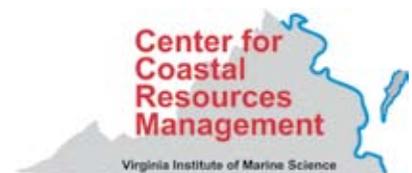




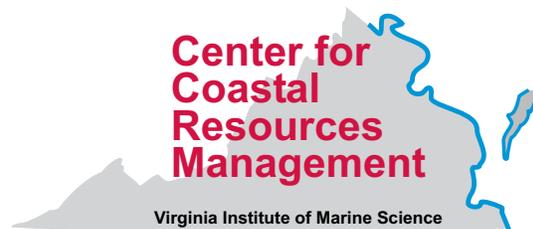
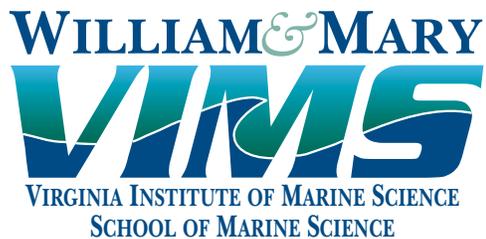
**CENTER FOR
COASTAL RESOURCES
MANAGEMENT**

**ANNUAL
REPORT
2006**



Center for Coastal Resources Management

2006 Annual Report



Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, Virginia 23062

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CENTER PROGRAMS

Background

The Center for Coastal Resources Management exists to develop and support integrated and adaptive management of coastal zone resources. To fulfill this mission, the Center undertakes research, provides advisory service, and conducts outreach education. These tasks are carried out by a staff of professional scientists and technical experts using a mix of state funding and grant/contract support.

Within its broader mission, the Center has specific tasks to support Virginia's wetlands and shoreline management programs. These core activities create a natural focus on the littoral zone and riparian lands in coastal and estuarine areas. Management of resources in these areas has evolved from resource-specific considerations to system-level perspectives. The Center has been an active agent in this change, and has developed the required internal capabilities and external collaborations to support multidisciplinary approaches to management and policy issues.

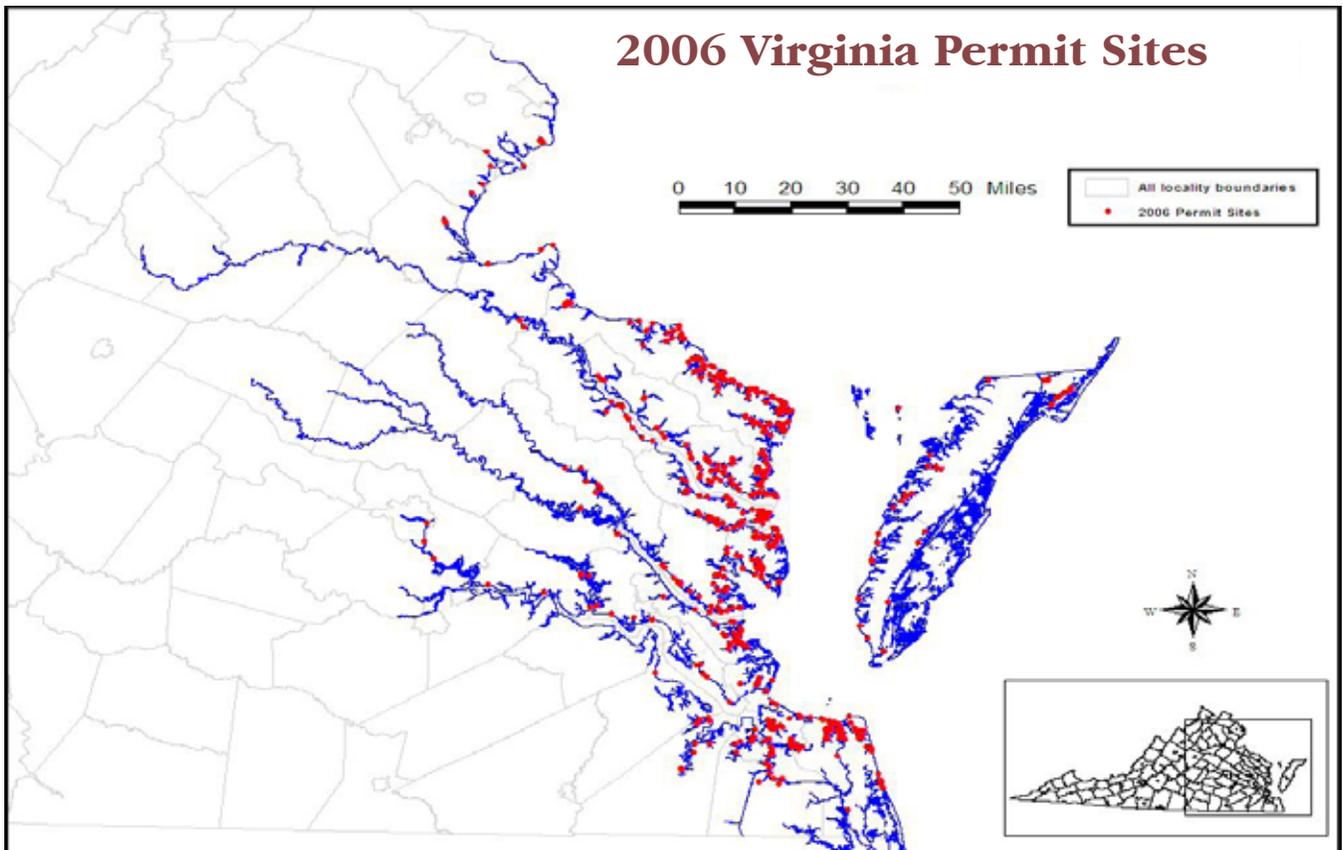
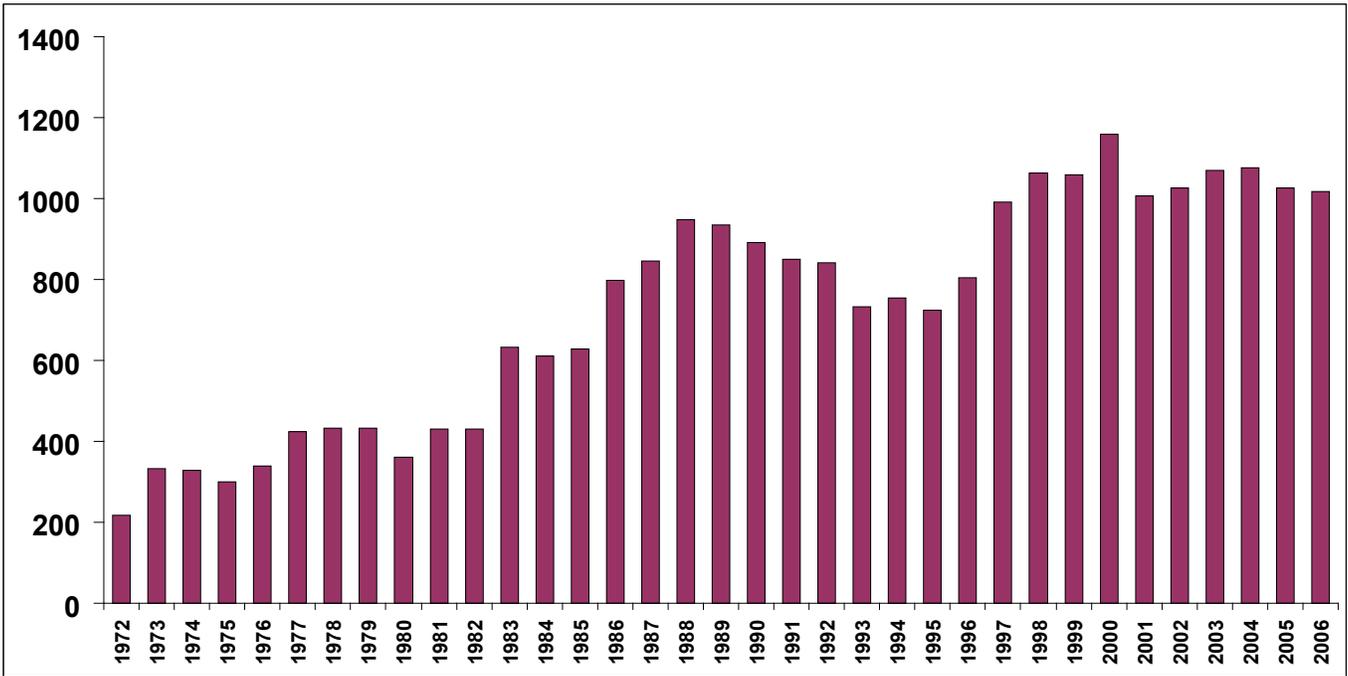
The Center currently manages its multiple activities within three broad and interacting programs.

The Wetlands Program



The Wetlands Program deals with both tidal and nontidal wetlands. The program conducts basic research on the structure and functions of these systems, collaborating with researchers throughout the mid-Atlantic region. A wide variety of applied research is also undertaken. This includes policy option analysis, functional assessment methods, inventory and monitoring techniques, and creation/restoration protocols. The Wetlands Program provides extensive support to the Commonwealth's two management programs through review of individual tidal wetland permit applications, training for local and state managers, and development/management of data bases supporting and tracking regulatory program activities.

