SURVEY OF THE ECOLOGICALLY SIGNIFICANT NATURAL AREAS OF THE CHESAPEAKE BAY REGION

Smithsonian Center for Natural Areas

ECOLOGY PROGRAM
SMITHSONIAN INSTITUTION

July 1, 1973

Dale W. Jenkins, Ph.D.
Principal Investigator

Jenkins, Dale W.
Survey of the ecologically significant natural areas of the Chesapeake Bay Reg

TABLE OF CONTENTS

CHESAPEAKE BAY REGION

PREFACE

Even the most casual traveller in Europe soon notices that the landscape,however picturesque, is never really wild, untampered with, or natural. Over the past 2,000 years virtually every square foot has been cropped, grazed, landscaped, or "improved" to such an extent that all memory, much less actual fragments, of the original environment has been lost. A classic and ironic example of this can be found in Scotland where the uplands were cleared of their pine and oak forests centuries ago to increase grazing land for vast flocks of sheep. The moorland which replaced the forest has become so much a part of the upland Scottish scene that governmental efforts to reforest certain areas have been vociferously denounced by Scots vitally concerned with preservation of the status quo.

In North America this point has not yet been reached; despite the herculean effort made in the last 300 years to cut and plow, drain or flood, level, fill, pave, and build, this continent still has an incredible diversity and relative abundance of natural areas, many hardly changed from their appearance a thousand years ago. Even in those areas that have been manipulated in some way — logged over, burned, or farmed - the links with the past are everywhere evident allowing the possibility, at least, of future restoration — an option no longer available over much of Europe.

When first seen by settlers from a rather worked over England the natural riches of this estuary, Chesapeake Bay, were mind boggling. Deep fertile soil, fish, shellfish, waterfowl, and game surpassed anything known in Europe for the preceding thousand years. Contemporary descriptions seem utopian by today's standards. It couldn't last, of course, and in a few generations (notice that it took several generations) tobacco farming had severely depleted soil fertility and sent countless tons first of topsoil, then of subsoil cascading down the runs, the creeks, and the rivers, silting up deep harbors, destroying bottom habitat, browning once clear flowing waters. Were it not for the deep sedimentary soils and low relief of the coastal plain, the deep weathered-in-place soils of the piedmont, the long growing season, and the even distribution of rainfall, man's impact over the last 350 years would be much more apparent.

Nevertheless, we have inherited some magnificent fragments of the earlier landscape. Isolated by the complex embayments of the drowned Susquehanna, much of the region has changed very little in the past 50 years. But with the extremely rapid growth of suburban complexes around Baltimore, Washington, and Richmond, the once spacious Chesapeake Bay Region is filling up. Marinas replace tidal marshes, isolated necks become coveted subdivisions, new roads over new bridges make once remote areas suddenly accessible and desirable for the commuter or second home owner, and profitable for the land speculator.

As a result of this pressure, the seemingly inexhaustible supply of tidal marshes, densely wooded shorefront, and quiet swamp forests of cypress and hardwoods has been severed and subdivided into isolated fragments, and these in turn have been surrounded and threatened by a variety of development schemes. Most thinking people agree that the most significant and viable of these fragments should be preserved, for the aesthetic and recreational enjoyment of present and future generations, for the insight such systems can give us about an environment which however modified, continues to be of great importance in our daily lives, and for the producitvity of our estuaries which we have heretofore taken very much for granted. Unfortunately, there is considerably less unanimity on which areas should be saved and how.

INTRODUCTION

The Nature Conservancy in conjunction with the Chesapeake Bay Foundation contracted with the Smithsonian Institution to make an ecological survey and study the Chesapeake Bay Region. This report summarizes the results of the study and suggests future action.

The urgency of preparing this report and initiating resultant land protection efforts is self evident. Pressures for development are increasing daily along all of Maryland's Western Shore and the major river estuaries. Many areas are being rapidly built up, and the completion of a second Chesapeake Bay bridge will bring comparable demands to other accessible portions of the Eastern Shore of Chesapeake Bay.

Maryland State officials privately question the power of current county zoning regulations and of recent State wetlands legislation to do more than delay major and destructive industrial and residential development projects as demographic and economic pressures grow. These same officials are frank to acknowledge that the only sure way of preserving natural resource areas is through purchase. The State of Virginia has no basic law for the protection of wetlands, and the prospects seem dim for wetlands legislation in the foreseeable future.

The governments of both States, as well as the U. S. National Park Service, have long-term plans for additional land acquisition proposals predominantly from the point of view of the recreational opportunity these lands can offer to the maximum number of people - a philosophy

often fatal to the preservation of undisturbed wild areas.

On the horizon is the emergence of national land use legislation with sweeping implications. In Congress the National Land Use Policy Act has passed the Senate and is being considered by the House.

In essence the question is how we organize, control and coordinate the process of changes so as to protect what we most value in the environmental, cultural and aesthetic characteristics of the land. Consideration is being given to fundamental reforms in the way state governments approach land use controls. Clearly recognized is the fact that states, not just local communities must have the responsibility to control land use decisions. A broad spectrum of controls as well as public land acquisition appears to be the answer to the problem of protection of environmental, cultural and historical amenities. Further, there is growing recognition that private property rights confer obligations that society can define and property owners should respect.

Conservation and protection of critical environmental areas must be a part of a larger effort to create what we want. In an era of massive change, the task is to maintain a creative balance between the interests of the conservationist and the demands of growth and development.

OBJECTIVES

SCOPE

HISTORICAL

FUTURE

DESCRIPTION OF THE STUDY AREA

GENERAL FEATURES

Chesapeake Bay lies between 76° and 76°30' north latitude and 37° to 39° 30' west longitude. It is approximately 165 miles long, extending from north of the Susquehanna River south to its juncture with Atlantic between Cape Charles and Cape Henry, Virginia (which capes are miles apart). It varies from 5 to 20 nautical miles in width; occupies 3,015 nautical square miles; the maximum depths are about 55 m but 50 percent of the area is less than 7 m deep and 8 percent is greater than 20 m deep; the mean depth is 7 to 9 m. Along its 4,600 miles of coastline, eleven major rivers, 50 large tributaries and 150 rivers and creeks drain into Chesapeake Bay through a series of sounds, tidal river embayments and tributaries. This has shaped the shoreline into a long and narrow central axis, the sides of which (particularly the western edge) are irregularly digitated by the tidal river estuaries. On the west shore and proceding south from the headwaters the following rivers enter the Bay: Susquehanna, Patapsco (Baltimore Harbor area), Severn, Patuxent, Potomac, Rappahannock, York and James. On the eastern shore, the Choptank, Nanticoke and Wicomico Rivers are the most important.

Chesapeake Bay, which has a drainage basin of 74,000 square miles, is the drowned estuary of the Susquehanna River (largest river in the eastern U. S.) which drains about 42 percent of this watershed. Runoff from the Susquehanna River controls the environmental condition of upper Chesapeake Bay. It contributes 49 percent of the annual freshwater

runoff into the entire Bay, and 87 percent of that north of the mouth of the Potomac.

The Potomac River estuary drains 22 percent of the Bay drainage basin and contributes about 18 percent of the total freshwater inflow into the Bay. The annual contributions by the other western rivers are: James - 16 percent; Rappahannock - 4 percent; York - 2 percent; and others - 4 percent. The eastern rivers (Choptank, Nanticoke and Wicomico) contribute only 7 percent of the total runoff.

The surface salt gradient over the 165 mile length caused by this silution ranges from about 30 parts per hundred at the entrance, to 15 near the mouth of the Potomac River about 70 miles up the Bay, to a freshwater condition in the inner reaches where the Susquehanna River enters. Spring floods and summer-fall dry (relatively) periods contribute to seasonal variations in salinity throughout the Bay! At equivalent latitudes, higher surface salinities are found on the eastern side because of the lower freshwater inflow there. Within the individual tidal river estuaries a salt gradient is also found. Generally, for those systems from the Patuxent River southwards, the surface salinity is 15.5 parts per hundred at the mouth which decreases upstream, the characteristic of the gradient depending on discharge volume and related features.

