APPENDIX ECM1: DESCRIPTIONS OF ESTUARINE, COASTAL AND MARINE HABITAT AND SPECIES TARGETS*

Habitats

Tidal Wetlands.

A wide diversity of tidal wetlands, stratified by salinity, including coastal salt marshes, brackish marshes and tidal fresh marshes, swamps and other wetlands, occur within the Chesapeake Bay Lowlands ecoregion. Tidal wetlands provide a large number of ecological functions. Both salt and freshwater wetlands provide nursery areas for juvenile fish, stabilize shorelines, and provide food and shelter to a variety of coastal wildlife. Salt marshes and brackish marshes are largely dominated by one or a few species of grasses, while tidal freshwater marshes have more structural and species diversity, often including shrubs, trees, and tall grasses. A classification of tidal wetlands, and detailed descriptions of their structure, composition and functioning, is provided by Cowardin et al. (1979). The US Fish and Wildlife National Wetlands Inventory provided the basis for Maryland's wetlands acreages and classification. Virginia performs its own regularly updated survey of tidal wetlands, the Tidal Marsh Inventory (VIMS). Because the Tidal Marsh Inventory was more recent and was subjected to extensive ground-truthing, it was used to identify tidal wetlands acreages and classifications for Virginia.

Submerged Aquatic Vegetation (SAV).

Several species of "underwater grasses" (actually, both monocots and dicots) are commonly found in the CBY ecoregion, they are collectively referred to as submerged aquatic vegetation (Table AECM1). Being vascular plants, their distribution is primarily controlled by water depth (2 m or shallower), which determines light penetration. The species composition of SAV beds varies primarily as a function of salinity, and beds may consist of one or several species (Orth et al. 2000). Hydrilla (*Hydrilla verticillata*) is an introduced exotic that is now cosmopolitan throughout tidal reaches of the Chesapeake Bay (get recent refs, in addition to Carter and Rybicki, 1986).

Submerged aquatic vegetation is a significant source of primary productivity in the Chesapeake Bay, and in the back bays along the Atlantic coast. They also remove sediments from the water, protect shorelines from waves and erosion, and add oxygen to the water. They provide food and shelter for many species of estuarine and coastal species, including fish, crabs and invertebrates. Many animal species preferentially use SAV beds versus other non-vegetated bottom habitats. For example, juvenile blue crabs are found in much higher densities in SAV beds than in adjacent non-vegetated areas. Additionally, several species of waterfowl depend on SAV for a large part of their diet. There are several ongoing restoration programs (e.g., EPA Chesapeake Bay Program, Alliance for Chesapeake Bay, Chesapeake Bay Foundation) to increase native SAV distribution throughout the Chesapeake Bay and Atlantic coastline.

The rangewide distribution of SAV species common to the Bay and coastal bays includes species that extend north along the Atlantic coast into New England (Hurley 1992) as well as southern species that can be found in estuarine waters throughout the Carolinas, Georgia, Florida, and the Gulf of Mexico (e.g., widgeon grass and wild celery) (Hurley 1992, Beck and Odaya 2000).

* Jasinski, P. 2002. Description of Estuarine, Coastal and Marine Habitat and Species Targets. Appendix ECM1 of the Chesapeake Bay Lowlands Ecoregional Plan. The Nature Conservancy, Mid-Atlantic Division, Charlottesville, VA.

Table AECM1. Typical Species of Submerged Aquatic Vegetation found in the CBY Ecoregion

(Orth and Dennison in EPA Chesapeake Bay Program 1993, Hurley 1992)