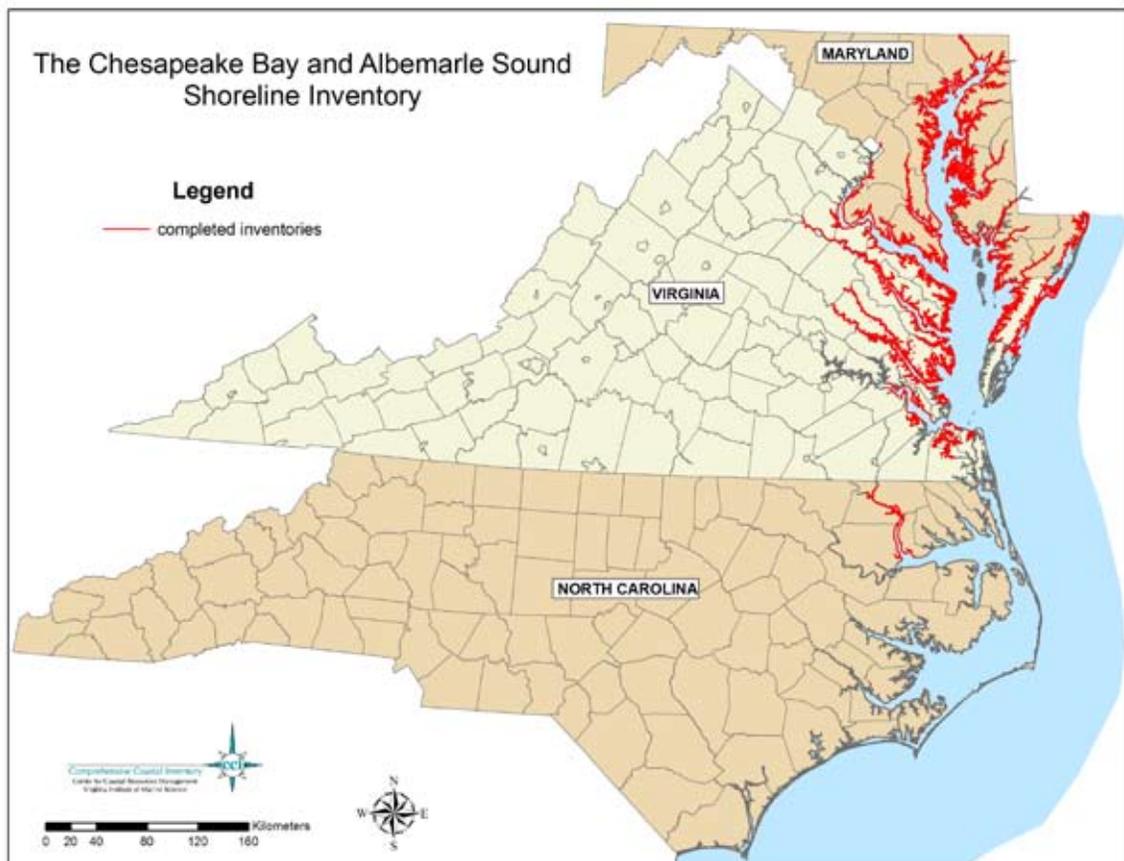
Permits Reviewed 1972 - 2006



Coastal Inventory Program



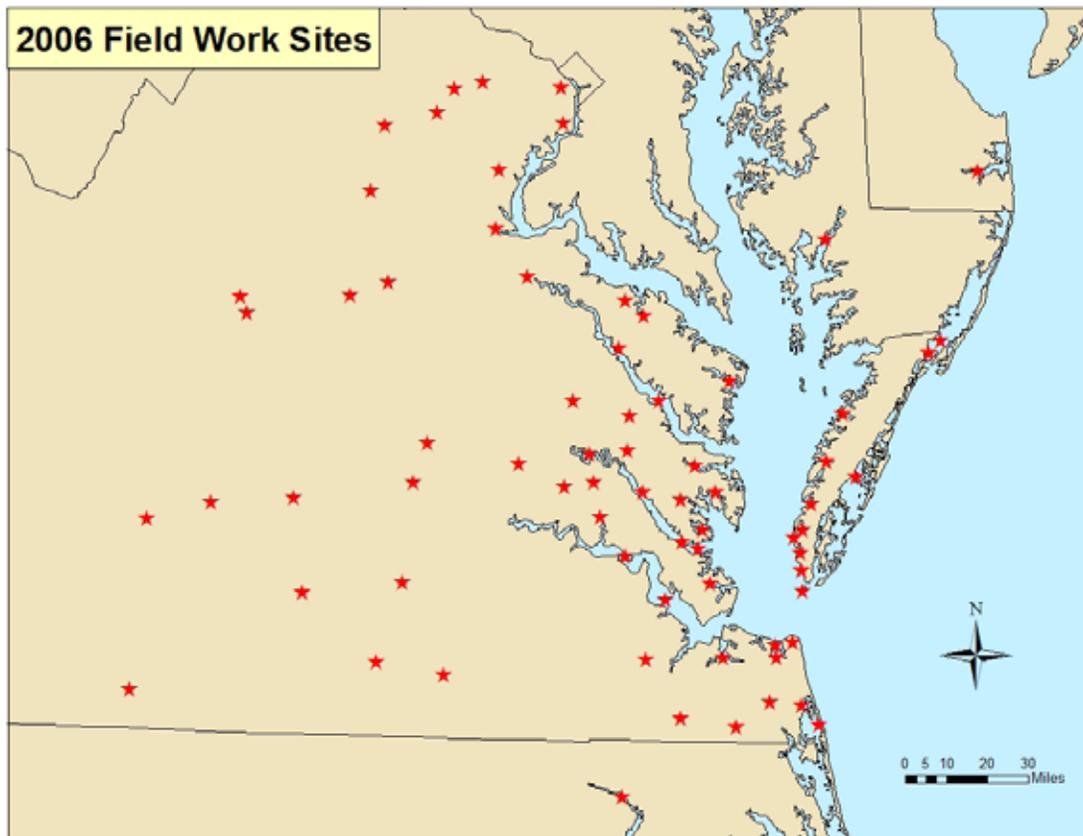
The Coastal Inventory Program has a basic mission to monitor tidal shoreline conditions and to develop policy/management recommendations based on analysis of that information. The Coastal Inventory Program has developed extensive capabilities in geographic information systems and in analysis of remotely sensed information. It has expanded its inventorying activities to include almost all terrestrial and aquatic resources within the coastal zone in support of the Center's focus on integrated and adaptive management. Development of GIS-based analytical protocols has become a major activity in the Coastal Inventory. Development of these tools has proven to be a most effective mechanism for integrating technical understanding and extensive data sets in a format that is comprehensible and informative for managers. The Coastal Inventory generates detailed shoreline condition inventories for every tidal county and city as part of its basic mission, and shares its extensive GIS data bases with state and federal agencies throughout the region.



Coastal Watersheds Program



The Coastal Watersheds Program evolved to deal with the water quality/quantity, land use, and habitat issues that were part of integrated management of coastal resources. The program focuses on basic and applied research in support of policy and regulation development. There are both regional and international elements in the Coastal Watershed Program. The program is working on development of indicators for health of aquatic ecosystems, use conflict management plans for shallow waters, anadromous fish spawning and nursery habitat studies, and climate change impact assessments. Because much of the work on use conflict analysis, shallow water management, and fishery habitat assessment is of interest in coastal systems around the world, the Center manages growing international collaborations through the Coastal Watersheds Program.

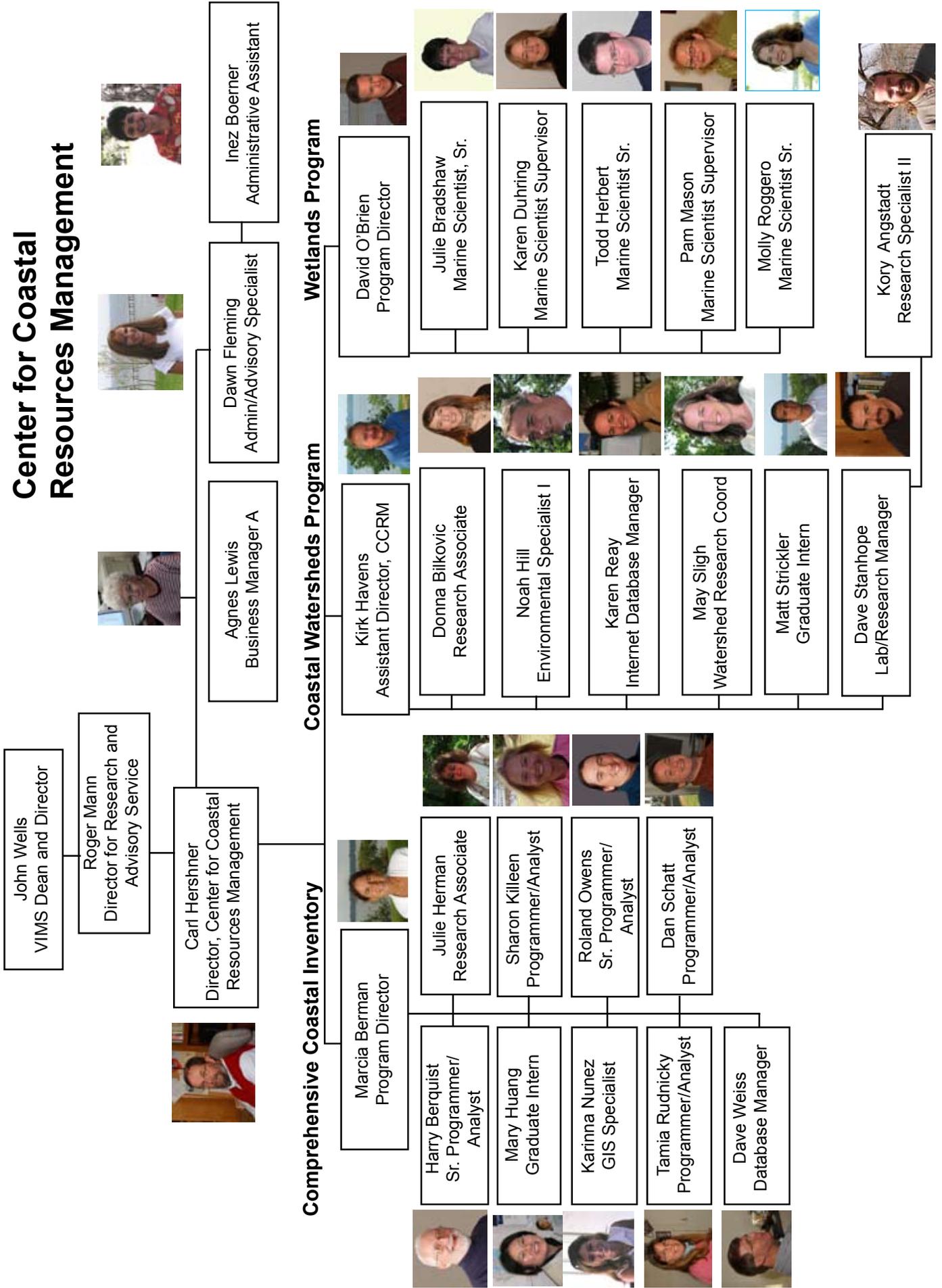


Personnel and Funding

The Center has a full time staff of about 28 individuals and supports several graduate students. The staffing varies slightly depending on grant and contract activities. Currently the Commonwealth of Virginia provides base funding for the Center that covers less than 50% of the salary expenses and about 15% of the annual operating expenses. The balance of funding is derived from grant and contract activity. The primary sources of this support have been the U.S. Environmental Protection Agency and Virginia's Coastal Resource Management Program (funding from NOAA). Other sources of recent funding have included National Oceanic and Atmospheric Administration, National Science Foundation, Virginia Department of Health, Virginia Department of Conservation and Recreation, and private donors.



