Chesapeake Bay Habitat Restoration: A Framework for Action

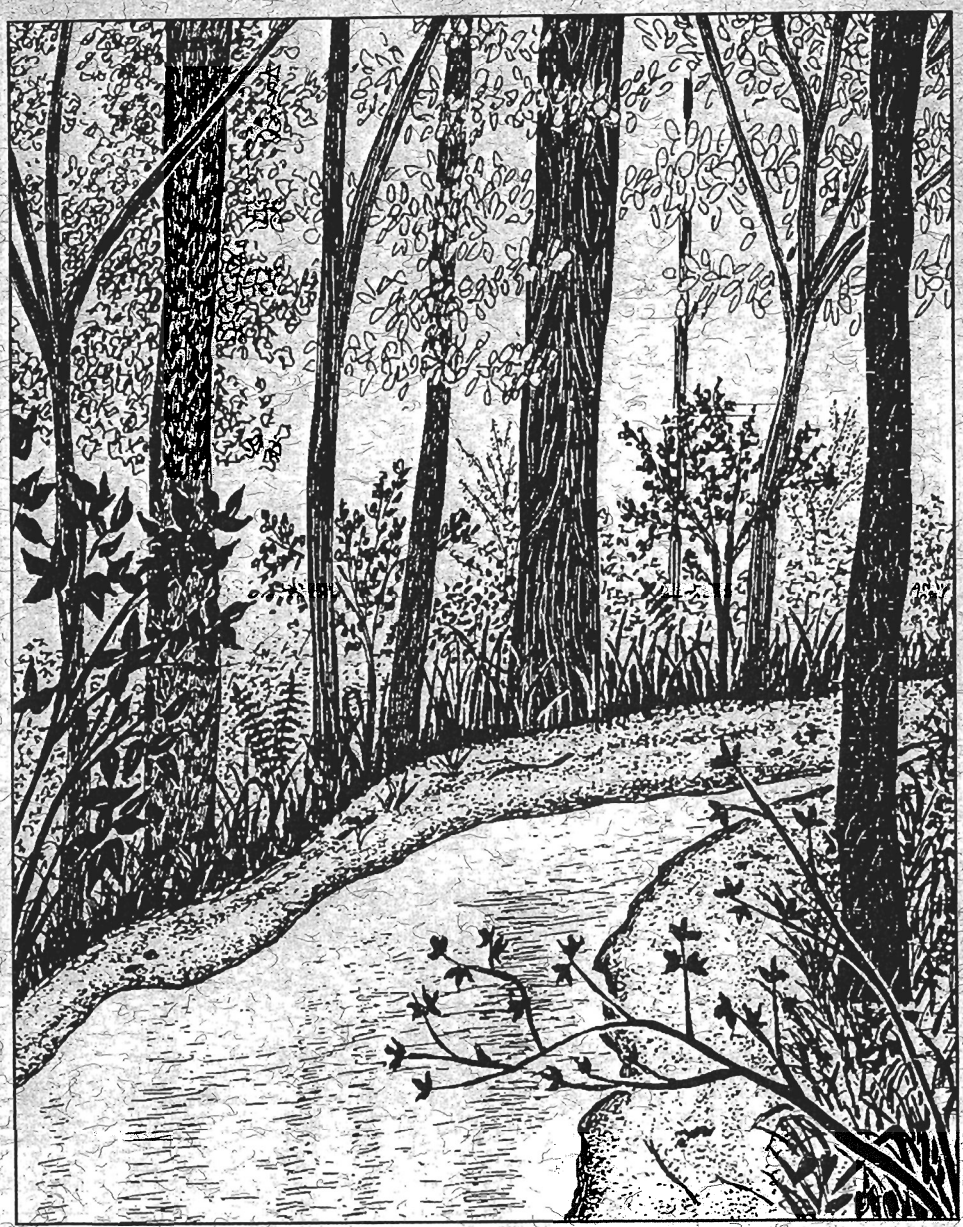

Illustration by Sandra Janniche, USFWS

Chesapeake Bay Program

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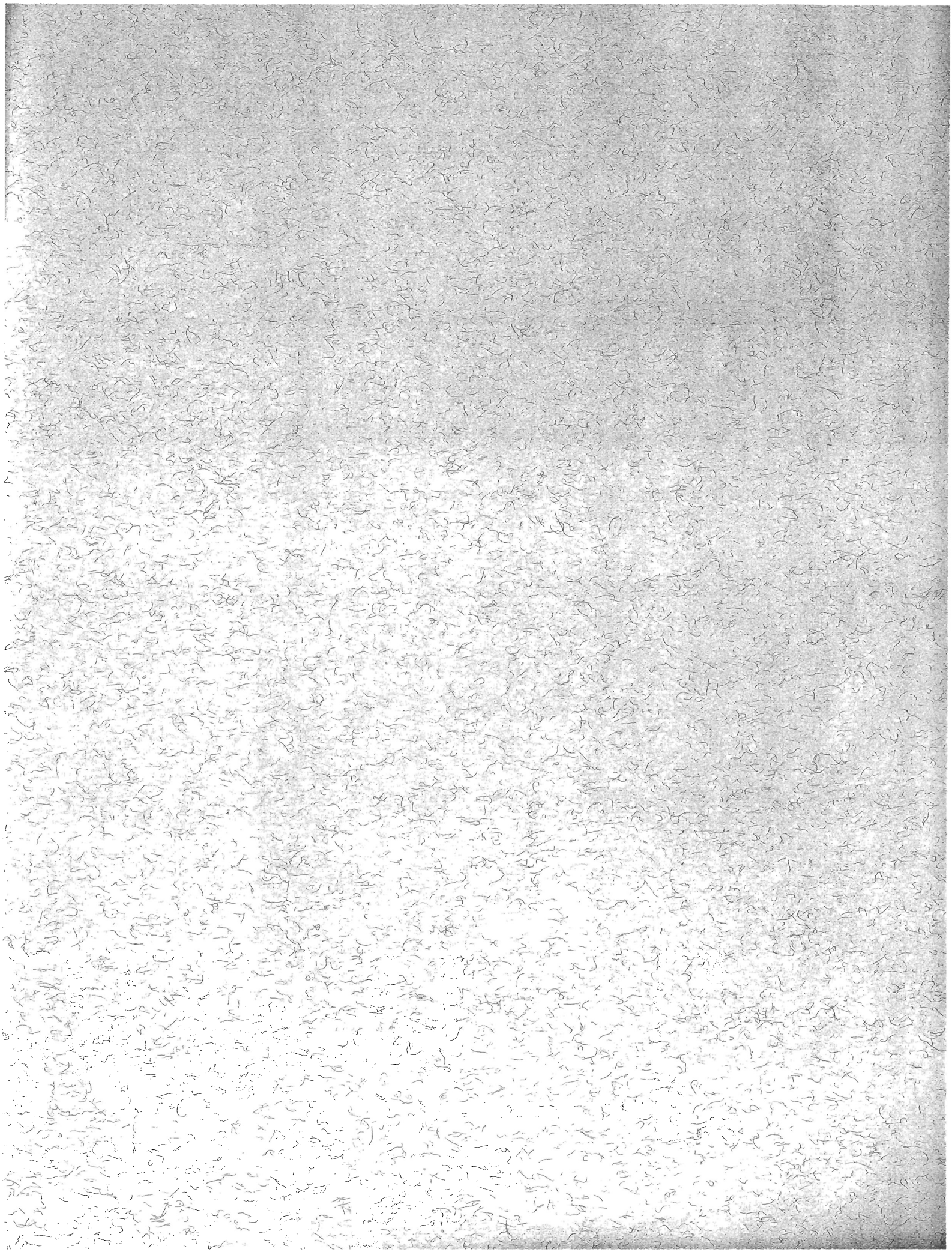

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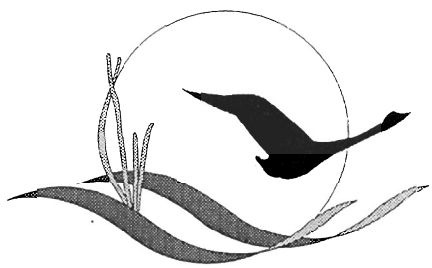

Chesapeake Bay Program

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Executive Summary

The Chesapeake Bay and its watershed have undergone vast changes since colonization of the area by European settlers. Human activities have significantly degraded its terrestrial and aquatic biological communities and development continues to diminish the remaining habitat needed by fish, shellfish, waterfowl, and terrestrial wildlife.

Recognizing the importance of the Chesapeake estuary, the Chesapeake Bay Program recently expanded the mandate of the Living Resources Subcommittee and the Habitat Objectives and Restoration Workgroup to "implement an integrated and comprehensive approach for habitat restoration . . ." (Chesapeake Executive Council, 1993c). This framework for action enhances existing Chesapeake Bay Program strategies, policies, and implementation plans, while providing a foundation for integrated restoration activities.

Based on an increased understanding of landscape and watershed processes, the framework targets the needs of specific living resources in four target habitat areas through on-the-ground restoration projects. Moreover, decision-making will improve as we strengthen our ability to target, integrate, and restore key habitat functions via three phases outlined in the framework:

Phase I: Facilitate habitat restoration projects, research and monitoring immediately.

Phase II: Develop a process for targeting habitat restoration projects within a landscape or watershed framework.

Phase III: Foster partnerships that use the expertise of federal, state, and local governments and public and private efforts to implement effective restoration projects throughout the Chesapeake Bay watershed, using the targeting information provided in Phase II.

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Introduction

The Chesapeake Bay has a surface area of 4,400 square miles, a length of 200 miles, and a watershed encompassing 64,160 square miles. The watershed contains five major rivers originating in the Piedmont Plateau Province and running through the Coastal Plain Province: the Susquehanna, Potomac, Rappahannock, York, and James. These rivers provide almost 90 percent of the freshwater flow to the Bay, bringing in minerals, nutrients, and sediments (US Army Corps of Engineers 1973).

The Bay is a highly productive coastal plain estuary; its broad and shallow form provides a unique array of habitats offering protection and sustenance to over 2,700 migratory and resident animal species. Habitat types throughout the Chesapeake Bay watershed range from the mixed hardwood forests of the Appalachian mountains to the saltwater marshes of the Bay. These habitats are influenced by climate, topography, soils, hydrology, plant and animal interactions, and an ever-expanding human population.

Certain habitats—wetlands, streams, forests, and riparian corridors—are directly and acutely affected by the clearing of vegetation, agriculture, and development. Land development, increased nutrient loadings to the Bay from nonpoint source pollution, and the overharvest of fish and wildlife have degraded the once productive habitats of the Bay, such as submerged aquatic vegetation beds and aquatic reefs. Other habitats, such as Bay islands and salt marshes, are declining in area due to sea level rise, shoreline erosion, regional subsidence, and other natural processes. Anthropogenic activities often exacerbate these problems. Appendix 1 summarizes the historical trends for major habitats in the watershed and the Bay.

Existing habitats should be conserved and degraded habitats restored. To accomplish this, the Chesapeake Bay Program (CBP) has called for a comprehensive habitat restoration plan: "Provide for the restoration and protection of living resources, their habitats, and ecological relationships" (Chesapeake Bay Agreement 1987), and "implement an integrated and comprehensive approach for habitat restoration . . . " Chesapeake Executive Council, 1993c).

For more than a decade, the CBP has focused on ambient water quality conditions to improve aquatic habitat. The CBP is committed to reducing nutrient levels by 40 percent by the year 2000—to be achieved through the Chesapeake Bay Programs's Tributary Strategies.

Beyond nutrient reduction efforts, most site-specific habitat restoration activities have been opportunistic and uncoordinated. This Habitat Restoration Framework provides a disciplined and streamlined approach to restoration activities in the Bay and its watershed.

By streamlining the approach, diverse efforts are coordinated and based on a common goal. As a result of various CBP planning commitments originating from the Living Resources Subcommittee (LRSc), the Ecologically Valuable Species Strategy, and the Habitat Objectives and Restoration Workgroup (HORW), a three-phase concurrent process emerged for the development of a CBP Habitat Restoration Program (Figure 1). Many of the policies, plans, and strategies developed by the LRSc either refer to or specifically require action on habitat restoration. This framework will enhance and integrate these efforts while reducing duplication and waste, using scarce funding more effectively, and increasing on-the-ground results.

A three-phase approach will allow immediate restoration results during the early implementation phase while building the CBP's ability to target, integrate, and restore key habitat functions. The HORW will be responsible for the overall integration of the habitat restoration projects and will ensure a smooth transition among the phases.

Restoration

Restoration often is defined formally as the reestablishment of pre-disturbance functions and related physical, chemical and biological characteristics (National Research Council 1992). In simpler terms, restoration returns an ecosystem to its approximate condition prior to disturbance. The return of this condition implies both physical and functional restoration with a goal towards a self-maintaining, ecologically-based system integrated with its surrounding landscape. A simplified example is the return of a channelized, sparsely vegetated stream to a meandering stream with a healthy riparian habitat.