LAND USE

In general terms the immediate Chesapeake Bay watershed, including the tidewater counties of Maryland, Virginia, and Delaware, covers an

area of about 100 by 200 miles or about 20,000 square miles of which 15,000 square miles is land. The general land use patterns are depicted in Table I.

TABLE I. LAND USE IN CHESAPEAKE BAY WATERSHED

	Maryland	Virginia	Delaware
Land	6800 sq. mi.	6700 sq. mi.	21 sq. mi.
Forest	68%	60%	48%
Agricultural Crops	23%	23%	32%
Pasture	6%	2%	2.5%
Urban/Industrial	3%	6%	9%
Coastal Marsh	-	-	8.5%

Forest vegetation covers an area of slightly over 6 million acres or 9,450 square miles. Forests cover 68 percent of the tidewater counties of Maryland, 60 percent of Virginia, and 48 percent of Delaware. The forests of the tidewater counties of Chesapeake Bay are Oak-Hickory-Pine as the major type, but also include Oak-Hickory, Oak-Pine, Loblolly-Shortleaf Pine, and Oak-Gum-Cypress in the southern part. In many areas with better soils there are a large number of mixed mesophytic deciduous species such as maple, tulip tree, beech, gum, various oaks, and floodplain species of ash, elm, maple, sycamore, and birch. The main timber trees are red and white oaks; tulip tree, pines, sweetgum and, at times, other hardwoods.

The agricultural cropland of the tidewater counties covers an area of 2,348,861 acres or 3,670 square miles. The value of agricultural crops and livestock of this region is an estimated $500 million dollars. The agricultural crops of the Chesapeake Bay watershed are shown in Figure 1. The eastern shore of Maryland is famous for truck crops due to its sandy productive soil, sufficient water and long growing peirod. The other most important crops are soybeans, corn and wheat. On the western shore of Maryland the major crops are hay, corn, tobacco, wheat, and some soybeans and vegetables. In the Virginia region the main agricultural crops are corn, soybeans, peanuts, wheat, barley and tobacco. In the Delaware area the main crops are corn, soybeans, hay, lima beans, barley, rye, oats and vegetables. The livestock and poultry industry is fairly extensive and includes dairy and beef cattle, hogs, and chickens. In Delaware the value of the livestock, poultry, and related products is about $95 million per year.

Another type of vegetation of Chesapeake Bay is the rather extensive saltmarshes and wetlands. This is estimated to be 8.5 percent of the land area of Delaware. Wetland areas are of great importance to wildlife and production of aquatic life. The main vegetation is composed of various grasses, saltbush, cattail and other associated species. Salt hay is mowed in some of the regions and is of value for mulch.

FIGURE 1 to be included later

QUEEN OF THE BAYS

The Chesapeake Bay has been called the "queen" of the bays in the U. S. because of its rich commercial and recreational resources. The finfish and shellfish commercial harvest in 1966 was 600 million pounds valued at $30,000,000. The annual income in Maryland from this industry for 1971 was $65 million. Chesapeake Bay also serves an important spawning and nursery area for migratory fish important recreationally and commercially from Maine to North Carolina.

The multi-uses of this bay, including industrialization and shipping (110 x 10^6 tons cargo annually), have led to a progressive deterioration in water quality. The National Estuary Study (Volume 1) characterizes the upper third (north from the Patuxent River) and the lower third (James River estuary and region from Norfolk to Newport News) as moderately to severely "modified" (i.e. polluted) through anthropogenic sources, 50 percent is listed as moderately modified and 6 percent as severely polluted. This has closed off shellfish grounds equivalent to 1.5 percent of the total area and resulted in loss of production equal to at least $1 million annually. The combined effects of deteriorating water quality, overfishing, and other factors have contributed to a continuous decline in oyster harvest. The harvest of 20 x 10^6 lb. of oyster meats in 1966 compares with a production of 117 x 10^6 lb. in 1880 - a 6-fold decrease!

In addition to grounds thus lost to shellfish, some 254,000 acres, or 9 percent of the total area, are less desirable to finfish because of organic, oil and thermal pollution. Oil pollution is a serious threat, since the Chesapeake Bay is an extremely important wintering area for waterfowl, including half of the 50,000 whistling swans in North America, and more than 75 percent of the wintering population on the Atlantic Flyway Canada Geese. A single oil spill in the upper Bay cost the lives of 5,000 ducks. Many of the estuaries of the Chesapeake Bay are realized or proposed sites of Nuclear Power Generating Plants which has prompted a thermal pollution symposium. This has led to mortality of attached plants and plankton, as will be elaborated upon in a later section.

Aside from man-made stresses, the occurrence of two rooted aquatic plants, introduced somehow from the Orient, have become a biological nuisance in tidal waters. These are the Eurasian milfoil, Myriophyllum spicatum, and the water chestnut (Eleocharis or Trapa?). The former kills oysters by its smothering growth (up to 3 m) and also chokes out valuable plants eaten by waterfowl. First detected in 1940, its explosive growth led to the development of dense weed beds of approximately 100,000 acres by 1963. A disease subsequently reduced this coverage to 50,000 acres in 1966. The water chestnut which infested about 9,000 acres in 1939 has almost been eliminated from the Potomac River and its tributaries, but other tributaries of the Chesapeake Bay still remained choked by this weed.

Natural catastrophes have also modified environmental conditions adversely in the Chesapeake Bay. The voluminous, unprecedented flooding associated with tropical storm Agnes in June, 1972 significantly diluted its waters altering critical salinity levels and jeopardized the oyster and clam crops. Siltation was another major adverse impact in the Bay, courtesy of Agnes. Shellfish have also become inedible because of sewage, pesticide runoff, and the stirring up of trace metals.

The biological richness and diversity, the multi-use problems found in the Chesapeake Bay, and its general importance to the bordering states of Maryland and Virginia, and beyond, are evident. It is thus surprising to find relatively few quantitative biological limnologic and oceanographic studies, including those dealing with phytoplankton dynamics, in this area. Only recently have estimates of primary production become available, but an energy budget similar to that prepared for Long Island Sound must await basic data for the various tropic levels.

In Virginia, a conservation needs inventory was published in February, 1970, that showed that 52 percent of the land needed conservation treatment of some kind. This included 64 percent of cropland, 70 percent pasture, 46 percent of woodland and 33 percent of other land. Susceptibility to erosion and unfavorable soil conditions in the root zone were the most serious problems. This report was based on available data, "grass roots" knowledge, and committee estimates.

PRESSURES ON THE LAND

Some areas in the watershed are farmed using very poor practices resulting in loss of soil and fertility. Much worn out and eroded land, particularly abandoned tobacco, land reverts with no management to unused scrubland. The total land area in farms in Maryland was about 5 million acres in 1900 and about 3.5 million in 1955. There is a decrease in cropland at present in the Western and Northern shore areas but an increase on the Eastern shore.

There is a possibility of obtaining abandoned farm land before it is developed in non-coastal areas, but there is a great demand for all coastal or river shores areas.

The Chesapeake Bay watershed is situated in the middle of a rapidly developing region which is becoming very heavily populated. The population of the immediate Bay area was 2.8 million people in 1960 and is expected to double by 1985. There will be great demand for recreation areas, open green space, a desire for preservation of wildlife and of unique biological or natural areas. The land and especially the coastal areas are being developed for housing, commercial, boating and other uses. The urban encroachment threatens the few remaining natural or little disturbed areas that are of great importance for wildlife, for bay fisheries and shellfish, and for preservation of unique natural areas. This is particularly true of tidal wetlands, marsh areas, and islands.

BIOTIC COMMUNITIES OF THE CHESAPEAKE BAY

Characteristic biota of the Chesapeake Bay region are defined in terms of typical vegetation, associated animal species and critical environmental factors.

