PLANNING METHODS FOR ECOREGIONAL TARGETS: ESTUARINE, COASTAL AND MARINE*

Target Selection

The identification of estuarine, coastal and marine conservation targets in the Chesapeake Bay Lowlands ecoregion, and Significant Conservation Areas (SCA's) that collectively captured the conservation targets, was influenced by four factors: 1) the size and scope of the area covered by tidal waters; 2) the goal of including representative occurrences of all of the estuarine, coastal and marine biodiversity characteristic of the ecoregion; 3) the significance of the region for migratory land birds, water birds, and waterfowl, as well as for spawning populations of fish; 4) a general absence of *rare* estuarine, coastal and marine species or communities in the ecoregion.

Tidal waters cover about 20% of the CBY ecoregion, and the ecological diversity within these marine and estuarine systems is impressive. The Chesapeake Bay mainstem spans about 200 miles from the mouth of the Susquehanna River to its connection with the Atlantic Ocean, making it the largest estuary in North America. The Bay also has the largest drainage basin on the eastern seaboard, receiving freshwater flow from over 64,000 square miles of land. On average the Chesapeake Bay holds more than 15 trillion gallons of water (EPA Chesapeake Bay Program 2000). A dozen major rivers empty into the mainstem Bay, along with hundreds of smaller rivers and creeks. Thousands of embayments, ranging from a few acres to tens of thousands of acres, line the shores of the Bay and its tributaries, producing a total length of Bay shoreline that has been estimated to be 11,684 miles (EPA Chesapeake Bay Program 2000). Moreover, the ecoregion also encompasses the entire Atlantic coastline of the Delmarva Peninsula, from the mouth of Delaware Bay on the north, to the confluence of the Bay and the Atlantic to the south. This 175-mile stretch of barrier islands, back bays and coastal saltmarsh systems contributes numerous marine-influenced species and habitats to the ecoregion, which is otherwise dominated by the estuarine systems found in and along the mainstem of the Chesapeake Bay.

The Chesapeake Bay has been widely recognized as the home of abundant blue crabs, oysters, and rockfish, and for its large expanses of tidal wetlands. The region is also known for its extensive coastal habitats (beaches, tidal flats, etc.) rich in food resources important to migrating birds in the Atlantic Flyway (e.g., Watts 1999). In addition, millions of ducks, geese, swans and other birds overwinter on the temperate shores of the Bay and the Atlantic Ocean (Watt 1999, Funderburk et al. 1992). The Chesapeake's tidal tributaries also provide important spawning and nursery sites for several species of fish, such as white perch, striped bass, herring and shad (MD Dept. Natural Resources 2000; Olney 1991; EPA 2000). Finally, an important source of primary productivity in the Bay, and a source of both food and physical habitat for many animal species - vertebrate or invertebrate, resident or migratory - is submerged aquatic vegetation (SAV), found in beds of a few acres to several thousand acres in shallow waters along the Bay's edge.

Our conservation planning approach for estuarine, coastal and marine biodiversity in the Chesapeake Bay Lowlands ecoregion was deliberately modeled on, and informed by, the ecoregional plan done by Mike Beck (Dir., Coastal Waters Program) for the Northern Gulf of Mexico (Beck 2000, Beck and Odaya 2001). Following this earlier lead, we first focused on

* Jasinski, P. 2002. Planning methods for ecoregional targets: Estuarine, Coastal and Marine. The Nature Conservancy, Mid-Atlantic Division, Charlottesville, VA

estuarine/marine "habitats" as conservation targets (Table 1), under the presumption that conservation of a good representation of these habitat types in the Bay and coastal bays would adequately protect the diversity of species found in tidal waters in the ecoregion. As Beck (2000) points out, estuarine/marine habitats are generally classified more coarsely than terrestrial vegetation communities, and may be defined by either dominant vegetation (e.g., SAV beds) or animal species (e.g., oyster reefs). Using estuarine/marine habitats as conservation targets, then, should result in the inclusion of a much larger number of similar but distinct natural community types, in addition to all of their associated species. This approach is completely analogous to using matrix forest blocks to capture common species and functional occurrences of widespread natural community types on land.

Table ecm1. Estuarine, Coastal & Marine Conservation Targets

Habitats: Tidal wetlands (all salinity zones)
Submerged aquatic vegetation
Sandy beaches and bars
Tidal flats
Species: Eastern oyster (*Crassostrea virginica*)
Blue crab (*Callinectes sapidus*)
Hard clam (*Mercenaria mercenaria*)
Soft clam (*Mya arenaria*)
Striped bass or Rockfish (*Morone saxatilis*)
Shad and River Herrings:
American shad (*Alosa sapidissima*)
Hickory shad (*Alosa mediocris*)
Alewife (*Alosa pseudoharengus*)
Blueback herring (*Alosa aestivalis*)
Yellow perch (*Perca flavescens*)
Atlantic loggerhead sea turtle (*Caretta c. Caretta*)
Colonial nesting waterbirds (e.g., great blue heron, snowy egret, great egret, little blue heron, green-backed heron, and black-crowned night heron)
Waterfowl aggregations (e.g., canvasback, pintail, scoters, ruddy ducks, tundra swans, and wood ducks)

Note that tidal marshes, swamps and other wetlands were combined for analysis into one "habitat" type, as opposed to separating out fresh and saltwater systems as was done in the Northern Gulf of Mexico plan (Beck 2000). Given the salinity gradient present in the Bay and most of its tributaries, and a significant seasonal migration of salinity zones up and down the Bay that varies with freshwater flow (**(ref?)**), defining particular wetlands as fresh, brackish or saline, and drawing boundary lines between them, is problematic (a constraint that was evident in some of the available tidal wetlands data layers). By stratifying SCA's along the north-south axis of the mainstem Bay (below), and including areas along the Atlantic back bays, we captured tidal marshes and swamps representative of the full range of variation (fresh, brackish, saline) present in the ecoregion

Our designation of species conservation targets in CBY (Table ecm1) differed somewhat from the Northern Gulf of Mexico work, for a couple of reasons. First, there are very few rare estuarine/ marine animal species in the CBY ecoregion, and those that do occur either occur on land and are geographically restricted (e.g., piping plovers and sea turtles on Atlantic beaches only) or lack sufficient occurrence records (e.g., sturgeon) to be useful for site selection analyses. (Note: good element occurrence data exists for most of the estuarine and coastal rare plant species in the ecoregion, so these targets were covered in the Species Target portion of the plan.) Second, the abundance of distribution data that was available for some of the more common and characteristic species in the Bay allowed us to add that information to the data on habitats, and do a more comprehensive analysis.

With considerable input and feedback from experts (see below) we settled on ten species or species categories that represent: a) species that are critical to the functioning of Bay ecosystems (e.g., oysters & clams); b) keystone species for important Bay ecosystems (e.g., blue crabs as significant benthic predators); c) species whose life history includes activity in multiple ecosystems, and which therefore provide indirect assessments of the state of those systems and the connectivity between (e.g., anadromous fish, waterbirds, waterfowl). Individually and together, many of the targets are "indicator" species whose presence and abundance indicates good water quality, intact and functional ecological processes, and appropriate trophic structure. Note that most of the targets are both commercially and recreationally harvested in the Bay and coastal bays, which explains why occurrence and/or distribution data were available for many of them. The targets are also some of the best known, most "characteristic" species in the Bay, for the same reason. Detailed descriptions of all of the estuarine, coastal and marine conservation targets are presented in Appendix ECM1.

