



# Virginia’s Eastern Shore *Seaside Management Plan*<sup>1</sup>

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## Introduction

### **Vision for the Seaside, Virginia's Eastern Shore:**

**The Virginia Seaside will be a healthy, functional and well-managed ecosystem whose unique natural resources sustain cultural, historic, and economic activities that are vital to Virginia's Eastern Shore communities.**

### **Why a Management Plan?**

The Seaside of Virginia's Eastern Shore, an inter-connected system of barrier islands, bays, and salt marshes, is a unique treasure. Recognizing that development and other natural and human forces threaten this valuable area, the Virginia Coastal Zone Management Program<sup>3</sup> initiated the *Virginia Seaside Heritage Program* (VSHP). The VSHP includes a Partnership consisting of localities, state and federal agencies, private partners, and academics. The Partnership is developing the tools necessary to support long-term restoration and management strategies. The Seaside area holds tremendous potential to demonstrate appropriate management of economic development and habitat restoration within a rare and fragile ecosystem.

The Virginia Seaside Heritage Program began as an ambitious three-year program. As a result of successes and momentum made by the program's partners during the first three years of the initiative, the Virginia Coastal Policy Team decided to continue funding the Seaside Heritage Program for three more years (funding through September 2008.) As this funding began to wind down, the Partnership developed this management plan to build upon early accomplishments and define shared needs and priorities.

The Partnership intends the *Seaside Management Plan* to serve a number of purposes:

- Portray the unique cultural, historic and natural resources of the Seaside;
- Promote the considerable worth of Seaside's natural resources;
- Establish priorities for continued action;
- Provide support for management decisions;
- Provide information useful for readers of the Plan;
- Formalize partnerships and provide an administrative structure for continued Seaside work;
- Attract funding and other support for the Plan's goals and actions;
- Ultimately, help sustain Seaside and Seaside-dependent resources.

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<sup>3</sup> The Virginia Coastal Zone Management Program (Virginia CZM Program) was established in 1986 to protect and manage Virginia's "coastal zone." The Program, part of Virginia's Department of Environmental Quality (DEQ), helps agencies and localities develop and implement coordinated coastal policies and solve coastal management problems. The Virginia CZM Program is part of a national coastal zone management program, a voluntary partnership between the National Oceanic and Atmospheric Administration (NOAA) and U.S. coastal states and territories authorized by the Coastal Zone Management Act.

The Virginia Coastal Zone Management Program will continue to assist with implementation of the Strategy and provide a dedicated source of funding for assessment and revision. Stakeholder engagement will continue to be important in determining how the plan will be developed and implemented.

## **Seaside, Virginia's Eastern Shore**

The Seaside of Virginia's Eastern Shore, an inter-connected system of barrier islands, bays, and salt marshes, is a global treasure. Submerged aquatic vegetation, oysters, riparian forest buffers, tidal wetlands, and sand dunes protect water quality, provide food and habitat for numerous coastal species and help buffer coastal areas from damaging wind and wave energy. The intertidal and shallow subtidal areas, undeveloped beaches and marshes support a diverse array of waterfowl and shorebirds. These habitats also serve as breeding, nursery and foraging sites for finfish and shellfish, which are of longstanding cultural and economic value as commercial and recreational fisheries. The Shore itself has been designated by the United Nations as a *Man and the Biosphere Reserve*, a designation intended to protect natural systems while enhancing the quality of life for the local community.

The Seaside has undergone several cycles of changes during the relatively short period of time following European settlement. During the 1800's, this barrier island system was valued for hunting, fishing, and recreating by people from Washington, D.C. to New York. Finfish and shellfish harvests provided income to thousands of Virginians. Unimaginable numbers of oysters, scallops, finfish, waterfowl and shorebirds were devoured from its seemingly limitless cornucopia.

But all that changed. Finfish and shorebird concentrations declined dramatically beginning in the late 1800's due to over-harvesting, disease, predation and loss of habitat. Powerful and destructive hurricanes and storms hit Virginia's Seaside in the 1880's, '90's and early 1900's. Rising sea levels and normal sea action covered settled areas. Eventually, the cottages, hunt clubs, resorts and small communities were gone.

Life has been relatively stable on the Seaside since the Great Depression. Prosperity ebbs and wanes as local and national economic conditions change. The natural resources continue to sustain life. But Seaside has not seen a great resurgence of underwater grasses, oysters, scallops, finfish and birds.

### *Pressures and Threats*

Direct pressures and threats to Seaside's plant and animal resources and water quality come from six primary areas. These are:

- 1) **Overharvesting**, including finfish, shellfish, waterfowl, and oysters;
- 2) **High-impact land conversion** causing loss of habitat, change of hydrology, and increased

sedimentation, primarily from coastal housing development;

**3) Incompatible human activity** such as egging, excessive use of fertilizers and pesticides, hardening shorelines, disturbing channels from boating;

**4) Introduction of non-native elements** such as disease (MSX, dermo), invasive species (phragmites), and predators (coyotes, foxes, raccoons);

**5) Potential use of off-shore areas for energy production** including biomass from seaweed and oil, gas and wind energy;

**6) Potential climate change** and resultant sea level rise and disturbance.

The most obvious impacts from development may be the loss of vegetation and land disturbance from re-grading. Land disturbance causes changes in hydrology, such as altering the flow of water, often concentrating runoff in ditches. The addition of impervious surface from rooftops, driveways, patios, and decks adds to the increase in the volume and velocity of runoff.

During development, the absorptive quality of a forest may be lost through removal and conversion to lawn. Roots, groundcover and duff no longer slow runoff or bind soil to prevent erosion. Water that used to infiltrate the soil becomes runoff, reaching the open water carrying excess sediment, nutrients and pollutants from lawn care, pet waste and automobiles. This over-enrichment of the water may lead to algae blooms, increased turbidity and the decline of water quality and habitat for submerged aquatic vegetation (SAV), oysters, and other living organisms dependent upon the habitat for food or shelter.

On-site wastewater systems, another characteristic of rural development, contribute a substantial amount of nitrogen to groundwater. Since a traditional system is designed to remove pathogens, not nutrients, one household septic system may generate as much nitrogen per year as an acre of agricultural land.

Shoreline modification can have a significant impact on aquatic resources. If modifications include hardening, such as bulkheads, SAV beds and habitat may be harmed by the resultant amplified wave energy. Other structures such as groins or breakwaters can alter natural circulation changing sediment deposition, or cause beach loss farther along the shoreline. Softer solutions involving grading of the shoreline and riprap may remove the existing woody vegetation in a buffer, eliminating habitat and losing the binding quality of woody roots and the absorptive quality of the forest duff. Cumulative changes along the shoreline can affect an entire tributary, often with unintended effects.

Access for boating activities has the potential to degrade water quality through the introduction of gas, oils and waste into the water. Boat wakes and propellers disturb sediments, thus increasing turbidity, and can directly damage SAV beds through scraping. The construction of multiple piers or docks and access ramps disturbs buffers, increases erosion and can destroy adjacent oyster and SAV beds, altering habitat for aquatic organisms. The cumulative effects include visual as well as physical consequences.

## **Seaside Partnership Successes**

Despite these concerns, management and restoration success has occurred and significant research and attention continues. The Virginia Seaside Heritage Program (VSHP) has been working to restore ecosystem functions since the fall of 2002. The VSHP is addressing management of the aquatic resources of the barrier islands, bays and salt marshes along the shore and completed an ambitious six-year program aimed at restoration, use-conflict resolution, and protection of this global treasure in 2007. Since 2001, the VSHP and other partners have been involved in a variety of projects focused on reducing the impacts of the pressures and threats to Seaside resources with a great degree of success. These projects, briefly outlined below, have helped VSHP develop the tools necessary to support long-term restoration and management strategies on the seaside of Virginia's Eastern Shore.