Species by Salinity Regime	Common Name
Polyhaline	
Zostera marina	Eelgrass
Ruppia martima	Widgeon grass
Zannichellia palustris	Horned pondweed
Mesohaline	
Zostera marina	Eelgrass
Ruppia martima	Widgeon grass
Zannichellia palustris	Horned pondweed
Stuckenia pectinata	Sago pondweed
Potomageton perfoliatus	Redhead grass
Myriophyllum spicatum	Water milfoil
Vallisneria americana	Wild celery
Oligohaline/Fresh	
Ruppia maritima	Widgeon grass
Potamogeton pectinatus	Sago pondweed
Potomageton perfoliatus	Redhead grass
Myriophyllum spicatum	Water milfoil
Vallisneria americana	Wild celery
Heteranthera dubia	Water stargrass
Hydrilla verticillata	Hydrilla
Elodea canadensis	Common Elodea
Ceratophyllum demersum	Coontail
Najas guadalupensis	Southern naiad
Zannichellia palustris	Horned pondweed

Historically abundant throughout the region, the Bay-wide acreage of SAV has declined significantly over the past few decades. According to a 1999 survey, SAV acreage in the Bay

was about 12% of historic levels (Orth et al. 2000, Chesapeake Bay Foundation 2000). **[Remove previous sentence, or reconcile with Mike Naylor's argument that real value is closer to 25%]** The dramatic baywide decline of all SAV species was first noted in the late 1960's and 1970's (Orth and Moore 1983) and was correlated with increasing nutrient and sediment inputs from development of the surrounding watershed (Kemp et al. 1983), greatly exacerbated by the historic flooding from Tropical Storm Agnes in 1972 (e.g., Orth and Moore 1983). The strong link between water quality and SAV distribution and abundance (Batiuk et al.1992) supports the concept that SAV is a good barometer of Chesapeake Bay health (Orth and Moore 1988).

Sandy Beaches and Bars.

Sandy beaches and bars are typically unvegetated, or sparsely vegetated, environments. Within the Chesapeake Bay Lowlands ecoregion, the broadest sandy beaches are found mostly in the lower Bay and along the Atlantic coastline. These beaches and bars provide feeding grounds for the abundant waterfowl and shorebirds. A number of common species also use these habitats for nesting areas, such as horseshoe crabs, terrapins, and some shorebirds. Atlantic beaches provide important nesting habitat for two globally rare animal species that are conservation targets in CBY, piping plover (*Charadrius melodus*) and the loggerhead sea turtle (*Caretta caretta*). In addition, two globally rare plant species that are CBY conservation targets grow on Atlantic beaches; seabeach amaranth (*Amaranthus pumilus*) and sea-beach knotweed (*Polygonum glaucum*). The former species, which is federally Threatened, had largely disappeared from its known locations on Atlantic beaches in Delaware, Maryland and Virginia until recently, when several small populations were recorded by Natural Heritage Program botanists and others. National Park Service and MD Wildlife and Heritage Division staff have initiated a reintroduction project in an attempt to reestablish viable populations of seabeach amaranth on Assateague Island (Chris Lea, pers. Comm.).

As is the case with all barrier islands along the entire Atlantic coast, beach and dune habitats in CBY are highly dynamic systems, constantly shaped and reshaped by winds, storms and ocean currents. Prevailing winds and nearshore currents cause Atlantic barrier islands to migrate slowly southward, with sand lost from the north end often transported to build new beaches and dunes at the south end. Hurricanes and nor'easters also move tremendous quantities of sand, both onshore and offshore, as well as along the main axis of the islands. Breaches or blowouts of the beach-dune systems can occur during major storms, creating new channels for flow between the ocean and back bays, and further altering the dynamics of these island systems.

Smaller sandy beaches border Bay islands and sections of shoreline in the lower Bay, and along the western shore of the Bay in Maryland, especially in Calvert County. Many of these beach habitats in Virginia and Maryland support populations of the Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*), which is federally Threatened and a CBY conservation target. Although not included as a conservation target here, sizable cliffs (up to 100' high) coincide with many of the beaches in Calvert County, and provide excellent habitat for the Puritan tiger beetle (*Cicindela puritana*), a federally Threatened species and CBY conservation target.

Tidal Flats.