The ecology of the Chesapeake Bay region has been influenced strongly by the presence of civilized man. But even before the colonists had set foot on the continent, Indians had made their presence known. Fire was an often used tool of the Indians for hunting purposes and clearing land.

Following colonization by white men, more intensive land clearing occurred during the eighteenth and early part of the nineteenth centuries. Lumber was needed for shelter and firewood and the virgin land was so plentiful that a shifting form of agriculture with little care for the soil became prevalent. Tobacco depleted much of the soil of its nutrients and when fields were abandoned, erosion quickly exhausted the topsoil. Then, at the time of the Civil War labor became scarce and much of the previously cultivated land was abandoned. These abandoned fields were invaded by pitch (P. rigida) and scrub (P. virginiana) pines. The species are typical pioneer tree species in old field or secondary succession.

Pine forests, although common, are not the climax vegetation but are dominant due to a history of disturbances including fire, agriculture and lumbering. Braun (1950) indicates that the northern portion of the Coastal Plain should actually be considered an Eastern Oak-Hickory Forest region due to the dominance of oaks (Quercus spp.) and hickories (Carya spp.) in the climax communities.

The northern portion of the Atlantic Coastal Plain is characterized by drowned river valleys, the best example of which is the Chesapeake Bay. The Chesapeake Bay is a unique estuary comprised of the drowned Susquehanna River Valley and several of its tributaries. The bay is unique because of its size and isolation from the Atlantic. Appendix "X" is a breakdown of the major plant community types with an indication of some of the critical environmental factors (limiting factors) controlling the community. After each description of a plant community type, some of the typical animal species found in the community are listed. The communities treated in that appendix are:

Salt Marsh

Brackish Marsh

Freshwater Marsh

Cypress-Gum Swamp Forest

Bottomland Hardwood Forest

Upland Pine Forest

Upland Hardwood Forest

Old Field Community

NATURAL AREA EVALUATION CONCEPT

This is the first known pilot model for systematically assessing the value of a region's natural areas where the assessment has been undertaken based only on a comprehensive study of the ecologically significant and important biota and features of the region. Surveys have been conducted in several states and in New England based on a wide variety of criteria including scenic value multiple use, recreational value, geological features, vlaue of land, and nearness to cities. Surveys have been made by various agencies - federal, state, local, and private - but no comprehensive ecological surveys for a natural region such as the entire Chesapeake Bay Region have been made without regard for state or county boundaries. This study is an attempt to overcome this limitation, to search out and evaluate ecologically important tidal zone areas, waterfront age, wetlands, salt marshes, islands, bays, and estuarine drainages associated with Chesapeake Bay and its tributaries.

The concept developed in this study utilizes the following approach.

SURVEY OF EXISTING PRESERVED AREAS

Make a comprehensive study and map all existing Federal, State, municipal and private areas under present protection. These include parks, forests, research sites, game refuges, game management areas, wilderness areas, scenic river areas, national natural landmark areas, all Federal lands including military bases and other public lands protected from

development and destruction. These have been mapped in detail on both a 1:250,000 scale map for the Chesapeake Bay region (Map 1), and on 7.5 minute quadangle maps on file in the Nature Conservancy and the Smithsonian Center for Natural Areas.

CRITERIA OF ECOLOGICAL IMPORTANCE AND SIGNIFICANCE

A survey of the ecologically important and significant biota and features of the region is required. This includes detailed zoological and botanical surveys and literature studies including plant community types; rare and endangered plants; unusual specimen trees and other plants; relic, restricted, endemic, out-of-range and outlier species and species unusual to the region; and sites with plant deposits and fossils. The zooligical surveys include rare and endangered species of animals - nesting and breeding, overwintering and migratory concentrations of animal populations, areas of high populations especially with high diversity; and unusual species, out-of-range, relic and endemic species of animals. Special anadromous fish breeding areas; prime wetlands; bogs; special areas as cedar or cypress swamp, outside of usual range; caves; cliffs; and other special sites are included.

QUANTITATIVE EVALUATION

A summary of the main ecological criteria for selection and quantitative evaluation is presented in Table 2. In this study, the list has been converted to specific categories and an arbitrary rating of one has been given to each item. This preliminary set of criteria and weighting system was developed for selection of natural areas not intended for recreation, parks and extensive public use. This is

Table 2
Criteria for Selection and Quantitative
Evaluation of Natural Areas

	Value	
	Exc. or High	Fair
A. Ecological type of community not represented in the National Natural Area System	6	3
1. High natural quality and lack of past or present disturbance.	X2	X1
2. Protectable viable ecosystem.	X2	X1
3. Diversity of species and communities.	X2	X1
B. Endangered, threatened or vanishing species and communities, and special gene pool species, that could be preserved by habitat protection.	6	3
1. National wildlife or esthetic significance.	X6	X3
2. Human economic significance.	X4	X2
3. Number of species.	X2	X1
C. Relic species, restricted species, at edge of range, unusual to region.	6	3
1. Degree of rarity, e.g., only example in region.	X2	X1
2. High number of species.	X2	X1
D. Nesting, breeding, overwintering, or concentrated migrating populations of animals.	4	2
1. High number of species.	X2	X1
2. High number of individuals.	X2	X1
3. Rare species.	X2	X1
E. Sites with deposits of peat, lignite, sediments, fossils, bones and artifacts, for study of past vegetational, climatic, archeological and paleontological history. (10-1)	10	5
F. Site with high exploration potential for factors in E.	10	5
G. Sites of well documented scientific research or discovery and type localities, or records over period of years. (10-1)	10	5
H. Oldest, largest or exceptional representatives and exceptional associations. (6-1)	6	1
I. Area where successional trends can be studied, e.g., sand dunes, fire burns, wind damange. (6-1)	6	1

summarized in Table 3 with a full discussion in the Section of this report entitled "Evaluation Criteria."

This system gives high priority to the ecologically important factors of the region, and does not consider factors such as cost, availability, use, and other important factors which are necessary in the later procurement phase.

To avoid the personal bias and ecological ignorance implicit in stating that an osprey nest is more "valuable" than an outlying stand of hemlock or a heronry, equal weights, wherever possible, were placed on equal categories. Thus an area with an oyster bar, an eagle nest, and a tidal marsh would receive 3 points. An area with just a tidal marsh would be awarded 1 point. Two other categories should be considered at this point, isolation and impaction. An ecosystem isolated from similar systems or surrounded by development may be more valuable than is represented by its intrinsic weight alone; e.g. a 100 acre marsh in Anne Arundel County as opposed to 100 acres or perhaps even 1000 acres in Corchester County. To take this under consideration in the weighting scheme, a natural area remote from others of its type or isolated by the destruction of surrounding or adjoining related natural areas, was awarded 2 points. Determinations were made from topographic maps which, except for the eastern shore of Maryland, are reasonably up to date. Impaction of natural areas in the final high priority list was checked in the field as part of the extrinsic factor evaluation.

TABLE 3. QUANTITATIVE EVALUATION FOR SELECTION OF NATURAL AREAS

	Points	
1. The Ecosystem		(8)
a. Shallow Marine	1	
b. Saline or Brackish Tidal Marsh	1	
c. Fresh Marsh	1	
d. Swamp Forest Hardwood	1	
e. Swamp Forest - Cypress	1	
f. Upland Hardwoods	1	
g. Bogs	1	
h. Ponds	1	
2. Size		
Under 99 acres - 1; 100-100a. - 2;1000-4999a.- 3; over 4,99a - 4		(4)
3. Rare and Endangered Animal Species birds-1; mammals-1; reptiles-1; other-1		(4)
4. Rare and Endangered Plant Species cryptogans-1; herbs-1; shrubs-1; trees-1		(4)
5. Seasonal Concentration of Animals		(3)
a. Overwintering Species	1	
b. Seasonal Breeders, spawning	1	
c. Migratory Stopovers and Concentrations	1	
6. Marine Invertebrates clam 1, oyster-1, crab-1		(3)
7. Range Phenomena		(4)
a. Northern Limit b. Northern Outlier	1	
c. Southern Limit d. Southern Outlier	1	
e. Eastern Limit f. Eastern Outlier	1	
g. Coastal Plain Outlier	1	
8. Geological Features		(3)
a. Geomorphological	1	
b. Structural	1	
c. Paleontological	1	
9. Archeological Features		(2)
a. Prehistoric Sites	1	
b. Historic Sites	1	
10. Isolation and Impaction		(4)
Isolation	2	
Impaction	2	

The higher the final total for each area the greater the variety of natural features and the more desirable the area. This system puts a premium on diversity. To be sure that areas of low diversity but of critical importance--a bog for example--were included in the final recommendations, the entire list was reviewed after numerical analysis and some areas were added to the list on the basis of ecological judgement.