### **Habitat Restoration**

- Since 2001, 18 million native eelgrass (*Zostera marina*) seeds have been broadcast over 140 acres in South, Spider Crab, Cobb and Hog Island bays. Seagrass now occupies an area of over 360 acres, a surprising success given the near-total absence of eelgrass from the seaside since the 1930s. Restoration efforts have also included water quality monitoring at the restoration sites to ensure continued conditions supportive of eelgrass.
- Since 2003, approximately 4.9 acres of oyster reefs have been constructed on public beds in Accomack County. An additional 3.9 acres of reefs have been constructed in Northampton County. As spatsets are still relatively dependable on Seaside, all reefs have been colonized and have significant oyster populations.
- *Phragmite australis* is an invasive wetland grass threatens native marsh plants on the seaside. Partners have successfully mapped all patches of phragmites on the mainland interface, lagoon system and barrier islands and have examined the effects of dredging, hurricanes and wildfires on phragmite proliferation. Priority control patches were identified based on the presence of sensitive rare species and habitats, and aerial and ground control with wetland herbicides has taken place on approximately 325 acres. Another 150 acres are scheduled for treatment this year.
- In an effort to improve avian bird habitat on the seaside, partners have collected data and mapped shorebird concentrations, the interactions between shorebird prey and clam aquaculture sites, and the suitability of barrier islands as habitat over time. Researchers have also studied the impacts of predators such as raccoon and red fox and the effectiveness of predator removal and aversive conditioning on the nesting success of shorebirds. Foxes and raccoons have been removed from several barrier islands, and predator removal and management continues.

### **Sustainable Industries**

- In order to ensure that ecotourism remains a sustainable industry, the Virginia CZM Program created an Ecotour Guide Certification Course to provide safe, responsible and

environmentally sound guidelines for responsible boating tours on the Eastern Shore. 25 guides participated in the program, nineteen were certified, and an additional five successfully passed the Ecotour Instructors Training to train and certify new guides.

- The Virginia Seaside Water Trail, developed by the Accomack-Northampton Planning District Commission and other Seaside Partners to build ecotourism infrastructure on the Eastern Shore, offers 100 miles of paddling routes through the barrier islands. The associated website offers information on launch sites, route descriptions and maps, and safety tips. The Virginia CZM Program is working with localities to install floating docks for easier and more environmentally friendly kayak access. Docks are in place in Chincoteague Eastside Landing, Wachapreague Town Marina, and Willis Wharf, and an additional dock is scheduled to be installed at Quinby Harbor this year.
- The Virginia Institute of Marine Sciences and five of the largest members of the clam aquaculture industry collaborated on the development of a set of Environmental Codes of Practice and Best Management Practices for environmental stewardship in the aquaculture industry. The draft ECOPs received endorsement from clam growers at a 2003 meeting on the Eastern Shore.

### **Management and Education**

- A water quality database cataloguing all available information collected between 1962 and 2003 at over 400 sites on the seaside has been constructed to track water temperature, dissolved oxygen, pH, and a number of pollutants in seaside waters over time. These data are also helpful in tracking habitat quality for both birds and eelgrass.
- The Virginia Eastern Shorekeeper and Creek Watcher volunteers have provided over 1000 hours of on-the-water patrols near public oyster beds, eelgrass restoration sites, and important beach and colonial nesting bird areas to extend the presence of local resource managers. Shorekeepers also produce an annual account of human impacts on the natural resources of the barrier islands to assist in policy decisions.
- A Seaside bird migration study was conducted in 2004 and 2005 to develop baseline data for assessing the potential impacts of wind farms along the seaside of the Shore.
- A series of workshops to educate landowners about phragmite history, ecology, abundance and control methods were offered during 2005 and 2006, reaching approximately 150 land owners in Accomack and Northampton Counties.
- A new brochure entitled “Life on the Beach Isn’t Always Easy,” is now available to educate visitors about the critical role island habitats play in the life-cycle of beach nesting birds.
- “Living Shorelines” are shoreline management options that help prevent erosion, while also enhancing the shoreline habitat. “Living Shorelines” often allow for natural coastal processes to remain through the strategic placement of plants, stone, sand fill and other structural and

organic materials. The concept was developed in Maryland and is now used in other States including Virginia.

- The Coastal GEMS internet mapping website now provides access to mapped Seaside resources such as the Seaside Water Trail, public access locations, barrier island access, forest change assessments, shorebird concentrations, and oyster and eelgrass restoration sites.

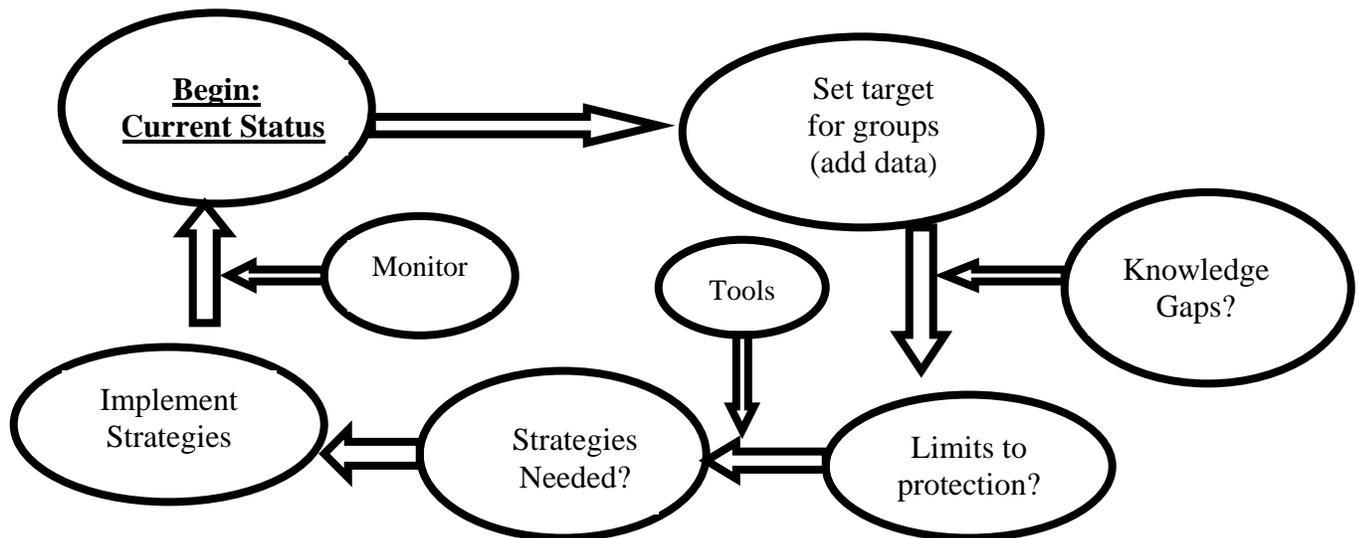
# Seaside Management Plan

The Seaside Partners adopted the following vision to guide the Management Plan’s goals and actions: **The Virginia Seaside will be a healthy, functional and well-managed ecosystem whose unique natural resources sustain cultural, historic, and economic activities that are vital to Virginia’s Eastern Shore communities.**

The Avian Partnership, a group of researchers, natural resource managers and advocates, developed a separate *Avian Management Plan* that includes Research and Monitoring, Education, and Management components. The Seaside Partners have incorporated components of the Avian Management Plan into this *General Management Plan*. The General Management Plan is organized by *Natural Resources Management*, *Water and Land Use Management*, and *Sustainable Economic Development* components.

