DRAFT Habitat and Research Activities to Protect and Restore Chesapeake Bay Living Resources and Water Quality

A draft fulfilling Section 202g of Executive Order 13508

This draft document is the Department of Commerce's (DOC) and Department of the Interior's (DOI) current draft report under Section 202(g) of Executive Order 13508, making recommendations to the Federal Leadership Committee (FLC) for application of science and new technologies to improve management decisions for habitats and living resources across all regions of the Chesapeake Bay watershed. DOC and DOI intend to release this draft document to the public concurrently with its submission to the FLC. After the FLC has considered this draft, along with the other draft reports prepared pursuant to the EO, it will prepare a draft strategy to restore the Bay and publish it in the Federal Register for public comment. The current draft report includes preliminary recommendations which may change as the draft strategy is developed. This draft document is not a final agency action subject to judicial review. Nor is this draft document a rule. Nothing in this draft document is meant to, or in fact does, affect the substantive or legal rights of third parties or bind DOC or DOI.

Table of Contents

ACKNOWLEDGEMENTS

The Habitat and Research Activities to Protect and Restore Chesapeake Bay Living Resources and Water Quality (202g) Report was co-led by Jennifer Greiner (USFWS Chesapeake Bay Coordination Office) and Bruce Vogt (NOAA Chesapeake Bay Office) with staff support from Krystal Freeman (Chesapeake Research Consortium). Technical input was provided by many agencies through the following core drafting team representatives: Alicia Berlin (USGS Patuxent), Dave Bornholdt (USGS), Tom DeMoss (EPA Region 3), Michele Gomez (USACE/ Baltimore District), John Jacobs (NOAA Oxford), Mark Mansfield (USACE/ Norfolk District), Andrew Milliken (USFWS Northeast Region), Steve Minkkinen (USFWS Maryland Fisheries Resource Office), Kevin Montgomery (DOD/ Navy), Wayne Owen (USDA FS), David Packer (NOAA NE Fisheries Science Center), Frank Panek (USGS Leetown), Dave Reynolds (NPS), David Rider (EPA), and Jennifer Wallace (NOAA Restoration Center).

EXECUTIVE SUMMARY

Success in protecting and restoring the Chesapeake Bay ecosystem will ultimately be measured by the vitality and richness of its living resources and the health and well being of the people who rely on them. People living along the Appalachian Mountains, the farmlands of the Delmarva Peninsula, and in our Nation's capital are all connected to and reliant on the goods and services provided by the Chesapeake Bay watershed. These ecosystem services include the fish, birds and other wildlife which make the Chesapeake Bay a National treasure. Over the years, lands draining to the Bay have been significantly affected by human activities that are compromising the ecological integrity and economic future of this national treasure. The Protect and Restore the Chesapeake Bay Executive Order provides an opportunity to take action by applying political and public will coupled with advanced technology and innovative science to address these detrimental impacts. Toward this end, our report focuses on actions to raise the bar for habitat protection and restoration across all regions of the Chesapeake Bay watershed. Our objectives and approach call for application of science and technologies to improve management decisions for habitats and living resources and the communities that depend on them:

- **Prioritize Actions to Maximize Ecological Benefits:** Identify outcomes for priority species and develop a watershed wide Spatial Management Plan to prioritize habitat protection and restoration actions in a way that maximizes benefit to critical living resources and water quality.

  Actions:

  - Develop a unified watershed-wide spatial map to drive integrated and proactive planning for the Bay and enable smarter decisions regarding ecological and economic tradeoffs.
  - Identify outcomes for priority species and use as guidance in placement of habitat protection and restoration projects.
  - Conduct an integrated ecosystem assessment including socioeconomic analysis to better engage people in sustaining the Bay.

- **Accelerate Habitat Protection and Restoration:** Target Federal resources toward establishing a network of terrestrial and aquatic protected areas and restoring the habitat gaps to link protected lands with open water.

  Actions:

  - Consider establishing aquatic protected areas and networking these areas with land-based preserves.

- Consider targeting Federal funding and technical assistance to conduct large scale habitat restoration for fish passage, wetlands, submerged aquatic vegetation, living shorelines, riparian buffers, uplands, forests, and streams.
- Enforce permit compliance to protect the functions and values of wetlands and other waters and create greater regulatory predictability.
- Support and implement National Fish Habitat Action Plan to promote the sustainability of Atlantic coast diadromous and other estuarine-dependent fishes and their essential habitats.
- Consider establishment of a new inter-jurisdictional, Bay-wide regulatory body to implement the regulations and strategies necessary for managing and restoring Chesapeake Bay fisheries.
- Conduct large scale oyster restoration through a new Bay-wide ecological strategy and incorporate oyster beds in living shoreline restoration projects.
- Strengthen Clean Water Act, Fish and Wildlife Coordination Act and NOAA Memorandum of Agreement permit reviews to include specific requirements to compensate for all unavoidable losses of "waters of the United States."
- Support implementation of actions identified in State Wildlife Comprehensive Action Plans.

- **Coordinate Research and Assessment:** Conduct a unified, integrated ecosystem assessment that describes the health of the bay based on scientifically identified ecological indicators and socioeconomic analyses and monitor the ecological response of priority habitats by use of indicator species.

  Actions:

  - Develop a coordinated research and assessment strategy that will fully utilize and enhance existing research and capacity to conduct the science needed to support ecosystem-based management.
  - Support sustained, long-term, broad-scale, multispecies monitoring framework to inform decision-making for priority living resources and habitats.

These actions will demonstrate needed Federal leadership in implementing a true ecosystem based management approach that considers the interdependence of all aspects of the ecosystem, allows for public engagement, and is adaptive. Implementing larger-scale, more integrated habitat restoration and protection projects designed to benefit priority species is necessary to achieve the vision of a resilient and sustainable Chesapeake Bay ecosystem.

CHARGE FROM EXECUTIVE ORDER

Section 202(g) directs Federal partners to develop focused and coordinated habitat and research activities that protect and restore living resources and water quality of the Chesapeake Bay and its watershed. Section 901 further directs partners to:

- Identify and prioritize critical living resources of the Chesapeake Bay and its watershed
- Conduct collaborative, research and habitat protection activities that address expected outcomes for these species
- Coordinate agency activities related to living resources in estuarine waters to ensure maximum benefit to the Chesapeake Bay resources.

INTRODUCTION

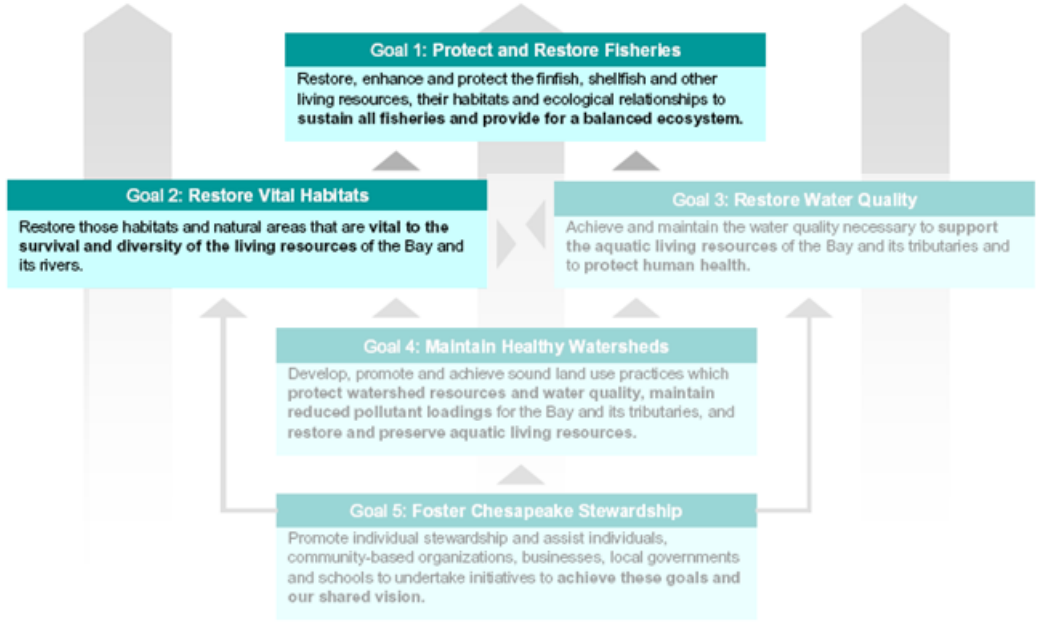
Problem Statement

The Chesapeake Bay and its watershed make up one of the most biologically productive systems in the world with more than 3,600 migratory and resident animal species that live, feed, find shelter, and reproduce in the estuary and its watershed. Habitats in the watershed provide a vital ecological link and migration corridor for fish and birds. The Chesapeake is one of the best studied ecosystems in the world, yet it remains in a degraded state due to a variety of stressors including poor water quality, eutrophication, low oxygen, development, disease, overfishing, invasive species, contaminants, and climate change. To succeed in achieving a system that is both resilient and sustainable in the face of these stressors, all stakeholders must embrace a management approach that is ecosystem-based. Sustaining and restoring the proper function of these habitats, through protection of healthy habitats and restoration of degraded ones, is essential to the long term resilience and sustainability of the Chesapeake ecosystem, the regional economy, and the quality of life enjoyed by the 17 million people who call this region home.

Goals

To achieve the vision of a resilient and sustainable Chesapeake Bay ecosystem, Federal partners must lead the way in implementing an ecosystem based management approach that considers the interdependence of all aspects of the ecosystem, allows for public engagement, and is adaptive. New ways to measure the impact of management actions (stimulus) on species outcomes (response) are needed in order to improve decision making for Bay habitats and living resources. This report focuses on ways to better achieve Goal 1 (Fisheries and other living resources) and Goal 2 (Vital Habitats) identified in the Chesapeake Action Plan (Figure 1.)

FIGURE 1



Source: Chesapeake Action Plan, Environmental Protection Agency, 2008.

Objectives

Subsequent sections of this report recommend Federal leadership in support of the following major objectives:

- **Prioritize Actions to Maximize Ecological Benefits:** Identify outcomes for priority species and develop a watershed wide Spatial Management Plan to prioritize habitat protection and restoration actions in a way that maximizes benefit to critical living resources and water quality.

- **Accelerate Habitat Protection and Restoration:** Target Federal resources toward establishing a network of terrestrial and aquatic protected areas and restoring the habitat gaps to link protected lands with open water.
- **Coordinate Research and Assessment:** Conduct a unified, integrated ecosystem assessment that describes the health of the bay based on scientifically identified ecological indicators and socioeconomic analyses and monitor the ecological response of priority habitats by use of indicator species.

These objectives align with the phases of the adaptive management approach. The concept of adaptive management has developed as a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. As such, it is a powerful tool for improving management decisions and outcomes. The application of adaptive management strategies is predicated on careful and scientifically designed monitoring of the outcomes of actions and decisions. It is a stepwise process that involves stakeholder involvement, management objectives, management alternatives, predictive modeling, monitoring plans, decision making, monitoring of responses to management, assessment and adjustment. Effective management of Bay living resources requires full implementation of an adaptive management framework with significant engagement across multiple sectors (citizens, academia, nongovernmental organizations, industry) and multiple government jurisdictions (Federal, state, local) to establish priorities, implement projects and policies, and evaluate performance.

Objective 1: PRIORITIZE ACTION TO MAXIMIZE ECOLOGICAL BENEFITS

Significant research has been conducted to document the relationship of species and their habitats in the Chesapeake Bay watershed. The Chesapeake Bay Program last published a comprehensive summary of this information in 1991[1], but much has changed in the past 20 years regarding the stressors on these habitats and the ability to detect corresponding species impacts, and that document only covered tidal waters. In particular, the approach used in that document, linking the presence of aquatic animals to fixed limits of single water quality variables such as salinity or dissolved oxygen, has been augmented with powerful food web or ecosystem modeling that takes many more abiotic and biotic relationships into account. Thanks to active support of the academic community and the wealth of sound science developed in the watershed, much is now better understood about species/habitat dependencies in the Chesapeake drainage. The challenge now is to

[1] Chesapeake Bay Program, Living Resources Subcommittee. 1991 revised edition. Habitat requirements for Chesapeake Bay living resources. Annapolis, Maryland.

engage the public and policy makers in applying that information to make decisions that are better for the Bay's critical living resources and habitats.

The Executive Order calls on the Federal family to identify and prioritize the Bay's critical living resources. Table 1 suggests a framework for prioritizing critical living resources of the Bay watershed by habitat type and corresponding stressors. Priority species were identified based on current scientific expertise of species' ecological, commercial, and recreational, significance and are assumed to be representative of the overall health of associated habitat types. While not presented in rank order, this list demonstrates Federal leadership to focus the dialogue on critical living resources in the Chesapeake Bay watershed. Both the Atlantic Coast and Appalachian Joint Ventures have used similar matrices to prioritize bird species and habitats. The U.S. Fish and Wildlife Service, Northeast Region, is developing a similar tool to implement its Strategic Habitat Conservation initiative. The Atlantic Coast Fish Habitat Partnership (proposed under the National Fish Habitat Action Plan) is using a similar approach to develop a Species Habitat Matrix that includes 25 habitats over 100 fish and shellfish species. This report recommends a transparent process for coordination among these various planning efforts, within the Chesapeake Bay Program structure and with public input, to validate and prioritize this list. The resulting table would be useful to a variety of conservation partners and resource managers at all levels in planning and designing habitat restoration and protection projects to maximize benefits to living resources and habitats across the watershed.