The list of CBY estuarine, coastal and marine conservation targets was modified during the planning process, as a result of feedback from experts, and constraints imposed by data availability. Several targets initially considered were not included on the final list because: 1) there was a scarcity of geospatial or other data; 2) they were covered in the Aquatic Communities (i.e., freshwater systems) portion of the planning process, or; 3) they were covered through the Species Target portion of the plan (i.e., there were Element Occurrences in state BCD's). For example, the diamondback terrapin (G4) was initially considered as a conservation target, as the species is state-listed in Maryland. But the only data available for terrapins comes from one river system in Maryland, and using that limited information would have provided a biased and inaccurate picture of the distribution of the animal in the ecoregion. However, we are fairly confident that diamondback terrapins were still captured in the portfolio, since their preferred habitats of sandy beaches (for nesting) and wetlands (for feeding) were identified as conservation targets.

Horseshoe crabs, found throughout the Bay and coastal region, were also initially considered as a conservation target. But there is almost no data on important nesting grounds within the ecoregion, and experts had very little information on what represented preferred foraging habitat for horseshoe crabs. Some of the Significant Conservation Areas identified here likely provide both nesting and feeding habitat for horseshoe crabs, but additional field work would be necessary to confirm that assumption. Atlantic and shortnose sturgeon were also offered as conservation targets by several experts, since they were once abundant in the Bay. But neither species has rebounded from overfishing earlier in this century, and beyond some recent, fairly limited restocking programs, both are mostly absent from the Bay. Experts provided information on bottom types and historical spawning grounds that were important to this species and could provide restoration opportunities. This information was evaluated in the identification of SCAs, so that if a site was already under consideration for other reasons it was given additional weight as potential sturgeon habitat.

Another species that was considered as a target is menhaden (*Brevoortia tyrannus*). This fish is one of the most ecologically important fishery species in the Bay. Menhaden have been a key component in the diets of striped bass, birds of prey, and waterfowl. Although, while menhaden populations in Chesapeake Bay were once legendary, today they are almost non-existent due to extensive over-fishing. No other Chesapeake Bay fish can take its place in the ecosystem (Franklin 2001). As filter feeding fish, schools of menhaden consume large quantities of phytoplankton, or algae. This helps control outbreaks of harmful algal blooms. The menhaden catch in 2000 was the second lowest catch in 60 years (Franklin 2001). Schools of menhaden move based on food availability, therefore mapping preferred habitat is difficult. Therefore it was excluded as a target species. However, even though menhaden are not anadromous fish, the juveniles tend to use the same brackish upstream nursery areas as young shads and herrings (Lippson and Lippson 1984). For that reason we feel confident that our SCAs capture areas that are also important to this valuable species.

Data Assembly and Viability Analysis

In order to identify a network of "significant conservation areas" (SCA's) that, taken together, would capture a representative and sufficient sample of the conservation targets, data (generally, spatially referenced polygons in GIS) on the distribution of conservation targets were collected from a variety of sources (Table ecm2) and mapped for the ecoregion (Map 16). The Chesapeake Bay is one of the best-studied estuaries in the world, with a wealth of available data. There are numerous state, federal, and research agencies currently doing research and restoration work within the ecoregion. State agencies within Maryland and Virginia supplied a substantial amount of data for this project, most of which is publicly available. Specifically, Maryland Department of Natural Resources (DNR) and the Virginia Institute of Marine Science (VIMS) provided much of the information on Chesapeake Bay targets. The Environmental Protection Agency (EPA), its Chesapeake Bay Program Office (CBPO), the US Geological Survey (USGS) and the National Oceanographic and Atmospheric Administration (NOAA) through its Chesapeake Bay Office provided several region-wide databases.

The Geographic Information System (GIS) software utilized for this project was ArcView 3.1, along with various extensions. Spatial Analyst v 1.1 was also used to develop spatial relationships among the various targets and to ensure spatial variability among SCAs.

Table ecm2. Sources for estuarine, coastal & marine target data in CBY

Data Type	Data Source	Contact info or URL
Maryland wetlands	MD Dept. Natural Resources Quarter quads on CD-ROM, updated on a rolling schedule (roughly 1990-	Bill Burgess, (410) 260-8755

	1998)	
Virginia tidal wetlands	Virginia Inst. Marine Science Survey done by county, rolling updates (roughly 1985-1999)	Marcia Berman, (804) 684-7188
National Wetlands Inventory	US Fish and Wildlife Service	http://www.fws.gov/nwi
Maryland natural oyster beds	MD Dept. Natural Resources	Bill Burgess, (410) 260-8755
Maryland Artificial Reefs	MD Dept. Natural Resources	Bill Burgess, (410) 260-8755
Virginia Oyster Reefs	Virginia Marine Resources Commission (VMRC)	Jerry Showalter (VMRC), (757) 247-2225 or Jim Wesson, (757) 247-2121.
Virginia Leased Bottom	Virginia Inst. Marine Science, and Virginia Marine Resources Commission	Marcia Berman, (804) 684-7188 or Jerry Showalter (VMRC), (757) 247-2225
Maryland waterfowl	MD Dept. Natural Resources, Component of the Sensitive Species Project Review Areas (SSPRA) coverage	Anne Williams and Lynn Davidson (410) 260-8700
Virginia Waterfowl	Surveys provided by Barry Truitt, John Porter (Uva), and VA DGIF	Barry Truitt, Va. Coast Reserve(757) 442-3049 John Porter, (757) 331-4323
Water quality-Potomac	ICPRB- Summary paper Expert input on localized Potomac resources	Claire Buchanan, ICPRB (301) 984-1908
Bay wide water quality	EPA Chesapeake Bay Prog.	David Jasinski, (410) 267-5700
Chesapeake Bay interpolator (1m x 1m grid)	EPA Chesapeake Bay Program	David Jasinski, (410) 267-5700
Multi-resolution Land Cover	EPA, Region III	http://www.epa.gov
1995 National Shellfish Register	NOAA	Distributed on CD-ROM, visit http://state_of_coast.noaa.gov
Rivers, counties, states	ESRI	http://www.esri.com
RF3 Stream coverage	EPA	http://www.epa.gov
Submerged aquatic vegetation Restoration Goals (Tiers I-III)	EPA, Chesapeake Bay Prog.	Brian Burch, (410) 267-5700
Submerged aquatic vegetation (SAV)- Annual coverages 1973-2000	Virginia Inst. Marine Science	http://www.vims.edu Dave Wilcox, (804) 684-7088
Blue crab distributions Settlement SAV beds Migration corridor Overwintering areas Male/female distributions	Virginia Inst. Marine Science, expert consultation based on biological and physical parameters	Rom Lipcius, (804) 684-7330
Fish passage/blockage database	Chesapeake Bay Program	Howard Weinberg (410) 267-5700
Environmental Sensitivity Index (ESI), shoreline composition and species distribution for Chesapeake Bay and Delaware Bay	NOAA	http://www.noaa.gov

Sensitive Areas	EPA, Region III	http://www.epa.gov Steve Jarvela, (814) 566-3259
Poultry houses in the Chesapeake Bay watershed	USGS, West Virginia	http://www.usgs.gov
Distribution of spawning and nursery habitat for migratory fishes in Maryland	Maryland DNR	Jim Mauer or Drew Koslow, (410) 260-8635
Legally defined striped bass spawning areas	DNR	Jim Mauer or Drew Koslow, (410) 260-8635
Distribution of spawning fish habitat in Virginia	VIMS, trawl survey	Herb Austin (804) 684-7000

Identification and mapping of SCA's in the Bay and coastal bays for this Plan was accomplished through three interdependent approaches: 1) spatial analysis of overlays of distributional data for all conservation targets (Map 16); 2) a "condition analysis" using water quality data to assess the "viability" (habitat quality) of SCA's; 3) expert opinion feedback, using both individual interviews and group workshops. Each of these approaches is discussed in more detail below.