To correct in part for the bias caused by unequal availability of evaluation data, Maryland and Virginia areas were evaluated separately. This was a necessary precaution, considering the much greater availability of information on sites in Maryland, in relation to that for Virginia. When the wetland survey, which the Virginia legislature has charged the Virginia Institute of Marine Sciences to undertake is complete, this imbalance may be easily redressed.

Due to financial and time limitations it was impossible to visit all of the areas under initial consideration. Preliminary sorting of available data should isolate the best areas which could then be visited for in-depth study, analysis, selection, and ranking. The extrinsic factor, especially, might be best evaluated in the field.

A weighting system is desired which gives greater importance to plant communities or types not in the National System of Natural Areas, than for those for which there are many examples. Also, the factors of diversity, quality, lack of past and present disturbance, protectability and other factors must be considered with appropriate weighting. The factors of esthetic and emotional value should receive a rating based on subjective instead of scientific grounds. An example would be the comparison of the importance of saving the condor or eagle in comparison

with a difficult-to-identify subspecies of sedge with no known scientific, economic, or other importance.

SELECTION OF PROPOSED NATURAL AREAS

After all of the ecologically significant and important data have been compiled and mapped, and data on various suggested and existing potential sites have been accummulated, it is then possible to begin evaluation and comparison. Ideally, natural areas are located on topographic maps and carefully field checked with the assistance of local people intimately familiar with the areas; then these data are carefully evaluated and a set of recommendations made. Under the best of circumstances this can take several years, during which time many of the areas under scrutiny may be developed and lost. Because of the critical time factor, the ideal is compromised to some extent. Published recommendations and suggestions from many scientists, conservationsits, open space planners, and others familiar with various parts of the Bay region, are combined with areas suggested by careful examination of topographic maps of the whole region in order to yield a list of potential natural areas. Evaluation of these in terms of their inherent ecological value (the intrinsic factor) and the development pressure to which they are subject (the extrinsic factor) produces a list of the natural areas most deserving of protection and in greatest need of protection. A random sample (e.g. 25%) are inspected in the field for a final check on the information and the method of selection. The final result is a list of areas ranked in order of their intrinsic and extrinsic merit.

EVALUATION CRITERIA

It would, of course, be ideal to know everything about a series of areas. Weights could be given to various factors, areas compared and the best areas selected with great precision. But even with the most carefully studied forests or marshes, we have only begun to scratch the surface of an immensely complicated ecology of plants and animals so interrelated with each other and with the environment that ecologists hardly know where to start unraveling. Because of the urgency of making an initial selection in the shortest possible time, it was necessary to use secondhand sources and information in the preliminary round of selection. The information was grouped into ten categories which reflect the most immediately obvious characteristics of each area.

THE ECOSYSTEM

Ecosystems are rarely discrete with sharp edges allowing neat demarcation. Usually there are gradients or ecotones where the species characteristic of one habitat are gradually replaced by those of another. Thus a salt marsh at its upper edge merges gradually with a fresh marsh and the marsh in turn passes without break into the forest on its edge. So in each area the dominant system was listed first with secondary systems following if their role on the total site was an important aspect of that site. Because of the ecotones between systems and the shifting dominence of species in systems from site to site, the broad specturm of systems recognized by many authoris has for convenience been reduced to eight types.

Shallow marine. This habitat is characteristic of shallow bays and creeks less than 8 feet deep and with a salinity range of 33 to 10 parts per thousand. If water clarity allows, rooted, submerged aquatics occur which include eelgreas (Zostera marina), ditch grass (Ruppia maritima), horned pondweed, (Zanichellia palustris), and pondweed (Potamogeton spp.)

Saline or Brackish Tidal Marsh. This type is flooded periodically, the period depending on the elevation of the marsh. The classic low marsh, flooded twice daily is characterized by cord grass (Spartina alterniflora). The frequency of low marsh increases from north to south in the Bay, particularly on the eastern shore. High marsh is composed of salt meadow grass (Spartina patens), spike grass (Distichlis spicata) and glasswort (Salicornia spp.) toward the lower and gounds and black rush (Juncus roemerianus), saltreed grass (Spartina cynosuroides), switch grass (Panicum virgatum), marsh elder (Iva. spp.) and sea myrtle (Baccharis halimifolia), toward the higher ground. High marshes are flooded more episodically than periodically, although they are wetted by most spring tides.

Fresh marsh. While fresh marshes are more abundant toward the head of the Bay where the water is virtually fresh, they are also found upstream in almost every tributary stream in the Bay. The more important species include three-square (Scirpus spp.), cattail (Typha spp.),common reed (Phragmites communis), wild rice (Zizania aquatica), and arrowhead (Sagittaria spp.)

Swamp Forest, Hardwoods. Although the two categories of"swamp forest, hardwoods" and "swamp forest, cypress" could be combined due to a considerable overlap in species, there are large tracts in the northern part of the Bay beyond the range of cypress, a southern coastal plain species. A swamp is ecologically distinct from a marsh although popular usage often confuses the terms. Basically, a swamp is a poorly drained site, often flooded in winter and spring with either lower water levels or no standing water in summer and fall. The vegetation is mostly trees with some shrubs and vines. A marsh whether flooded year round (most fresh marshes) or periodically (most tidal marshes) is covered with herbaceous plants and a few shrubs perhaps but no trees. The hardwoods representative of the first type of swamp forests are black gum (Nyssa sylvatica), red maple (*Acer rubrum*), tupelo (*Nyssa aquatica*), swamp poplar (*Populus heterophylla*), various oaks (Quercus spp.), sweet gum (*Liquidambar styraciflua*), and sweet bay (*Magnolia virginiana*).

Swamp Forest, Cypress. The species characteristic of this habitat are basically the same as for the proceeding habitat, but with the addition of cypress (*Taxodium distichum*) as a dominant species.

Upland Hardwoods. Best developed on solpes and higher ground, the dominant species are hickory (*Carya spp.*), various oaks (*Quercus spp.*), short-leaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), Virginia pine (Pinus *virginiana)*, tulip poplar (*Liriodendron tulipifera*), black gum (*Nyssa* sylvatica), and sweet gum (*Liquidambar styraciflua*). Important understory trees include dogwood (Cornus florida), and ironwood (*Carpinus caroliniana)*. In disturbed areas, old fields, burns and waste land, the pine species often form dense stands - *Pinus echinata* and *p. virginiana* to

the north, and _P. taeda_ to the south.

Bogs. Rather limited in size and distribution, bogs differ significantly from swamps and marshes. While the latter wetlands are neutral to alkaline in reaction, bogs are so acid that biomass accumulates in their basins in the form of peat rather than decomposing and being recycled in the system as is more often the case in marshes and swamps. Typical species may include a variety of unusual plants, such as pitcher plant (_Sarracenia spp._) orchids, sundews (_Drosera spp._) and blueberries (_Vaccinium spp._). The most characteristic species is sphagnum moss (_Sphagnum spp._)

Ponds. Both fresh and salt ponds have been lumped here for convenience although their floras are quite different. Salt ponds contain many of the species found in shallow marine habitats but _Ruppia maritima_ is most often found. Fresh ponds have a wide range of species: submerged aquatics such as tape grass (_Vallisneria americana_), water milfoil (Myriophyllum spp.), and bladderwort (Utricularia spp); and emergent species including arrowhead (Sagittaria supp.), and pickerel weed (Pontederia spp.), as well as plants characteristic of fresh marshes.