Tidal flats (also known as, intertidal or mud flats) are muddy-to-hard bottom areas exposed only at low tides. The type of substrate present determines the biotic community within the flat. Soft-bottom flats are comprised mainly by silt and clay particles, whereas hard-bottom flats have a higher percentage of sand particles. Marine animals are sensitive to the size of sediment

particles; consequently, certain animals common to soft muds are never found in sandy-mud, and vice versa. However, the composition of mud flats in the Chesapeake Bay is quite variable, and many estuarine and coastal organisms have adapted to a wide range of sediment types (Lippson and Lippson 1984).

Seaweeds often grow or float among the shells, rocks, and other structures present in the intertidal areas. Sea lettuce (*Ulva lactuca*), seaweed (*Enteromorpha* spp), and horned pondweed (*Zannichellia palustris*) are often found along tidal flats. The algae and bacteria that grow here provide additional food for fish, shellfish, and other animals using this habitat. Typical tidal flats visitors include shorebirds, hard and soft clams, fiddler crabs, blue crabs, mussels, worms, mantis and marsh shrimp, and snails. These areas are rich feeding grounds for waterfowl and shorebirds.

Species

Eastern (American) Oyster

The Eastern, or American, oyster (*Crassostrea virginica*) is the characteristic bay oyster. Oysters are prized for their commercial value, but they also play (or once played) a significant ecological role in the Bay and region. Once the mainstay of the Bay's fishing industry, declines due to over-harvesting, disease, and loss of habitat have made them a scarce commodity. In fact, commercial harvests in 1998 were about 2% of those seen in the 1950's, when 30-40 million pounds were taken annually from the Chesapeake Bay (EPA 1999a, Chesapeake Bay Foundation 2000, NOAA 1999). Newell (1988) has estimated that standing stocks of the Eastern oyster within the Bay were as high as 188×10^6 kg dry tissue weight prior to the major harvests of the late 19th Century. Due to continued overfishing and disease, however, the current population is estimated to be only about 1.9×10^6 kg dry tissue weight (Newell 1988). Bay region oyster populations are subject to two diseases, MSX and Dermo. MSX kills oysters while still in the spat stage, while Dermo can kill adult oysters long before they are big enough to reproduce or harvest. However, MSX is more lethal in waters between 15-30 ppt, which partially accounts for the difference in oyster stocks between Maryland and Virginia. In 2000, Virginia watermen harvested only about 10% as many oysters as watermen working in Maryland.

Oysters can grow on a variety of bottom types, although they require firm substrate to form substantial populations. The oyster is a true estuarine species, able to tolerate salinities from 5-30 ppt (Galtstoff 1964) and can be found at water depths between 8-25 feet (Lippson 1989). They are ecologically important for the habitat oyster reefs provide to other animals, and for their filtering abilities. It has been suggested that oysters were once so plentiful here that they could filter the entire volume of Bay water in 3-6 days; because of the drastic declines in oyster populations, however, the same process would now take about 325 days (Newell 1988). The Chesapeake Bay Foundation and numerous other public agencies, environmental groups and community associations conduct oyster restoration programs within the region, primarily by working to establish artificial and restored reefs.

Oyster reefs or bars are underwater, three-dimensional structures created when dense colonies of oysters cluster together. Once established, they maintain themselves because oyster larvae settle and grow on other oyster shells. The oyster bar community serves as a productive, characteristic habitat of the Bay and coastal region. The hard shells of the oysters allow many sessile organisms to attach and grow, while providing shelter to small fish, crabs, and other marine organisms. Associated animals include: sea anemones, barnacles, mussels, sea squirts, mud

crabs, and oyster toadfish. Within oyster reefs, both the density and diversity of species is much higher than on adjacent soft bottom areas (Newell and Breitburg 1993).

Maryland oyster harvests accounted for about 90% of the Bay's oyster harvest in 2000. The dockside value for oyster landings in Maryland and Virginia in 2000 was about $5.5 million. This accounts for only about 10% of the nation-wide harvests (NOAA/NMFS Chesapeake Bay Office 2001).

Blue Crab.