Center for Coastal Resources Management



Center Fellows

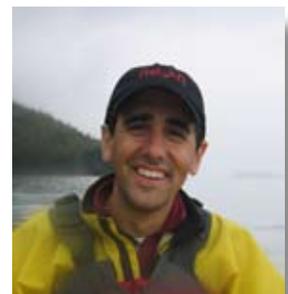
The Center Fellowship Program is designed to enhance capabilities to provide the very best research and advice by ensuring a constant influx of new ideas and perspectives. The goal is to bring dynamic young scientists into close collaboration with Center staff on a continuing basis. Each year one or two researchers from other institutions will be appointed to a two-year term as Center Fellows. Each Fellow is expected to spend a minimum of one week in residence at the Center giving seminars and leading workshops in areas of their particular expertise. In addition, Fellows are engaged in development of proposals for collaborative research that may extend well beyond their formal appointments. Fellows are selected by the Center's leadership based on nominations from Center staff or colleagues at other institutions. The selection process emphasizes the goal of bringing in post-doctoral scientists who have begun careers as independent researchers, with expertise that compliments but does not duplicate Center staff expertise. Fellowship Program success is measured by the number of new research topics and approaches developed from these collaborations. These appointments started on May 1, 2004.



Dr. Anamarija Frankic is an assistant professor in the Environmental Earth and Ocean Science Department of the University of Massachusetts in Boston. She is interested in coastal ecosystem management, and particularly in adaptive management applications to establish sustainable practices in coastal environments. Anamarija received a B.S. in Biology and an M.S. in Ecology and Limnology from the University of Natural

and Mathematical Sciences in Zagreb, Croatia, her homeland. Her Ph.D. was earned at the Virginia Institute of Marine Science, College of William and Mary. Anamarija is currently teaching and conducting research on management of aquaculture, protected areas, and tourism/ecotourism. She has worked as a contractor and consultant for the World Bank and Global Environment Facility on a variety of ecosystem conservation projects in Croatia, and has been an active participant in multiple workgroups sponsored by the United Nations. She has worked with CCRM staff in establishing collaborations with coastal centers in Croatia and Ireland, and has directed and/or participated in research projects focused on integrated coastal management involving CCRM staff and students.

Dr. Chris Pyke is the Director of Climate Change Services for CTG Energetics, Inc., a team of engineers, architects, planners, and ecologists dedicated to integrating sustainability principles with the development of the built environment. He coordinates CTG's climate change services, including greenhouse mitigation and adaptation. He also contributes to CTG's Sustainable Communities practice.



Dr. Pyke is a member of the Chesapeake Bay Program's Scientific and Technical Advisory Committee and the National Ecological Observatory Network's Science and Human Dimensions Committee. His recent work includes publications in *Frontiers in Ecology and the Environment*, *Conservation Biology*, *Biological Conservation*, *Ecosystems*, *Ecological Modeling*, and *Climatic Change*, and *Wetlands*. Dr. Pyke received a Ph.D. (2002) and M.A. (1998) degrees in Geography from the University of California, Santa Barbara and a B.S. (1996) in Environmental Geology from the College of William and Mary.



Dr. Denice Wardrop is a research faculty member in the Cooperative Wetlands Research Center at Pennsylvania State University. Dr. Wardrop has been engaged in investigation of nontidal wetlands structure and function in the ridge and valley province of Pennsylvania. She has also been an active participant in a number of technical advisory committees at the state, regional, and federal level, including the national committee on Biological Assessment of Wetlands. Dr. Wardrop's expertise is particularly important to the VIMS' Center staff as they undertake development of new wetlands assessment protocols for the Commonwealth of Virginia. She is currently collaborating with the VIMS' researchers in a multi-institutional project to develop indicators of aquatic ecosystem health. This work is now evolving to pursue related lines of research through new proposals.

Center Adjunct Research Faculty

CCRM Adjunct Research Faculty are College of William and Mary colleagues from other departments or schools. These individuals collaborate with Center staff on a continuing basis in basic and applied research. Adjunct Research Faculty expand the expertise available for CCRM projects, constituting a very efficient mechanism for addressing multidisciplinary issues. Appointments are for fixed terms and are renewable as the work of the Center and the interest of faculty members dictate. Success in the Adjunct Research Faculty program is judged by generation of collaborative proposals and research products. The first appointments to the CCRM Adjunct Research Faculty were made in December 2005.

Dr. Randy Chambers is Associate Professor of Biology and Director of the Keck Environmental Field Laboratory at The College of William and Mary. He received a B.A. in Biology from Gettysburg College, an M.S. in Zoology from the University of Massachusetts-Amherst, and a Ph.D. in Environmental Science from the University of Virginia. His research interests are in environmental science and the ecology and restoration of wetlands. Currently, he teaches courses in watershed ecology, environmental science and policy, and wetland ecosystems. Dr. Chambers' most recent projects include an evaluation of invasive plants in tidal wetlands, long-term research in the Florida Coastal Everglades, and the study of turtles in southeastern Virginia wetlands.





Dr. Gregory Hancock is Associate Professor of Geology at the College of William and Mary. A geomorphologist and hydrologist, Greg is interested in the impacts of land use change on Coastal Plain streams, and the effectiveness of engineered structures (i.e. retention ponds) on minimizing these impacts. He is collaborating with James City County to evaluate the effectiveness of retention ponds for controlling stormwater runoff, and is investigating the impacts of urbanization-induced channel incision on local riparian groundwater systems.

Center Associate Researchers

CCRM Associate Researchers are scientists from other institutions, government agencies, and/or the private sector who collaborate with Center staff on research and advisory projects. Appointment as an Associate Researcher is based on sustained productive interaction. Appointments are for fixed terms and renewable as appropriate. The first appointments of CCRM Associate Researchers were in September 2005.

Daniel Redgate is an Environmental Scientist at Kimley-Horn and Associates, Inc. His research interests include Hydrology, Assessment and Restoration of Streams and Wetlands; Watershed Modeling, Assessment and Water Quality Improvement. Dan is presently working as a consultant in the assessment and design of stream and wetland ecosystems, and in the evaluation of watershed-scale water quality improvement measures. He received a B.S. in Ecology from The Pennsylvania State University, and an M.S. degree from the Virginia Institute of Marine Science, The College of William and Mary. While studying at VIMS, Dan's research focused on the hydrology of forested wetlands and seasonal water budgets of forested wetland mineral flats. Dan has since worked on the assessment and design of numerous wetland and stream restoration sites for the purpose of compensatory mitigation and for watershed water quality improvement. His research interests are wetland and stream hydraulics and hydrobiology, riparian ecology and restoration science. He is working on the development of regional hydraulic geometry relationships for stream design, an evaluation of techniques for the assessment of stream quality, and the assessment of perennial, intermittent and ephemeral streams. Dan is a member of the Society of Wetland Scientists and the Virginia Association of Wetland Professionals.



Dr. Ed Sharp was born in Uniontown, PA, attended Wheeling College and John Carroll University and received a Ph. D. from Texas A&M University in 1966. He conducted basic research in the area of applied nonlinear optics at the U.S. Army Night Vision & Electro-Optics Laboratory and the U.S. Army Research Laboratory until this past year. Presently he



is working as a consultant on the use of infrared imaging equipment in novel application areas. His major areas of interest include laser crystal physics, thermal imaging materials and devices, electro-optic and nonlinear-optical processes in organic materials, beam-control devices, optical solitons, harmonic generation, holographic storage, and photorefractive effects in ferroelectric materials. He is the author or co-author of more than 100 technical publications and holds over 15 patents on optical materials and devices. He is a member of the American Optical Society, IEEE, The American Ceramic Society, and SPIE. Ed currently is working on developing methodologies for the use of thermal imaging in natural resource research.

Center Graduate Students



Mary Huang - Mary is a Ph.D. candidate at the Virginia Institute of Marine Science investigating the role of tidal wetlands as a source of fecal coliform by analyzing the model predicted errors between observed data and water quality model predictions. The results of this work may have an impact on the development of shellfish total maximum daily loads (TMDLs) in Virginia.

Matt Strickler - Matt is also a joint M.A./M.S. candidate for the Thomas Jefferson Program in Public Policy at the College of William and Mary and Department of Coastal and Ocean Policy, Virginia Institute of Marine Science. He is exploring the interactions among shellfish aquaculture, coastal land use, and shallow water environments. His research interests include marine resource policy and economics, coastal zone management, and recreational fisheries.



Center Interns

Each year the Summer Intern Program places twelve to fifteen undergraduates with faculty mentors for a summer research experience. Internships are available in many areas of marine science, including biological, geological, chemical, physical, environmental science, fisheries and management emphases. CCRM hosted five summer interns:



Heather Austin returned this summer to conduct a comprehensive literature review on disturbances & ecological services of nontidal wetlands. She earned a BA in biology from St. Olaf College, MN and has applied to grad school where she is seeking a Master's/PhD in marine biology. Heather is currently working in a gastroenterology lab at the University of Virginia as a research and lab specialist, helping doctors who are working on a cure for Crohn's disease.

Ben McFarlane is currently enrolled in a Masters program for urban planning. He has interned with the Center's Comprehensive Coastal Inventory Program since his sophomore year at University of Virginia. This year Ben worked with CCRM's Coastal Watershed Program where he conducted a literature review concentrating on the effects of riparian buffers on fish communities for the Dominion Power project.