Monitoring, research, and training are crucial to any program because habitat restoration techniques are constantly evolving. Many techniques, applications, and approaches are considered models or experiments. As these "model approaches" evolve, the results should be evaluated to assess whether the models meet project objectives. For example, techniques considered as the "standard" in wetland mitigation or restoration should be scrutinized to determine if the stated functional objectives are met (e.g., wildlife benefits, flood retention, nutrient uptake). As new approaches are developed and proven, this information should be disseminated throughout the watershed using workshops and training sessions. The three phases in the framework are flexible in implementing a habitat restoration program in this evolving field by addressing deficiencies in information and supporting training throughout the watershed.

Restoration activities, alone, will never outpace the losses resulting from continued habitat conversion and degradation. Even with a concerted watershed-wide effort to restore habitat, the protection and management of these habitats will require continued advances in point and nonpoint source abatement, acquisition and incentive programs for key buffer areas, and regional development plans that protect aquatic systems.

Phase I: *Immediately facilitate habitat restoration projects, research, and monitoring.*

Under Phase I, currently available funding will be directed to those habitat restoration projects that provide the greatest potential for success and the biggest benefit to the living resources. Accounting for the status of existing CBP restoration efforts, Phase I identifies new opportunities for immediate projects. Phase I calls for project guidelines and evaluation criteria and identifies additional funding and information sources outside of the CBP.

Phase II: *Develop a process for targeting habitat restoration projects within a landscape or watershed framework.*

This phase provides a process to guide the identification of landscape or watershed-scale projects through the integration of CBP activities—such as linking habitat restoration to ongoing initiatives such as the Chesapeake Bay tributary strategies and developing priorities based on living resource needs. Ultimately, the goal of this phase is the development of a geographical data base for targeting restoration projects through geographic information system (GIS) technology; limited targeting, however, can occur immediately. The data base will incorporate existing living resources habitat requirements as well as information on existing water quality and habitat conditions. Targeting projects will allow more effective habitat restoration efforts and more efficient use of limited funds.

Phase III: *Foster partnerships that use the expertise of federal, state, and local governments and public and private efforts to*

implement effective restoration projects throughout the Chesapeake Bay watershed, using the targeting information provided in Phase II.

Using the data base developed in Phase II, this phase will integrate restoration programs, mitigation activities, and enforcement actions throughout the Chesapeake Bay watershed to maximize ecosystem benefits. Phase III fosters the exchange of information from widely varying management entities. Funding opportunities and constraints, mitigation and enforcement restrictions, and past successes and failures will be examined as cross-program opportunities are explored.

The HORW will work closely with other LRSc workgroups and other CBP subcommittees to solicit, identify, and evaluate potential restoration sites and projects. The workgroup will also work closely with the CBP Data Center and other computer groups for data base development and will solicit funds for workshops and other activities required for the integration of habitat restoration programs within the watershed.

Major functions of the HORW will include:

- preparing proposal guidelines;
- identifying restoration needs;
- proposing and advocating the funding of restoration projects;
- targeting and tracking habitat restoration projects through a regional data-base and workshops;
- requiring and reviewing progress reports from project grantees;
- overseeing the preparation and review of strategy progress, evaluation reports, and other materials; and
- ensuring that the results of research and monitoring are reflected in subsequent guidance.

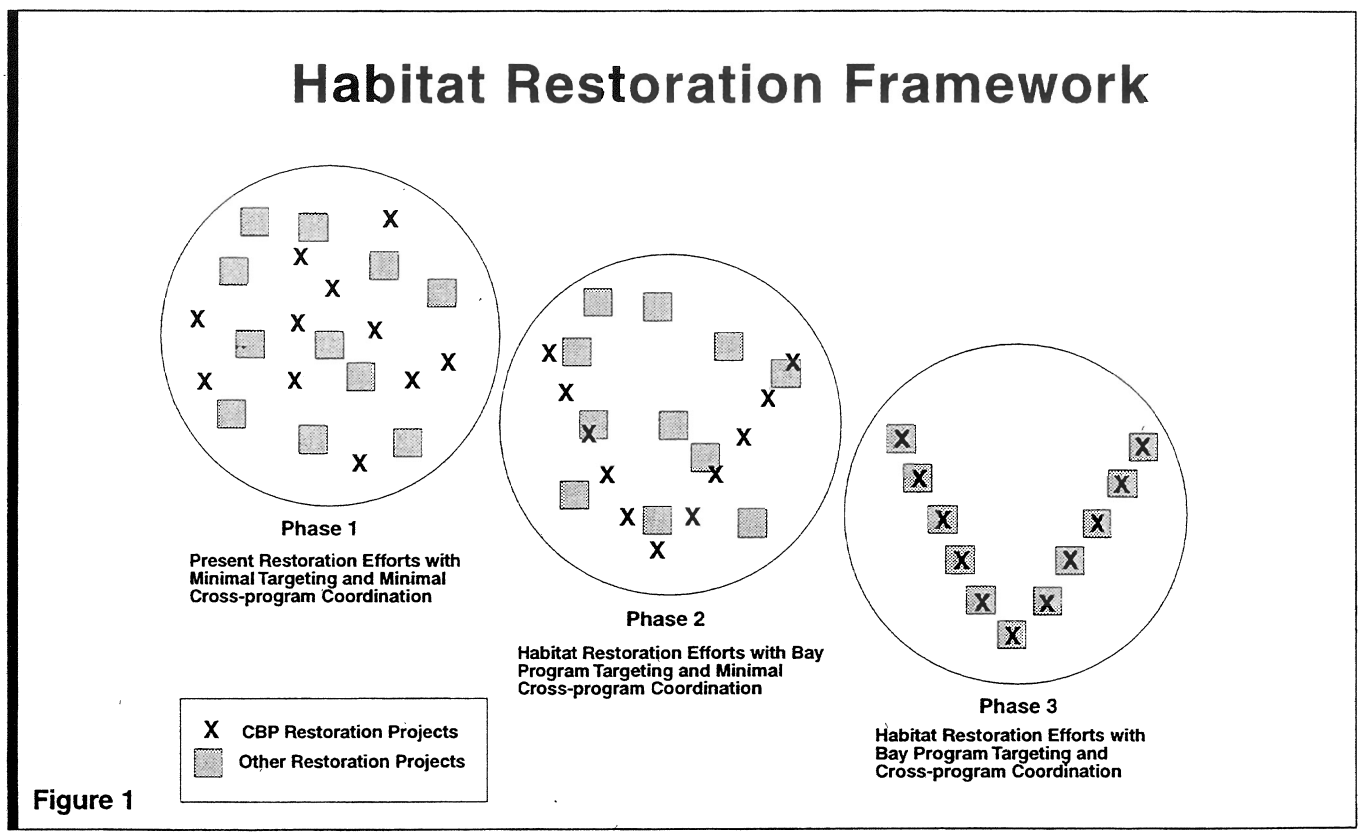

Figure 1

Priority Habitat Areas

Past management strategies concentrated on species of economic or recreational importance; this framework selects species (certain plants and animals and their life stages) that are indicators of habitat restoration success. In other words, successful restoration of anadromous fish spawning reaches suggests associated habitat benefits for other plants and ani-mals inhabiting the same area will also result.

Four target habitat areas were selected to focus restoration efforts using selected indicator species:

1) **freshwater tributaries and streams**, including nontidal wetlands, focus on the needs of anadromous fish for spawning and nursery areas;

2) **shallow water areas (tidal)**, including submerged aquatic vegetation beds, focus on the needs of juvenile fish and crabs for refuge and feeding areas for waterfowl;

3) **open water areas (tidal)** focus on both adult fish feeding and mobility and oyster reef communities; and

4) **islands and inlands**, including forested wetlands, focus on waterfowl and neotropical birds.

The following goals are based on the habitat needs described below and the status of the habitats described in Appendix I.

Freshwater Tributaries

Indicator Species

Anadromous fish

Goals for Restoration

- Open 582 miles of fish spawning habitat in major tributaries between 1993 and 1998 and an additional 626 miles by 2003 (Chesapeake Executive Council, 1993c).
- Restore nontidal wetland acreage to CBP baseline levels.
- Ensure, through restoration, upstream habitat suitable for spawning by anadromous and resident fish.
  - Provide riparian buffers where appropriate on all water courses.
  - Identify existing riverine wetlands and restore historical wetland habitat.
  - Restore in-stream habitat.
- Ensure water quality suitable for successful spawning.

Habitat Needs

Anadromous fish spend their adult lives in the ocean but spawn in freshwater tributaries and streams. In the Chesapeake Bay, these fish include striped bass, blueback herring, alewife, American shad, hickory shad, shortnose sturgeon, and Atlantic sturgeon. Catadromous species, on the other hand, spend their adult lives in freshwater tributaries and spawn in the ocean. Only one catadromous species, the American eel, inhabits the Chesapeake Bay. Finally, semi-anadromous fish, such as white and yellow perch, principally inhabit tidal tributaries of the Chesapeake Bay but spawn in the freshwater reaches.

While each of these species has specific habitat requirements, all need to have unobstructed access to and from their spawning grounds. Migratory fish are excluded from "a major portion" of their historic spawning and freshwater nursery habitats in the Chesapeake Bay watershed due to dams and other obstructions that block spawning streams and riparian areas (Chesapeake Executive Council 1988a). For example, nearly 300 river miles are blocked in the Susquehanna River drainage (Chesapeake Executive Council 1988a) and 227 miles or nearly 13,000 acres of historic spawning area are blocked in the James River (Virginia Department of Game and Inland Fisheries

1992). As the Chesapeake Executive Council (1988a) has reported, hundreds of stream obstructions exist.

- Maryland has inventoried 887 barriers, including 445 dams.
- Virginia has inventoried 1,496 barriers, with nearly one-quarter of these identified as potentially affecting the upstream passage of migratory fish.
- Pennsylvania has identified 138 obstructions in the Susquehanna River.
- The District of Columbia has identified five obstructions in Rock Creek.

Beyond access to spawning areas, anadromous and semi-anadromous species require good water quality for spawning and egg and larval development. Anadromous fish spawn on all types of substrates, ranging from gravel bottoms to vegetated areas. As a result, these species must have access to a wide variety of substrates. Many of the anadromous species found in the Bay require specific temperature and pH conditions and dissolved oxygen (DO) levels. Salinity, flow conditions, and suspended solids also affect spawning success. The combination of heavy metals such as aluminum with low pH can be detrimental to successful spawning and larval development.

Development has affected the chemical and physical balance of the water quality in spawning areas. For example, the absence of a vegetated buffer between agricultural lands and tributaries can affect critical life stages by allowing nonpoint sources of nutrients to enter the tributary. The runoff may also increase the amount of suspended sediments and contaminants received by these aquatic habitats. Lower DO also is caused by higher water temperatures resulting from the decrease in shade-providing forests along streams. With fewer trees, more sunlight strikes the water. Urban and suburban development adjacent to streams or freshwater tributaries can disrupt natural stream flow conditions through:

1) stormwater inputs and water diversions;

2) increased suspended solids and temperatures;

3) lower DO resulting from point and nonpoint releases of nutrients to the waters;

4) increased water acidity, accelerating the release of heavy metals harmful to eggs and larvae; and

5) released contaminants into the water.

All of these examples decrease the available spawning and nursery areas for certain species of anadromous and resident fish, as well as associated species that depend on the same habitat.

Shallow Water Habitat (Tidal)

Indicator Species

Juvenile fish, crabs, diving ducks, herons

Goals for Restoration

- Restoration of 114,000 acres of submerged aquatic vegetation baywide (Chesapeake Executive Council, 1993c).
- Nonstructural erosion control where possible.
- Restoration of benthic communities to areas of historical occurrence.
- Restoration of tidal marsh acreage to CBP baseline levels.

Habitat Needs

The shallow water or littoral zone provides critical habitat for many species (and life stages) of invertebrates, fish, and waterfowl in the estuarine reaches of the Chesapeake Bay. Small species (e.g., grass shrimp, sand shrimp, and killifish) and juveniles of larger species (e.g., blue crab, spot, croaker, and striped bass) use SAV beds, tidal marshes, and shallow shoreline margins as critical refuge and nursery areas. Large predatory species (e.g., blue crab,

spot, croaker, striped bass, ducks, herons, and raptors) also use the productive shallows as foraging habitat.

While SAV beds, oyster reefs, and tidal marshes are well recognized as critical habitats, the importance of shallow shoreline margins has been less appreciated until recently. Ongoing research at the Smithsonian Environmental Research Center indicates that many small species and individuals of fish and crustaceans use the nearshore as a refuge from larger aquatic predators. Along forested shorelines, fallen trees and limbs significantly increase the refuge value of the nearshore. Because of recent declines in the abundance of SAV and oyster reefs, large woody debris along forested shorelines constitutes the remaining major structural habitat in shallow sub-estuaries, particularly in the mid to upper reaches of the Bay, and has, therefore, assumed increased importance.