TABLE 1 – Critical Living Resources of the Chesapeake Bay Watershed by Region and Priority Habitat

Region	Priority Habitats	Critical Living Resources*	Stressors
Coastal Plain (Tidal waters)	Estuarine • Tidal wetlands (including emergent tidal freshwater marsh and forest) • Riparian forest buffers • Submerged Aquatic Vegetation (SAV) • Open water •Benthos • Oyster reefs • Beach and dunes • Working/agricultural lands • Grass/shrub lands • Islands •Suburban and Urban	• Blue Crab • Menhaden • Striped Bass • Oysters • Eelgrass • Widgeon Grass • Black Duck • Scoters • Saltmarsh Sharp-tailed Sparrow • Canvasback • Wood Thrush • Prairie Warbler • Prothonotary Warbler • Atlantic Sturgeon • Northern Diamond-backed Terrapin • Horseshoe Crab • American Eel • Soft Shell and Surf Clams • Delmarva Fox Squirrel • Bald Eagle • Bay Anchovy • Wild Rice •Tiger Beetle	• Poor water quality • Eutrophication • Invasive species • Contaminants • Development/ habitat loss and fragmentation • Climate change • Overharvesting • Sea level rise • Storm and drought • Saltwater intrusion • Altered freshwater • Dredging
Piedmont (Non-tidal, strictly freshwater)	Riverine • Forested wetlands • Riparian forest buffers • In-stream habitat • Freshwater marshes Uplands •Working/agricultural lands •Grass/shrub lands	• American Eel • River Herring • Shad • Smallmouth Bass • Yellow Perch • Bog Turtle • Amphibian • Prothonotary Warbler • Louisiana Waterthrush • Prairie Warbler • American Woodcock • Grasshopper Sparrow • Green Heron • Bald Eagle • Delmarva Fox Squirrel	• Poor water quality • Eutrophication • Invasive species • Contaminants • Development/habitat loss and fragmentation • Climate change • Overharvesting • Poorly managed forestry • Mining • Hydropower • Dams/ fish blockages •Dredging
Appalachia (Uplands)	Terrestrial • Old growth forest • Isolated wetlands • In-stream habitat •Cold water streams	• Freshwater Mussels • Brook Trout • Cerulean Warbler • Eastern Hellbender • Louisiana Waterthrush • Golden-winged Warbler • Worm-eating Warbler • American Eel • Indiana Bat	• Poor water quality • Invasive species • Contaminants • Development/habitat loss and fragmentation • Climate change • Overharvesting • Dams/ fish blockages •Mining •Poorly managed forestry

* **Note:** While not yet ranked, this list represents Federal leadership to focus the dialogue on critical living resources in the Chesapeake Bay watershed, as required under the Executive Order. This report recommends a process for coordination among various planning efforts, within the structure of the Chesapeake Bay Program and with public input, to validate and prioritize this list and get it into the hands of decision makers to guide project design toward achievement of species outcomes.

Recommendations

- Invite the Scientific and Technical Advisory Committee, Citizens Advisory Committee, regional groups such as the Atlantic States Marine Fisheries Commission and Atlantic Coast Joint Venture to participate in a strategic decision making process to validate and prioritize species and habitats identified in Table 1.
    - Distribute the validated matrix to resource managers at Federal, State, and local levels as guidance for planning and implementing habitat and restoration projects that maximize benefits to critical living resources and water quality. *Suggested Lead: NOAA and FWS via the Fisheries and Habitat Goal Implementation Teams*

- Conduct a full integrated ecosystem assessment of the Chesapeake Bay that includes a synthesis and quantitative analysis of information on relevant physical, chemical, ecological and human processes. This should include a socioeconomic assessment to determine what aspects of the ecosystem (goods and services) are most valuable to the humans that live within the Bay watershed and to better understand human use of the Bay, the benefits they gain, and their effects on it. The assessment findings should be applied to improve ecosystem based management (EBM) implementation. *Suggested Leads: NOAA, USGS*

- Develop a watershed wide Spatial Management Plan for the Bay to drive integrated and proactive planning and enable smarter decisions regarding competing ecological and economic tradeoffs. Spatial Planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological and economic objectives (http://www.unesco-ioc-marinesp.be/msp_guide). The plan should be developed by compiling existing information and collecting new data on spatial impacts of current uses/activities, natural, cultural, and historic resources to identify special and unique areas for priority protection and restoration actions. The plan should show where inter-jurisdictional conflicts need to be addressed/aligned to improve protection and restoration. This spatial plan should be consistent with the Marine Spatial Planning efforts currently being defined by the Interagency Ocean Policy Task Force led by the Chair of the Council on Environmental Quality and could initially be modeled after the Massachusetts spatial plan (http://commpres.env.state.ma.us/mop/draft_plan/tech) *Suggested Leads: EPA, NOAA, USGS*

Objective 2: ACCELERATE HABITAT PROTECTION AND RESTORATION

Immediate emphasis must be place on what actions Federal agencies and their partners can take in the short term to protect existing high-quality habitat and restore areas that have been degraded. Federal resources need to be coordinated and targeted toward projects with a high certainty of success. This includes establishing a network of terrestrial and aquatic protected areas to ensure what we have now is conserved and restoring gaps in habitat connectivity to reopen migration corridors and link land and open water habitats. Protection and restoration of habitat will benefit restoration of priority living resources, contribute to improved water quality, and preserve the aesthetic value that lures so many people to the Bay each year.

Habitat Protection

Protected areas serve to reduce sedimentation and improve water quality, function as nurseries for the Bay's critical species (including the indicator species), serve as "control" sites for research and monitoring, provide a setting as educational sites for schools and visitors and provide compatible recreational opportunities. While many areas of the watershed already benefit from some level of protection, Federal agencies have an opportunity to combine existing programs with new tools to better enhance the contiguity of protected lands and to expand this network to the aquatic zone. This section describes existing protected habitats in the Chesapeake Bay watershed, identifies gaps where habitats need some form of protection, and provides recommendations for Federal action.

Millions of acres of habitat in the 64,000 square mile Chesapeake watershed are already protected by Federal, State, and local government programs and private organizations such as The Nature Conservancy, The Natural Lands Trust, and other land trusts. Tables 2 and 3 indicate the status and ownership of protected lands in the watershed as of 2007.

TABLES 2 and 3. Protected lands organized by ownership and GAP Status (categorizes the degree of maintenance of biodiversity for each distinct land unit) in the Chesapeake Bay Watershed as of 2007 from Secured Lands of the Northeast *(The Nature Conservancy in Collaboration with the Northeast Association of Fish and Wildlife Agencies, 2008.)*

Ownership	Number of Parcels	Acres Protected	Hectares Protected
Federal	1,692	2,058,449	833,025
State	3,080	3,742,736	1,514,632
Local	318	68,377	27,671
Tribal	10	1,239	501

Private For Profit	57	5,229	2,116
Private Land Owner	2,310	161,287	65,271
Private Non-Profit	532	77,299	31,282
Unknown	79	10,703	4,331
Sum	8,078	**6,125,319**	**2,478,829**

GAP Status	Number of Parcels	Acres Protected	Hectares Protected
unknown	82	10,793	4,368
1	567	801,019	324,161
2	2,082	517,414	209,390
3	5,347	4,796,093	1,940,910
	8,078	**6,125,319**	**2,478,829**

GAP 1: Permanent Protection for biodiversity.
Examples: nature reserves, research natural areas, wilderness areas, and Forever Wild easements.
GAP 2: Permanent protection to maintain a primarily natural state.
Examples: National Wildlife Refuges, many state parks, and high use National Parks.
GAP 3: Buffer lands, protected as natural cover but typically subject to extractive uses such as logging.
Examples: State or Town forest managed for timber, and land protected from development by forest easements

Many federal, state, and non-government programs are being implemented to help protect and preserve quality habitats of the Chesapeake Bay watershed (Appendices B and C). Federal leadership to protect terrestrial and aquatic areas to maximize habitat values for species and ecosystem services focus on the following areas:

- Decision Support
- Funding
- Designation and acquisition
- Enforcement and compliance

Decision Support

Decision support tools to focus habitat protection range from simple expert-opinion driven focus area maps (e.g. important waterfowl focus area maps drawn by the state waterfowl biologist in each state) to more complex, data and model driven approaches that allow for assessment of impacts on populations from predicted changes. There is a need to improve the information and tools available to decision makers by identifying and prioritizing gaps and assessing benefits.

Recommendations

- Work with Federal agency partners and states on area-wide planning process authorities such as Special Area Management Plans (SAMPs) and Advanced Identification of Disposal Areas (ADID) to provide the public and potential permit applicants with information on the functions and values of wetlands and other

waters, creating greater regulatory predictability by providing an indication of factors to be considered in permit reviews. *Suggested Leads: USACE, FWS, NOAA*

- Prioritize Federally-funded land and water protection actions in a manner that maximizes habitat benefits for critical species in Table 1. *Suggested Leads: FWS and NOAA*
- Through the cross-Federal Integrated Ocean and Coastal Mapping (IOCM) Program, inventory Federal and State data and acquire complementary Light Detection and Radar (LIDAR), Synthetic Aperture Radar (SAR) and high resolution data to develop a comprehensive Bay watershed characterization to better target wetland restoration sites, particularly for forested wetlands. *Suggested Lead: USDA – Agricultural Research Service, USGS & NOAA*
- Utilize geospatial infrastructure and observations throughout the Bay watershed, including a network of Continuously Operating Reference Stations (CORS), tide stations, and surface elevation tables, tied to the National Spatial Reference System, to provide survey control for remote sensing and high accuracy data on local rates of sea level rise. *Suggested Lead: NOAA and USGS*
- Submit Chesapeake Bay Special Resources Study to Congress, urging implementation of major recommendations. *Suggested Lead: NPS*
- Establish a Bay-wide network of reference sites to be used as models for habitat restoration and used to implement adaptive management measures. *Suggested Leads: NOAA & USFWS*

Funding

A variety of funding mechanisms exist to protect habitat in the Chesapeake watershed (Appendices B and C). The challenge is to target funds to achieve outcomes for critical species in Table 1 using the decision support tools recommended above coupled with the following Federal delivery mechanisms and partnerships. The vast majority of land within the Chesapeake Bay watershed is held by private landowners. As a complement to land acquisition strategies, we must utilize all available tools and programs (such as the USFWS Partners for Fish and Wildlife program, NRCS private lands programs, etc) to encourage and support private landowners to use land conservation methodologies, techniques, and tools to meet the intentions of the Executive Order.

Recommendations

Support the following Federal programs and, where appropriate, target additional funding increments for protection of quality habitat in the Chesapeake Bay watershed: Land and Water Conservation Fund, North American Wetlands Conservation Act, Forest Legacy program , Coastal and Estuarine Land Conservation Program, National Coastal Wetland Conservation grants, Cooperative Endangered Species Conservation Fund (State Wildlife Grants and Recovery Land Acquisition grants), USFWS

Chesapeake Bay Coastal Program, Fish and Wildlife Coordination Act (wetland and waterway programs), Magnuson-Stevens Reauthorization Act (Essential Fish Habitat), Energy Policy Act (traditional and renewable energy projects), Marine Debris Research, Prevention, and Reduction Act (marine debris and derelict fishing gear), Estuary Restoration Act, agency consultative programs, and invasive species programs. *Suggested Lead: NOAA and FWS*

- Following the model set by the National Fish and Wildlife Foundation in 2008 for the Chesapeake Bay Small Watershed Grants program, agencies should require applicants to target critical species identified in Table 1 and priority areas identified in the Spatial Management Plan. *Suggested Lead: FWS, USGS, NOAA*

- Support the National Fish Habitat Action Plan, a national investment strategy to maximize the impact of conservation dollars on the ground. Under the Action Plan, Federal, state and privately-raised funds will be the foundation for building regional partnerships that address the Nation's biggest fish habitat problems. Federal agencies should also support pending National legislation authorizing a comprehensive strategy to support and fund for effective conservation of our national waterways and the fisheries associated with them. Suggested Lead: FWS and NOAA

- Monitor net change in forest, wetland and riparian land cover in five year intervals at the county scale so that protection of these areas can be credited for nutrient load reduction in the next calibration of the Chesapeake Bay Program's watershed model. *Suggested Lead: USDA and EPA*

Designation and Acquisition

- Fully utilize existing Federal authorities to protect habitat:

    - Consider establishing a network of aquatic protected areas (sanctuary sites) throughout the bay that link protected lands with open water and benthos. This could be achieved by establishing Marine Protected Areas, a Chesapeake Bay National Marine Sanctuary, and expansion of the National Estuarine Research Reserve System and requires significant consultation with the States and an open public process. *Suggested Lead: NOAA*
    - Develop Special Area Management Plans (SAMPs) under the federal Coastal Zone Management Act (CZMA) to coordinate and support protection of tidal and submerged lands, including existing SAV beds, and improve avoidance of impacts, coordinate mitigation, and enlist local governments in conservation. *Suggested Lead: NOAA*

- Consider designation of Chesapeake Bay tributaries as part of the National Wild and Scenic River system. No Federal designations currently exist in the Bay watershed. *Suggested Lead: DOI*
- The Department of Defense (DoD) should coordinate with Federal, state, local, and NGO partners under the Army Compatible Use Buffer (ACUB) program to direct their encroachment mitigation dollars, within mission needs, towards purchase or easement protection of lands identified as ecologically significant. This concept should also apply to surplus lands, where DoD would work with other Federal agencies to ensure lands transferred from DoD ownership are conserved in a way that prevents encroachment. DoD should also give internal priority to encroachment mitigation that also has ecological and historical value. *Suggested Lead: DOD*
- Improve coordination among Federal and State agencies on the disposal of foreclosed properties through the Farm Service Agency *Suggest Lead: USDA*

Enforcement and Compliance

To strengthen and secure Federal investment in habitat protection within the Chesapeake Bay watershed, several existing authorities could be strengthened with particular emphasis on addressing invasive species introduction.