Juan Arevalo from the Coastal Marine Resources Center, University College Cork, in Ireland spent four weeks in the spring of 2006 working in the center on various GIS and remote sensing projects. Juan had expertise in geospatial database development but came to the center to learn field techniques associated with geospatial data gathering and and collection. He is originally from Valencia, Spain.



Center Collaborations

East Carolina University

Baltimore District Corp of Engineers

Chesapeake Bay National Estuarine Research Reserve

College of William and Mary

Delaware Department of Natural Resources & Environmental Control

Maryland Department of the Environment

Maryland Department of Natural Resources

NOAA Chesapeake Bay Program Office

Pennsylvania State University

Smithsonian Environmental Research Center

U.S. Dept of the Army, Night Vision & Electro-optics Div. (retired)

U.S. Environmental Protection Agency

University College Cork, Ireland

University of Maryland

University of North Carolina

University of Oregon State

Virginia Department of Conservation & Recreation

Virginia Department of Forestry

Virginia Polytechnic Institute and State University





CENTER PROJECTS

Riparian Shoreline Assessment and Mapping for the Chowan River, NC



PI: Berman

Funding Agency: Albemarle Pamlico National Estuary Project (APNEP)

Period: 5/16/05-5/15/06

Amount: \$30,000

This project produces an inventory of shoreline conditions for the Chowan River Basin. Following a survey and analytical protocol applied in Virginia and Maryland (see also Comprehensive Shoreline Inventory for the state of Maryland, and Shoreline

Situation Reports) this inventory expands the geographic extent of a Mid-Atlantic mapping initiative southward. Like products from the Virginia and Maryland regions, final survey results, data, and maps will be posted on the internet when project is completed at: <http://ccrm.vims.edu/gisdatabases.html>

GIS Conversion of VMRC Fisheries Management Areas

PI: Berman

Funding Agency: NOAA/CRMP

Period: 6/01/05-12/31/05

Amount: \$30,000

This project generates a GIS database of the location of Virginia's managed fisheries areas within the Bay. Fisheries Management Areas (FMAs) within Virginia include artificial reefs, sanctuaries, oyster reefs, and important finfish spawning grounds, to name a few. They are the cornerstone of the Federal government's Marine Managed Areas Inventory for Virginia. FMAs are surveyed, managed, and regulated by the Virginia Marine Resources Commission. In a cooperative project between VIMS and VMRC, these data have been converted to GIS formats for integration into other state and federal aquatic management initiatives. Among them is Blue Infrastructure, which collects and disseminates aquatic resource data in an interactive GIS format accessible through the Internet. Virginia's FMA boundaries and database have been added to Blue Infrastructure as a project deliverable. Link to project page at:

http://ccrm.vims.edu/blueinfrastructure/bi_intro.html



Comprehensive Shoreline Inventory for the State of Maryland



PI: Berman

Funding Agency: NOAA/MD DNR

Period: 8/01/02 – 9/28/06

Amount: \$340,000

This project involves application of the shoreline inventory protocols developed by the Center to all of the tidal shoreline in Maryland. The resultant data base provides a spatially explicit inventory of shoreline condition, resources, and structures in a GIS accessible format. The project involves extensive

field work to complete boat surveys of the shoreline with advanced GPS equipment. Link to GIS databases at: http://ccrm.vims.edu/disclaimer_shoreline_situation.html

Field Inventory of Phragmites

PIs: Berman, Havens

Funding Agency: various, inhouse

Period: ongoing

The delineation of Phragmites along tidal shorelines is being collected in conjunction with data for the Shoreline Situation Reports. Analysis of status and trends in distribution will be used in management and policy recommendations.



The Stability of Living Shorelines - An Evaluation



PI: Berman

Funding Agency: NOAA

Period: 10/1/2004 - 12/03/2006

Amount: \$160,000

This project provides scientific rationale for the expanded use of soft structure stabilization for tidal shoreline protection. A series of tests was performed to develop a profile of landscape suitability for soft shoreline stabilization. Analyses were performed on data describing shoreline

condition. Shoreline change mapping in selected study areas determine effectiveness of shoreline treatments. An environmental assessment combines various data to develop the shoreline profile for effective soft stabilization and develops a spatial suitability model. Final products include a report and outreach material posted to a dedicated website to be announced.

Shoreline Situation Reports for Selected Localities: Caroline and Stafford and Westmoreland Counties



PI: Berman
Funding Agency(s): NOAA
Period: ongoing
Amount: \$55,000

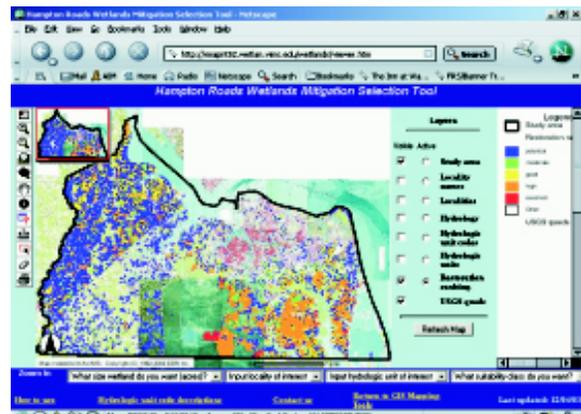
This project advances the development of Shoreline Situation Reports throughout the cities and localities within the Tidewater region of Virginia. Shoreline Situation Reports were first developed by VIMS in the 1970s to support coastal management activities and decisionmaking. CCI is attempting to update the series, and publish a new inventory for each

city or locality. The process includes robust data collection in the field using GPS equipment, post processing of data using GIS and remote sensing tools, and the development of map inventories on a county by county basis. With funding from the Virginia Coastal Resources Management Program, three additional inventories will be added to the Virginia Shoreline Inventory shortly. The counties of Caroline and Stafford are now online and Westmoreland County will come online early 2007. GIS data for all published inventories are posted under Shoreline Situation Reports at: <http://www.vims.edu/ccrm/gis/gisdata.html>

Internet Based Decision Tool for Siting Wetland Restoration Sites in Hampton Roads, Virginia

PI: Berman
Funding Agency: In-house
Period: ongoing
Amount: \$82,361

Revised in 2005, the update now includes Virginia's entire coastal zone. This project uses the protocol and findings of the



Advanced Identification of Wetland Restoration sites, to develop an interactive, web-based management tool to assist regulators, developers, and project agents in location of potential compensatory mitigation sites in Hampton Roads. The model has been run for the entire coastal zone in Virginia. Link to ArcIMS at

<http://rmapnt52.wetlan.vims.edu/wetlands/viewer.htm>

Ecosystem Approaches to Aquatic Health Assessment: Linking subtidal habitat quality, shoreline conditions and estuarine fish communities

PIs: Bilkovic, Hershner

Funding Agency: NOAA/NCBO

Period: 3/01/05 – 5/1/06

Amount: \$113,344



In the Chesapeake Bay, there is currently no comprehensive assessment of aquatic habitat heterogeneity or understanding of the effects of multiple stressors on the viability of these habitats. This project tests the use of side-scan sonar technology as a tool to define subtidal nearshore habitat in two representative watersheds of the Chesapeake Bay. Resulting habitat information was used to determine if specific subtidal habitats are associated with shoreline condition and/or nearshore fish communities in the James River. To accomplish this, we collected and mapped detailed information on nearshore subtidal habitat, surveyed nearshore fish communities, and compared available quantitative shoreline inventory information. Sonar

images revealed limited vertical structure in the surveyed nearshore of the James River. Fish assemblages responded to changes in developed lands at multiple spatial scales. Fish community integrity was reduced in areas with highly altered shorelines (bulkhead), and when developed riparian lands were greater than 23%. Additionally, there was a reduction in subtidal structure when adjacent shoreline conditions were altered. Land use and shoreline condition may be effective representations of integrative measures of stress that relay the state of degradation in a system. For more information see the final report

Final Report: http://ccrm.vims.edu/projreps/Bilkovic_NCBO_Final%20report_May2006.pdf

Presentation: http://ccrm.vims.edu/powerpoints/Bilkovic_dmERF_files/v3_document.htm

Sturgeon Spawning Habitat on the James and Appomattox Rivers

PIs: Bilkovic, Hershner
Funding Agency: USFWS
Period: 11/01/05 – present
Amount: \$12,945

This project's objectives are to conduct bottom mapping of potential Atlantic sturgeon spawning reaches using side-scan sonar to ascertain the presence and location of essential spawning habitat (e.g. gravel beds) in the James and

Appomattox rivers. Areas surveyed include the upper reaches of the James River from Shirley Plantation to Richmond; as well as the Appomattox River from the mouth to the Colonial Heights Bridge.



Maintenance of Virginia Nontidal Wetlands Database

PIs: Fleming, Weiss
Funding Agency: In-House
Period: ongoing
Amount: N/A

Maintenance of a website-accessible database for nontidal wetlands permitting in Virginia. For more information, please see http://ccrm.vims.edu/wetlands/nontidal_impacts.html

Occurrence of the Invasive Weedy Species *Phragmites australis* Adjacent to Agricultural Lands and its Response to Conservation Reserve Program (CRP) Control Methods.

PIs: Havens, Chambers
Funding Agency: USDA
Period: 8/1/03 – 7/31/06
Amount: \$179,280

This project focuses on developing a model of *Phragmites* invasiveness at upland/wetland interfaces by determining the mechanism of invasion, competition and spread of *Phragmites*.



With respect to weed control, one of our applied hypotheses is that CRP sites enhance N removal prior to groundwater discharge to the wetland-upland interface, and that best management practices like buffer strips are environmentally sound forms of controlling Phragmites invasion and spread.

Intermediate Development of a Forested Headwater Wetland HGM Model for Wetlands Management in Virginia

PI: Havens

Funding Agency: US EPA

Period: 10/01/04 - 09/30/06

Amount: \$178,774

The Forested Headwater Wetland Subclass is unique in that it is partially defined in law by the average current flow (or lack thereof) in the associated stream. This project continues the development of an HGM model for the Forested Headwater Wetland subclass by determining the extent of these wetlands systems as related to annual average stream flow. The final report will include development of a preliminary definition of Forested Headwater Wetlands for HGM model development and preliminary data collection of potential HGM variables.