Like the Bay's margins, unvegetated intertidal and shallow sub-tidal flats are often overlooked as important habitats. Unvegetated flats are highly productive foraging areas for fauna which use adjacent vegetation and other structural components as refuge from predation. Although shallow, unvegetated flats lack macrovegetation, photosynthetic microorganisms living in the surface layer of bottom sediments play an important role in the biological cycling of dissolved nutrients. Uptake of nutrients by the microbial flora can control the rate that dissolved substances are released across the sediment-water interface—an important factor in their availability for use by phytoplankton and macroalgae. The microbial flora also serve as a food source for the deposit-feeding bottom assemblages, which in turn are fed upon by higher trophic levels represented by crabs and fish.

Shallow sub-estuaries of the Bay thus provide a variety of critical habitats for aquatic species. The integrity and health of the Bay ecosystem are dependent on maintaining a proper mix and distribution of these varied habitat components, including those habitats, such as unvegetated flats and forested shorelines, which were not valued until recently.

Open Water (Tidal)

Indicator Species

Adult fish, shellfish beds/reefs, waterfowl

Goals for Restoration

- Reduce nitrogen and phosphorous to 40 percent of the 1985 levels from controllable sources by the year 2000 (1987 Chesapeake Bay Agreement).
- Designate 5,000 acres each in Maryland and Virginia and 1,000 acres in the Potomac and create new oyster reef habitat there by the year 2000 (Chesapeake Bay Program 1994).
- Reduce the input of chemical contaminants from all controllable sources to levels that result in no toxic or bio-accumulative impact on the living resources that inhabit the Bay (Chesapeake Executive Council 1994).
- Ensure desirable zooplankton and phytoplankton community structure (Chesapeake Executive Council 1993b).

Habitat Needs

Open or pelagic waters provide key habitat for fish species such as striped bass, bluefish, weakfish, American and hickory shad, blueback herring and alewife, as well as bay anchovy and Atlantic menhaden—two of the three finfish species that currently dominate Chesapeake Bay. Over 500,000 wintering ducks including scoters, oldsquaw, mergansers, and some diving ducks also depend on open water for shellfish, benthic invertebrates, and forage fishes.

Fish production depends on both the number of individuals in the population and the growth rates of these individuals. The growth

rate is also closely related to reproductive potential because bigger females often produce more and larger eggs, boosting the rate of larval survival (Zastrow et al. 1989; Monteleone and Houde 1990). Fish growth rates are closely linked to water temperature and food supply. As summer anoxia in the deep trench closes off much of the deep, cooler open water habitat, fish are squeezed into the shallower, warmer parts of the open water. Each fish species has an optimal temperature for growth that is frequently exceeded in these shallower, warmer areas. This habitat squeeze often results in poor growth conditions for the fish. These conditions are accompanied by an increased overlap of habitat between predator and prey (Brandt and Kirsch 1993).

Oyster reefs have a unique and important ecological role in the estuarine environment. An oyster reef is a solid, highly structured ecological community which provides habitat for Bay species of shellfish, finfish, and crabs. The oysters, themselves, also contribute to good water quality since they and other attached reef dwellers are filter feeders, consuming suspended organic particles through bio-filtration.

Inlands and Islands

Indicator Species

American black ducks, colonial waterbirds, and neotropical migratory birds

Goals for Restoration

- Link fragmented riparian corridors for neotropical migratory birds (e.g., hooded warbler) using information from other government programs such as Partners in Flight, Gap Analysis, and riparian surveys.
- Increase the amount of isolated habitat, such as uninhabited islands, through a variety of innovative restoration techniques.

Habitat Needs

Depending on the species, habitat needs range from undisturbed nesting areas to large contiguous tracts of mature upland forest. As a result, efforts must be directed towards the restoration of many habitat types.

Neotropical Migratory Birds

Long-term studies suggest that the populations of many neotropical migratory land bird species are in decline. Habitat loss and degradation have created additional stress at each step of the birds' life cycle including deforestation in the tropics, coastal development along flyways, and forest fragmentation in northern homelands.

In the Chesapeake Bay region, migrants use several habitats such as barrier islands, scrub-shrub, deciduous forests, coniferous forest, and mixed forest. The Atlantic Flyway provides a major route for migratory birds returning to their Central and South American homelands after breeding in North America. A recent report concludes that the coastal habitat from Cape May, New Jersey to Cape Charles, Virginia provides the most significant stopover area for migrating land birds in this flyway (Mabey et al. 1993). The Bay, and much of its watershed, lies within these boundaries.

Neotropical birds also breed within the Bay watershed. Riparian woodlands, coastal shrub-scrub, and upland woodlands in the Bay region are consistently cited as primary breeding habitat for neotropical birds.

Waterfowl

Breeding habitat for black ducks in the Chesapeake Bay has been greatly reduced over the years. These ducks require undisturbed uplands for nesting, situated close to protective coastal marshes where these birds raise their young. In the Bay, offshore islands provide such habitat. Those offshore islands that have trees also provide nesting habitat for colonial waterbirds, eagles, and osprey.

Habitat Restoration Implementation

The following section explains the three-phase process to achieve immediate restoration results during the early implementation phase while building the CBP's ability to target, integrate, and restore key habitat functions.

Phase I

Phase I: Support Existing Restoration Efforts

Objective: *Immediately facilitate habitat restoration projects, research, and monitoring.*

Chesapeake Bay Program Habitat Initiatives

Phase I will incorporate existing CBP commitments, including nutrient reduction strategies for the Bay's major tributaries, removal of blockages to anadromous fish migration, protection of eroding Bay islands and wetlands, restoration of submerged aquatic vegetation (SAV), and creation of aquatic reefs. The framework incorporates other policies and implementation plans, such as the *Wetlands Policy* (Chesapeake Executive Council, 1988b), the *Waterfowl Policy and Management Plan* (Chesapeake Executive Council, 1988b), and the nutrient reduction and tributary strategies.

Many of these efforts focus on the mainstem and tidal tributaries and are not linked to restoration of other habitat types necessary for supporting living resources. This framework complements and enhances these efforts by linking other key habitat restoration projects for maximum effectiveness.

Chesapeake Bay Program funding for habitat restoration began in fiscal year (FY) 1992 with artificial oyster reef projects in Maryland. In FY 1993, the CBP funded the removal of five blockages to allow fish passage and provided funding to rebuild island habitat on Poplar and Bodkin islands. In FY 1994, CBP expanded the scope of its habitat restoration support by funding: two fish passages, a design for a third passage, seed money for the design of a passage at Little Falls dam, and continued funding for Poplar Island, aquatic reefs in Virginia and Maryland, and various wetland, riparian, and stream restoration projects.

Implementation

For Phase I, the HORW will work with workgroup members and other workgroup chairs to solicit habitat restoration projects. The CBP will forward project applications to interested parties along with explanations of information requirements and due dates for submission. Members of the HORW will review all submitted candidate projects and recommend the best projects to the LRSc for funding. Progress will be assessed at annual workshops where current grantees discuss the progress of funded habitat restoration projects and potential grantees are briefed on the contents of the framework, guidelines, and criteria.

The HORW will use annual guidelines and the following criteria to evaluate proposals. The following criteria will allow a comprehensive review of the relative strengths and weaknesses of each project and will give preference to the best overall projects.

- Relationship to Bay Program habitat priorities

The project proposes to restore a priority habitat area as defined in this document (i.e., freshwater tributaries and streams, shallow water, open water, inlands and islands).

- Species of concern habitat benefit

The project specifically addresses a significant habitat need related to an Indicator Species. Also included are species identified as

endangered or threatened, and those defined as "Ecologically Valuable Species" by the LRSc.

- Comprehensiveness

The project considers and addresses all aspects of habitat needs (i.e., chemical, physical, and biological) in the project area. Also, preference is given to a comprehensive, integrated project that addresses habitat requirements of multiple species in the biological community.

- Adequacy of design

The project documents the feasibility and effectiveness of techniques intended to address specific habitat restoration needs.

- Integration with other priority projects or programs

The project is part of an existing comprehensive and integrated proposal (i.e., projects are incorporated into a watershed or tributary planning program). Projects addressing priority problems identified by watershed or tributary programs receive preference.

- Cost-effectiveness

The project meets program objectives in the most cost-effective manner. Preference is given to projects made cost-effective by non-structural measures, volunteers, conservation corps when appropriate, or inclusion of matching funds or other in-kind contributions.

- Ease of Implementation

The project can be implemented in a timely manner. If a project is large, complex, and dependent on multiple funding sources with long-term implementation dates, the portion of the project funded by the CBP should be implemented separately and be consistent with the objectives of the program.

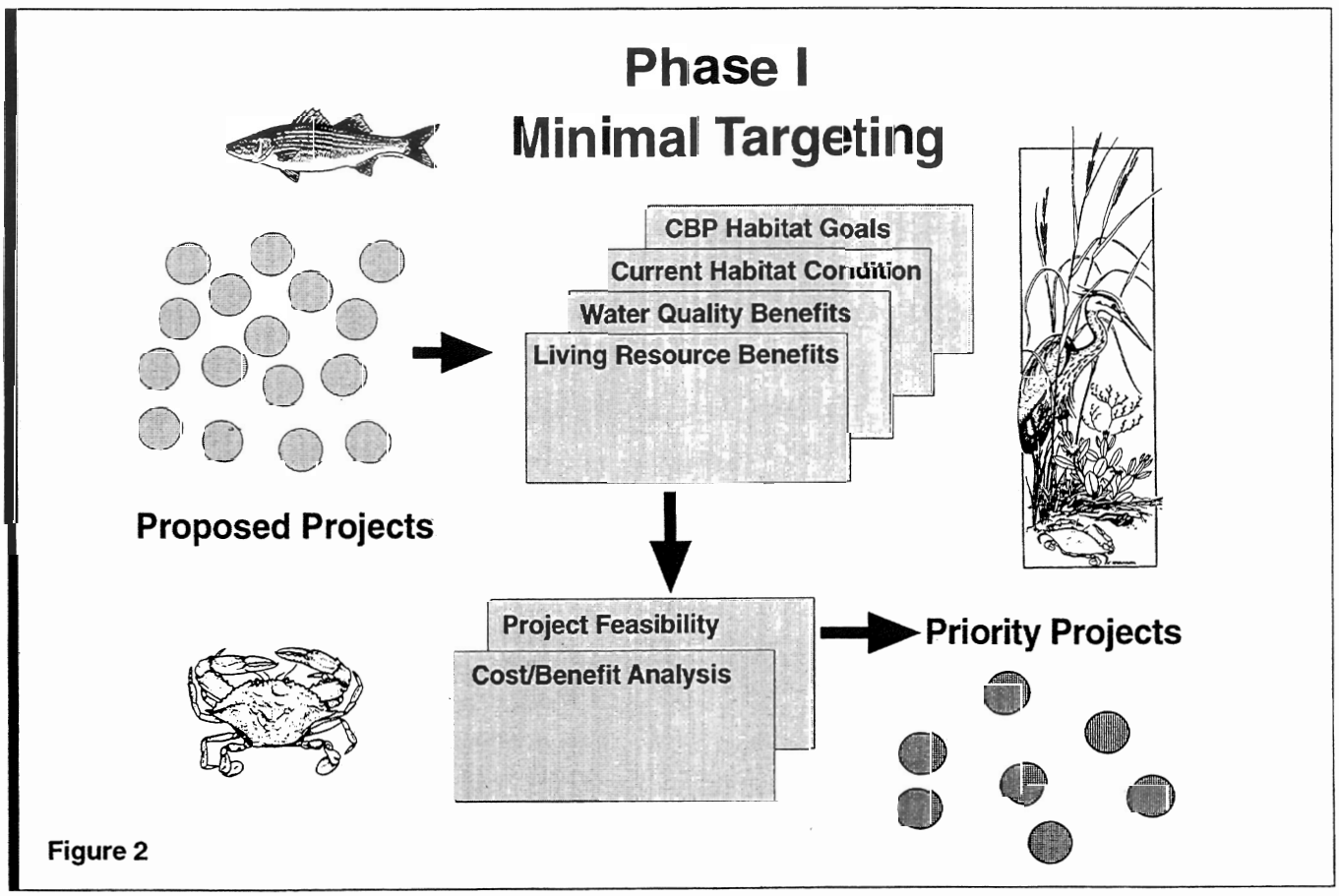

Figure 2

- Management

The project has a maintenance and monitoring component. The applicant must secure a long-term protection and maintenance commitment when habitat restoration activities are conducted on private lands The grantee is responsible for EPA grant reporting requirements.