Recommendations

- Implement the Compliance and Enforcement Strategy called for in Section 302(iii) of Executive Order 13508. This includes: identification of top priority sub-watershed(s) (wetlands focus area) defined as areas undergoing rapid growth with high nutrients and/or sediment load; assessing extent and cause of wetlands loss in wetlands focus area using remote sensing and field inspections; addressing unpermitted fill in wetlands focus area using appropriate enforcement tools and best available science and practices to ensure that mitigation is designed and located appropriately to maximize habitat and water quality values. *Suggested Lead: EPA Office of Water*
- Strengthen Clean Water Act, Fish and Wildlife Coordination Act and NOAA Memorandum of Agreement permit reviews to include specific requirements to compensate for all unavoidable losses of "waters of the United States" including vegetated wetlands, non-vegetated intertidal wetlands and open waters and subtidal bottom. *Suggested Lead: FWS and NOAA*
- Strengthen review of projects and programs that may damage habitat by aggressively applying tools such as NOAA and FWS Habitat Consultations to more effectively minimize and mitigate habitat damages. *Suggested Lead: NOAA and FWS*
- Increase wildlife inspection efforts to prevent both intentional and unintentional introductions of terrestrial and aquatic invasive species at the

port of Baltimore and Dulles International Airport. *Suggested Lead: FWS Law Enforcement Operations*

- Develop rapid response teams in each state to eradicate or control infestation of invasive species before they can become established by using the Model Rapid Response Plan developed by Maryland Sea Grant as a model. *Suggested Leads: FWS and NOAA with funding through the Aquatic Nuisance Species Task Force; USDA Animal and Plant Health Inspection Service*
- Fully support implementation of the Chesapeake Bay Nutria Eradication Program strategic plan. *Suggested Lead: FWS*

Bringing it all together: A Wetland Example

The ecosystem services (habitat values, trophic interactions, nutrient and sediment attenuation, storm surge reduction, flood water absorption, groundwater recharge) provided by wetlands are well documented in the scientific literature. Federal, State, local, and private partners across the Chesapeake watershed have been working to protect and restore tidal and non-tidal wetlands, and annually report acres restored toward the Chesapeake Bay Program's 25,000 acre goal. In general, however, agency efforts are not well coordinated, protection of existing high-quality wetlands is not adequately incentivized, progress is not monitored in a way that ensures replacement of wetland functions and values, and success is not articulated in terms of wetland-dependent species outcomes and ecological functions. Following are adaptive management actions that Federal partners may collaborate on to address these problems:

<u>Plan and Prioritize</u>

- Develop a watershed-wide Spatial Plan to prioritize high value, at-risk wetlands for protection and degraded wetlands in high nutrient loading areas with hydric soils for restoration (EPA, FWS, NOAA, NRCS, USACE)
- Inventory Federal and State wetland coverage data and acquire complementary LiDAR, Synthetic Aperture Radar (SAR) and high spatial or spectral resolution data to develop a comprehensive Bay Watershed characterization to better target wetland restoration sites, particularly for forested wetlands.
- Instrument selected wetland areas with Continuously Operating Reference Stations (CORS), tide stations and surface elevation tables to measure precise local rates of sea level rise and compare with monitoring data on different marshes' ability to keep pace, to inform prioritization of protection and restoration efforts.

- Work with Federal agency partners and states on area-wide planning process authorities such as Special Area Management Plans (SAMPs) and Advanced Identification of Disposal Areas (ADID) to provide the public and potential permit applicants with information on the functions and values of wetlands and other waters, creating greater regulatory predictability by providing an indication of factors to be considered in permit reviews.
- Establish cooperative weed management area teams to address invasive species in defined geographic areas throughout the watershed.

Implement

- Provide financial incentives for landowners in Chesapeake watershed for wetland protection and restoration on private land (NRCS – Wetland Reserve Program)
- Build capacity for providing direct on-the-ground technical assistance for wetland restoration (FWS – Partners for Fish and Wildlife, Coastal Programs, NOAA Office of Habitat)
- Require applications for Federal funding for wetland projects to identify outcomes for wetland-dependent species (FWS – North American Wetland Conservation Act, National Coastal Wetlands Conservation grants, Partners for Fish and Wildlife and Coastal Programs, NRCS – Wetland Reserve Program)
- Assign credit in CBP watershed model for protection of wetlands and consider extra credit for restoration of forested wetlands/wetland riparian complexes as incentive for States to restore these habitat types.

Monitor and Evaluate

- Identify ecological indicators of wetland condition for geographic regions of the Chesapeake watershed
- Plan, design, and implement a National Wetlands Condition Assessment to establish a national baseline of wetland condition and enable the evaluation of condition trends over time (EPA). This will build on work of the U.S. Fish and Wildlife Service to produce a national report on the status and trends of wetland acreage.
- Require recipients of Federal funding for wetland projects to upload a shape file to the National Wetland Inventory to assist with accountability and progress reporting.
- Work with Federal interagency wetlands partners to expedite National Wetlands Inventory updates and implement the new Wetlands Data Standard (EPA, FWS)

Enforce and Adapt

- Consider registry of pre-approved opportunity sites with conditions suitable for efficient regulatory decision making, specifically for mitigation planning and implementation through a comprehensive watershed analysis (USACE Baltimore and Norfolk District's regulatory programs and EPA Region III)
- Identify and address unpermitted wetland fill activity through the Compliance and Enforcement Strategy called for in Section 302(iii) of Executive Order 13508 (EPA)
- Require 3-5 years of invasive species control for wetland mitigation sites as part of permit process.

Habitat Restoration

The Chesapeake Bay has hundreds of thousands of acres of estuarine and coastal bays, rivers, and streams that provide productive and diverse habitats for finfish, shellfish, and other wildlife. Associated uplands in the Chesapeake watershed likewise provide a broad range of habitats for diversity of plant and animal species. Federal and non-federal agencies and organizations continue to make incremental gains in restoring habitat and water quality despite growing development and land-use pressures. This section briefly describes current habitat restoration efforts, identifies gaps in restoration implementation and recommends Federal actions to accelerate future habitat restoration efforts.

Funding

A variety of funding mechanisms exist to protect habitat in the Chesapeake watershed and a scores of restoration projects have been completed and are underway, however they have been conducted with little coordination across agencies and with a piecemeal approach. To drive effective habitat restoration funding and projects need to be strategically placed for large scale, multifaceted restoration targeted at improving living resources.

- Prioritize Federally-funded habitat restoration actions in a manner that maximizes habitat benefits for critical species in Table 1. *Suggested Leads: FWS and NOAA*
- Coordinate funding and prioritize large scale restoration efforts by tributary to accelerate restoration of ecosystem function. *Suggested Leads: FWS and NOAA*

Fish Passage

Physical structures that block or impede fish migrations to historic upstream spawning habitats are potentially the most important factor in the decline of migratory fish populations in the Bay. Over 5,000 miles of fish spawning habitat on Bay tributaries are currently blocked by dams, culverts and other man-made obstructions. By removing dams or installing fish lifts, ladders and other passageways, migratory fish like American shad, river herring, American eels and white and yellow perch are able to return to upstream spawning and nursery grounds. Resident fish like bass, walleye and catfish also benefit from the removal of fish passage blockages in rivers. To reopen historic spawning habitat to anadromous fish, state, federal and nonprofit groups have developed strategies to identify fish blockages, evaluate habitat, prioritize sites, and initiate and complete either upstream and downstream fish passage projects or dam removals.

A protocol for ranking fish passage projects was developed by the Chesapeake Bay Fish Passage Work Group which includes Federal (NOAA, FWS, NRCS) and state governments (PA, MD, and VA) and non-profits including American Rivers. Priority status is given to:

- Meet criteria listed in the Chesapeake Bay Fish Blockage Prioritization;
- Target blockages that have been documented as blocking fish migrations to stretches of high quality critical habitats;
- Dam removals over fish passage construction, where practical;
- Projects that enhance passage of migratory fish over resident fish and/or where shad and herring stocking programs occur.

Given the number of dams, culvert road blockages, or other blockages that need passage, there are hundreds of opportunities for fish passage in the Chesapeake Bay watershed if landowners are willing and funding is available.

Recommendations

- Consider means to stabilize funding for Fish Passage Coordinators in the States of Maryland, Virginia and Pennsylvania to continue implementation of on-the-ground habitat restoration projects. EPA's Chesapeake Bay Program funding for fish passage coordinators in each of these states was withdrawn in 2009. *Suggested Lead: EPA via State Implementation Grants*
- Establish criteria for dam removal that will not require dredging of accumulated sediments behind the dam. *Suggested Lead: FWS and EPA*
- Utilize the Open Rivers Initiative to provide funding and technical expertise for community-driven, small dam and river barrier removals, primarily in coastal states. *Suggested Lead: NOAA*
- Following the Maryland model, develop and implement a strategy for Chesapeake Bay Fish Blockage Prioritization in Pennsylvania and Virginia, as well as other bay program states. *Suggested Lead: FWS*
    - In tributaries where stocks of migratory fish have been severely reduced or extirpated, re-stocking of these systems with larval migratory fish should be coupled with barrier removal to ensure successful restoration of migratory runs. *Suggested Lead: FWS*
    - Water quality upstream of fish barriers should be considered to ensure that migratory species runs proposed to be restored are capable of sustaining successful spawning activity. The Maryland Biological Stream Survey is a good tool for this in Maryland and similar efforts should be initiated and supported by Federal agencies in the other bay states. *Suggested Lead: FWS*
    - Provide sufficient upstream and downstream passage for diadromous fish (i.e. Shad, river herring American eel) by opening historical migration and spawning runs thereby allowing for population growth and sustainability. *Suggested Lead: FWS and NOAA*
    - Develop a web-based interactive tool where the public may identify and locate manmade fish barriers, including small dams and culverts. *Suggested Lead: FWS*

Living Shoreline Restoration

Nonstructural shoreline erosion techniques are available for low to medium-energy environments that use a natural "living shorelines" approach. Living shorelines are defined as shoreline stabilization techniques that use natural habitat elements to protect shorelines from erosion while also providing critical habitat for Bay wildlife.

A Living Shoreline Summit held in 2006 brought together marine contractors, policy-makers, scientists, land owners, marine engineers, regulators, and government agencies to discuss the past, present, and future of nonstructural erosion control methods in the Chesapeake Bay. These disparate groups together identified gaps and ideas for future actions to promote living shoreline activities in the region, focusing on 1) Outreach and education; 2) Incentives; 3) Data and tools; 4) Research; and 5) Planning, policy, and regulation. The recommendations by these groups identify mechanisms to better promote living shoreline practices Bay-wide; improve coordination and streamline activities throughout all levels of government; and identify opportunities to increase funding and incentives for design and construction. Using funds from a variety of sources, Maryland and Virginia have created detailed inventories of existing shoreline conditions (eroding, hardened, natural, accreting), likely causes of these conditions (wind, waves, tides, boat wakes), and recommended actions. Additionally, a number of rivers (such as the South River in Maryland and Mathews County in Virginia) have initiated or completed comprehensive shoreline documentation and recommendations at an even more refined scale, all in an effort to assist landowners and to help prioritize implementation of projects. From these and other projects, the restoration community has refined what works and under what conditions.

In spring 2008 Maryland passed the Living Shoreline Protection Act; the challenge now is for Federal agencies to coordinate with the states, private property owners and contractors to implement this Act. The Maryland DNR Department of Natural Resources has developed "*Maryland Shorelines Online,"* which is a coastal hazards web portal, centralizing information and data on shoreline and coastal hazards management in Maryland. The Baltimore District of the USACE is preparing several shoreline management documents and guides as part of the Maryland Shoreline Management Study. This effort does not, however, include Virginia shorelines. NOAA partners with the Chesapeake Bay Trust and Maryland Department of the Environment to provide funding and technical expertise on living shorelines projects to local governments and private homeowners.

Recommendations

- Identify opportunities to promote the implementation of living shorelines over hard stabilization options**.** These incentives include existing grant and loan programs for both public and private property owners, and should be widely publicized and expanded for existing programs. These programs should be paired with other incentives such as technical support in engineering design

and construction and should include a process to streamline Federal permitting of living shoreline projects. *Suggested Lead: NOAA and FWS Coastal Program*

- Provide technical and financial assistance on living shoreline strategies through CZMA and community-based restoration programs.
- Improve existing project selection and design criteria to reflect the recent science-based assessments and modeling. The criteria and standards for design that currently exist are relatively general, with information collected by practitioners shared in a relatively informal way. Recent monitoring efforts designed to measure project success in variable energy regimes offer a chance to fine-tune these criteria. *Suggested Lead: NOAA and USACE*
- Incorporate Living Shorelines as a priority in Networked Education for Municipal Officials (NEMO) with curricula created for local government decision makers. NEMO draws on partnerships with nonprofit organizations and government agencies to offer a slate of workshops on the issues that most concern local officials. *Suggested Lead: NOAA*
- Work with states, primarily Maryland and Virginia, to identify critical segments for living shoreline restoration and accelerate focused living shoreline restoration projects to address the identified areas. *Suggested Lead: NOAA*

Tidal Wetlands, Submerged Aquatic Vegetation (SAV) Restoration

Restoration projects in tidal wetlands and nearshore areas have typically included one or more of the following techniques: removing fill material from previously impacted wetlands; re-setting the elevation of the wetland area to maximize exchange of water with the tides, creating or re-connecting tidal channels that carry the critical flow of water into and out of these wetland areas, removal of invasive plants such as *Phragmites*, and re-planting with native wetland plant material. Maintaining healthy tidal wetlands may also depend on control of invasive and overabundant animal species such as mute swans and nutria. For SAV restoration, considered a subset of tidal wetland restoration, only the last technique has been used.

In 2003, the U.S. Army Engineer Research and Development Center (ERDC) and the National Oceanic and Atmospheric Administration Chesapeake Bay Office began a comprehensive research effort to restore SAV in the tidal Chesapeake Bay region. New techniques and equipment developed as part of this research have introduced the capability to collect and disperse millions of eelgrass seeds. These results, documented in a 2008 report, demonstrate these programs' success in developing tools and techniques necessary to plant SAV at scales unattainable with technologies existing only a few years ago.