Determination of Minimal Instream Flow for Recreational Use

PIs: Havens, Hershner, Berquist

Funding Agency: inhouse

Period: ongoing

Amount: n/a

Recreational canoeists established a network of gages in the 1970's that reflect stream levels on Virginia's rivers. This network of gages depicts at what level canoeing would become impracticable. As such, this is a potential measure of minimal instream flow requirements for recreational boating.

This project uses the established network of gages and GPS technology to tie them to elevation benchmarks in order to relate the depicted stream levels to USGS stream gage data.

Ecological and Socioeconomic Indicators for Integrated Assessment of Aquatic Ecosystems of the Atlantic Slope



PIs: Hershner, Havens, Bilkovic, Varnell, Berman

Funding Agency: US EPA

Period: 4/01/01 – 2/18/06

Amount: (F) \$1,163,435

Project objectives are to 1) develop and test ecological and socioeconomic indicators of aquatic resource condition, construct models that use environmental, geographic, and stressor data to predict indicator responses, and use models to link upstream watersheds and downstream estuaries. 2) Develop large scale measures for characterizing landscape attributes and land-use patterns to serve as predictors of a range of environmental conditions. 3) Deliver a nested suite of

indicators to managers, where the implications of aggregating models at various scales are considered, and for which reliability is known. This is a collaborative project with Pennsylvania State University, Smithsonian Environmental Research Center, East Carolina University, and the Environmental Law Institute. Final report:

http://ccrm.vims.edu/projreps/eagles_02-03.pdf

Shallow Water Use Management Plan

PI: Hershner

Funding Agency: n/a

Period: 7/1/00 - present

Amount: n/a

This project used GIS to evaluate conditions suitable for a variety of activities that may occur within the shallow water zone of the estuary. Uses include SAV growth, aquaculture, crabbing, recreational fishing, etc. Nearly 20 uses were modeled. First use suitability models were developed, specifying conditions which must exist for a particular use to occur. Second, GIS algorithms are prepared to analyze

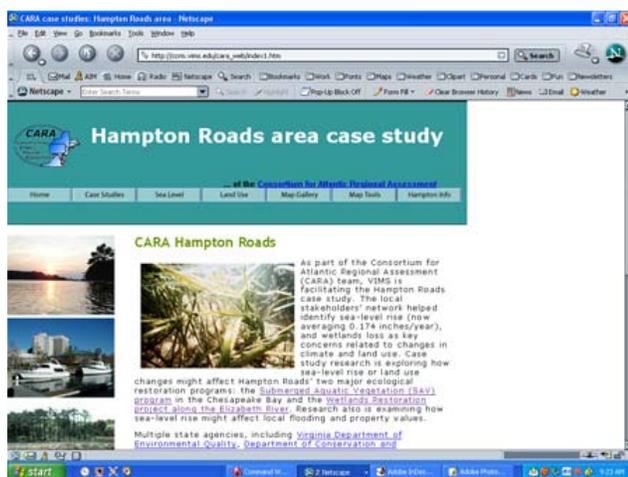
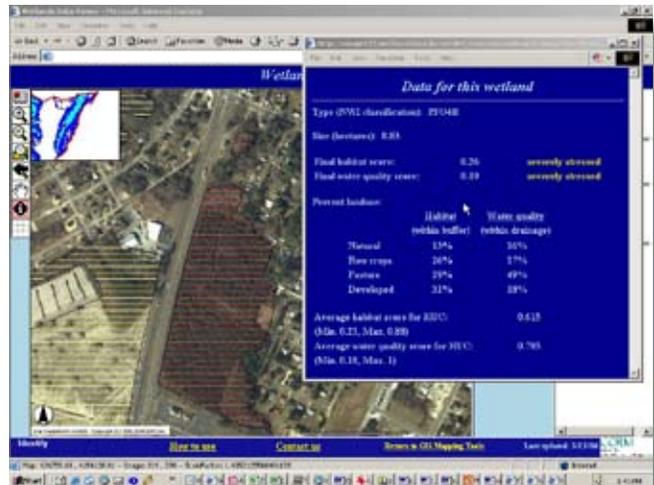


available environmental data and indicate areas of suitable conditions for each use within the shallow water zone. Spatial models of use suitability were then combined according to a conflict prediction model to identify potential use conflicts. Final steps in the project will be identification of management issues and options, and development of policy recommendations.

Development of Nontidal Wetland Inventory, Functional Assessment, and Monitoring Strategy for Virginia

PIs: Hershner, Havens, O'Brien
Funding Agency: USEPA/Virginia DEQ
Period: 10/1/03 – 9/30/06
Amount: \$606,405

This project develops and implements a three level assessment protocol for nontidal wetlands in Virginia. This is the first phase of a series of projects which are intended to provide assessments across all of Virginia. In this project a level I – GIS based assessment will be completed on all wetlands mapped by the National Wetlands Inventory in Virginia. Level II assessments involving field assessments of stressors will be initiated in the coastal plain of Virginia. Level III assessments will involve detailed analysis of habitat and water quality functions on selected sites.



CARA/MUAR

PI: Hershner, Reay
Funding Agency: PSU/NOAA/EPA
Period: 10/1/02 – 3/30/06
Amount: \$60,000

This project involves collaboration with researchers from Penn State University, Rhode Island University, and Carnegie Mellon University. The Center's role is facilitation of a case study of climate change and landuse change information use in Hampton Roads, VA.

The project is intended to result in development of a climate change center that can provide web-based information of maximum utility to local planners and decision makers. The CARA Hampton Roads website can be found at http://ccrm.vims.edu/cara_web/index1.htm

Wetlands Permit Review and Report Generator

PIs: Hershner, Berman, O'Brien

Funding Agency: inhouse

Period: ongoing

Amount: n/a

This project enhances the permit reporting process to increase the amount of information presented while automating systematic reporting. This is the first system of its kind that combines expert staff review with landscape information retrieved from spatial databases. The report generator is always being modified as new landscape information is available. The reports along with the original application and related photos are posted online in a searchable database:

<http://www.vims.edu/ccrm/wetlands/newpermits.html>



Garden Club of America Scholarship



PI: Hershner, Reay

Funding Agency: Garden Club of America

Period: annual (2000 to present)

Amount: \$500

The Center manages the annual advertisement, review, and selection of recipients for the Garden Club of America Scholarship for Wetland Studies. Each year the Center advertises and responds to inquiries regarding the award. In February it receives, reviews, and ranks applicants and makes a recommendation to the GCA for that

years awards. Awards are open to any graduate student undertaking a field oriented study of wetlands at an American university. For more information, please see

http://ccrm.vims.edu/garden_club.html

Marine Debris Project

PIs: Hershner, Havens, Bilkovic, Jasinski

Funding Agency: NOAA/NMFS

Period: 9/21/05 – 9/30/06

Amount: \$65,000

This project was intended to demonstrate the feasibility of using side scan sonar surveys to locate abandoned or “ghost” fishing gear, particularly crab pots, in the Virginia tidal waters of the Chesapeake Bay, analyze existing records of ghost pots from the trawl survey program

in Virginia, investigate the potential effect of ghost pots on fish communities in Virginia waters; and initially survey of the lower York River for ghost fishing gear. Products include a digital map of the surveyed area, annotated to indicate location of all identifiable fishing gear detected by the side scan sonar as well as a brief preliminary assessment of survey methodology and derelict trap impacts on marine organisms.



Tidal Wetlands Management Technical Support

PI: Hershner

Funding Agency: Virginia Coastal Program/NOAA

Period: annually 10/1-9/30

Amount: \$80,000



This project has been a continuing grant renewed annually to support the advisory service provided by the Wetlands Program to the Tidal Wetlands Management program. In particular this grant helps fund the travel costs for site visits and meeting attendance by staff scientists, the publication costs for the Wetlands Newsletter, and some of the expenses of maintaining the tidal wetlands permit data base on line on the Center's web site at

<http://www.vims.edu/ccrm/wetlands/newpermits.html>

Funding was provided to support production of the following publications:

- Virginia Wetlands Report. Spring 2006, Vol. 21, Issue 1. Integrated Coastal & Shoreline Management Guidance. http://ccrm.vims.edu/vwr/vwr_2006_spring.pdf
- Virginia Wetlands Report. Fall 2006, Vol. 21, Issue 2. Tools of the Tidal Shoreline Management Trade. http://ccrm.vims.edu/vwr/vwr_2006_fall.pdf

Preliminary Restoration Support Activities and Technical Advisory

PIs: Hershner, Bilkovic

Funding Agency: CH2MHill

Period: 11/1/05-5/31/06

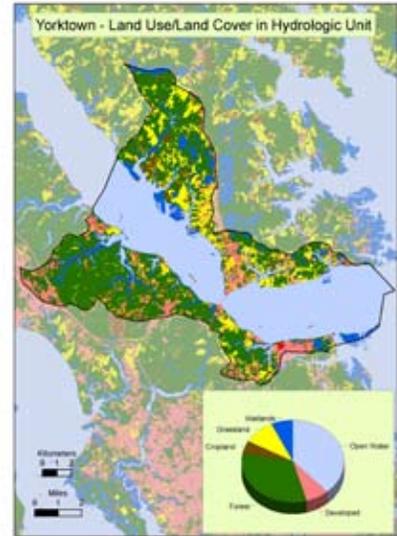
Amount: \$68,000

This report is designed to provide background information for evaluation of restoration options in mitigation situations for power generating stations in Virginia. The report provides

information on fish species that might be targeted for restoration activities.

There are at least four general ways in which environmental compensation might occur associated with generating station cooling water intakes. These include:

1. direct replacement of lost organisms through culture and stocking programs;
2. enhancement of support-species populations to increase survival in stocks of impacted species;
3. direct enhancement of aquatic habitat to increase suitability for impacted species; and
4. enhancement of watershed conditions to generally improve local and downstream aquatic habitats.



Seasonal Monitoring, Fecal Coliform Loads, Lynnhaven River System



PIs: Hershner

Funding Agency: Virginia Beach

Period: 11/1/05-3/31/07

Amount: \$53,259

A collecting and sampling program was developed for fecal coliform following runoff events in the Lynnhaven River System. This information will be used to support water quality and TMDL modeling.