SIZE

The prime function of size as a criterion lies in the viability of the system to be protected. This varies greatly from system to system. A tenth-acre bog may be quite defensible with some surrounding ecotone

to act as a buffer. Ranking the habitats listed above according to minimum viable size, bogs would come first (very small areas are preservable), followed by ponds, marshes, shallow marine communities, and forests. The area of each site considered has been measured by planimeter on 7-1/2 minute topographic maps. Obviously the largest area possible of any given habitat would allow the greatest number of options if multiple use is to be considered in the management of the preserved area.

RARE AND ENDANGERED ANIMAL SPECIES

One of the most important considerations in the selection of natural areas is the protection that the area gives to endangered or uncommon species. Topping the list is that species so important as our national symbol and so increasingly rare in our daily lives, the southern bald eagle (Haliaeetus leucocephalus leucocephalus). Despite the decline of its eagle population by at least 60% in the last 10 years, the Bay region is the most productive area for southern bald eagles, north of Florida. Around 90 nests, not all active in any given year, can be found in Delaware, Maryland, and Virginia. Yet in 1936 there were over 250 active nests in the same area. Not only have the number of nesting eagles declined but there has been a shift from the upper parts of rivers and the norhtern part of the Bay to the estuarine segments of the rivers and the southern Bay. Despite pesticide-induced egg shell thinning (recored for a number of birds of prey as well as fish predators such as the cormorant and brown pelican), the major cause of eagle mortality continues to be shooting, pollution of feeding areas, and loss of habitat to various forms of development. The prognosis is not good since the reproductive rate, 5-35%, is considerably

below that necessary for a stable population.

Although the osprey (Pandion haliaetus) is not officially considered to be an endangered species, populations are declining in many places along the East Coast. Annual production to guarantee replacement for a stable population has been estimated at between 0.95 and 1.30 young fledged per breeding female. In only a few parts of the Bay is this figure reached every year. Despite the decline, the Bay region has the highest concentration of nesting osprey in the United States - roughly estimated at 1400 pairs. Reasons for the decline, where observed, seem similar to those responsible for the southern bald eagle decline. All eagle and osprey nests observed to be in use between 1970 and 1972 were plotted on topographic maps of the Bay area. Since wildlife preservation was not the specific goal of this survey, areas were not selected solely because of a nesting eagle or osprey, but every consideration was taken to include nests in all areas selected.

The Delmarva fox squirrel, also known as the Bryant fox squirrel (Sciurus niger cinereus), is a subspecies of the more widespread eastern fox squirrel. Never very abundant or widespread in its range, the Delmarva fox squirrel is confined today to four eastern shore counties in Maryland: Kent, Queen Anne, Talbot, and Dorchester. The population apparently lies somewhere between 500 and 1000. Although protected in Maryland since 1971, this species is easily confused with the more abundant eastern gray squirrel (Sciurus carolinensis) and so many are probably killed during the hunting season. Continued reduction of habitat by real estate developments and cutting of the old-aged, mixed pine-hardwood stands which are the prime habitat have doubtless contributed to population

decline as well. All recent sightings of this species have been marked on base maps and considered in the selection of natural areas on the eastern shore.

Two other endangered species are recorded from the Bay region: the Maryland darter, Etheostoma sellare, and the bog turtle, Clemmys muhlenbergi. The fish, small and rather nondescript, is found in only two streams, Deer Creek and the east branch of Swan Creek, both tributaries of the Susquehanna in Harford Co., Maryland. While the population size is unknown, it is assumed because of the very limited habitat to be rather small. Since the species appears to be an endemic at the periphery of the range of its closest relatives, it has not been abundant for rather a long time, historically speaking.

The bog turtle as its name suggests is limited to wetland areas in the northeast and the southern Appalachians. Because of its rather secretive behavior its numbers are difficult to determine. Its decline can be inferred both from the destruction of its rather limited habitat and the high value placed on it by pet shops because of its scarcity. It has been protected in Maryland, the only state in the Bay region where it occurs, since 1972.

Other uncommon species whose presence has been noted when information was available are beaver, mink, otter, terrapin, and various rails.

RARE AND ENDANGERED PLANT SPECIES

It comes as a surprise to many that plants as well as animals may be rare or even endangered. There have, of course, always been both endemic plants and animals representing those species either coming or going

evolutionarily. The seaside alder (Alnus maritima) is such an endemic in the Bay region. But many species have persisted for a very long time without every becoming especially abundant. Man's mass disruption of habitats, however, has radically altered the picture allowing tremendous increases in the populations of species able to accommodate the changes, and driving many of the remainder close to extinction. The problem of determining which species are rare is far more difficult than might be supposed. First, there is in general far less interest in plants than animals hence plant distributions are less well known than are most vertebrate distributions. Second, records of past collections are often impossibly vague, (e.g., "eastern shore," or"Somerset County," or "north of Baltimore") which makes location of a plant colony virtually impossible. Third, there is no available monitor of changing plant abundance. A species listed in a flora (which might have been written 20 years ago or more) as abundant or wide ranging might over 20 years of environmental degradation in its range be completely eliminated. It was not until this past year that the Smithsonian Institution pulled together a first report on endangered plants of the United States. Most of the few records of endangered plants in natural areas of the Bay region were taken from that source Many more might be discovered it an adequate search were undertaken.

SEASONAL CONCENTRATION OF ANIMALS

While endangered, rare,and uncommon species are critically important and figure strongly in the selection of desirable natural areas, the most striking feature of Bay wildlife is the seasonal concentration of various species. There are three major groups: overwintering species, seasonal breeders, and migratory stopovers.

Overwintering Species. Many Bay area residents, hunters or not, eagerly eagerly look forward to the October arrival of noisy skeins of geese and ducks followed later by whistling swans. By Apri., the old-squaw, scaup, canvasback, mergansers, Canada geese, and swans have returned to their northern breeding places but their economic and ecologic impact is considerable. Unlike the endangered species which tend to stay put (even the migratory species among them are relatively conservative about their nesting sites), overwintering species frequently move about on their wintering grounds and have even adapted new habits as old food supplies disappear and new ones appear. Swans (Cygnus columbianus) which as recently as a few years ago fed offshore in shallow water while the less wary geese flew inland to feed on stubble fields, have now begun to emulate the habits of geese and can be seen in flocks of several hundred on fields far from open water. This may be due in part to a decrease in the supply of food offshore resulting from increased turbidity, and pollution. Regardless, it is diffucult to anticipate which bay or river the overwintering species will concentrate in from year to year. Hence setting aside natural areas to accommodate overwintering species is a chancy business unless the areas are specifically managed for waterfowl, which management may then interfere with other uses or values of a given area. Nonetheless, unusual concentrations of overwintering waterflow have been noted and considered as a criticism for natural areas selection.

Seasonal Breeders. There are several major species of anadromous fish - striped bass (Morone saxatitis) herring, (Alosa aestimlis) Hickory shad,

(Alosa midiocris), white shad and American shad (Alosa sapidissima) - which ascend freshwater streams to breed, many in large enough quantities to be of commercial value. The striped bass is of course a highly regarded sport fish as well. The importance of small tributary streams as breeding areas and their attendant marshes as nurseries for the subsequent fry has been considered in assessing natural area value.

Wood duck nesting concentrations have been noted where information was available. Thisspecies, considered endangered 30-40 years ago, has made an astonishing come-back. One of the few ducks which is a cavity nester, the wood duck (Aix sponsa) declined as the old trees which had proper nesting cavities were logged off and younger trees cut before reaching proper size. Analysis of the problem led to the happy solution of providing artificial nesting sites and the wood duck while not as abundant as black duck or mallard is once again relatively common. Since the male is one of the most beautifully marked birds in North America, inclusion of nesting data in the natural area evaluations was considered appropriate.