Spatial Analysis

Once available data layers for conservation targets had been assembled and mapped, draft SCA's were designated using one or more of three criteria: 1) areas of high target diversity; 2) areas of unique diversity; 3) stratification along the dominant gradient in the Bay, from freshwater in the north to brackish/saline water in the south, and between the western and eastern shores (especially for widely distributed targets). Stratification accomplishes at least three objectives: 1) it maximizes the likelihood of capturing all of the targets; 2) it increases the representation of genetic variation within species captured at geographically distinct portfolio sites; 3) it increases the likelihood of retaining viable occurrences in the portfolio over time, since local catastrophes are expected to eliminate local populations of one or more targets, but replicate occurrences elsewhere will survive. These criteria were evaluated qualitatively rather than quantitatively for the most part, using maps primarily at 1:24,000 scale, and initial SCA boundaries were approximate. The identification and mapping process was iterative over several months, as new target data layers were obtained and included, as the results of the condition analysis (below) were incorporated into the selection process, and as information came in from experts familiar with the targets and the sites.

Condition Analysis

We performed a condition analysis of the Chesapeake Bay as a way of filtering poor-quality occurrences from the collection of potential conservation areas. All else equal, an area encompassing a good diversity of conservation targets and with high water quality, would be chosen for the portfolio over an equally diverse area with poor water quality. To do the condition analysis, we used the US EPA Chesapeake Bay Program monitoring segments. This monitoring scheme segments the Chesapeake Bay and its tributaries into 82 different segments (Map 17), although the Chesapeake Bay Program only routinely sponsors monitoring at 162 stations within 72 of these segments (Map 17). Thirty-three of these segments were classified as mesohaline, 18 as oligohaline, 7 as polyhaline, and 14 as tidal fresh. The Chesapeake Bay Program developed this segmentation scheme to divide the Bay and its tributaries by salinity regime, and therefore similar hydrodynamic characteristics.

Salinity was chosen as a stratifier because salt content plays such a large role in determining community structure and processes within the estuary. The segmentation scheme is also a well-established standard used by many cooperating estuarine researchers throughout the Bay system. The Chesapeake Bay ranges from polyhaline (~35 ppt) near its mouth to tidal fresh in the upper reaches of most tributaries and near the mouth of the Susquehanna. The Atlantic coastline is largely polyhaline, while most of the coastal bays and inlets generally have slightly lower salinities (25 ppt and above). However, due to the lack of available water quality monitoring data for the Atlantic coastal region within CBY, the condition analysis did not include the Atlantic coastal bays and shoreline.

The condition analysis examined the status and trends for the following eight parameters: total suspended solids (TSS), Secchi depth, percent light at leaf (PLL), dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), chlorophyll a, bottom dissolved oxygen, and surface dissolved oxygen. The Chesapeake Bay Program has developed a number of water quality criteria, based on these parameters, to assess the status of estuarine habitat. For example, levels of bottom dissolved oxygen (DO) along the Bay's bottom are critical to many benthic and pelagic species (e.g., oysters, striped bass, and blue crabs; EPA Chesapeake Bay Program 1999). The Chesapeake Bay Program has established a limit of 3.0 mg/L as the minimum acceptable level for bottom waters during the summer months (Funderburk et al. 1992). Although bottom levels of DO tend to be the lowest, water column levels of DO are important to most estuarine species of plants and animals. Many of the Bay's important fishery species (yellow perch, alewife, shad, blueback herring, striped bass) require at least 5.0 mg/L of DO in the water column or they will become stressed (Funderburk et al. 1992).

Levels of the nutrients nitrogen and phosphorus are very important to overall water quality. These nutrients enter the Bay and Atlantic coastal region from the air, land, and Atlantic Ocean. Excess amounts of these nutrients can cause rapid and uncontrollable algal blooms. These blooms cloud water and deprive underwater grasses of sunlight. Additionally, when the algae die they settle out to the bottom. Their decomposition there uses up oxygen needed by other plants and animals, often leading to critically low dissolved oxygen levels.(EPA Chesapeake Bay Program 1999).

Each of the eight water quality parameters is associated with "critical" months, those months when the target level of the parameter is most important to living resources. For most of these parameters, the critical months are between May and September, when most Bay region living resources are active and breeding. Additionally, as water temperatures increase during these months, dissolved oxygen levels in the water column decrease. The condition analysis was run using data only from the critical time periods. To get a better idea of water quality trends, we looked at 3 distinct time periods for comparison purposes. The analysis looked at monitoring results within the 72 segments for 1997 (the latest available data), 1991, and again for 1984-1997 (the entire time period with available data). Experts generally agreed that certain parameters should carry more weight than others, therefore PLL and bottom dissolved oxygen were given additional weight within the ranking analysis (Funderburk et al. 1992, Marcia Olson and Dave Jasinski, pers. comm.). The analysis of these three time periods resulted in a ranking of segments based on how well they met the established thresholds for each parameter. The rankings were also stratified by salinity, so we could analyze which segments in each salinity zone consistently met the criteria.

What resulted were a few segments within each salinity regime that consistently had excellent water quality (Map 17). Although the initial SCA identification was done separately and independently, many of the same areas of the Bay were highlighted by both approaches. This demonstrates the important relationship between water quality and healthy living resources.

The condition analysis was spatially and technically informative, and the results suggested that the information was best incorporated into discussions at each of the expert workshops. In the end however, limitations in the data prevented us from using the analysis either to select conservation areas, or to remove areas from consideration. First, because all water quality parameters were provided by segment, the process could not provide reliable information on systems smaller than a segment. For example, some smaller creeks and rivers may have good water quality, but because they are aggregated with larger tributaries of poorer quality, they may not appear to meet water quality standards. Second, and similarly, some SCA's fell into two different Bay segments, and determining the appropriate parameters to use was unclear. Third, comparable data were not available for the coastal bays along the Atlantic, because the Chesapeake Bay Program doesn't sample there. One could argue that, being different systems, the coastal bays cannot meaningfully be compared to Bay segments, even if water quality data were available.

Expert Opinion

Expert opinion on conservation targets and SCA's were solicited in two ways during the planning process; personal interviews and group workshops. Academic and agency experts were contacted individually (by phone and email) throughout the plan's development for information and feedback regarding conservation targets. Two expert panels were also held to address the selection of conservation targets and Significant Conservation Areas in the Bay and coastal bays. The first was held in Annapolis, Maryland on March 2, 2001 to primarily evaluate areas within Maryland and Delaware waters. On March 15, another meeting was held in Gloucester Point, Virginia (VIMS) to address targets and conservation areas within Virginia waters. A great deal of effort was put into ensuring that experts in all of the appropriate disciplines were represented at these meetings. There were 25-30 experts at each meeting, from various state and federal agencies, academic research laboratories and regional environmental groups (Appendix ECM2, appended to this section). We also met more informally, prior to the expert workshops, with a small group of Chesapeake Bay Foundation scientists to discuss an early draft of our conservation target list and mapped conservation areas.

The experts were asked to evaluate the choice of conservation targets and the data and assumptions being used to select SCA's. In many cases, experts provided valuable feedback on specific site conditions and features, and helped to qualify existing data. For instance, a regional GIS coverage for restored oyster reefs showed the highest density of reefs along the western shore of the Bay in Maryland. Benthic ecologists working in Maryland, however, indicated that none of those projects have been successful. The same experts were able to identify other areas that represented healthier reef systems.