Tidal wetland restoration is well documented and the methodology is fairly well established. However, because coastal wetland systems, such as salt marshes, are particularly vulnerable to rising sea level, and their inland migration may be

restricted, it is not fully understood how changing sea levels will affect existing and restored tidal wetland systems. The restoration of SAV in the Chesapeake Bay faces dual challenges of poor water quality and rising water temperatures. The poor water quality has been linked to reduced SAV growth and survival. Federal agencies need to determine how much of an emphasis to place on tidal wetland and/or SAV restoration given these stressors.

Recommendations

- Apply precise positioning combined with analyses of local tidal variations to enable restoration practitioners to restore wetlands/place plants appropriately within the land water interface to achieve the desired inundation patterns and increase restoration success rates. Using this approach allows incorporation of long term sea level trends from nearby tide stations thus facilitating the incorporation of potential sea level rise scenarios into the planning and design process. *Suggested Lead: NOAA*
- Coordinate existing funding sources for on-the-ground restoration projects to fund larger more comprehensive wetland restoration projects in the Bay. *Suggested lead: NOAA and FWS*
- Require that GIS shape files be submitted as part of annual inventory by Chesapeake Bay Program for all wetland enhancement, restoration, and protection projects*. Suggested Lead: EPA*
- Consider use of carbon sequestration credits for tidal wetland projects. *Suggested Lead: EPA*
- Continue SAV restoration and monitoring in areas that have demonstrated success and apply new restoration techniques as they become available. *Suggested Lead: NOAA, USACE, FWS*

Remote Chesapeake Bay Island Habitats

Several projects are being developed to restore Chesapeake Bay remote island habitats. These efforts include but are not limited to, Poplar Island, Mid-Bay Islands (James and Barren), and Smith Island. Islands provide critical habitat for a number of uses including nesting, foraging, cover, and migration. One of the most obvious wildlife resources that depend on island habitats are various water-related bird species. Some are critically dependent on islands while others only rely on islands for either part of their life cycle, or part of their population. For the Chesapeake Bay Executive Order's goals to be accomplished, resource managers may need specific data on spatial and temporal habitat use, population sizes and trends, and information on risks to populations and critical habitat stability. Chesapeake Bay islands are critically important habitats but are also strategic for managers to evaluate and monitor for a variety of reasons. Due to island's relative isolation from most human-related impacts found elsewhere in similar coastal habitats (i.e, land use impacts from economic development, etc.), management actions can often be planned and implemented for an island with many less restrictions than on a similar

habitat found along an adjacent mainland coast. Because many water-related birds are among the toughest to monitor due to their secretive nature or sensitivity to disturbance, they are somewhat easier to study on an island setting where there are relatively few disturbances, compared to the coastal mainland where they may be frequently disturbed and have to adjust appropriately (creating behavioral bias in study samples).

There is not a comprehensive plan that documents historic habitat footprints and habitat losses, and that identifies where to restore the largest attainable footprint of remote island habitats.

Recommendations

- Develop a comprehensive plan that documents historic Chesapeake Bay Island habitat footprints and habitat losses, and that identifies where to restore the largest attainable footprint of remote island habitats, and the resulting costs and benefits. *Suggested Leads: NOAA*, USACE, and FWS

Native Oyster Restoration and Aquaculture

The native oyster, *Crassostrea virginica*, has played a key role in the ecological and economic health of the Bay. Over-harvesting, habitat destruction, and disease have reduced oyster populations to less than 1% of historic levels. The dramatic decline in oysters has had devastating effects on the ecology, economy, and culture of the Bay. Yet, oysters remain a keystone species in the Bay's ecology. Oysters form large reefs that provide habitat for a wide range of marine plants and animals. In addition, they feed by filtering microscopic plants from the water, and in the process improve water quality and clarity. Rebuilding reefs and stocking them with oysters is a high priority for the Bay. It is a long-term process that will require significant funding and the participation and commitment of federal and state agencies, academia, industry, nongovernmental organizations and partnerships, and the public.

Federal agencies agree the best approach for oyster restoration comes from large-scale, science-based ecological restoration projects and are therefore working with the states of Maryland and Virginia as well as the Maryland Oyster Advisory Commission and the Virginia Blue Ribbon Oyster Panel to direct federal funds toward priority restoration objectives that involve predominantly non harvestable restoration projects. Four over-arching issues must be addressed to realize improvements in native oyster populations:

1) increased oyster production for both population growth, aquaculture, and potential harvest
2) improved and expanded oyster habitat and substrate and self-sustaining disease resistant populations
3) establishment of an inter-jurisdictional harvest policy that is based on sustainability of the fishery, and
4) improved water quality.

Collectively federal agencies, states, and nongovernmental organizations have put forward a number of plans for oyster restoration and have implemented many successful restoration projects. However, there is no coordinated bay-wide oyster restoration policy and plan in place that integrates the efforts of all partners to address the above overarching issues. This plan is needed in order to implement bay-wide oyster restoration policies and projects on the scale necessary to substantially increase oyster abundance and realize the crucial ecological services healthy oyster reefs provide.

Recommendations

- Using the various oyster restoration reports and findings such as the recently completed Bay-wide Oyster Programmatic Environmental Impact Statement (EIS), the Virginia Blue Ribbon Panel, and Maryland Oyster Advisory Commission reports as foundation documents to develop a bay-wide, inter-jurisdictional oyster restoration strategy that targets ecological restoration. This strategy should include an action plan that describes approaches to:
    - implement large scale tributary-specific approaches and monitoring plans that evaluate performance of existing and future restoration projects;
    - improve techniques to reclaim oyster habitat and develop substrate alternatives;
    - increase hatchery production;
    - develop self- sustaining disease resistant oyster populations;
    - conduct a bay-wide oyster stock assessment;
    - identify aquaculture contributions to restoration, including technical assistance and training for watermen;
    - integrate oyster restoration with other habitat restoration projects such as living shorelines;
    - increase enforcement policies and capabilities;
    - identify research priorities to improve restoration projects; and
    - develop a geo-referenced oyster database for modeling and management purposes. *Suggested Leads: NOAA, USACE, FWS*

Riparian Buffers

Riparian, or streamside, forest buffers provide habitat for wildlife, stabilize stream banks from erosion and keep river waters cool, an important factor for many fish. Well-maintained forest buffers also naturally absorb nutrients and sediments, helping improve water quality in neighboring streams and rivers. Bay Program partners have been working since 1996 to restore riparian forest buffers in the watershed. Their original goal of 2,010 miles of buffers by 2010 was met in 2002. In 2003, Bay Program partners established an expanded riparian forest buffer goal to restore 10,000 miles of forest buffers by 2010. Through August 2007, approximately

5,720 miles of forest buffers had been restored in Maryland, Virginia, Pennsylvania and the District of Columbia. In addition, Maryland, Virginia, Pennsylvania and the District of Columbia have proposed in their tributary strategies to restore some 50,000 miles of riparian forest buffers to help reach water quality goals for major rivers that drain into the Bay.

Recommendations

- Riparian buffers should be managed to ensure native vegetation is being established/maintained along the waterways. *Suggested Lead: U.S. Forest Service*
- Use the Partners for Fish and Wildlife Program to coordinate and deliver riparian buffer restoration on private lands. *Suggested Lead: FWS*
- Develop an exotic and invasive species control manual for habitat managers identifying the best management practices by species and region and what activities should be avoided when implementing habitat projects. *Suggested Lead: FWS*
- Develop a rapid riparian and channel assessment method *Suggested Lead: FWS Stream Program*
- Revise riparian forest buffer goal to include width requirements sufficient to support outcomes for forest-dwelling birds and other wildlife species in Table 1. *Suggested Lead: U.S. Forest Service and FWS*
- Limit or eliminate development within riparian areas, using a similar approach such as Maryland's *Critical Areas* legislation and Virginia's Chesapeake Bay Preservation Act *Suggested Lead: EPA*
- Consider extra credit in the next calibration of the Chesapeake Bay watershed model for riparian/wetland complexes. *Suggested Lead: EPA*
- Establish long-term monitoring of restored buffers to evaluate success against defined objectives, and create incentives to ensure that restored buffers remain intact. *Suggested Lead: USDA*

Upland Habitats (beyond the riparian zone)

There are many initiatives in the bay watershed to attempt to control or guide land development and slow the wholesale loss of uplands habitats to other land practices. State laws throughout the watershed regulate ground-disturbing activities in riparian areas, commonly to reduce sediment delivery to streams. Federal lands (e.g., National Parks, National Wildlife Refuges, and National Forests) within the Chesapeake watershed have land management plans that establish operating restrictions for activities within riparian areas. Many local governments manage riparian vegetation within sub-watersheds that deliver municipal water supplies. There is a need to better understand both the historic vegetation of the watershed and the potential impacts to current vegetation to future impacts from climate change, development and other activities

Recommendations

- Accelerate targeted habitat protection and restoration by developing integrated prioritization tools such as a habitat protection layer for the Chesapeake Online Adaptive Support Toolkit (COAST). Stakeholder involvement should be included in the prioritization process. The Habitat Prioritization Planning Tool developed by NOAA's Coastal Services Center is an example of a product that can use multiple existing GIS data layers and habitat prioritization products to engage multiple stakeholders in the decision making process. *Suggested Leads: USGS, NOAA, and FWS*
- Implement actions identified in the State Wildlife Comprehensive Action Plans as well as the Partners for Fish and Wildlife strategic plan. *Suggested Lead: FWS*
- Improve coordination and develop partnerships with local entities to promote priority riparian restoration and protection efforts and minimize environmental impacts of land use decisions. *Suggested Lead: NPS*

Freshwater Riverine (in-stream habitat)

There is no coordinated conceptual ecological or numerical model for planning and monitoring restoration of in-stream habitats. The Susquehanna River Basin Commission and PA Fish and Boat Commission created a Habitat Suitability Model in Pennsylvania for Brook Trout. Other Bay Program states and rivers do not have a similar model. The Nature Conservancy, in partnership with the USACE and the Susquehanna River Basin Commission and the Interstate Commission on the Potomac River Basin, is currently identifying freshwater flow targets in segments of the Susquehanna and the Potomac Rivers, providing a model that could be applied in other Bay tributaries.

The U.S. Fish and Wildlife Service's Chesapeake Bay Field Office stream staff lead an effort to survey streams at U.S. Geological Survey gage stations in four hydro-physiographic regions in Maryland to develop quantitative regional relationships between drainage area and stream discharge and dimensions. This is a cooperative project with the Maryland Department of Transportation, State Highway Administration, and USGS, along with a number of advisory agencies. Survey results provide essential information to reduce impacts to streams from road crossings, develop improved stream channel restoration designs, and evaluate stream channel conditions.

In addition, the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office and many Federal and state agencies and conservation organizations co-sponsored a series of applied natural channel design review workshops. The workshops are extremely popular with participants, representing local, state and Federal agencies and non-governmental organizations. Participants learn basic concepts of stream assessment and behavior and how it applies to stream and riparian restoration. The

Stream Restoration Program continues to support River Short Courses through our partners and the National Conservation Training Center.

Recommendations

- Coordinate and assist implementation of collaborative, science-based habitat protection and restoration under the National Fish Habitat Action Plan (NFHAP) in accordance with state-led efforts in the Chesapeake Bay Watershed by:
  - Actively supporting planning and specific projects of the Atlantic Coast Fish Habitat Partnership (ACFHP) and the Eastern Brook Trout Joint Venture; especially strategic objectives for the Mid-Atlantic region;
  - Enhancing integration and implementation of high priority NFHAP habitat restoration projects with similar efforts under the Highlands Action Plan, Office of Surface of Mining, and Susquehanna River Basin Commission; and
  - Providing strategic coordination and technical assistance to NRCS in the implementation of Farm Bill programs and practices targeting Chesapeake Bay tributaries and species of management concern. *Suggested Leads: FWS and NOAA*

- Establish sustainable flow ranges in major tributaries and streams to the Chesapeake Bay and assess the impact of these ranges of flows to the Bay's ecosystem. *Suggested Lead: USACE*

- Strengthen technical assistance to landowners and local, state, and Federal resource agency managers in evaluating and restoring stream systems using natural channel design. *Suggested Lead: FWS Stream Restoration Program*

Bringing it all together: A Headwater Stream Example

Purpose: Brook trout habitat restoration in the Upper Potomac River watershed is a high priority project in the National Fish Habitat Action Plan (NFHAP) Eastern Brook Trout Joint Venture (EBTJV). Ongoing projects at Big Run and Whitethorn Creek are aimed at restoring and protecting degraded sections of essential brook trout habitat on tributaries to the South Branch of the Potomac River in West Virginia. Coldwater trout streams on private land in the upper Potomac watershed are often impaired due to nutrients and sediment from non-point sources, livestock grazing and destruction of riparian vegetation. Riparian restoration, livestock exclusion and natural stream channel restoration will decrease temperatures and provide cover and holding habitat in these wild brook trout system located in the headwaters of the South Branch of the Potomac. Thanks to significant involvement from local landowners with Federal and state partners, these projects will restore and protect habitat for native Eastern brook trout.

Partnerships: The projects represent unique partnerships among businesses, conservation organizations, academia, scientific societies, government and private citizens. Cooperative habitat restoration efforts in Big Run, a portion of which flows through Monongahela National Forest, involves partnerships among the US Forest Service, the FWS Partners for Fish and Wildlife Project, the Natural Resource Conservation Service, Trout Unlimited, the West Virginia DNR and several private and corporate supporters. In 2009 the NFHI unveiled its 2009 'Waters-to-Watch' list, a collection of rivers, streams, lakes, watershed systems and shores that will benefit from strategic conservation efforts to protect, restore or enhance their current condition which included the local initiatives to restore habitat in Whitethorn Creek. The Whitethorn Creek project was included in this 'Waters-to-Watch' list and represents a cooperative venture among the Eastern Brook Trout Joint Venture, Trout Unlimited and the West Virginia Division of Natural Resources.

