational Experiences at least three times—in grade school, middle school, and high school—as part of the state's implementation of the 2014 Chesapeake Bay Watershed Agreement. A watershed experience consists of an outdoor science investigation and a follow-up action project, which is used to teach concepts in biology, chemistry, and physics classes. VATIDES is building the capacity of teachers to conduct outdoor science and education at the beginning of their careers and has the potential to impact generations of Virginia students. The program is currently funded through a NOAA B-WET grant.

Accomplishment: The Chesapeake Bay-Virginia Reserve and Virginia Institute of Marine Science Marine Advisory Program are leaders in creating exceptional educational opportunities for university undergraduate and graduate students, pre-service teachers, and teachers to learn about communicating science and conducting outdoor science education. Two highlights are the Virginia Teachers Innovating and Designing Experiential Science (VATIDES) program and the Virginia Scientists and Educators Alliance (SEA) program.

Recommendation: The NOAA Office for Coastal Management encourages the Chesapeake Bay, Virginia Reserve and Virginia Institute of Marine Science to continue to build on the Virginia Teachers Innovating and Designing Experiential Science (VATIDES) program to support and train pre-service teachers in outdoor science education and fieldwork.

The reserve runs extremely popular summer camps that students and parents describe as transformative and a key part in their decision to pursue a career in science, natural resources, and environmental education. The field trip experiences are praised by teachers and parents in the region. The reserve hosted a NOAA Hollings scholar who conducted a survey to look at the impacts of the first 10 years of VIMS summer camp. The survey found that the majority of students majored in science and went to college.

A cornerstone public educational offering has been Discovery Labs, which began in 2007. Typically, the reserve hosts eight events a year with an expert presentation, research and management issues related to the topic, and relevant kids' activities. The program averaged 643 participants per year, pre-COVID-19. In March 2020, the activities were moved online through 2021. In 2020, close to 9,000 participated in eight events, greatly expanding the reserve's reach. The reserve also pivoted in other activities during COVID and developed a social media campaign, webcasted book readings for younger students, and held a Virginia SEA expo. Going forward, the reserve will need to consider the balance of focusing on its core audiences and opportunities to conduct programming with a greater order of magnitude, or more reach.

The reserve's education program supports state-level curriculum development. The education coordinator served on a committee that created content guidelines for a secondary-level environmental science course and trained teachers on how to hold meaningful field experiments. The education coordinator also helped develop oceanography content guidelines and will be serving on a newly formed committee to look at how the state can provide equitable experiences to all students. The education coordinator also served as chair of the Virginia Resource-Use Education Council, a consortium of state agencies that promotes K-12 environmental education.

Accomplishment: The Chesapeake Bay-Virginia Reserve provides students with life-altering learning opportunities, which have encouraged many students to consider a career in STEM.

The reserve has a very successful education program but finding and maintaining funding for educational programming is challenging and requires pursuing multiple grants. The education program benefits from having dedicated funding for its summer camp. The addition of staff support for communication and administration of grants would help the education program maintain its high level of programming and continue to grow in priority areas. The new master's in marine science program at the institute is also providing the reserve with access to students who are interested in policy, outreach, and education fields and participating in reserve programming.

The evaluation team and participants identified a number of opportunities the reserve may wish to consider.

- Explore opportunities for the reserve and institute to facilitate a joint degree program for students to obtain a teaching license while obtaining an MA or MS degree at the institute.

- Explore the opportunity to develop or contribute to a natural resource management course at the institute, as the reserve builds its capacity and deepens its engagement in natural resource management.
- Continue partnering with other educational organizations to leverage funding and increase staff capacity.

Evaluation Metrics

Beginning in 2012, national estuarine research reserves began tracking their success in addressing three evaluation metrics specific to their programs. The evaluation metrics include a five-year target and provide a quantitative reference for each program about how well it is meeting the goals and objectives it has identified as important to the program. The education, coastal training, and stewardship sectors track data by cooperative agreement cycle. The research sector collects data by calendar year. In 2017, national estuarine research programs began a new five-year period and set targets specific to their programs from existing national measures. The first four years of data collection for the period of 2012-2017 are included in the evaluation.

