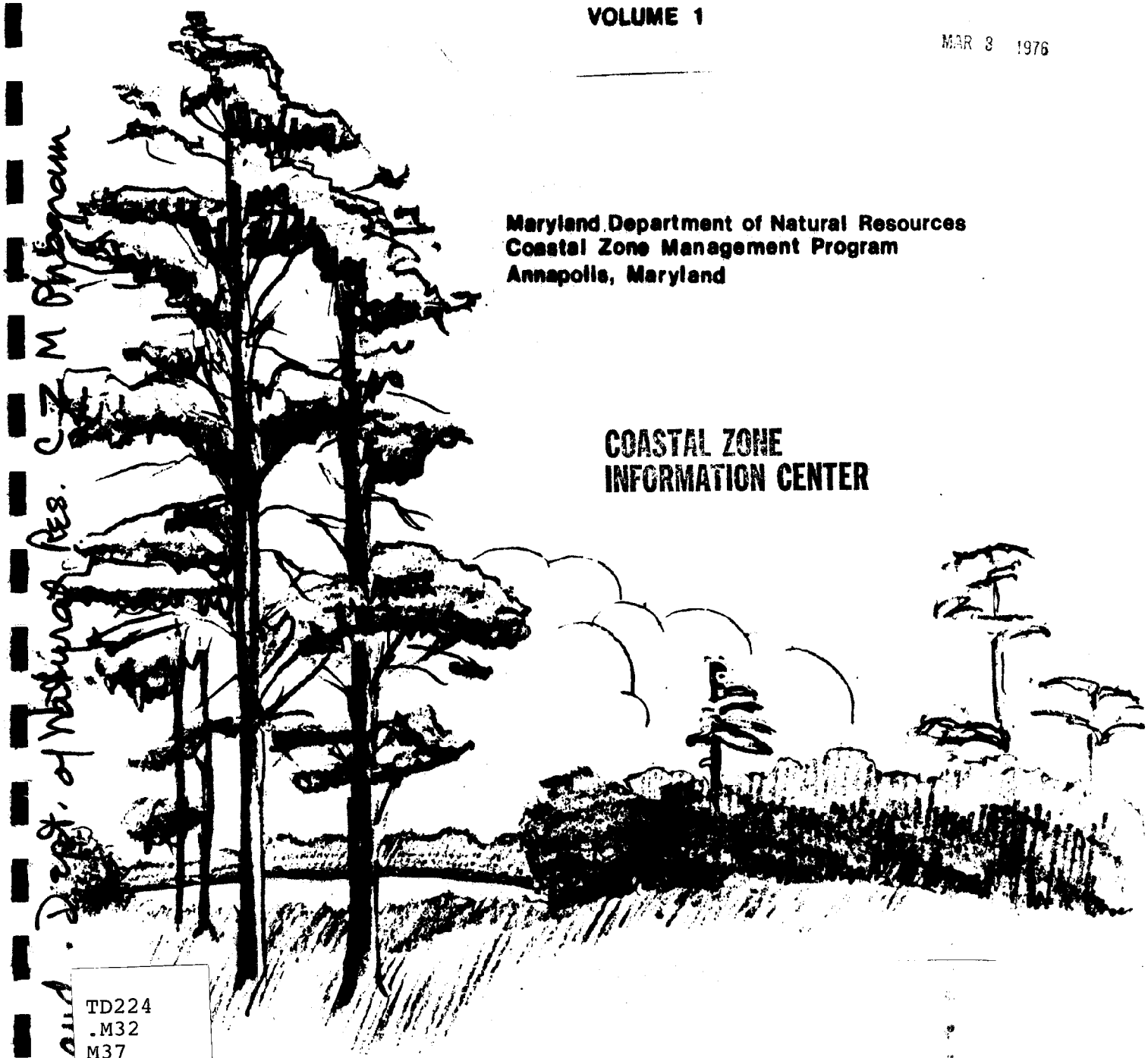
MARYLAND UPLANDS NATURAL AREAS STUDY

VOLUME 1

Maryland Department of Natural Resources
Coastal Zone Management Program
Annapolis, Maryland



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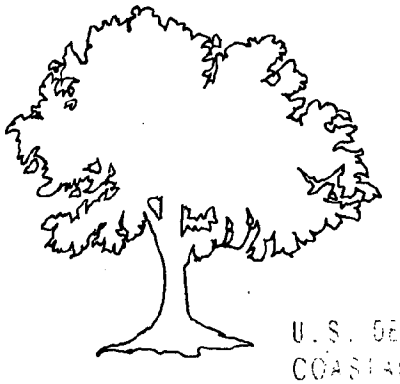
MARYLAND UPLANDS NATURAL AREAS STUDY

Volume 1: Eastern Shore

Prepared for

Maryland Department of Natural Resources

Coastal Zone Management Program



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As is apparent from the variety of people with whom we have worked, the study incorporates a diversity of disciplines. In bringing the various elements together, we have relied heavily on the knowledge and labor of the professional staffs of the Department of Natural Resources, the Department of State Planning, and the Soil Conservation Service as well as members of the scientific community. In addition, we have had the good fortune to be able to visit with many knowledgeable and interested residents of the Eastern Shore. We are grateful for the courtesies, hospitality, and kindness they showed us, as well as for their valuable insights.

We are especially appreciative of the congenial working atmosphere created by Tom Chaney and Bill Jackson of the Coastal Zone Management Program, and of the advice and cooperation they have offered. William Tans has kindly permitted us to include his paper, "Priority Ranking of Biotic Natural Areas", reprinted from the Michigan Botanist, Vol. 13, 1974, as part of this report. It appears as Appendix A in this report.

The discussion of Aquatic Buffer Zones, included in the discussion of derived parameters in Chapter III, is part of an unpublished report undertaken independently of this study. It has been adapted and included for informational purposes.

PREFACE

When studying the natural environment an underlying presumption is that all things are interrelated. No system, process, or object in nature is totally self-contained or unchanging. With this proposition in mind, a data gathering program was developed for a natural areas inventory. This study is designed to provide field data gathered by qualified field personnel on specific upland natural areas as an information base for planning and management decisions.

The Maryland Uplands Natural Areas Study Volume I describes the scope, objectives and methodologies of the natural areas inventory of Maryland's coastal zone. The data parameters used in the inventory as well as the potential users and the uses of the data are discussed. A special effort was made to describe in detail the processes and considerations relating to aquatic buffer zones. It is through the hydrologic processes that upland natural areas are most directly related to coastal aquatic environments. The discussion of buffer zones in this volume provides detail necessary to understand the natural processes in these zones and to allow delineation of aquatic buffer zones. Included in Volume I is a discussion of the rationale behind the choice of parameters inventoried and the techniques used in the natural areas inventory. A discussion of how areas might be evaluated for specified uses or relative quality is also part of this volume.

Volume II of this study is a field notebook for field surveyors as developed for inventorying Maryland's Eastern Shore. The field notebook describes the methods and techniques for data collection and explains how the data should be encoded onto data forms. The field survey is being carried out in two phases with the Eastern Shore inventory being completed during the summer of 1975. The Western Shore inventory will be carried out during the summer of 1976.

A volume of computer print-outs containing data on each inventoried natural area maps of site locations will be available following the completion of the field survey and the computer storage of the data. Data relevant to each natural area are formatted for easy comprehension and can be made accessible through the use of photo-copying for selective distribution.

PERSONNEL

The following personnel were responsible for the completion of this report:

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INTRODUCTION

Pursuant to the Coastal Zone Management Act of 1972 (Federal Register, November 29, 1973), the State of Maryland is completing a Natural Areas Inventory for use in the "designation of areas of particular concern" (section 305 (b) (3) Coastal Zone Management Act). This Natural Areas Inventory concentrates on relatively undisturbed inland areas including streams, forests and non-tidal wetlands such as bogs, marshes, ponds, and wooded swamps. This study, a part of the Natural Areas Inventory, is restricted to Maryland's Eastern Shore.

The purpose of this study is to provide both objective and descriptive data on identified potential natural areas. This information will be used to (1) describe and evaluate the inherent value of an area as a natural ecological unit and to (2) ascertain the value of specific areas for certain compatible uses.

"Natural areas" can be defined many ways. Two studies in Maryland have produced definitions similar to each other. A Smithsonian Institute study (1974a) defines a natural area as "an area of land or water where natural ecosystem processes operate relatively undisturbed and where natural biological communities, their interactions, structures and functions can be studied". This definition is very similar to that of the Wisconsin Scientific Areas Preservation Council definition (1973), wherein "scientific areas are natural areas".

A second study, by the Maryland Department of State Planning (1968), uses a broader definition of natural areas. They are "areas where, at present, natural processes predominate and are not significantly influenced by either deliberate manipulation or accidental interference by man".

Because the potential uses of these areas go beyond scientific research and education, the second, broader definition was adopted for this study.

(1) This definition of natural areas is not meant to imply that a natural area is automatically considered an area of particular concern. (2) As part of this study each of the natural areas sampled will be evaluated as to its uniqueness, use potential and degree of disturbance. (3) A natural area which is sensitive to impacts or is scarce, or which contains unusual or unique features may be an area of particular concern. (4) This study will aid in determining criteria for identifying those natural areas which are of particular concern.

Vegetated land and balanced aquatic systems in a natural state have a variety of potential uses ranging from buffer zones and recreation areas to sites for sewage disposal or residential communities. But the impact of development on the environment often involves long-term, serious changes in natural systems. Many functions or uses of the natural environment require the existence of undisturbed forests, wetlands, old fields and other natural features. Section 305(b)(2) of the Coastal Zone Management Act requires that the State define what constitutes permissible land and water uses within the Coastal Zone which have direct and significant impact on coastal waters. In addition, Section 305(b)(5) requires the State to develop "broad guidelines on priority of uses in particular areas including specifically those uses of lowest priority". Rules and regulations published pursuant to the Act indicate that the broad guidelines to be developed are to be closely tied with the requirements of 305(b)(2) and (3) which deals with areas of particular concern and permissible uses. This study is part of the process for developing these guidelines.

One of the major purposes of a Natural Areas Inventory is to provide data on sites for State agencies and departments which regulate or acquire land for particular uses. The usefulness of a study such as this depends on (1) the level of detail of the information for a particular function or use, and (2) the ease with which the information can be acquired, retrieved, and used. The level of detail and comprehensiveness needed and the uses to which natural areas might be put were determined through interviews with personnel in agencies of the Department of Natural Resources. During these interviews parameters related to natural areas which would convey useful information to these agencies were determined.

This study also developed a format for information storage and a system for easily retrieving, displaying and manipulating resource information. The system developed is compatible with the Department of State Planning's MAGI computer system.

It is not the aim of this study to develop an objective ranking system for evaluating natural areas for particular uses or for relative degrees of quality. Rather, agencies in the Department of Natural Resources, separately or collectively, will develop a ranking system for natural areas to identify the uses they deem to be permissible. As part of their responsibilities, these agencies must develop a means for identifying areas of particular concern within natural areas, develop a method and rationale for ascribing relative significance (ranking) to coastal areas, and map those areas of particular concern to the State.

Many states have begun or completed Natural Area Inventories. The scope and depth of these studies varies. The merits of Maryland's study are that 1) all parameters were predetermined and selected according to their utility in evaluating natural areas for specified uses or relative quality, or according to other data needs of agencies, 2) the data are easily quantified and the survey technique readily replicated, 3) candidate natural areas were extensively field surveyed, 4) sites were visited for the purpose of validating all secondary sources of information, and 5) data forms were checked for completeness prior to computer storage of the data. In the past, many natural areas studies have lacked one or more of these merits. Several have had to resort to only compiling existing sources of information which are sometimes outdated or questionable.

This study was not able to survey all existing upland natural areas. An initial list of natural areas thought to be of interest, scarcity, or critical importance was used for field study. The list was developed from interviews with expert or knowledgeable people and from questionnaires, scientific studies and site field notes. To expand the initial list of sites, field surveyors interviewed knowledgeable local citizens and local agency personnel (e.g., county foresters) to find additional sites. Areas which could be important to this study may have been overlooked. However, the data collection forms and the computer format used provide the flexibility for adding sites. It is recommended that State personnel use these data forms when visiting new sites. A program could be developed by the Department of Natural Resources to inventory all remaining undeveloped areas during the course of an agency's routine field activities.

The data assembled for each site includes geology, hydrology, soils, vegetation structure and floristics, wildlife, ownership, zoning, area size, and other parameters. Field surveys collected data on vegetation floristics and structure, slope, area size, presence of wildlife, type of water body, type of water bottom material, depth of waterbody and the presence of unique, interesting and other natural features. Information or data recorded but not field surveyed came from sources such as county soil surveys, zoning maps, State geology maps, and personal interviews. Items of interest obtained in interviews or from reports but not actually seen by the field staff were recorded as having been acquired from a secondary source, with the source noted. Time and the scope of this project precluded the use of such rigorous or time consuming field tasks as laying quadrats or taking detailed bird censuses. A role of this study is to collect base data that may be used in selecting a site for a particular use (see "Potential Uses"). After selection a more detailed site analysis will have to be carried out in order to ensure the site is appropriate for the proposed use.

A common organizational problem is that data are often fragmented among several departments or agencies, few of which have centralized data centers. Maryland's Department of State Planning is now in the process of developing such a centralized system. This study will bring together natural areas data for decision makers.

Of necessity, decisions are often based on incomplete or minimal information about the quantity and quality of resources. In many instances, needed data have never been collected or are so old that they are no longer valid. This study is intended to fill part of this data need.

It is important that those using the information generated by this study realize the assumptions which went into its development.

It was assumed that:

1. The natural areas identified for study contain the majority of the unique, interesting, unusual, or critical areas in Maryland's Coastal Plain.

2. From interviews with data users and from an analysis of their needs it is possible to establish a tailored data gathering and storage system to fit specific agency needs.

3. To be useful for decisions, descriptive information needs to be replicable and complete, but not highly technical.

4. Subjective data can be collected objectively and uniformly from person to person when properly trained.

5. Data can be collected at one time by one person and then ranked and evaluated by another person later.

6. A data collection system can be devised to minimize differences between survey personnel, allowing for uniform data collection.

OBJECTIVES

The purpose of this study is to provide both objective and descriptive data on identified natural areas. This information will be used to (1) describe and evaluate the inherent value of an area as a natural ecological unit and to (2) ascertain the value of specific areas for certain compatible uses. The emphasis of this study is field survey, data collection, and preliminary evaluation.

The study's objectives are:

1. To develop a bibliography of references on the vegetation and wildlife communities of Maryland's Coastal Zone.

2. To determine environmental parameters routinely used by agencies or personnel in analyzing the importance and environmental significance of specifc areas.

3. To select from among the parameters those which could be inventoried as part of a natural areas study.

4. To record previously undocumented information pertaining to specified undeveloped areas.

5. To review aerial photography of all specified natural area sites.

6. To identify the parameters and techniques most useful in achieving the goals of this study.

7. To develop an uncomplicated, flexible and efficient sampling method to collect and summarize large quantities of field data.

8. To develop a flexible system for describing the mosaic of plant communities, site types and wildlife in the region.

9. To develop comprehensive field data collection forms for use in recording information which has a format compatible with current State computer storage.

10. To prepare a list of materials needed for field sampling and develop a strategy for completing the sampling procedure.

11. To develop a preliminary data evaluation technique which is flexible, versatile, uncomplicated and which provides both subjective and objective analyses. The evaluation technique should be versatile enough to be used in evaluating such topics as natural quality and use potential by selective choice and re-ranking of parameters.

12. To prepare a general description and graphic presentation, for educational purposes, of plant communities in the Coastal Plain.

STUDY DEVELOPMENT

In designing this data gathering program, the following considerations were included.

1. Site Selection
   Aerial photography review

2. Parameter determination
   a) Users and their data needs
   b) Potential data uses
   c) Parameters (Objective)
   d) Parameters (Derived)

3. Existing data base

4. Field survey procedure

5. Data format and use of computers

6. Evaluation

SITE SELECTION

The natural areas selected as candidates for field investigation were chosen by Coastal Zone Management Program personnel using secondary sources and their personal knowledge of sites along streams and shorelines. These latter areas are of importance to aquatic systems and are of particular interest to the Coastal Zone Management Program. The secondary sources include:

1. Catalogue of Natural Areas in Maryland. Department of State Planning, August, 1968. (Updated).

2. Survey of the Ecologically Important Natural Area of the Chesapeake Bay Region. Smithsonian Center for Natural Areas, 1974.

3. Bibliographic references, Department of State Planning, card file of sites obtained from search of publications on related topics.

4. Environmental inventory questionnaires. Department of State Planning pamphlet, July, 1973.

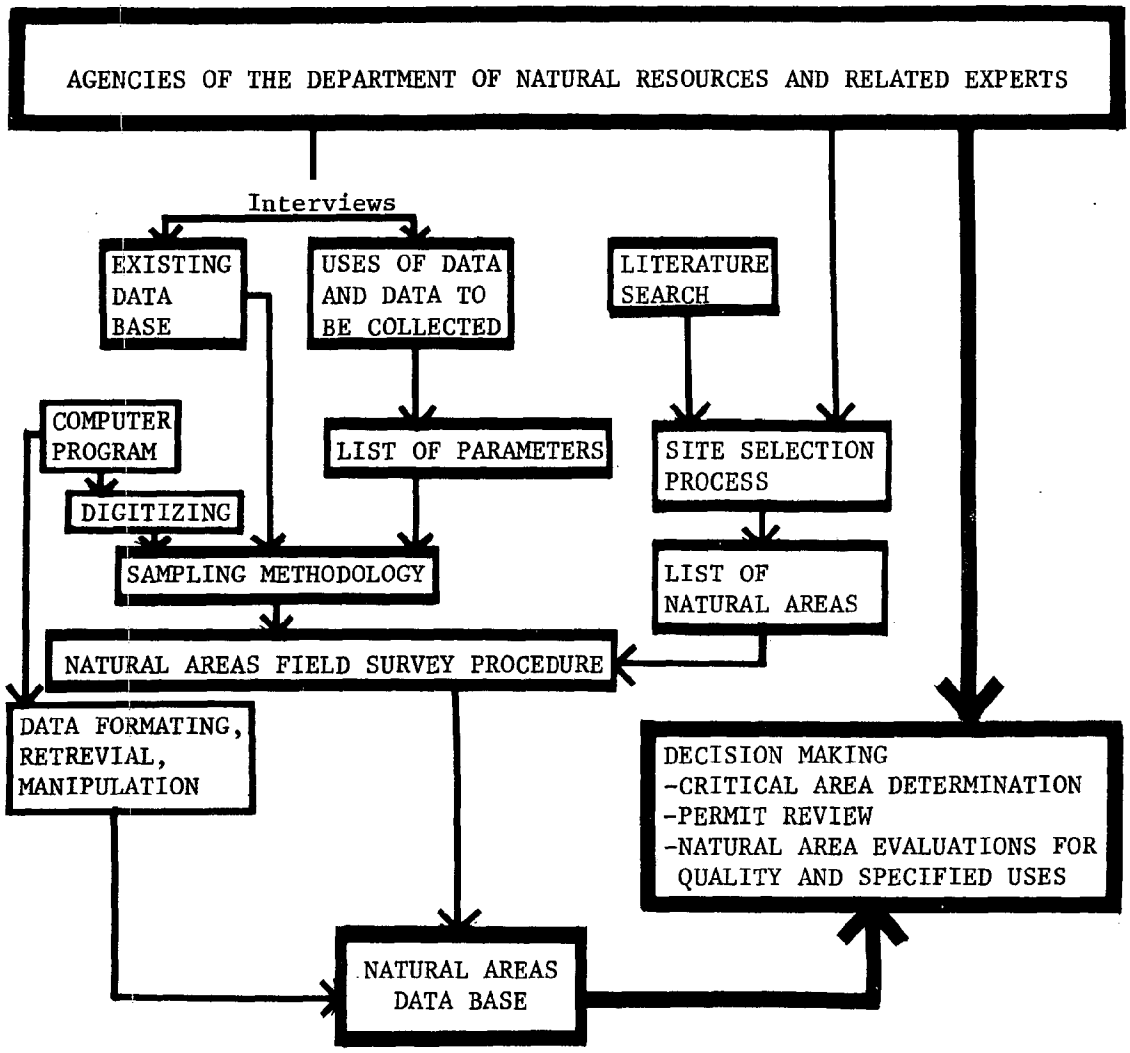
5. Big Tree Champions of Maryland. Maryland Forest Service, Department of Natural Resources, 1973.

6. Wetlands in Maryland. Department of State Planning, Department of Natural Resources, Department of Economic and Community Development, September, 1973.

STUDY DEVELOPMENT

The flow-diagram below illustrates the processes involved in the development and execution of this project, as explained in the following pages.

Figure 1



7. Areas delineated by Grace Bush, Johns Hopkins University, as being of botanical interest, 1975.

8. Atlantic Coastal Plain Critical Areas Study. U.S. Department of the Interior.

9. Bird nesting sites. Bernard Holla, Wildlife Administration, 1974. (Unpublished).

10. Department of Natural Resources Eastern Shore Study. Jackson, 1973.

The areas satisfying the criteria included in these reports are those which are included in at least one of the following:

1. Areas which have unusual or interesting natural features meriting protection by the state or local government. These natural features might consist of:

    a. Natural habitats supporting unique wildlife population or a species whose range is limited in the state or whose numbers are so limited as to warrant special consideration.

    b. Natural areas possessing unique features such as:

        1. Sandy beaches or sand dunes.
        2. Bluffs having unusual exposed geologic strata or offering vistas.
        3. Scarps.
        4. Inland rivers having wild character, profuse blooming flora, unusual floral communities, or mature, regenerating forests.
        5. Forest communities at a species range limit such as bald cypress, laurel oak, loblolly pine or overcup oak.
        6. Endangered forest species such as chestnut or elm.
        7. Trees which are currently national or state champions and trees over 200 years old.