## A. Natural Resources Management

The purpose of the natural resources Management Plan is *to conserve and manage Seaside land and water resources in a manner that protects their natural values, such as habitats, food webs, and plant and animal species, while accommodating compatible, traditional and new uses.* Natural resource management of species includes the management of consumptive species (e.g., oysters, fish), and the protection and restoration of target species. Habitat management focuses on water quality, non-tidal wetlands, saltmarshes, aqueous bottom, shellfish beds, submerged aquatic vegetation beds (SAV), upland areas, and barrier islands. The general approach for development of species and habitat models follows:



**Goal A1: Manage Seaside resources in a manner that links habitat and species management in order to sustain a natural, healthy, functional, and balanced ecosystem.**

*Why:* Habitat conservation and species protection are intrinsically linked. In order to recover and protect target species, habitat must be protected. **NEED TO ADD MORE RATIONALE.**

*Objective A1-1:* Develop goals and action plans for habitat that promotes species recovery and conservation for each target species. **DEVELOP A PRIORITY LIST.**

*Tasks:* Convene smaller task groups for each of the target group to develop specific goals as well as action plans for achieving those objectives for each of the high priority target species for this goal. The target species include shellfish, migratory birds, crustaceans, breeding birds, fish; depleted, rare, threatened, and endangered species (R.T.E); and exemplary natural communities **EXPLAIN WHY EACH IS IMPORTANT.** Habitat includes non-tidal wetlands, saltmarshes, sub-aqueous bottom, shellfish beds, oyster reefs, tidal flats, submerged aquatic vegetation beds (SAV), upland areas, barrier islands, spartina grass, sea grasses, marshes and dunes.

*Objective A1-2:* Evaluate the progress in meeting those objectives annually and adjust each action plan as needed.

*Tasks:* Convene task groups annually for each of the target group to assess and adjust objectives and tasks.

*Timeframe:* Develop specific habitat and recovery objectives and tasks in 2007-08 and update progress annually.

*Measurable Results for Goal A1:*

- ✓ Objectives and strategies developed for each target group.
- ✓ Annual evaluation completed and strategy adjusted.
- ✓ Habitat recovered and protected per task group goals.
- ✓ Species recovered and protected per task group goals.

**[OLD A2 MOVED TO WATER/LAND USE SECTION; THIS IS FROM AVIAN PLAN]**

**Goal A2: Support and supplement current policies and programs that prevent further degradation and loss of habitat.**

*Objective C1-1:* Work with existing state and local governments to implement protective policies.

*Tasks:*

- 1) Work with local governments and state agencies on habitat protection policies and natural resource laws.
- 2) Work with VA Marine Resources Commission (VMRC) to designate the ungranted state lands on the seaside as a Western Hemisphere Shorebird Reserve Network (WHSRN) site.

*Objective C1-2: Use posting and seasonal closure of critical habitat for species of concern.*

*Tasks:*

- 1) Work with private landowners to post their lands.
- 2) Develop consistent nesting and closure signage, both in appearance and language, for all landowners (agencies and organizations). Additional signs with agency logos, local restrictions and ownership can supplement closure signs. All signs should accurately reflect lawful penalty information, if included in text.
- 3) Work cooperatively to maximize enforcement of area restrictions and to assess the need for additional enforcement capacity.

**Goal A3: Support development of an effective natural resource education strategy.**

*Why:* Without public support for Seaside protection strategies as well as on-going stewardship, management plans will fail. For people to care about Seaside, they must see the importance of Seaside to their lives.

*Objective A-3-1: Support development of targeted behavior changes through programs with key messages relating to natural resource issues.*

*Tasks:*

- 1) Catalog existing education resources.
- 2) Identify specific gaps.
- 3) Develop curricular materials.

*Objective A-3-2: Reach specific publics with key messages relating to natural resource issues.*

*Tasks:*

- 1) Conduct workshops with small groups of interested individuals that allow for one-on-one connections. [THIS NEEDS MORE SPECIFICITY – WHAT SORT OF WORKSHOPS AND WHO?]
- 2) Implement programs for youth (at parks and within schools, 4H etc.)
- 3) Support VIMS and LTER speakers' bureaus on key topics with prepared, shared messages.

*Timeframe:* On-going.

*Measurable Results for Goal A3:*

- ✓ Catalog of existing education resources developed.
- ✓ New curricula developed.
- ✓ Speakers' bureau messages developed.
- ✓ Numbers of workshops, people reached.
- ✓ Surveys demonstrate improved understanding and support for protection.

**Goal A4: Protect and augment nesting and foraging habitat by encouraging natural barrier island processes.**

*Objective A4-1: Prioritize restoration/enhancement and land protection efforts.*

*Tasks:*

- 1) Use Important Bird Areas (IBAs) as first screen to prioritize restoration sites.
- 2) Clarify who's doing what and maximize augmentation efforts to serve multiple purposes/goals.

*Objective A4-2: Support land protection, restoration and enhancement efforts.*

*Tasks:*

- 1) Promote the following tools:
  - Acquisitions, easements, Purchase of Development Rights (PDRs)
  - Restoring native vegetation
  - Restoring hydrology
  - Restoring SAV and oyster reefs
  - Supplementing selected manmade placement sites islands with dredge material
  - Augmenting sand deposition on dredge spoil piles

**Goal A5: Eradicate the most harmful invasive species.**

*Objective C4-1: Develop a cooperative invasive species plan.*

*Tasks:*

- 1) Invasive plant species and their effect on habitat.
- 2) Invasive animal species and how they effect avian populations.???NOT TASKS.

## **B. Water and Land Use Management**

**Goal B1: Maintain a functioning Seaside ecosystem that supports viable fisheries and other economically important resources as well as cultural and recreational activities.**

*Why:* Most residents want to live in a place with a vibrant community, a vigorous economy and a healthy natural environment. “Over the long run, a successful society is supported by both a healthy economy and a healthy environment...” (Center for Compatible Economic Development, 1996) A functioning ecosystem is necessary to achieve economic and social goals. Seaside especially needs stronger protection measures for shellfish to ensure continued viability of shellfish farming in the face of development that can harm water quality.

[where does this go? 3) Map and protect shoreline vegetative buffers.]

*Objective B1-1:* Implement blue-green infrastructure planning that combines comprehensive coastal resource data, maps, and information from all natural resource agencies and coastal partners [IN ORDER TO ...].

*Tasks:*

- 1) Conduct an assessment of sensitive areas utilizing existing data on seaside resources (i.e., compare county data with data layers in Coastal GEMS).
- 2) Prioritize areas of special concern.
- 3) Utilize CommunityViz software to understand current zoning’s full build-out and associated impacts from impervious surfaces.

*Timeframe:* Began in spring 2007.

*Objective B1-2:* Reduce nonpoint sources of water contamination.

*Tasks:*

- 1) Develop a Seaside nonpoint strategy that would include stormwater management and septic strategies (e.g., determine impacts from septic tanks and acceptable pollution loadings on water resources);
- 2) Determine if a reserve drain field for new housing development is needed based on soils and seasonal water table (Accomack County);
- 2) Recommend revising the Chesapeake Bay Preservation Act to include impervious cover percentage suggested by current local science;
- 3) Request that Accomack County expand the Chesapeake Bay Preservation Act requirements to apply to Seaside;
- 4) Conduct a marketing campaign both onshore and inland to increase education about buffers and best management practices for storm water management.

*Timeframe:* 2007-2010.

Objective B-1-3: Support local efforts to develop water quality standards for shellfish aquaculture protection areas and establish requirements to conduct an alternatives analysis for proposed point source discharges.

*Tasks:*

- 1) Meet with county boards about special water quality standards to protect shellfish. Pursue other informal public outreach as appropriate.
- 2) Conduct rulemaking process with full public participation towards adoption of special water quality standards that require alternatives analysis for proposed point source discharges.
- 3) Recommend reserve drain fields in counties and use of cost-effective and environmentally protective on-site sewage disposal systems.

*Timeframe:* 2008-2009

Objective B-1-4: Reduce the proportion of impervious cover.