A small number of heronries are still present in the Bay region, mostly of the great blue heron (Ardea herodias) but other types of heronies are found too - green heron (Butorides virescens), black-crowned night heron (Nyctocorax nycticorax), and American egret (Casmerodius albus). At the present less than 20 active heronries have been listed, although others probably exist. Hopefully in the coming year a more accurate tabulation can be made matching the excellent work done by the eagle and osprey workers who have contributed so much to our knowledge of these species in the Bay region.

Migratory Stopovers. Many places, especially along the eastern shore, are utilized by shorebirds, birds of prey, and passerines passing north or south. The birds pause to feed and rest for a few days before resuming their migratory flights. Wherever possible such areas have been located.

MARINE INVERTEBRATES

Clam and oyster beds do not exist in vacuo but are quite intimately related both to the bay or estuary where they are located and the nearby marshes which provide the production which the shellfish, in part, harvest. Since shellfish are sessile as adults, some, especially oysters, (Crassostrea virginica) which lack the siphon that permits clams (Mya arenaria, Mercenaria) to be buried by silt, are quite sensitive to siltation. Clams are also dependent on detritus from marshes for food, especially in the younger stages. Adult crabs (Callinectes sapidus) may feed in turn on smaller detritus feeders. Although crabs are quite mobile and migrate during the winter into deeper water near the mouth of the Bay, their attraction to certain areas in the summer reflects the high productivity of those areas. These places have been identified wherever possible along with oyster bars and clam beds.

RANGE PHENOMENA

Since both plants and animals are closely tied to their habitats as well as their niches, their ranges can usually be rather closely plotted. This is certainly true for the larger animals and woody plants. Because of its position halfway up the Atlantic Coastal Plain, the Bay region includes many edns of range or outlying populations.

Northern Limit. Many species with an essentially southern distribution extend into the Bay region; e.g. cypress (*Taxodium distichum*) and live oak (*Quercus virginiana*).

Northern Outlier. Some southern species have disjunct populations, often just a few individuals, well north of the contiguous populations:e.g. water hickory, (*Carya aquatica*).

Southern Limit. Essentially northern species whose southern-most distribution extends into the Bay region: e.g. black ash, (Fraxinus nigra).

Southern Outlier. Disjunct populations in the Bay region apart from the southern continguous populations: e.g. balsam poplar, (Populus balsamifera).

Eastern Limit. Species whose distribution is mid-western occasionally extend east to the Atlantic coast: e.g. chinkapin oak, (*Quercus muehlenbergii*).

Eastern Outlier. Scattered populations of a few basically mid-western species are found in the Bay region; e.g. bur oak, (*Quercus macrocarpa*).

Coastal Plain Outlier. Upland species characteristic of the Appalachians are occasionally found in small colonies deep in the coastal plain over a hundred miles from the nearest upland population: e.g. white pine (*Pinus strobus*), and hemlock (*Tsuga canadensis*).

Regardless of their nature these distrubutions are of far greater importance than as mere geographical curiosities. Any organism living on the edge of its range is operating on the edge of its adaptation to its environment as well and it may be particularly sensitive to environmental stresses with which it can cope in the center of the range. If we are to understand the ecological amplitude of any species it must be studied under extreme conditions as well as optimal ones. For this reason a few acres of scraggly hemlocks on the eastern shore may be worth a hundred acres on the Blue Ridge. These range phenomena have been located as precisely as records allow and they enter importantly into the natural area selection process.

GEOLOGICAL FEATURES

We are often preoccupied with the biological features of a natural area, particularly when the relief is low, bedrock is far below the surface, and the landscape is dominated by a dense vegetational cover. But geological features, however subtle, can be extremely important in connecting the present to the past and giving some idea of the evolution of a landscape as well as of the organisms which presently occupy it. There are three geological features which have been considered in this natural area evaluation.

Geomorphological. Landforms give important clues to the nature of forces which have shaped the Bay landscape. Evidence for successive lowering and raising of the sea level correlated with glacial and interglacial periods in the last 100,000 years can be seen in various terrace scarps marking former shorelines.

Structural. Erosional sections through sedimentary strata give insight into the conditions under which various materials were deposited and when. Outcrops and faultlines are other indications of past environments and resoltuion of physical forces.

Paleontological. Fossils, mostly of Miocene age (25,000,000 years before present), are abundant in many exposed Bay front areas; Calvert Cliffs is probably the best know example. Again, the nature of the material (snail shells, shark teeth, whale bones), and its age, give a clear look into past environments, part of a continuum of environments leading to the present. More than any other geological feature, fossils bring home to the general public the meaning of geological time as opposed to historical time and allow appreciation of the present as only an ephemeral point on

a very long and ancient track leading from an obscure past into an equally obscure future.

ARCHEOLOGICAL FEATURES

Just as geological features give insight into geological time, archeological features allow greater appreciation of historical time. Two features have been recognized in this study.

Prehistoric Sites. The habitation of the Bay region by man long predates discovery of the area by Western Europeans. Indian middenheaps, shellmounds, and village sites dot the region. When carefully probed by trained workers, a great deal of information can be obtained not only about the people, their culture, and its relationship to other cultures, but the environment which existed at the time. Fish and mammal bones, plant parts, shells--all are indications of past environments, often the only evidence we have in a given area. The preservation of these sites and their careful analysis is an important concommitant to the full understanding of nearby natural areas. All known sites have been plotted on topographic maps.

Historic Sites. The long history of European settlement in the Bay region is recorded in the deserted townsites, silted harbors, manor houses, primative roads, canals, and mills that abound in the area. While not all are worth preserving, representative samples in each category should be preserved and restored after careful research (as has been done so well at Williamsburg) so that today's public can have some appreciation of the kind of environment that settlers of another age encountered and the way in which they coped with a virgin wilderness they considered hostile. Since much of the blame for environmental degradation in the

Bay region traces back to their activities, it might be extremely instructive in an age of heightened environmental awareness to observe their errors. Sites which have been preserved or should be, particularly if they are useful in interpreting the natural area fragments in the region, have been located and listed wherever possible.

ECOLOGICALLY SIGNIFICANT AND IMPORTANT BIOTA AND AREAS

Many species of plants and animals in the Chesapeake Bay region are presently endangered and will be lost if their few and local habitats are not permanently protected. A number of species are already extinct in this area.

A survey is in progress to determine the abundance and distribution of rare, indigenous, and endangered species of plants and animals of the region; the representatives occurring that are normally found far to the north, south, or west; and species of practical value. Also important wintering, breeding, or migration concentration grounds are being studied for various species of birds, mammals, reptiles, amphibians, fish and shellfish. The best representatives of various species and communities of deciduous forest begetation are being determined and mapped.

Many areas around the Bay and along its tributary rivers and streams play host to unique or endangered forms of wildlife and these have been plotted on an overlay map. There are over 68 active nesting sites of the bald eagle, which represents an unfortunate reduction from a one-time high of over two hundred. The last small communities of the endangered Delmarva fox squirrel (once common on the Eastern Shore and along the Susquehanna River into Pennsylvania) and the indigenous and rare Maryland Darter, a fish known from a few specimens in two small streams in Maryland, have been mapped. There are a diminishing number of nesting sites of the osprey. Throughout the Chesapeake Bay area river estuaries there are 18 important rookeries of herons and egrets. Along the western side of the Eastern shore in Maryland are peninsulas in which many species of passerine

birds congregate for rest and food when periods of strong easterly winds occur during the fall migration. The tidal marshes and wetlands are vital breeding and concentration areas for six species of rails including the rarely seen and little-known Black Rail; shore birds of all varieties depend on undisturbed access to tidal mud flats along the Bay shore; whistling swans, Canada Geese, and concentrations of most of the duck species of eastern North America winter in certain locations in the Bay and its tributaries. Especially important spawning and development areas for almost all of the commercially valuable fish and shellfish have been mapped. Many other ecologically important animals are known and are being mapped.