Monitoring: These projects provide opportunities for federal, state, non-governmental organizations and others to offer volunteer and educational opportunities, including stream adoption by local communities. At the Whitethorn Creek Restoration Project local middle-school students will perform habitat assessments, stream surveys, and long-term monitoring to help determine the success of the project. Other monitoring programs will provide information that can be used to constantly update brook trout population status in the watershed. These efforts will provide information needed to identify restoration and protection priorities and to assess the effectiveness of brook trout and habitat conservation actions within an adaptive management framework.

Outcomes: Sustainable wild brook trout population in headwaters of the Chesapeake Bay. Significantly reduced non-point source runoff affecting high quality streams and the Chesapeake Bay watershed.
Outputs: Efforts to date in Big Run have resulted in the restoration of 45 acres of riparian forest, 1.5 miles of cattle exclusion, provided alternate water sources for cattle and improved public access.

Fisheries

Since European settlement, the Chesapeake Bay's rich estuarine ecosystem has supported major fisheries and the livelihoods of residents who adopted a water-dependent way of life. Over recent decades, however, many of the fish and shellfish that sustained these fisheries for over three centuries have declined dramatically in abundance or productivity. Several factors have contributed to declines in fish and shellfish populations in the Chesapeake. Pollution and habitat loss threatened the viability of many species. At the same time, overfishing during the past century by both commercial and recreational fishermen has reduced the spawning potential of

some stocks. These changes have altered habitats and biological communities in the Bay and, consequently, its potential as a viable fisheries ecosystem.

In order to restore the Bay fisheries, we need to clearly describe the structure and function of the Chesapeake Bay ecosystem, including critical habitats and key species interactions to enhance knowledge of the ecosystem and its fisheries to support long-term management objectives. This requires an approach that moves beyond single species management plans.

When the Chesapeake Bay Program (CBP) formally adopted multispecies management as a goal in its Chesapeake 2000 agreement (CBP, 2000a), it emphasized the need for greater understanding of species interactions, habitats, and water quality before effective multispecies plans can be implemented. Full consideration of such factors in management plans will provide an ecosystem approach to fisheries management. As a result, the Chesapeake Bay Fisheries Ecosystem Plan (FEP)—a strategic umbrella document that describes the major structure, functions, and key fish and shellfish species of the ecosystem and emphasizes adherence to ecosystem principles in the regulatory process was published in 2006.

Based on the principles in the FEP, NOAA and Maryland Sea Grant, in coordination with state and federal agency partners and research institutions, is facilitating the development of a new operational format for ecosystem-based fishery management in the Chesapeake Bay. This project will lead to the adoption of five ecosystem-based fishery management plans (EBFMPs) which move beyond traditional single species management plans to consider the interconnections between species, their physical and living environments, and human influences. This innovative approach establishes a sustainable scientific infrastructure for addressing critical ecosystem issues for fish and shellfish species in Chesapeake Bay through collaboration between state and federal agency partners, research institutions, and non-governmental organizations in an adaptive management context. This collaborative process links science and management and provides a sustainable structure and process for addressing short, mid, and long term ecosystem issues for fisheries management in Chesapeake Bay. Maryland Sea Grant is now focusing on integrating a wide variety of stakeholders into the EBFM process and plans to launch this component of the project in October, 2009.

Recommendations

- Consider establishment of a new inter-jurisdictional, Bay-wide regulatory body to implement the regulations and strategies necessary for managing and restoring Chesapeake Bay fisheries. This body should have shared Federal Sate leadership and should have the authority to develop, implement, and enforce the rules necessary for coordinated management and restoration of fisheries. Suggested Lead: NOAA

- In coordination with States, Federal investment should be directed toward better understanding the status and trends of resource abundance and distribution through more accurate, timely and comprehensive stock assessments to accelerate ongoing ecosystem based fishery management efforts and develop, improve and implement inter-jurisdictional fisheries management plans. Federal capabilities necessary for these measurements include the ability to: assess fish-stock and protected-resource status and health; monitor living resources (spanning multiple trophic levels) at appropriate levels of species resolution; assess the spatial and temporal variability (both natural and use-induced) of resources, quantify the impacts of habitat degradation on fish production, and provide long-term and sustained monitoring and mapping of natural and resources. *Suggested Lead: NOAA and FWS*

- Development and implementation of these capabilities would enable consideration of alternative management approaches such as quota based management systems, limited access programs including catch shares, individual transferable quotas and effort limits, gear restricted areas including sanctuaries, and adaptive approaches to living resources management. *Suggested Lead: NOAA and FWS*

- Support and encourage the development, implementation, and enforcement of effective interstate conservation and management of Chesapeake Bay and Atlantic coastal fishery resources. Federal agencies should work with the states and the Atlantic States Marine Fisheries Commission (ASMFC) to restore and ensure the sustainability of Chesapeake bay fisheries, by applying the same degree of scientific scrutiny to existing state and inter-jurisdictional management plans as is applied to Federally managed stocks under the Magnuson-Stevens Fishery Conservation and Management Act. As a precondition for future Federal investment, management plans should be updated to include current assessments of overfishing, coordinated inter-jurisdictional management approaches/policies and enforcement, and precautionary measures to prevent future collapse. In accordance with, The Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5101-5109; Title VIII of Pub. L. 103-206, as amended) if management plans are found out of compliance, a moratorium imposed by the Secretary of Commerce can be placed on fishing for, or landing, the managed species within waters of that state. *Suggested Lead: NOAA*

- Support the Atlantic Coastal Fish Habitat Partnership (ACFHP) under the National Fish Habitat Action Plan (NFHAP). ACFHP brings together fishery and non-fishery associated organizations (governmental (federal, state, local) and non-governmental organizations (academic, non-profit, professional) to

collaboratively benefit coastal habitats along the Atlantic seaboard. The partnership will promote the sustainability of Atlantic coast diadromous and other estuarine-dependent fishes and their essential habitats through on-the-ground habitat protection and restoration projects. *Suggested Lead: NOAA and FWS*

- Near term habitat actions should be undertaken immediately to advance fisheries restoration including capping contaminated sediments in industrialized watersheds, minimizing impacts to benthos and SAV from dredging and disposal activities, removing marine debris and derelict fishing gear, stabilization of stream banks and channels, and benthic mapping to identify essential fish habitat. *Suggested Lead: NOAA and USACE*

Multi-Species Management (Delaware Bay Example)

Each spring millions of horseshoe crabs (*Limulus polyphemus*) emerge from Delaware Bay to spawn on beaches and thousands of migratory shorebirds stopover in the estuary to feed on horseshoe crab eggs. However, increases in horseshoe crab harvest during the 1990s, particularly for whelk bait, has reduced horseshoe crab abundance and threatened this fascinating ecological relationship. Traditional single-species fisheries management has not adequately accounted for recovery objectives for long-distance migrants, such as the Red Knot (*Calidris canutus rufa*). In response, a collaboration among US Geological Survey, US Fish and Wildlife Service, Atlantic States Marine Fisheries Commission, and Atlantic-coast state agencies was formed to develop an alternative approach. Through the adaptive management process, managers, scientists, and stakeholders have worked together to specify objectives, identify management actions, develop predictive models, and evaluate trade-offs between competing objectives. The collaboration has resulted in more conservative management decisions and increased juvenile horseshoe crab abundance.

Objective 3: COORDINATE RESEARCH AND ASSESSMENT TO SUPPORT LIVING RESOURCES

Identifying Natural and Anthropogenic Stressors

Living Resources of the Chesapeake Bay Watershed are subjected to a variety of natural and anthropogenic stressors. These stressors broadly fall into seven categories: 1) habitat loss and fragmentation, 2) water quality impairment, 3) climate change, 4) disease and pathogens, 5) chemical contaminants, 6) harvest pressure, and 7) exotic (invasive) species. While future conditions of the Bay ecosystem may depend on a combination of changes in climate, population, and land-

use patterns, habitat loss is a significant stressor. For instance, land-use changes associated with urbanization generally result in increased impervious surface leading to erosion and sediment yields. Evidence to date has clearly shown that suspended-sediment yields are highest in the Piedmont Physiographic Province and lowest in the Coastal Plain Province. A very large proportion of the sediment that is transported out of the Piedmont is trapped within 30 river kilometers of the fall line above the Coastal Plain.

Water quality impairment serves as a direct stressor, alters available habitat, and can limit the success of restoration efforts. Eutrophication is considered to be the largest aquatic pollution problem in the US and is associated with increased harmful algal blooms and large areas of anoxic waters or "dead zones" in Chesapeake Bay. In addition, this process results in the loss of submerged aquatic vegetation and limits the success of restoration efforts. The importation of nutrients into the Chesapeake watershed is an overarching concern that may limit the ability to address habitat issues.

As discussed in the report under Section 202(d), climate change is an additional stressor for living resources. Climate change and variability likely will affect sea-level rise and changes in precipitation patterns and intensity that will alter stream flow and water temperature and directly impact coastal habitats and stream corridors. More acidic water in the system will reduce calcium in the water needed for aquatic species such as oysters. Superimposed on these changes are anthropogenic factors of population growth and changes in land use that may exacerbate some or all of the changes induced by climate change. This on-going and projected degradation in water quality will directly influence the health, abundance and distribution of living resources within the Bay. Understanding and managing these potential impacts can best be done at the landscape scale and by applying state-of-the-art monitoring and remote sensing tools supported by appropriate science and technology.

Impacts of other stressors can result in increased disease outbreaks, high parasite loads, and decreased disease resistance. For instance, mycobacteriosis is a chronic bacterial disease of Chesapeake Bay striped bass currently affecting a large proportion of the adult population. In addition to mortality associated with chronic infectious disease, the economic impact of disease outbreaks to recreational and commercial fisheries could be significant due to consumer and angler avoidance. Some of the mycobacteria that commonly infect fishes can also cause infections known as Fish Handler's Disease in people. Disease issues have also severely limited the ability to restore the American oyster, and the habitat and water quality benefits they provide. The parasites MSX and Dermo can collectively claim a substantial amount of the harvestable oyster population in a given year. It is anticipated that disease issues will become even more prominent in future years in response to climate change.

Contaminants can also harm living resources. For example, in the Piedmont Province of the Potomac River, evidence collected by the USGS suggests that

presence of endocrine disrupting chemicals (EDCs) is affecting immune systems in fish and may be related to a high incidence of intersex in smallmouth bass populations. Intersex, or the presence of immature oocytes in male testis, is a well known biological indicator of chemical contamination. The factors affecting reproductive abnormalities such as intersex of fishes may be caused by endocrine disrupting contaminants from both human and animal populations and loss of habitat that affect transport of contaminants. Additional research will be needed to describe these relationships and to devise management strategies. Contaminants not only influence living resources, but also pose a significant human health risk. Consumption advisories are in place for over a dozen species in Maryland, Virginia and other states' waters due to PCB, mercury, and pesticide accumulation.

Overharvesting of living resources can significantly impact not only individual populations, but ecosystem processes and dynamics. Over-harvest is commonly implicated in cases of stock decline in Chesapeake Bay (e.g.; oyster, striped bass, blue crab), and in some cases, individual fisheries may influence the success of others (e.g., striped bass and Atlantic menhaden). Current efforts, such as NOAA's Fisheries Ecosystem Planning document book and that coordinated by Maryland Sea Grant, are beginning to pave the way for ecosystem based approaches to management of living resources. However, much additional work is needed in terms of research, monitoring, modeling, and implementation.

Invasive species or animals and plants that are not native to the Bay have the potential to negatively affect the ecosystem. According to the Chesapeake Bay Program (CBP), invasive species rank second, after habitat destruction as a threat or stressor in the Bay watershed. There are over 200 invasive species known to the Bay watershed and some are known to cause serious ecological problems. Some examples of invasive species that pose serious threats to living resources in the Bay watershed include nutria, mute swans, northern snakehead, zebra mussels, phragmites, purple loosestrife and water chestnut. Upland exotic invasive plant species (such as garlic mustard, tree of heaven, or Japanese honeysuckle) can adversely impact riparian soil stability leading to increased sediment delivery to streams throughout the watershed. The North East Marine Exotic Species Information System (NEMESIS), developed by the Marine Invasions Research Laboratory, at the Smithsonian Environmental Research Center provides a comprehensive source of information on species introduced to Chesapeake Bay and adjacent Atlantic waters and coastal bays. Research capabilities are needed to understanding the range, distribution and biological effects of invasive species; to develop and evaluate containment, control or eradication techniques and to develop models to predict introductions due to climate change.

Research, Monitoring, and Assessment Needs

Research, monitoring, and assessment activities are conducted by Federal, State, county, academic, consultant, non-government organization, citizen groups among

others throughout Chesapeake Bay. These programs have served well to identify stressors in Chesapeake Bay, understand ecosystem processes, and monitor outcomes. The challenge is in effectively coordinating and focusing these approaches to reduce redundancy, evaluate the success of management actions, focus on key uncertainties in planning, and achieve common goals. Increasingly, we are recognizing the importance of managing and evaluating the ecosystem as a whole, rather than specific parts. Research, monitoring and assessment of living resources in the Bay watershed would benefit from landscape scale, holistic approaches to monitoring and assessment. Opportunities include:

- Interagency coordination of research, monitoring, and habitat restoration activities including prioritization of efforts.
- Assessment and prioritization of Chesapeake Bay sub-watersheds
- Understanding the effects and impacts of stressors on living resources, especially the interactions of multiple stressors
- Public outreach and education for many different stakeholders and at appropriate levels.