*Tasks:*

- 1) Approach localities to change site plan regulations for impervious cover on-site (currently 16% or more) to better address pollutant loads, based on the most recent scientific recommendations (match Luckenbach et. al 2008 estimated date of completion).

*Timeframe:* 2008-2010

*Measurable Results for Goal B1:*

- ✓ Water quality standards for shellfish aquaculture developed and adopted.
- ✓ Chesapeake Bay regulations extended to Seaside (Accomack County).
- ✓ Site plan regulation changes proposed to Accomack and Northampton Counties.
- ✓ Nonpoint strategy developed.
- ✓ Marketing campaign developed and implemented.
- ✓ Blue-green infrastructure planning implemented. [THIS IS TOO BROAD]

**Goal B2: Maintain sufficient water quality to sustain habitat that supports target species.**

The target species currently include shellfish, birds, fish, and crustaceans. WHY IS THIS DIFFERENT THAN A1? shellfish, migratory birds, crustaceans, breeding birds, fish; depleted, rare, threatened, and endangered species (R.T.E); and exemplary natural communities

*Why:* Water quality is key for sustaining habitat essential for a functioning ecosystem. In order to recover and protect target species, water quality must be protected.

*Objective B2-1:* Develop and test regionally appropriate, linked hydrographic and land-use loading water quality dynamic models.

[WHERE DOES THIS GO?: Develop an improved understanding of nutrient dynamics]

*Tasks:*

Identify and prioritize Seaside Hydrologic Units [which lagoons?] for beginning the modeling.

*Objective B2-2: Assess existing water quality conditions.*

*Tasks:* Develop water quality monitoring system for purposes of habitat restoration and preservation.

*Objective B2-3: Ensure that water quality standards are sufficient to protect target species.*

*Tasks:*

- 1) Engaging localities and the general public, evaluate existing water quality standards for target Seaside species.
- 2) Suggest new water quality standards if existing standards are not protecting resources.
- 3) Promote implementation/enforcement of water quality standards.
- 4) Annually evaluate the progress of groups in meeting water quality standards.

*Timeframe:* By 2010

*Objective B2-4: Protect water resources by preventing harmful uses.*

*Tasks:*

- 1) Using blue-green infrastructure planning found in Coastal GEMS to identify sensitive blue infrastructure (wetlands, oyster reefs, SAV beds, shellfish farms), identify locations of current uses and potential threats and create plan to minimize conflicts among those uses.
- 2) Participate in TMDL assessments and Implementation Plans (IP's) and review monitoring strategies.

*Timeframe:* 2008-2011

*Measurable Results for Goal B2:*

- ✓ Models developed and tested.
  - ✓ Water quality monitoring system developed.
  - ✓ Evaluation of existing water quality standards completed and assessed for adequate protection.
  - ✓ Water quality evaluation completed.
  - ✓ Water quality standards met.
- 
- ✓ Locations of current uses and potential threats identify and plan to minimize conflicts among those uses created.

✓ TMDLs and TMDL IP's assessed and monitoring strategies reviewed.

***Goal B3: Work proactively with corporate farmers, private landowners and local land trusts to promote existing land conservation programs that protect natural resources, habitats, and the species that depend on them.***

**[NEED TO DEVELOP OBJECTIVES AND TASKS (THIS WAS FROM THE AVIAN PLAN)]**

## **C. Sustainable Economic Development**

**Goal C1: Determine short and long-term costs and benefits of existing and potential economic activities on the Eastern Shore for natural resource-dependent industries.**

*Why:* Economic development can be conducted in ways that reduce impacts on and protect natural resources. Information to businesses planners, and decision makers for an economic future that preserves cultural, historic and natural resources of the Eastern Shore is needed in order to allow local decision makers to direct change. This must be done in ways that respect local decision-making authority and existing economic development plans.

*Objective C1-1: Conduct a cost/benefit analysis for natural resource-dependent industries (aquaculture, plasticulture and traditional and specialty agriculture) and recreation (ecotourism, recreational fishing and hunting).*

*Tasks:*

- 1) Conduct analysis and clarify connections between economic prosperity and natural resources protection.
- 2) Engage the public in resulting findings, using user surveys and education programs.
- 3) Assist with development and support of the resulting economic model.

*Timeframe:* 2007 - 2011 (in order to be done prior to the next 5 year comprehensive plan)

*Measurable Results for Goal C1:*

- ✓ Cost/benefit analysis conducted.
- ✓ Awareness of the model among the target populations (e.g., public officials, businesses).

**Goal C2: Enhance viable and sustainable ecotourism industries and resource-based recreation.**

*Why:* Communities on the Shore actively seek increased economic development. Ecotourism is one form of economic development that can be done in a way that preserves the cultural, historic and natural resources of the Eastern Shore. At the same time, ecotourism can educate about the significance of Seaside and the need for protection.

*Objective: Determine desired and appropriate resource-based recreation opportunities for the area.*

*Tasks:*

- 1) Inventory existing infrastructure, providers and targets and destinations.
- 2) Determine potential client base, user demands and needs.
- 3) Establish thresholds for use of targets and destinations.
- 4) Educate the public about tasks #1 and #2.

*Timeframe:* 2008 - 2011.

*Measurable Results for Goal C2:*

- ✓ Inventory completed.
- ✓ Information disseminated.

**Goal C3: Enhance viable and sustainable agriculture and forestry.**

*Why:* Agriculture and forestry, important aspects of Seaside's economic activities, can have a significant impact on natural resources. With intention and proper planning, agriculture and forestry activities can be conducted in a way that preserves the cultural, historic and natural resources of the Eastern Shore. Local and regional markets may be especially suitable for expansion.

*Objective C3-1:* Educate targeted constituencies and the public about how agriculture and forestry practices affect natural resources.

*Tasks:*

- 1) Develop information about how agriculture and forestry practices affect protected and threatened natural resources.
- 2) Educate planners, farmers, Soil and Water Conservation District employees, and others about those impacts.

*Objective C3-2:* Determine desired and appropriate agriculture and forestry opportunities for the area.

*Tasks:*

- 1) Support the work of farmers, industrial poultry operations, The Nature Conservancy and large landowning agencies, and economic development officials who are investigating opportunities.
- 2) Educate planners, farmers, and others about those opportunities.

*Objective C3-3:* Support increased sustainable agriculture initiatives, including development of markets, particularly suited to the Eastern Shore.

*Tasks:*

- 1) Work with existing economic development programs to incorporate these initiatives.

*Objective C3-4:* Provide tools (e.g., purchase of development rights) and incentives to support sustainable practices.

*Tasks:*

- 1) Develop information concerning appropriate tools and incentives.
- 2) Distribute among appropriate publics.

*Measurable Results for Goal C3:*

- ✓ Information developed about impact of agriculture and forestry practices on natural resources.
- ✓ Key publics educated about those impacts.
- ✓ Working group to investigate opportunities convened and report completed.
- ✓ Key publics educated about those opportunities.
- ✓ Existing economic development initiatives incorporated these initiatives.
- ✓ Information concerning appropriate tools and incentives developed and distributed among appropriate publics.

**Goal C4: Enhance viable and sustainable aquaculture**

*Why:* Shellfish aquaculture, a growing part of Seaside's economic activities, has little significant impact on natural resources. With intention and proper planning, aquaculture can be conducted in a way that preserves the cultural, historic and natural resources of the Eastern Shore.

*Objective C4-1:* Incorporate sustainable practices into an overall feasibility and implementation plan.

*Tasks:* As part of an overall feasibility and implementation plan:

- 1) Identify best management practices.
- 2) Determine high-return industry that is least developed, e.g., land-based saltwater finfish.
- 3) Identify funding sources for pilot and seed programs.
- 4) Encourage development of insurance programs.