The plant life of the Chesapeake Bay area is rich in species and includes indigenous and rare species needing protection. There are only a few bogs remaining with northern plant species, and several northern outposts of southern species such as bald cypress and long-leaf pine which should be preserved. A list and distribution of rare and local indigenous plants is being prepared. The rare, indigenous, and endangered species are being mapped on an overlay together with species representative from northern bogs, western prairies, and southern forests. The best examples of the main forest types are also being mapped. Various types of wetlands are being plotted, especially those containing ecologically significant and important species.

It is very important to preserve stands of representative forest types of the eastern deciduous forest, especially those few remaining virgin stands, and areas that have gone without disturbance for long periods of time. Certain of these areas should be preserved for future generations to

demonstrate a few examples of the natural vegetation of the region. These are also of great importance as baseline or benchmark areas for environmental monitoring and as research natural areas. Such areas, of course, provide a suitable habitat for preserving ecologically significant or rare species of plants and animals.

PROPOSED NATURAL AREAS

After compiling all available information, visiting many of the proposed natural areas, and assigning a tentative quantitative evaluation to the various areas, three lists have been developed. These include presentation of the evaluation of areas considered for natural areas (Table 4), a preliminary evaluation of areas not proposed as natural areas or not fully evaluated (Tabel 5), and river systems suggested for scenic river studies (Tabel 6).

The areas tentatively proposed for consideration as natural areas are a first list based on the best evaluation possible with the information available, the accessibility of sites, and the limitations of time. Careful field studies in the growing season by competent scientists may well change the evaluations and result in re-ordering the priorities. However, there are sufficient valid data to present a valuable preliminary list with a number of high priority areas which can be proposed as natural areas. These should be carefully checked and a phase 2 evaluation initiated. This would include determination of proposed human activity impacts, land cost, land availability, ownership, protectability, management required, and determination of the best methods for procurement after coordination with State, Federal, and Land governments, and with other organizations and individuals.

The sites with the highest quantitative evaluation include the following:

Virginia:

- College Creek Marsh
- Potomac Creek
- Sunken Meadow
- Bluff Point Marsh
- Chotank Creek
- Morris Creek Marsh
- Goodwin Islands
- Accokeck Creek
- Grays Creek Marsh
- Poroptank Marsh
- Simpson, Yarmouth, Wright Islands
- Smoot Tract

Maryland:

- Chaptico
- Chicone Creek, Big Creek Marsh
- Deep Cove Creek
- Principio Creek
- Bacon Ridge Branch
- Bresh Pond
- Hood Point, Piney Point, Marshy Creek
- Kent Point

The sites with the highest quantitative evaluation include the following:

Virginia:

- College Creek Marsh
- Potomac Creek
- Sunken Meadow
- Bluff Point Marsh
- Chotank Creek
- Morris Creek Marsh
- Goodwin Islands
- Accokeck Creek
- Grays Creek Marsh
- Poroptank Marsh
- Simpson, Yarmouth, Wright Islands
- Smoot Tract

Maryland:

- Chaptico
- Chicone Creek, Big Creek Marsh
- Deep Cove Creek
- Principio Creek
- Bacon Ridge Branch
- Bresh Pond
- Hood Point, Piney Point, Marshy Creek
- Kent Point

Red Point

The Cedars, Church Creek, Ring gold Point

Kill peck Creek, Trent Hall Creek

Cabin John Creek

Cove Point

Flat Creek

Green Brier Swamp

Elk River

Mattawoman Creek

Swan Point Neck, Wise Marsh, Neale Sound, Weir Creek

Zekiah Swamp, Gilbert Swamp Run, Allens Fresh

Fishing Creek

Harbor Cove, Lowes Point

Warehouse Creek

Deep Landing

Howell Point

Landgord Marsh, Richardson Marsh, Marumsco Creek

Maryland Neck, Najemoy Creek, Wards Run

South Marsh Island

Burgess Creek

This includes 12 sites in Virginia and 28 sites in Maryland. These 40 sites are presently considered to be the most important sites for immediate procurement. Emphasis should be placed on the field study of these sites to determine the validity of the data and to confirm their natural value and present condition. Four of the sites in Virginia and 15 of these selected sites have been visited by the staff and their

status confirmed, but more detailed field visits are required:

The proposed sites include 105 areas categorized as follows:

Community Type	
Salt Marsh	1
Tidal Marsh	28
Fresh Marsh	31
Upland Forest	8
Swamp Forest	20
Brackish Marsh	13
Pond	3
Pinewood	1
Bog	1

Analyzed another way, 74 percent of the areas are marshes, ponds or bogs; 19 percent are swamp forest; and 7 percent are upland forest.

BIBLIOGRAPHY

In the process of being prepared.

APPENDIX I. SMITHSONIAN CENTER FOR NATURAL AREAS AND STAFF

Smithsonian Center for Natural Areas

The Smithsonian Center for Natural Areas was formally established in June 1972, as part of the Ecology Program, Office of Environmental Sciences, in response to urgent requests from various agencies and in recognition of the need to assist in the protection of our natural areas.

The Center's mission is to work to preserve, protect and increase the quality of our environment for the benefit and enjoyment of urban as well as rural America, in particular for the physical and spiritual welfare of future generations. In our rapidly urbanizing country, this will assure that future generations will have the invaluable heritage of carefully selected plant and animal communities...natural areas.

The Center provides ecological competence in planning and setting priorities for the selection and preservation of natural areas in urban as well as more remote locations. The intent is to bring together on a comprehensive basis the relevant technical and scientific information for sebsequent inclusion in the institutional decision making process, and thereby play an active, instrumental but delicate role in seeing that significant conservation goals are achieved.

The Center is completing definitive criteria for the establishment of priorities in the selection of natural areas to provide a uniform approach for adoption by public as well as private agencies. The Center has a natural area registry program which is compiling, evaluating and computerizing a comprehensive inventory of approximately 15,000 natural areas in the United States. Special emphasis is being given to studies

of rare or endangered flora or fauna. The first list of rare or endangered plants in the United States is being developed.

The Center is currently administering several major regional surveys of natural areas and is considering others. This report on Chesapeake Bay represents one such effort with the staff involved listed in Table I-1. Additionally, a comprehensive conservation and protection plan has been developed for the Maine coast, involving over 200,000 acres and 1,100 miles of coast line.

The Center's program includes a project to assist the Army Corps of Engineers in assessing the "state of the art" of environmental inventory information and methodology, and analyzing the environmental inventory process with respect to the Corps project planning needs. Additionally, a project to identify potential natural landmarks in the Atlantic Coastal Plain exists under a contract with the National Park Service. Finally, assistance is being provided to the Air Force in the development of a model ecological survey for selected Air Force bases and their environs.

Future aspects of the Center's program will include conservation leadership training and the dissemination of natural area information for general educational purposes. It is hoped the Center can be a vehicle to provide a select number of outstanding men or women a challenging opportunity to establish a conservation-oriented career, and conserve as a focal point for developing an educational program and teaching materials about natural areas.

TABLE I-1. STAFF

This study was conducted by the staff of the Ecology Program and the Center for Natural Areas. They include the following:

Principal Investigator

Dale W. Jenkins, Ph.D. - Ecologist and Project Director

Special Consultant

Richard W. Wagner, Ph.D. - Ecologist

Project Staff

Stephen L. Keiley, MBA, Director, Center for Natural Areas

Data Gathering and Evaluation

Fonda R. Hivick, M.A. - Botanist
Russell Kologiski, B.S. - Botanist
Gary S. Waggoner, M.A. - Ecologist

Clyde Reed, Ph.D. - Consultant
Edward F. Rivinus, M.A. - Consultant

Interpretation and Cartography

Luis Calvo - Cartographer
David Kunhardt, A.B. - Administration Assistant
Bryan Thompson , MLA - Landscape Architecture
J. Copperidge Wilson, B.S. - Zoologist
David Vreeland, B.S. - Geographer

Secretarial and Clerical

?
?
?
?