Recommendations

- Federal and State partners and the academic institutions of the Chesapeake Bay region should collaboratively develop a strategic research and assessment program that will fully utilize and enhance the resources and capacity of these partners to identify, prioritize, and conduct the science needed for ecosystem-based management in the Chesapeake Bay.

  The collaborative research and assessment program should:
  1) Identify scientific research and assessment needs for ecosystem-based management in the Bay extending across short-, mid-, and long-term timeframes;
  2) Prioritize those scientific research and assessment needs in consultation with advisors from key sectors of the Bay community and from a wide a cross-section of the public stakeholders;
  3) Complete an inventory of the scientific research capacity amongst the federal, state and academic partners of the Bay;
  4) Facilitate deliberation among Federal, State, and other Bay stakeholders to link scientific needs with existing research capacity and resources, identify areas for enhancement, and take actions implement the enhancements; and
  5) Enable the application of sound science to resource management decision-making. *Suggested Lead: NOAA, STAC*

- Prioritize research, monitoring, restoration and protection needs by river basins based on the Spatial Management Plan. The three principal regions previously outlined in Table 1 and their associated habitat types should be managed within the context of their river basin. Focused efforts of all

Federal agencies in a sub-watershed would allow connectivity between upland and aquatic research and restoration efforts and provide a natural means of reducing redundancy and fragmentation of projects. Within basin seamless water/land GIS maps to link living resources with critical habitats for use in better targeting and prioritizing restoration and protection should be developed. *Suggested Lead: USGS and FWS through establishment of Landscape Conservation Cooperatives*

- Continue to develop organismal, histologic, immunologic and molecular tools to evaluate the general and reproductive health of living resources in response to natural and anthropogenic stressors. These include tools to evaluate agricultural and forestry runoff, wastewater treatment effluents and other sources of contaminants for effects on fish, wildlife and human health. Tool development should also include diagnostic tools for rapid assessment and monitoring of emerging infectious diseases and linkages to other environmental stressors, particularly nutrients and contaminants that may lower disease resistance in these organisms and to understand the underlying interactions. As part of this approach, a set of standardized health indices for monitoring of key species should be established. *Suggested Leads: USGS and NOAA*

- Identify and provide engineering solutions for fish passage, evaluate existing passage structures for efficacy, and develop the tools necessary to evaluate the biological significance of fish passage improvements to anadromous fish stocks. Within the river basin approach, large habitat projects such as fish passage should be linked with in-stream habitat improvements. *Suggested Leads: FWS and NOAA*

- Further existing research on the use of filter feeding bivalves to improve water quality, either through raising bivalves for food (aquaculture) or strictly for water quality benefits (ecosystem engineering). Bivalves that are not eaten by humans could be more safely raised in water bodies that have bacterial, contaminant, or other impairments. *Suggested Lead: NOAA and USACE*

- Conduct fish and shellfish aquaculture research to assess the viability of using aquaculture methods for restoring fishery and other import species to the bay. *Suggested Lead: NOAA*

Modeling Tools and Applications

Current management paradigms focus on single sector or species issues (e.g., nitrogen loads or blue crabs). However, as society has begun to understand the importance of the ecosystem and how one issue affects many, management has moved from a narrow view point to a more synthesized view of the ecosystem.

Biological indicators can contribute to obtaining the most integrative and diagnostic assessment of ecosystem condition.[2] As these types of tools are being developed, they will allow us to better organize knowledge at of the landscape and ecosystem levels and to identify gaps in the knowledge base. As these tools mature they may be used, individually or in model ensembles, to help explore the impacts of management decisions and polices on the ecosystem and landscape using an adaptive management framework and a model-based management strategy evaluation.

Many efforts are underway to help expand our simplified views of the ecosystem and landscape that influences it. For example the Chesapeake Bay Program Watershed Model and the USGS Chesapeake Bay Land-use Change Model can be useful in explaining and forecasting changes in human activities and water quality in the focus areas. The output from these models can be used in concert with the CBP Eutrophication model and Habitat Suitability and Stock-Recruitment Forecast models to assess the impacts of land use on important biological resources. The linkages of such tools that are already in use will be beneficial for moving forward with ecosystem-based management. This assemblage of models can facilitate analysis and enhance understanding of climate variability and human-induced impacts on habitat and species distributions within the Bay watershed.

In addition to creating ensembles of existing models, new holistic models will need to be developed. In general, models for watershed focus areas within physiographic provinces and habitat types need to be developed. The USGS Spatially Referenced Regression on Watershed (SPARROW) nutrient and sediment models are examples of the types of modeling used to address the spatial relationships of land-use, watershed characteristics, and water quality. In addition, spatially-explicit models of the ecosystem such as the Chesapeake Bay Ecopath with Ecosim Model and the Atlantis Model currently under development will be necessary for synthesis of ecosystem information and for management strategy evaluation. Similarly, a decision-support system, the Chesapeake Online Adaptive Support Toolkit (COAST), is being developed by USGS and CBP office to help resource managers employ an adaptive-management approach to design, implement, and evaluate management actions.

These modeling tools in combination with other existing tools or tools being developed can be utilized to:

- Improve the understanding of nutrient and sediment sources and transport.
- Determine the extent and causes of fish kills and degraded fish habitat and health.

[2] Brooks, Robert P et al,. Next Generation of Ecological Indicators of Wetland Condition. 2007, EcoHealth 4, 176-178.

- Develop comprehensive fish population dynamics and stock assessments
- Assess factors affecting birds and their habitats.
- Assess the effects of climate change on water quality, habitat and living resources.
- Separate effects of environmental stressors, natural conditions, trophic interaction and harvesting to foster more effective natural resources management.
- Improve the understanding of public perceptions and valuation of habitat protection and restoration.

Recommendations

- Sustained, long-term, broad-scale, multispecies monitoring programs across all life stages are needed to fulfill single-species management needs as well as ecosystem-based management needs. Some previously funded monitoring programs such as the one for zooplankton in tidal waters may need to be restarted. Existing monitoring systems should be better integrated to help achieve this goal, such as the National Estuarine Research Reserve Systems' nascent Sentinel Sites program. *Suggested Lead: USGS and NOAA*
- Data from monitoring and research and applications like fish stock assessments should be made readily available via a single access-point system that allows integration of data at all levels of the ecosystem. This will allow data to be used in a timely and effective manner by all management agencies. *Suggested Lead: EPA and USGS*
- Federal and State partners are currently working to update aquatic species distribution maps for various life stages using dissolved oxygen (DO) as a proxy to characterize habitat quality (Appendix A). A parallel effort should be undertaken for terrestrial species. *Suggested Lead: USGS, NOAA, FWS, EPA*

CONCLUSION

This report provides a suite of recommendations (Table 4) for Federal leadership to raise the bar for habitat restoration and protection in the Chesapeake Bay watershed. A common theme is the need to implement larger-scale, more integrated habitat restoration and protection projects in order to achieve the Fisheries and Habitat goals in Figure 1. Our approach calls for application of innovative science and new technologies to improve management decisions for habitats and living resources and the communities that depend on them. Development and application of ecosystem based management, spatial planning, and advanced land-management practices through public engagement, outreach and education, in concert with efforts by the EPA and USDA to reduce non-point source runoff of nutrients and pesticides, will promote more sustainable use of resources and resilience of habitats in the Bay and its watershed and result in resilient economies and communities, stable jobs, abundant and healthful supplies

of seafood, both wild-caught and farm-raised, recreational opportunities and aesthetic values, lowered pollution, and cleaner air and water.

TABLE 4. Recommendations Arranged by Objectives

Objective	Category	Recommendation	Suggested Lead(s)	Related 202 report
Prioritize Actions to Maximize Ecological Benefits		Validate Species/Habitat matrix using strategic decision making process	NOAA/GIT 1 and FWS/GIT 2	
		Conduct integrated ecological assessment	NOAA, USGS	202f
		Develop watershed-wide Spatial Management Plan	EPA, NOAA, USGS	202f
Accelerate Habitat Protection and Restoration	Habitat Protection			
	Decision Support	Use area-wide planning process authorities (SAMPs and ADID)	USACE and EPA	
		Prioritize federally-funded land and water protection to maximize benefits to critical living resources	FWS and NOAA	
		Acquire high resolution data (LiDAR and SAR) to assist in targeting restoration projects	USDA, USGS, NOAA	202d
		Utilize geospatial observations on local rates of sea level rise	NOAA and USGS	202d
		Submit CB Special Resources Study to Congress supporting major recommendations	NPS	202e
		Establish network of reference sites	NOAA and FWS	
	Funding	Support Federal land acquisition programs and consider targeting funding increments to CB watershed	FWS, NOAA, NPS	202e
		Implement National Fish Habitat Action Plan	FWS and NOAA	
		Monitor net change in forest, wetland, and riparian land cover to build data to credit habitat protection as nutrient load reduction BMP	USGS	
	Designation and Acquisition	Consider establishment of a network of protected areas that link protected lands with open water	NOAA and FWS	202e
		Develop SAMPs under CZMA	NOAA	
		Consider designation of CB	DOI	

Objective	Category	Recommendation	Suggested Lead(s)	Related 202 report
		tributaries under National Wild and Scenic River system		
		Direct encroachment mitigation funds toward purchase/easement of ecologically significant lands	DOD	
		Coordinate disposal of foreclosed properties thru Farm Service Agency	USDA	
	Enforcement and Compliance	Implement Compliance and Enforcement Strategy called for in Section 302 of EO, including addressing unpermitted wetland fill and mitigating to replace lost values	EPA Office of Water	202a
		Strengthen interagency MOAs on permit review to require compensation for losses of wetlands, open waters, and subtidal bottom	FWS and NOAA	
		Increase wildlife inspection efforts at major ports to prevent invasive species introductions	FWS Law Enforcement Operations	
		Develop Rapid Response Teams in each state to control infestations	FWS and NOAA thru ANSTF, USDA APHIS	
		Fully support implementation of the CB Nutria Eradication Program strategic plan	FWS	
		Strengthen review of projects and programs that may damage habitat by proactively applying consultative tools	*NOAA and FWS*	
	Habitat Restoration			
	Funding	Prioritize Federally-funded habitat restoration actions in a manner that maximizes habitat benefits for critical species in Table 1.	*FWS and NOAA*	
		Coordinate funding and prioritize large scale restoration efforts by tributary to accelerate restoration of ecosystem function.	*FWS and NOAA*	
	Fish Passage	Consider funding Fish Passage Coordinators in MD, VA, and PA	EPA via State Implementation	

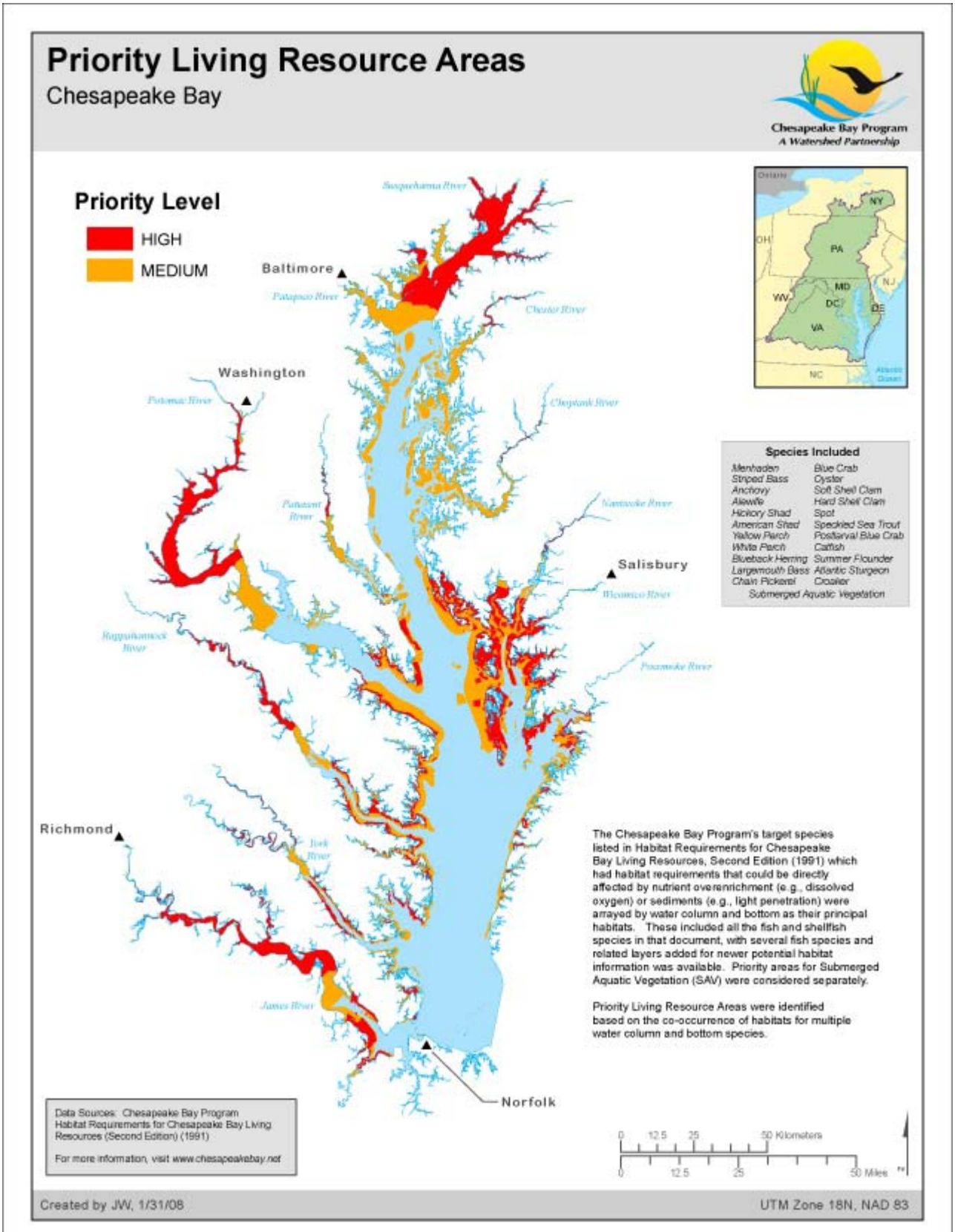
Objective	Category	Recommendation	Suggested Lead(s)	Related 202 report
			Grants	
		Establish criteria for dam removal that will not require dredging of accumulated sediments	FWS and EPA	
		Utilize the Open Rivers Initiative to support community-driven, small dam and river barrier removals	NOAA	
		Expand fish blockage prioritization protocol developed for MD to VA and PA	FWS	
	Living Shorelines	Promote implementation of living shorelines over hard stabilization; including funding, engineering, and construction incentives and streamlined permitting	NOAA Restoration Center and FWS Coastal Program	
		Provide assistance on living shoreline strategies through CZMA and community-based restoration programs	NOAA	
		Improve project selection and design criteria to reflect latest science	NOAA	
		Incorporate living shorelines in workshops for local officials	NOAA NEMO	
		Work w/ MD and VA to identify critical segments for living shoreline construction	NOAA	
	Tidal wetlands/SAV	Apply analysis of tidal variation to place plants appropriately in land-water interface	NOAA	
		Coordinate existing funding for large-scale projects	NOAA and FWS	
		Require reporting of GIS shape files for all wetland projects	EPA - CBP	
		Consider use of carbon sequestration credits for tidal wetland projects	EPA	
		Use SAV abundance as outcome measure for load reduction efforts	EPA and USDA	
	Islands	Document historic CB island footprints and habitat losses and conduct cost/benefit of restoration	NOAA	
	Oyster Restoration and Aquaculture	Use various oyster restoration reports to develop bay-wide, interjurisdictional ecologically-	NOAA, USACE, FWS	