2. Areas which are crucial to an ecological system and should be protected from inappropriate development or use. Such areas may not readily support development or may contain hazards to public health and safety. This category might include:

    a. Streamside forests which buffer aquatic systems from upland contaminations such as silt, bacteria, and toxic chemicals.

    b. Low wetlands which support many wildlife species, and perform such useful functions as water filtration, floodwater storage, and nutrient assimilation.

3. Areas which can be considered to contain a primary state resource. These areas include:

    a. Natural wildlife habits of high productivity.
    b. Primary forest production areas.
    c. Areas of exceptional scenic quality.

4. State owned lands

Field personnel interviewed people contacted prior to the field survey, who had knowledge of sites. Additional sites discovered through the interviews were added to the field survey list if they met any of the preceding criteria. If candidate natural areas were visited but did not meet the criteria they were not surveyed. Sites which were reported but could not be found or no longer existed were recorded as such.

AERIAL PHOTOGRAPHY REVIEW

Aerial photographs are a valuable tool in successful field surveying. Aerial photographs allow field personnel to locate and orient themselves in the field. At the same time, photos allow field personnel to distinguish between different land and vegetation types and permit them to calculate acreage.

The field survey file for each candidate natural area included a photo copy of a 1:20,000 or 1:15,840 scale black and white aerial photograph. Budgetary constraints precluded the purchasing of actual photos for field use. The copies were used to delineate the boundaries of the natural areas and provide the base information for mapping each natural area. These maps are on file with the Coastal Zone Management Program and are filed by natural area number (See Appendix A for natural area numbering system).

PARAMETER DETERMINATION

POTENTIAL USERS

An initial step in this study was to identify potential data users in State government and their specific information needs.

The data requirements of planners at all levels of government are related to the types of programs with which they are involved. Each program has data needs which can be met, in part or in whole, by a well-conceived data-gathering process.

The planned users of the inventory data, those with a continuing and timely need, are state agencies and departments with both functional and regulatory responsibilities. So that data gathering could commence with a clear understanding of how the data was going to be used, DNR personnel and state and local planners were interviewed. At the same time, knowledgeable people and experts in related fields were interviewed about data needs so as to make the study as broad based as possible. (See Table 1).

Table 1. **PEOPLE INTERVIEWED**

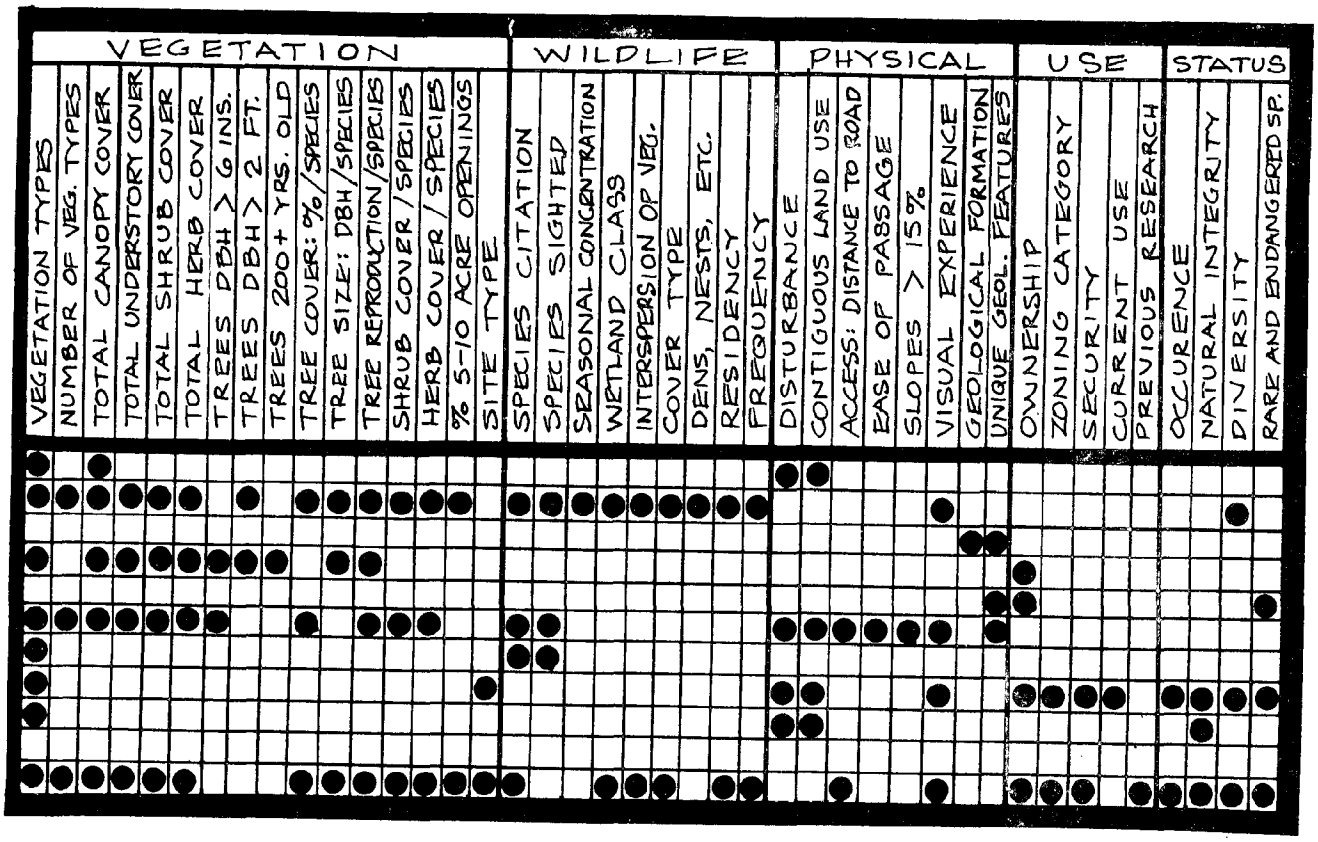
Wildlife		
Nick Carter	Fisheries Administration	DNR
Bernard Holla	Wildlife Administration	DNR
Chandler Robbins	Ornithologist	Patuxent Wildlife Research Station
Craig Ten Broeck	Wildlife Administration	DNR
Francis Golet	Department of Forestry and Wildlife Management	Univ. of Rhode Island
Geology		
Randy Kerhin	Md. Geological Survey	DNR
Vegetation		
Grace Brush	Geography Department	Johns Hopkins Univ.
James Burtis	Forestry Service	DNR
State Planning		
John Antenucci	Div. of Comprehensive Planning	Dept. of State Planning
Recreation		
William Kramer	Capital Programs Admin.	DNR
Kenneth Ropp	Capital Programs Admin.	DNR
Lewis Rudasill	Capital Programs Admin.	DNR
Environmental Services		
Lee Jaslow	Environmental Services	DNR
Coastal Zone Management		
Thomas Chaney	Water Resources Admin.	DNR
William Jackson	Water Resources Admin.	DNR
Earl Bradley	Water Resources Admin.	DNR
Soil		
Bruce Nichols	Soil Conservation Service	USDA
Natural Areas Studies		
Thomas Siccama	School of Forestry	Yale University
Harold Erickson	Biology Department	Towson College

Table 2. **PARAMETERS FROM INTERVIEWS**

PARAMETERS: / AGENCIES AND EXPERTS	SIZE		WATER												SOILS				
	SIZE OF AREA	MINIMUM DIMENSION	TYPE OF WATER BODY	SIZE OF WATER BODY	DEPTH OF WATER BODY	VAN DEUSEN INDEX	BOTTOM MATERIAL	WATER TABLE DEPTH	DISTANCE TO WATER BODY	BEACH FRONTAGE	BEACH WIDTH	BEACH TYPE	% STREAM SHADED	AQUATIC BUFFER ZONE	WELL DRAINED SOILS	RUNOFF POTENTIAL	ERODIBILITY (K)	SOIL TYPES	NATURAL SOILS GROUPS
FISHERIES ADMINISTRATION			●	●	●		●	●					●	●					
WILDLIFE ADMINISTRATION	●		●	●	●		●		●					●					
GEOLOGICAL SURVEY																			
FORESTRY SERVICE	●																	●	
STATE PLANNING	●																		●
CAPITAL PROGRAMS	●	●	●	●		●			●	●	●	●			●	●	●		
ENVIRONMENTAL SERVICES	●													●					
COASTAL ZONE MANAGEMENT	●		●	●			●	●	●	●	●	●	●	●		●	●	●	●
SOIL CONSERVATION SERVICE	●		●	●	●		●	●	●					●	●	●	●	●	●
EXPERTS IN RELATED FIELDS	●							●										●	

In this way, data users were involved in the design of the information system. From an analysis of the data users' needs it is possible to establish the functions, scope, and assumptions of the inventory program and establish a basis for selecting the methods and techniques for actually conducting the inventory and communicating the resulting information.

As a result of interviews and a literature search the essential and desirable parameters for the natural area inventory were determined. Table 2 is a list of the parameters which were found to be important to this study. It also indicates those parameters felt by individuals in each agency to represent data needs relevant to their management responsibilities.



A study such as this one is not an end in itself, but part of a series of ongoing actions related to information collection and updating in order to improve the quality of information available for decision making.

Similarly, this study is not a self-contained tool for decision making. To assess the importance of resource areas in meeting particular needs and to assess threats to these areas, data other than that gathered by this study is needed. For example, information on economic resource demands or demographic characteristics must be weighed with natural data in decision making.

Within the context of this study, where additional information may be needed to make more sophisticated or comprehensive evaluations, this need was noted according to the particular use.

Those parameters which will be useful for evaluations are listed with each potential use. The parameters are discussed in detail in the section on Parameters, following the section on Potential Uses.

POTENTIAL USES

The potential uses to which the collected data may be put cover a broad range of activities. These uses include:

Forest wildlife management
Wetland wildlife management
Forest hunting
Wetland hunting
Active recreation
Passive recreation
Commercial forestry
Champion trees
Fisheries
Scientific research
Education

This list of potential uses is not all-inclusive, rather it includes only the potential uses which were determined to be most relevant to existing programs and agencies.

Wildlife

The potential uses of natural areas, as related to the programs of the Wildlife Administration, are for hunting and wildlife management of forests and wetlands.

Wildlife depends upon plants for food and cover. Animal protection through preservation of habitats maintains ecological cycles, preserves genetic diversity, and insures both game and non-game wildlife populations for recreational activities.

The increasing numbers of people who hunt, trap or simply watch wildlife, coupled with diminishing habitats for wildlife production pose a major problem for Maryland's Wildlife Administration. The Administration has three major responsibilities: (1) to provide a public recreational opportunity for consumptive users of wildlife, (2) to provide public recreational opportunity for non-consumptive users of wildlife; and (3) to control the impacts of human activities so as to guarantee that the survival requirements of all wildlife species are met in the state (MDNR, Wildlife Administration, 1975).

The last decade has seen a great increase in public interest and involvement in outdoor activities, especially wildlife related recreation. The statewide number of licensed hunters continues to increase at about 4.3% per year. The growth in licensed hunters, according to the Wildlife Administration, is projected to increase approximately 2.77 times faster than the annual rate of population increase in the state between 1975 and 1985 (MDNR, Wildlife Administration, 1975).

With increasing development, the number of projects requiring environmental impact statement review and/or comments regarding their impact on wildlife is expected to increase from approximately 250 in 1969 to a projected 600 in 1975. (MDNR, Wildlife Aministration, 1975).

"In general, the nature of wildlife recreation and, consequently, the Administration's focus, will shift from largely wildlife management to a greater emphasis on non-consumptive uses of wildlife." (MDNR, Wildlife Administration, 1975).

Wildlife Management

Parameters for evaluation include:

Forest:

Size of Area (acres)
Forest Type (e.g., loblolly pine-oak)
Average DBH for Dominant Trees
Percent cover of Dominant Trees
Reproduction of Dominant Trees
Understory Trees (% cover)
Shrubs (% cover)
Herbs (% cover)
Distance of Water Body
Type of Water Body
Size of Water Body
Bottom Material (e.g., peat, muck, silt, sand)
Percent of 5-10 Acre Openings
Presence of Seasonal Concentration of Wildlife
Contiguous Land Use
Disturbance
Species (citations)
Species Sighted
Presence of Dens or Nests
Security
Ownership
Natural Integrity

Wetlands:

Site Type (e.g., upland isolated)
Wetland Class (e.g., shrub swamp)
Vegetation Interspersion (e.g., pattern)
Size
Cover Type (e.g., % cover by pattern)
Surrounding Land Use (e.g., agriculture, residential)
Disturbance
Aquatic Buffer Zone
Security
Ownership
Natural Integrity

The Wildlife Administration has established a non-game program because it recognizes the tremendous growth of non-consumptive recreation, particularly nature study and birdwatching. In Maryland, over $13 million was spent in 1971 for wildlife enjoyment on such things as the purchase of bird feeders, supplies, and visits to the zoo. Over 304,000 households participated in these activities (Environmental Research Group, 1974). Wildlife management for non-game species is a major goal of the state. (MDNR, Wildlife Adm., 1975.)

Forests and upland old-fields provide resources for many animal species. Only a small portion is available for wildlife management. The acquisition of wildlife areas and assisting owners of private wildlife areas are major interests of the Wildlife Administration. (MDNR, Wildlife Adm., 1975.)

According to many ecologists, wetlands are the most valuable wildlife habitat. Wildlife diversity is usually higher in bottomlands than uplands because (1) the growth of food plants depends upon the availability and abundance of nutrients, nutrients are relatively abundant in bottomlands and alluvium (Jahn and Hunt, 1964) and (2) a regional water table permits the flow of nutrients through surficial geologic deposits which maintains a relatively constant water level. Upland wetlands may not be as diverse because perched water tables are associated with greater water level fluctuation, lower nutrient levels, and less diverse vegetation than regional water tables (Golet and Larson, 1974).

Because they result from perched water table conditions, upland wetlands have shorter life expectancies than bottomland wetlands. Plant remains accumulate, often under acidic conditions, and plant succession is likely to be more rapid than in the bottomlands.

Additional parameters for study might include seasonal bird data and a harvest index. Bird census data are collected by local birdwatchers and are now being organized by Chandler Robbins of the Patuxent Wildlife Research Station. Harvest or population counts of game species are available in the Wildlife Administration.

In general, wildlife diversity is fostered by a highly diverse plant community. Large areas generally provide the greatest diversity. However, a wide distribution of smaller areas with different habitats may insure larger and more widespread populations of animals than a few large wildlife refuges. This is particularly important for certain non-game species (Smithsonian, 1974a).

Interest in field trails, birdwatching, hiking and nature appreciation has mushroomed. In an economic survey of wildlife recreation in Maryland it is estimated that the 2.7 million days spent on hunting by householders, in Maryland in 1971 were worth almost $104 million to those households. It is also estimated "that 14.5 million days spent in wildlife enjoyment in Maryland were worth more than $1.2 billion to the householders in Maryland." (Environment Research Group, 1974).

Hunting

Parameters for evaluation include:

Forest:
Size
Percent of Opening 5-10 Acres/Square Mile
Seasonal Concentration of Wildlife
Contiguous Land Use
Access to Area
Species (citations)
Species Sighted
Ownership
Vegetation Types

Wetlands:
Site Type
Wetland Class
Vegetation Interspersion
Size
Cover Type
Surrounding Land Use
Disturbance
Aquatic Buffer Zone
Seasonal Concentrations of Wildlife
Access to Area
Species (citations)
Species Sighted
Ownership
Security

In 1971, hunters spent more than $17 million on hunting activities, including services, supplies and licenses. Over 38,000 household were involved (Environmental Research Group, 1974).

The Upland and the Forest Wildlife Programs within the Wildlife Administration are concerned with mourning doves, pheasants, quail, rabbits, woodcock and with wild turkey, white-tailed deer, sika deer, ruffed grouse, gray squirrels, eastern fox squirrel, and red (pine) squirrel, respectively. The major goal of these programs are to (1) maintain suitable habitats, (2) maintain populations in balance with their environment, and (3) give hunters and others the opportunity to hunt and enjoy these species.

Dabbling ducks, diving ducks, sea ducks, geese, American coot, rail, gallinule, and jack snipes are among the major wetland game birds. Furbearers such as muskrat, nutria, beaver, and raccoon are the major mammals trapped in wetlands. Water fowl provide about 370,000 user-days of recreation to hunters, while furbearers provide about 382,500 user-days to commercial and recreational trappers. Furbearers accounted for income in excess of $1 million for trappers in 1972-73. In the state the number of hunters is expected to increase while available habitat is expected to decrease. By 1980, to meet this challenge, the Wildlife Administration plans to acquire an additional 35,000 acres for state wildlife management and to incrase the land available to hunting through expanded cooperative management agreements with private and public land holders (MDNR, Wildlife Administration, 1975).

This natural areas study provides site data to aid in implementing these plans.

Additional parameters worth consideration, but not included in this study are population counts or harvest indexes of game species and hunting pressure in the county. This data is currently available in offices of the Wildlife Administration.

Recreation

The Capital Programs Administration is responsible for capital improvements, open space programs, shore erosion control and waterway improvements. Land Planning Services is responsible for planning related to public lands, and Program Open Space is responsible for the acquisition of land for fulfilling the roles of the Department of Natural Resources, and for the development of capital improvements on these lands. Land Planning Services and Program Open Space will use the results of the natural areas survey to determine if there are additional areas that should be added to the state system for protection and made available to the public for suitable outdoor recreational uses (William Kramer, pers. comm.).

Increasing leisure time and disposable income have put pressure on recreation land throughout the state. There is an increasing public need for open space and recreational lands. At the same time, critical areas have to be acquired to prevent their conversion to more intensive uses (MDNR, Capital Programs Administration, 1975).

The need for recreation planning is based on projected recreational demands. Over 18,000 acres are to be acquired by the end of fiscal year 1981. (MDNR, Capital Programs Administration, 1975).

Active Recreation

Parameters for evaluation include:

- Size of Area (acres)
- Minimum Dimension of Area
- Slope (less than 15% and greater than 15%)
- Soil Erodibility
- Presence of Well Drained Soils
- Tree-Cover
- Average DBH of Canopy Trees
- Number of Vegetation Types Present
- Shrub Cover
- Disturbance
- Type of Water Body
- Size of Water Body
- Stream Classification (Van Duesen)
- Soil Type
- Access to Area
- Mobility Through Area
- Contiguous Land Use
- Unique, Rare, Unusual Features
- Visual Analysis
- Ownership

Maryland's Eastern Shore, particularly the lower Eastern Shore has well-distributed open space and recreational areas. Although the open space is considerable, nearly 90% of the open space acreage is in sizeable wildlife management areas that have limited active recreational potential. Active recreation usually includes those activities which require facilities and developed activity areas such as ball fields.

The major consideration of sites for active recreation are that the soils and slope permit development, that the area be of adequate size (generally not less than 500 acres) and that it be easily accessible to the public.

Additional considerations should include distance to population centers, recreation demands for specified uses, and water quality data.

Passive Recreation

Parameters for evaluation include:

- Size of Area (acres)
- Number of Vegetation Types
- Rare, Unique or Unusual Features
- Type of Water Body Present (e.g., lake, pond, stream)
- Size of Water Body
- Stream Classification
- Presence of Well-Drained Soils
- Vegetation Types Present
- Types of Disturbance
- Contiguous Land Use
- Access to Area (e.g., highway, road etc. and distance to highway, road etc.)
- Mobility Through Area (e.g., thickness of understory and wetness of soil)
- Visual Analysis
- Ownership

Hiking, primitive camping, nature study, and canoeing are various forms of "passive" recreation. These recreational activities are similar in that the major goal in each is the enjoyment of the natural environment. Major prerequisites for these activities are isolation and solitude. Larger areas are necessary to furnish these conditions for a sizeable user population. Long, relatively wild corridors could also be employed to provide solitude and isolation.

The impacts on the environment from recreational use depend largely upon the intensity of use and the timing of the activity with respect to biological cycles. Hiking through an area during the breeding season, for example, may prove very damaging to wildlife, whereas the same activity at a different time of the year would be relatively harmless.

Birdwatchers are nearly equal in number to hunters (Allen, 1972). Therefore, the diversity of bird species or habitats of rare species may be an increasingly important consideration when choosing the uses of a particular area. This is an instance in which wildlife management and recreation activities have common goals which create opportunities for mutually reinforcing programs.

A parameter which was not measured by this study, but which is important in evaluating an area for passive recreation, is water quality.

Forest Service

Commercial Forestry

Parameters for evaluation include:
- Average DBH of Dominant Trees (Stand Size Class)
- Size of Area (acres)
- Soil Type
- Contiguous Land Use
- Access to Area
- Ownership
- Security
- Disturbance
- Regeneration/Species

Maryland's commercial forest land is 46 percent of the land area in the state, or close to 2,885,000 acres (Ferguson, 1967).

Farms account for about one-fourth of this commercial forest land -- 767,000 acres. Forest industries own about 101,000 acres. Public agencies own 6 percent of the commercial forest land -- 189,000 acres, of which the state owns 144,000 acres. Municipalities own 31,000 acres and Federal agencies own 14,000 acres (Ferguson, 1967).

Many other types of owners such as businessmen and wage earners and professional people own almost two-thirds of the commercial forest land -- 1,828,000 acres. Most of these holdings are less than 100 acres (Ferguson, 1967).

On the southeastern shore (Somerset, Worcester, Wicomico, Dorchester Counties) almost half of the forest area -- 260,000 acres is commercial loblolly pine forest.