Evaluation Metrics: 2012-2017

Metric 1

Goal: *Reserve Management Plan Goal 3.* Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making.

Objective: *Reserve Management Plan Goal 3, Objective 1.* By 2017, communicate results of research, environmental monitoring, and best available science-based information to assist in improved coastal resource management.

Strategy: Conduct applied research, with an emphasis on reserve focus areas (ecosystem vulnerability to climate and human-induced stressors; functions and linkages of land-margin ecosystems; water quality), and disseminate results in appropriate scientific and resource management publications.

Performance Measure: From 2012-2017, number of peer-reviewed journal manuscripts authored or co-authored by reserve staff and submitted annually for publication addressing one or more of the reserve's priority research focus areas.

Target: From 2012-2017, one (1) peer-reviewed journal manuscript authored or co-authored by reserve staff and submitted annually for publication addressing one or more of the reserve's priority research focus areas.

Results:

- Year 1 (2012-2013) = 1 peer-reviewed journal article published
- Year 2 (2013-2014) = 2 peer-reviewed journal articles published
- Year 3 (2014-2015) = 1 peer-reviewed journal article published
- Year 4 (2015-2016) = 3 peer-reviewed journal articles published
- Year 5 (2016-2017) = 4 peer-reviewed journal articles published

Total: 5 of 5 years met or exceeded target. The reserve averaged 2.2 peer-reviewed journal manuscripts annually with a total of 11 over the 5-year period.

Discussion: The reserve exceeded its target three out of five years. The number of papers per year increased during the last two years. The data includes peer-reviewed papers published in journals reported on annually in the progress reports or included in the CBNERR-VA Research Bibliography (2021) at https://www.vims.edu/cbnerr/_docs/research_docs/publish.pdf.

Note: The reserve did not use the National Estuarine Research Reserve System research database for reporting and instead reported through the semi-annual cooperative agreement reports. Therefore, research publications are tracked by cooperative agreement cycle and by publication date.

Metric 2

Goal: *Reserve Management Plan Goal 4.* Increase public awareness, understanding, and appreciation of coastal environments.

Objective: *Reserve Management Plan Goal 4, Objective 1.* By 2017, increase student and teacher knowledge and understanding of coastal environments through formal education programs.

Strategy: Provide inquiry- and science-based field, laboratory, and classroom instruction to students that focus on the value and conservation of estuaries.

Performance Measure: From 2012-2017, number of K-12 and college student education programs hosted by the reserve that focus on the value and conservation of estuaries.

Target: From 2012-2017, 20 K-12 and college student education programs will be hosted by the reserve that focus on the value and conservation of estuaries. (annual)

Results:

- Year 1 (2012-2013) = 64 education programs
- Year 2 (2013-2014) = 51 education programs
- Year 3 (2014-2015) = 75 education programs
- Year 4 (2015-2016) = 36 education programs
- Year 5 (2016-2017) = 47 education programs

Total: 5 out of 5 years exceeded target. The reserve averaged 54.6 Education Programs a year and completed 273 education programs.

Discussion: The reserve exceeded its five-year target by over 10 times. The target was set at a very low level.

Metric 3

Goal: *Reserve Management Plan Goal 3.* Promote the effective management and conservation of natural and cultural coastal resources through informed decision-making.

Objective: *Reserve Management Plan Goal 3, Objective 1.* By 2017, communicate results of research, environmental monitoring, and best available science-based information to assist in improved coastal resource management.

Strategy: Provide the best available science-based information and skill building opportunities, with an emphasis on reserve focus areas (ecosystem vulnerability to climate and human-induced stressors; functions and linkages of land-margin ecosystems; water quality; integrated ocean observing systems) to coastal resource decision-makers and other appropriate stakeholder groups through a variety of formats, including training workshops, sponsored conferences, and developed information products.