Workshop attendees confirmed the significance of most of the draft SCA's, and also offered justification for additional conservation areas not originally identified. For example, one such area is at the Bay's mouth. This deepwater conservation area was suggested for several reasons. The area is important for over-wintering female blue crabs, it is the primary migration corridor for several species, it is valuable habitat for spawning fish and feeding waterfowl, and it connects with a recently designated Natural Resources Defense Council Priority Ocean Area for Protection (NRDC 2001). The experts also endorsed the idea of having two levels of SCA designations, labeled "Tier 1" and "Tier 2." Tier 1 areas are the best representations of targets and healthy ecosystems. The Tier 2 designation was developed for conservation areas that might already be better represented by a Tier 1 area, but which also provide significant target coverage. The boundaries of a number of draft SCA's were also modified as a result of input from experts at the workshops.

Mike Beck, Director of the Conservancy's Coastal Waters Program, provided considerable insight, advice, information and assistance for the estuarine, coastal and marine portion of the CBY plan. Mike met with working group members several times and consulted periodically via phone and email. He provided relevant literature and expert contact information, as well as many of the slides we used in the introductory presentation made to the experts workshops. He also critically reviewed both early draft and final results of our work.

Finally, a draft version of this section of the ecoregional plan, and the Summary Results (above) was provided to all of the experts who had provided input on estuarine, coastal and marine targets and SCA's during the planning process. Comments, clarifications and suggestions made by experts who reviewed the draft report have been incorporated into the current document.

Conservation Goals

Setting ecoregional conservation goals for species and communities in terrestrial systems (i.e., numbers of populations, or areal extent of a habitat type) remains an emerging discipline. Similarly, the rationale for setting conservation goals for estuarine/marine species and communities is poorly developed (Beck and Odaya 2001). Again following the lead of the Northern Gulf of Mexico plan, we set the conservation goal for Significant Conservation Areas in CBY that they collectively contain at least 20% of the current distribution of each community and species target for the ecoregion (Beck 2000). Studies of marine reserves in fisheries management have suggested that 20% of the area of concern is the minimum necessary to preventing overfishing of the stock, to increase yields, to buffer against population fluctuations, and to provide some connectivity among reserves (NOAA Plan Development Team 1990, National Research Council 1999, Roberts and Hawkins 2000, Chesapeake Bay Commission 2001). Several other studies, on the other hand, have suggested that at least 30% or 40% of the system may need to be included in reserves in order to ensure that all native species or taxa are protected (Turpie et al. 2000, Ward et al. 1999).

As Beck and Odaya (2001) point out, conservation goals would ideally be assessed against historical rather than current distributions of target species and communities. But historical data rarely exist, or are available only in a form (e.g., a paper map) of indeterminable accuracy. Even in the absence of current data, however, historical information is sufficient to tell us that many estuarine, coastal and marine species and communities are far less abundant and widespread today compared to their historical distributions and numbers. Where current distributions are half or less of historical distributions, the 20% goal is an absolute minimum, and much higher coverages should be considered (Groves et al. 2000).

Unfortunately, several CBY targets are far less common now than they once were. Most notably, Eastern oyster (*Crassostrea virginica*) populations within Chesapeake Bay have declined 98% from historical levels (EPA 1999a, Chesapeake Bay Foundation 2000). Once legendary, most

Chesapeake Bay oyster reefs are now the result of ongoing restoration programs. Oyster populations have suffered from over-harvesting, disease, and increased sedimentation within the Bay. Almost as dramatic has been the loss of the Bay region's submerged aquatic vegetation (SAV), which now covers only about 12% of its historical extent (Chesapeake Bay Foundation 2000, EPA Chesapeake Bay Program 1999a). These losses have been largely due to increased nutrient and sediment runoff, including the devastating effects of Tropical Storm Agnes in 1972, which not only flushed many years worth of chemicals and sediment into the Bay, but also significantly reduced salinities for an extended period of time, due to the massive pulse of freshwater that entered the Bay (e.g., EPA Chesapeake Bay Program 1993, other refs).

The loss of SAV beds, as well as fishing pressures and other disturbances, have also recently caused blue crab (*Callinectes sapidus*) populations to drop below 50% of their historical numbers (EPA 1999a, Chesapeake Bay Foundation 2000, Chesapeake Bay Commission 2001). Additionally, anadromous fish species have been significantly affected by overfishing, habitat losses and blockages, and water quality degradation. Their concentrated upstream spawning areas make them easy targets for fishing, and/or subject to the impacts of runoff from farm fields and development. Those stresses, along with the presence of physical blockages (dams, culverts, etc.) on many tributaries that prevent migration to upstream spawning grounds, has resulted in dramatic reductions in most of the region's migratory fish species, such as shad, river herring, and sturgeon.

APPENDIX ECM2: EXPERTS ON ESTUARINE, COASTAL AND MARINE HABITATS AND SPECIES, AND SIGNIFICANT CONSERVATION AREAS, IN THE CBY ECOREGION

Expert	Affiliation
Herb Austin	College of William and Mary Virginia Institute of Marine Science
Mike Beck	Coastal Waters Program The Nature Conservancy
Peter Bergstrom	US Fish and Wildlife Service Chesapeake Bay Field Office
Donald Boesch	University of Maryland – CEES Horn Point Environmental Lab
Dave Brinker	Wildlife and Heritage Division ,MD Dept. of Natural Resources
Gene Burreson	College of William and Mary Virginia Institute of Marine Science
Tom Fisher	Horn Point Lab Univ. of Maryland Center for Environmental Science
Doug Forsell	US Fish and Wildlife Service Chesapeake Bay Field Office
Charles S. Frentz	Oyster Recovery Partnership
Greg Garman	Dept. of Biology Virginia Commonwealth University
Bill Goldsborough	Chesapeake Bay Foundation
Bill Harvey	Wildlife and Heritage Division MD Dept. of Natural Resources
Carl Hershner	College of William and Mary Virginia Institute of Marine Science
Tuck Hines	Smithsonian Environm. Res. Center
Steve Jordan	Fisheries Service MD Dept. Natural Resources
Romuald Lipcius	College of William and Mary Virginia Institute of Marine Science
Mark Luckenbach	Virginia Institute of Marine Science Eastern Shore lab
Maurice Lynch	College of William and Mary Virginia Institute of Marine Science

Roger Mann	College of William and Mary Virginia Institute of Marine Science
Jim McCann	Wildlife and Heritage Division MD Dept. of Natural Resources
Steve McInish	Virginia Commonwealth University
Ken Moore	College of William and Mary Virginia Institute of Marine Science
Bob Murphy	University of Maryland Chesapeake Biological Laboratory
Mike Naylor	Resource Assessment Service MD Dept. of Natural Resources
Roger Newell	Horn Point Lab Univ. of Maryland Center for Environmental Science
John Olney	College of William and Mary Virginia Institute of Marine Science
Robert Orth	College of William and Mary Virginia Institute of Marine Science
Richard Osman	Academy of Natural Sciences
Dave Secor	University of Maryland Chesapeake Biological Laboratory
Albert Spells	U.S. Fish and Wildlife Service
Bill Street	Chesapeake Bay Foundation
Barry Truitt	The Nature Conservancy Virginia Coast Reserve
Bryan Watts	College of William and Mary Center for Conservation Biology

RESULTS FOR ESTUARINE, COASTAL AND MARINE CONSERVATION TARGETS*

Portfolio Occurrences

In CBY, we identified 18 Significant Conservation Areas (SCA's) that captured the 14 estuarine, coastal and marine targets (Map 4). The SCA's range in size from 1300 to 262,000 acres (1,276,986 ac total), and occur throughout the salinity gradient in the ecoregion, from freshwater (i.e., Susquehanna) to saline (e.g., Cape Henlopen, Lower Bay, Lower Eastern Shore; Map 4). Eleven SCA's fall all or in part in Virginia (including Nanjemoy and Blackwater/ Bay Islands), while nine occur in Maryland and one occurs in Delaware.