Lumber production in Maryland is at a high level. Since 1933 the trend in lumber production has been gradually upward. Generally, the growing-stock volume in Maryland will continue to increase annually during the next 30 years; however, this increase will be at a continually decreasing rate (Ferguson,1967).

This natural areas study will be helpful to the Forestry Service in determining areas of high timber land quality, timber size, and potential for commercial forestry.

Champion Trees and "Tree Hall of Fame"

Parameters for evaluation include:
- Trees Possibly Over 200 Years Old
- Unusually Old Large Trees

In the first Big Tree contest sponsored by the American Forestry Association in 1940, the State of Maryland led all other states in the number of Champion Trees. In 1955, when the national list was republished, Maryland led the field with 45 champions. As a result, it has been dubbed "The Big Tree State". Now the State of Maryland has embarked on a program of identifying trees over 200 years old for the U.S. Bicentennial celebration. The "Tree Hall of Fame" program intends to identify, preserve, mark and honor these trees (Twining, 1975). Thus far, 50 trees have been nominated and certified by State foresters as meeting the standards.

Nearly all of these trees are oaks. The white oak is Maryland's State tree and the Wye Oak in Talbot county, has been declared to be the finest specimen of its species in the United States. Black and red oaks and other hardwoods such as beech, walnut, English elm, tulip poplar, and hickories have received certification (Jim Burtis, pers. comm., and Twining, 1975). This study will be helpful in locating trees over 200 years old and unusually large old trees.

Fisheries

Parameters for evaluation include:
- Type of Water Body (e.g., stream, pond, shrub swamp)
- Percent of Water Body Shaded by Tree Cover
- Disturbance
- Depth of Water Body
- Interspersion of Vegetation (pattern)
- Aquatic Buffer Zone
- Bottom Material (e.g., muck, peat, silt, sand, cobbles, gravel)
- Access to Area

"The Fisheries Administration is responsible for maintaining abundant populations of shellfish and finfish through biologically sound management practices; and for providing commercial and recreational opportunities through the controlled harvest of commercial and game species". (Fisheries Administration, 1974).

Much of the emphasis of the Fisheries Administration programs is on tidal waters; however, "eighty-five ponds in all geographic areas of the state were checked for habitat condition and fish balance". Also, in 1974, "Maryland waters were stocked with 396,000 warm water finfish and 328,000 trout." (Fisheries Administration, 1974). Field surveys have been conducted on seventy-two streams in eight river drainage systems to assess their importance to anadromous fish species. This study will provide additional data to the Fisheries Administration Staff.

Scientific Research

Parameters for evaluation include:
Number of Vegetation Types
Vegetation Types
Occurrence
Previous Research Done in Area
Seasonal Concentrations of Wildlife
Rare, Unique, Unusual Features
Rare, Unusual, Unique Species
Unusual Diversity or Productivity

Natural areas serve as outdoor laboratories for ecological studies. Competition, animal behavior, succession, disturbance, biological production, microclimate, and nutrient or energy cycles are among the topics which can be studied in these areas. From a land management perspective, studies of wildlife habitat relationships and practices for improving timber growth and yield are important. If the research topic is one highly sensitive to disturbance the land under study must be carefully protected.

According to the United States Federal Committee on Research Natural Areas, a research natural area is defined as:

> An area where natural processes are allowed to predominate and which is preserved for the primary purposes of research and education . These areas may include: (a) typical or unusual faunistic and/or floristic types, associations or other biotic phenomena, (b) characteristics or other outstanding geologic, pedologic, or aquatic features or processes.
>
> Research natural areas have these objectives:
>
> (1) To assist in the preservation of examples of all significant natural ecosystems for comparison with those influenced by man.
>
> (2) To provide educational and research areas for scientists to study the ecology, successional trends, and other aspects of the natural environment.
>
> (3) To serve as gene pools and preserves for rare and endangered species of plants and animals. (quoted in Smithsonian, 1974b, p. 158).

Areas which have been subject to previous or continuing research are of particular value because historical data is available for comparison with current and future research. Long-term trends and changes can be studied. Data from this current inventory will be useful in college level courses, as well as for theses and dissertations at the graduate level (Harold Erickson, pers. comm.). It may also be of use to scientists working in related fields (Grace Brush, pers. comm.). Any additional data parameters needed for scientific research are dependent on the type and detail of the particular study.

Education

Parameters for evaluation include:
- Number of Vegetation Types Present
- Size (acre)
- Rare, Unique, Unusual Features
- Wildlife Species (citations)
- Wildlife Species Sighted
- Significance (e.g., local, state, national)
- Occurrence
- Access to Area

Natural areas are outdoor classrooms for teaching the principles of ecology, botany, geology, conservation and land management to students of all ages and levels of sophistication. The State's remaining natural forests, wetlands, and water bodies are places wherein students and the public can observe nature first hand. They can observe the landscape and wildlife at different ages and stages of maturity, and see something of the intricate and complex functionings of nature.

For school field trips, access to the area via roads and highways and the ease of walking through an area are of prime importance, especially where young, more adventurous and naive students are involved. Where difficulties exist, such as wet soils or dense prickly thickets, the potential use of the area is diminished. The type of vegetation community present is also important. A floodplain forest or a swamp may be very diverse in wildlife and plant species while a relic bald cypress swamp is more interesting from an historic, climatic or regeneration point of view. Where many different vegetation communities or natural features exist in relatively close proximity, the variety of available experiences is greatly increased over areas having a single interesting feature. Where areas have little variety, lack unusual or unique natural features, and are difficult to get to, the experience available may limit the frequency of visits.

PARAMETERS

The parameters for which this study collected data are:

1. Objective parameters
   - Area size
   - Type of water body (Van Duesen Index)
   - Size of water body
   - Depth of water body
   - Bottom material
   - Water table depth
   - Distance to water body
   - Beach type, frontage, width
   - Percentage of stream shaded by trees
   - Well drained soils
   - Runoff potential
   - Erodibility coefficient
   - Soil series, type, site index
   - Natural soils group
   - Vegetation type
   - Number of vegetation types present
   - Total vegetation cover
   - Trees with DBH greater than 6 inches
   - Trees greater than 2 feet DBH
   - Trees older than 200 years
   - Tree cover by species
   - Average tree size (DBH) by species
   - Percent of 5 to 10 acre canopy openings in forest
   - Site type
   - Wildlife citations
   - Wildlife sighted
   - Residency, frequency, and seasonal concentration of animals
   - Wetland class
   - Vegetation interspersion
   - Cover type (wetland)
   - Dens and nests
   - Disturbance
   - Contiguous land use
   - Slope
   - Geological formation
   - Previous research
   - Ownership, current use, zoning
   - Rare and endangered species

2. Derived parameters (subjective)
   - Access to area
   - Security
   - Visual Experience
   - Ease of passage
   - Natural integrity
   - Diversity
   - Occurrence
   - Wetland wildlife rating
   - Aquatic buffer zone

These parameters are relevant to one or more potential uses, as discussed in the preceding section.

Natural or critical area evaluation systems require the isolation and documentation of explicit parameters. Decision makers can then begin to understand the relative importance of each parameter for a particular use. The rationale behind the choice of each parameter being used in this study is discussed and documented below.

Objective Parameters

Area Size

As a rule, "bigger is better". Generally, the larger the area the greater the diversity of communities or species in the ecosystem. This is chiefly due to a greater opportunity for variations in topography, vegetation, disturbance, and moisture conditions.

A minimum suitable size for particular uses is difficult to determine. In some cases, small areas such as 0.1 acre bog may contain unique, interesting and possibly endangered species of plants. On the other hand, areas of 20-40 acres may be too small for commercial forestry purposes (Institute of Environmental Studies, University of Wisconsin,1974). In Delaware, twenty acre woodlands have been found to provide sufficient habitat diversity to support a high diversity of breeding bird species (Linehon, et al., 1967). This size does not imply a "steady state" or wilderness condition, it signifies merely that significantly more birds are found per unit area in stands of 20 or more acres than in smaller stands.

In small, isolated areas the home-range requirements for large predators may not be met. As a result these small areas may require intervention by man to prevent excessively large populations of primary herbivores (Smithsonian, 1974a).

Spencer (1968) indicates that for water fowl production many small marshes (less than 100 acres) are preferable to a few larger ones. Water fowl production probably is more closely related to shoreline length than to wetland size, per se (Hochbaum, 1944; Weller, 1964; and Golet, 1973). On the other hand, McGilvery (1968) considers isolated wood duck brood areas under 10 acres of marginal value.

When considering land for the purpose of determining site suitability for state level recreation, a minimum area of 500 acres and a minimum dimension of 1200 feet is considered to be adequate for a new park by the Capital Programs Administration (Kramer and Ropp, pers. comm.).

For wildlife management the consideration of size is relevant with respect to the protection of the ecosystem and meeting the home range requirements (nestings, breeding, food, and shelter) of the species present.

For hunting, the larger the area the greater the habitat opportunities for game animals such as deer. Larger areas usually contain more openings in the canopy, and less outside disturbance, therefore, the chances of encountering game animals are much higher (Institute of Environmental Studies, Univ. of Wisconsin, 1974).

For educational purposes, the larger the area, the greater the diversity of ecosystems, communities, and species likely to be available for study.

Type of Water Body and Van Duesen Index

The type of water body in a natural area is an indicator of what activities can take place there. The Capital Program Administration is concerned with whether a water body is good for fishing, boating, swimming, or other activities. The water body type classification used in this study combines the freshwater wetland types of Shaw and Fredine (1956), and the basic Van Duesen stream index (Van Duesen, 1954) with the addition of ocean, bay and pond types.

Size of Water Body

The areal extent of a water body relates primarily to its potential use in recreation. Forty acres has been suggested by the Recreation Department as an approximate minimum size for active recreation (Kramer and Ropp, pers. comm.).

The size of water body also determines its utility to resident and migrating wildfowl. In general large, broad expanses of water are more suitable as resting or wintering habitat, while a mixture of water areas and upland or wetland is more suited to breeding.

Together with depth, the size of a water body determines it's suitability as fish habitat and as a site for primary productivity of emergent and submerged aquatic vegetation for wildfowl.

Depth of Water Body

The depth of a stream or pond is important in determining the types of vegetation and animals which live there. For the purposes of the study, though, the criterion is restricted to recreational considerations. Water bodies less than a foot deep are not suitable for boating or water sports, while areas which are greater than 1 foot deep generally are suited.

Bottom Material

The bottom material is one of several features which help determine the capacity of a watercourse or water body to support various aquatic organisms.

In general, large rocks or cobbles provide the greatest diversity of habitats for fish and their primary food sources, insect larvae. As the particle size of bottom material decreases so does the diversity and size of aquatic habitats. Less protection is available for young fish and insect larvae.

Where fine particles predominate as a coating on rocks or as a smooth continuous bottom material, past or ongoing sedimentation is suspected. Although streams in some types of geology (e.g., shale) are characterized by silty bottoms, in others, sediment generated by earth moving or agriculture may be found, indicating a major disruption to the biotic system. Sediment not only eliminates habitats by filling crevices, it also may blanket rocks, roots, and twigs, making it impossible for aquatic organisms to gain a hold. It also prevents light from penetrating to diatoms and algae, which provide food for insect larvae.

In ponds and lakes fine particles generally predominate on the bottom. The organic composition of the bottom is of special importance with regard to the water body's nutrient regime as well as the biological oxygen demand. Ponds with large quantities of organic bottom ooze may have a low oxygen level during certain seasons which restricts the species composition. Such low oxygen levels may be due to the use of oxygen by bacteria in the decomposition of organic detritus.

Water Table Depth

The highest level to which the soil or underlying rock material is wholly saturated with water during the wet season marks the upper edge of the water table. In certain places a perched water table may be separated from the regional water table by a relatively dry zone.

Depth to water table and soil drainage are apparently the two major variables responsible for the mosaic of vegetation communities on the Eastern Shore, according to Shreve (1910), Grace Brush (pers. comm.) and Bruce Nichols (pers. comm.). The position of the water table greatly affects the rate of weathering (oxidation)in the soil. In temperate regions such as Maryland's Eastern Shore, water percolates through the soil's zone of aeration to the water table. In this upper zone organic matter is broken down by oxidation. Where the saturated zone is near the surface soil conditions may be relatively anaerobic and the breakdown of organic matter is slowed.

The availability of soil moisture is reflected in plant distribution. Some plants root above the water table and are capable of surviving protracted periods of drought. In other instances, though the ground may be dry at the surface, the water table may be close enough to the surface to be reached by plant roots. Wet ground is occupied by sycamore, birch, willow and other species on the northern Eastern Shore and by loblolly pine and cypress on the southern Eastern Shore. Where the water table intercepts the ground surface, forming seeps or springs or saturated soils, marsh-like vegetation may occur.

Due to the fluctuating nature of the ground water system, knowledge of the depth of water table of an area is essential for management purposes. Where areas are channelized or drained, the vegetation of the area can be seriously altered. Information on water table depth is attainable from County Soil Surveys.

Distance to Water Body

The distance from a natural area to a stream is an indication of its potential value for recreation as well as its probable use by certain wildlife species. Natural areas bisected by streams have higher wildlife diversity and may have a higher recreational value.

Beach Type, Beach Frontage, and Beach Width

The Eastern Shore has very few beaches or public recreation facilities which provide public access to the shore of Chesapeake Bay. In general, there are three beach types along Chesapeake Bay - banks or bluffs, low sloping sandy beaches without dunes, and sloping sandy beaches with dunes (Jackson, pers. comm.). The type of beach determines to a large extent the uses to which it can be put.

Beach frontage or the length of beach along the shore is an important consideration for siting public beaches. Beaches greater than 1500 feet long are priority areas for public beach sites. Generally, the widths of beaches are small. Where beach width is greater than 20 feet, the beach is a prime location for public recreation.

Percentage of Stream Shaded by Trees

By shading a stream, a floodplain forest stablizes water temperatures. At the same time it provides food and nutrients to the biota within a stream. Should the vegetation be removed and sunlight allowed to penetrate the water, the diurnal water temperature fluctuations may raise the temperature above the tolerance of game fish (Auberton and Patrick, 1965) and other stream organisms. When unshaded, many habitats essential to the aquatic system are eliminated. This can have a serious effect on the trophic relationships existing in many streams (Orser and Shure, 1972; Vannote, 1975).

Well Drained Soils

Well drained soils, nearly free of mottling above 36 inches and commonly of an intermediate texture, are generally good for camp sites (Kramer and Ropp, pers. comm.). Sites with large areas of well drained soils are good candidates for parks where other parameters meet the Capital Program Administration's criteria for state parks.

Runoff Potential

Runoff potential is the potential of the soil to shed rainwater. A rating system has been developed to analyze soil runoff potential (Chiang, 1971). This runoff potential rating is based on soil catenas. Soils are grouped in seven runoff potential categories according to internal drainage, depth, texture and subsurface conditions. The rating system enables hydrologists or land management personnel to classify the soils hydrologically. D. and D^+ rated soils have the highest runoff potential while A soils have the lowest. This system expands the Soil Conservation Service's hydrologic soil groups, and includes relevant soils information for hydrologically reclassifying certain soils based on recent research.

Erodibility Coefficient

The erodibility coefficient* is the erosion rate per unit of erosion index for a specific soil in continuosly cultivated fallow ground on a 9% slope, 72.6 feet long. This factor is used by the Soil Conservation Service in calculating the erosion from a particular soil. For land managers, the erodibility coefficient is a good indication of the type of management practices (i.e., retention ponds, sediment traps) which will be required to protect adjacent areas from siltation and other damages. In buffer zones along streams, highly erodible soils must be covered with vegetation at all times to protect the aquatic system from sediment. Erodibility information is available from the Soil Conservation Service for each soil series.

Soil Series

A soil series is a group of soils developed by the same genetic combination of processes acting on the same geologic material. Its horizons have similar differentiation characteristics and arrangement in the soil profile. Except for the "A" horizon texture (which is used to classify soil series into types), all soils having similar physical chemical and morphological characteristics such as structure, texture, pH, base saturation, organic matter content, topographic position, drainage, depth, color, parent material and horizon thickness, characteristics and arrangement belong to the same series (Maryland Department of State Planning, 1973).

Soil series are named for the geographic location where they were first described. Hence such names as Pocomoke Series and Evesboro Series.

A soil type is a subdivision of the soil series based on the texture of the upper or "A" horizon. Soil individuals belonging to the same type have similar characteristics, as described by the soil series, as well as the same surface texture. Soil types derive their name by adding the surface texture description to the series name. (For example Sassafras silt loams)

Soil types have been grouped into woodland suitability groups which indicate suitability for growing particular species of trees. Woodland suitability groups require similar practices for conserving soil and moisture and have similar potential for wood crops.

The potential productivity of a soil for trees is expressed as the site index, which is the average height, in feet, that a specified kind of tree growing on that soil type will reach in 50 years. This data was not recorded in this inventory. Some of this work has been completed for some species, e.g., loblolly pine (Soil Conservation Service, 1970b). By knowing the vegetation, DBH, and soil type, a forester will have a good insight as to the suitability of the site for timber management.

Natural Soils Group

A natural soils group is a classification system of the Maryland Department of State Planning which groups soils by similar major properties

*The Erodibility Coefficient is the K factor in the Soil Conservation Service's Universal Soil loss equation, E=RK(LS)CP.

and features. The soil types of each county are grouped around six characteristics of planning interest: agriculture, productivity, erosion susceptibility, permeability, depth to bedrock, depth to water table, and stability. In general, the natural soil groups are arranged in order of increasing limitation for most uses. The State Planning Department uses this classification system for state planning purposes. All soils in the state have been reclassified in this way and this data has been spatially stored in the MAGI Computer System.

Vegetation Type

Vegetation type (e.g., oak-hickory) reflects the dominant or codominant species of a site. This information can be used for various evaluations of the site. Some species have more value for commercial forestry than others. Some vegetation types have a higher species diversity or reflect different types of disturbance. For example, the sycamore-river birch vegetation type is found in areas which are frequently flooded. Some are interesting from a historical, climatic, geographical, or regeneration point or view, such as the bald cypress type. By knowing the vegetation type, knowledgeable personnel in the Department of Natural Resources can make estimates as to the suitability of the site for recreation. For example, a mature oak-beech stand usually has a very scenic, well groomed appearance with an open understory. Hemlock stands are very scenic but their roots are sensitive to trampling (Fowells, 1965) therefore, active recreation must be limited. For hunting and wildlife management, different vegetation types support different wildlife populations.

Number of Vegetation Types Present

This parameter is a measure of habitat diversity. In general, the more vegetation types present the greater the diversity. For recreation, research, and education purposes, it serves as an indication of sites providing greater varieties of species or experience opportunities.

Total Vegetation Cover

Knowing the amount of cover in each layer of vegetation (canopy, understory, shrub, and herb layer) is a prerequisite to understanding a vegetation community and the role it plays in the natural system.

Most planning considerations relating to noise and air pollution abatement, climatology, runoff control and even aesthetics, speak to the density and distribution of leaf surfaces by height, depth, and width of vegetation (Robinette, 1972). MacArthur (1964) considers vegetation structure in preference to floristic composition when considering bird species diversity. Over time, vegetation structure changes. This change in structure controls plant community composition either by shading out intolerant species or by allowing more light into the community, permitting more light tolerant plants to survive (Horn, 1971; and Cody, 1974).

When planning for future use, one must consider the present vegetation structure, the longevity of that structure, the potential uses which can be made of that particular structure, and succeeding vegetation structures. In the short term, one must also evaluate what effects particular events (e.g., fire, selective cutting, abandonment, and development) might have on the structure, and evaluate the probability of these impacts occurring and their spatial extent.

Trees with Average DBH Greater than 6"

Recreation facility planners in the Capital Programs Administration consider a stand of trees less than pole timber size (approximately 6" DBH) too scrubby to warrant consideration as a recreational site. DBH, however, is only one criterion to consider. If the area has other features of interest or if contiguous areas meet the criterion, the stand with trees averaging less than 6" DBH may be included in the park.

Trees Greater than 24" DBH

Old large trees are often good den and nest sites for wildlife (Craig Ten Broech, pers. comm.). The frequency of trees with two-foot diameter at breast height (DBH) is a good preliminary parameter for evaluating sites for wildlife.

Trees Older than 200 Years

In the first Big Tree contest sponsored by the American Forestry Association in 1940, the State of Maryland led all other states in the number of champion trees. Again in 1955, when the national list was published, Maryland led the field with 45 champions. As a result it has been dubbed "The Big Tree State". Now the State of Maryland has embarked on a program of identifying trees over 200 years old for the Bicentennial celebration.

Tree Cover By Species

Cover is the term generally used to indicate the area occupied by a species, and is usually a measure of area covered by the crown or canopy of a tree. Cover and basal area are used by many ecologists to determine the dominant species (Phillips, 1956). Dominant species are those species whose cover shades the greatest percentage of the ground surface.

By determining the amount of cover of each species, the relative density or relative frequency of the species can be determined.

Average Tree Size (average DBH by species)

Average tree diameters are estimates of the average tree size in a stands.

Average tree diameter provides recreation personnel with information for park siting. Larger trees may define sites with naturally open and park-like understories which are generally more desirable for park lands. With the other data collected in this study wildlife managers may use tree size data in formulating a habitat description.

Percent of 5-10 Acre Canopy Openings in the Forest

"Small openings scattered throughout a forest add substantially to the quality of the wildlife habitats because of the favorable "edge effect" created. Game species prefer the more open conditions of the forest edge to those of the forest interior. A landscape with 3 to 5 percent of the area in openings 5 to 10 acres in size is considered to be of highest quality for such forest wildlife. Forested regions with no openings or

with more than 5 percent of the area in openings are considered to provide lower quality habitat for game species" (Institute of Environmental Studies, Univ. of Wisconsin, 1974).