Performance Measure: From 2012-2017, number of targeted and requested training workshops held annually to build coastal decision-maker capacity and promote the use of recent research results on reserve focus areas.

Target: From 2012-2017, six (6) targeted and requested training workshops held annually to build coastal decision-maker capacity and promote the use of recent research results on reserve focus areas.

Results:

- Year 1 (2012-2013) = 9 training workshops
- Year 2 (2013-2014) = 5 training workshops
- Year 3 (2014-2015) = 11 training workshops
- Year 4 (2015-2016) = 7 training workshops
- Year 5 (2016-2017) = 5 training workshops

Total: The reserve met its target 3 out of 5 years. The reserve averaged 7.4 training workshops a year and had a total of 37 training workshops over the 5-year period.

Discussion: The reserve met its target 3 out of 5 years. Overall the reserve had a strong Coastal Training Program with numerous trainings, but some years were much higher than others.

Evaluation Metrics: 2017-2022

Metric 1

Goal: Improve the scientific understanding of estuaries and their watersheds through the development and application of reserve research, data, and tools.

Objective: Scientific, management, and education audiences will know about and effectively use research, data, and products to understand the effects of climate and land-use change on estuaries, ecosystem services, and human well-being.

Strategy: Communicate reserve research through publication in peer-reviewed journals, social media, and presentations at conferences (e.g., biennial York River Research Symposium) and organizational seminars.

As a university-based reserve administered by the Virginia Institute of Marine Science, William & Mary, Chesapeake Bay-Virginia Reserve staff are ingrained with the philosophy to conduct research that matters. Peer-review and publication of research findings is the foundational step to measure and maximize scientific impact to academia and benefits to human society and the

environment. The reserve will continue its history of applied scientific contributions with an emphasis on water quality and environmental impacts to critical estuarine habits.

Performance Measure: From 2017-2022, number of peer-reviewed published papers and technical reports authored or co-authored by reserve staff.

Target: From 2017-2022, 10 peer-reviewed published papers and technical reports authored or co-authored by reserve staff.

Results:

Year 1 (2017-2018)	2 peer-reviewed papers
Year 2 (2018-2019)	2 peer-reviewed papers
Year 3 (2019-2020)	9 peer-reviewed papers
Year 4 (2020-2021)	8 peer-reviewed papers

Total to Date: 21 peer-reviewed papers

Discussion: The reserve has a high-performing research program and publishes extensively. The initial target was low relative to the reserve’s capabilities. During the first two years, the reserve solely reported on just enough papers to meet the target and in the past two years began reporting more comprehensively.

Note: The reserve did not use the National Estuarine Research Reserve System research database for reporting and instead reported through the semi-annual cooperative agreement reports. Therefore, research publications are tracked by cooperative agreement cycle, and the list includes not only published papers but those in pre-publication.

Metric 2

Goal: Improve the scientific understanding of estuaries and their watersheds through the development and application of reserve research, data, and tools.

Objective: Reserves and coastal researchers will increase their collaborative research to address the needs of decision-makers and stakeholders.

Strategy: Use a permit system to coordinate and track research and related activities within reserve boundaries.

Providing secure and long-term places for research and education is an important goal for the success of reserve and protected area networks. The Chesapeake Bay-Virginia Reserve requires a basic research permit, to be submitted by principal investigators, for all approved research and monitoring activities with reserve boundaries. Benefits of such permits include (1) potential for value-added collaborations, coordination, and exchange of information; (2) assurance that proposed activities do not interfere with ongoing efforts of others or with reserve monitoring efforts; and (3) delivery of a final product for reserve archives. Note: monitoring projects are only tracked under “Monitoring” and research projects only under “Research” in the NERRS Research database. Research and monitoring projects are tracked by calendar year, not cooperative agreement cycle.