Expert opinion informed and refined the identification of a group of 14 Tier 1, or highest-quality Significant Conservation Areas and a group of four Tier 2, or good-but-lower-ranked SCA's (Map 4, Table ecm3 at end of chapter). The Tier 1 areas, which range in size from 1,300 ac to 262,000 ac (average = 83,000 ac) include 11 within the Chesapeake Bay and three along the Atlantic Coast (Table ecm3, Map 4). These SCA's are well-distributed along both the western and eastern shores of the Bay, in the mouths of major rivers (e.g., 1, 9, 11), in upstream, brackish, tidal water sections of major rivers (e.g., 2, 3, 6, 7), as well as open-water portions of the mainstem Bay (e.g., 8, 10). Individual Tier 1 areas extend into as many as five of the Bay segments identified by the Chesapeake Bay Program, and all of the SCA's together occur in 38 of the 80-odd segments defined for the Bay. Descriptions of each SCA, with maps and lists of the ecoregional targets present, and a brief discussion of major stresses affecting each, are presented below.

The estuarine, coastal and marine habitat targets are abundant in many of the SCA's, but their acreages vary significant among sites (Table ecm3). Among Tier 1 areas, two contain more than 10,000 acres of SAV beds, while seven contain less than 100 ac and four have none. Similarly, tidal marsh cover varies from less than 1,000 acres in five SCA's, to as much as 69,000 ac in the Lower Eastern Shore SCA. Sandy beaches, too, are very abundant in several SCA's but absent from four others. Significant Conservation Areas that captured moderate or high acreages of most of the habitat targets include Nanjemoy Creek and Mid-Potomac River, Blackwater and Bay Islands, and Assateague and Chincoteague. Areas with only low or moderate acreages of two or more of the habitat targets include Dragon Run, the Upper York Complex, Chickahominy River and the Nanticoke River. Note, however, that these latter SCA's are some of the smallest of the entire group (acreages of habitat targets were not standardized for variation in SCA size). Not surprisingly, the Lower Open Bay SCA contains none of the habitat targets, and the Cape Henlopen SCA captures only beach habitat (Table ecm3).

Target habitat acreages among the four Tier 2 SCA's were generally less for SAV and tidal marshes than in Tier 1 sites, but beach habitat was somewhat more abundant in Tier 2 than Tier 1 areas (Table ecm3). The Tier 2 SCA's, though, were only a third the size of the Tier 1 SCA's, on average.

Many of the estuarine, coastal and marine species targets were captured at Medium or High levels in most of the Significant Conservation Areas, both Tier 1 and 2 (Table ecm2). Thirteen of

* Jasinski, P. 2002. Results for Estuarine, Coastal and Marine Conservation Targets. The Nature Conservancy, Mid-Atlantic Division, Charlottesville, VA.

the Tier 1 areas contain populations of at least six of the ten species targets, and four SCA's (Lower York Complex, Nanticoke, Choptank, and Lower Eastern Shore) each captured 8 targets. Two other areas – Upper York Complex and Nanjemoy Creek – contain 7 targets each, and in the latter SCA, five of those are at High abundance. The Blackwater and Bay Islands SCA captured only 5 of the ten targets, but shad and herring spawning grounds would not occur in this part of the Bay, and this was is the only SCA in which all of the occurrences are ranked "High." Among Tier 2 SCA's, three of the four contained six of the species targets, and two (Upper Chester and Mattawoman) had four of those occurrences ranked "High" (Table ecm3).

Ignoring oysters and loggerhead turtles, each of the species targets occurred in at least seven SCA's across all Tier 1 sites, and four targets – blue crabs, rockfish, waterfowl aggregations and waterbirds – were captured in 12 or more Tier 1 SCA's (Table ecm3). Across Tier 2 SCA's, six of the ten species targets were found in at least 3 of the four sites.

Descriptions of Significant Conservation Areas

This section provides a description of each Significant Conservation Area identified in the plan, along with the approximate acreage and the habitat and species targets present in that area. In addition, we list and briefly discuss some of the most significant stresses and threats known for each area; this assessment is necessarily qualitative and cursory, and is not meant to be a comprehensive. The information here is based on qualitative evaluation of the data layers for target distributions, as well as expert input and literature reviews (where cited).

Tier 1 Areas

Susquehanna Flats (29,900 acres)

Targets present: Tidal freshwater marshes, freshwater SAV (native and non-native), tidal flats, coarse sand beaches, upstream spawning habitat for shad and herring, striped bass, and yellow perch, waterfowl, and colonial nesting waterbirds.

Major Stresses: Direct losses, sedimentation, eutrophication, exotic species

The Susquehanna Flats region is a wide, shallow region at the mouth of the Susquehanna River. The majority of this area is less than 10 feet deep, while channels from the Northeast and Susquehanna Rivers reach close to 20 feet. SAV beds have increased in size and density over the last several years. In fact, SAV beds present in this region account for over 70% of the SAV in the upper Bay and about 10% of the total Bay (Orth et al. 2000). SAV and tidal wetland plant species present are comprised of species characteristic of the tidal fresh environment. While some exotic species of SAV are present, the size and perseverance of these beds cannot be overlooked. However, exotic species, like Eurasian watermilfoil (*Myriophyllum spicatum*) and Hydrilla (*Hydrilla verticillata*), continue to displace native grasses like Redhead grass (*Potomageton perfoliatus*) and Wild celery (*Vallisneria americana*) (Orth et al. 2000, Carter and Rybicki 1986).

Many anadromous fish species (shad, herring, striped bass, etc) pass through the Susquehanna Flats on their way to northern spawning grounds. The SAV beds found here are active nursery areas for those and other fish and shellfish species. Male blue crabs migrate to this area during the warmer summer months. Coarse sand beaches and wide tidal flats border the area, making it important foraging grounds for fish and birds. A major concern for this area is the high level of both nutrients and sediments washing down the Susquehanna River. Much of this input stems from the high level of agriculture within the Susquehanna watershed. Fortunately, however some of the inputs are countered by the fact that over 60% of the watershed is currently forested (MRLC 1991-1993).

Nanjemoy Creek and Mid-Potomac River (56,100 acres)

Targets present: Tidal freshwater marshes; tidal salt/brackish marshes; tidal flats; SAV; Eastern oyster habitat; blue crabs; shad, herring, yellow perch and striped bass spawning reaches; waterfowl, and colonial nesting waterbirds.

Major Stresses: Toxics, exotics, direct losses

The Nanjemoy Creek watershed per se is largely forested (70%; MRLC, 1991-1993), as is a much larger area along the Potomac River to the west, south and east, helping to control the amount of sediments and nutrients washed into the creek and adjacent river. The upstream portions of Nanjemoy Creek provided historical spawning grounds for alewives, perch, shad, herring, and striped bass. Because unique hard bottom areas are present within this stretch of the Potomac River, sturgeon sightings have been reported from this area; few other areas within the Chesapeake Bay region provide the hard bottom type preferred by sturgeon. Tidal freshwater wetlands and forested shoreline reaches provide good habitat for great blue heron and other waterbirds. The tidal mouth of Nanjemoy Creek has a strong and diverse population of SAV, although some exotic species are present as well. The SAV beds and tidal flats are good feeding grounds for fish and waterbirds. Both male and female blue crabs use this section of the Potomac River during summer months.