Site Type

Site type is a site description associated with vegetation based on relative topographic and hydrologic conditions. Site types are useful in describing and classifying natural areas because in understanding the site type one has an understanding of soil depth and moisture, general slope, and water table conditions which determine the vegetation type to be found.

Wildlife Citations

The observations of local birdwatchers, naturalists, or scientists give an indication of what animal species are likely to be found when visiting a site. Caution should be taken in using citations not documented by scientific research. Laymen may mistake a dog for a fox or a gray squirrel for a Delmarva fox squirrel. Observations may no longer be valid because of the passage of time since they were made. They do however, give additional information for uses such as hunting, education and wildlife management.

Wildlife Sighted

During the summer survey, trained field personnel may observe an animal. Its presence in a particular site can be viewed as documented to date.

Residency & Frequency

Different animals, especially birds, have different residency and habit requirements. Many animals establish a nesting site and move about in the vicinity to procure food. The particular season of the year during which an animal occupies a certain habitat is referred to as its time of residency. The space around the nest or resting space where the animal gathers food, and cares for its young is called the home range. Some mammals, such as mice and shrews, have permanent home ranges. Others, particularly medium sized mammals and some birds, shift home range. These are referred to as semi-permanent home ranges. Seasonal home ranges exist where animals migrate during winter and summer. The residency of a particular species give an indication of when the habitat is used. This could be important for wildlife management purposes, for recreation and park siting, or for timing human use. People, for example, may cause excessive disturbance to animals during nesting and mating seasons.

The frequency of a species is an indicator of its abundance in terms of state or regional populations. This is important for identifying areas which may be important as gene pools for rare or endangered species or areas which may be of interest to researchers or non-consumptive users.

Wetland Class

Wetland classes used in this study are synonymous with the fresh water wetland types outlined by Shaw and Fredine (1956): deep fresh marsh, shallow fresh marsh, fresh meadow, shrub swamp, wooded swamp, and bog. Wetland classes have been used by wildlife biologists for years and are important in evaluating wildlife habitats (Golet, 1973).

Vegetation Interspersion

Vegetation interspersion refers to the pattern or mosaic of different vegetation structures.

"Vegetation interspersion influences population density and wildlife species diversity" (Golet, 1973). Since most wildlife species require more than one type of vegetation, their population density depends partly on the presence and length of certain kinds of edge. Small stands have more edge per unit area than large stands. Since long, narrow strips of vegetation, such as those flanking streams, are extremely significant to wildlife, these should be considered during wildlife habitat evaluations (Golet and Larson, 1974). "High wildlife value is associated with wetlands that contain a high degree of interspersion; that is, a great length of edge and a high number of types of edge" (Golet, 1973).

Cover Types (Wetlands)

The relative proportions of cover and open water and the degree of interspersion affect wildlife (Weller and Spatcher, 1965; McGilvrey, 1968). Collectively, these features make up the cover type. The length of cover-water edge per unit area of wetland increases in smaller wetlands or in wetlands interspersed with cover or with an irregular shoreline. "The importance of cover-water edges to waterfowl production are (1) greater isolation for each pair (2) creation of water areas protected from strong winds (3) provision of areas from which to take flight, and (4) provision of areas of generally greater productivity of diverse types of food." (Golet, 1974).

Dens and Nests

When observers are present, many animals are difficult to find. They are often hiding or asleep. The best indications of their presence are borrows, dens, cavities in trees, and nests, which may or may not be disguised. The presence of large old trees is a good indication of potential den and nesting sites (Ten Broeck, pers. comm.). "The decline of wood duck population (Aix sponsa) 30-40 years ago was due to the loss of proper nesting sites in old trees which were logged off and younger trees cut before reaching proper size" (Smithsonian, 1974a).

Disturbance

Plant communities are constantly changing. Such changes are, in part, responses to natural disturbances such as fire, windthrow, disease, erosion siltation, flooding, drought and litter accumulation in the absence of natural burning. Natural disturbances area not always as far reaching or intense as those induced by man. Denuding large areas of natural vegetation can generate erosion and siltation volumes 100 times greater than the natural rate (Wolman, 1964). Alterations in water tables can change the

vegetation composition of an area. Excessive noise from highways and industries can drive animals away.

Areas with some types of disturbance may not be suitable for certain uses. Silty streams are not suitable for swimming, and clear-cut forests are aesthetically displeasing to the recreational user.

Contiguous Land Use

The use being made of land adjacent to a natural area can affect the natural integrity of the area. Where air pollution, noise, roads, erosion, mass wasting, or toxic chemicals occur on contiguous sites the area's hunting, recreation, or education quality may be diminished. Where natural areas are surrounded by forest, old fields, and water bodies, the diversity of plant and animal communities is increased. At the same time, these contiguous areas buffer or insulate the area from offsite disturbances.

"The nature of the surrounding habitat is generally of great importance to wildlife, especially in wetlands. Many waterfowl species depend upon adjacent upland areas for food and nesting sites. For breeding, blue wing teal prefer wetlands bordered by pasture or wild hay land (Bennett, 1938), while the availability of nesting cavities (mature woods) is the key factor determining an area's potential for wood duck production (Hawkins and Bellrose 1940; Grice and Rogers, 1965; McGilvery, 1968). Wood ducks also favor wooded surroundings, particularly oak woods, because mast is an important food." (Golet, 1973).

Slope

For the purposes of this study, 15% slopes were considered to be critical since slopes greater than 15% are generally too difficult to use as camping and recreational sites.

Geological Formation

The geology of an area determines the path of streams and the type of soils which occur and, therefore, the type of vegetation and animal communities present in an area. At the same time, knowing which formations act as aquifers and which contain valuable minerals and fossils adds to the considerations in decision making during the planning process.

Previous Research

An area which has been the subject of previous scientific study is of value because it is possible to use the historical data to understand the natural system and its dynamics. Natural areas where previous research has occurred are good candidates for future scientific studies.

Ownership, Current Use, and Zoning

Although resource parameters have been emphasized in most management efforts, existing use, land ownership, zoning and security data are often considered important, if not essential, in ultimate implementation phases of critical area regulatory or acquisition programs. Existing or planned residential or industrial uses may, as a practical matter, pre-empt the future use of natural areas. Land ownership often affects the potential

use of an area. For example, an area presently owned and managed as a national park will be inaccessible for mining and industrial uses; an area in small lot ownership is unsuitable for most commercial forestry. At the same time, current use and zoning is considered highly relevant by courts in determining the reasonableness of use standards.

Ownership is also important in planning and decision making. If a natural area is owned by the state, further action can perhaps wait, and its chances of being preserved are high. If it is owned by a development corporation its ultimate fate is uncertain. By the same token, natural areas owned by several parties may be much more difficult to acquire or preserve, depending on the temperaments, goals, and convictions of each owner. Land owned by a single party is perhaps easier to acquire or preserve.

Zoning is a probable (though very changeable) indication of the area's destiny. Zoning variances and revised master plans can alter the zoning at short notice.

Rare and Endangered Species

Many plant and animal species are being destroyed or displaced as a result of human activities. Overgrazing, fire, increased flooding, introduced exotic species, diseases, pesticides and herbicides are elements in the destruction of habitats. Some of these species are of national significance, others are important as gene pools. For many species, preservation of habitat or environment is sufficient. Others may require special laws to prevent hunting, picking, or collecting. The species of endangered plants and animals are well documented in the following references:*

Natural History Society of Maryland. 1969. The Amphibians and Reptiles of Maryland and the district of Columbia; in, Bulletin of the Maryland Herpitological Society. Vol 5:4,99-153.

Robbins, Chandler. 1975. (Unpublished). Rare and Endangered Birds of Maryland. Patuxent Wildlife Research Station.

Smithsonian Institution Center for Natural Areas. 1974. Natural Areas of the Chesapeake Bay Region.

Taylor,G. 1973. Present Status and Habitat Survey of the Delmarva Fox Squirrel. College Park: Natural Resources Institute Publication no. 555, 29 pp.

*(A complete list of rare and endangered species found in Maryland is contained in Volume II, Field Notebook.)

Derived Parameters (Subjective)

The following parameters are considered derived parameters in that they are not direct measures of a phenomenon, but rather represent a synthesis of measures or a ranking of phenomena.

In a sense, these derived parameters represent a preliminary evaluation of certain sections of data.

Access to Area

Access to area is an estimate of the ease of approach to the natural area. It was ranked on the following scale:

1. Easy - Major highway, road or trail to the site.

2. Moderate - Road or trail a moderate distance from the site.

3. Difficult - Isolated area, not near road or surrounded by wet soils.

Security

Security is the term applied to the probable time frame within which physical alteration by man may occur. If the area is "threatened with destruction in five years" and it is a high priority natural area, the need for action is immediate. On the other hand, if it is a low priority site, the decision may be made to forfeit it as a natural or critical area candidate.

Security was estimated based on the following ranking scheme:

1. Threatened with destruction within five years

   a. areas currently being disturbed by man. (i.e., channelization, siltation, logging, construction)
   b. areas currently under plan to be altered (i.e., sewer lines, homes)
   c. areas contiguous with new development, highway interchanges
   d. areas zoned commercial, residential, industrial

2. Areas safe for five years

   a. areas not currently threatened with destruction, but not currently protected

3. Areas safe indefinitely

   a. areas owned by conservation organizations, designated as wildlife management areas or parks.

4. Unknown

Visual Experience

Beyond the collection of natural features data, and perhaps touching closer to the true goals of the decision making process than what is registered in the data, is a subjective valuation of the site for its impression on the observer. Registering experiences is a highly subjective task, but it is not without merit. Field personnel, trained to be sensitive to nat-

ural phenomena, are attuned to the more encompassing values of the aesthetic experience found in a site. Visual experience has objective components, such as view length, topographic diversity, or frequency of water views, which lend themselves to comparative evaluations. These types of information, in conjunction with the subjective evaluation of a site by the field worker, are available to data users. The data user can make his own assessment of the site based on the available data and, with the other comments available to him on the data print out, arrive at his own valuation of the site.

The following data were gathered by the field surveyor, then used to determine the score, as indicated below:

Auditory

Noise from offsite	little/none	audible	loud	
Nature of offsite noise	infrequent	intermittent	constant	

Visual

Typical length of views	long	intermediate	short	mixed
Typical nature of views	panoramas	enclosed	mixed	
Scale of landscape elements	large	moderate	small	mixed

SCORE:	3	2	1
____Size of site	large	moderate	small
____Variety (diversity)of visual elements	great	moderate	little
____Views of water	frequent	occasional	rare/none
____Rate of landscape change over distance	rapid	moderate	slow
____Complexity of topography	complex	intermediate	simple
____Personal impression of site	impressive	pleasant	unnoteworthy

____Experience Total Score

Experience Term

	Score	
1.	6-9	low
2.	10-14	medium
3.	15-18	high

Ease of Passage

The ease with which one can walk through an area is important for hikers, birdwatchers, or educational expeditions. Where hazards or obstacles exist such as wet soils or dense thorny thickets, the probability the area being used decreases, particularly with younger aged groups. When the soil is dry or the understory open, as in mature oak-beech communities, the likelihood of people walking through the area increased.

The degree of difficulty a hiker would encounter when walking through each subsection of a natural area was estimated according to the following scale:

1. Difficult - Thick understory or wet mucky soil
2. Moderate - Interspersed understory or wet soils
3. Easy - Open understory, dry soils

Natural Integrity

Natural integrity is a measure of the degree to which an area is characterized by naturally regenerating vegetation, mature or stable vegetation, and the absence of man-induced disturbance. Areas which have been disturbed to the point that original communities can no longer reproduce themselves may not be appropriate candidates for acquisition. For example, a mill pond which currently fosters many unusual emergent aquatic plants may be changing vegetation composition fairly quickly due to siltation or a high nutrient input. A decision has to be made as to this site's value in light of its changing nature. In contrast, a mature oak-beech forest or shrub community may be constantly renewing itself and will exhibit its current character for many years to come.

The present integrity of the natural area on the basis of natural regeneration, age, and the absence of man-induced disturbance was determined based on the following scale:

1. Naturally Permanent - Vegetation or physical feature is relatively stable as revealed by the pattern of regeneration or the absence of physical deterioration. Disturbance is insignificant although some natural disturbance may be in evidence. Vegetation is mature or relatively stable because or its ability to resist succession.

2. Naturally Transitory - Vegetation or physical feature is changing due to plant succession either as a consequence or manmade or natural disturbance such as fire, erosion or flooding. Vegetation is relatively young and dynamic.

3. In Need of Management -Area will require management to maintain present character.

4. Uncertain - Possible source of change is not evident.

Diversity

The number of different vegetation communities and other natural features within a natural area are an indication of the area's diversity. This measure of heterogeneity includes the range of physical objects and phenomena in an area. Areas of high diversity are often superior sites for scientific study and education. These diverse areas provide a diversity of experiences for the visitor.

The number of different vegetation communities or other natural features which the site contains were ranked according to the following system:

1. High - Contains numerous different vegetation communities, animal habitats, or physical features such as streams, bogs, scarps.

2. Medium - Contains a few different vegetation types and habitats or features.

3. Low - Contains predominantly one vegetation community or natural feature.

Occurrence

Where an unusual natural feature occurs within a natural area or where the natural area provides the habitat for a particular plant or animal or community which is in some way rare, unique or unusual the occurrence of the site is defined in terms of this feature, plant, animal or community. This subjective measure of importance is determined in the field by field personnel and indicates the comparative evaluation of natural areas rather than a comparison between natural areas and the remaining landscape. With the designation of an area as common, infrequent, rare, or unique, the layman or decision maker has a first approximation of the relative frequency of that type of natural area in Maryland's Coastal Plain.

The relative frequency of the vegetation type(s) in the natural area in the context of its frequency of occurrence on the Delmarva Peninsula was estimated based on the following scale. Where an unusual natural feature occurs within the natural area or where the natural area provides the habitat for a particular plant or animal which is in some way rare, unique or unusual, then "occurrence" is defined in terms of this feature, plant or animal.

1. Common - Physical features or organism frequently encountered in the region.

2. Infrequent - Physical features or organism not commonly found at present; however, none are rare, endangered or unique.

3. Rare - Natural area containing an unusual physical feature or organism which is rare, endangered or at the geographic limit of its distribution.

4. Singularly Unique - Natural area containing a physical feature, organism or special habitat for an organism for which the area is the only known location in which it occurs.

Wetland Wildlife Rating

The Wetland Wildlife Rating parameter was derived using a standard evaluation technique developed by Larson and Golet, (1974) as shown in the evaluation section of this report (pg. 63).

Aquatic Buffer Zone

Owing to its importance to the Coastal Zone Management Program, various aspects of the aquatic buffer zone are extensively detailed below.

In recent decades, the degradation and loss of aquatic systems has underscored the need for sound ecological management of streams, ponds and wetland. Increased public awareness of the relationship of land use, water quality, and aquatic life led to the enactment of the Coastal Zone Management Act of 1972 as well as to passage of the 1972 amendments to the Federal Water Quality Act. Such legislation provides the potential for environmental protection through responsible State action.

As mandated in Section 205 of the Coastal Zone Management Act of 1972, states are required to delineate areas of particular concern and indicate permissible land uses. Sites with rare or otherwise important species and physical features are candidates for designation as areas of concern.

Within all sites containing water courses or water bodies, a critical zone of land exists between the water and the neighboring upland. This zone is of particular concern because it is both fragile and, under natural conditions, acts as a buffer to the aquatic system. Throughout the coastal zone, buffers play a variety of roles. They are of primary importance in protecting aquatic systems against impacts accompany agriculture and development, which include sediment, toxic chemicals such as herbicides and pesticides, fertilizers, nutrients, oils and bacteria. In addition, this zone detains runoff and controls erosion on streamside slopes. These vegetated buffers provide a visually diversified landscape and contribute to environmental quality by providing wildlife shelter, nesting sites and food.

The present land use pattern of the Eastern Shore contains many lush stream side forests of sufficient width to serve important protective functions with respects to aquatic biota. The natural vegetation in these buffer zones maintains the health of the aquatic system by (1) maintaining a balanced nutrient regime, (2) moderating water temperatures by shade, (3) providing aquatic organisms with food sources, (4) reducing the scouring of stream bottoms and (5) preventing sedimentation through control of runoff and erosion. Thus, when retained in a natural condition, buffer zones serve as maintenance-free "public works projects". Once destroyed, these amenities and their services are lost and are difficult, if not impossible, to replace at reasonable cost. Functionally equivalent benefits can only be attained by public expenditures for water filtration, dredging, recurrent stocking of streams with fish, flood control programs and the creation of artificial wildlife habitats. Natural amenities are irreplaceable.

The following discussion outlines the key features considered in the identification of aquatic buffers and in ascertaining adequate buffer widths under varying conditions. First is described the key physical processes which occur along water bodies and watercourses, these are then related to appropriate buffer widths. A discussion of possible compatible uses is included. This discussion is detailed to provide decision makers with a thorough understanding of the processes and considerations involved in determining adequate widths for aquatic buffer zones.

Runoff

When rain strikes the ground it can dislodge soil particles and transport this sediment, as well as any oil residues, pesticides, fertilizers, to watercourses. In general, it is the properties of the soil which determine whether the rain will infiltrate into the ground or move overland as runoff to the aquatic system. If the rate of rainfall is greater than the capacity of the soil to absorb it, or if the soil is already saturated, the unabsorbed excess becomes overland flow, and the water and its contents can reach the aquatic system.

If the precipitation is absorbed by the soil it may move toward the surface water system by a variety of pathways. If the soil is deep and of fairly uniform permeability, the subsurface water moves downward to the zone of saturation and then flows within the soil to the nearest watercourses. (Dunne, 1974).

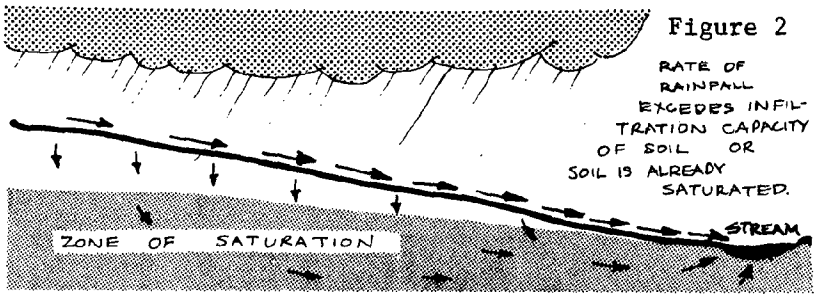


Figure 2

OVERLAND & GROUND FLOW

IN HOMOGENOUS SOIL

RUNOFF TRANSPORTS SEDIMENT, NUTRIENTS, AND TOXIC CHEMICALS TO AQUATIC SYSTEMS.

Soils or rocks with varying properties may complicate this simple pattern (Davis and Dewiest, 1966). Generally, ground water flows slowly, and the underground paths of flow are long. Therefore, most underground flow contributes only to the stream's baseflow, the basic stream flow to which storm water is an addition.

If percolating water encounters an impeding horizon (claypan or fragipan) in the subsoil, at some shallow depth part of the water will be diverted horizontally over the impeding layer and will reach the watercourses sooner by a shorter path. This diversion through the soil, often along the impeding surface, is called sub-surface flow, and is one form of the general ground flow. (Dunne, 1974).

Where water follows this shorter path or where steeper slope gradients occur, water may reach the stream channel more quickly than by typical groundwater flow and may contribute to the storm peak-flow of the stream (Weyman, 1970, Ragan, 1968). On some slopes, sub-surface flow may intersect the ground

surface and emerge as a spring or seep. The water then traverses the surface of a saturated area as return flow (Dunne, 1974).

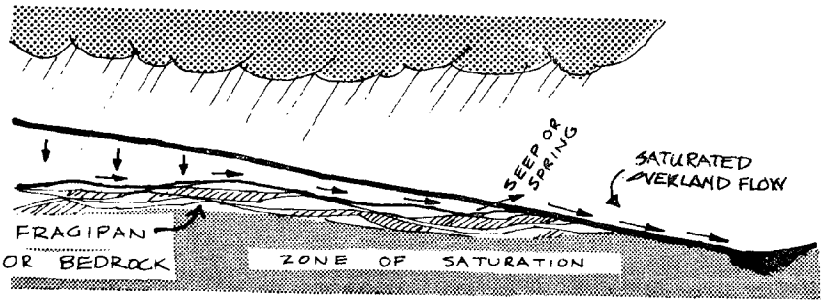


Figure 3
SUB-SURFACE, RETURN, AND SATURATED OVERLAND FLOWS

Rain falling directly onto saturated soils near streams cannot infiltrate into the wet soil, but runs over the surface to the stream channel. This is termed saturated overland flow. It is impossible to separate saturated overland flow from return flow and the two together are usually considered saturated overland flow (Dunne, 1974).

Partial Areas

The occurrence of each water flow process is a function of geology, physiography, soil properties, vegetation and land use in a particular region. Recent studies of undeveloped watersheds in the eastern United States and in England have shown that a saturated area adjacent to streams contributes the greatest runoff volume during storms. A number of investigations (Table 3) support the idea that most overland flow occurs from areas that make up no more than 10%, and usually only 1-3% of a drainage basin (Dunne and Black, 1971). Betson (1964) first discussed these areas when he realized that only partial areas of entire basins in the Tennessee Valley could be contributing runoff to storm flow. Hence, he coined the term "partial area" for these saturated, often shallow, stony, or compacted areas. This modifies the classic theory of Horton (1933) which implies that most rainfall events exceed the infiltration capacity of the soil and that overland flow is commonly widespread in area.