Performance Measure: From 2017-2022, the average number of research and monitoring projects carried out per year within reserve boundaries.

Target: From 2017-2022, an average of twenty-five (25) active research and monitoring projects carried out per year within reserve boundaries.

Results:

- Year 1 (2017-2018) = 27 *active research and monitoring projects
- Year 2 (2018-2019) = 46 active research and monitoring projects
- Year 3 (2019-2020) = 38 active research and monitoring projects
- Year 4 (2020-2021) = 31 active research and monitoring projects

Average to Date = 35.5 active research and monitoring projects

Discussion: As discussed throughout the findings, the reserve's monitoring data is highly valued and the reserve is a partner in many active research projects in the region. The reserve is on its way to exceed its five-year target.

Note: The reserve did not use the National Estuarine Research Reserve System research database for reporting and instead reported through the semi-annual cooperative agreement reports. Therefore, active research and monitoring projects are tracked by cooperative agreement cycle.

*No data was reported specific to year one. Year one data is based on what was reported in Year 2 and only includes research and monitoring projects clearly active over the 2017-2018 cooperative agreement period. The actual number is likely higher.

Metric 3

Goal: Advance environmental literacy and appreciation, allowing for better resource stewardship and science-based decisions that positively affect estuaries, their watersheds, and communities.

Objective: Educators and students will better understand and use the reserve system and NOAA resources for place-based and inquiry-based learning.

Strategy: Provide teacher trainings that are consistent with NERRS TOTE criteria and state science performance standards.

Ongoing professional development provides teachers with a myriad of benefits, including up-to-date information exchange, exposure to new curriculum and data, emerging technology-based tools, and experiential learning opportunities. The multiplier effect translates into a much greater number of students being impacted with each teacher that participates in professional development opportunities. The reserve system's Teachers on the Estuary (TOTE) is a research and field-based teacher training program that aligns Next Generation Science Standards and state standards, provides access to estuary and reserve education resources, and links educators and scientists in a supportive learning environment.

Performance Measure: From 2017-2022, number of Teachers on the Estuary (TOTE) educators participating in reserve-sponsored TOTE workshops.

Target: From 2017-2022, 100 teachers will participate in reserve-sponsored TOTE workshops.

Results:

- Year 1 (2017-2018) = 18 teachers
- Year 2 (2018-2019) = 16 teachers
- Year 3 (2019-2020) = 0 teachers
- Year 4 (2020-2021) = 22 teachers

Total to Date = 56 teachers

Discussion: The reserve set an ambitious target for its TOTE workshops. The reserve's ability to meet this target was impacted by COVID-19 in year 3, but the reserve was able to offer virtual teacher training in 2021. Due to the impacts of COVID-19, the reserve is unlikely to meet its five-year target.

Conclusion

For the reasons stated herein, I find that the Virginia Institute of Marine Science's operation and management of the Chesapeake Bay-Virginia National Estuarine Research Reserve, including education, research, and interpretative activities, is adhering to the programmatic requirements of the Coastal Zone Management Act and its implementing regulations.

These evaluation findings contain one necessary action that must be completed by the date given and nine recommendations that must be considered before the next regularly scheduled program evaluation, but that are not mandatory at this time. Recommendations that must be repeated in subsequent evaluations may be elevated to necessary actions.

This is a programmatic evaluation of the Chesapeake Bay-Virginia National Estuarine Research Reserve, which may have implications regarding the state's financial assistance awards. However, it does not make any judgment about or replace any financial audits.