The portion of the Potomac River included within this area has recently seen increased numbers of menhaden and other fish. These increases are thought to be associated with improving water quality and healthier communities of phytoplankton and zooplankton. Wastewater treatment plant upgrades, better land use management practices, and increases in SAV within the upstream reaches of the Potomac are likely the reasons for improved water quality.

Blossom Point Proving Grounds is located on the southeastern side of Nanjemoy Creek. It has been associated with high levels of some toxic chemicals within adjacent waters. Another source of concern for this area has been the encroaching development from Waldorf and La Plata.

Upper Rappahannock River (19,000 acres)

Targets present: Tidal brackish marshes, tidal freshwater marshes, tidal flats, blue crabs, spawning reaches for striped bass, shads and herrings, and yellow perches, waterfowl, and colonial nesting waterbirds.

Major Stresses: Direct losses, sedimentation

Consistently high numbers of spawning fish have been recorded in the upper Rappahannock River in recent years, even when numbers were decreasing in other rivers. Striped bass, yellow perch, herring, and shad all spawn within this area. The river is edged with wetlands, both brackish and freshwater, providing habitat, nursery, and feeding grounds to finfish, waterfowl, and colonial nesting waterbirds. During summer months, blue crabs (primarily males) migrate into this area looking for food and refuge. Tidal flats within the area are also home to healthy benthic communities. More than 40 pairs of breeding bald eagles have been reported within this area. The upper Rappahannock provided refuge to bald eagles when populations elsewhere were depressed or extirpated. Although this portion of the river does not have extensive SAV beds, those that are present have increased over the last several years.

Dragon Run (1,300 acres)

Targets present: Tidal freshwater marsh, juvenile and adult striped bass habitat, colonial waterbird aggregations, and waterfowl.

Major Stresses: Eutrophication, sedimentation

The upper portion of the Piankatank River is commonly referred to as Dragon Run. Most of this area is a tidal fresh, forested wetland. The surrounding landscape is relatively undeveloped, with most of the land in the watershed in forest (65%) and agricultural (19%) use. The nature of the landscape attracts colonial nesting waterbirds and many species of waterfowl. Plant and animal communities are very diverse within the area. In summer months, high densities of male blue crabs are often found within this region.

Lower York Complex (Mobjack Bay, Chisman Creek, and Poquoson River) (65,300 acres)

Targets present: salt marshes, SAV, tidal flats, fine grain beaches and bars, blue crabs, oysters, blue crabs, striped bass, hard clam, soft clam, loggerhead sea turtles, waterfowl aggregations, colonial nesting waterbirds.

Major Stresses: Eutrophication, over-harvesting,

The Lower York complex encompasses areas to the north and south of the York River's mouth. The area to the north is referred to as Mobjack Bay and is a polyhaline embayment of the Chesapeake Bay. Several smaller tributaries feed into Mobjack Bay, which is a very productive area. To the south are Chisman Creek and Poquoson River, also polyhaline environments. The entire Lower York complex is home to healthy populations of SAV and tidal wetlands. Because of the extent of SAV beds and location, this area is very important for juvenile blue crab settlement. As blue crab zooea come back into the Bay from the Atlantic, SAV beds provide good nursery habitat and shelter from predators. The beds within this area are in close proximity to the Bay's mouth, and therefore are well utilized by small blue crabs. Male and female blue crabs can be found in this area year-round. The beaches and bars are also very productive feeding and nesting grounds for colonial nesting waterbirds. Despite being well-within disease range, there are several oyster reef restoration projects here. Oysters continue to settle and grow, although most still succumb to disease before reaching commercial size. Oysters, blue crabs, hard and soft clams, and many species of finfish are commercially caught within the Lower York complex. Although there are no reported nests for loggerhead sea turtles within this area, adults can be found here during the summer.

Upper York Complex (Mattaponi and Pamunkey Rivers) (25,800 acres)

Targets present: Tidal freshwater and brackish marshes, tidal flats, blue crabs, spawning reaches for striped bass, yellow perch, and shads and herrings, soft clams, waterfowl and waterbird aggregations.

Major Stresses: Eutrophication, sedimentation, sea level rise

The Upper York complex is a tidal freshwater to oligohaline environment. It is a very productive area for migratory fish, such as striped bass, and shad. Adults and juveniles of these fish species are found in high numbers here. These fish also use these areas as spawning reaches. Both the Mattaponi and Pamunkey Indian Reservations have been very instrumental in shad restoration programs within this area. Tidal freshwater and brackish wetlands are extensive throughout the Upper York complex and provide nursery areas for several species of finfish, blue crabs, and other animals. Primarily male blue crabs are found in this SCA, and they are found here only during summer months. The plant communities within this area are also very diverse, especially within the tidal freshwater marshes. Colonial nesting waterbirds and waterfowl feed within the marshes and along the tidal flats found here.

Chickahominy River (11,200 acres)

Targets present: Tidal freshwater and brackish marshes, blue crabs, spawning reaches for striped bass, shad, herring, and yellow perch, congregations of waterfowl and colonial nesting waterbirds.

Major Stresses: Direct losses, eutrophication, sedimentation

The Chickahominy River watershed is largely forested. The river itself is fringed with tidal freshwater wetlands. The dominant wetland communities include arrow arum and pickerelweed, yellow pond lily, and very diverse freshwater mixed plant communities. The Chickahominy system is important for migratory fish, such as striped bass, shad, herring, and yellow perch. Adjacent tidal wetlands attract and provide home for many species of waterfowl and migratory songbirds. Male blue crabs are found here during the warmer summer months.

The proximity of Richmond, Virginia to this area has led to increasing development pressures on the system. Development within the watershed has also increased sediment and nutrient loadings to the river.

Lower Open Bay (179,400 acres)

Targets present: Blue crabs, striped bass, hard clam, loggerhead sea turtles.

Major Stresses: Over-harvesting, sedimentation, eutrophication

This area is important to the life cycle of blue crabs, as well as other Bay species, both target and non-target. It is used as a migration corridor for blue crabs as they re-enter the Bay as zoeae. It includes important over-wintering grounds for female crabs, which also migrate into this area to spawn. Because it is well-known that female blue crabs over-winter here, the area is targeted for winter dredging operations. These efforts have greatly reduced the numbers of female blue crabs left for spawning. This area is also important for sea turtles migrating up and down the Atlantic coast, which enter the Chesapeake through this area. Menhaden, croaker, spot, weakfish, and summer flounder also use this area as spawning grounds (Natural Resources Defense Council 2001). Hard clams can be found within this SCA.

Nanticoke River (17,700 acres)

Targets present: Tidal brackish and freshwater marshes, tidal flats, coarse sand beaches, blue crabs, oysters, hard clam, soft clam, spawning reaches for striped bass, yellow perch, and shads and herrings, waterfowl aggregations and colonial nesting waterbirds.

Major Stresses: Eutrophication, sedimentation, over-harvesting, direct losses

The upstream portions of the Nanticoke River are important spawning and nursery grounds for many species of migratory fish. The river is also year-round home to blue crabs, male and female. Although the river has almost no SAV, it still provides productive feeding and habitat grounds for waterfowl, fish, and shellfish. Hard and soft clams are found within the Nanticoke River. The coarse sandy beaches also provide nesting and feeding habitat for waterbirds. Waterfowl are found within this SCA feeding on small fish and clams.

The Nanticoke River watershed is about 43% agricultural land. Sediment, fertilizers and pesticides drain from agricultural lands into the Nanticoke River causing eutrophication, decreased water clarity, and other problems for its estuarine plant and animal communities. Much of the Eastern Shore is currently experiencing rapid development due to sprawl from Western Shore urban centers, such as Annapolis and Baltimore. The Nanticoke watershed in Delaware is under increasing development pressure, especially on agricultural and forested lands.