*Measurable Results for Goal C4:*

- ✓ Best management practices identified.
- ✓ Pilot programs initiated.
- ✓ Insurance program initiated.

**Goal C5: Create a Seaside identity as a valued and accessible research region.**

*Why:* Like Woods Hole, this identity could add value to the region, inform the public about the value of the resource, enhance support for the research, and add to tourism income.

*Objective C5-1:* Create a branding for the Seaside as a vital research area.

*Tasks:*

- 1) As part of an overall feasibility and implementation plan create a means to coordinate activities and increase visibility for the research at two levels, one for scientists and the other for general educators;
- 2) Create a periodic Seaside Science Symposium to share findings with key publics.

*Objective C5-2: Continue coordination and communicate guidelines for conducting scientific research, military maneuvers, and channel dredging activity. Guidelines for scientific research are complete at the agency level. Coordination on avian disease is especially important.*

*Tasks:*

- 1) Develop a central database as a repository for partners' research. (n.b. This database should limit information about the location of certain species.)
- 2) Continue cooperation with military (they control their own guidelines).
- 3) Coordinate with the Corps of Engineers (they control their own guidelines).
- 4) Develop reference guidelines among all partners. Using the Southern Tip Partners' MOU as a template, VCAP could develop other reference guidelines to provide guidance to the COE and the military as to what best management practices they should be using respectively for channel dredging and military maneuvers in order to best support protection and enhancement of habitat.

*Measurable Results for Goal C5:*

- ✓ Central database established.
- ✓ Reference guidelines established.
- ✓ Seaside Symposium established.
- ✓ Brand recognition as determined by surveys.

**Goal C6: Increase skilled local workforce to enhance sustainable industries.**

*Why:* There are currently few economic opportunities that encourage and enable local residents to stay on the Shore and actively participate in the preservation of the cultural, historic and natural resources.

*Objective C6-1: Increase hiring of local residents for skilled positions.*

*Tasks:*

- 1) Support training programs within vocational tech, internships for local students and curricula in local schools.
- 2) Support public education activities about the resource through outreach programs at all school levels.
- 3) Encourage employers to hire locally via creation of a job clearinghouse.

*Measurable Results for Goal C6:*

- ✓ Development of job clearinghouse.

## Appendix

- Partners Grants Summary 2002-2006
- **List of species found on the seaside** (Sources include the 1990 DOT study of Barrier Islands) and the Natural Heritage Inventory, Coastal GEMS)
- Partner agencies **and contact information**
- Other?

### Seaside Partners Grants Summary: 2002 – 2006

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#### Program Coordination

CZM/DEQ: Laura McKay

Total allocated: \$61,345

The \$21,644 in FY 2002 was spent on design and printing of the Beach Nesting Bird Brochure (14,000 copies were printed – 9,000 by USFWS); printing of two Eastern Shore News inserts on the SHP; salary for Lindy Dingerson to work with Jim Perry of VIMS on Ecotour guide certification – 19 guides were certified; GIS computer software and training. About \$8k was spent on design and printing of 17,000 Seaside Water Trail brochures.

The \$5,456 in FY 2003 was spent on GIS software, licensing and training and design of the Seaside Water Trail brochure. The result of the GIS expenditures is that the following data layers are now available on the Coastal GEMS website: Hard Clam Aquaculture Permit Sites; Clam Aquaculture Suitability Sites; Seaside SAV Planting Sites and SAV Coverage; State Constructed Oyster Reefs; Barrier Island Ownership; Important Bird Areas; Migratory Songbird Stopover Habitat; Birding & Wildlife Trail; Seaside Water Trail; Invasive Reed Sites; and Seaside Heritage Program Boundary. \$35,000 in FY 2004 and 2006 funds have not yet been spent. FY 2005 funds were redirected to UVA for the Seaside Management Plan (\$44,100).

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#### Avian Projects

CCB: Bryan Watts

Total allocated: \$303,936

These projects were designed to synthesize management tools across an array of avian communities along Seaside habitats through the analysis of existing data sources and targeted collection of new data.

The \$30,000 in FY 2002 was used to produce GIS data layer of shorebird concentrations area based on data collected during aerial surveys of transects along the lower Delmarva seaside in the mid 1990s. These data were then used in a FY 2003 assessment project.

The \$65,000 allocated in FY 2003 were used to 1) Assess management conflicts between migratory shorebird habitat use and clam aquaculture (35% of FY funding) that has determined that clam aquaculture and shorebird habitat use occur in adjacent spatial locations, but the two resources do not typically overlap and do not result in a conflict for management, and 2) Develop a digital image library and portfolio of aerial photography resources of the lower

Delmarva Seaside (65% of FY funding). For the latter task, we archived 8 yrs of aerial photographs into orthorectified digital images, then used these as baseline data for a FY 2004 assessment of bird distributions and habitat.

In FY 2004, a total of \$93,512 were used to 1) Determine changes in habitat suitability of the barrier islands for beach nesting birds over time (80% of FY funds), 2) Assess the overlap in Phragmites distribution and high marsh habitat (11% of FY funds), and 3) Proof and archive a 30-yr data set on colonial nesting birds along the barrier island chain (9% of FY funding). Each of these projects have produced respective GIS data layers and summary information that will be used to forecast avian population response to habitat availability. Results from task 1 are still in production and are specifically investigating stability in habitat dynamics. Results of task 2 have shown that Phragmites has invaded nearly 50% of high marsh patches and potentially represent a threat to birds and other wildlife that depend on these habitats. Results from task 3 provides a digital map and database of 1,921 waterbird colonies composed of 955,635 individuals.

A total of 50,936 in FY 2005 were used to determine the effect of Phragmites on the density and distribution of breeding birds that specialize on high marsh habitats. The majority of these funds were used to collect field data on high marsh birds using maps synthesized in FY2004 as a blueprint for study site selection. Remaining funds are directed towards data analysis and synthesis which is ongoing.

In FY 2006, \$65,000 are being used to 1) Extend the study on the effect of Phragmites on high marsh birds during the winter season (77% of FY funds), and 2) To determine stopover lengths and resource use of migratory Red-Knots on the Seaside (23% of FY funds). The collection of winter high marsh bird data is ongoing and collection of Red-Knot information will begin in the spring of 2007.

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### **Shorebird Prey Characterization & Aquaculture Conflicts, Water Quality Data, Aquaculture Best Management Practices (BMPs), Oyster Inventory**

VIMS: Mark Luckenbach

Total allocated: \$181,900

Shorebird Prey and Clam Aquaculture Conflicts: The ultimate goal of this three-year project was to develop an understanding of how clam aquaculture in the seaside bays affects the feeding activity of migratory shorebirds. During FY 2002 we obtained data on areas of shorebird concentrations in the lower coastal bays from aerial surveys conducted by Dr. Bryan Watts (Task #12.01). We also obtained data from the VMRC on shellfish leases in the area that will be used to produce GIS layers that will show regions of potential overlap. (Due to limitations in the format of the VMRC data, we are still in the process of putting these into a GIS format.) We used high resolution aerial photography obtained from the VA Geographical Information Network to map the locations of clam nets in the southern portion of the coastal bays. The combined maps show areas of actual overlap between shorebird foraging areas and aquaculture. A digital map showing these areas of overlap was provided to VA CZM Program. A more detailed sampling design was provided to VA CZM Program along with the map showing locations of shorebird concentrations and aquaculture operations. IN FY 2003 benthic organisms that serve as potential prey for shorebirds were quantified at 3 clam aquaculture sites from 4 sub-habitats-(1) in the macroalgae on top of the nets, (2) in sediments between the nets, (3) in