Jeffrey L. Payne, Ph.D.
Director, NOAA Office for Coastal Management

August 22, 2022

Date

Appendix A: Response to Written Comments

Greta Olsen

Ernest F. Hollings Scholar

I am writing to tell you about my experience as an intern at the Chesapeake Bay National Estuarine Research Reserve in Virginia. This summer (June-August 2021), I worked virtually with the education department at CBNERR-VA through the NOAA Hollings program. As a part of the program, I got to participate in a research project at NOAA-affiliated research facility, and the project offered by CBNERR-VA was the one I selected. My main project was [to] design and implement an evaluation instrument for the marine science portion of Camp Launch, an informal learning experience for underserved students led by William and Mary. Over the course of the summer, I also helped to lead a Teachers on the Estuary workshop, create educational resources on coastal acidification in the Mid-Atlantic Region, and taught lessons and led activities related to Camp Launch.

I am currently a senior at the University of Kansas studying chemical engineering and was mainly drawn to my project because of the opportunity for educational outreach. After my first meeting with Sarah Nuss, my project mentor, I immediately knew that CBNERR was a place where sharing knowledge was highly valued, and employees cared about the environment and people around them. As a small-town Kansas girl who had never been to the east coast, my experience with CBNERR was completely eye-opening. I didn't realize how integral the Chesapeake Bay was to the culture and economy of the region. Even though I was helping to teach students and teachers about the Chesapeake Bay, I personally learned so much about the importance of the watershed and how to protect it, as well as about all of the wildlife and plants that live there.

One of my favorite parts of the summer was looking at an evaluation tool used for the Camp Launch students called the "Draw a Scientist Test". We slightly modified the test and asked ninth and tenth grade students to take five minutes to draw a marine scientist at work. After they were done drawing, students were asked to write three words they thought of related to their drawing. The drawings ranged from a stereotypical mad scientist in a lab to a scientist scuba diving with sharks, but most drawings heavily featured some sort of aquatic animal. After two weeks learning about the Chesapeake Bay, interviewing marine researchers, and getting tours of different research labs and doing research projects of their own, the students were again asked to draw a marine scientist at work. From my analysis of the drawings, it was clear that students expanded their knowledge of what work and tools a marine scientist used, and their drawings became more specific and included topics like the types of sediment and water chemistry.

When looking at the words used to describe their drawings, students predominantly used words describing the scientist in the pre-test, like "smart" and "hardworking". In the post-test, activity related words, like "investigating" and "observing" were the most common category of word[s]. These students were able to change their perceptions of a marine scientist in just a few weeks of camp because the CBNERR staff worked so hard to ensure that they would see a

wide range and realistic representation of the sciences related to the Chesapeake Bay. Teaching lessons with CBNERR also showed me how much I enjoy sharing my knowledge with others and that I want to include some part of teaching or mentorship in whatever my future career might be.

Although I unfortunately had to complete all of my internship virtually due to the pandemic, the CBNERR staff worked hard to make me feel a part of the team with regular check-ins and meet & greets. Plus, all of the programming this summer was virtual, so I didn't miss out on anything. I loved (just like the students and teachers did) the virtual field trips to the Chesapeake Bay, where staff would pull a sein[e] net or oyster trap and give all of us at home an up-close look at all the creatures that live in the waters. Even from 1000 miles away, I got a clear picture of what the Bay is like and how important it is to the people and animals that live there.

I truly enjoyed my time at CBNERR-VA. I learned so much about the Chesapeake Bay and gained the personal insights that education outreach, with a focus on the environment is something I want to continue. I have attached a few of my favorite marine scientist drawings from this summer to show what the students learned.

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Ms. Olsen for providing comments regarding her experience as a Hollings Scholar working with the reserve. The findings highlight many achievements of the NERR that depend on the contributions of Hollings Scholars. The partnerships of the NERR with the Hollings Scholars program has been, and we hope will continue to be, very successful.

**Marta P. Sanderson (she/her/hers)
Research Associate/Lab Manager
Virginia Institute of Marine Science**

I would like to take this opportunity to provide some of my personal comments on one of the many educational activities implemented by CBNERR at VIMS – the VIMS Summer Camps.