Marine Science Teaching Marsh

PI: Hershner

Funding Agency: Dreyfus Foundation

Period: Private Funds

Amount: \$30,000

Funding was provided for improvements to the VIMS Teaching Marsh via improved signage and informational kiosks, updated video cameras, and modifications to the educational

website. The website will describe wetland plant species found within the VIMS Teaching Marsh as well as general marsh properties and function. Website information will also include learning activities for children.



Development of an Inventory and Multi-Level Assessment Method for Virginia, Maryland and Delaware Tidal Wetlands

PIs: O'Brien, Havens, Berman, Hershner

Funding Agency: EPA

Period: 10/01/05-03/31/07

Amount: \$207,897

This project is designed to provide the Virginia Marine Resources Commission, Virginia Department of Environmental Quality, Delaware Department of Natural Resources and Environmental Control, Maryland Department of Natural Resources and the Maryland Department of the Environment with the ability to report the current extent and condition of estuarine wetlands within three major river systems of the Delmarva. CCRM will develop a Level I, Level II and Level III tidal wetland inventory and assessment methodology for the Delmarva using the estuarine segments of the York River, Virginia, Nanticoke River, Maryland and the Indian River, Delaware as our subject watersheds. Level I involves the GIS-based analysis of remotely sensed data while the Level II protocol will be derived from data collection techniques established by the VIMS Comprehensive Coastal Inventory Program (CCI) for mapping shoreline condition. Level III will produce a reference domain for mid-Atlantic estuarine wetlands using a combination of published literature, existing data and field data collection. Reference sites selected for this tier will be representative of the disturbance and ecological variability within the target watersheds. It is hoped that the development and

implementation of a multi-level approach to tidal wetland inventory and assessment along with the utilization of these data by the aforementioned state environmental programs will serve as a prototype for expanded investigations across these states in the future.

Chesapeake Bay Dune Systems Evolution and Status

PIs: Varnell, Hardaway

Funding Agency: VA Coastal Program

Period: 10/01/00 - 09/30/05

Amount: \$530,000

This project combines GIS, GPS, remote sensing, ground surveys, and applied knowledge of sandy shorelines to map and classify the primary and secondary dune and beach systems in Virginia's portion of the Chesapeake Bay. Analyses of vegetation, grain size, and offshore bathymetry complement beach and dune geomorphology to create a holistic assessment for managers, researchers, planners, and waterfront property owners. Analyses of management structure and history are combined with physical attributes to critique management effectiveness and develop policy recommendations. Products include comprehensive locality-specific inventories, shoreline change models, management guidelines, and a geologic-based classification system for estuarine dune fields. Text and digital reports are available. For more information see VIMS Shoreline Studies. <http://www.vims.edu/physical/research/shoreline/>



Rappahannock County Riparian Buffer Study

PI: Herman

Funding Agency: U.S. Army Corp of Engineers

Period: 03/01/06 - 09/30/06

Amount: \$30,000

Riparian buffers are important zones for maintaining water quality and providing critical habitat. Rappahannock County has a rural landscape that presents the opportunity to record baseline conditions of riparian buffers. This study involved analyzing a small drainage area in the Upper Thornton River watershed to offer guidance on targeting riparian buffer restoration. Methods included using aerial imagery and GIS to delineate land uses and buffer cover in 100 ft. buffers around streams. Results indicate that in the study area 51% of the riparian lands potentially need some restoration and several recommendations for riparian buffer restoration were made in the final report. Final Report:



http://ccrm.vims.edu/projreps/final_report_std.pdf

Constructing Probability Surfaces of Ecological Change in Coastal Aquatic Systems through Retrospective Analysis of *Phragmites australis* Invasion and Expansion.

PIs: Wardrop, Whigham, Havens

Funding Agency: US EPA

Period: 2/1/05-1/31/07

Amount: \$299,995 (VIMS \$29,317)

The project will develop a unique analytical method, which involves constructing a probability surface, which can be used to identify thresholds for the transition of coastal marshes to dominance by *Phragmites*. Any set of conditions can then be placed upon the probability surface, allowing the statistical method to be used in a predictive fashion. The method could be applied to a wide variety of aquatic ecosystems for which state changes occur over either a spatial and temporal extent, or both.



Shoreline Situation Reports and their Application for Tidal Wetlands Management - A Demonstration Project in Westmoreland County

Principal Investigator: Berman

Funding Agency: VA Coastal Zone Management Program

Period: 3/1/2006-3/31/2007

Amount: \$55,000



This project has two primary phases. The first is to conduct a second shoreline inventory of conditions existing in the county of Westmoreland, Virginia. The second phase reviews and extracts shoreline alteration projects from the VIMS Wetlands Permit Database that have been permitted between the years 2001 (first survey) and 2006. The projects will be compared with shoreline structures that have been observed and mapped between 2001 and 2006 as part of the inventories. This demonstration project is intended to determine if the combined

activities of maintaining a database of construction activity and conducting shoreline surveys collects sufficient information to 1) report on resource trends over time; 2) identify violations or construction of unauthorized structures along the shoreline, 3) delineate hot spots of shoreline activity and heightened risks to ecological resources.

Habitat Restoration Options for Generating Stations

Virginia Dominion Power

PIs: Hershner, Bilkovic, Roggero

Funding Agency: CH2MHill

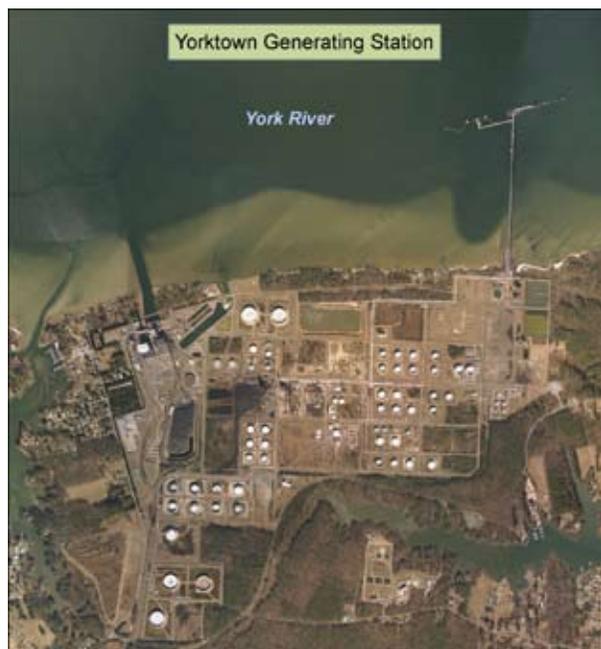
Period: August 2006-December 2006

Amount: \$80,000

Environmental compensation for impingement and entrainment (I&E) losses in cooling water intakes can take three basic forms: 1) replacement of lost individuals; 2) enhancement of aquatic habitat to increase system productivity/condition; or 3) enhancement of watershed conditions to improve general aquatic ecosystem condition. In each case the objective is to restore the population of impacted aquatic species, and to compensate for the ecosystem consequences of the loss of the native individuals. In Virginia, improvement of the aquatic habitat in the Chesapeake Bay and its major tributaries is a primary goal of resource managers and policy makers. For tidal waters, our focus will be on three predominant types of aquatic habitat restoration: seagrass, oyster reef and salt marsh. Advancing specific restoration options as part of compliance plans for generating stations will require a technically sound “scaling” to link impingement and entrainment losses to restoration project outcomes. We reviewed the status of restoration scaling for environmental compensation in estuarine environments.

Presentation: \\139.70.26.250\ccrm\watershed\PROJECTS\Dominion_Restoration\PROJECT2_June2006\Workshop information\Workshop_27Sep2006\Workshop presentation_web.pdf

For freshwater systems, we examined three potential restoration options for the mitigation of impingement and entrainment (I&E) losses at freshwater generating stations are 1) fish passageway/impediment removal, 2) riparian buffer enhancement, and 3) fish stocking. These options are not mutually exclusive, and in fact, a combination of two or more of these options together may be more effective than any one option by itself. For example, combining either fish passageways or fish stocking with riparian buffer enhancement may help ensure survival of new fish recruits to a system by providing them with appropriate water quality and habitat features.



Lynnhaven River Shallow Water Fish Survey and Shoreline Inventory

PIs: Bilkovic, O'Brien, Berman

Funding Agency: US Army Corps of Engineers

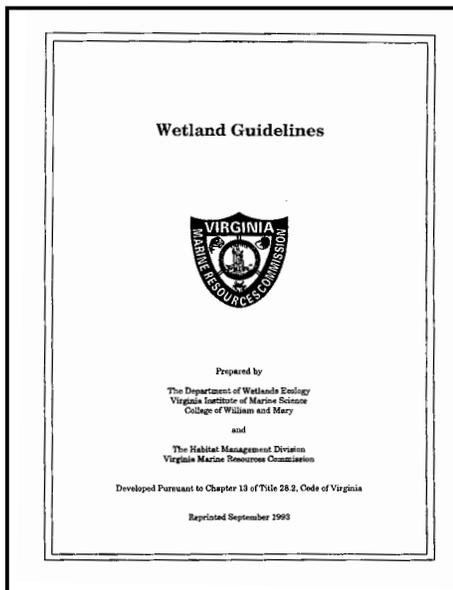
Period: 9/12/06 – 9/11/07

Amount: \$134,695

The utilization of fish communities within dredged and undredged tidal creek systems of the Lynnhaven River is being assessed. Measures of fish communities will include abundance, size, diversity and other fish community metrics developed for shallow water environs. The shoreline condition of the Lynnhaven River Watershed will be comprehensively inventoried with a protocol specifically developed for Virginia and Maryland coastlines which includes a method for collecting, classifying, mapping and reporting conditions to assess riparian shorelines. Fish community information will be related to habitat characteristics including shoreline condition. Observed relationships would support the use of riparian management practices that mitigate loss of critical shallow water habitats, and further link habitat and fishery management.



Wetlands Guidelines Revisions



PI: Mason

Funding Agency: VA Coastal Zone Management Program

Amount: \$45,000

The Center for Coastal Resources Management, VIMS, has undertaken an initiative to provide integrated scientific guidance for better-informed decision-making regarding Virginia's shoreline systems. We are working on a revised Wetland Guidelines document on a parallel track with our on-going comprehensive guidance initiative. The Wetlands Guidelines will be based upon the current scientific understanding of the ecology of wetlands and role in the landscape. The document will provide an overview of the state of the science and identify environmental preferences and supporting rationale for shoreline management options.