sediments at the location of old nets ("ghost nets"), (4) 50 - 100 m away from the nets-and from (5) a site that had no history of clam aquaculture. A total of 48 benthic and epibenthic taxa were identified across all sites, with the clam aquaculture sites having a higher species richness and abundance compared to the reference site. These survey data indicate considerable variation in the species composition and abundance of potential prey within the various sub-habitats within aquaculture sites. Aerial survey data from earlier phases of this work lacked the resolution to indicate where within these sites shorebirds forage. So for FY 2004, ground-based surveys of shorebirds were used to quantify where shorebird foraging was occurring within clam aquaculture sites. In FY 2004 concern over the potential impact of predator exclusion nets used in clam aquaculture on foraging habitat and prey availability for migratory shorebirds was addressed by (1) examining the potential areas of overlap of the two uses and (2) the availability of benthic invertebrates that serve as prey for foraging shorebirds at sites with and without clam aquaculture. The results indicate that there is currently only limited overlap between primary shorebird foraging habitats and clam aquaculture sites. This finding is largely the result of the limited aerial exposure of the clam beds which are generally planted in the shallow subtidal and very low intertidal regions of mudflats. Surveys of benthic invertebrates which serve as prey for shorebirds were undertaken in the early summers of 2004 and 2006 at clam aquaculture and control sites. The findings from both years indicate that both species numbers and total prey abundance in the sediments on clam farms (both between the nets and at locations which previously had nets) are comparable to both local and distant control sites. Further, they reveal that the macroalgae (seaweed) on the surfaces of the nets harbor species numbers and prey abundances that are comparable to or even greater than those found in surface sediments on and off clam farms. These prey include a wide array of species generally considered to be infaunal, including many that are known prey items for shorebirds. In short, although the time available for shorebirds to forage at clam aquaculture sites is limited by tidal exposure, our data suggest that abundant and diverse prey are available at these sites.

Water quality database: An inventory of all available water quality data from the Virginia seaside bays was compiled and formatted for over 400 sites on the seaside spanning the period from 1962-2003 into both ACCESS and EXCEL databases containing over 41,000 entries. Parameters in these databases include dissolved oxygen, pH, water temperature, salinity, nitrate, nitrite, total dissolved nitrogen, orthophosphate, total dissolved phosphate, total suspended solids, fixed suspended solids, volatile suspended solids, dissolved organic nitrogen, dissolved organic phosphorous, chlorophyll a, pheophytin, urea, DFAA, DCAA, DOC, PAR, Brown Tide counts, secchi depth and fecal coliform counts. These data were provided by several sources including VIMS (5 sources within), ODU, VDH, and links to existing databases provided by EPA, UVA LTER, and DEQ. Metadata were also produced for the database. Data are provided with latitude and longitude for importation into GIS. The databases, metadata and a listing of web links were provided to VA CZM as a final product.

Aquaculture Codes of Practice and BMPs: There is currently no formal group that represents this industry, so we worked closely with the five largest members of the industry (representing ~80% of the total production) and developed draft sets of guidelines for both the Environmental Codes of Practice and BMP's. The draft ECOP were presented at the 2003 annual meeting of clam growers on the Eastern Shore and received their general endorsement. The ECOP provides a set of guiding principals for environmental stewardship by the industry. The

Environmental BMP's (i) identify specific environmental and social issues and potential conflicts, (ii) propose best management practices that minimize undesirable environmental consequences and promote social acceptance of clam aquaculture, and (iii) identify where information gaps exist for the further development of BMP's. The BMP's have recently been updated to include the findings and recommendations from a survey of derelict clam netting conducted as another element in the Seaside Heritage Program and from the shorebird prey study referenced above. The BMP's now incorporate elements related to site selection, site deliniation, predator protection, biofouling management, waste management, maintenance of water quality, disease management, exotic species, aesthetics and public education.

### **SAV Mapping, Restoration and Isotope Analyses**

VIMS: Bob Orth

Total allocated: \$554,000

44.6% has been expended in direct restoration activities, including planting of test plots for identifying locations for large scale plantings, the actual large scale plantings with seeds in South, Spider Crab and Hog Island bays (which include efforts expended to harvest and store seeds until utilized in the restoration efforts), and the on-ground monitoring of the successful establishment of seedlings. Since 2001, we have broadcast 18 million seeds into 141 acres in South, Spider Crab, Cobb, and Hog Island bays. Eelgrass has spread considerably in South Bay, especially into areas south of the original set aside which has now been designated as additional set aside for the VIMS work. This gives us a total of 727.85 acres of set aside in South Bay. We also received a 500-acre set aside in Hog Island Bay.

44.6% has been expended on the intensive water quality monitoring effort that has mirrored the restoration efforts, including the placement of a continuous water quality monitoring station in South Bay, to insure water quality conditions are adequate to support eelgrass. Water quality data over the course of the seagrass restoration program has shown those parameters necessary for seagrass survival (light, turbidity, chlorophyll) to be within the range of the habitat requirement established for seagrass.

7.2% was expended in an analysis of the fish communities associate with restored beds in South Bay and their trophic analysis using stable isotopes. Research has shown fish communities abundant in restored seagrass beds and isotopic signatures of trophic groups similar to algae found within seagrass beds.

3.6% was expended on mapping seagrass beds from aerial photography. This aspect has shown seagrass to now occupy an area of approximately 360 acres. This will be updated for 2006 once the numbers have been tabulated.

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### **Oyster Restoration and Clam Dredge Analysis**

VMRC: Jim Wesson

Total allocated: \$295,944

Since 2003, \$205,000 has been expended to build oyster reefs on Seaside. The oyster reefs have been constructed from shell and built on public oyster beds. Approximately 4.9 acres

of oyster reefs have been constructed in Accomack County, and 3.9 acres of oyster reefs have been constructed in Northampton County.

Local watermen/contractors construct the oyster reefs with either shucked shells, or locally harvested fossil shells. Reefs generally require at least 25,000 bushels per acre, and they are constructed on degraded, intertidal reef footprints.

Spatsets are still relatively large and dependable on Seaside, so all reefs have been colonized and have significant oyster populations. Oyster diseases still significantly impact the larger oysters. All reefs are marked as “NO HARVEST” areas, but poaching continues to be an issue.

In 2005 – 2006, an aerial survey of dredging activity was also conducted. In comparison to a similar survey in 1994 – 1995, there has been a significant decline in both clam and crab dredging activity. Many of the dredge boats were observed on areas where harvest was not allowed--mostly in waters less than 4 feet mean low water. These results were presented of the Virginia Marine Resources Commission meeting in January 2007. Rather than tightening dredging regulations, the regulations were changed to allow for possibly more dredging activity, allowing simultaneous catches of both clams and crabs by the same boat. This was a practice that was stopped after the 1994-95 dredge survey.

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#### Eastern Shorekeeper Activities

ESK: Richard Ayers

Total allocated: \$97,200

The Virginia Eastern Shorekeeper was designed to increase the visibility of VCZMP, Seaside Heritage projects through on-the-water patrols and targeted public outreach. Initial work in accessing the amount and impact of discarded calm aquaculture netting evolved into working with the clam industry to voluntarily implement the aquaculture Best Management Practices developed by VIMS through VCZMP funding. Over a three year period the amount of net on barrier island beaches dropped by 41 percent and the major growers have begun to actively police their co-op and independent growers. A majority of the remaining net appears to be from a few careless growers and coastal storm events.

Specific projects: annual assessments of human usage on the barrier islands designed to assist public land managers with policy decisions; subcontracted production of a summary of progress (1996-2006) on the Virginia Coast Avian Partnership (VCAP); provided up-to-date resource information to local kayak and nature operators; conducting a feasibility study of camping platforms for Virginia Seaside Water Trail; trained 35 local citizens as volunteer Creek Watchers – each received a four hour course on basic watershed protection and were taught what to look for and how to report observations. The next class, March 4th, has all 20 seats pre-registered. Eighteen additional one hour overviews have been conducted for local civic, church and community organizations reaching well over 400 others.