APPENDIX II. ORGANIZATIONS CONTACTED

The survey staff and volunteers have conducted an extensive program of direct contacts with individuals and groups having authoritative knowledge of the Chesapeake Bay area. These have included officials of Federal agencies, such as the Department of Defense, the Army Corps of Engineers, the U. S. Fish and Wildlife Service, the General Services Administration, the National Marine Fisheries Service, and the National Park Service. State officials have been contacted in the Maryland Department of Natural Resources and the Virginia Commission of Outdoor Recreation; also contacted were universities and other research groups such as the University of Maryland, American University, Virginia Institute of Marine Sciences, and the Chesapeake Biological Laboratory at Solomon's Island. A listing of the organizations contacted is shown in Table II-1.

Several organizations, such as the Audubon Naturalist Society of the Central Atlantic States, the Chesapeake Bay Foundation, the Maryland Ornithological Society, and the Virginia Society of Ornithology, have undertaken to assist the project staff on a voluntary basis by soliciting information and recommendations from their members who are directly familiar with the Chesapeake Bay area. Volunteers assisted in contacting other private groups, local officials, and individuals ot obtain more detailed information on specific areas.

Table II-1. Public Agencies and Conservation-Related Groups Contacted to Date

PRIVATE

1. American Fisheries Society
2. American Shore and Beach Preservation Society
3. Audubon Naturalist Society of the Central Atlantic States, Inc.
4. Audubon Society of Southern Maryland
5. Canoe Cruisers Association
6. Central Atlantic Environment Service
7. Chesapeake Bay Foundation
8. Citizens Committee on the Chesapeake Bay
9. Conservation Council of Virginia
10. Conservation Foundation, The
11. Federated Garden Clubs of Virginia
12. Garden Club of Virginia, The
13. Izaak Walton League (local chapters)
14. Junior League (local chapters)
15. Kent Conservation, Inc.
16. League of Women Voters (state chapters)
17. Maryland Environmental Trust
18. Maryland Ornithology Society
19. Maryland Wetlands Committee
20. Maryland Wildlands Committee
21. National Campers and Hikers Association
22. National Wildlife Federation (state chapters)
23. Nature Conservancy, The
24. Northern Virginia Conservation Council
25. Philadelphia Academy of Natural Sciences
26. Potomac River Association of St. Mary's County
27. Sierra Club (local chapters)
28. Talbot County Historical Society
29. Virginia Society of Ornithology
30. Wilderness Society, The
31. Wye Institute

STATE

Maryland State Department of Natural Resources
  1. Chesapeake Biological Lab (Solomon's Island), University of Maryland Natural Resources Institute
  2. Department of Chesapeake Bay Affairs
  3. Department of Forests and Parks
  4. Fish and Wildlife Administration

Maryland State Department of Planning

Commission of Game and Inland Fisheries
Commission of Outdoor Recreation
Virginia Institute of Marine Sciences
Virginia State Department of Conservation and Economic Development
  Division of Parks

FEDERAL

1. Department of Commerce
    - National Marine Fisheries Service

2. Department of Defense
    - Air Force
    - Army (Baltimore District Corps of Engineers)
    - Navy

3. Department of the Interior
    - U.S. Fish and Wildlife Service
    - U.S. Geological Survey (and CARETS program)
    - National Park Service

4. Smithsonian Institution
    - Chesapeake Bay Center for Environmental Studies

APPENDIX III. MAPPING AND GRAPHIC ANALYSIS

A primary goal of the ampping and graphic analysis of data was to use a grographic inventory approach whereby each element of data would be mapped at a common scale on a standard base map of the entire Chesapeake Bay study area. In investigating the map resources available for the Bay area, there was no existing map of the entire bay that would be sufficiently detailed to portray area information such as wetlands or other important natural areas. Thus,it was necessary to prepare a base map by making a mosaic of the seven 1:250,000 scale U. S. Geological Survey topographic maps that cover the area.

It was decided that data should be mapped on transparent overlays, to allow for manipulation and analysis, and on topographic map base sheets that could be inexpensively reproduced as osalid prints. Several reproducible mylar base sheets were prepared, each containing a photographic copy of the map mosaic, and displaying the standard information such as cities and towns, roads, topography, and water features.

Because of the need for more detailed mapping of specific sites and natural phenomena, it was necessary to prepare a sit of 1:24,000 scale (7-1/2 minute) USGS topographic quadrangle maps covering the study area represented on the 1:250,000 scale map. A complete set of 285 maps was assembled and keyed to the larger study area map by numerical index.

During the initial data collection stage of the project, it quickly became apparent that availability and uniformity of data would be a major limiting factor in attempting to conduct a comprehensive analysis of the many biological and physical factors which a scientist or conservation planner would ideally wish to consider. Some of the categories of information that a researcher would consider to be central in a theoretical natural areas planning model were unavailable at the time of the study. Even though the bay area is one of the most important locations of diverse scientific studies in the United States, several types of basic data have never been collected. For example, vegetation mapping was not available for the study area.

Once the available data was assembled from published reports and personal contacts, the following color-keyed maps and overlays were prepared:

A. 1:250,000 scale (one inch is approximately four miles)

1. Areas currently protected

(a) national forests, parks, other federal lands

(b) national wildlife refuges

(c) parks - state, regional, local

(d) forests - state, regional local

(e) wildlife management areas and preserves: state, regional, local

(f) other state, regional, and local lands

(g) quasi-public conservation areas

(h) private conservation areas

(i) military lands

2. Zoological Factors
    - (a) anadromous fish breeding areas
    - (b) bald eagle nests
    - (c) osprey nests
    - (d) major heronries
    - (e) whistling swan over-wintering areas
    - (f) Delmarva fox squirrel
    - (g) Maryland darter
3. Botanical Factors
    - (a) prime wetlands
    - (b) Bogs
    - (c) *Taxodium distichum* (Bald Cypress)
    - (d) *Chamaecyparis thyoides* (White Cedar)
    - (e) *Tsuga canadensis* (Hemlock)
    - (f) special plants (see lists in Appendix V)
    - (g) rare or endangered plants (see lists in Appendix V)

By analyzing this data, and by consiering other natural areas, wetlands, and open space planning studies done for Maryland and Virginia, it was possible to outline a tentative system of natural areas on the 1:24,000 scale maps. The areas were then redrawn on a larger bay area map that represents the culmination of this phase of the study:

4. Areas Proposed for Protection
    - (a) natural areas
    - (b) buffer zones (surrounding land critical to the viability of the natural areas)

B. <u>1:24,000 scale</u> (one inch equals 2000 feet)

The following phenomena were mapped at the above scale on USGS quadrangle sheets and then indexed to the larger study area map.

1. natural areas (primary sites)
2. buffer zones
3. bald eagle nests
4. osprey nests
5. major heronries
6. Delmarva fox squirrel
7. federally owned conservation, recreation, and military lands
8. state owned conservation and recreation lands

The above map sets are available for reference use at the Center for Natural Areas, Smithsonian Institution, 3300 Astral Building, L'Enfant Plaza, Washington, D. C. 20560 (Tel. 381-6568). Copies (blackline osalid prints) of the 1:250,000 scale maps of the entire study area are available, at printing cost, from the Center for Natural Areas. The combined set of large and small scale maps is according to the staff's knowledge at this time, the only single area-wide compilation of such data for the entire Chesapeake Bay region.

In addition to the mapping, a data retrieval system was set up to handle non-graphic data. While a computer would represent the ideal repository for data of this nature, time limitations and the need for portability of the information suggested a simpler, interim solution. Data cards (Burroughs Y-9 Unisort) that utilize a punch-hole sorting technique were typed for each natural area. The system can handle 22 blocks of ten bits each of 220 items per card. Desired information

can be located in the master key describing the block information, a rod run through the proper hole, and the cards punched for that hole fall loose and deliver that data. The major advantages of the system are the capability for easily transporting the entire deck, the elimination of alphabetization and cross indexing, and the ability, with a modest amount of hand sorting, to group and regroup the data in any desired way.