Both of my children have had the fortune of attending several of the VIMS Summer Camps over the last eight years. The summer camps have always been well organized, educational, and fun! Each camp focuses on different aspects of the Chesapeake Bay, from the animals and plants that are vital to the ecosystem, their habitats, and ways to help preserve and protect the bay and the environment in general. I continue to be impressed with the well thought out and planned educational components of each summer camp that incorporate hands-on experiences at appropriate age levels. Sarah Nuss and her team have all excelled at sharing their enthusiasm and knowledge of the bay with the kids during summer camps. It is extremely unfortunate that the pandemic resulted in two years of cancellation of the summer camps but hopefully they will be able to return to hosting these wonderful summer camps.

My children still look forward to hopefully attending more VIMS Summer Camps. They have also expressed interest in one day being able to volunteer to help with the summer camps for

younger kids. Any educational program that can hold a child's attention and interest over 8+ years and inspire them to want to return as volunteers is certainly doing something right and should be commended for its excellence.

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Ms. Sanderson for her comments. The office concurs with Ms. Sanderson's comments regarding the success of the summer camps, and the evaluation findings include a discussion of the summer camp program and its success in encouraging students' interest in science and the local environment.

Mike Rigdon

Chairman

Lake Anna Civic Association's Environmental Preservation Committee

I am Chairman of the Lake Anna Civic Association's Environmental Preservation Committee. We are primarily concerned with water quality and hazardous algae blooms in the Upper York River Watershed. The York River Roundtable managed by the Virginia Institute of Marine Science has provided an opportunity to bring stakeholders from the Blue Ridge Mountain Piedmont together with those from downstream near the Chesapeake Bay. This communication bridge provided by the Roundtable has enabled exchange of environmental concerns, water quality data, and ideas among people from various parts of the watershed who would otherwise have never met each other. The Roundtable is proving to be key to the eventual development of a unified approach to environmental issues across the entire York River Watershed.

I feel that the leadership provided by VIMS in bringing people together to discuss sub-regional issues is crucial for the success of efforts to supply truly clean water to the Bay from the York River.

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Mr. Rigdon for his response and concurs that the York River and Small Coastal Basins Roundtable provides a valuable platform for collaboration on water quality and conservation within the watershed. The NOAA Chesapeake Bay Office is a member of the roundtable and is very appreciative of the reserve's efforts. Reinvigorating the roundtable is highlighted as an accomplishment in the findings.

Donna M. Bilkovic

Assistant Director

Center for Coastal Resources Management

I am a research professor and serve as the assistant director to the Center for Coastal Resources Management (CCRM) at Virginia Institute of Marine Science. I and my colleagues at CCRM regularly interact with the CBNERR program in research, outreach and education. These efforts include

- Partnering with CBNERR researchers on multiple externally funded research grants and these projects rely on the excellent outreach and training programs and personnel that reside at CBNERR.
- CBNERR reinvigorated a multi-stakeholder York River Small Coastal Basins Roundtable (YRSCBR) to inform restoration and management in those watersheds and many members of CCRM are actively engaged in the YRSCBR. The Roundtable serves as an important outlet for science communication with key stakeholders.
- We regularly access monitoring data collected and managed by CBNERR for our work. CBNERR associated faculty serve as student committee members or provide expertise to our CCRM graduate students
- Collaboration on the development of the first Chesapeake Bay Marsh Resilience Summit (<https://chesapeakebayssc.org/marsh-summit/>)
- Collaboration on outreach and training events to provide science-based guidance on coastal management issues

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Dr. Bilkovic for her comments. The evaluation findings highlight the efforts cited by Dr. Bilkovic, including the York River Small Coastal Basins Roundtable, the reserve's monitoring data, and the Marsh Resilience Summit.