The Shorekeeper and volunteer Creek Watchers have provided over 1000 hours of on-the-water patrols on the Virginia seaside near publicly funded oyster reef and sanctuaries, eelgrass beds and important beach and colonial nesting bird areas to extend the presence of local resource managers and provide state law enforcement agencies an additional set of eyes on the water.

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## Phragmites Projects

DCR: Rick Myers

Total allocated: \$325,394

Year One: Phragmites distribution and abundance on the Seaside was estimated using existing data. Threats to rare species, critical wildlife habitats, and exemplary natural communities were assessed and Parramore Island was identified as a high priority location to begin control efforts. Phragmites response to the 2002 wildfire on Parramore Island was assessed and shown to be increasing rapidly – 230% increase in four years. Monitoring plots were established on Parramore Island to measure Phragmites control efficacy. Hurricane Isabel in Sept 2003 prevented attempts to spray Phragmites on Parramore Island during Year 1.

Year Two: An aerial GPS census of the Seaside was completed and all patches of Phragmites on the mainland interface, lagoon system, and barrier islands were mapped. A total of 2,024 acres of Phragmites was mapped in 1,404 patches. Average patch size was 1.4 acres. The largest patch covered 186 acres on Wallops Island. An 8-page map atlas plus large county maps were printed displaying locations of Phragmites on the Seaside as of 2004. Parramore Island monitoring plots were re-located following Hurricane Isabel and re-measured to establish current vegetative conditions. Hurricane effects on the current Phragmites invasion of Parramore Island were assessed, indicating further rapid Phragmites expansion since 2003. Phragmites abundance was reassessed on Fisherman's Island – 10 years after an initial assessment. There were 26 ha of Phragmites present, a five-fold expansion during the 10 year period.

Year Three: Four landowner workshops on Phragmites control were conducted, two on April 19 & 20 in Accomack County and two others on June 21 in Northampton County. A total of 28 persons attended. Topics covered were Phragmites Ecology and Life History, Distribution and Abundance of Phragmites on the Eastern Shore, Methods for Phragmites Control, and Sources of Assistance to Landowners. Contracted aerial Phragmites control treatments (220 acres) were applied at Parramore Island Natural Area Preserve on August 25, 2005 using Habitat herbicide. Contracted ground-based control of Phragmites (7 acres) was conducted at Mutton Hunk Fen Natural Area Preserve in Accomack County. DCR staff conducted ground-based control of Phragmites (1.5 acres) at Wreck Island Natural Area Preserve in Northampton County. A mid-1990's Phragmites control and restoration project at two Swash Bay sites was re-evaluated. Results showed that while some desirable plants still exist and function as habitat for native wildlife species, the restoration sites are badly degraded by decreased plant species diversity as a result of Phragmites re-colonization. A native Phragmites survey was conducted with biologists visiting a randomly selected subset of the 1,404 mapped Seaside Phragmites patches to make on-site native vs. non-native determinations. None of the 81 sampled sites supported native Phragmites, suggesting that little if any native Phragmites exists on the Virginia Eastern Shore Seaside. A GIS-based Risk Assessment model was developed which assigns relative threat levels based on proximity of natural heritage resources to mapped Seaside Phragmites patches and displays these in an 8-page map atlas.

Year Four: Five landowner workshops were conducted on Phragmites control with emphasis placed on the responsible use of approved herbicides and a recommendation to use contracted pest control specialists and combine resources with neighboring landowners to bring down costs. A total of 124 persons attended in 2006. Extensive ground and aerial monitoring conducted in May and August on Parramore Island indicated good control efficacy in 2005;

however, 40 acres of Phragmites still remained and was scheduled for 2006 treatment. DCR contracted an aerial pesticide applicator and treated 146 acres of Phragmites with Habitat herbicide on September 25-26, 2006. Acres treated by site were: 92 acres at Wallops Island; 40 acres at Parramore Island; 14 acres at Mockhorn WMA. DCR staff treated two acres of Phragmites at Wreck Island Natural Area Preserve using Habitat herbicide and ground application methods. A refined Least Cost Analysis GIS model of vegetative Phragmites spread was developed which, when intersected with rare species habitat and natural community data layers, predicts which natural heritage resource occurrences are most threatened by Phragmites invasion. Phragmites patches located near high risk resources were considered as a high priority target and scheduled for future control treatments. Phragmites Management Guidelines were developed for specific Seaside habitat types such as colonial bird nesting sites, mainland forest-marsh interfaces, barrier island swales, and dredge spoil sites. A new Web tool, the Phragmites Mapping Application (PMA) was constructed to assess which Seaside land holdings currently support Phragmites invasions and to what extent. The user can zoom, pan, view, and print maps of Phragmites occurrences on the Seaside. Phragmites occurrences may be superimposed over the county tax parcel layers and polygons can be screen digitized to measure areas covered by Phragmites.

Year Five: Work will include continued monitoring and Phragmites control treatments on high priority Seaside locations with a goal of controlling at least 150 acres in 2007 using Habitat herbicide. Additional workshops will be held to inform Eastern Shore landowners about methods to control Phragmites on their property. A new brochure on controlling Phragmites in Virginia will be developed. A draft management plan for Phragmites on the Eastern Shore Seaside will be developed.

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#### Shorebird Predator Controls

VMNH: Nancy Moncrief & Ray Dueser

Total allocated: \$167,100

(1) Annual trapping and removal of raccoons and red foxes has generally produced (A) reduced numbers of resident mammalian predators, (B) increased breeding populations for several waterbird species, (C) reduced rates of nest depredation (i.e., egg loss), and (D) higher nest productivity for those species for which productivity is monitored each year (i.e., American Oyster-catcher, Piping Plover and Wilson's Plover). At the same time, the total removal of raccoons from an island has proven to be very challenging, even for professional trappers, and each year the one to-a-few remaining (or recently arrived) individuals depredate a significant number of nests. The per-raccoon cost of trapping increases sharply as the number of raccoons declines. There is thus need for a relatively low-cost technology to reduce nest depredation by any remaining raccoons.

(2) We examined the avian census and nesting data collected by our research colleagues on the islands. Even when incomplete, the removal of raccoons and red foxes (A) promotes increased abundance of breeding waterbirds only for some species, on some islands, under some circumstances, but (B) appears to result in higher nest survival and nest productivity for those avian species that have been monitored closely (Piping Plover, Wilson's Plover, American Oystercatcher). The benefits of predation management may or may not be accurately reflected in

bird counts, even counts of breeding pairs, but are more clearly evident from analysis of nest productivity.

(3) We deployed artificial beach-nests to assay the composition of the nest-predator community on the islands, determine the relative importance of various nest predators in terms of their ability to locate isolated nests and artificial colonies and their tendency to depredate nests, and compare predation intensity before and after intensive predator removals on Parramore Island. Examination of ~2,000 artificial beach-nests indicate that (A) depredation rates may run as high as 99% of nests per day, (B) raccoons and red foxes are far-and-away the most important nest predators on the islands, but Herring Gulls, Great Black-backed Gulls, American Crows and ghost crabs can be important locally and occasionally, (C) red foxes were much more effective at locating and depredating nests, on a nightly basis, than were raccoons, (D) the intensity of mammalian nest depredation was greatly reduced following predator removal on Parramore (from 98% per day in 2003 to 9% per day in 2004).

(4) To test the potential of aversive conditioning as a supplemental tool in predation management on the Virginia barrier islands, we tested the efficacy of oral estrogen to induce in raccoons an aversive response to egg consumption. We conducted a pen trial with captive raccoons in summer 2006. The pen trial incorporated 18 mixed-age, wild-caught raccoons maintained individually in large pens set in a deciduous forest in eastern Virginia. We found that (A) control animals fed non-treated eggs have an almost infinite capacity for egg consumption, (B) raccoons do indeed develop an aversion to egg consumption following ingestion of eggs injected with oral estrogen, and (C) oral estrogen can be effectively deployed through injection in Japanese Quail eggs.