- Model

The project is designed to serve as a model for future habitat restoration projects and incorporates effective and/or innovative approaches to solving problems.

- Cooperation and support

The project is endorsed by other public agencies, landowners, and parties necessary for successful implementation and long-term viability. Written endorsement is required.

Actions

1) Develop an application and guidelines for interested parties wishing to submit restoration proposals for Phase I CBP funding (HORW). Ongoing from April 1994 and annually thereafter

2) Conduct an annual workshop on restoration techniques and grant application preparation.

3) Continue to identify and implement restoration work in the four priority habitats.

- Seek continued funding for removal of blockages identified in the *Fish Passage Funding Strategy* or its revision (Fish Passage Workgroup). Ongoing from FY 1993
- Seek continued funding for state fish passage coordinators to meet the five and ten-year goals, especially to coordinate complex efforts such as the utility passage work on the Susquehanna River (Fish Passage Workgroup). Ongoing from FY 1993
- Continue support for innovative habitat restoration demonstration projects such as those on Poplar and Barren islands (Wetlands Workgroup). Ongoing from FY 1993
- Implement the Aquatic Reef Habitat Restoration Plan which contains a scientifically-based approach for siting and constructing oyster reefs for ecological purposes (Aquatic Reef Workgroup). Ongoing from FY 1995
- Continue to seek funding for wetland, riparian, and stream restoration activities using the criteria outlined above along with annual guidelines (HORW Workgroup). Ongoing from FY 1994

4) Identify research that is essential in guiding restoration targeting, design specifications, and the understanding of habitat functional dynamics. Promote research projects as appropriate. Ongoing from FY 1994

5) Seek funding for research and training needs to enhance the success of restoration projects. Ongoing from FY 1994

6) Develop an annual report that summarizes habitat restoration progress along with recommendations for improvement (HORW). Ongoing from February 1995

Phase II

Phase II: Habitat Restoration Program Integration and Targeting

Objective: *Develop a process for targeting habitat restoration projects within a landscape or watershed framework.*

Although restoration activities identified in Phase I provide an important short-term goal, a system must be developed that better targets restoration efforts in the long term. With limited funding, restoration projects must occur where they are needed most. The correct identification of optimal restoration sites results in the best use of funding resources.

Phase II will develop an approach to target habitat restoration based on the needs of specific plants and animals or their life stages. This phase depends on effective use of available information on species habitat requirements, distribution and abundance, and the relative condition of the four habitat types across the watershed. Phase II, consequently, will be founded on the development of a GIS that includes information for each targeted habitat area to assist CBP managers in identifying key restoration opportunities. Select information may include: the presence or absence of blockages on anadromous fish spawning habitat; water quality conditions in areas potentially able to support SAV growth; substrate and average salinity conditions for potential reef habitat; linear miles of connected riparian habitat on first, second, and third-order streams; and extent of impervious surface draining into a degraded stream reach.

Site-specific habitat restoration targeting under Phase II will have three basic components: data gathering, data analysis, and restoration targeting. Data gathering includes the immediate use of existing information on habitat requirements, species and habitat distribution and abundance (maps and atlases), and newly acquired data. Targeting will begin with available non-digitized materials.

A variety of data and information sources is essential in building a computer-based GIS that facilitates rapid access to comprehensive habitat and species information, while also providing analytical capabilities. In Phase II, the CPB will fulfill and expand its commitment to establish a GIS. Data "layers" expected to be incorporated into the data base will include: shoreline, watershed boundaries of the tributaries, bathymetry, water quality, submerged aquatic vegetation, wetlands, riparian habitat, stream blockages, land use (urban, agriculture,

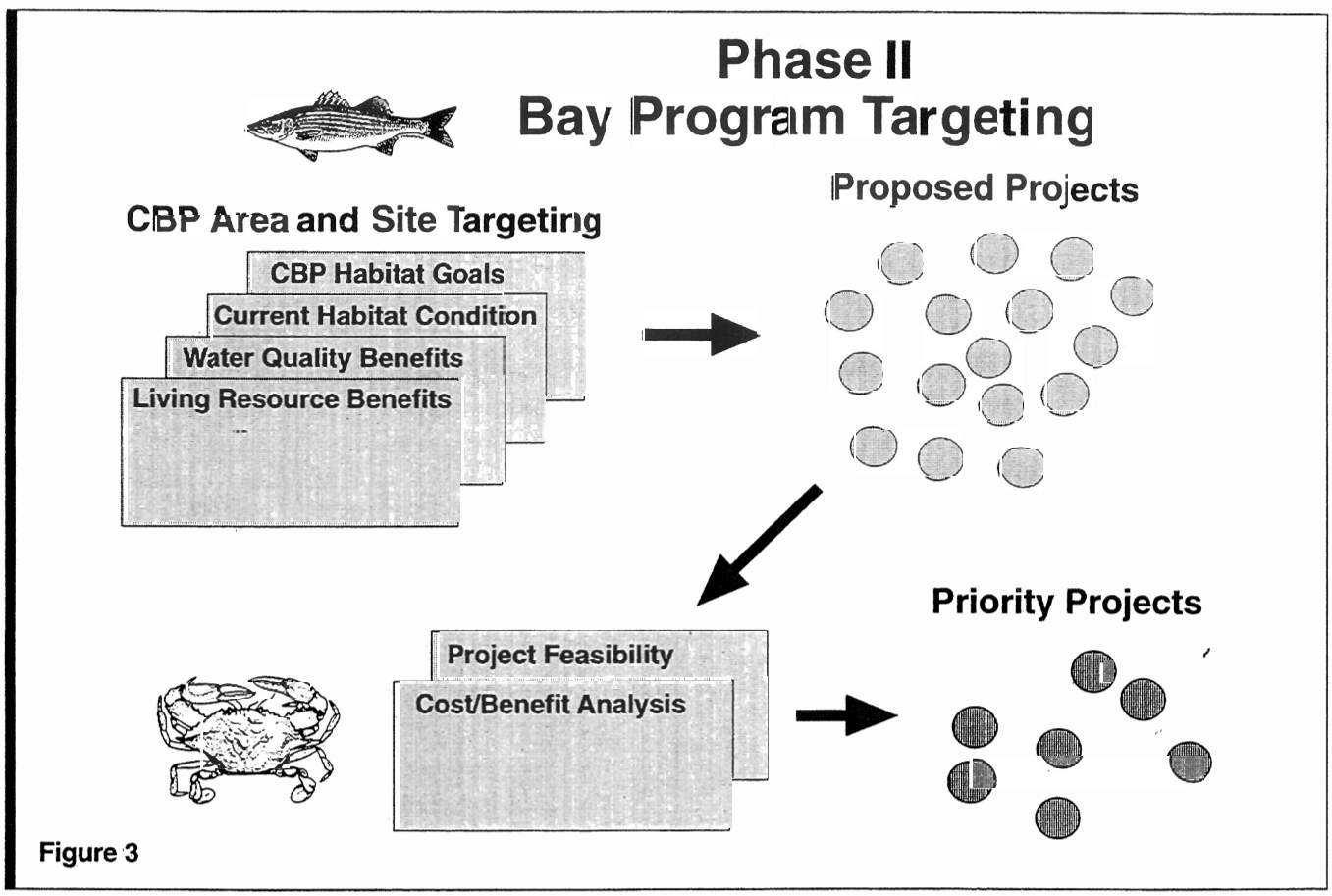

Figure 3

etc.), species spawning and foraging grounds, oyster beds, anoxic and hypoxic expanses of waters, and other spatial data needed to characterize the watershed and estuary.

Restoration targeting will be achieved best when these multiple data layers can be overlaid and analyzed to determine where:

1) indicator species' habitat is most degraded;

2) restoration efforts can benefit multiple species of concern;

3) initial project feasibility can be assessed;

4) costs can be minimized; and

5) intensive targeting establishes models for restoration within select watersheds, particularly as they relate to the nutrient reductions called for in the CBP Tributary Strategies.

Additionally, based on known habitat requirements, data can be generated to characterize conditions of the watershed and estuary needed to meet restoration goals, thereby providing a "benchmark" or relative measure of restoration success.

While actions under this phase are specific to the targeted habitat area, watersheds that incorporate several targeted habitats and associated actions will receive preference. This emphasis will be reflected in changes to project selection criteria developed for Phase I. Phase II targeting will be used as the cornerstone for building the partnerships and networks in Phase III. The following section describes Phase II implementation.

Freshwater Tributaries and Streams

This component will develop a targeting strategy to prioritize project locations. A geographical data base will be one of the tools used to ensure that proposed projects fall within areas suitable for the restoration of anadromous fish spawning. This data base will initially use existing data and expand as new information is developed for habitat requirements, water quality, stream conditions, and land uses.

Using the tributary boundaries established by the tributary strategies, the data base will include all known blockages to spawning grounds, the status of blockage removal or fish passage construction, and historical spawning locations. With this information, proposed sites for anadromous fish habitat restoration can be geographically located. If the site is an historic spawning area with no existing blockages, or if blockages have been targeted for removal within five years, this proposal could be a priority. In addition, riparian habitat and stream survey information will help determine if the proposal is comprehensive.

As other stream survey information becomes available, prioritization of potential habitat restoration sites can be refined by assessing existing conditions in relation to those necessary or optimal for successful anadromous fish spawning. Actions needed for initially compiling the data base follow. Refinement of the targeting method, however, will require the collection of additional information.

Actions

Data Gathering

1) By 1996, develop a GIS to use as a tool in determining target restoration areas (CBP/LRSc Computer Center support).

By FY 1995,

- develop a base map using established tributary strategy boundaries.
- use existing coverage information such as SAV, wetlands, forests, and river reaches.
- acquire blockage and stream survey information agreed to by the Fish Passage Workgroup and signatories.

- develop a survey for the computer center to use in requesting available geographic information for freshwater tributaries and streams.

By FY 1996

- continue acquiring data layers as identified by the HORW and the Fish Passage Workgroup.

2) By 1995, develop techniques for determining anadromous fish spawning habitat restoration projects (HORW/Fish Passage Workgroup).

3) Continue stream surveys in areas where anadromous fish will have access by 2003 (Fish Passage Workgroup).

- Consider the following parameters in stream surveys:
  - canopy cover (riparian habitat)
  - condition of stream channel (physical, chemical, and biological)
  - wetland areas
  - historical habitat
  - land use/ownership (public/private)
  - implement appropriate methods for assessing habitat suitability (e.g., Habitat Suitability Index, Rosgen method).

4) Complete an assessment of the status of riparian forests in the Bay watershed and establish a mechanism for tracking change and assisting with the tributary strategy process (Forestry Workgroup).

Data Analysis

5) Compare water quality results with data from the *Habitat Requirements for Chesapeake Bay Living Resources* (Chesapeake Bay Program, 1991), designated uses, etc. (Criteria and Standards Workgroup).

- Complete the Criteria and Standards data base.
- Analyze existing standards against existing habitat requirements for anadromous spawners, larvae, and juveniles.
- Locate designated use areas in each of the jurisdictions.
- Make recommendations for areas where water quality standards do not meet habitat requirements.

6) Develop better habitat requirements information for anadromous spawners, eggs, larvae, and juveniles (Fishery Management Plan Workgroup/HORW).

Restoration Targeting

7) By 1995, determine five stream reaches best suited for restoration activities to serve as model areas for future basinwide efforts.

Other Priority Actions

8) Complete and begin to implement a Riparian Forest Restoration and Management Plan (Forestry Workgroup).

9) Establish nontidal wetland baseline levels (Wetlands Workgroup).

Shallow Water Habitat (Tidal)

Similar to the freshwater tributaries and streams, this component relies on the expansion of an existing data base system. The expansion already has begun. The consideration of a base map for this information should include tributary strategy coverage as well as other existing information used in the mainstem.

A measure of SAV annual coverage as well as a Tier I SAV restoration goal and a Tier III SAV restoration target have been developed; the Tier II target will be developed in 1996 (see Appendix I for information on tier development). Some information on sediment types exists and SAV aerial photography could be used to assess marsh, flats, and beach conditions in the areas flown for SAV coverage.

Water quality and SAV data exist and projects are underway to understand the linkage between the mainstem water quality monitoring program and nearshore conditions.

By using and expanding our current knowledge, areas can be targeted to ensure that water quality conditions are met and SAV returns. In areas where water quality standards are met but SAV is not returning, transplant pilot projects may be considered. This information is also useful in locating areas for marsh and riparian restoration and to ensure that the shallows are considered when deciding between vegetated and non-vegetated (e.g., bulkheads and riprap) shoreline erosion controls.

Actions

Data Gathering

1) By 1996, develop comprehensive geographic information system to determine target areas for restoration (LRSc Computer Center support).

- Develop a base map. Use existing coverage information such as SAV and bathymetry.
- Use existing data on bivalve distribution and abundance.