Partial areas are dynamic, expanding and contracting seasonally and with variations in storm duration and intensity. When expanded during storms, the outer edge of these areas can be considered the outer edge of the functional aquatic system. Under dry conditions the areas contract. In general, partial areas parallel the water's edge, but their shape and size is dependent on local geology, soils, relief, vegetation and land use. At a minimum, partial areas are critical to the protection of aquatic systems. They are the natural zone of overland flow and are highly erodible.

Table 3. **PROPONENTS OF PARTIAL AREA THEORY**

S.E. Forest Exp. Station, 1962	S.E.F.E.S.	Postulate	West Virginia
Betson, 1964	Tennessee Valley Authority	Postulate	Tennessee
Ragan, 1968	U.S. Forest Service	Field Study	Vermont
Dunne and Black, 1971	McGill & Cornell Universities	Field Study	Vermont
Chiang, 1971	D.E.P. Penn.	Computer Model (Pers. comm.)	Pennsylvania
Hills, 1971	Bristol Univ.	Field Study	England
Freeze, 1972a,b	IBM, Thomas Watson Research Center	Computer Model (sub-surface runoff)	New York
Grubruck and Heald, 1974	U.S.D.A. Watershed Research Center	Field Study (Phosphate transport)	Pennsylvania

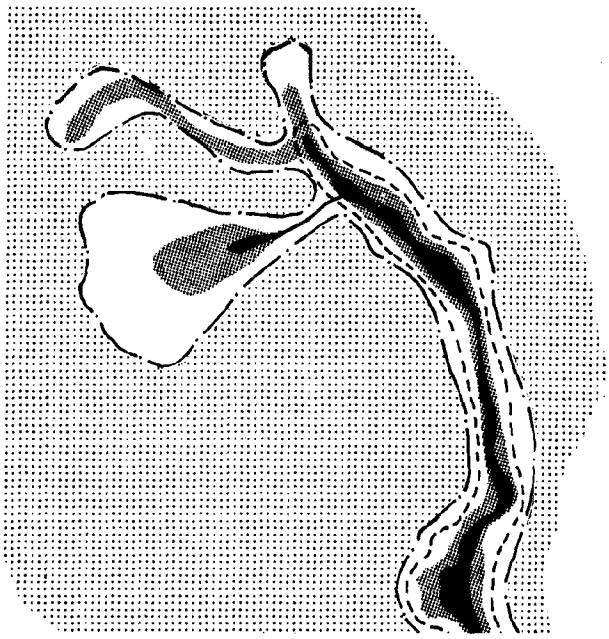


Figure 4

AREAS PRODUCING OVERLAND FLOW:
IN SUMMER STORMS
IN EXTREME AUTUMN STORMS
AREAS WITHIN DASHED LINES PRODUCED SUB-SURFACE FLOW:
IN SUMMER STORMS
IN EXTREME AUTUMN STORMS
0 80
SCALE IN FEET

(ADAPTED FROM THOMAS DUNNE, UNPUBLISHED PhD. THESIS, THE JOHNS HOPKINS UNIVERSITY, 1966: AREAS CONTRIBUTING RUNOFF UNDER VARIOUS STORM CONDITIONS HAPPY VALLEY BASIN NEAR DANVILLE, VT., IN: LEOPOLD, 1974, WATER, A PRIMER.)

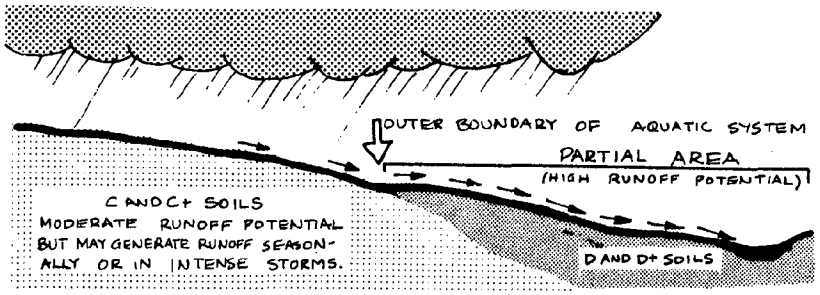
Soils are a good indicator of where partial areas are located. Chiang, (1971) has recognized that certain physical soil properties help identify the relative runoff potentials of different soils. Chiang's method of classification is an expansion of the Soil Conservation Service's Hydrologic Soils Groups, as well as a reclassification of certain soil series (Table 4).

Table 4. RUNOFF POTENTIAL RATING TABLE (Chiang, 1971)

	I	II	III	IV	V	VI	VII
	Well Drained			Moderately well drained	Somewhat poorly drained	Poorly crained	Very poorly drained
	shallow (18")	moderately deep (18"-36")	deep (36")				
1. Medium texture or mixture of coarse to fine texture	C or (+D)***	+C	B or (+B)**	+C	C	+D	D
2. Coarse texture	+C or (+D)***	B	+B or (A)** (B)*	B	+C	+D	D
3. Fine texture	C or (D)***	C	+C or (B)**	C	C	D	D
4. Medium textured soil on vertically fractured rock	+C	B	+B	+C	C	+D	D
5. Coarse textured soil on vertically fractured rock	B	+B	A	B	+C	+D	D

Revised rating for well-drained soils:
* if fragipans or clay pans exist in deep soils
** if the soil is deeper than 10 ft. and excessively well drained
*** if the soil is less than 9" deep

This system recognizes that shallow soils over impermeable bedrock, as well as deep soils with shallow fragipans or clay lenses, may quickly become saturated, generating runoff. This is supported by other recent studies (Hewlett and Hibbert, 1967; Hewlett and Nutter, 1970; Whipkey, 1965). Soils classified by Chiang as D and D^+ have high runoff potentials and are roughly equivalent to partial areas (Chiang, 1974, pers. comm.). Where these soils exist in juxtaposition to aquatic systems, they should be considered the outer boundaries of the aquatic system. In addition, C and C^+ soils may become saturated seasonally or during storms, and generate runoff. Although these soils generate runoff less frequently, they may be included as part of the buffer zone.



OVERLAND FLOW ON D AND D+ SOILS

Figure 5

Several processes combine to reduce the infiltration capacity of the soil during a storm. When soils are cleared of vegetation, the filling of fine pores with water reduces capillary forces drawing water into the soil and the storage potential of the soil is more quickly reached. If clay is present in the soil, the clay particles swell as they become wet, reducing soil pore size. The impact of the raindrops, the major cause of erosion, (Young and Weirsma, 1973) breaks up soil aggregates, splashing fine particles over the surface and washing them into pores where they impede infiltration. At the beginning of a storm, percolation generally exceeds rainfall intensity and there is little accumulation of water on the soil surface. As either the intensity increases or the infiltration rate is decreased by saturation, rainfall exceeds infiltration capacity. At first, this excess rainfall fills surface depressions. When the depressions become filled the excess becomes overland flow traversing the land in a system of rills (Emmett, 1970).

Slope

Another consideration in the protection of aquatic systems from excess runoff and siltation is the slope of the adjacent land. On slopes greater than 10 percent the slope of surface depressions is too steep to permit a significant retention of water and silt (Leopold, 1968). In fact, depending on the pattern of land management or the type of soil, surface depressions may be absent. Where denuded slopes of greater than 10 percent occur next to aquatic systems, particularly with soils having high erosion potentials, they pose a significant hazard to the aquatic system. In developing watersheds, where the soils are denuded of vegetation, the sediment yields in streams can be increased to 100 times their natural rates (Wolman, 1964).

Slopes greater than 10 percent must be carefully managed, particularly along streams, and should be kept covered with vegetation. They should be considered as part of the buffer zone depending on their proximity to the aquatic system.

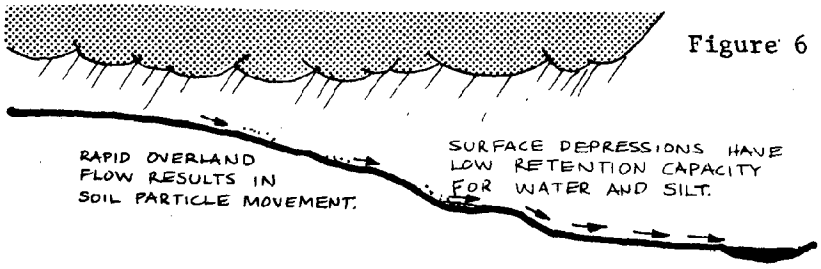


Figure 6

Urbanization

In an urbanizing watershed, the path of surface water flow is largely determined by sewers, roads, rooftops and other impervious surfaces and by land uses. The two factors governing the stream flow regime are the percentage of the watershed area made impervious and the rate at which the water is transmitted to stream channels. The former is governed by the type of land use, the latter by the density, size and characteristics of tributary channels and storm sewers (Leopold, 1968). Impervious surfaces in uplands which are connected to aquatic systems by sewers are, in effect, man-made partial areas. Alternative methods for infiltrating water on site, such as pervious pavement and rooftop or other types of detention ponds, should be given serious consideration over shunting water directly to aquatic systems via sewers.

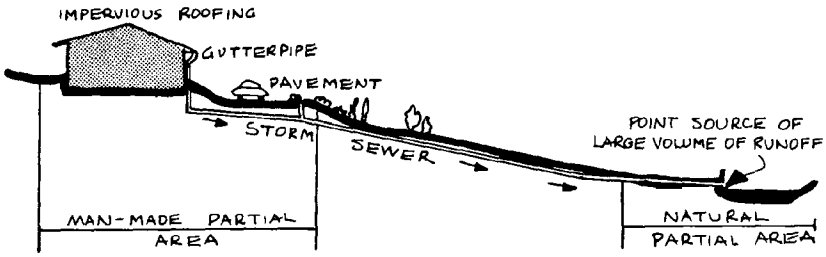


Figure 7

Surfaces such as lawns, pastures and trails are usually compacted and may act as impervious surface. In intense storms surfaces such as lawns become matted and runoff occurs in sheets and rills. When next to aquatic systems, they do not provide the impediment to runoff necessary for the system's protection. Vegetation undergoing natural succession is much more effective in detaining and retaining runoff.

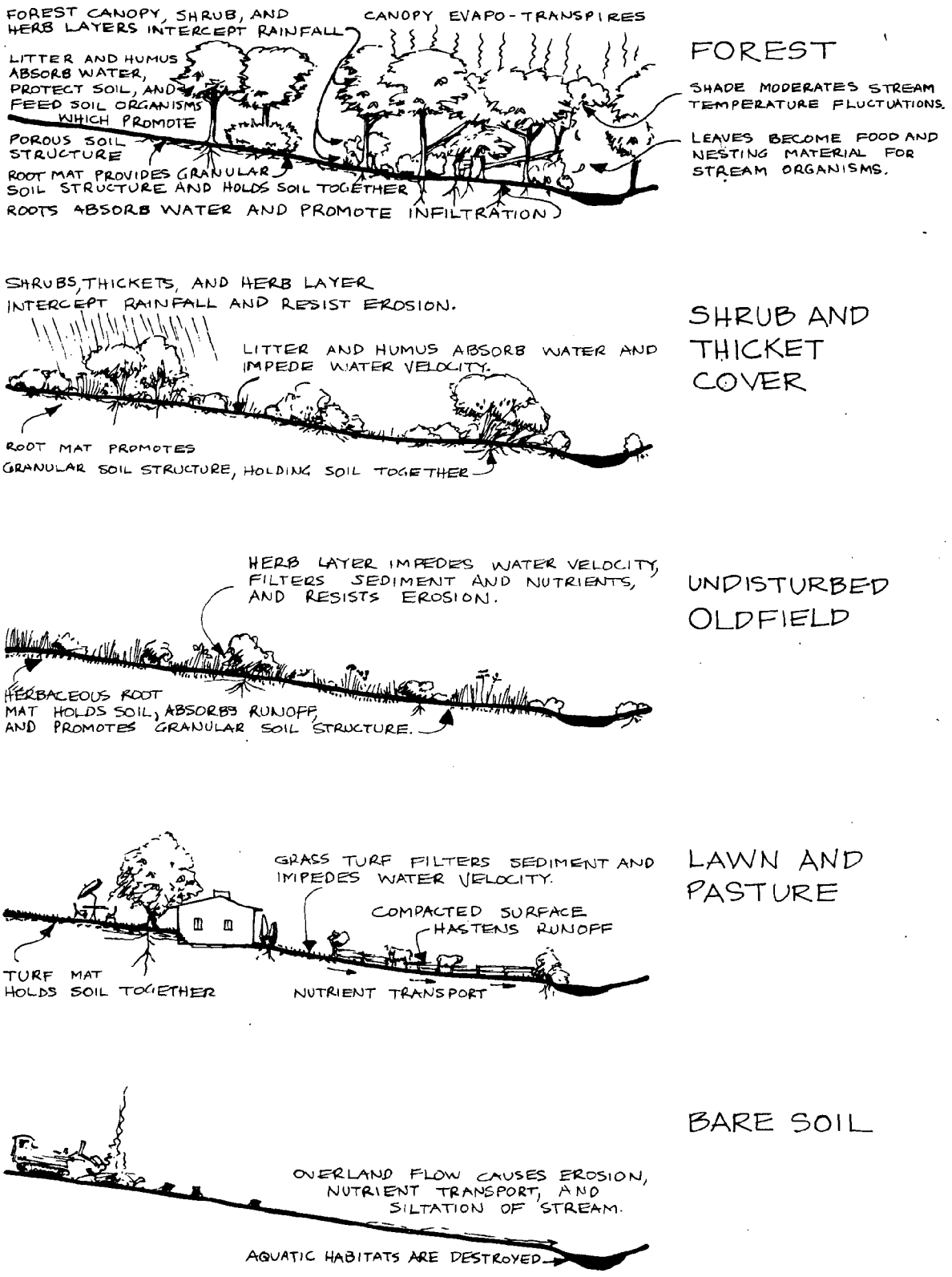
Vegetation

Vegetation protects the soil from raindrop impact, traps sediment, and impedes overland flow. At the same time, root systems, particularly in partial areas, absorb significant volumes of soil water during the growing season, thereby potentially increasing the infiltration capacity of streamside soils.

The foliage and roots of streamside trees such as blackgum, willow, red maple and beech are substantially more efficient than other plants at removing water from the soil (Fowells, 1965; Lee, 1942). Trees also provide litter and humus which absorb and store water. Roots which penetrate deep into the ground aerate the soil, maintaining its porosity and granular structure (Buckman and Brady, 1974). Shade from a floodplain or streamside forest moderates temperatures in the stream, thus buffering aquatic organisms

Figure 8

AQUATIC BUFFERS



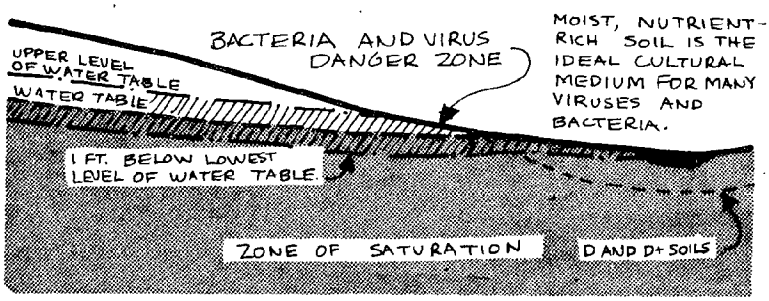
from temperature extremes. Leaf material also serves as a significant source of food and nutrient for aquatic flora and fauna (Vannote, 1975). If vegetation is removed and more sunlight allowed to penetrate the water surface, diurnal temperature fluctuations may exceed the tolerance of aquatic fauna during one or all of the life phases (Auberton and Patrick, 1965), meanwhile, the food necessary for certain organisms may be eliminated by tree removal (Vannote, 1975).

Biological Contamination

The soil is a rich medium for culturing both pathenogenic and non-pathenogenic bacteria. The nutrient rich, moist soils of partial areas are especially important in this respect.

Bacteria and viruses move through the soil with ground water flow. The movement of the pollution in the soil is connected with and dependent upon the rise and fall of the ground water table and the alternation of wet and dry weather conditions (Stiles and Crohurst, 1923).

The soil between the highest water table level and one foot below the lowest water table level is called the bacterial danger zone (Stiles and Crohurst, 1923). Here the conditions are ideal for bacterial growth. Partial areas often have a seasonal high water table at or near the surface, therefore, the bacterial danger zone is at or near the surface in these areas.



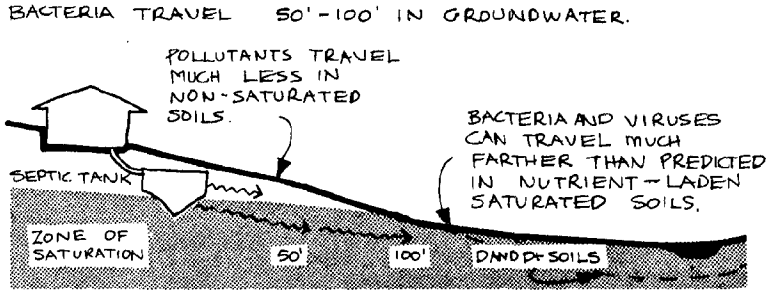
SOIL AS MICROBIAL SUBSTRATE

Figure 9

The properties of the soil in contact with bacterial or virulent sources play a dominant role in the subsequent life and movement of the contaminant (Caldwell, 1937, 1938). Soils which are very fine to fine grained sands with a high clay content are best suited to remove biological contamination (Romero, 1972). Bacteria in wet, nutrient rich soils have been known to survive up to five years, however, 60-100 days is probably a more common life span in temperate climates (Romero, 1972).

Many scientific studies report various sicknesses and epidemics caused by viruses traveling more than 50 feet in soil. Most controlled experiments indicate that viruses have a tendency to deteriorate within 10 feet of their source (Romero, 1972). Significant concentrations of anaerobic bacteria probably travel 50 feet according to Caldwell (1938, 1937);and Romero (1972) concludes that under ideal conditions the maximum travel distance of biological contaminants within ground water ranges from 50 to 100 feet. However, contaminant movement in non-saturated soils is considerably less than in saturated soils, with maximum lengths of travel appearing to be in the vicinity of 10 feet. Bacteria or viruses might travel considerably farther

than predicted if contaminated water is intercepted by a stream during the course of travel (Romero, 1972). If impregnated with bacteria and viruses by septic tanks or leaky sewers, partial areas, which shed surface waters to streams, may become contaminated, creating a health hazard.

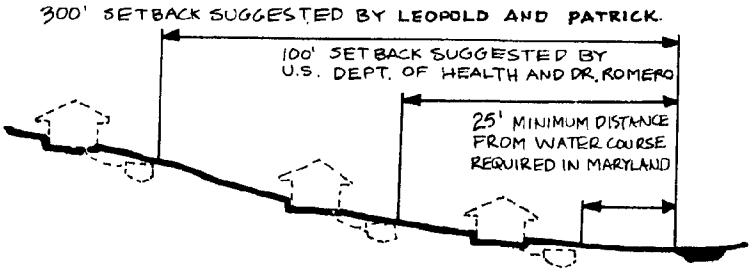


VIRUS AND BACTERIA TRAVEL

Figure 10

Setbacks

The United States Public Health standards suggest a minimum setback of 100 feet between wells or watercourses and septic tanks (Romero, 1972). The Maryland Health Department requires a minimum setback of 25 feet from wells and watercourses. Romero (1972) recommends a 100 foot setback from all wells and water bodies unless it can be shown that a shorter distance will not increase the probability of contamination. Aquatic biologists and hydrologists realize that circumstances dictate different setbacks, and that a setback of 300 feet should be recognized as a standard if all bacteria and nutrients are to be filtered out by the soils, (Leopold, 1968; Patrick, pers. comm.)



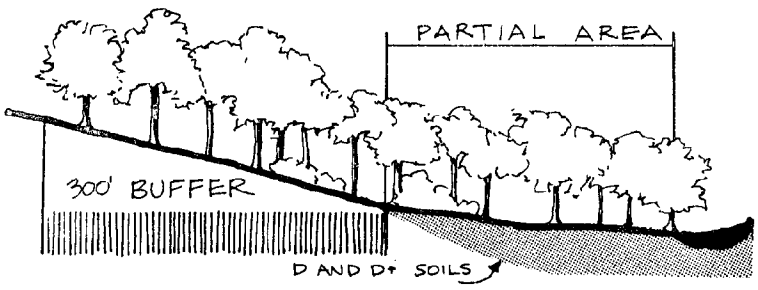
VARIOUS RECOMMENDED SETBACKS

Figure 11

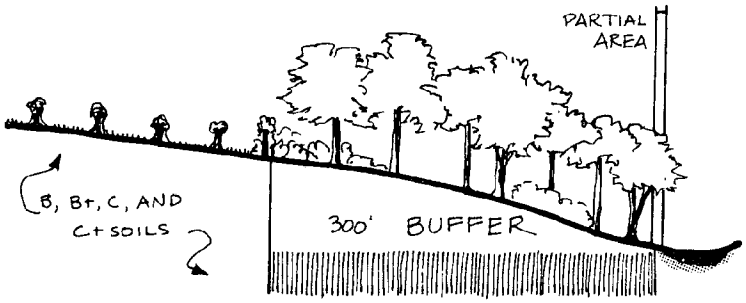
Using partial areas increases the accuracy of determining the length of setbacks from water bodies and aquatic systems. The setback should be delineated from the landward edge of the partial areas (D and D^{+} soils). Thus, while the setback is standard, the distance from the water body is variable depending on the width of the partial area. As noted above setbacks less than 50 feet will probably not filter out the biological and nutrient contaminants. Setbacks over 300 feet increase the adequacy.

The following illustrations show the considerations of soil character and vegetation used to evaluate the adequacy of aquatic buffer zones during the field survey of sites for this study.