(5) We also ran a field trial of estrogen-induced aversive conditioning on the bird-free Skidmore Island section of Eastern Shore of Virginia National Wildlife Refuge in summer 2006. Ten mixed-age raccoons were captured on this small (44 ha) island, for a population density of approximately ~1 raccoon per 4 ha overall (~1 per ha upland). Each individual was fitted with a large numbered and color-coded tag in each ear (for photographic identification) and a radio collar. We established six artificial colonies, and monitored depredation events with two automatic cameras per colony. We accumulated over 2,000 photographs of individually recognizable raccoons, and deployed 600 dozen treated and non-treated chicken eggs during a 39-day period. We ran a 13-day treatment period during which estrogen-injected eggs were deployed in the colonies, and a subsequent 13-day challenge period during which non-treated eggs were deployed in the colonies and treated (“barrier”) eggs were placed outside the colonies.

Our tentative results are that (A) all 10 resident raccoons became averted to egg consumption within 2-4 days, (B) this aversion was persistent for a period of at least 26 days, long enough to bridge the period of avian egg-laying and incubation (C) the treatment effect was significant for all six colonies: the mean number of treated eggs damaged per day during the treatment phase (5.7) was greater than the mean number of non-treated eggs damaged per day during the challenge phase (1.0), (D) raccoons could not distinguish treated from non-treated eggs: during the challenge phase the mean number of non-treated eggs damaged per day for all colonies combined (1.0) was not different from the mean number of treated buffer eggs damaged per day for all colonies (1.9), (E) averted raccoons altered their foraging behavior significantly to visit “colony” areas less frequently and to visit fewer colonies, and (F) buffer eggs provided reinforcement of the aversion for the occasional raccoon that chose to sample.

(6) Genetic analysis (mtDNA haplotypes) of tissue samples collected from 200+ mainland and island raccoons indicates that (A) raccoon movement is less restricted from the

mainland to adjacent islands (west to east) than between islands (north to south), (B) raccoon movement between the mainland and islands occurs more frequently in the north (Assawoman through Cedar) than in the south, and (C) the overall distribution of mtDNA haplotypes in raccoons on the Virginia barrier islands is best explained by contiguous range expansion (i.e., a gradual “moving front” of range expansion) as opposed to episodic and restricted gene flow (i.e., a series of infrequent colonizations from diverse sources).

We conclude from these studies that predation management remains a useful method to enhance and restore avian nesting habitat on the Virginia barrier islands. Trapping-and-removal has proven effective in reducing raccoon and red fox numbers on several islands. In reality, however, removals are seldom complete; it is common for 1-3 raccoons to remain on an island (or to re-colonize an island very quickly) even after a productive removal program. Aversive conditioning appears to hold substantial promise for reducing depredation by predators on any island having low numbers of predators, either naturally or following a trapping campaign. The observed estrogen aversion was real, it influenced the foraging activity of individual raccoons, and it lasted long enough to bridge the period of avian egg-laying and incubation. Predation management is both more feasible and more effective as a conservation strategy on the Virginia barrier islands than has been reported from several studies conducted on extensive mainland areas elsewhere in North America.

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#### Water Trail & Floating Docks

AN PDC: Elaine Meil

Total allocated: \$142,500

Seaside Water Trail Development: \$25,000. AN PDC developed a canoe/kayak water trail in part by subcontracting research to Southeast Expeditions. A brochure was drafted containing route alignments, skill levels, paddling times, put-in information, safety considerations, information on the Seaside Heritage Program, etc. The brochure was later redesigned and printed by VA CZM.

Chincoteague Floating Dock & Wachapreague Floating Dock: \$25,000. A-NPDC completed construction of two floating docks at Chincoteague Eastside Landing and Wachapreague Town Marina. Both were constructed in 2005. Signs have been put up acknowledging NOAA and the Virginia CZM Program.

Willis Wharf Floating Dock: \$22,500. A-NPDC completed construction of the floating dock at Willis Wharf. It was constructed in 2006. A sign has been put up acknowledging NOAA and the Virginia Coastal Program.

Willis Wharf Improvements: \$22,000. This scope of work is not yet finalized but may include a telescope for the Willis Wharf observation deck, a wheelhouse for the deck to provide cover and a place for brochure/information storage; removal of concrete along the berm; and/or planting of native grasses and shrubs along the berm.

Quinby Floating Dock: \$18,000. A-NPDC is working on obtaining Section 306A documentation for the site. A-NPDC staff is working with the Harbor committee to site the floating dock in coordination with other work the Committee is doing at the site. It is anticipated in the spring to submit an application for the various permits required.

Interpretive Signage: \$30,000. A-NPDC is working with DGIF and VA CZM to design and install interpretive signage at locations on the Eastern Shore: Oyster, Willis Wharf and

Chincoteague. One meeting between DGIF, CZM and the A-NPDC has been held to determine the content and basic concept of the signs.

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Willis Wharf Observation Deck

DGIF: Jeff Trollinger

Total allocated: \$30,000

Since the inception of the project we have completed all environmental, wetlands and historic resource evaluations on the site. All design work for the structure has been completed, including tying the observation deck access to the floating dock previously installed at Willis Wharf. In the coming year, Northampton County will conduct the actual construction of the deck, including screening the porta-johns. Further developments will include incorporating interpretive signage on marsh wildlife, coastal ecosystems and the Virginia Birding and Wildlife Trail into the structure. Additional interpretive signage and kiosks are planned for four other locations along the Seaside Water Trail. Design for these is underway (see AN PDC grant on Interpretive Signage above).

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Ecotour Guide & Teacher Certification Courses

VIMS: Jim Perry

Total allocated: \$32,250

The Ecotour Guide Certification was designed with the goal of safe, responsible, and environmentally sound guidelines to encourage more responsible kayak and boating tours on the Eastern Shore and other Virginia coastlines. The course curriculum was revised to include updated material and some new content, such as barrier island rules and regulations and pertinent information about approaching wildlife. The ecotour logo was developed as part of a marketing mechanism for the certified guides. The course took place on November 17-18, 2003. Twenty-four guides were in attendance. The certification consisted of two days of class-based activities as well as field objectives. Nineteen of the participating guides passed the final exam to become ecotour certified. These guides were sent a package containing a certificate of completion, two ecotour decals, and a letter of congratulations.

The Eastern Shore Eco-Tour Instructors Training Course was presented to currently certified VIMS/DEQ Eastern Shore guides in November and December of 2005. Taught at the VIMS Wachapreague Laboratory, the course consisted of 16 hours of classroom instructions (syllabus attached). Of the 25 certified guides, seven (7) attended the course and five (5) successfully passed (see list below). Certificates, information on how new instructors will conduct and test a class, and a CD with class slides have been provided to the new Instructors. Guides who passed the class are: Dave Burden, Bo Lusk, Ray Miles, James Clark, and James M. Johnson Jr. Contact with all Certified Instructors will be maintained through Dr. James Perry's office.

## Seaside Program Core Partners

National Oceanic and Atmospheric  
Administration, Office of Ocean and Coastal  
Resource Management

Virginia Coastal Program,  
Department of Environmental Quality

Accomack-Northampton Planning  
District Commission

Southeast Expeditions

The Nature Conservancy

University of Virginia

US Fish and Wildlife Service

Virginia Commonwealth University

Virginia Department of Conservation and  
Recreation, Division of Natural Heritage

Virginia Department of Game and  
Inland Fisheries

Virginia Department of Mines, Minerals  
and Energy

Virginia Eastern Shorekeeper

Virginia Institute of Marine Science  
College of William & Mary,

Center for Conservation Biology

Virginia Marine Resources Commission