Blackwater and Bay Islands (135,700 acres)

Targets present: Tidal salt marsh, tidal brackish wetlands, SAV, tidal flats, beaches and bars, oysters, hard clam, waterfowl, colonial nesting waterbirds.

Major Stresses: Sea level rise, over-harvesting, sedimentation

The vast expanses of tidal marshes in lower Dorchester County, Maryland, as well as the string of bay islands to the south (which are fringed by brackish marshes), are rapidly eroding. The marshes and islands are eroding due to a combination of natural geologic processes (esp., land subsidence), sea level rise, and altered sediment regimes imposed by man-made structures. The tidal marshes have also been severely impacted by nutria, an exotic herbivore introduced to the area about xx years ago. Nutria feeding on marsh vegetation may be accelerating the marsh loss caused by physical processes. At current rates, many coastal geologist estimate that these marshes and islands may be lost within the next 50 years. Most of these islands are sparsely developed, if at all, and lack large predators that would prey upon nesting birds. Thus, they provide sanctuary and abundant habitat for waterfowl and colonial nesting waterbirds. The surrounding waters are also rich with shellfish, both clams and oysters. Male and female blue crabs are found in large numbers throughout this SCA, during both summer and winter months. fringe many islands, although erosion and sedimentation are causing decreases in these wetlands.

Choptank River (96,600 acres)

Targets present: Tidal salt and freshwater marshes, SAV, tidal flats, beaches and bars, oysters, blue crabs, soft clams, yellow perch, striped bass, shad, and herring spawning reaches.

Major Stresses: Over-harvesting, sedimentation, eutrophication, exotics

The Choptank River provides important spawning and nursery grounds for finfish. All major anadromous fish species known in the Chesapeake Bay region use the upstream portions for spawning. There are also several oyster reef restoration projects within the Choptank River. Although the river usually has lower levels of oyster spat recruitment than more southern areas, it has higher than average survival rates of oysters. The river is largely outside of the oyster disease range and represents good opportunities for oyster recovery programs. Soft clams can also be found along the Choptank's bottom, often in high densities (Funderburk et al. 1992). Large populations of blue crabs are found throughout the Choptank. Both male and female blue crabs use this area during the summer, although males predominate. Additionally, male blue crabs over-winter within the lower Choptank River (Funderburk et al. 1992). One reason for the large populations of macro-benthics and waterfowl aggregations is the diversity of native SAV species, including widgeon grass (*Ruppia maritima*), sago pondweed (*Potomageton pectinatus*), and horned pondweed (*Zannichellia palustris*) (Orth et al. 2000). The SAV beds draw in large populations of waterfowl. However, over the last two years of monitoring, SAV beds have decreased substantially within the Choptank. This may be due to increased sedimentation and decreased water clarity from agricultural runoff, or coastal development.

Cape Henlopen (19,400 acres)

Targets present: Salt marshes, beaches and bars, tidal flats, striped bass, blue crabs, hard clam, waterfowl, colonial nesting waterbirds.

Major Stresses: **[sea level rise? horsecrab harvesting? overfishing?]**

Beaches, bars, and tidal flats here support diverse populations of shorebirds and waterfowl, and extensive intertidal habitats provide rich feeding grounds for both birds and finfish.. Horseshoe crabs lay eggs throughout Delaware Bay, and millions of migratory waterbirds come to these beaches to feed on that abundant food source. Blue crabs are also found within this SCA, and adult striped bass use the area as a foraging ground.

Assateague and Chincoteague (241,700 acres)

Targets present: Salt marshes, SAV, tidal flats, beaches and bars, oysters, blue crabs, hard clams, waterbirds, loggerhead sea turtles, waterfowl aggregations.

Major Stresses: Eutrophication (from groundwater discharge), over-harvesting, sand starvation

This area captures vast expanses of tidal marshes, shallow coastal bay waters, and barrier island habitats along the Maryland and Virginia eastern shores bordering the Atlantic Ocean. Much of the area is in federal ownership, managed by the US National Park Service. Due to extensive SAV beds throughout the inlets and back bays, fish and loggerhead turtles use the area both for refuge and as foraging grounds. Piping plover and other migratory shorebirds and waterfowl use these beaches as stopovers and nesting areas. Small populations of horseshoe crabs nest on back bay beaches. The bays and inlets also support large populations of blue crabs, which face high fishing pressure. These areas tend to warm up earlier than the Chesapeake Bay itself. Therefore, blue crabs are often active earlier in the season that in the Bay. Hard clams are also found along the sandy bottoms within this SCA.

Ocean City, Maryland is directly to the north of this area. This urban center maintains a jetty that starves the Assateague and Chincoteague beaches of southward migrating sand. This has led to increased rates of beach erosion.

Lower Eastern Shore (262,300 acres)

Targets present: Tidal salt and brackish marsh, tidal flats, beaches and bars, SAV, oysters, blue crabs, hard clams, soft clams, striped bass, waterfowl, colonial nesting waterbirds, hard clams, waterfowl, colonial nesting waterbirds.

Major Stresses: Eutrophication, over-harvesting, sedimentation

Also characterized by vast expanses of coastal bay and barrier island habitats, this area along the Lower Eastern Shore is home to large and diverse colonies of waterbirds, waterfowl, and shellfish. This stretch of Atlantic beach provides stop-over and/or over-wintering grounds for millions of migratory birds. This area has the highest known concentration of piping plover nests in the region (Truitt, pers. comm.). Healthy populations of hard clams, oysters, and blue crabs are also found here, especially within the bays and inlets. Additionally, large concentrations of young loggerhead sea turtles feed and find shelter within the bays and inlets.

Tier 2 Areas

Aberdeen (15,200 acres)

Targets present: Tidal brackish and freshwater marshes, SAV, tidal flats, beach, blue crabs, striped bass, yellow perch, shads and herrings, waterfowl, colonial nesting waterbirds.

Major Stresses: Sedimentation, eutrophication

The Aberdeen area is adjacent to the Aberdeen Proving Grounds property. The shoreline is comprised mainly of tidal brackish-freshwater wetlands and consistently supports high concentrations of waterfowl. Male and female blue crabs are found within this SCA, especially during summer months. Adults and juvenile migratory finfish also use the nearshore habitat within this SCA for foraging and shelter. The area is affected by nutrient and sediment runoff from adjacent land areas.

Upper Chester River (7,600 acres)

Targets present: Tidal freshwater and brackish marshes, SAV, beaches, tidal flats, blue crabs, soft clams, spawning reach for striped bass, yellow perch, shad, herring, and waterfowl.

Major Stresses: Direct losses, sedimentation, eutrophication

The upper Chester provides a year-round home to male blue crabs and is an important spawning river for migratory fish. Large concentrations of waterfowl visit the area to feed within the SAV beds and tidal wetlands. This area represents the northern extent of soft clams and oysters. Both male and female blue crabs are found throughout the Upper Chester. This SCA also represents a probable juvenile and nursery area for menhaden, an ecologically important fish (Funderburk et al. 1992). Although almost 60% of its watershed is used for agricultural purposes, the water quality remains fairly good. However, the area is threatened by increasing development of agricultural and forested lands.

Mattawoman Creek (2,000 acres)

Targets present: Tidal freshwater wetlands, SAV, tidal flats, blue crabs, spawning reaches for striped bass, shads and herrings, and yellow perch, waterfowl, and colonial nesting waterbirds.