Objective	Category	Recommendation	Suggested Lead(s)	Related 202 report
		based restoration strategy		
	Riparian Buffers	Manage buffers to maintain native vegetation along waterways	USDA Forest Service	
		Coordinate and deliver technical assistance on private lands	FWS Partners for Fish & Wildlife Program and NRCS	202b
		Develop invasive species control manual for habitat managers	FWS	
		Develop rapid riparian and channel assessment method	FWS Stream Program	
		Revise CBP buffer goal to include width requirements sufficient to support outcomes for forest-dwelling birds	USDA Forest Service and EPA	
		Eliminate development in all riparian areas using MD's Critical Areas legislation as a model	EPA	
		Consider extra credit in CBP watershed model for riparian/wetland complexes	EPA	
		Establish long-term monitoring of restored buffers to evaluate success	USDA Forest Service	
	Uplands	Target protection and restoration through integrated spatial planning	NRCS, FWS, NOAA, USGS	202f, 202b
		Implement actions in State Wildlife Comprehensive Action Plans	FWS	
		Coordinate and develop partnerships with local decision-makers to restore buffers	NPS	
	Riverine	Assist implementation of National Fish Habitat Action Plan	FWS and NOAA	
		Establish sustainable flow ranges in major tributaries and streams	USACE	
		Strengthen technical assistance to landowners and resource managers in evaluating stream systems	FWS Stream Program	
	Fisheries	Coordinate with States on more accurate, timely and comprehensive stock assessments	NOAA and FWS	
		Consider alternative	NOAA and FWS	

Objective	Category	Recommendation	Suggested Lead(s)	Related 202 report
		management approaches (catch shares, gear restricted areas, individual quotas)		
		Support effective interstate conservation and management of fishery resources through more conservative fisheries management plans and Federal funding conditions	NOAA	
		Support sustainability of Atlantic Coast fishes and habitat thru NFHAP	NOAA and FWS	
		Cap contaminated sediments in industrialized watersheds, minimize dredging and disposal activities that impact benthos and SAV, stabilize stream banks and channels	NOAA and USACE	
Coordinate Research and Assessment	Research, Monitoring and Assessment	Collaboratively develop strategic research and assessment program	NOAA and STAC	202f
		Prioritize research, monitoring, restoration and protection needs by river basin based on above assessment	USGS and FWS through Landscape Conservation Cooperatives	202f
		Continue to develop science on health of living resources	USGS and NOAA	202f
		Provide engineering solutions for fish passage, evaluate existing structures for efficacy, and evaluate biological significance of improved techniques	FWS and NOAA	
		Further research on use of filter feeding bivalves to improve water quality	NOAA and USACE	
		Consider aquaculture options for fish and shellfish stock enhancement	NOAA	
	Modeling, Tools, and Applications	Support sustained, long-term, multispecies monitoring programs across all life stages	USGS and NOAA NERRS Sentinel Sites program	202f
		Improve access to monitoring data	EPA and USGS	
		Complete update of aquatic species critical life stages maps and conduct similar mapping effort for terrestrial species	EPA, NOAA, USGS, FWS	

APPENDICES

Appendix A: Priority Living Resource Areas: Areas with High Potential Fish and Shellfish Diversity


Priority Living Resource Areas
Chesapeake Bay
Chesapeake Bay Program
A Watershed Partnership
Priority Level
HIGH
MEDIUM
Susquehanna River
Baltimore
Patapsco River
Chester River
Washington
Potomac River
Choptank River
Patuxent River
Nanticoke River
Salisbury
Wicomico River
Rappahannock River
Pocomoke River
Richmond
York River
James River
Norfolk
NY
PA
OH
MD
NJ
WV
DC
DE
VA
NC
Species Included
Menhaden
Striped Bass
Anchovy
Alewife
Hickory Shad
American Shad
Yellow Perch
White Perch
Blueback Herring
Largemouth Bass
Chain Pickerel
Blue Crab
Oyster
Soft Shell Clam
Hard Shell Clam
Spot
Speckled Sea Trout
Postlarval Blue Crab
Catfish
Summer Flounder
Atlantic Sturgeon
Croaker
Submerged Aquatic Vegetation
The Chesapeake Bay Program's target species listed in Habitat Requirements for Chesapeake Bay Living Resources, Second Edition (1991) which had habitat requirements that could be directly affected by nutrient overenrichment (e.g., dissolved oxygen) or sediments (e.g., light penetration) were arrayed by water column and bottom as their principal habitats. These included all the fish and shellfish species in that document, with several fish species and related layers added for newer potential habitat information was available. Priority areas for Submerged Aquatic Vegetation (SAV) were considered separately.
Priority Living Resource Areas were identified based on the co-occurrence of habitats for multiple water column and bottom species.
Data Sources: Chesapeake Bay Program Habitat Requirements for Chesapeake Bay Living Resources (Second Edition) (1991)
For more information, visit www.chesapeakebay.net
0 12.5 25 50 Kilometers
0 12.5 25 50 Miles
Created by JW, 1/31/08
UTM Zone 18N, NAD 83

Note: Map reflects aquatic habitats and species only. A parallel effort should be undertaken for terrestrial species.

Appendix B: Current Federal Chesapeake Bay Habitat Protection Tools

Program Name	Brief Description	Organization
National Natural Landmarks	Established in 1962, this program identifies and encourages the preservation of a range of nationally significant geological and ecological features. With 586 landmarks in 48 states and four territories, it is the only natural areas program of national scope that identifies and recognizes the best examples of biological and geological features in both public and private ownership. Participation in the NNL Program involves a voluntary commitment on the part of the landowner to retain the integrity of their NNL property as it was when designated.	National Park Service (NPS)
Units of the National Park System	Some units of the National Park System are set aside largely for their nationally significant ecological values. In the Chesapeake Bay watershed, Shenandoah National Park is one example, much of which is already conserved.	National Park Service (NPS)
Units of the National Wildlife Refuge System	The U.S. Fish and Wildlife Service manages 17 National Wildlife Refuges encompassing 76,000 acres in the watershed. Acquiring all lands within the land acquisition boundaries of these refuges would add an additional 330,000 acres.	United States Fish and Wildlife Service (USFWS)
Coastal and Estuarine Land Conservation Program (CELCP)	Established by Congress in 2002 "for the purpose of protecting important coastal and estuarine areas that have significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses,"	National Oceanic and Atmospheric Administration (NOAA)

	giving priority to lands that can be effectively managed and protected and that have significant ecological value.	
National Estuarine Research Reserve System (NERRS)	A network of protected areas established for long-term research, education and stewardship. This partnership program between NOAA and the coastal states protects more than one million acres of estuarine land and water, which provides essential habitat for wildlife; offers educational opportunities for students, teachers and the public; and serves as living laboratories for scientists.	National Oceanic and Atmospheric Administration (NOAA)
Units surrounding existing military bases	The Readiness and Environmental Protection Initiative (REPI) takes advantage of a relatively new authority (10 USC, Sec. 2684a) Congress enacted in 2002 authorizing DoD to partner with state and local governments, and non-governmental organizations to acquire from willing sellers conservation easements on private lands. REPI serves to forestall incompatible land use and protect high-value habitat so that DoD retains the discretion to use military lands free of encroachment-related restrictions and environmental constraints. With REPI agreements and funding DoD can cost-share the acquisition of conservation easements creating “win-win” situations for all partners.	Department of Defense (DOD)
Units of the National Forest System	The Chesapeake Bay Program completed a Resource Lands Assessment to identify the most important remaining forests and wetlands in the Bay watershed. The Resource Lands Assessment identifies conservation focus areas that help	USDA Forest Service and Chesapeake Bay Program (CBP)

	guide government, land trusts, and other organizations with forest protection efforts.	
National Fish Habitat Action Plan	The mission of the National Fish Habitat Action Plan is to protect, restore and enhance the nation's fish and aquatic communities through partnerships that foster fish habitat conservation and improve the quality of life for the American people. This mission will be achieved by: 1) Supporting existing fish habitat partnerships and fostering new efforts; 2) Mobilizing and focusing national and local support for achieving fish habitat conservation goals; 3) Setting national and regional fish habitat conservation goals; 4) Measuring and communicating the status and needs of fish habitats; and 5) Providing national leadership and coordination to conserve fish habitats.	Fish Habitat Partnership (FHP)
EPA 319	In accordance with guidance issued by EPA under Section 319 of the Clean Water Act, Section 319(h) funding decisions are made by the states. States submit their proposed funding plans to EPA. If a state's funding plan is consistent with grant eligibility requirements and procedures, EPA then awards the funds to the state.	Environmental Protection Agency (EPA)
Special Area Management Plan (SAMP) and Coastal Zone Management Act (CZMA)	"Special Area Management Plans" (SAMPs) are broadly defined in the Coastal Zone Management Act (CZMA) as "plans which provide for increased specificity in protecting significant natural resources, reasonable coastal-dependent economic growth, improved protection of life and property in hazardous areas, including those areas likely to be affected by land subsidence, sea level rise, or fluctuating water levels of the Great	National Oceanic and Atmospheric Administration (NOAA)

	Lakes, and improved predictability in governmental decision making." The CZMA encourages states to prepare these types of plans.	
North American Wetlands Conservation Act	Provides matching grants to organizations and individuals who have developed partnerships to carry out wetlands conservation projects in the United States, Canada, and Mexico for the benefit of wetlands-associated migratory birds and other wildlife.	United States Fish and Wildlife Service (USFWS)
National Coastal Wetland Conservation Grant Program	It was established by the Coastal Wetlands Planning, Protection and Restoration Act (Breaux Act) of 1990. Under the program, the U.S. Fish and Wildlife Service provides matching grants for acquisition, restoration, management, or enhancement of coastal wetlands. About $6 million in grants are awarded annually through a nationwide competitive process. Funding for the program comes from excise taxes on fishing equipment and motorboat and small engine fuels.	United States Fish and Wildlife Service (USFWS)
Neotropical Migratory Bird Conservation Act	The Neotropical Migratory Bird Conservation Act (NMBCA; Public Law 106-247), passed by the U.S. Congress in 2000, establishes a matching grants program to fund projects that promote the conservation of migratory birds in the United States, Latin America, and the Caribbean.	United States Fish and Wildlife Service (USFWS)
Cooperative Endangered Species Fund	The program provides funding to States and Territories for species and habitat conservation actions on non-Federal lands. States and Territories must contribute a minimum non-Federal cost share of 25% for the estimated program costs of approved projects, or 10% when two or more States or Territories implement a joint project. A State or Territory must currently have, or enter into a	United States Fish and Wildlife Service (USFWS)

	cooperative agreement with the Secretary of the Interior to receive grant funds.	
Land and Water Conservation Fund	The LWCF State Assistance Program was established by the LWCF Act of 1965 (Section 6, Land and Water Conservation Fund Act of 1965, as amended; Public Law 88-578; 16 U.S.C. 4601-4 et seq.) to stimulate a nationwide action program to assist in preserving, developing, and assuring to all citizens of the United States of present and future generations such quality and quantity of outdoor recreation resources as may be available and are necessary and desirable for individual active participation. The program provides matching grants to States and through States to local units of government, for the acquisition and development of public outdoor recreation sites and facilities. Grant funds are also available, to States only, for fulfilling the statewide comprehensive outdoor recreation planning requirements of the program.	National Park Service (NPS)
Wildlife Habitat Incentive Program (WHIP)	A voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land. The Food, Conservation, and Energy Act of 2008 reauthorized WHIP as a voluntary approach to improving wildlife habitat in our Nation. The Natural Resources Conservation Service administers WHIP to provide both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP cost-share agreements between NRCS and the participant generally last from one year after the	Natural Resource Conservation Service (NRCS)