Blue crabs (*Callinectes sapidus*) are one of the most commercially important species in the Chesapeake Bay region. In recent years, they have been the most valued commercial species in the Bay. In 2000, approximately 47 million pounds of Bay crabs were commercially harvested, carrying a dockside value of about $50 million (NOAA/NMFS 2001). This represents about 20% of the nation-wide catch for this species. But humans are not the only species that likes to feed on blue crabs, making them ecologically important as a food source for shorebirds, rays, turtles, and fish. Their biology, however, makes them a particularly difficult species to manage. Blue crabs begin their lives near the Bay's mouth, where female crabs release larvae (zoea). The currents carry the zoea out into the Atlantic ocean where they develop into shrimp-like megalopae and drift back into the Bay on wind-driven currents. Here they shed their shells and become juvenile blue crabs. They preferentially settle on SAV beds, which provide shelter and food (e.g., Heck and Orth 1980). After a year of growth, young blue crabs migrate throughout the Bay, but gender plays a large role in determining their annual migration patterns. Male crabs roam throughout the Bay searching for food, while females migrate towards the lower Bay in spring and fall to spawn. Females also overwinter in the deeper waters of the lower Bay (e.g., Schaffner and Diaz 1988). This migration pattern has led to a largely male harvest in Maryland, while the Virginia fishery largely depends on females (Chesapeake Bay Commission 2001).

Submerged aquatic vegetation beds and tidal wetlands are important to blue crab survival. Immediately after molting, crabs are more vulnerable to predators and often hide in the vegetation of wetlands or SAV beds for protection. Young crabs use these areas as nurseries, and all crabs forage within them. Studies have indicated that up to ten times more crabs can be found within grass beds than in adjacent unvegetated areas (Orth and van Montfrans 1987, Thomas et al. 1990).

With declines in other commercial species, fishing pressures on blue crabs has increased over the last several years. Researchers believe that populations naturally fluctuate, but habitat losses and increased harvest efforts have destabilized the Bay's blue crab population. The lowest recorded level of blue crab spawning stock was in 1968. Stock measurements in 1999 and 2000 hovered just above that level (Chesapeake Bay Commission 2001). The highest rates of fishing mortality, when harvesting pressures on crab stocks led experts to suggest the fishery might be in danger of collapsing, occurred in the 1970s and again in the 1990s (Chesapeake Bay Commission 2001). Maryland and Virginia are currently working together on a Bi-State Blue Crab Advisory Committee to develop a comprehensive plan to manage crabs more effectively, including possibly designating a spawning crab sanctuary in the lower Bay in Virginia (Rom Lipcius, personal comm., Chesapeake Bay Commission 2001). The long-term management of this species will also depend on the establishment of better harvest targets and continued restoration of underwater grasses.

The original natural distribution of blue crabs was from Nova Scotia to northern Argentina, but the species has been introduced to Europe and the Mediterranean Sea and has been reported in Japan (Van Heukelem 1992, Williams 1984). They are an important commercial fishery from the Carolinas to Florida, and in the Gulf of Mexico (NOAA/NMFS Chesapeake Bay Office 2001). In 2000, Maryland and Virginia waters produced about one quarter of the nation-wide blue crab harvests (NOAA/NMFS Chesapeake Bay Office 2001).

Hard Clam.

Hard clams (*Mercenaria mercenaria*) are found along the eastern coast of North America from the Gulf of St. Lawrence to Texas. They are a hardy species with few known diseases affecting wild hard clam populations. Hard clams prefer sandy areas of moderate salinity or higher (above 20 ppt) within the Bay and along the Atlantic coastline. In the Bay, this species ranges from the intertidal zone to depths greater than 6 feet (Funderburk et al. 1992). They are filter feeders and have become increasingly important to watermen as the oyster fishery has declined. In 2000, Maryland reported a dockside value of over $13,000 for hard clams (NOAA/NMFS Chesapeake Bay Office 2001). Virginia supports a large commercial fishery of hard clams, based primary on aquaculture management and harvest. Annual landings for hard clams in Virginia probably exceed $10 million. Hard clams are important food sources for blue crabs, horseshoe crabs, large fish, and gulls.

Soft Clam.