Integrated Guidance Project

PI: Mason

Funding Agency: in-house

Period: ongoing



Virginia is battling to change the current trend toward environmental degradation. The effects of direct, secondary and cumulative impacts have had significant adverse impacts on water quality, habitat and aquatic resources. It has become increasingly apparent that in order to reduce the cumulative and secondary impacts of activities within the multiple jurisdictions and multiple management programs affecting the littoral and riparian zones, better coordination and integration of policies and practices is necessary. The concept of integrated coastal management embodied by sustainability, adaptability and effective coordination

provides a framework to address the current problems inherent in coastal management generally, and shoreline management specifically. There are currently a variety of local and state programs managing shoreline development activities. Each of these programs have their own set of regulatory and guidance documentation. And each managed resource, or jurisdictional area, offers various ecosystem services that are valued by society. These services include water quality maintenance and improvement, terrestrial and aquatic wildlife habitat and recreational amenities to name a few. What is lacking is comprehensive guidance from an ecosystem perspective to promote an integrated management approach for the many regulatory programs that have some responsibility for coastal, shoreline resources. This project involves the development of comprehensive guidance for shoreline management based on ecosystem services. Various combinations of riparian and littoral condition will be modeled for two services; habitat and water quality. The impacts of various shoreline development practices will be assessed based upon those services, and environmental preferences that minimize adverse impacts and/or maximize beneficial outcomes will be identified.

Refinement and Validation of a Multi-Level Assessment Method for Mid-Atlantic Tidal Wetlands

PIs: O'Brien, Hershner, Havens

Funding Agency: EPA

Period: 10/01/06-09/30/07

Amount: \$134,334

This project will build upon work conducted under the "Development of an Inventory and Multi-Level Assessment Method for Virginia, Maryland and Delaware Tidal Wetlands" project currently being conducted by CCRM and collaborative partners from the Delaware Department of Natural Resources and Environmental Control, and Maryland Department of Natural Resources. The Level III assessment protocol developed under this ongoing effort will be utilized in this study to sample approximately 20 additional estuarine tidal wetland sites within the York River, Virginia and Indian

River, Delaware watersheds. Additional data collected at these sites will be used to help validate the Level I and Level II condition assessment models developed under previous research efforts. We hope that the development, refinement and validation of a multi-level assessment model will result in its implementation by state and local environmental management and regulatory agencies across the Delmarva region.

Coastal Maritime Forests in Virginia - Delineation and Distribution

PI: Marcia Berman

Funding Agency: VA Coastal Zone Management Program

Period: 2/1/2006-3/31/2007

Amount: \$37,500

This project delineates coastal maritime forests using remote sensing techniques. Fieldwork conducted by the Department of Forestry validates the delineation. A website will be generated to display mapped forest cover and report the distribution of coastal maritime forest habitat in Virginia on a county by county basis.



Geographic Information Support to Chesapeake Bay Erosion Feasibility Study, Maryland

PI: Marcia Berman

Funding Agency: Baltimore District US Army Corps of Engineers

Period: 8/8/2006-1/31/2008

Amount: \$125,000

This project determines the risk to natural habitat (beaches and marshes), and socio-economic resources that can be attributed to shoreline erosion. The project also looks at the influence boat wake activity has on shoreline erosion in protected embayments. The degree of vulnerability will be determined using a GIS based spatial model. The output will be displayed in an interactive map environment.

Shellfish Aquaculture Suitability Model

PI: Marcia Berman

Funding Agency: Virginia Coastal Resources Management Program

Period: 10/1/2006-9/30/2007

Amount: \$85,000

Using GIS, a landscape model will be developed to delineate areas suitable for shellfish aquaculture. This model will consider physical and biological parameters associated with good shellfish growing

areas, as well as upland land use considerations that can enhance or impede the success of an aquaculture operation. The model will be developed using GIS and final products will include an interactive mapping site to display the suitable areas. This project expands on earlier efforts to explore shallow water use conflicts in Virginia.

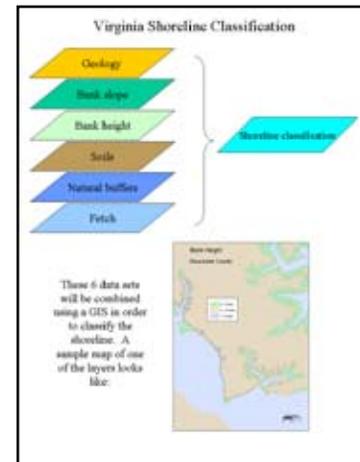
Virginia Shoreline Classification

PI: Marcia Berman, Julie Herman, David O'Brien

Funding Agency: unfunded

Period: 9/15/2005-present

Using basic geomorphic characteristics of the coastal landscape, the shoreline of coastal plain of Virginia is being classified. The selected characteristics will serve as indicators of shoreline stability, potential management strategies, and current and future vulnerability. This is a regional assessment and is not intended for application to parcel level shoreline management issues.



A photograph of a large flock of birds, likely terns, flying over a body of water near a sandy beach. The birds are in various stages of flight, with some wings spread wide. The water is calm, reflecting the sky and the birds. The beach is visible in the background, and the sky is a clear, pale blue. The image is split vertically by a white curved line.

Advisory Activities



Advisory Activity

	Information Requests	Additional Site Visits/ Field Consults	Meetings	Advisory Reports/ Publications	Permit Website Hits
January	143	10	32	83	339
February	145	5	19	76	574
March	165	15	20	62	336
April	123	16	17	69	397
May	151	13	25	51	292
June	171	16	30	75	444
July	136	19	19	71	608
August	168	12	18	71	424
September	174	21	26	67	409
October	189	25	18	28	321
November	181	13	23	78	510
December	96	7	22	66	358
Total	1842	172	269	797	5012

Advisory Committees

CCRM Staff provided service on the following advisory committees:

Albemarle Pamlico National Estuary Program - Scientific and Technical Advisory Committee (STAC)

Albemarle Pamlico Scientific and Technical Advisory Committee (STAC) Executive Committee

Chesapeake Bay Local Assistance Division (CBLAD) Technical Advisory Committee

Chesapeake Bay Program (CBP) Implementation Subcommittee

Chesapeake Bay Program (CBP) Living Resources Subcommittee

Chesapeake Bay Program (CBP) Monitoring and Modeling Workgroup

Chesapeake Bay Program (CBP) Scientific and Technical Advisory Committee

Chesapeake Bay Program (CBP) Sediment Workgroup

Department of Conservation and Recreation (DCR) York River Watershed Roundtable

Department of Forestry Virginia Riparian Buffer Workgroup

Department of Environmental Quality (DEQ) Virginia Coastal Policy Team

Elizabeth River Project Steering Committee

Elizabeth River Trust Technical Advisory Committee

Mid-Atlantic Wetlands Workgroup

National Fish and Wildlife Foundation (NF&WF) Chesapeake Bay Targeted Watershed
Grant Steering Committee

Virginia Geographic Information Network (VGIN) STATE GIS User Group

VIMS Administrative Council

VIMS Communications Group

Virginia Association of Wetlands Professionals

Virginia Marine Resources Commission (VMRC) Habitat Management Advisory Committee

Outreach Education Classes

Presentations and demonstrations were provided to educate state and local agency personnel, wetlands board members and staff, marine contractors, permitting agents, and the general public on tidal wetland issues.

March 10, 2006

Avoid – Minimize – Compensate Through Integrated Shoreline Management

Tidal Wetlands Workshop (116 attended)

Photo gallery of meeting day <http://ccrm.vims.edu/seminarpresentations/spring2006/tidalwetlandswkshp1.html>

- Integrated Shoreline Management: Theories & Case Studies
- Living Shoreline Projects: Definitions, Challenges & Public Demonstration Projects
- Norfolk Citizens Wetlands Education Workshop (Kevin Dubois, City of Norfolk)
- Interactive Panel Discussion: Tidal Wetland Mitigation/Compensation Policy
- General Assembly Update

September 19, 2006

Introduction to Riparian Buffers (80 attended)

Jointly sponsored by CCRM, CBNERR, DCR Chesapeake Bay Local Assistance, VA Dept. of Forestry, Chesapeake Bay Program

- Water Quality Functions & Values of Riparian Buffers (William Reay, CBNERR)
- Habitat Functions & Values (Brian Roosa, VA Game & Inland Fisheries)
- Backyard Woods (Adam Downing, VA Cooperative Extension)
- Local Government Panel Session: Current Issues, Problems or Concerns with Riparian Buffers/Management & Policy Issues
- Components of an Effective Buffer (James Fulcher, VA Dept. of Forestry)
- Buffer Restoration & Mitigation (Judy Okay, Chesapeake Bay Program)

October 4, 2006

Healthy Bay for Healthy Kids: Cooking with Virginia's First Lady

Twelve 1st and 2nd graders, along with a parent, had the opportunity to “cook” with Virginia’s First Lady, Anne Holton, while learning the importance of sustaining our natural resources. The event began with Dr. Kirk Havens



sharing fun facts about what is needed to have a healthy Bay. The kids then made a chef's hat to wear in preparation for their "no-knife, no-boil" cooking. They followed along with Virginia's First Lady as Chef John Maxwell showed how to make a healthy and delicious Chesapeake Bay seafood dish. The participants left with a better understanding of our environment, happy palates, and new ideas for cooking with kids. The recipe, cooking demonstration, and clips from the Healthy Bay segment are available on-line through VIMS' web site

<http://www.vims.edu/events/healthy.htm>

October 13, 2006

Tools of the Tidal Shoreline Management Trade

Tidal Wetlands Workshop (71 attended)

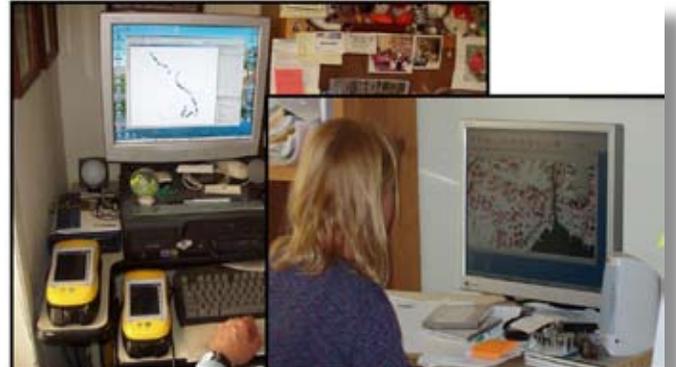
<http://ccrm.vims.edu/workshops/fall2006/fall2006/wetlandswkshp.htm>

Morning Presentations

- Introduction to GIS Tools
- Other On-Line Tools & Databases
- Tool Applications & Case Studies

Afternoon Breakout Sessions

- Wetlands Board "Boot Camp"
- GIS Tools
- Tools for Managing Beaches & Dunes (Scott Hardaway, VIMS)
- Tools for Siting & Designing Living Shoreline Projects



December 6 & 7, 2006

Living Shorelines Summit (174 attended)

<http://ccrm.vims.edu/workshops/livingshoreline/livingshorelineinfo.htm>

This summit brought together a variety of interest groups who work with or are interested in alternative techniques for erosion protection in Virginia & Maryland that emphasize the use of natural habitat elements for water quality & habitat values.