Ms. Jamie R. Young, M.Ed.
Earth Science teacher
Old Donation School

I just wanted to take a minute to let you know how valuable the workshops I participated in at CBNERR-VA have been. I have gone to the Estuaries 101 PD, the SAV Workshop and the TOTE workshop. All of them allowed me to bring back a variety of lessons/strategies that are so useful in my Earth Science classes. It is rare to go to professional development of this caliber. We not only worked with peers from all over but the field experiences allowed us to really delve into and understand the content so that we can better teach our students.

I hope CBNERR-VA has the chance to keep offering these quality opportunities for teachers. Thanks for your support of CBNERR-VA

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Ms. Young for her comments. The evaluation findings highlight the reserve's success in providing high-quality training opportunities for teachers.

Jessica Steelman
Coastal Planner
Accomack-Northampton Planning District Commission

I am writing to comment on the pleasure it has been to both collaborate with and learn from Chesapeake Bay NERR-Virginia and their Coastal Training Program, namely the Coastal Training

Program Coordinator. Since my time with the Accomack-Northampton PDC, which began back in December 2019, I have been actively engaged in trainings and courses offered by the CTP. My first experience was with Social Science Basics for Coastal Managers offered in-person in December 2019, which was a great starting point for me as the newly hired Coastal Planner with the A-NPDC. This course left me not only with a network I could continue learning from and working with, but with a greater understanding of how to be a great Coastal Planner and incorporate my background (BA Psychology) with my new career. Over the years, as we all know, courses have gone through the virtual phase - several of which I took, but one that stands out in particular because it offered the same feel and sense of networking as the in-person course. The Equitable Collaboration for the Coast series was beneficial in terms of lessons learned, but was also facilitated in a way that encouraged engagement, interaction, and perpetuation of networking after the course came to an end.

I have also had the pleasure of working with the Coastal Training Program coordinator in a collaborative nature through efforts such as being on the planning and development team for the Coastal Partners Workshop, hosted by the Virginia Coastal Zone Management Program. Working with the coordinator is always inspiring as her ideas flow freely and she is able to envision ideas offered by others and bring them together for a comprehensive experience. Even in collaborating with the coordinator, I learn how to better my own skill set as a planner and enjoy observing her techniques as a coordinator. Throughout experiences such as these, I look forward to continued collaborations with the Coastal Training Program coordinator and CBNERR, some of which we have already set preliminary plans for such as managed retreat, responsible recreation and tourism, and of major importance and focus this past year - resiliency - namely the impacts of flooding and sea level rise on agriculture.

NOAA Office for Coastal Management Response: The Office of Coastal Management thanks Ms. Steelman for her comment and is pleased to hear about her work with the Coastal Training Program. The findings recognize many of the achievements of the new Coastal Training Program coordinator.

Diane Brooks
Teacher

This is an excellent workshop and one of my favorites that I have attended and definitely should continue in the future for new teachers so they understand how important it is to teach about the Chesapeake Bay.

NOAA Office for Coastal Management Response: The Office of Coastal Management thanks Ms. Brooks for her comment. The evaluation findings discuss the positive impact of the reserve's teacher trainings.

Bill McConnell, Ph.D.
Director of Teacher Education
Associate Professor of Education
Co-Editor: The Teacher Educators' Journal
Virginia Wesleyan University

The VA-TIDES program has provided me (Associate Professor of Education & Director of Teacher Education) with excellent resources and training in sound Environmental Literacy Instructional Methods and Models (like the MWEE and ELM) so that our department can institutionalize this type of curriculum and instruction in our Teacher Education Program. Some specific examples of how this training provided such benefits are below:

1. VA-TIDES team presented clear and coherent direct instruction on MWEEs in a virtual format that was recorded. We can use this in future courses in our program.
2. VA-TIDES supported us in person on our campus so that my students and I could talk through the intricacies and logistics of specific outdoor investigations with large groups of students that would be great for our locale (i.e., water quality testing, quadrats, Leaf Packs). The expertise provided during this session assisted me and my students by providing different tricks and tips from experts who have done these investigations with K-12 students many times. These tips will be shared for years to come.
3. Putting a program like this into an existing class can be daunting. Staff of the VA TIDES program took time to talk through logistics of how this type of instruction could be a part of my class/program. This brainstorming and discussion helped me through the planning of it, and over the past two years the program has blossomed into something that is sustainable and meaningful for our students. I am also planning to include it in another course as well.