ADEQUATE

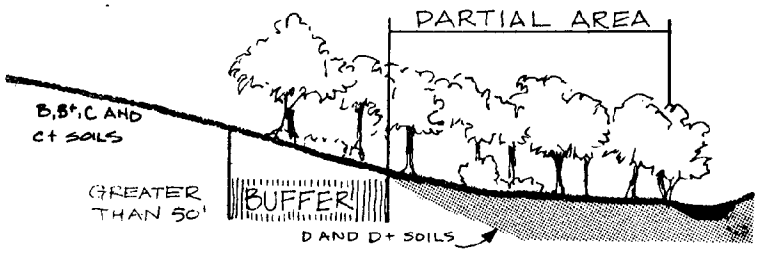


WIDE
STREAM-SIDE
PARTIAL AREA

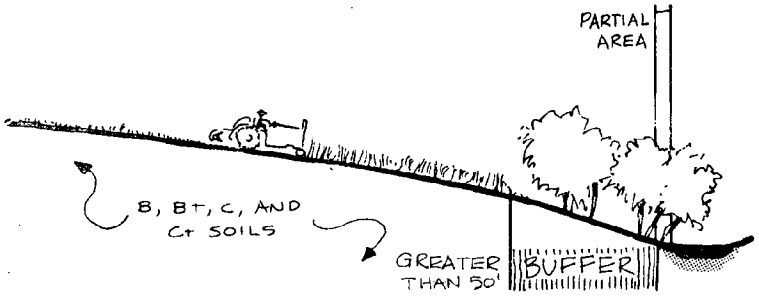


NARROW
STREAM-SIDE
PARTIAL AREA

QUESTIONABLE



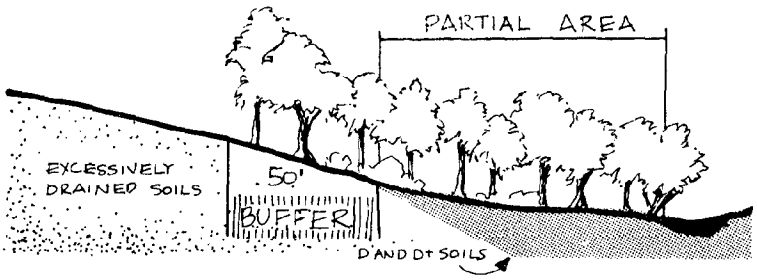
WIDE
STREAM-SIDE
PARTIAL AREA



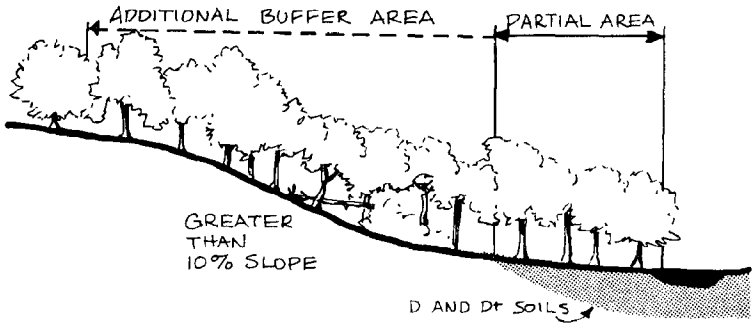
NARROW
STREAM-SIDE
PARTIAL AREA

Figure 12

QUESTIONABLE (POSSIBLY INADEQUATE)



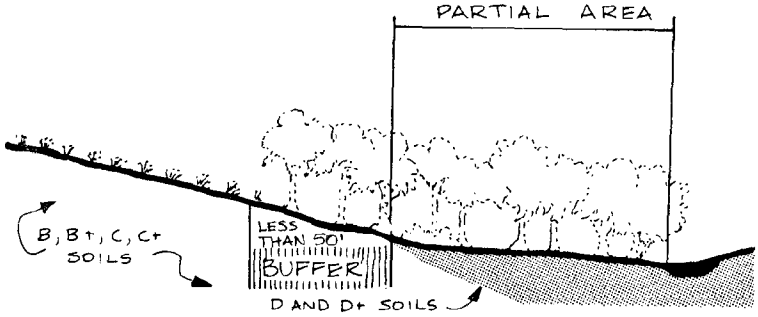
MINIMAL SET-BACK NEAR EXCESSIVELY DRAINED SOILS



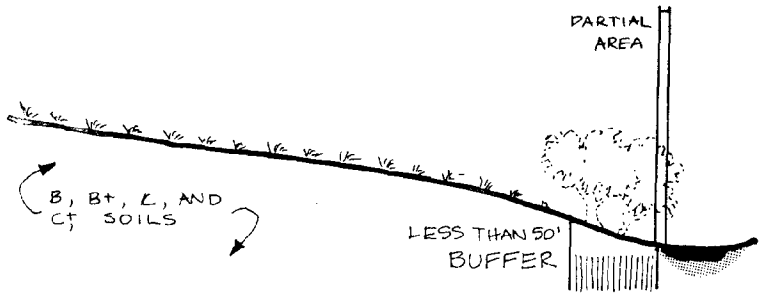
STEEP SLOPES

WHEN SLOPES GREATER THAN 10% OCCUR NEAR OR ADJACENT TO PARTIAL AREAS, THEY MIGHT BE INCLUDED IN THE BUFFER ZONE. EROSION AND HIGH RUNOFF MAKE THESE AREAS SOURCES OF POLLUTION.

INADEQUATE



WIDE STREAM-SIDE PARTIAL AREA



NARROW STREAM-SIDE PARTIAL AREA

Figure 13

Additional Considerations

Other parameters not discussed here, but important in designs for sites adjacent to aquatic systems, are contour configuration, slope shape and stability, soil erosion potential, bulk density of soil, specific nutrient and food cycles, trophic relationships, the relationship of headwaters to mainstreams, and ecological methods for controlling and managing vegetation in buffer zones. Some of these, such as contour configuration and slope shape and stability are more applicable to areas of greater topographic relief than are found in the Coastal Plain.

Aquatic Buffer Zone

The width of vegetated land necessary to satisfactorily buffer an aquatic system varies, depending on the soil's ability to store water and the type and extent of vegetation in the buffer. Buffers were rated in the following manner:

1. Adequate - Any soil with a low to moderate runoff potential (A through C) having a cover of natural or successional vegetation 300 feet in width from the edge of an aquatic system.

2. Questionable - Any belt of natural or successional vegetation along a wetland, watercourse or water body less than 300 feet but greater than 50 feet in width.

3. Inadequate - Any belt of natural or successional vegetation along a wetland, watercourse or water body less than 50 feet in width.

EXISTING DATA BASE

LITERATURE SEARCH

Most scientific literature concerning the Coastal Plain's natural systems relates to Chesapeake Bay. To our knowledge, educational institutions on the Eastern Shore doing scientific research have focused on tidewater areas. Upland inland areas have not been treated in a comprehensive way. While forestry and wildlife research has been done, little ecological study has taken place. Therefore, no comprehensive body of literature is available on these areas.

The most comprehensive information sources available are publications of statewide scope, such as Plant Life of Maryland (Shreve, et al., 1910), and animal distribution studies of the Natural History Society of Maryland and of the Maryland Ornithological Society.

Beginning with the bibliographies of recent regional studies (Smithsonian, 1974, Natural Areas of the Chesapeake Bay Region, and Wallace, McHarg, Roberts and Todd, 1972, Maryland Chesapeake Bay Study) relevant books and articles were noted. From these, other references were found. Citations were recorded on computer data coding forms for eventual use in the data print-out.

Several groups of literature, emerged -- reflecting different scales of study:

1. Regional studies, often related to Bay planning.

2. Area-wide studies such as flora and fauna distribution surveys.

3. Site inventories of various sorts, mostly compiled by state agencies.

4. Species - or site-specific research on particular plants and animals.

5. Methodological research used in defining and measuring parameters. (This is the largest body of literature).

As the bibliography increased, sources directly useful to the survey planners or field staff were acquired or copied. These are annotated and the citation is retrievable in the print-out. Other works are cited because they relate to the Coastal Plain natural systems and may be of help to researchers. (See Bibliography).

CONTACT WITH KNOWLEDGEABLE PEOPLE

Chesapeake Bay has been widely studied. When it involves some aspect of the Bay, naturalists, educators, and legislators are well aware of each others activities. Natural studies in the uplands of the Eastern Shore, however, have not been conducted at a scale which fosters this kind of interchange. Few people are in touch with each other regarding the upland areas. No comprehensive upland ecological research has been done until recently.

Knowing this, we approached several types of knowledgeable people:

1. Naturalists residing outside the study area but having knowledge of the area.

2. Resident naturalists and others, such as state and private foresters, fisheries scientists, and birders.

3. Local groups concerned with conservation.

4. Individuals familiar with particular sites, e.g., hunters, land owners. (These were difficult to identify until after the field survey team actually began site-level investigations.)

State and county officials were the most accessible contacts. Within the time limits of the initial canvass, many were interviewed personally or by phone. Each was asked for input into the development of relevant parameters for the study and, in addition, for the names of local groups and individuals whom they thought might have an interest and input to the study. These people were, in turn, contacted. The point was reached where people recommended others who were already contacts. This indicated to us that on the first run we were in contact with most of the knowledgeable people

of the area. Addresses and other information are on file. All individuals and groups suggested were listed for future reference by the field survey teams or by the Department of Natural Resources.

Everyone personally contacted was asked to pinpoint particular sites they thought would be of interest as natural areas. County maps were used for this purpose. As it turned out, few people could name areas other than known wildlife refuges, parks, or forests. Each person identified areas related to his particular interest, for example, particularly rich birding areas, or good fishing streams or spectacular wildflower sites. Most people refrained from nominating others' private property.

ASSEMBLING EXISTING DATA

Many State and Federal agencies, as well as universities and research stations, have data useful to a natural areas study. The Department of State Planning, local planning departments, the Soil Conservation Service, the Wildlife Administration, and the Water Resources Administration have contributed data to this study. Dr. Grace Brush, of the Geography Department, Johns Hopkins University, and Dr. Chandler Robbins, of the Patuxent Wildlife Research Station, were particularly helpful in developing species lists of plants and birds, locating interesting areas and assisting in making contacts with knowledgeable people on the Eastern Shore. Data gathered from agencies and individuals included: soil data, zoning information base maps, aerial photography,watershed designation, wildlife data, geographic outliers of plants, and interesting plant communities.

NATURAL AREAS FIELD SURVEY PROCEDURE

The procedure by which physical and biological parameters were field sampled was developed with the following objectives in minds.

1. Simplicity - for use by semi-trained personnel.
2. Objectivity - based on quantified, replicable data.
3. Versatility - for use by several agencies.
4. Efficiency - requiring a minimal amount of time at each site.
5. Sensitivity - able to identify specific relevant parameters.
6. Comprehensive - includes all relevant parameters.
7. Flexibility - able to be used in different types of areas and in different sized areas, capable of being expanded or abbreviated as time or circumstance dictate.
8. Representative -able to provide an accurate representation of an area when only part of the area can be sampled.

The purpose of the field survey procedure developed for this project is to characterize the dominant aspect of the natural area's vegetation and other natural features. The objective is to develop a description of an area through the use of words; the procedure is not intended to generate data for specific scientific purposes. It is a preliminary survey technique and in certain cases may be a basis for more detailed studies by other investigators. No original work is attempted to estimate or model the potential effects of various impacts on ecological systems.

The field survey of a natural area begins with the team familiarizing itself with air photos, soil surveys and topographic maps related to the site to become acquainted with general patterns of slope, soil moisture, and the vegetation as well as with the location of watercourses, water bodies and contiguous land uses.

On the basis of this overview, a preliminary determination is made of the size and shape of the areas to be sampled. The surveyor then enters the area and records data on each previously identified sub-section. On the basis of this reconnaissance the dimensions of sub-units may be changed to facilitate description.

Within each sub-section several circular plots 10 yards in radius are established and plant cover estimated by species in each physiognomic stratum (canopy, understory, shrub and herb layers) (Niering and Egler, 1966). In addition, the average diameter of trees in the plot is recorded and the location of each plot marked on air photos.

During the survey animals are noted and their abundancy estimated. Where wetlands occur within a natural area they are rated for potential wildlife value by a separate procedure.

Immediately upon completing the survey the surveyors review all data entered on the data sheets and develop a paragraph describing the distinctive features of the natural area, the vegetation pattern and dynamics, historical notes, animals, unusual geologic features and the role of the site in the coastal zone aquatic system.

All data sheets are then rechecked and miscellaneous data entered such as zoning and the names of persons with knowledge of the site.

NATURAL AREA AND WETLAND SURVEYS

The vegetation sampling procedure was adapted from Niering and Egler (1966). The wetlands sampling procedure was adapated from Golet and Larson (1974). A complete description of the survey procedure can be found in Appendix A.

MATERIALS

Materials required to conduct a natural areas survey using the methods described here are neither elaborate nor expensive. The materials include:

1. U.S. Geological Survey quadrangle maps
2. tree diameter tapes
3. data sheets and clip boards
4. compass
5. lots of bug spray
6. plant and animal identification keys
7. collection bags
8. plant presses
9. field notebooks

Travel times to sites along waterways can be significantly reduced if canoes or motor boats are available.

DATA FORMAT AND COMPUTER

Data for the natural areas inventory must be assembled from a wide variety of sources. It must be brought together in an internally consistant format, with a reasonable manpower effort, which includes the ability to update and amend the data. The system must be able to accept new data as changes are detected or new sites are found. The data must be available in maps, texts, and tables, depending on the agency or user needs.

The Department of State Planning's MAGI computer system has the capability of storing spatial information by using map coordinates. After this field study is completed, the MAGI coordinates of each site will be encoded into the MAGI computer storage. This will allow the data to be used for State Planning purposes and will provide easy access to the information by planners.

Data collected from each site were encoded on data forms designed for easy key punching. This avoided the costly step of transferring the data to key punch forms. Use of a standard data form reduced the amount of writing done in the field and demanded that the surveyor at least consider all possible parameters. An example of a data sheet is illustrated in Figure 16.

In many cases, the user must have ready access to the information, often on short notice. The print-outs were formated so that legal sized photo copies could be made.

For evaluations, any parameters can be selected and a list of areas containing them can be generated. Examples are: all sites within a particular county, all sites with trees greater than 2' DBH, all sites with unusual geologic features.

Since land use patterns, trends, and status are dynamic, the need for updating information is a major consideration in formating data. The computer program developed for this study is simple and flexible, and can be easily updated.

Data are available as a computer print-out for each site. The data are organized so that the first page allows the user to get an idea of the salient features of the site, its current use and status, etc., (Figure 17). If a catalog of natural areas were to be published, this first print-out page provides a good general description of each natural area and in-

Figure 14

VEGETATION SAMPLING

Data Form — Worksheet

CARD#6

Col No.		coun.	elect. dist.				coun. site	field site	sub sec		
1	5					9					

	Species	LAYER	IMPORT	Avpct cov	DBH	SPECIES NAME	REPROD	1 cov	1 DBH	2 cov	2 DBH	3 cov	3 DBH	4 cov	4 DBH	5 cov	5 DBH
14																	
22																	
30																	
38																	
46																	
54																	
62																	
70																	

CARD#7

3																	
11																	
19																	
27																	
35																	
43																	
51																	
59																	
67																	

CARD#8

3																	
11																	
19																	
27																	
35																	
43																	
51																	
59																	

Canopy, Understory, Shrub, Herb- Total Average Cover

Layer
1. canopy 3. shrub
2. understory 4. herb

Importance
1. unique or rare
2. champion tree(>2ft.)
3. endangered

Avg. % Cover	
0-<5	5-50
1-10	6-60
2-20	7-70
3-30	8-80
4-40	9-90

Reproduction
X-yes
O-no

Average DBH

1=1-4"	6=18-24"
2=4-6"	7=24-30"
3=6-9"	8=30-36"
4=9-12"	9= > 36"
5=12-18"	

cludes a useful level of information pertaining to the site. The print-out second page lists more detailed information and is intended for the use of those with specific data needs (Figure 18).

The parameters in Figures 17 and 18 are explained below, or in the discussion of derived parameters, or in Appendix A, the Field Notebook.

To characterize and locate natural areas, two systems were used, one to characterize the nature of the area, the other to specify its location. The elements of character and of location are discussed below.

CHARACTER

Primary, Secondary, Tertiary Categories

To indicate the salient features of a natural area, descriptive categories were developed. These categories follow the format of the New England Natural Areas Study (Siccama, 1975). Table 5 lists eight categories and the descriptive statements associated with each. These accent the salient features of a natural area. Each natural area may be given as many as three descriptive statements, but no less than one. These are printed on the first page of the data print-out for each site and are listed as primary, secondary and tertiary categories.

By using these descriptive statements, the user can quickly gain an impression of the important features of the area and decide if he is interested in knowing more about the site.

Location - Site Type - Ecological Unit

A brief, short-hand description of the location and nature of the site is available in the location - site type - ecological unit description. The location part tells where the site is on the Eastern Shore relative to broad categories (e.g., upland bay shore, edge of tidal stream). The site type describes topographic and hydrologic conditions (e.g., ridge top, lower slope, deltaic bottomland). The ecological unit describes what type of natural system will be found there (e.g., forest, marsh, pond, unusually large tree). Examples of how these would read are:

Bay shore - lower slope - pond
Interior - deltaic bottomland - marsh
River shore - floodplain - forest

LOCATIONS

County

For ease of reference, the first location designation is the county name. Each natural area is referred in the data to the county in which it wholly or chiefly occurs. This information appears on the first page of the print-out and allows for data retrieval by county.

Election District

Each county is divided into several election districts. The election district is the next location level.

JOHNSONTOWN-SHIPPEN CR... 150793300021305

LOCATION,SITE TYPE,ECOLOGICAL UNIT	TIDAL STREAM SHORE	LOWER SLOPE	FORESY
NEAREST TOWN,COUNTY,ELECTION DISTRICT	POMONA	KENT	NUMBER 7
AREA,ELEVATION,WATERSHED	0278 ACRES	0000 FEET	CHESTER

ONE LINE DESCRIPTION- LARGE PINE-OAK FOREST ALONG THE CHESTER RIVER

PRIMARY CATEGORY- FOREST
SECONDARY CATEGORY- SIGNIFICANT AND UNUSUAL WATER-LAND INTERFACES
TERTIARY CATEGORY- HABITAT AREA OF RARE, ENDANGERED AND UNIQUE BIRD

****

OCCURRENCE	INFREQUENT
VISUAL EXPERIENCE	MEDIUM
DIVERSITY	MEDIUM
ACCESS TO AREA	EASY
NATURAL INTEGRITY	NATURALLY TRANSITORY
CONTIGUOUS LAND USE	N-AGRICULTURE S-WATER BODY E-WATER BODY W-AGRICULTURE
AQUATIC BUFFER ZONE	N-ADEQUATE S-NOT APPLICABLE E-NOT APPLICABLE W-ADEQUATE
SECURITY	AREA SAFE FOR FIVE YEARS
CURRENT USE	SEVERAL HOMES
OWNERSHIP	PRIVATE INDIVIDUAL (MORE THAN ONE OWNER)
ZONING	RURAL
INVENTORY DATE	06/19/75

LOBLOLLY PINE AND OAKS CHARACTERIZE THESE FORESTS ON THE CHESTER RIVER. IT IS ONE OF THE LARGEST FOREST IN THE VICINITY, AND HAS OVER A MILE OF SHORELINE ON THE CHESTER RIVER AND ONE OF ITS SMALL TRIBUTARIES, SHIPPEN CREEK. THIS FOREST DEMONSTRATES UPLAND SUCCESSION--IN ONE SUBSECTION COVERING 21% OF THE SITE, A DENSE UNDERSTORY OF SWEETGUMS IS COMING UP UNDER A CANOPY OF LOBLOLLY PINES. SEEDLINGS OF OAK AND OTHER TOLERANT HARDWOODS ARE COMMON ON THE FOREST FLOOR. IN THE OTHER SUBSECTION MAKING UP 79% OF THE AREA, OAKS, SWEETGUM, RED MAPLE, AND BEECH HAVE MOSTLY REPLACED THE PINES AS THE DOMINANT CANOPY TREES. WILDLIFE IS ABUNDANT, ESPECIALLY DEER AND UPLAND GAME. NO OSPREY NESTS WERE SIGHTED IN THIS SITE, BUT THOSE NESTING ALONG THE CHESTER RIVER FREQUENT THE AREA. BALD EAGLES NO LONGER NEST IN THE SITE, BUT OCCASIONALLY VISIT. SEVERAL HOMES HAVE BEEN BUILT WITHIN THE SITE AND OWNERS INTEND TO PRESERVE THE NATURAL AREA.

BIBLIOGRAPHY
MARYLAND DEPT. STATE PLANNING 1975 (UNPUBLISHED) INVENTORY OF MARYLAND CRITICAL AREAS.

PEOPLE CONTACTED
MR. AND MRS. JAMES G. HAUPT, R.D.3, CHESTERTOWN, MD. 21620.
GEORGE F. JOHNSON, R.D. 3, CHESTERTOWN, MD. 21620.