Soft clams (*Mya arenaria*) prefer relatively shallow, sandy, mesohaline areas of the upper Bay and Atlantic coastline. They occur mostly in Maryland waters, but are found in some areas of Virginia. Their distribution is restricted by several variables, particularly salinity, sediment type, anoxia, and predation. Predation is thought to be the most important source of mortality for this species, although disease and toxics are also a factor. They are an important benthic filter feeder, removing microscopic algae from the water column. Crabs, eels, rays, fish, shrimp, and waterfowl all feed on soft clams. In 2000, Maryland reported almost $1 million in dockside value from soft clam commercial harvests, representing about one-twelfth the nation-wide harvest (NOAA/NMFS Chesapeake Bay Office 2001).

Striped Bass.

Striped bass (*Morone saxatilis*), also known as rockfish, is a large, anadromous fish found along the entire eastern coast of North America (Funderburk et al. 1991). It is also found along the west coast in many bays and estuaries (Setzler-Hamilton et al. 1988). Striped bass spend most of their lives in the Bay or Atlantic ocean but throughout the late winter and spring migrate to the tidal freshwater portions of tributaries to spawn. Juveniles sometimes remain in these freshwater areas for up to two years. They can live up to 30 years and females do not reach spawning age until they are around seven years old.

The rockfish population in Chesapeake Bay represents a remarkable success story for fisheries management. In the mid-late 1970's scientists became aware that the species was in trouble along the East Coast. Maryland issued a total moratorium on the fishery in 1985, although Virginia did not follow suit until 1989. The fishery re-opened for a limited 1990-91 season. By 1995, the Atlantic States Marine Fisheries Commission declared the species restored. Striped bass are voracious predators, mostly on fish and blue crabs. In their early life stages they are important prey for other species. There is increasing concern that low dissolved oxygen (DO) in

deeper waters has reduced much of the summer habitat of adult and sub-adult striped bass (Setzler-Hamilton and Hall, Jr. 1991). Contaminants have also been associated with larval mortality in Chesapeake Bay tributaries (Mehrle et al. 1986, Setzler-Hamilton and Hall, Jr. 1991).

Striped bass landings in the Bay represent over 50% of the nation-wide totals. In 2000, over 3.5 million pounds of striped bass were commercially harvested in Maryland and Virginia waters. The dockside value of this harvest was about $5.5 million (NOAA/NMFS Chesapeake Bay Office 2001).

Shad and River Herrings.

Each spring shad and river herring come into freshwater reaches of the Chesapeake Bay to spawn. Shad and herring are anadromous, meaning they begin their lives in freshwater reaches but spend most of their adult lives in the Atlantic Ocean. Shad and herring are believed to return to their natal streams to spawn (Lippson and Lippson 1984). There are four anadromous species of shads and herrings in the Bay, each with a number of common names. American shad or white shad (*Alosa sapidissima*) and hickory shad (*Alosa mediocris*) are the largest of this group. Two species of river herrings are commonly found in the Bay, the alewife or big-eye herring (*Alosa pseudoharengus*) and the blueback herring, also occasionally called alewife, (*Alosa aestivalis*) (Lippson and Lippson 1984).

Anadromous species are more vulnerable to both overfishing and habitat losses than other fish species. Their concentrated runs make them easy targets for harvesting, and much of their spawning habitat has been blocked (especially by dams) or degraded by human disturbances and developments. Formerly some of the most abundant and valuable fisheries in the Bay, stocks of shad and herring stocks are currently depleted. Current restoration efforts focus on restocking and the removal of obstructions, or creating fish passages. Fish passages are ladders or lifts that allow migratory fish to get past large dams. Shad and herring are important food sources for a variety of animals, including osprey, green heron, striped bass, large-mouth bass, and perch.

Shad range along the Atlantic coastline from Canada to Florida. Herrings are found along the Atlantic coast, from Canada to South Carolina (EPA Chesapeake Bay Program 1989, Rulifson et al. 1982). Due to their wide range, these species represent an important ecological component of freshwater, estuarine, and marine communities for most of the East Coast. Commercial harvests of river herrings in the 1980s were 80-90% lower than during the previous decade (EPA Chesapeake Bay Program 1989). Shad have experienced similar population declines over the last several decades. There is currently no viable commercial fishery of shad within the Bay. Both shad and river herrings have suffered from the effects of pollution and over-fishing throughout their ranges.