- Current Status of Research – Engineering & Ecological
- Site Suitability & Design Methods
- Decision-Making Tools
- State-Specific Management & Policy
- Education & Outreach



After Hours Lectures

Funding for this lecture series is provided by the CBNERRVA and CCRM programs at VIMS and the VIMS Communications Department. There were five “After Hours” lectures given in 2006 to a total audience of 350 people.

<http://www.vims.edu/afterhours/2006.htm>

- Sand Dunes of the Chesapeake -
Scott Hardaway
(January 26, 2006 & March 30, 2006)



- The Tide Next Time -
Dr. John Boon
(February 22, 2006)



Hiatus due to auditorium renovation.

- Jellyfish in Chesapeake Bay: Rise of the Slime? -
Rob Condon
(October 26, 2006)
- A Mercurial Change for the Bay? -
Dr. Steve Brooks
(November 30, 2006)



CCRM Website Report

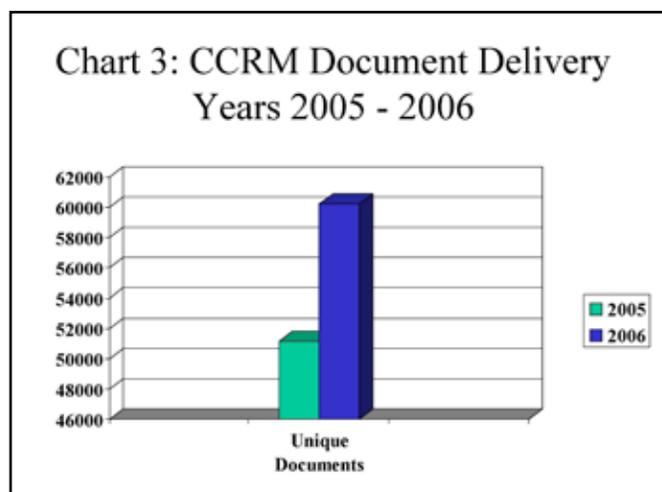
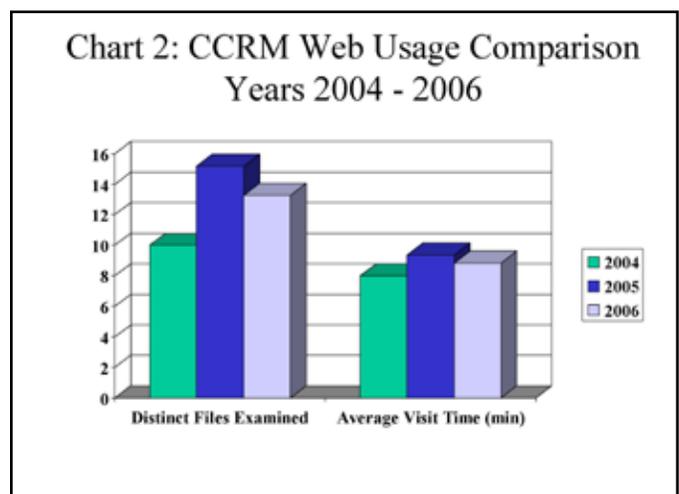
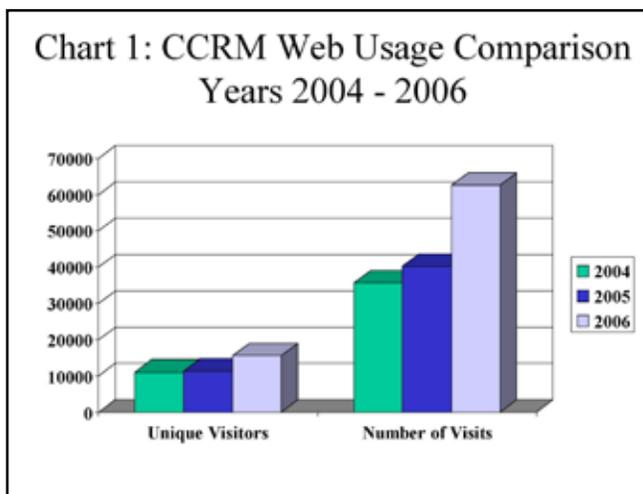
ccrm.vims.edu

The annual report on CCRM Web usage shows that 15,560 unique visitors accessed the site with 62,567 total visits during 2006. A typical visitor examined 13.28 distinct files before leaving the site and a typical visit lasted for 8.84 minutes.

A comparison of 2004 - 2006 CCRM website statistics shows an overall increase in the number of unique visitors and number of visits to the system. In 2006, there was an increase of 4,206 unique visitors and 22,321 more visits (Chart 1).

There was a decrease in the number of distinct files examined as well as the average visit time between 2005 and 2006 (Chart 2).

The web server delivered 60,172 unique documents one or more times each with delivery of 78 distinct types of documents; an increase of 9,026 unique documents and delivery of 23 distinct documents, respectively (Chart 3).







Publications

Center Publications

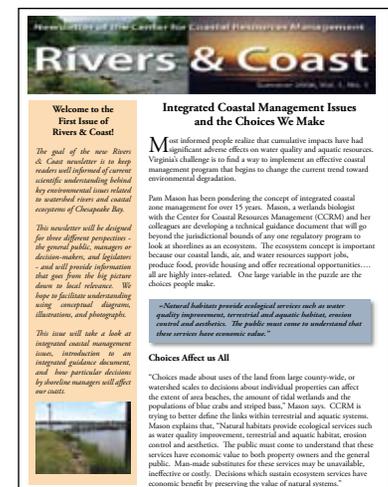
CCRM now produces two biannual newsletters – the updated Virginia Wetlands Report and the new Rivers & Coast. The Virginia Wetlands Report continues to inform readers of near-shore environmental science and related issues in an effort to influence better tidal shoreline decisions, and in addition to a new look, now serves to announce upcoming workshops and educational opportunities, both inside and outside of VIMS. The Rivers & Coast newsletter is designed to keep readers well informed of current scientific understanding behind key environmental issues as they apply to watershed rivers and coastal ecosystems of the Chesapeake Bay. The newsletter is written for three perspectives – the general public, managers or decision-makers, and legislators – and provides information that goes from the big picture down to local relevance. Both newsletters were mailed to over 1800 individuals, including all local wetlands board members, local and state agency personnel, General Assembly members, and interested private citizens. In addition to being distributed for free and available to any interested subscriber, they are available online.

Virginia Wetlands Report. Spring 2006, Vol. 21, Issue 1.
Integrated Coastal & Shoreline Management Guidance.
http://ccrm.vims.edu/vwr/vwr_2006_spring.pdf

Rivers & Coast. Summer 2006, Vol. 1, No. 1.
Integrated Coastal Management Issues and the Choices We Make.
<http://ccrm.vims.edu/rivers&coast/rivers&coastfullcolor.pdf>

Virginia Wetlands Report. Fall 2006, Vol. 21, Issue 2.
Tools of the Tidal Shoreline Management Trade.
http://ccrm.vims.edu/vwr/vwr_2006_fall.pdf

Rivers & Coast. Winter 2006, Vol. 1, No. 2.
Living Shorelines.
<http://ccrm.vims.edu/rivers&coast/rivers&coastfullcolor112906.pdf>





CCRM Quality Assurance/ Quality Control Policy

The Center for Coastal Resources Management conducts applied research and serves as a scientific advisor to federal, state and local agencies, and the general public. The Center recognizes the importance of how work processes are implemented to ensure that data collected are of the needed and expected quality for their desired use. In order to provide accurate information to user groups, the CCRM is dedicated to an aggressive, proactive Quality Assurance and Quality Control program. A myriad of activities occur within the Center, including direct support of laboratory and field investigations, support and training of graduate students and interns, training of resource agency personnel and the public, direct support of state agencies and local governments, and sponsorship of lectures, seminars, conferences and visiting scientists. Research activities include both field and laboratory measurements and the development and validation of ecological models. The general goal of the CCRM Quality System is to ensure accurate, reproducible, and unbiased data.

Operational Procedures

The Center recognizes the need for specific plans for individual data collection operations to ensure that data or information collected are of the needed and expected quality for their desired use. As a Center, the quality assurance operation procedures differ from that of an individual research contract. Each principal investigator is responsible for submitting a project-specific quality assurance plan to the relevant Program Quality Assurance Manager and the Center Quality Assurance Manager. The principal investigators will use the underlying principles described in this document as a framework for the specific quality assurance and quality control plans for each project. These plans should detail:

- The specific objectives of the project, including the hypothesis to be tested.
- The data quality objective for the variables to be measured.
- The specific sampling and analytical protocols required to meet the data quality objective.
- The individual responsible for quality assurance for the project.

All noncompliance or deviation from the approved quality assurance plan will be reported to the Program Quality Assurance Manager and the Center Quality Assurance Manager. A copy of the draft plan can be obtained from the CCRM if a purpose for the report is included in the request. More information about CCRM QA/QC can be found at

<http://ccrm.vims.edu/qaqc.html>

<http://ccrm.vims.edu/>

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