	last conservation practice is implemented but not more than 10 years from the date the agreement is signed.	
Conservation Reserve Enhancement Program (CREP)	A voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. The program is a partnership among producers; tribal, state, and federal governments; and, in some cases, private groups. CREP is an offshoot of the country's largest private-lands environmental improvement program - the Conservation Reserve Program (CRP).	USDA's Farm Service Agency (FSA)
Conservation Reserve Program (CRP)	The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation (CCC). The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian	Natural Resource Conservation Service (NRCS) USDA's Farm Service Agency (FSA)

	buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.	
Recovery Land Acquisition	Loss of habitat is the primary threat to most listed species and land acquisition is often the most effective and efficient means of protecting habitats essential for recovery of listed species before development or other land use changes impair or destroy key habitat values. Land acquisition is costly and often neither the Service nor the States individually have the necessary resources to acquire habitats essential for recovery of listed species. Recovery Land Acquisition grant funds are matched by States and non-Federal entities to acquire these habitats from willing sellers in support of approved or draft species recovery plans. The Recovery Land Acquisition program was established in fiscal year 2001.	United States Fish and Wildlife Service (USFWS)
Habitat Conservation Plan Land Acquisition	This program was established by Congress in fiscal year 1997. This program was designed to reduce conflicts between the conservation of listed species and land uses on specific parcels of land. Under this program, the Service provides grants to States for land acquisitions that are associated with approved (permitted) HCPs. The Service considers the use of Federal acquisition dollars by States for habitat protection adjacent to HCP areas to be an important and effective mechanism to promote the recovery of threatened and endangered species. The HCP Land Acquisition program has three primary purposes: 1) to fund land acquisitions that complement, but do not replace,	United States Fish and Wildlife Service (USFWS)

	mitigation responsibilities contained in HCPs, 2) to fund land acquisitions that have important benefits for listed and candidate species, and 3) to fund land acquisitions that have important benefits for ecosystems that support listed and candidate species.	
Continuing Authorities Program (CAP) Aquatic Ecosystem Restoration	The USACE can conduct studies and implementation under this program which is for smaller scale aquatic ecosystem restoration projects. Constraints on this program are a national program limit of 50 million per year and a per project Federal ceiling of 5 Million per project. Projects are cost shared 65% Federal/35% non-Federal. Projects can range from freshwater riparian to freshwater wetlands to small stream and river restoration actions. This program also applies to shoreline restoration, salt marsh restoration, and other actions in brackish and saltier waters.	U.S. Army Corps of Engineers (USACE)
CAP Beneficial Use of Dredged Material	The purpose of this authority is to carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging for construction, operation, or maintenance by the Secretary of an authorized navigation project. The national program limit is 15 million and there is no per project limit. Projects are cost shared 75% Federal/25% non-federal.	U.S. Army Corps of Engineers (USACE)
National Estuary Habitat Restoration Program	National Estuary Habitat Restoration Program gave the USACE authority to conduct small estuary habitat restoration projects. This program is driven by interagency collaboration and the local sponsor's initiating the effort via an application or proposal they submit to start the	U.S. Army Corps of Engineers (USACE)

	process. One SAV restoration has already been implemented under this program by USACE Norfolk District. Federal share cannot exceed 65 % of the total project cost. This is a very small program with very minimal funding.	
CAP Project Modifications for the Improvement of the Quality of the Environment	CAP Project Modifications for the Improvement of the Quality of the Environment gave the USACE authority to revisit past USACE projects and see if there are improvements which can be made to help the aquatic ecosystem in the old project area. Constraint on this program are a National program ceiling of 40 Million per year and a per project ceiling of 5 Million Federal. Projects are cost shared 75% Federal/25% non-federal and can range from freshwater to saltwater. USACE Baltimore District has implemented several 1135 projects in the bay Watershed ranging from fish passage projects to wetlands restoration to drought flow projects for rivers.	U.S. Army Corps of Engineers (USACE)
The USACE Construction General Program (CG Program)	The USACE Construction General Program is how all of our smaller CAP projects are funded as well as the only vehicle for the construction of large scale restoration projects such as Poplar Island.	U.S. Army Corps of Engineers (USACE)
Chesapeake Bay Environmental Restoration and Protection Program	This program provides environmental assistance to non-Federal interests in the Chesapeake Bay watershed in the form of design and construction for water-related environmental infrastructure and resource protection and development projects affecting the Chesapeake estuary, including projects for sediment and erosion control, protection of eroding shorelines, wastewater treatment and	U.S. Army Corps of Engineers (USACE)

	related facilities, beneficial uses of dredged material, restoration of submerged aquatic vegetation, and other related purposes that enhance the living resources of the estuary. The program is cost-shared 75 percent federally funded and 25 percent non-Federally funded.	
Estuary Restoration Act	The Estuary Restoration Act was passed into law in November of 2000, and makes restoring our estuaries a national priority. The interagency Council implementing the Act published a Strategy in December of 2002, with the goal of restoring one million acres of estuarine habitat by the year 2010. Progress toward the goal is being tracked via NOAA's National Estuaries Restoration Inventory. Representatives from the National Oceanic and Atmospheric Administration, Department of the Interior, Environmental Protection Agency, U.S. Department of Agriculture, and U.S. Army work together to implement the Act.	
Magnuson Stevens Reauthorization Act (Essential Fish Habitat)	NOAA Fisheries, regional Fishery Management Councils, and Federal and state agencies work together to address habitat threats by identifying Essential Fish Habitat (EFH) for each federally managed fish species and developing conservation measures to protect and enhance these habitats.	
Federal Power Act (FPA)	Under FPA the Federal Energy Regulatory Commission (FERC) uses its authority to exercise jurisdiction over hydropower projects, but also over hydrokinetic (wave, tidal, current) ocean energy development of projects through the issuance of preliminary permits for pre-licensing activities in coastal and offshore	

	waters. FPA also grants NMFS the authority to prescribe fishways and to propose conservation measures to address any adverse effects to fish and wildlife resources at projects licensed by FERC.	
Energy Policy Act (traditional and renewable energy projects)	Requires the Departments of Commerce, the Interior, and Agriculture to conduct trial-type hearings for disputed issues of material fact raised by the permit applicant or other parties involved in the project concerning the Departments' FPA prescriptions and conditions. It also created a new opportunity for interested parties to submit proposed alternatives to the Departments' conditions and prescriptions, which triggers a requirement for the Departments to analyze the effects of their prescriptions and conditions and all submitted alternatives on non-resource related issues (e.g., energy supply, water supply, flood control, air quality).	
Marine Debris Research, Prevention, and Reduction Act (marine debris and derelict fishing gear)	Legally establishes the NOAA Marine Debris Program. The Act sets a $10M authorization for NOAA for implementation of the program, including mapping, identification, and impact assessments, removal and prevention activities, research and development of alternatives to gear posing threats to the marine environment, and outreach activities. The Act also re-establishes the Interagency Marine Debris Coordinating Committee which NOAA co-chairs.	
USFWS Partners for Fish and Wildlife Program	The Partners for Fish & Wildlife program restores, improves, and protects fish and wildlife habitat on private lands through alliances	

	between the U.S. Fish and Wildlife Service, other organizations, and individuals, while leaving the land in private ownership.	
USFWS Coastal Program	The Coastal Program focuses the U.S. Fish and Wildlife Service's efforts in bays, estuaries and watersheds around the U.S. coastline. The purpose of the Coastal Program is to conserve fish and wildlife and their habitats to support healthy coastal ecosystems. The Service provides funding through the program to 22 high-priority coastal ecosystems.	
USDA Wetlands Reserve Program	The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.	

Appendix C: Current State and Non-governmental Chesapeake Bay Habitat Protection Programs

Program Name	Brief Description	Organization
GreenPrint Maryland	Uses color-coded maps, information layers, and aerial photography to show the relative ecological importance of every parcel of land in the state. The web-enabled tool applies the best environmental science and geographic information systems to the work of	Maryland Department of Natural Resources (MDDNR)

	preserving and protecting environmentally critical lands. The system informs land conservation decisions and works to build a broad, informed public consensus for sustainable growth and land preservation decisions.	
Virginia Conservation Lands Needs Assessment	The VCLNA is a tool for integrating and coordinating the needs and strategies of different conservation interests, using GIS (Geographic Information System) to model and map land conservation priorities and actions in Virginia. The VCLNA allows the manipulation of issue-specific data sets that can be weighted and overlaid to reflect the needs and concerns of a variety of conservation partners.	Virginia Department of Conservation and Recreation (VADCR)
Pennsylvania Conservation Landscape Initiative	Several state agencies, local governments, nonprofits, and other groups have collaborated to drive strategic investment and actions around sustainability, conservation, community revitalization, and recreational projects. Currently with seven landscapes are working within this collaborative framework; the landscapes hold several qualities in common, including a presence of lands held by the Pennsylvania Department of Conservation and Natural Resources.	Pennsylvania Department of Conservation and Natural Resources (PaDCNR)
Maryland Heritage Areas	Locally designated and state-certified regions where public and private partners make commitments to preserving historical, cultural, and natural resources for sustainable economic development through heritage tourism.	Maryland Heritage Areas Authority (MHAA)
Pennsylvania Heritage Areas	State Heritage Areas are officially designated landscapes with distinctive regional assets that cultivate community and economic development, encourage tourism, and develop recreational and cultural activities. The program is a key component of the state's tourism industry, and is administered by the Pennsylvania Department of Conservation and Natural Resources in conjunction with an	Pennsylvania Department of Conservation and Natural Resources (PaDCNR)

	interagency task force.	
Resource Lands Assessment (RLA)	Provides a regional multi-state look at the most important remaining resource lands in the Chesapeake Bay watershed. The RLA uses Geographic Information Systems (GIS) models and expert knowledge to assess the value of resource lands within the watershed to: 1) Provide guidance to state and local government in land protection strategy development. 2) Serve as an information resource for the land trust community. 3) Suggest conservation focus areas to complement watershed restoration plans. 4) Identify areas important to maintain for the forest products industry.	Chesapeake Bay Program (CBP)
Maryland's Green Infrastructure Assessment	The Maryland Department of Natural Resources is working to identify those undeveloped lands most critical to the state's long-term ecological health. These lands, referred to as Maryland's green infrastructure, provide the natural foundation needed to support diverse plant and animal populations, and enable valuable natural processes like filtering water and cleaning the air to take place. As urban and exurban development eliminate and fragment our remaining natural lands, it is critical to identify and focus protection on those areas we can least afford to lose. Identification and prioritization of the green infrastructure is an ongoing process, as newer data and improved methodologies become available.	Maryland Department of Natural Resources (MDDNR)
River Conservation Plans	Developed to conserve and enhance river resources through preparation and accomplishment of locally initiated plans. The program provides technical and financial assistance to municipalities and river support groups to carry out planning, implementation, acquisition, and development activities. A registry is established to recognize local river conservation efforts.	State agencies

State Wildlife Grants	The State Wildlife Grants Program provides federal grant funds for developing and implementing programs that benefit wildlife and their habitats, including species not hunted or fished. Priority is placed on projects that benefit species of greatest conservation concern.	State agencies
Maryland Critical Areas Program	The Critical Area Law requires that each local jurisdiction identify and provide for the establishment, preservation, and maintenance of Habitat Protection Areas. These areas include: a naturally vegetated 100-foot buffer (the Buffer); non-tidal wetlands; the habitats of threatened and endangered species, and species in need of conservation, and their habitat; significant plant and wildlife habitat; and, anadromous fish-spawning areas.	Maryland Department of Natural Resources (MDDNR)
Virginia Chesapeake Bay Protection Act, *Virginia healthy waters cleanup plan, and Virginia Tributary Strategies*	The Virginia General Assembly enacted the Chesapeake Bay Preservation Act in 1988. The Act is a critical element of Virginia's multifaceted response to the Chesapeake Bay Agreement. The Regulations address non-point source pollution by identifying and protecting certain lands called Chesapeake Bay Preservation Areas. The Regulations use a resource-based approach that recognizes differences between various land forms and treats them differently. The lands that make up Chesapeake Bay Preservation Areas are those that have the potential to impact water quality most directly.	Virginia Department of Conservation and Recreation (VADCR)
Virginia protected lands	Virginia allows an income tax credit for 40 percent of the value of donated land or conservation easements. Taxpayers may use up to $100,000 per year for the year of sale and the ten subsequent tax years. Unused credits may be sold, allowing individuals with little or no Virginia income tax burden to take advantage of this benefit.	VADCR, Virginia Land Conservation Foundation (VLCF)
Protected MD lands	Easements typically set out certain activities that are prohibited, such as	Maryland Department

	commercial uses, draining and filling of wetlands, subdivision, etc., while also clarifying the rights retained by the landowner, such as the right to residential, agricultural uses, and the right to maintain, repair and replace existing homes, barns, garages or other structures. A central purpose of easements is to limit or prohibit residential, commercial, and industrial development, while typically allowing agricultural, horticultural and forestry uses. The primary goal is to protect the property and preserve it in its current state while not interfering with the landowner's current uses of the property.	of Natural Resources (MDDNR)
Stronghold watersheds MD	Maryland Stronghold Watersheds Program defines priority areas for biodiversity protection. Stronghold watersheds are the places where rare, threatened, or endangered freshwater fish, amphibians, reptiles, or mussel species have the highest numbers (abundance and number of occurrences). Special protection of these watersheds is necessary to ensure the persistence of these imperiled fauna.	Maryland Department of Natural Resources (MDDNR)
Important Bird Areas Program (IBA)	This program is a global effort to identify and conserve areas that are vital to birds and other biodiversity. By working with Audubon chapters, landowners, public agencies, community groups, and other non-profits, Audubon endeavors to interest and activate a broad network of supporters to ensure that all Important Bird Areas are properly managed and conserved. This program recognizes that coupled with global warming, habitat loss and fragmentation are the most serious threats facing populations of birds across America and around the world. By working to identify and implement conservation strategies at Important Bird Areas, we hope to minimize the effects that habitat loss and degradation have on birds and other biodiversity.	National Audubon Society