Major Stresses: Direct losses, eutrophication, sedimentation, exotics

Mattawoman Creek is a very diverse, tidal freshwater environment. Although being encroached upon by development, it is still productive nursery and habitat for several water-dependent species, including waterfowl, fish, reptiles and mammals. More than 60% of the Mattawoman's watershed is still forested, including many forested wetlands and riparian forest buffers. This SCA represents a refuge to many species of waterfowl and colonial nesting waterbirds. The upstream area is also an active spawning reach for striped bass, shads and herrings, and yellow perch. The major stresses are related to urbanization taking place within the watershed, including sprawl around Waldorf, Maryland.

Pocomoke Sound (90,500 acres)

Targets present: Salt marsh, SAV, tidal flats, beaches/bars, blue crabs, oysters, hard clams, soft clams, waterfowl, colonial nesting waterbird aggregations.

Major Stresses: Eutrophication

Blue crabs congregate within Pocomoke Sound; both sexes and all life stages can be found year-round within this area. Hard and soft clams are also found within this SCA, with soft clams being particularly abundant along the northern border of the area (Funderburk et al. 1992). The shoreline is fringed with abundant SAV and wetlands, attracting water-dependent avian species. About 20% of the watershed area is in agricultural use, which is low for the Eastern Shore, but there are a large number of poultry houses in the watershed. This leads to high levels of nutrients, both nitrogen and phosphorus, entering the river and tidal waters downstream. Many scientists believe that extreme eutrophication in this system led to the *Pfiesteria piscida* outbreaks of 1998. This microorganism causes lethal lesions in finfish, and has numerous effects on humans that come into contact with it in certain life stages.

Progress Towards Goals

The conservation goals (20%) were met or exceeded for all of the habitat conservation targets (Table ecm3). For species targets, our qualitative analysis (Table ecm4) suggest that a considerable proportion of the ecoregional distribution of each species was captured in the 14 Tier 1 sites. Although we cannot assign quantitative values to target species occurrences in SCA's, every Tier 1 area captured at least three species targets, 10 captured Medium or High occurrences of at least four targets, and 11 captured six or more species targets (Low, Medium or High; Table ecm2). Notably, the Tier 2 Significant Conservation Areas also captured at least five species targets each, and several of these areas (e.g., Upper Chester River, Mattawomen Creek) had High abundances of four of the targets (Table ecm3).

Table ECM4: Success towards meeting conservation goals for habitat targets.

Habitats	Baywide Totals	% of Baywide total, all SCA's			20% Goal Met?
		Tier 1 Sites	Tier 2 Sites	Tier 1 and 2 Sites	
SAV	64,689 ac	79%	8%	85%	Yes
Tidal Marsh*	327,365 m^2	34%	2%	36%	Yes
Tidal Flats	Unknown				Assumed
Beach/bar	2,441,369 m^2	17%	6%	23%	Yes
Reefs	33	36%	0	36%	Yes

*Includes tidal salt, brackish, and fresh marshes

Table ecm3. Occurrences of habitat and species targets in Significant Conservation Areas.

Significant Conservation Area (SCA) [1]	Area[2] (acres)	CBP Segments[3]	SAV[4] (acres)	Tidal Wetlands[5] (acres, type)	Tidal Flats[6] (ac)	Beach[7] (m)	Oyster reefs[8] (size)	Blue Crabs	Striped Bass	Shad & herrings	Yellow perch	Hard clams	Soft clams	Logger-head	Water fowl aggreg.	Water birds
Tier 1																
Susquehanna Flats	29,900	CB1 NORTF	5,918	732 tf		68,000	-	Low[9]	Low	Med[9]	Med				High[9]	Med
Nanjemoy Creek and mid-Potomac River	56,100	POTOH POTMH	5,186	2,230 sm, pf		115,000	-	Med	Med	High	High		High		High	High
Upper Rappahannock River	19,000	RPPTF RPPOH	35	121 tf		70,000	-	Low	High	High	High				Med	High
Dragon Run	1,300	PIAMH	0	475 tf, pf	0	171	-		Low						Low	High
Lower York Complex	65,200	YRKPH MOBPH	9,033	980 sm		38,000	1 reef >1,000 yds^3	High	Low			High	Med	Low	Med	Med
Upper York Complex	25,900	YRKMH PMKOH PMKTF MPNOH MPNTF	0	2,500 sm/tf		5370	-	Med	High	High	High		Low		Low	Med
Chickahominy River	11,200	CHKOH JMSOH	96	1,225 tf, pf		0	-	Low	High	High	High				Med	High
Lower Open Bay	179,400	CB8PH CB6PH CB7PH Atlantic	0	0	0	0	-	High	Low			Med		Med	Low	Low
Nanticoke River	17,700	NANMH NANOH	0	6,800 sm, pf		0	-	High	High	High	High	Med	High		High	High
Blackwater and Bay Islands	135,700[10]	TANMH HNGMH	11,216	11,231 sm, pf		52,900	-	High				High	High		High	High
Choptank	96,600	CHOMH1 CHOMH2 CHOOH CHOTF CB4MH	3,045	11,800 sm/tf/pf		43,780	10 reefs >6,000 yds^3	High	High	High	High		High		Med	High
Cape Henlopen	19,400	Atlantic	-	N/A		32,187	-		Low			Low			High	
Assateague and Chincoteague	241,700[10]	Atlantic	16,900	5,355 sm		125,000	-	High	Low			Low		Med	High	High
Lower Eastern Shore	262,300[10]	CB7PH Atlantic	50	68,810 sm/pf		156,700	1 reef >5,000 yds^3	High	Med			High	Med	Med	High	High
Tier 1 Totals	**1,161,400**	**30 segments + Atlantic**	**51,479**	**112,259**		**415,937**	**12 reefs**									
Tier 2																
Aberdeen	15,238	CB2OH GUNOH	1	1,154 sm	0	64,300	-	Low	Low	Low	Med				High	Low
Upper Chester	7,559	CHSOH	29	2800	0	33,000	-	Low	High	High	High				High	Med

		CHSTF		sm/tf/pf												
Mattawoman	2,011	MATTF	356	420 tf/pf		13,000	-	Low	High	High	High				Med	High
Pocomoke Sound	90,533	POCMH CB7PH TANMH	4691	1866 sm/pf		27,700	-	High				Med	High		Low	Low
Tier 2 Totals	**115,341**	**8 segments**	**5,077**	**6,240**		**138,000**	**0**									
Tier 1 + 2 TOTALS	**1,276,986**	**38 segments +Atlantic**	**56,556**	**118,499**	*****	**553,937**	**12 reefs** >12,000 yds[3]									

Sources and Notes:
[1]Areas are listed in counter-clockwise order, starting at the head of the Bay.
[2]Estimates based on polygon size in GIS; digitized boundaries are approximate, especially along shorelines
[3]Chesapeake Bay Program, 1997 Segmentation Scheme. This segmentation scheme does not include the Atlantic coastline so the Atlantic segment was added for the purposes of our analysis.
[4]Submerged aquatic vegetation numbers based on 1999 aerial monitoring survey, Orth et al. 2000.
[5]sm = salt marsh, tf = tidal fresh, pf = palustrine forested; tidal wetlands acreages were developed using USFWS, NWI, data for MD and the Virginia Tidal Marsh Inventory for VA.
[6]Tidal flat information will be determined from NWI
[7]Beach data derived from the NOAA ESI, 1994
[8]Baywide oyster reef data maintained by the US EPA Chesapeake Bay Program
[9]Qualitative assessment of abundance in the SCA, relative to the average occurrence across all appropriate habitats in the ecoregion
[10]Acreages include upland areas above high-tide level within polygon; these are estimated to make up no more than XX% of the total area of the SCA