COMPUTER PRINT-OUT (First page)

JOHNSONTOWN-SHIPPEN CREEK WOODS 150793000021305

	01	02
SUBSECTION SAMPLED & SIMILAR SS		
AREA OF SUBSECTION	059 ACRES	219 ACRES
SOIL TYPE & NATURAL SOILS GROUP	SAA B1	ENA F3
RUNOFF POTENTIAL	SLIGHT (B)	HIGH (D)
DEPTH TO WATER TABLE	5-6 FT	1 FT -
WELL DRAINED SOILS	YES	NO
SLOPE AND SOIL ERODIBILITY	15%-,MEDIUM (.28)	15%-,HIGH (.43)
EASE OF PASSAGE	EASY	MODERATE
DISTANCE TO WATER BODY	0-10 FEET	0-10 FEET
TYPE OF WATER BODY	TIDAL STREAM	TIDAL STREAM
WATER BODY SIZE AND DEPTH	30 ACRES + 3 FOOT +	30 ACRES + 1 FOOT +
TYPE OF BOTTOM MATERIAL	SAND	SILT
BEACH LENGTH AND WIDTH		
BEACH TYPE		
PERCENT OF STREAM SHADED		
WETLAND WILDLIFE RANK		
DISTURBANCE PRIMARY & SECONDARY	SELECT CUTTING WINDTHROW	SELECT CUTTING MOTOR VEHICLES
VEGETATION TYPE	LOBLOLLY PINE	LOBLOLLY PINE-HARDWOOD
TOTAL AVERAGE COVER BY LAYER	C=60% U=70% S=40% H=80%	C=60% U=90% S=40% H=30%

KEY TO VEGETATION

L-LAYER
C-CANOPY
U-UNDERSTORY
S-SHRUB
H-HERB
COV-AVERAGE PERCENT COVER
I-IMPORTANCE
R-RARE OR UNIQUE
C-CHAMPION TREE CANDIDATE
E-ENDANGERED
DBH-DIAMETER AT BREAST HEIGHT

LA	VEGETATION	COV	I	DBH
C	LOBLOLLY PINE.	60		12-18
C	BLACK WALNUT.	00		6-9
C	BLACK LOCUST.	00		6-9
U	SWEET GUM.	50		
U	FLR DOGWOOD.	10		
U	RED MAPLE.	00		
S	SWEET GUM.	30		
S	WINEBERRY.	00		
H	JAP HONEYSUKL.	30		
H	TRUMPT CREEPER	10		
H	VA. CREEPER.	00		
H	JCK-N-TH-PLPIT	00		
H	WINEBERRY.	00		

LA	VEGETATION	COV	I	DBH
C	AMERICAN BEECH	10		12-18
C	WHITE OAK.	20		12-18
C	LOBLOLLY PINE.	10		12-18
C	HICKORY.	00		12-18
C	SWEET GUM.	10		12-18
C	COM PERSIMMON.	00		6-9
C	PIN OAK.	00		6-12
C	WILLOW OAK.	00		12-18
U	FLR DOGWOOD.	30		
U	HICKORY.	00		
U	COM PERSIMMON.	10		
U	RED MAPLE.	10		
U	AMER. HOLLY.	40		
U	BLACK OAK.	10		
S	SWEET GUM.	00		
S	WINTERBERRY.	00		
S	SYMPHORPOS	00		
H	SMILAX	00		
H	JAP HONEYSUKL.	00		
H	SENSITIVE FERN	00		
H	SWEET BAY.	00		
H	LO SWT BLUBRY	00		
H	VA. CREEPER.	00		

KEY TO ANIMALS

S-SOURCE
O-OBSERVED
R-REPORTED
D-DEN,NEST,SPOOR
F-FREQUENCY
A-ABUNDENT
C-COMMON
R-RARE
RES-RESIDENCE
BR-BREEDING
MI-MIGRATORY
WC-WINTER CONCENTRATION
YR-YEAR AROUND RESIDENT
UN-UNKNOWN
X- ANY 'X' DENOTES INPUT ERRO

ANIMAL	S	F	RES
WH TAILED DEER	D	A	YR
OSPREY	R	C	BR
BALD EAGLE	R	R	UN

ANIMAL	S	F	RES
WH TAILED DEER	D	A	YR
BALD EAGLE	R	R	UN

*GEOLOGY LOWLAND DEP *
*MINIMUM DIMENSION 400-600 FT *
*# VEGETATION TYPES 2 *
*PERCENT 5-10 AC OPENINGS 3-5% *
*VISUAL EXPERIENCE SCORE 13 *

COMPUTER PRINT-OUT (Second page)

Table 5. DESCRIPTIVE CATEGORIES

GEOLOGIC (Landform)
- Gorges
- Distinctive mountain features
- Cliffs, bluffs
- Natural rock outcrops of geologic significance
- Manmade rock outcrops of geologic significance (road cuts and quarries)
- Natural sand, beach, dune features
- Fossil evidence
- Scarp
- Other unusual geologic features

SOILS
- Unusual soil groups undisturbed by human activity

HYDROLOGIC
- Significant and unusual water-land interfaces (e.g., islands; scenic stretches of coast, rivers, streams, lakes or ponds)
- White water stretches
- Waterfalls
- Natural Springs
- Marshes, bogs, swamps, flats (coastline)
- Marshes, bogs, swamps, flats (inland)
- Aquifer recharge areas
- Water areas supporting unusual or significant freshwater aquatic life
- Lakes or ponds of unusually low productivity
- Lakes or ponds of unusually high productivity
- Unusual natural river, lake or pond
- Stream and wetland margin habitat
- Floodplain
- Lake or pond
- Other unusual hydrologic feature

BIOLOGICAL-FLORAL
- Rare, remnant or unique species of plants
- Unique plant community
- Plant community unique to a geographic area
- Individual plant specimen(s) or unusual significance (e.g., large trees)
- Plant communities of unusual age or maturity
- Plant communities of unusual diversity and productivity
- Areas exhibiting outstanding seasonal color
- Forest
- Managed Forest
- Field or shrub swamp

BIOLOGICAL-FAUNAL (terrestial animals)

- Habitat areas or rare, endangered and unique species
- Habitat areas of unusual significance to a faunal community (e.g., feeding, breeding, wintering, resting)
- Faunal communities unusual to a geographic area
- Habitat areas supporting faunal communities of unusual diversity and productivity
- Habitat areas exhibiting other interesting features

BIOLOGICAL-FAUNAL (birds)

- Habitat areas or rare, endangered and unique species
- Habitat areas of unusual significance to a faunal community (e.g., feeding, breeding, wintering, resting)
- Faunal community unusual to a geographic area
- Habitat areas supporting faunal communities of unusual diversity and productivity

BIOLOGICAL-FAUNAL (aquatic life)

- Habitat areas of rare, endangered and unique species
- Habitat areas of unusual significance to a faunal community
- Faunal communities unusual to a geographic area
- Habitat areas supporting faunal communities of unusual diversity and productivity

CULTURAL-AESTHETIC-VISUAL

- Manmade features having unusual aesthetic features of aesthetic significance due to natural setting (e.g., old mill along creek)
- Scenic gravel or unimproved roads
- Vista points
- Trail systems
- Unusual juxtaposition of manmade and natural features
- Unusually scenic area
- Archaeological site

Nearest Town

For locating natural areas on county topographic maps and road maps the print-out gives the name of the town nearest the natural area.

Watershed

To know which watercourse or drainage basin within which a natural area occurs, major basin, minor basin, sub-basin, and basin segment are recorded for each area. On the print-out for the site the name of the major watershed basin is shown. Where sites occur in more than one minor basin, an asterisk (*) appears as the last digit of the site number.

EVALUATION

Evaluation systems are developed to aid decision making. A fine-grained evaluation system does not have to precede general regulatory activities. Data about a site may only require a general classification of areas (e.g., wetlands) for regulatory needs. Classes of wetlands (e.g., bogs, marshes, swamps) may not be essential.

However, in making acquisition and land use decisions, a more detailed level of evaluation is needed. When there are limited resources to purchase lands, it is imperative that monies be expended on the most important areas. The need to determine gradations between areas is particularly acute for comprehensive planning. Without a determination of the more important lands, much of the land would be classified as "critical", making "critical" a meaningless term (John Antenucci, pers. comm.). At the same time, there is a need to determine which areas are of statewide significance. "Areas of critical statewide concern have generally been those which (a) are used by or have impact upon state citizens from more than one local jurisdiction, and (b) are not adequately protected or managed at the local level" (Institute for Environmental Studies, 1975). The Institute for Environmental Studies at the University of Wisconsin (1975) has listed several tests that might be applied to determine whether an area is of statewide significance. This list is worth reviewing when setting up an evaluation program.

Through evaluation of the data, when areas are ranked, decision makers are in a position to develop priorities and make judgements with respect to their program needs.

Evaluation systems typically are quantitative because other types of evaluation (e.g., qualitative statements) are impossible to rank by themselves. Leopold (1969), suggests that quantitative data carries more weight with decision makers than arguments based on emotion or personal feeling. But, not all parameters can be easily quantified. Subjective, qualitative evaluations also have their place in an evaluation scheme as well.

It is not within the purview of this study to develop a rigorous, objective ranking system for evaluating natural areas. Rather, agencies in the Departments of Natural Resources and State Planning, separately or collectively, will develop such evaluation systems to rank areas, to determine their permissible public or private uses, and to develop priorities for implementing these determinations. This study includes several preliminary subjective evaluations as well as an objective ranking for wildlife habitat in freshwater wetlands. This objective evaluation is intended to act as an example for other evaluation systems to be developed by the State. Below is a discussion of how a more extensive and objective evaluation might be done and some important considerations and limitations related to objective evaluation systems are illuminated.

One method of evaluation requires a two step process. This first step ranks general classes of areas by relative value. (For example, loblolly woods vs. oak woods vs. wetlands). The second step is to perform an evaluation of each of these site classes to determine which type within the class

is more important relative to the others in the class. (For example, within wetlands; bogs vs. marshes vs. swamps).

Another evaluation process would involve the ranking of these various types of land by their scarcity, ecological value, recreation value or other values. Each value can be weighted, and each land type scored. In this way, totals can be derived which rank classes of land by stated values, weighted to reflect the values of the evaluating agency. Combinations of these two evaluation methods, or other methods, can also be employed. The important point to remember is that an evaluation scheme is a method for dispersing information on land areas into a ranking system in an effort to distinguish one from the other.

The data collection system in this study was developed to allow for the identification of the most valuable natural areas of Maryland's Coastal Plain. In part, the data was collected so it could be used to either rank areas for quality or naturalness or to rank areas for specific uses. For each evaluation a different set of parameters must be assessed. For example, passive recreation requires the assessment of such factors as the area size, the number of vegetation types, the size of water bodies, stream classification, the presence of well-drained soils, and the nature of contiguous land uses. Ranking of wetlands for wildlife management requires such factors as the site type, wetland class, vegetation interspersion, types of disturbances, and cover type. At the same time, parameters used in assessing the relative quality of oak-beech forests are different than those used in assessing the relative quality of mill ponds. Some rating systems are fine-grained. A parameter such as area size, can have several different categories (e.g., over 500 acres, 100-500 acres, less than 100 acres) and each category could have a different weight or rank for different evaluation needs.

A number of attempts have been made to develop rating systems designed to permit comparison among areas based upon numerical scores. The rating systems that have been developed differ in the number of parameters considered, the level of information detail required concerning the parameters, the amount of subjectivity required in producing a numerical rating for any particular parameter, and the mathematical manipulations performed in arriving at a final overall rating for the area. An excellent discussion of the different types of rating systems is contained in the Smithsonian Institution Center for Natural Areas report (1974b).

Natural area parameters can be evaluated through two general types of assessment -- subjective or objective.

In this study, subjective elements were included because (1) certain parameters are so variable that they were difficult to quantify (e.g. visual experience) or, (2) the parameter provides a general statement about the character of a site.

The subjective parameters appear on the first page of the computer print-out for each site.

Subjective parameters include: access, security, visual experience, ease of passage, natural integrity, diversity, occurrence and aquatic buffer zone.

Objective parameters are (1) specific quantitative variables (e.g., size of area, soil erodibility, distance of water body or (2) specified descriptors (e.g., zoning, contigious land use, ownership, vegetation type).

There are many data manipulation problems encountered in the use of a numerical rating system; therefore, the results obtained from numerical rating systems should be used with caution. Some rating systems order the data for each factor, by given criteria, without considering the interval between each rank or some fixed zero point. This type of scaling is known as ordinal, and limits the validity of any mathematical operations which may be performed. As Brandes (1973) notes:

> The most important point about ordinal rankings is that not much more than "A" is taller than "B" can be said with them. Even though A may be ranked four and B ranked eight, it is not legitimate to say that B is four units higher than A or twice as tall as A. Although the numbers designating the ranking may be manipulated by conventional arithmetic, the results, in terms of properties of the objects ranked, are meaningless.

There is a tendency to treat data, many times distinguished on a "good--bad, high--low, first--last" basis, as if they were measuring differences in magnitude which reflect a meaningful difference in the properties of objects or factors being ranked (Smithsonian, 1974). It may appear necessary to combine the ordinal ratings by summing them, as the Illinois and Wisconsin natural area rating systems do. Certain factors may be weighted and then summed to obtain an overall weighted score (Golet, 1973), Institute for Environmental Studies, 1974). "Translating the result back into a meaningful statement reflecting the conditions in the real world is often not possible without implicitly inputting more information or making arbitrary choices. The temptation of balancing convenience and realism is only one of the problems involved. The rules of scaling are still being violated: ordinal numbers are still being multiplied by constants and summed." (Brandes, 1973).

When using numerical scores, many variations of numerical totalling can be used; however, it should be noted that the total scores are only meaningful with respect to one another. The numbers in themselves have no real value. Weights and ranks are subject to bias; weights assigned may vary from individual to individual depending on knowledge or values. Also, the final or total score for any natural area being assessed is adversely skewed where a subscore, not available for one of the parameters, is scored as a zero, as though it were counted when in fact it wasn't. That is, if no data exists for a particular parameter for one natural area, but is available for other areas, the score of the one area may be significantly lower than it should be.

Ranking encounters several other problems. No one person has seen all of the areas to be ranked. This problem is compounded by the difficulty of assessing an area in only one visit. Finally, the more factors involved in the evaluations, the more averaging there will be; thus, particularly outstanding qualities and differences may be masked by the

shear mass of data. A major effort should be made to make the evaluation as succinct as possible. Some evaluation systems rely too heavily on an ephemerial factor such as the presence of rare or endangered species. Consequently, when the factor changes, the rank of the area changes radically.

In evaluating areas for protection or acquisition, the State will be faced with decisions such as which bogs or which beech stands should have top priority. The need to determine gradations or continuums in biotic communities, or any potential critical area, is particularly acute for comprehensive planning. The task, then, is to rank the specific classes from highest to lowest priority. As an example, Tans (1974) has developed criteria and a ranking system to evaluate priority for biotic communities for the Wisconsin Scientific Areas Preservation Council. As Tans (1974) notes:

> "A system designed for priority ranking of natural areas would be of benefit for (1) selection of the most representative example of a natural area type when several examples of the same type are undergoing simultaneous evaluation; (2) comparing the relative "value" of natural areas and natural features where such factors as disturbance, quality, diversity, etc. vary from one area to another; (3) forcing systematic analysis of traits to consider each factor as objectively as possible".

The criteria used are included as Appendix B. This study provides the data necessary to do a similar priority ranking system.

The technique used in this study for wetland evaluation is taken from Classification and Evaluation of Freshwater Wetlands as Wildlife Habitat in the Glaciated Northeast (Golet, 1973). This paper was adapted for the use of the field surveyors. The total score for wetland wildlife habitats appears on the second page of the data print-out. Golet's system is a "point rating with weighing of factors" type of evaluation and is similar to the Institute of Environmental Studies,(1974) evaluation system. An example of the rating system is shown in Figure 19; an example of the data sheet is shown in Figure 20. For a discussion of how the evaluation is done see "Wetlands" in Appendix A.

In conclusion, three considerations are essential to a useful rating system (Smithsonian, 1974b):

1. Distinguish between those judgements which are primarily subjective and those which are primarily objective, and don't mix the evaluation where it is inappropriate.
2. For those judgements that are to be quantified, it should be made quite explicit what criteria are being used to judge relative values, the techniques to be employed in doing so, the type of scaling operation being applied to the data and the type of mathematical operations used in obtaining an overall rating.
3. The presentation of the final rating should be made in such a way that the relevant criteria responsible for making a given area "critical" or of "top priority" are shown.

Figure 17

WETLAND WILDLIFE RATING

Wetland Classes

5 acre minimum		Dominance Class	Richness Class	Rank
1.	Open water	4,2	5 or more	3.0
2.	Deep marsh	3	4	2.5
3.	Shallow marsh	7,6	3	2.0
4.	Seasonally flooded flats	1,8	2	1.5
5.	Meadow	5	1	1.0
6.	Shrub swamp			
7.	Wooded swamp			
8.	Bog			

Size

		Rank
9.	Very small - less than 10 acres	1.0
10.	Small - 10-50 acres	1.5
11.	Medium-sized - 51-100 acres	2.0
12.	Large - 101-500 acres	2.5
13.	Very large - greater than 500 acres	3.0

Site Types

		Cover Types	Site Types	Rank
14.	Upland-isolated	24	17,18,19	3.0
15.	Upland-lakeside	23		2.5
16.	Bottomland-isoladed	22,26	15,16	2.0
17.	Bottomland-lakeside	20,21,25		1.5
18.	Bottomland-streamside	27	14	1.0
19.	Bottomland-deltaic			

Cover Types

20. Cover occupies more than 95 percent of the wetland area.
21. Cover occupies 76-95 percent of the wetland area, occurring in a peripheral band.
22. Cover occupies 76-95 percent of the wetland area, occurring in dense patches or diffuse open stands.
23. Cover occupies 26-75 percent of the wetland area, occurring in a peripheral band.
24. Cover occupies 26-75 percent of the wetland area, occurring in dense patches or diffuse open stands.
25. Cover occupies 5-25 percent of the wetland area, occurring in a peripheral band.
26. Cover occupies 5-25 percent of the wetland area, occurring in patches or diffuse open stands.
27. Cover occupies less than 5 percent of wetland area.

Figure 17 (continued).

Wetland Wildlife Categories - cont.

Surrounding Habitat Types

		Habitats	Rank
28.	Agricultural or open land	2 or more of	
29.	Forest land	28,29,30 making	3.0
30.	Salt marshes	up more than 90%	
31.	Mining or waste disposal area	1 or more of	
32.	Urban land	28,29,30 making	2.0
33.	Outdoor recreation facilities	up 50-90%	
		1 or more of	
		28,29,30 making	1.0
		up less than 50%	

Vegetative Interspersion

		Rank
34.	Type 1	1.0
35.	Type 2	2.0
36.	Type 3	3.0

Wetland Juxtaposition

37. Hydrologically connected to other wetlands (different dom. class) or open water bodies within one mile.

(or)

Hydrologically connected to other wetlands (same dom. class) within 1/4 mile

(or)

Wetland greater than 500 acres, with three or more wetland classes (including deep marsh or shallow marsh).

38. Hydrologically connected to other wetlands (different dom. class) or open water bodies from 1-3 miles away.

(or)

Within 1/2 mile of other wetlands (different dom. class) or open water bodies, but not hydrologically connected).

39. All other possibilities

	Rank
37	3.0
38	2.0
39	1.0

WETLAND WILDLIFE RATING

Figure 18

Col. No.		Sig. Coeff.		Rank		Sub-score
1	**Class Richness** [6/]	5	×	____	:	____
13	**Dominant Class** [ ]	5	×	____	:	____
14	**Size** [ ]	5	×	____	:	____
16	**Site Type** [ ]	4	×	____	:	____
18	**Cover Type** [ ]	3	×	____	:	____
	Surrounding Habitat	4	×	____	:	____
20	[ ] Agricultural or open					
22	[ ] Forest					
24	[ ] Salt Marsh					
26	[ ] Mining or waste disposal					
28	[ ] Urban					
30	[ ] Outdoor Recreation					
32	**Vegetative Interspersion** [ ]	3	×	____	:	____
34	**Juxtapostion** [ ]	2	×	____	:	____
						TOTAL SCORE
36	**TOTAL SCORE** [ ]					____

GLOSSARY

Aquatic Buffer Zone - a band of vegetation contiguous with wetlands and watercourses which protects an aquatic system from excess runoff, erosion and contamination from non-point sources of pollution such as fertilizers and pesticides. The width of vegetated land necessary to adequately buffer the aquatic system varies, depending on the soil's ability to store water and the type and extent of the vegetation in the buffer.

Aquatic System - a wetland, watercourse, or water body and contiguous areas with D or D+ soils.

Bacterial Danger Zone - soil between the highest water table level and one foot below the lowest water table level; where conditions are ideal for bacterial growth.

Basal Area - the area, usually measured in square feet, of the cross-section at breast height of a single tree or of all trees in a stand.

Baseflow - stream flow derived from deep percolation of infiltrated water that enters the permanently saturated ground water system and discharges into the stream channel.

Buffer - a limited use area between a developed area and a protected area.

Categories - a division within a parameter used for the purpose of scaling.

Class - a group of areas considered as a unit (e.g., wetlands, forests, fields).

Community - any assemblage of populations living in a prescribed area or physical habitat.

Contamination - befoulment through contact with a pollutant (e.g., pesticide, herbicide, toxic chemical, oil residue, bacteria, sediment).

Contiguous Land Use - the type of use being made of land adjacent to and bordering a natural area.

Critical Area - areas where man's activities can have a relatively severe impact on natural systems. Critical areas may also be habitats which are infrequently found in a state or in the nation as a whole.

DBH - tree diameter at breast height (4.5 feet above the ground).

Detritus - particles of plant matter in varying stages of decomposition.

Disturbance - a disruption, or perturbation, of an ecosystem resulting from human activity.

Diversity - the number of different vegetation types, animal species or physical features (e.g., streams, scarps, bogs) which the natural area contains.

Drainageway - a pathway for watershed drainage, characterized by wet soil vegetation; often intermittent in flow.

Edaphic Climax - where topography, soil, water, fire and other disturbances are such that the climatic climax cannot develop.

Endemic - a species of limited geographic extent.