Data Needs

- Continue annual SAV aerial surveys and expand to include adjacent marshes and other land cover information (SAV Workgroup).
- Expand citizen monitoring to include SAV and benthic areas (Monitoring Subcommittee and SAV Workgroup).
- Obtain bathymetry and shoreline digitized data (NOAA Chesapeake Bay Office).
- Assess extent of bivalve food resource for waterfowl (National Biological Service).

Data Analysis

3) Develop Tier II SAV restoration target by May 1995 (SAV Workgroup).

4) Refine the relationship between the midchannel monitoring programs and nearshore water quality (Monitoring Subcommittee).

5) Compare water quality criteria and standards for designated and existing uses with monitoring data and habitat requirement information for juvenile fish and crabs to determine whether additional water quality standards are necessary (Criteria and Standards Workgroup).

Restoration Targeting

6) Complete analysis of water quality conditions and presence or absence of SAV by 1995 to determine nearshore areas most suitable for restoration (Chesapeake Bay Program Office).

Other Priority Actions

7) Adopt benthic goals and measure progress (Monitoring Subcommittee and Living Resources Subcommittee).

8) Establish tidal marsh baseline levels (Wetlands Workgroup).

9) Study impact of sea level rise and recommend shoreline restoration techniques (Wetlands Workgroup).

Open Water (Tidal)

For open water habitat, the development of tools such as the water quality and ecosystem processes models to link water quality conditions with living resources is critical. To use these tools effectively, the zooplankton and phytoplankton indicator studies should be continued, ensuring the establishment of linkages between water quality and plankton communities as well as those between the plankton community and fish species. Continued work on the estuarine *multi-metric*

approach will indicate the condition of the open water for fish habitat. The geographic data base will be necessary to best site and design aquatic reefs. Locations of existing oyster reefs, bottom conditions, salinity, and depth are all necessary for this portion of the data base.

Actions

Data Gathering

1) Data base development.

- Complete oyster bar chart digitizing.
- Use existing sediment, salinity, and depth information to site areas for restoring aquatic reefs (Aquatic Reef Workgroup).

2) Conduct surveys of waterfowl using open water habitat to complement existing nearshore mid winter surveys (Waterfowl Workgroup).

Data Analysis

3) Compare dissolved oxygen goals with water quality standards and modeling efforts (Ecologically Valuable Species Workgroup and Criteria and Standards Workgroup).

Restoration Targeting

4) Use existing CBP estuarine index of biotic integrity.

- Incorporate other indicators (benthos and plankton) into the index of biotic integrity (IBI) to target areas for nonpoint source best management practices (Ecologically Valuable Species Workgroup).

5) Aquatic Reefs

- Implement the Aquatic Reef Habitat Restoration Plan that contains a scientifically-based approach for siting and constructing oyster reefs for ecological purposes (Aquatic Reef Workgroup).

Other Priority Actions

6) Monitoring

- Continue with the development of zooplankton indicators and ecosystem models to better understand the linkages between adult fish and water quality more fully (Living Resources Monitoring Workgroup and Monitoring Subcommittee).
- Use monitoring data to develop phytoplankton indicators (Monitoring Subcommittee).

Inlands and Islands

Neotropical Migratory Birds

Management decisions should concentrate on restoring and protecting habitats that benefit many species including breeding and transient birds. A paucity of data regarding individual habitat needs for specific species of interest, coupled with a lack of demographics trend data, suggests the need for increased efforts to measure and monitor biodiversity, habitat conditions, and environmental trends. By determining the specific habitat sites where priority breeding and transient birds occur, habitat restoration efforts can be concentrated on these areas.

Partners in Flight and the Gap Analysis team have collaborated to identify habitat requirements for select neotropical migratory species—to establish where those requirements are met and to identify gaps in the habitats (Stauffer and Best 1980; Mabey et al. 1993). Data base development for inlands and islands will incorporate the results of this work to target areas where habitat gaps occur in the watershed and to prioritize areas where gaps overlap with the restoration needs of other habitat types.

Waterfowl

Like neotropical birds, waterfowl require a variety of habitats for both stopovers and

wintering. The Bay islands provide particularly good habitat for waterfowl such as the black duck because of their relative isolation from human contact. Implementation for inlands and islands includes the identification of those islands that are eroding and those conditions suitable for innovative restoration techniques such as the beneficial use of dredged material.

Actions

Data Gathering

1) Evaluate and measure forest fragmentation and the extent of riparian forest buffers loss (Forestry Workgroup).

Data Analysis

2) Compare and analyze relationships among waterfowl abundance and distribution with that of SAV and bivalves (Waterfowl Workgroup).

Restoration Targeting

3) Work with Partners in Flight and the Gap Analysis team to identify areas within the Chesapeake Bay watershed to restore habitat (HORW).

4) Incorporate Gap Analysis GIS into the Phase II data base for targeting restoration sites (HORW).

Other Priority Actions

5) Seek continued funding to provide technical and financial support for innovative island habitat restoration demonstration projects (Wetlands Workgroup).

6) Develop better technical specifications for forest restoration (Forestry Workgroup).

Phase III

Phase III: Program Coordination

Objective: *Foster partnerships that use the expertise of federal, state, and local governments and public and private efforts to implement effective restoration projects throughout the Chesapeake Bay watershed, using the targeting information provided in Phase II.*

Many natural resource management programs operate within the Chesapeake Bay watershed. While some focus on single components of the landscape (e.g., wetlands or riparian zones), an increasing number are using an ecosystem or watershed approach. The watershed approach encompasses a range of concerns including water quality projects, land development criteria, and habitat restoration initiatives. In recent years, several watershed programs have become operational including the Lackawanna River Citizens Master Plan, the Maryland Targeted Watershed Program, the Anacostia River Watersheds Six Point Action Plan, and the Potomac River Watershed Visions Project (appendices III and IV).

Although development of watershed, ecosystem, and sustainable development management programs continues, no mechanism exists to accommodate the "big picture." In other words, no organization or entity tracks the diverse federal and state efforts within the Chesapeake Bay watershed. Moreover, the laborious process of obtaining financial and technical assistance through established federal, state, and private sources tends to exclude projects initiated at the local or private level.

This lack of a unifying theme begs for an approach that uses existing mandates and interests found within all levels of government and involves citizen groups and industry.

As an example, the U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (Corps), Maryland Port Administration (MPA), and the Alliance for the Chesapeake Bay (Alliance) collaborated at Eastern Neck National Wildlife Refuge to accomplish several objectives. Significant erosion problems were alleviated at the refuge by breakwaters and the placement of clean dredge material. The site was then planted with native wetland plants, securing the area and creating habitat for

species of concern. As a result, mandates for each participating organization were met: MPA disposed of clean dredge material, the Corps dredged while also preventing erosion, the USFWS provided technical assistance in habitat restoration, and the Alliance involved citizens in revegetating the wetland.

The Chesapeake Bay Program seeks to foster these partnerships using Phase II results. As resource needs are determined, Phase III will bring together federal, state, and local activities to target restoration initiatives that address multiple objectives.

Actions

1) Using the list of existing programs in appendices II and III, convene periodic workshops for habitat restoration programs to:

- Develop an understanding and awareness of this strategy and its contents.
- Have program representatives describe existing programs, their focus, level of funding, and limitations (HORW/Federal Agencies Committee - June 1995, 1997).

2) Make accessible and expand the data base developed under Phase II for habitat restoration for use by other habitat restoration programs within the Chesapeake Bay watershed.

3) Conduct workshops for citizens and local government on the importance of habitat, the need to consider impacts of land use on habitat, and restoration techniques and training.

4) Assess the need for a clearinghouse to:

- gather and analyze data for targeting and monitoring restoration activities; and

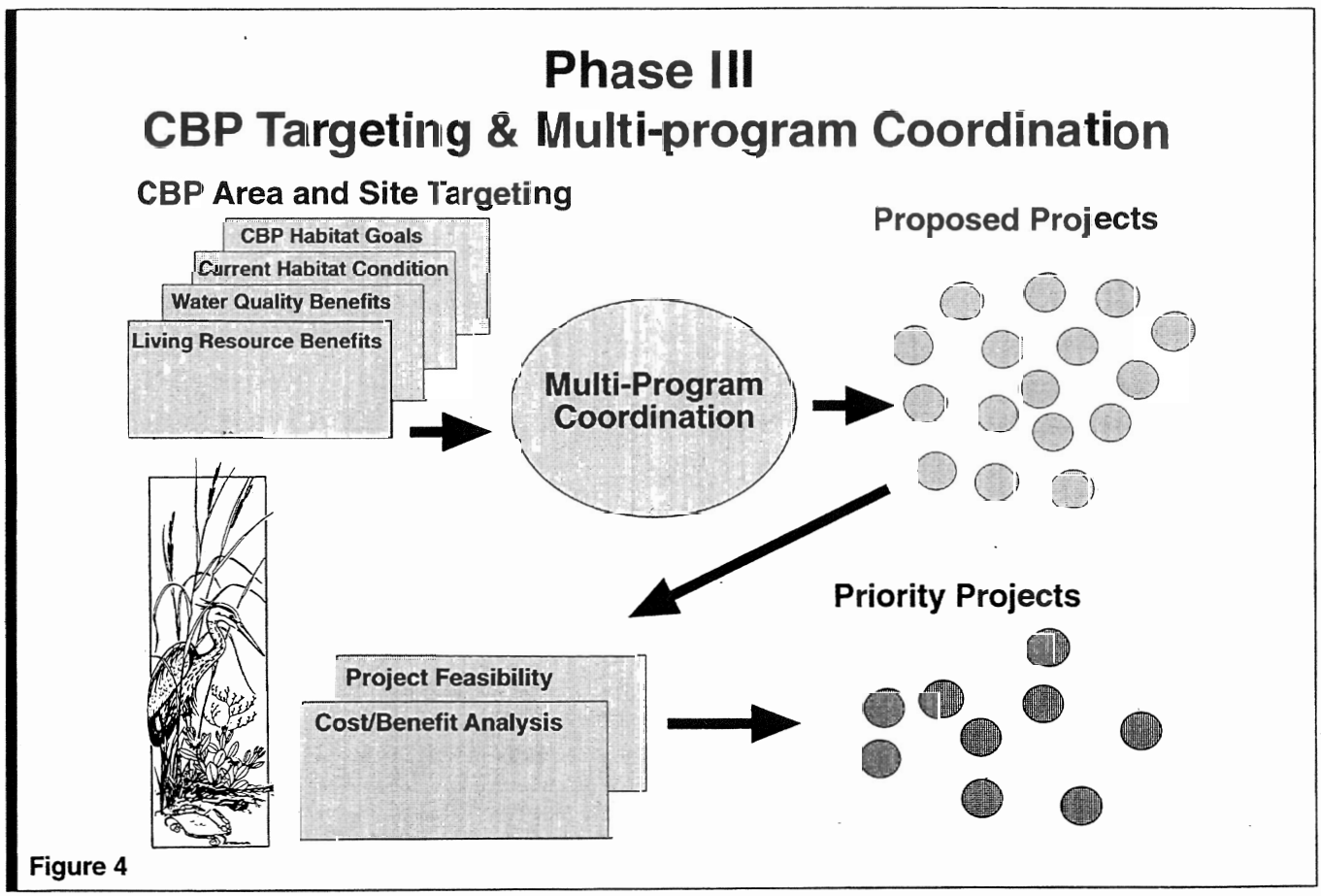

Figure 4

- streamline restoration efforts by providing interested parties with one location for obtaining information on resources (e.g., site availability, funding sources, technical consultants, citizen volunteer groups) necessary for completing a restoration project (HORW - May 1995)

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Appendix 1: Habitat Trends

Migratory Fish Habitat

In the 1987 Chesapeake Bay Agreement, the signatories committed to "provide for fish passage at dams, and remove stream blockages wherever necessary to restore passage for migratory fish" (Chesapeake Executive Council 1987). Projects include notching and breaching dams, constructing fish ways, retrofitting highway culverts, or demolishing blockages. A Baywide Fish Passage Workgroup was established by the LRSc to develop "future fish passage initiatives...and funding recommendations" to facilitate the removal of blockages for upstream fish migration.

The workgroup adopted an official strategy and strategy implementation plan in 1988 and 1989, respectively (Chesapeake Executive Council 1988a and 1989b). As a result, a comprehensive funding strategy was developed which identified and prioritized 25 sites for federal funding. When completed, these projects will restore passage to 226 river miles in the watershed (Fish Passage Workgroup 1992). In addition to Bay Program-supported projects, a multi-agency fish passage project is planned for the Potomac River at Little Falls Dam to restore passage to ten river miles. The workgroup's efforts supplement comprehensive plans for the Patapsco River (U.S. Fish and Wildlife Service 1991) and the James River (Virginia Department of Game and Inland Fisheries 1992).