Yellow Perch.

Yellow perch (*Perca flavescens*) are freshwater fish that are also common in the brackish waters of upper estuaries. They spawn in freshwater areas in the late winter, making them the traditional first catch for many fishermen each year. Populations of yellow perch in the Bay have declined since the mid-1960's (Piavis 1991). Increased sedimentation, eutrophication from excessive nutrient loadings, acid rain, and blockages to spawning habitat have all likely contributed to these declines. In addition, with recent declines in other major sport and commercial fish species (e.g., striped bass, shad, and herring), many fishermen have targeted more harvest effort on

yellow perch (Piavis 1991). Recommendations for the restoration of this species include better land use practices (to decrease sedimentation, nutrient run-off, and toxic inputs), removing stream blockages to spawning grounds, and more restrictions on the fishery (Klauda 1989, Auld 1974, Hayward and Margraf 1987).

The range of yellow perch stretches from South Carolina north to Nova Scotia, west through the southern Hudson Bay region and Saskatchewan, and south to the northern half of the Mississippi drainage (Richkus and Stroup 1987). Although widespread along the Atlantic Coast, yellow perch suffer from habitat degradation, stream blockages, and fishing pressure throughout their distribution.

Atlantic Loggerhead Turtles.

Of all sea turtles, the Atlantic loggerhead (*Caretta c. caretta*) is the most abundant within the Chesapeake Bay region. Although this area is not an important nesting ground for the Atlantic population, loggerhead nesting has been recorded in Virginia on the barrier islands of the Eastern Shore, and on the Western Shore near the Bay's mouth (Musick 1988). The turtles usually enter the Bay in large numbers in the late spring/early summer to feed. Individuals establish home ranges of only a few miles in area, usually at the edges of channels where they move with the tide and search for food. The SAV beds here provide rich foraging grounds for them. Loggerhead turtles prey on the abundant shellfish found here, especially horseshoe crabs and blue crabs. Their diet also includes jellyfish, shrimp, fish, and sea grass. Each year, there are between 250-300 sea turtle strandings within the Bay. Most of these occur as the turtles are entering the region. Reasons for most strandings are unclear but likely involve entanglement in fishing nets, boating accidents, or illness. Loggerheads cannot overwinter in this area because the low water temperatures would be fatal.

Colonial nesting waterbirds and waterfowl aggregations.

The Chesapeake Bay region's extensive wetlands, riparian forest buffers, and beaches attract and support a large diversity and tremendous number of birds that use estuarine and coastal habitats. Over 180 species of birds regularly breed within the Mid-Atlantic region, many of which are associated with coastal habitats. Many of the waterbirds and waterfowl are identified in a recent regional report (Watts, 1999) as being conservation priorities. These species include Piping Plover, Salt Marsh Sharp-tailed Sparrow, Roseate Tern, American Oystercatcher, Seaside Sparrows, Wilson's Plover, and Clapper Rail.

Dozens of bird species migrating along the Atlantic Flyway find temporary food and shelter within the Chesapeake Bay region. Nearly a million waterfowl over-winter in the region each year. For example, tundra swans, Canada geese, and a large number of waterfowl, including canvasbacks, pintails, scoters, eiders, and ruddy ducks all spend their winters here. Large populations of bald eagles and osprey nest along the shores. Worldwide populations of these birds are dependent on available Chesapeake nesting and over-wintering habitat, as well as abundant food resources.

Among the colonial nesting waterbirds within the region are the great blue heron, great egret, snowy egret, cattle egret, little blue heron, green heron, black-crowned night heron, American bittern, and glossy ibis. These birds wade along the shorelines to forage within wetlands and tidal flats for food. Fortunately, populations of most wading birds have remained constant or increased in recent decades, as in the case of the great blue heron.