Erodibility Coefficient - (K factor) - the erosion rate per unit of erosion index for a specific soil in continuously cultivated fallow ground on a 9% slope, 72.6 feet long. This factor is used by the Soil Conservation Service to calculate the erosion from a particular soil.

Exotic species - any plant or animal species not naturally a member of the plant community in which it is found.

Fauna - a collective term for the animal species present in an ecosystem.

Floodplain - a flat, low-lying area bordering a river or stream which is flooded only at times of high water.

Flora - a collective term for the plant species present in an ecosystem.

Floristics - plant species composition of an area.

Ground flow - the movement of water within the ground.

Ground water - that part of the subsurface water which is in the zone of saturation.

Habitat - the area of residence for an animal species or a community of species.

Home range - the area to which individuals, pairs, or family groups of vertebrates and the higher invertebrates restrict their activity.

Infiltration - the flow or movement of water through the soil surface into the ground.

Mottling - colored spots in soil horizons which indicate the existence of fluctuations in the ground water level.

Natural area - areas where at present natural processes predominate and are not significantly influenced by either deliberate manipulation or accidental interference by man.

Natural integrity - the degree to which a natural area is characterized by the natural regeneration of vegetation, mature or stable vegetation and the absence of man-induced disturbances.

Natural soils group - a new classification system of the State of Maryland's Department of State Planning which groups soils into similar major properties and features. The soil typologies of each county are regrouped around six categories of interest: agriculture, productivity, erosion susceptability, permeability, depth of bedrock, depth of water table, and stability. In general, the natural soil groups are arranged in order of increasing limitation for most uses.

Occurrence - the relative frequency of the vegetation type(s) or natural features in a natural area within the context of its frequency of occurrence on the Delmarva Peninsula.

Overland flow - water flowing over the ground surface.

Parameter - a topic whose information is amenable to collection and analysis

Partial area - dynamic, saturated, often shallow, stony or compacted areas near streams which contribute large volumes of runoff during a storm.

Perched water table - water table above an impermeable bed underlain by unsaturated rocks of sufficient permeability to allow movement of ground water.

Percolation - movement under hydrostatic pressure of water through the interstices of the ground.

Primary productivity - the amount of organic matter produced by photosynthesis.

Quadrat - a sampling area, usually square, of relatively small but consistent size.

Return flow - subsurface flow which intersects the ground surface and emerges as a spring or seep.

Runoff - the discharge of water through surface streams, expressed usually in units of volume such as gallons, cubic feet or acre-feet.

Runoff potential - the potential of the soil to shed rainwater. The runoff potential rating is based on soil catenas. Soils are grouped into seven runoff potential rating categories according to internal drainage, depth and texture of the soil as well as subsurface soil conditions. The rating system enables hydrologists or land management personnel to classify the soils hydrologically. D and D^{+}soils have the highest runoff potential while A soils have the lowest. This system not only expands S.C.S. hydrologic soil groups but also includes relevant soils information to reclassify certain soils based on recent research.

Saturated overland flow - surface water flowing over saturated soils near streams and drainage ways.

Security - the probable period of time during which no significant man-induced, direct or indirect alteration of a natural area is foreseen.

Sedimentation - the process of gravitational deposition of soil and other particles transported by water.

Soil series - a group of soils developed by the same combination of genetic processes. Its horizons have similar differentiating characteristics and arrangement in the soil profile and soils have developed from the same kind of parent material. Except for the "A" horizon texture (which is used to classify soil series into types) all soils having similar physical, chemical and morphological characteristics such as structure, texture, pH, base saturation, organic matter content, topographic position, drainage, depth, color, parent material and horizon thickness, type and arrangement belong to the same series.

Soil series are named for the geographic location where they were first described. Hence names such as Pocomoke, Sassafras, etc.

Soil type - a subdivision of the soil series based on the texture of the "A" horizon. Soil individuals belonging to the same type have similar characteristics as required by the soil series as well as the same surface texture. Soil types derive their name by adding the surface texture to the series name.

Subsection- a division of a natural area which reflects a discrete vegetation type, site-type or natural feature.

Substrate - layer beneath the soil surface.

Subsurface flow - water flowing through substrate, often along impeding layers (fragipan) in the soil.

Succession - a systematic series of species replacement in a biological system.

Transpiration - giving off of moisture and gases through the surface of leaves and other parts of a plant.

Trophic level -a step in the food chain.

Type - a subdivision of a class, a group having distinguishing characteristics, (e.g., pond, marsh, swamp; oak-beech, mixed oak, oak-pine).

Uplands - sites where the soil is dry or moist most of the year including ridges, upperslopes, midslopes, lowerslopes and well drained stream terraces.

Vegetation - the mosaic of plant communities in the landscape.

Vegetation structure - the density and distribution of leaf surfaces vertically and horizontally. Canopy, understory, shrub and herb layers are common descriptions of vegetation structure.

Vegetation types - an assemblage of plants consisting of particular species composition. The vegetation type is named for the dominant or co-dominant species. Vegetation types such as "Oak-Hickory" or "Bald cypress", may include as many as 20 different species of trees, as well as numerous shrubs and herbs. In some cases the transition between adjacent types are gradual; therefore the description given the vegetation type is more typical of the center of the type than its edge.

Water table - the highest level at which the soil or underlying rock material is wholly saturated with water. In certain places a perched water table may be separated from a lower water table by a dry zone.

Well drained soil - soils nearly free of mottling and commonly of an intermediate texture.

Wetland - any area where the water table stands at or above the land surface for at least part of the year. Wetlands are described according to the degree of wetness and the type of vegetation which the site supports.

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APPENDIX A

The following is an explanation of the rating system developed for the Wisconsin Scientific Areas Preservation Council for possible use in their program. It is taken verbatim from "Priority Ranking of Biotic Natural Areas". (Tans 1974, pp. 33-39).

INTRODUCTION-A BRIEF HISTORY OF WISCONSIN'S NATURAL AREA PRESERVATION EFFORTS

Wisconsin, long known as a pioneer in natural area preservation, initiated its efforts in 1945[1] when the Conservation Commission unanimously approved a resolution by Commissioner Aldo Leopold which created the Natural Areas Committee. Its duties were to "lay out a plan to acquire...a system of small areas representing the native vegetation of Wisconsin, including samples of woodland, marsh, bog, beach and prairie, to be held and used solely for educational and scientific purposes,..." The resolution included an appropriation of $5,000 for natural area acquisition, but once exhausted it was never renewed. During its seven-year existence, the Natural Areas Committee identified several outstanding natural areas such as Cedarburg Bog, Scuppernong Prairie, and Parfrey's Glen, which was later purchased from the funds appropriated.

The Natural Areas Committee was abolished in 1951 with the creation of its successor, the State Board for the Preservation of Scientific Areas. The Board was charged by statute to advise local, state, and federal agencies regarding the selection, acquisition, utilization, and maintenance of scientific areas. With a capable leader in ecologist John T. Curtis plus the enthusiastic support of the other member-naturalists, the Board established 16 scientific areas by the end of 1952 and 27 areas through 1953. The Board operated without a staff or budget.

The allocation of a budget in 1966 was responsible for a renewed vitality in Wisconsin's preservation program. Within several years the large backlog of uninspected natural areas was reduced, and additional potential scientific areas and a variety of natural features were delineated and field-checked. More recently, the Scientific Areas Preservation Council, formerly the State Board for the Preservation of Scientific Areas, has encouraged and sponsored the field work for complete natural area inventories of nine southern Wisconsin counties in order to identify natural areas of both state and local significance.

Today, 22 years after the original legislation, natural area preservation in Wisconsin has progressed far and witnessed many changes. There are now 105 state scientific areas encompassing nearly 15,000 acres. The majority of scientific areas are on lands acquired for hunting, fishing, park, and forestry purposes by several agencies, most notably the Wisconsin Department of Natural Resources (DNR).

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[1]Minutes of Wisconsin Conservation Commission, February 13, 1945, pp. 23-24.

The Council has not been alone in its efforts toward natural area preservation. Nonprofit conservation agencies, especially the effective Wisconsin Chapter of the Nature Conservancy, and a variety of other private groups have been instrumental in locating and purchasing natural areas under circumstances where public agencies have been unable or slow to become involved. There are indications, too, that planning and administrative personnel in Wisconsin at the county and state level are becoming actively aware of the need to at least identify representative natural communities and features of the landscape.

Both public agencies and private groups dedicated to natural area preservation have been limited by a lack of money. Private groups have had to rely on donations to finance their projects, and until recently, only a token amount of money had been appropriated by public agencies specifically for natural area acquisition. A modern precedent was set, however, when $100,000 from the Outdoor Recreation Act Program (ORAP)[2] was earmarked for natural area acquisition by the Wisconsin DNR for the 1971-73 biennium. The Council, having the responsibility for recommending the top-priority tracts, planned that two or three areas could be purchased annually through judicious use of the funds.

In view of the limited acquisition funds, the need of an evaluation system became apparent even though Council and staff have utilized criteria to identify and select the highest priority areas for years on an informal basis. For nearly thirty years the Council and its predecessors have accumulated inventory data on a large number of high-priority natural areas, many of which have remained under private ownership. From this backlog of natural areas plus those to be identified in the future, a relatively few will be selected as acquisition candidates. In addition, there has been an increasing number of individuals and agencies requesting help in natural area evaluation. Fulfilling all the requests is difficult, but providing an evaluation system upon request would allow others to familiarize themselves with evaluation techniques.

A system designed for priority ranking of natural areas would be of benefit to Council and staff for 1) selection of the most representative example of a natural area type when several examples of the same type are undergoing simultaneous evaluation; 2) comparing the relative "value" of natural areas and natural features where such factors as disturbance, quality, diversity, etc., vary from one area to another; 3) forcing systematic analysis of tracts to consider each factor as objectively as possible.

THE EVALUATION SYSTEM

This is a preliminary approach to a priorty ranking of natural areas,[3] and it emphasizes the evaluation of vegetative characteristics as the basis for comparing areas and establishing priorities. Additional features such as geological or archaeological sites, animal species preserves, and other natural features of the landscape deserve recognition in natural area eva-

[2]ORAP-Outdoor Recreation Act Program is a $200 million bonding program for land acquisition and development in Wisconsin.

[3]The Scientific Areas Preservation Council utilizes the terrestrial plant community classification scheme of John T. Curtis in The Vegetation of Wisconsin (1959).

luation. Council staff will continue to seek the advice of numerous specialists as necessary so that top-priority zoological, archaeological, and geological sites receive adequate representation within the scientific area system.

This evaluation of natural areas does not consider scenic beauty, ease of access, potential for enjoyment of nature, availability of public facilities, or hazards to visitors. Public enjoyment, safety, and convenience factors are of important consideration in parks and other less restricted areas but of lesser significance in natural area evaluation.

The ranking system is founded on a systematic analysis of the areas to be ranked based on criteria which are grouped into four categories: 1) determination of natural area value (biological characteristics), including quality, commonness, and community diversity; 2) physical characteristics and use value, the former including size and buffer considerations; 3) degree of threat; and 4) availability. Areas of both public and private ownership can be ranked with this system.

Factors concerned with management and protection of natural areas, although vitally important for long-term maintenance of an area, were omitted from the ranking. Examples include unauthorized use by snowmobiles or other vehicular traffic, the cost of fencing, enforcement, or boardwalk construction, and the time and energy needed for these. These factors often become problems after an area has achieved scientific area status, but they would seldom be of such importance that they would affect a decision regarding preservation.

Although all factors need to be considered in evaluating the "value" of a potential scientific area, certain factors are more important than others. For example, consider quality of an area versus the presence or absence of a buffer zone. Quality is obviously one of the most important determinants of natural area selection, while a buffer zone, which increases the probability of more complete protection, is not instrumental to the existence of a natural area. To equalize these and other factors, a weighted system of point allocation was utilized in the ranking.

The weighting of criteria utilized in evaluating natural areas was determined by analysis of the reasons for which areas were established as scientific areas as well as the long-term goals of the Council. Both are related to the nature and distribution of the presettlement vegetation types in the state and their historical preservation and conversion to the existing types. The results indicated that of the eight factors utilized in the ranking, both quality and threat were of greatest overall importance and most often of primary consideration in an area's evaluation. They were weighted the heaviest. The remaining criteria in order of decreasing importance are: size and buffer, commonness, community diversity, availability, and finally, use value.

PROBLEMS OF A RANKING SCHEME

Ranking natural areas involves several problems, any one of which will influence the results. No one person has seen all of the areas to be ranked, and this problem is compounded by the difficulty in assessing an area in one visit. Council staff has found it necessary to investigate

an area two or three times during different seasons to obtain a reasonable analysis of an area's features. No one should attempt to rank a natural area on the basis of another's report or without a personal inspection.

Secondly, the more factors involved in evaluating an area the more averaging there will be; thus the outstanding qualities and deficiencies will be masked. The perfect blend for an evaluation is one which uses the fewest criteria but most accurately reflects an area's worth.

Thirdly, there is the problem of obtaining a single and meaningful numerical score for each area evaluated taking into consideration the three disparate qualities: biological (and physical) characteristics, threat, and availability. A simple additive scoring scheme was discarded because it could equate two areas, for example, one of which was for sale and the other which was not available. Similarly, natural areas with high quality and not threatened, and low quality, threatened areas could be ranked alike. Multiplicative scoring has been suggested and appears to more accurately portray the relative "value" of natural areas. It was decided, however, that any scoring system which provided a composite score for the above characteristics, no matter how it was derived, masks the critical criteria relating to ultimate preservation by acquisition: availability and threat. The final scoring system retained separate scores for biological and physical characteristics, availability, and threat for quick and accurate comparison of areas.

Lastly, this system was developed to identify the best natural areas from a select group representing the best of known natural areas in the state. Evaluating the differences between natural areas in a select group proves more difficult than comparing natural areas with a wide range of differences. Other problems like the lack of reference materials on most areas and the occasional occurrence of personal preferences hinder objectivity.

USING THE RANKING SCHEME

The defined criteria under each heading should be systematically applied to an area to award points, but be aware of the point differences for the various criteria. Note that for those criteria which have only even points defined, the scorer may allocate odd numbers. This may ease the relative comparison of areas for some scorers. Great care should be taken in evaluating an area to avoid intermingling elements of different factors. Work with others who know the areas well and pool information to reduce emotional point.

For each area evaluated, sum the points allocated for quality, commonness, community diversity, size, and buffer. The higher the total the greater a natural area's "value". This total and points allocated for availability and threat can then be compared for each of the areas evaluated to rank them comparatively.

CRITERIA FOR PRIORITY RANKING OF BIOTIC NATURAL AREAS

1. Determinants of Natural Area Value (Biological Characteristics)

   A. Quality-Quality is a ranking of an area based on the excellence of its main features as measured by 1) diversity of native plant

or animal species, i.e., are the expected (modal) species present? 2) plant community structure and integrity; 3) the extent of significant human interference (disturbance) to the community. Disturbance includes logging, pasturing, development, fire, herbicides, water level change, ditching, etc., and it may be evidenced by exotic weedy invaders, loss of intolerant species, and increase of aggressive native plants. 4) The extent to which a community corresponds with our concept of the identified natural community as it existed before settlement.

Quality analysis of the different natural area types found in Wisconsin requires that different criteria be applied to each type. In all forests, for example, old-growth timber is a very important factor, while in certain forest types such characteristics as a rich spring flora, an overabundance of armed shrubs, and tree size class diversity are important in evaluating quality. It is beyond the scope of this paper to examine the characteristics of the different community types as well as what constitutes a significant disturbance to a particular type, and it is expected that anyone ranking natural areas is well familiarized with the region's ecology.

Point Allocation	Points
Highest Quality - area approaches the ideal community type; no disturbance or disturbance not visible.	10
High Quality - evidence of very minor disturbance.	8
High Quality - at least one type of more obvious disturbance.	6
Moderate Quality - one or more types of disturbance to community is obvious and community integrity threatened. (Area is of local significance and may be of state significance in the future).	4
Low Quality - disturbance with resultant loss of the biotic community structure. May still have value as species habitats. (May now or in future be of local significance, but without the presence of nonbiotic features, the area should be dropped from consideration for state significance.)	2

B. Commonness-Commonness is a measure of the importance of a natural area type derived by evaluating the acreage of the type in presettlement vegetation, the method of historical conversion of the type and its resultant degree of destruction, restricted nature of occurrence, the presence of rare or endangered species, and the amount of the type in the present landscape of the region. Commonness indicates the comparative evaluation of natural areas rather than a comparison between natural areas and the remaining landscape. Using the latter definition, one would be required to rank all natural areas as very uncommon. Natural area types like white oak-black oak forest in southern Wisconsin and a northern mesic forest are ordinarily viewed as being common, whereas a mesic prairie and a coastal beach community are very uncommon.

Point Allocation	Points
Very Uncommon - low acreage in presettlement vegetation and present vegetation, nearly complete conversion of type, restricted occurrence, the presence of two or more rare or endangered species, or the only known location of a nonbotanical feature.	6
Uncommon - moderate amount of type in presettlement vegetation and/or partial conversion of type, moderate amount of acreage of type in present landscape of region, no known rare or endangered species.	4
Common - frequent to abundant in the present landscape, the type has increased since the advent of white settlement, or an adequate representation of the type within the scientific area system.	2

C. Community Diversity - The number of plant community types or other natural features within a tract is defined as community diversity. It is desirable to include within a natural area more than one biotic community type or natural feature to protect a continuum of types expressed across different soil, topographic, bedrock, slope, and water regimes. This allows protection of a greater range of habitat types and their biotic members, some of which may not necessarily be confined to a single community type. It also greatly increased the scientific and educational use value over that of a single isolated community or feature.

Point Allocation	Points
Great Diversity - four or more community types or features	5
Moderate Diversity - two or three types or features	3
No Diversity - single community type or feature	1

II. Physical Characteristics and Use Value
Size and Buffer are scored together.

A. Size - The minimum recommended size for plant community types, assuming adequate buffer protection, varies according to the nature of the type. A minimum size for woodlands is near 40 acres, while a remnant prairie 5 acres in size is sufficiently large to maintain its community integrity. For many natural area types, especially those which have been severely diminished in total area and those which have extreme geographical limitations, it is now necessary to totally preserve the remaining examples, regardless of size.

B. Buffer Zone - A buffer zone is deemed adequate if it will afford protection to a natural area from the direct and indirect activities of man and from the elements. The adequacy of an need for a buffer zone are determined on an individual area basis considering the following variables: the vegetation type in the buffer zone

and the size of the natural area; the nature of the natural area's boundary (road, river, fence, or not defined); and the compatibility of adjacent land use, land owndership pattern, topography, and expected degree of encroachment.

Point Allocation	Points
Greatly exceeds minimum size, excellent buffer, no threat of encroachment	8
Adequate size and buffer	6
Adequate size, inadequate buffer	4
Inadequate size, adequate buffer	2
Both inadequate	0

C. Use Value - Use value is an indicator of the value of an area as measured by the amount of current and potential educational and other use the tract may receive. Use is intended to include formalized class and instructional activities, research, and informal nature use. The latter would include tours by various conservation-oriented groups and individuals. For use evaluation, consider proximity to a metropolitan area and major colleges and universities, adaptability to such use, and the ability of the area to absorb use without deteriorating.

Structured educational and individual use of natural areas is extremely important as a learning experience. However, educational experience is secondary to preservation for the future, hence its low point valuation here.

Point Allocation	Points
Outstanding value - annually used by several schools or groups for both casual and structured activities; near metropolitan areas; extensive field station use or potential for extensive use	4
Intermediate to high value	2,3
Moderate value	1

III. Degree of Threat

Degree of threat is, unfortunately, a very important consideration in evaluating natural area priorities. Were there sufficient funds available to protect all of the choice natural areas, and better public understanding of the need, threat would be of little consequence in a priority rating. Because only limited funds are at hand, those areas that are threatened must be acted upon first in a crisis-by-crisis approach.

Threat may be defined as a rating of an area's security in respect to the maintenance of the structure and integrity of its plant communities and other natural features. In this evaluation, threat for the foreseable future is considered.

Points to consider are:

1. Region of the state, land use patterns in the vicinity, local and state zoning or their lack.

2. Potential of the tract for development, construction, drainage or impoundment, grazing, lumbering, windbreak planting, reforestation, plant introduction, etc.
3. Vulnerability to such projects as sewer, highway, pipeline, mining, or other noncompatible use.
4. Owner attitude toward preservation.
5. Possibility of increasing taxes, especially on lakeshore property.

Point Allocation	Points
Threat is imminent; main features currently being developed or destroyed	10
Threat is imminent to portion of main features	8
Threat is moderate; development probable in future	6
Disturbance encroaching upon area	4
Little threat - destruction unlikely	2

IV. Availability - Availability is an assessment of the probability that an area will come under protective ownership, and it is evaluated by analyzing the following factors:

A. Cost of purchasing or protecting an area (lease, easement, etc.) with or without funding aid. Consider complexity of ownership.
B. Will the owner sell? To the state? Consider the main features of a tract as an entity and not small parcels of the whole.
C. An area may be considered for donation by its owners.

Point Allocation	Points
Available - offered as donation or owned by cooperating public agency	5
Available or at near appraisal cost, within an approved land acquisition boundary, or possible candidate for donation	4
Probably available at high cost	3
Availability in doubt - perhaps in time	2
Not available or available by condemnation	1

One caution is appropriate here. This system is not designed to finalize an area's priority ranking, but instead to indicate its comparative ranking when analyzed along with other natural areas. Ideally this ranking scheme will provide an aid to the evaluation and selection of top-priority natural areas. And, following the example of all viable systems, if it is expected to become increasingly useful, its evolution will see periodic revision and reevaluation.

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