In 1993, the Chesapeake Executive Council agreed to a ten-year target of opening 1,357 miles of fish spawning habitat along major tributaries with a sub-goal of opening 582 miles within five years (Chesapeake Executive Council, 1993d). As of 1993, over 20 fish passage projects were completed in the watershed, resulting in the opening of nearly 150 miles of stream and their associated habitats (Fish Passage Workgroup, 1993).

Riparian Habitat

A riparian habitat is a complex assemblage of plants and other organisms adjacent to streams and rivers and an integral part of the riverine-riparian ecosystem (National Research Council 1992). Riparian habitats include streambanks, floodplains, and wetlands and form a transitional zone between upland and aquatic habitats. In the Chesapeake Bay watershed, riparian habitat was historically composed of deciduous and mixed forest types.

Ecologically, riparian areas link the flow of energy from terrestrial to aquatic systems and serve as buffers and filters by removing or intercepting sediment, nutrients, organic matter, and pesticides or other pollutants from runoff and subsurface flow before entering the surface waters (Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Kunishi 1988). Riparian areas also moderate stream flooding and temperatures, represent the start of the aquatic food chain by contributing vegetative organic matter to the streams, and serve as habitat for aquatic and terrestrial wildlife (Stauffer and Best 1980; Dickson 1989; Keller et al. 1993).

Although 58 percent of the watershed is forested, forest statistics in their current format cannot be used to determine the extent of riparian forest. The only comprehensive survey for major Maryland river systems indicates from 45 to 74 percent of stream miles have riparian habitat on one side (i.e., have a forested buffer greater than 100 feet wide) and 28 to 44 percent have riparian habitat on both sides.

Wetlands

Wetlands provide valuable functions for the watershed including floodwater storage, removal and processing of nutrients and sus-

pended solids, and habitat for plant and animal species. Although most of the wetlands within the Chesapeake Bay watershed have been delineated and classified through photointerpretation over the last two decades (Cowardin et al. 1979), a watershed-based inventory and complete accounting of their acreage does not exist. Estimates of wetlands status and trends for the Mid-Atlantic states from the mid 1950's to the late 1970's and early 1980's (Tiner and Finn 1986) and for the Chesapeake Bay watershed from 1982 to 1989 (Tiner et al. 1994), however, do exist. The latter report gives estimates of 1.7 million total wetland acres in the watershed. Nontidal forested wetlands made up much of the total acreage (990,000 acres representing 60 percent). Other major wetland types include nontidal shrub-scrub (177,000 acres), salt marshes (170,000 acres), and freshwater marshes (167,000 acres).

Losses of all major wetland types occurred during the survey period. A net loss of about 500 acres of the watershed's salt and brackish marshes occurred primarily from conversion to open water. Freshwater marsh and wet meadow net loss, totaling nearly 4,000 acres, occurred via draining and filling for upland uses or conversion to ponds and lakes. The net loss of shrub wetlands was about 1,000 acres. Forested wetlands sustained the greatest loss of any wetland type during this study period—a net loss of over 14,000 acres. These trends mirror longer term net wetland losses over the past 200 years (Dahl 1990) (Table 1).

Submerged Aquatic Vegetation

At least 16 species of submerged aquatic grasses and macroalgae, collectively termed submerged aquatic vegetation (SAV), occur in the Chesapeake Bay and its tributaries. Beds of these plants provide food and shelter to a wide variety of species such as blue crabs, juvenile fish, and wintering waterfowl, and are an ecological sink for nutrients and suspended sediments. Beginning in the late 1960's and continuing into the 1970's, SAV distribution and abundance declined throughout the Bay due to nutrient enrichment and increased suspended sediment loading (Stevenson and Confer 1978; Orth and Moore 1983).

In 1978, the first baywide aerial SAV survey estimated 40,700 acres of SAV in the saline, brackish, and tidal fresh waters of the Bay and its tributaries (Anderson et al. 1980). The next survey (1984) documented 38,000 acres (Orth et al. 1985). Since that time, annual surveys have shown modest but continued increases in SAV coverage—estimated at

Table 1. Estimated Long-term Wetland Losses (1780 to 1980) in the States of the Chesapeake Bay Watershed

State	Wetland Acres Lost	Percent of Wetlands Lost
Virginia	774,000	42
Maryland	1,210,000	73
Pennsylvania	628,000	56
West Virginia	32,000	24
Delaware	257,000	54
New York	1,537,000	60

Note: Figures and percentages are state totals and include areas both inside and outside the watershed (from Dahl 1990).

70,600 acres in 1993 (Orth et al. 1993). Increases in the late 1980's and early 1990s represent gains in the mid-Bay but are tempered somewhat by slow or no SAV recovery in the upper Bay.

In 1989, the CBP established a policy "to achieve a net gain in submerged aquatic vegetation (SAV) distribution, abundance, and species diversity in the Chesapeake Bay and its tidal tributaries over present populations" (Chesapeake Executive Council 1989a). The CBP's Executive Council, through Directive 93-3, agreed to an interim SAV restoration goal of 114,000 acres baywide. At the current rate of recovery this acreage should be achieved by the year 2005. Finally, the Executive Council directed that a target level be developed for the restoration of SAV to all shallow water areas delineated as existing or potential SAV habitat down to the one-meter depth contour (Tier II (Batiuk 1992)).

The CBP supports development of "regional water quality objectives that will result in restoration of submerged aquatic vegetation through natural revegetation." Direct transplanting of SAV, however, is infeasible for broad-scale restoration. Weather, habitat conditions, and long fetches may discourage transplanting although in some cases select transplanting may occur (Hurley and Reshetiloff, in preparation).

Open Water

In the 1960s and 1970s, massive blue-green algae blooms became common in tributaries with a consequent increase in turbidity and the intensification of summer anoxia in the deep trench. These signs of open water eutrophication focused the Chesapeake Bay Program's initial restoration efforts on nitrogen and phosphorus reductions and led to the development of a 40 percent nutrient reduction goal by the year 2000.

Parallel declines in pelagic fisheries species prompted coordinated efforts to better manage harvests. Progress, however, has been mixed. Whereas tributaries such as the Potomac show local improvement due to reduced point source pollution and striped bass are returning to the Bay after a multi-year fishing moratorium and two favorable spawning seasons, other pelagic fish stocks remain low or continue to decline. Summer anoxia continues to plague much of the mainstem and most of the tributaries and phytoplankton species assemblages still indicate an ecosystem stressed by eutrophication.

Aquatic Reef Habitat

Historically, oyster reefs covered extensive portions of the Chesapeake Bay bottom. The areal extent and physical condition of oyster reef habitat has declined dramatically since the 1870's due to overharvest, excess sedimentation, poor water quality, and diseases. Newell (1988) estimates a 98 percent decline in biomass in the Bay from 1870 to the present.

As a result of their large historical acreage, oyster reefs provided important habitat for other Chesapeake Bay fauna. The reefs continue to provide the major source of natural hard substrate for reef communities in the Bay, and provide food and refuge for many species of fish and crustaceans. The oysters along with the associated benthic species they support, play a significant role in the dynamics of the Bay energy budget. For example, oysters and other filter-feeders transfer energy from plankton to bottom communities (Newell 1988; Ulanowicz and Tuttle 1992).

The CBP is developing an Aquatic Reef Habitat Plan to guide the restoration of aquatic reef habitat in Chesapeake Bay (Chesapeake Executive Council 1994). This plan identifies the need to restore natural oyster reef habitat in Chesapeake Bay and also calls for the creation of a reef sanctuary program.

Maryland and Virginia have implemented programs to create artificial reef habitat in Chesapeake Bay. To date, Virginia has created five artificial reef sites in the lower Bay, be-

tween Glynn Island and Cape Henry, using a variety of materials and techniques (Virginia Marine Resources Commission 1993). Virginia also has an Oyster Reef Replenishment Program, in which natural oyster reefs are restored through the addition of oyster shells and the rearrangement of existing shells. Two sites have been completed: 1) a 0.93 hectare (2.3 acre) site in the Piankatank River was restored by the addition of 200,000 bushels of shells retrieved from shucking houses; and 2) a 5.8 hectare (14.3 acre) site in the James River was restored by raking existing shell into a more pronounced profile then capping the reef with new shell from shucking houses. Virginia is also experimenting with an innovative and cost-effective technique for restoring the vertical profile to natural oyster reefs (James Wesson, personal communication, 1993).

The Maryland artificial reef program—Selected Habitats for Aquatic Reef Ecosystems (S.H.A.R.E.)—creates hard substrate in the Bay for oyster settlement. In 1968, several artificial reef structures were deployed in Maryland waters to evaluate materials and techniques. In the Eastern Bay, a tire-in-concrete reef supports a thriving cover of oysters, aquatic organisms, and associated nekton. The Maryland Oyster Repletion Program, operated by the state's Department of Natural Resources, deposits fossil oyster shell on degraded natural reefs to restore the vertical profile and surface heterogeneity. Replenished reefs continue to be harvested, however, resulting in damage to the reef structure.

Chesapeake Bay Islands

Shoreline erosion of the major islands of the Chesapeake Bay has proceeded in recent years at alarming rates ranging from 1.5 feet to over 31 feet per year (Donham 1992). The worst case scenarios for some areas, such as James, Barren, and Poplar islands, project their disappearance within ten to 50 years. Eroding shoreline bluffs account for island loss in the northern portion of the Bay above the Choptank River, whereas erosion of both marsh edges and interiors occurs in the southerly, seaward islands. Losses are due to sea-level rise, wind, and wave action. In addition to their natural functions as refuges and rookeries for waterbirds, these islands protect expanses of submerged aquatic grasses and productive shallow waters; their demise would be a serious loss of natural resources in the Bay.

In 1992, the EPA funded a project to sink derelict barges off the western shore of Poplar Island to protect the remaining shoreline. In the next phase of this project, the Maryland Port Authority and the Corps will place clean dredge material from routine channel maintenance operations into the shallows of the former island "footprint."

At Eastern Neck National Wildlife Refuge, seven acres of wetlands have been restored and 800 feet of shoreline protected using breakwaters and clean dredge material. The Corps and the USFWS plan similar stabilization and dredge material placement for Barren Island. Properly designed and engineered "beneficial use" of clean dredge material represents the best current means for prolonging the existence of these islands.

Appendices II to IV
Habitat Restoration Programs

Agency	Fish Passage	Riparian	Streams	Aq. Reefs	SAV	Tidal Wetlands	Non-tidal Wetlands	C.B. Islands	Forests
Federal									
USDA - ASCS		3*				4	1, 2, 4, 5, 6, 23		5, 6, 23
USDA - SCS		3				4	1, 2, 4		
USDA - FS		5, 6					5, 6		5, 6
USDOI - FWS		7	7			8, 9, 10	7, 8, 9	8, 9, 10	7
USDOC - NOAA	11	11	11		11	11	11		
EPA	12	12	12	12	12	12	12	12	
COE	14, 16	14	14		13, 14	13, 14	13, 14	15, 16	
State									
PA - Game Comm.		17	17						
PA - Fish & Boat	18	18	18						
PA DOT	19	19	19				19		19
PA - DEP		20	22				20,21		20
PA - DCA		22					21		
MD DNR		23, 24, 25, 26, 27, 28	28			30	23, 24, 25, 26, 27, 28, 29, 31		24, 26, 27
MDE		32	32			32	32		
MD - DOT	33	33	33			33	33		33
VA - DOT	34	34	34			34	34		34
VA - DCR		35, 36, 37, 38, 40, 41	35, 36, 38, 40			39			36, 37, 42
VA - DGIF	43	43	43			43			
MWCOG	44	44	44			44	44		44
Other									
MD Env. Trust		45	45			45	45		
C.B. Trust		46	46			46	46		
PA Org. Watersheds	47	47	47				47		
Waterfowl Festival						48	48		
Ducks Unlimited						49	49		
M.A.R.S.H.						48	48		
Nat'l Fish & Wildlife Foundation	51	51	51			51	51	51	51

* See following descriptions

Appendix 2: Federal Programs and Corresponding State Offices

The following federal and state offices can answer questions on restoration and conservation. For a complete program description and questions regarding the applicability of a program within a state, contact the agency's state office responsible for that program. No single program offers financial and technical assistance such as design, construction procedures, and establishment of native species for a complete restoration project but each will address a particular phase of a project.

U.S. Department of Agriculture

USDA, Consolidated Farm Service Agency and the Natural Resources Conservation Service

1) The Wetlands Reserve Program is available for landowners in Virginia, Maryland, Pennsylvania, and New York. Under the program, permanent easements are purchased from participating landowners of farmed wetlands, prior converted wetlands, and riparian areas that link wetlands. Participants agree to accept no more than the fair market value in return for a lump sum payment and cost-share assistance (up to 75 percent) for implementing wetland restoration projects.