Overall, I have been extremely pleased with this program and the help that Sarah, Lisa, Bethany, and Tara have provided.

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Dr. McConnell for his comments. The office concurs that this is a successful program and has included a recommendation that the reserve continue to focus on this type of effort. The current program is funded through a grant, and the reserve will need to pursue additional grant funding to continue the program.

Rachel Riesbeck
School & Youth Program Specialist
Virginia Aquarium & Marine Science Center

I have attended a few programs with CBNERR including a teacher workshop, a mini-conference, a couple evening programs, and the VA SEA lesson plan expo (in-person, last two virtual versions). All of these workshops and programs have been well organized, informative,

collaborative, and highlight current topics important to our region. I have received dozens of resources that I've been able to use for my own professional development and that I've tweaked to use with student/youth audiences. It is so vital to have educators connected with a research organization so they can translate this information to the public. It is especially valuable to students who need to understand how science is conducted and use those skills to apply towards new knowledge. I would love to continue attending programs with CBNERR in the future and collaborating on other projects. If I can provide any more feedback, please let me know.

NOAA Office for Coastal Management Response: The NOAA Office for Coast Management thanks Ms. Riesbeck for her comments. The evaluation findings discuss the positive impact of the reserve's teacher trainings.

Beverly Myrick
Hermitage Elementary
School Office Associate

It has been a couple of years since I participated in a program through CBNERR-VA. I enjoy the oyster workshops as well as learning how to set up a "Chesapeake Bay" aquarium for our finds on our oyster floats. I use the information I received at those with the Ecology Club at Hermitage Elementary. I will be glad when I am able to attend another one.

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Ms. Myrick for her comments. The evaluation findings contain discussions of the reserve's educational opportunities, and we hope you will continue to enjoy future reserve programs.

Belinda T. Henriques
Meadowbrook High School
Earth & Space, Oceanography Science Educator
Earth & Space PLC Leader
Academic Team Coach

I teach Earth Science and Oceanography for Meadowbrook High School in Chesterfield VA. I have attended 2 workshops. One was virtual and one was in person. Both workshops were vital to my understanding of the Chesapeake estuary and the teaching resources and the experience of working with the staff has been immeasurable. It further improved my knowledge and it also provided me with practical lesson plans that I have been able to incorporate into my classroom.

About a month ago, I went to participate in a critter pull with other teachers. We went into the York river and with the help of everyone there - I was able to bring back to my classroom three fish and one crab. The education coordinator has been so wonderful in answering all of my questions and encouraging me - that having a brackish tank was doable!

The work that they are doing will help the future generations in understanding this important ecosystem. They provide the only resource that brings the estuary and ocean directly into my classroom.

Thank you for this opportunity to express my appreciation for the work they are doing and how valuable they are for teachers in Virginia.

NOAA Office for Coastal Management Response: The NOAA Office for Coast Management thanks Ms. Henriques for her comments. The evaluation findings discuss the positive impact of the reserve’s teacher trainings.

Veronica Tangiri

Ms. Tangiri shared a summary of a NOAA East Coast Satellite Data Training Project titled “Sediment, Turbidity and Water Temperature from Virginia Rivers into the Chesapeake Bay” (2019). The project explored the spatial data of sediment, temperature, and turbidity from four major rivers (Potomac, Rappahannock, York, and James Rivers) in Virginia that drain into the Chesapeake Bay.

NOAA Office for Coastal Management Response: The NOAA Office for Coastal Management thanks Ms. Tangiri for sharing her project and participating in the public meeting.