2) The Agricultural Conservation Program provides cost-share funds and technical assistance to establish permanent vegetative cover, erosion control, wildlife enhancement, and development of new shallow water areas or restoration of existing ones. The USDA will pay up to 75 percent of the total cost with a maximum of $3,500 per year.

3) The Conservation Reserve Program encourages the enrollment of highly erodible cropland or land contributing to poor water quality into reserve. Land that is entered into the program under the filter strip provision does not have to meet erodibility criteria and may be planted with grasses, trees, shrubs, or other forbs beneficial to wildlife. Farmers receive rental payments, cost sharing, and technical assistance to plant vegetation that decreases soil erosion and sedimentation. Annual rental payments may not exceed $50,000 per person per year. Up to a 50 percent cost share is available for establishing vegetative cover, including trees, water quality improvements, and other conservation measures. (Note: Funds are depleted in most states)

   All three programs are offered through county offices of the Consolidated Farm Service Agency. The Natural Resources Conservation Service, through local Soil Conservation District Offices, provides technical support for these programs.

4) The Shallow-water Wildlife Areas Program provides up to 65 percent of the cost to develop or restore shallow water areas for wildlife habitat. Funding is available for construction costs, creation, and protection of wildlife habitat and cover.

USDA, Consolidated Farm
Service Agency
Conservation and Environmental
Protection Division
P.O. Box 2415, Room 4725
Washington, DC 20013

USDA, Natural Resources Conservation Service
Conservation Planning Division
P.O. Box 2890
Washington, DC 20013
(202) 720-1845

U.S. Department of Agriculture
Pennsylvania State CFSA Office
1 Credit Union Place, Suite 320
Harrisburg, PA 17110
(717) 782-4593

U.S. Dept. of Agriculture
Natural Resources Conservation Service
1 Credit Union Place, Suite 340
Harrisburg, PA 17110
(717) 782-2202

U.S. Department of Agriculture
Maryland State CFSA Office
8335 Guilford Rd.
Columbia, MD 21046
(410) 381-4550

U.S. Dept. of Agriculture
Natural Resources Conservation Service
Suite 301
339 Busch's Frontage Road
Annapolis, MD 21401
(410) 757-0861

U.S. Department of Agriculture
Virginia State CFSA Office
Federal Building
400 North 8th Street
Richmond, VA 23240
(804) 771-2591

U.S. Dept. of Agriculture
Natural Resources Conservation Service
Federal Building
400 North 8th St., Rm. 9201
Richmond, VA 23240
(804) 771-2455

U.S. Forest Service

5) The Forestry Incentives Program provides cost-share assistance (up to 65 percent) for the preservation and restoration of wooded swamps. Assistance includes a forest management plan, technical advice on enhancement of wildlife habitat, inventory and status of vegetation, management of endangered species, and help locating approved vendors.

6) The Forest Stewardship Program/Stewardship Incentive Program provides a cost share of up 65 percent to enhance forest lands and associated wetlands. Assistance may not exceed $10,000 per year per person. Technical assistance is available for wetland and soil type identification, vegetation status and inventory, and endangered species identification and management plans.

U.S. Department of Agriculture, U.S. Forest Service
Cooperative Forestry Staff
Auditors Building
201 14th Street, SW
Washington, DC 20250
(202) 205-1374

Both programs are offered through county offices of the Agricultural Stabilization and Conservation Service. The Maryland Department of Natural Resources provides technical support for these programs.

U.S. Department of the Interior

U.S. Fish and Wildlife Service

7) The Private Lands Assistance and Restoration Program (Partners for Wildlife) provides up to $10,000 per project ($500 to $1,000 per acre maximum) to restore degraded or prior converted wetlands along with riparian and forested areas. Technical assistance is available for reestablishing natural communities, promoting habitat for endangered, threatened, or candidate species, and designing self-sustaining projects.

8) The North American Waterfowl Management Plan Joint Venture Projects offer financial assistance for the restoration of wetlands significant to waterfowl and other wetland-dependent species.

9) The North American Wetlands Conservation Act provides funding for wetland conservation projects involving acquisition, restoration, and enhancement. Grants require a minimum one-to-one grant match from any non-federal source.

10) The National Coastal Wetlands Conservation Grants Program provides a 50 percent cost-share to states for the acquisition, restoration, and management of wetlands and other coastal resources.

U.S. Fish and Wildlife Service
North American Waterfowl and
Wetlands Office
4401 N. Fairfax Drive
Arlington, VA 22203
(703) 358-1784

North American Waterfowl
Management Plan
Atlantic Coast Joint
Venture Coordinator
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
(413) 253-8301

National Coastal Wetlands
Conservation Grants Program
Deputy Assistant Regional Director
Division of Federal Aid
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
(413) 253-8501

U.S. Fish and Wildlife Service
Pennsylvania Field Office
315 S. Allen St., Suite 322
State College, PA 16801
(814) 234-4092

U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401
(410) 573-4500

U.S. Fish and Wildlife Service
Virginia Field Office
P.O. Box 480
White Marsh, VA 23183
(804) 693-6694

U.S. Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)

11) NOAA operates several programs related to habitat restoration: habitat research, habitat protection, endangered and threatened species protection, fishery conservation and management, coastal zone management, and marine sanctuaries and estuarine research reserves. NOAA offers technical assistance in these areas.

NOAA also participates in the Coastal America Program, which forms regional federal, state, and local partnerships to solve priority coastal problems such as habitat loss, nonpoint source pollution, and dredged material disposal. NOAA administers the National Sea Grant College Program and several small grant programs that could perform habitat restoration work: Interjurisdictional Fisheries Act and Anadromous Fish Conservation Act grants to states and the Saltonstall-Kennedy Act, Chesapeake Bay Studies, and Oyster Disease Research competitive cooperative agreements.

For all NOAA programs:

NOAA Chesapeake Bay Office
410 Severn Avenue, Suite 107A
Annapolis, MD 21403
(410) 267-5660

For state-level programs (coastal zone management, Sea Grant):

Maryland Department of
Natural Resources
Tidewater Administration
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401

Sea Grant College Program
0112 Skinner Hall
University of Maryland
College Park, MD 20742
(310) 405-6371

Commonwealth of Virginia
Department of Environmental
Quality
P.O. Box 1009
629 E. Main Street
Richmond, VA 23240

Sea Grant College Program
Madison House
170 Rugby Road
University of Virginia
Charlottesville, VA 22903
(804) 924-5965

U.S. Environmental Protection Agency

12) Under Section 319(h) of the Federal Clean Water Act, the Environmental Protection Agency (EPA) has established nine general nonpoint source (NPS) pollution categories that affect surface and ground waters. These categories include: agriculture, silviculture, construction, urban runoff, resource extraction/exploration/development, land disposal (runoff/leachate from permitted areas), hydrologic/habitat modification (streambank modification), other (atmospheric deposition, storage tank leaks and spills), and unknown sources. States address NPS pollution by developing

assessment reports, adopting management programs, and implementing these management programs.

Section 319(h) provides grants to states to assist in implementing specific programs and best management practices addressed in the state management plans. A new component for these grants are projects dealing with watershed resource restoration. Ten percent of the funding must be spent for projects to restore wetlands, lakes, rivers, streams, shorelines, riparian areas, seagrass beds, and other aquatic habitat.

The implementation of 319(h) NPS grant projects begins with an annual solicitation for NPS pollution prevention/remediation projects from eligible organizations, agencies, and associations, among others. The solicitation process varies by state. Approved projects and funds vary annually.

Environmental Protection Agency
Chesapeake Bay Program
410 Severn Avenue, Suite 109
Annapolis, MD 21403
(410) 267-5700
(800) 968-7229

Pennsylvania Department of
Environmental Protection
Bureau of Land and Water Conservation
Nonpoint Source Section
P.O. Box 8555
Harrisburg, PA 17105
(717) 787-5259

Maryland Department of the Environment
Chesapeake Bay Watershed Administration
Nonpoint Source Division
2500 Broening Highway, Building 30
Baltimore, MD 21224
(410) 631-3584

Virginia Soil and Water Conservation
Department of Conservation and
Recreation
203 Governor Street #106
Richmond, VA 23219
(804) 786-4382

Department of Defense

U.S. Army Corps of Engineers (COE)

13) Section 204, Water Resources Development Act of 1992 authorizes the Secretary of the Army to carry out projects for the protection, restoration, and creation of aquatic and ecologically-related habitats including wetlands, in connection with dredging for construction, operation, or maintenance of an authorized federal navigation project.

14) Section 1135(b) of the Water Resources Development Act of 1986 allows the COE to carry out a program to investigate, study, modify, and construct projects for the restoration of fish and wildlife habitat where degradation is attributable to water resource projects constructed by the Corps of Engineers.

15) Section 22, Water Resources Development Act of 1974 provides authority for the Corps of Engineers to assist states in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources. Typical studies involve the analysis of existing data for planning purposes using standard engineering techniques. Most studies become the basis for state and local planning decisions.

16) In addition to the authorities described above, the Corps of Engineers has specific authority for the study of potential habitat restoration projects. Examples of such projects include Susquehanna River Basin Fish Restoration and Poplar and Bodkin Islands Habitat Restoration.

U.S. Army Corps of Engineers
Baltimore District
Planning Division
P.O. Box 1715
Baltimore, MD 21203
(410) 962-4900

U.S. Army Corps of Engineers
Philadelphia District
Planning Division
100 Penn Square East
Philadelphia, PA 19107
(215) 656-6540

U.S. Army Corps of Engineers
Norfolk District
Planning Division
803 Front Street
Norfolk, VA 23510
(804) 441-7761

Appendix 3: State Programs

Pennsylvania Programs and Corresponding Offices

17) The Stream Bank Fencing Program provides funds for installation and fencing to keep livestock away from the streambanks and out of streams. Technical assistance is available for planting tree and shrub species suitable for streambank stabilization and wildlife habitat.

Pennsylvania Game Commission
Stream Bank Fencing Program
2001 Elmerton Avenue
Harrisburg, PA 17710
(717) 787-4250

Bureau of Land and Water Conservation
P.O. Box 8555
Harrisburg, PA 17105
(717) 787-5259

18) The Adopt-A-Stream Program provides supervision, tools, and equipment for fish habitat improvements and restoration and stream corridor management. Aquatic and habitat surveys and technical designs are available. The commission will provide certain materials for projects on a 50/50 matching basis, not exceeding $500 in materials per year. The commission will purchase the materials deemed necessary.

Pennsylvania Fish and Boat Commission
Adopt-A-Stream Program
P.O. Box 1673
Harrisburg, PA 17105
(717) 657-4518

Pennsylvania Fish and Boat Commission
Adopt-A-Stream Program
450 Robinson Lane
Bellefonte, PA 16832
(814) 359-5219

19) The Surface Transportation Program (STP) funds enhancement projects that add community or environmental value to any active or completed transportation project. Ten percent of the state's share of the STP has averaged approximately $9.1 million. Project sponsors must provide at least 20 percent of the cost. Matches may include the value of right-of-way donations, engineering, and maintenance.

Pennsylvania Department of Transportation
Transportation and Safety Bldg. - Room 918
Harrisburg, PA 17120
(717) 787-5246

20) The Pennsylvania Forest Stewardship Program and Stewardship Incentive Program assists residents who own five or more acres of woodland. Cost-share money is available to

develop a woodland management plan. The Stewardship Incentive Program includes practices for the protection, restoration, and improvement of wetlands and riparian areas.

Pennsylvania Forest Stewardship Program
Bureau of Forestry
PA Department of Environmental Protection
P.O. Box 8552
Harrisburg, PA 17105
(717) 787-2106

21) The Pennsylvania Wetlands Program provides educational and technical assistance to county conservation districts, landowners, and other commonwealth agencies to restore, protect, or enhance wetlands.

Division of Wetlands Protection
Bureau of Dams, Waterways and Wetlands
PA Department of Environmental Protection
P.O. Box 8554
Harrisburg, PA 17105
(717) 787-6827

22) The Keystone Recreation, Park and Conservation Fund provides a guaranteed funding source for parks and recreation facilities and natural areas including river protection and conservation. A $50 million bond issue and 15 percent of the state's realty transfer tax receipts will be put in the fund which will also benefit historic sites, educational facilities, zoos, and public libraries.

Bureau of Recreation and Conservation
Department of Community Affairs
Room 522 Forum Building
Harrisburg, PA 17120
(717) 783-2658

Program Planning and Development
PA Department of Environmental Protection
P.O. Box 8475
Harrisburg, PA 17105
(717) 787-2316

Maryland Programs and Corresponding Offices

Maryland Department of Natural Resources

23) The Forestry Incentives Program and the Forest Stewardship Program/Stewardship Incentive Program (see Appendix I, USDA, Forest Service, Agricultural Stabilization and Conservation Service).

24) The Woodland Incentives Program provides cost-share and technical assistance for the reforestation of open land or cutover woodlands and the management and enhancement of woodlands and forested wetlands. The program provides up to 50 percent of the project cost, not exceeding $5,000 per year in funding.

25) The Buffer Incentives Program offers $500 per acre for the establishment of forested buffer strips. Technical assistance is available for site preparation, methods of plantings, spacing, and deciding on appropriate tree and shrub species.

26) The Westvaco Cost-Share Program provides a 50 percent cost share for reforestation including forested wetlands. Site selection, planting, and other technical assistance are available.

27) The Glatfelter Cost-Share Program provides a 50 percent cost share for the purchase of seedlings (minimum order of 1,000 plants) for reforestation including forested wetlands. Technical assistance is available for all phases of planting.

Maryland Department of Natural Resources
Forestry Division, E-1
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401
(410) 974-3776

28) Program Open Space provides 100 percent assistance to counties for land acquisition and 75 percent assistance with the improvement and development of recreation areas. Wetlands, wildlife habitat, stream protection, and historical significance are a few of the criteria for project funding. Although the funding is not specifically for restoration projects, it is a valuable step in land acquisition.

Maryland Department of Natural Resources
Program Open Space, E-3
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD
(410) 974-3589

29) The Maryland Nontidal Wetlands Program provides educational and technical assistance to landowners, private organizations, developers, and others to minimize impacts on existing wetlands and recommend ways to restore, protect, enhance, and conserve nontidal wetlands through other financially funded programs.

Maryland Department of Natural Resources
Nontidal Wetlands Division E-2
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401
(410) 974-3841

30) The Maryland Non-structural Shore Erosion Control Act provides cost share of 50 percent of the design and construction costs to halt or decrease shoreline erosion. Revegetation reduces erosion and restores wetland habitats along the shore. Technical assistance includes soil conservation practices, grading, stormwater management techniques, and identifying other wetland assistance programs.

Maryland Department of Natural Resources
Shore Erosion Control, E-4
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401
(410) 974-3727

31) The Maryland Waterfowl Restoration Program provides technical assistance for waterfowl conservation on private lands through a ten-year license agreement with landowners to create or rehabilitate ten acres or more of wetland habitat. Landowner expenditures constitute a tax deductible contribution to the state.

Maryland Department of Natural Resources
Wildlife Division, E-1
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401
(410) 974-3195

Maryland Department of the Environment

32) The Small Streams and Estuary Restoration Cost-Share Program is available to state and local governmental entities. For most projects, the program will fund up to 50 percent of eligible costs, which may include feasibility, design, administration, and construction. Matching funds may include in-kind services but may not include funds from other Maryland agencies.

Maryland Department of the Environment
Non-point Source Capital Programs
2500 Broening Highway
Baltimore, MD 21224
(410) 631-3520

Maryland Department of Transportation

The Maryland Department of Transportation offers one program that is available to interest groups and other state and local governments.

33) The Surface Transportation Program (STP) funds enhancement projects that add community or environmental value to any active or completed transportation project. Ten percent of the state's share of the STP has averaged approximately $6.5 million during the last three years. Project sponsors must provide at least 50 percent of the cost. The match could include the value of right-of-way donations, engineering, maintenance, or volunteer labor. Project sponsors will be

reimbursed for expenditures only after federal funds are obligated and a memorandum of agreement is executed.

Maryland State Highway Administration
Regional and Intermodal Planning
707 N. Calvert Street, Room 213
Baltimore, MD 21203
(410) 333-1145

Virginia Programs and Corresponding Offices

The Virginia Department of Transportation offers one program, available to interest groups and other state and local governments.

34) The Surface Transportation Program (STP) funds enhancement projects that add community or environmental value to any active or completed transportation project. Ten percent of the state's share of the STP has averaged approximately $7.5 million. Project sponsors must provide at least 20 percent of the cost. The match could include the value of right-of-way donations, engineering, and maintenance.

Virginia Department of Transportation
Program Section
1221 E. Broad Street
Richmond, VA 23219
(804) 786-2919

The Virginia Department of Conservation and Recreation offers eight agricultural BMP cost-share programs available to private landowners only.

35) The Grazing Land Protection Program provides a 75 percent cost-share up to $7,500 per person per year for livestock water systems and fencing to eliminate direct access to streams. The Natural Resources Conservation Service (NRSC) has technical responsibility for the program.

36) The Permanent Vegetation Cover on Critical Areas Program provides up to $7,500 per person per year for land shaping and planting permanent vegetative cover on critically eroding areas. The Natural Resources Conservation Service has technical responsibility for the program (except for logging trails, skid trails, and any other component where tree planting is recommended) which is assigned to the Virginia Department of Forestry.

37) The Reforestation of Erodible Crop and Pasture Land Program is a one-time incentive payment of $75 per acre to stabilize land by planting trees. Cost-share assistance for the planting process (site preparation, seedlings, labor, etc.) is permissible from other sources. The Virginia Department of Forestry has technical responsibility for the program.

38) The Stream Protection Program provides a cost share of 75 percent of the expense of streambank stabilization, fencing, and livestock crossings. Streams must border agricultural or forested lands and must be fresh water. The Natural Resources Conservation Service has technical responsibility for the program.

39) The Vegetative Stabilization of Marsh Fringe Areas Program provides a one-time 50 percent cost-share for the purchase and cost of transplanting, labor, fertilizer, and on-site preparation (other than structural) to establish marsh grass plant species. The DSWC - Shoreline Erosion Advisory Service has technical responsibility for the program.

40) The Woodland Buffer Filter Area Program provides a one-time incentive payment of $100 per acre for the establishment of shrubs and forest tree species along streams. Cost-share assistance for the planting process (site preparation, seedlings, labor, etc.) is permissible from other sources. The Virginia Department of Forestry has technical responsibility for the program.

41) The Grass Filter Strip Program provides a one-time filter strip cost-share of 10¢ per linear foot for 25 feet or wider strips. The Natural Resources Conservation Service has technical responsibility for the program.

42) The Woodland Erosion Stabilization Program provides financial assistance for land grading and planting permanent vegetation on critically eroding areas on forest harvesting sites. The program requires that the state cost-share payment, alone or combined with any other cost-share program, will not exceed 75 percent of the total eligible costs. The Virginia Department of Forestry has technical responsibility for the program.

Department of Conservation and Recreation
Division of Soil and Water Conservation
203 Governor Street, Suite 206
Richmond, VA 23219
(804) 786-2064

Virginia Department of Game and Inland Fisheries

43) The Wildlife Habitat Program provides information on how to enhance a variety of wildlife habitats. Participating nurseries can supply discounted plant materials.

Virginia Department of Game and Inland Fisheries
Wildlife Habitat Program
P.O. Box 1104
Richmond, VA 23230
(800) 252-7717
(804) 367-1000

District of Columbia Programs and Corresponding Offices

44) The Metropolitan Washington Council of Governments can provide information on the multi-agency Anacostia River Restoration Program.

Metropolitan Washington Council of Governments
Department of Environmental Programs
777 North Capitol Street
Washington, DC 20002
(202) 962-3340

Appendix 4: National, State, and Regional Land Trusts and Private Organizations

45) Maryland Environmental Trust

The Maryland Environmental Trust Conservation Easement Program provides financial and technical assistance.

100 Community Place, First Floor
Crownsville, MD 21032
(410) 514-7900

46) Chesapeake Bay Trust

The trust provides financial, technical, and educational assistance.

60 West Street
Annapolis, MD 21401
(410) 974-2941

47) Pennsylvania Organization for Watersheds and Rivers

This organization provides technical and educational assistance to river groups.

P.O. Box 765
Harrisburg, PA 17108
(717) 236-8825

48) Chesapeake Wildlife Heritage Waterfowl Festival

Chesapeake Care Program provides technical, and educational assistance.

P.O. Box 1745
Easton, MD 21601
(410) 822-5100

49) Ducks Unlimited

The Matching Aid to Restore States Habitat (MARSH) Program provides technical and educational assistance.

1155 Connecticut Avenue, NW #800
Washington, DC 20036
(202) 452-8824

50) MARSH Atlantic Flyway Coordinator

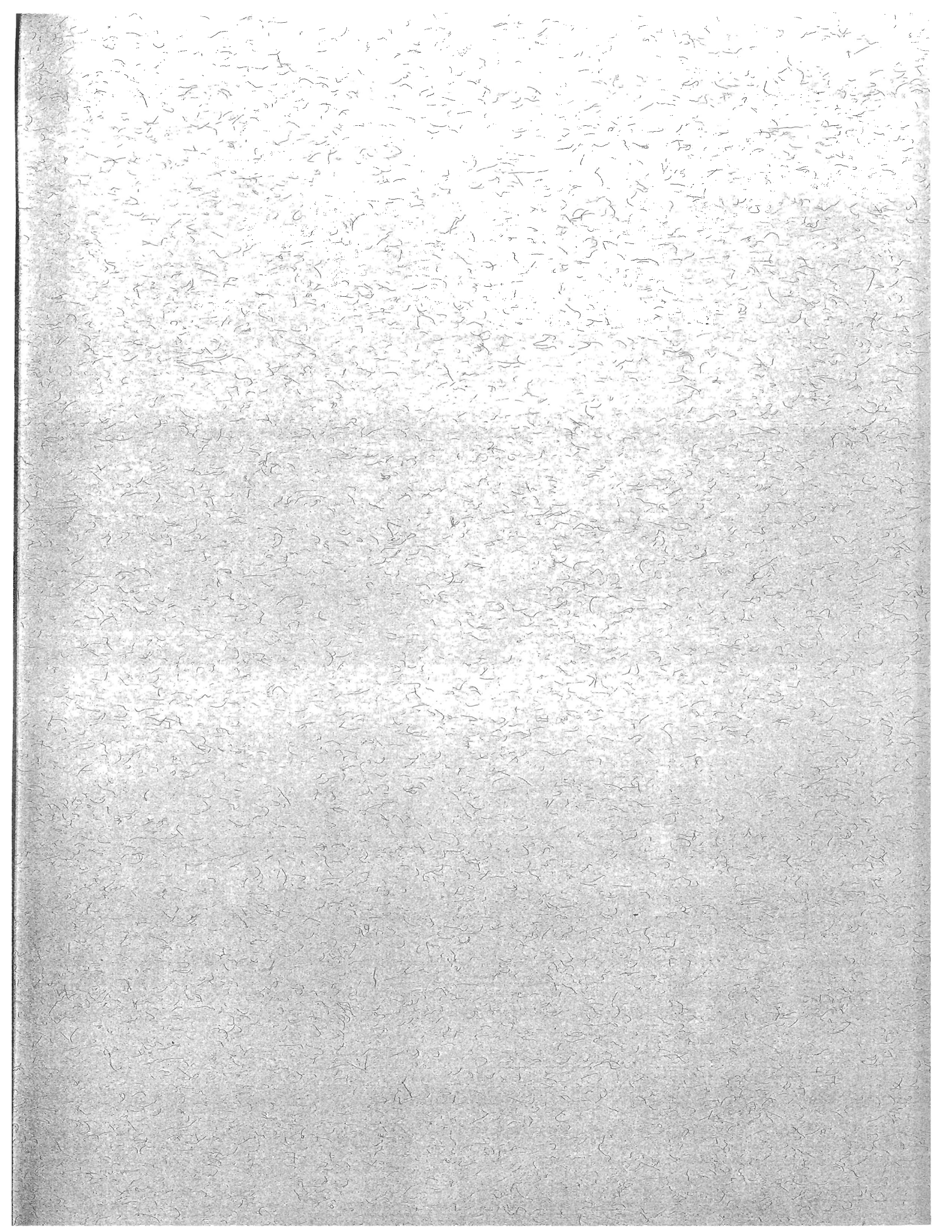
The Matching Aid to Restore States Habitat (MARSH) Program provides technical and educational assistance.

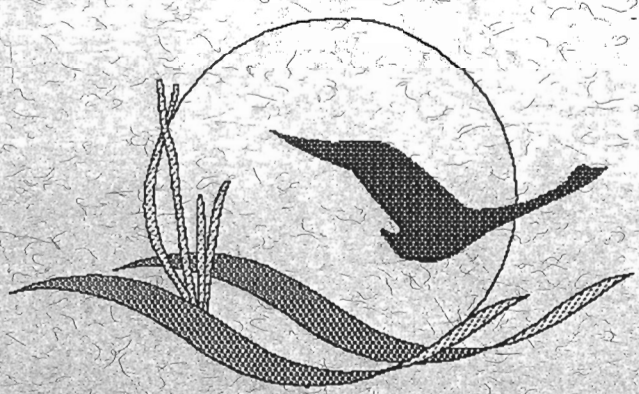
219 County Road
Bedford, NH 03102
(603) 626-7706

51) National Fish and Wildlife Foundation

The foundation provides matching funds to state and private organizations (non-federal match required).

1120 Connecticut Avenue, NW, Suite 900
Washington, DC 20036
(202) 857-0166





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