

A GUIDE TO THE NATURAL COMMUNITIES OF THE DELAWARE ESTUARY



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A GUIDE TO THE NATURAL COMMUNITIES OF THE DELAWARE ESTUARY: VERSION I

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PREFACE

The *Guide to the Natural Communities of the Delaware Estuary* and its companion, *Key to the Delaware Estuary Ecological Systems and Natural Communities*, are tools for conservation planners and practitioners. The Guide was created to help protect, preserve, and restore many of the species and habitats that comprise the Delaware Estuary Watershed.

The *Guide* describes 185 natural community types encompassing 35 broader-scale ecological systems known to occur in the region. Community types were identified using the National Vegetation Classification System (NVC), approved by the Federal Geographic Data Committee as the U.S. vegetation standard. Each of the three Estuary state's vegetation classifications was crosswalked to the NVC, providing a common language across multiple jurisdictions.

The Guide describes an impressive variety of natural communities within a wide-ranging landscape. The Delaware Estuary Watershed crosses four eco-regional boundaries and contains diverse assemblages of ecological systems. Of the 35 ecological systems, it was found that roughly 26% are upland systems, 49% are wetland systems, 6% are submerged aquatic systems, and 20% are combinations of uplands and wetlands. Likewise, the *Guide* describes a wide array of natural communities. Of the 185 natural communities (plant associations of the NVC), 36% are forest types, 11% are woodland types, 11% are shrubland types, 37% are herbaceous vegetation types, and 3% are sparse vegetation types.

The conservation status ranks of the Estuary's natural communities plays a critical role in developing strategies to protect regional biological diversity. These ranks provide insight to the rarity of some communities within the watershed. When looking at the conservation ranks, it was found that 23% of the associations are considered at-risk globally and 32% are considered at-risk at the state level.

The information contained in the *Guide* can help growth management decision-making, steering development away from ecologically sensitive resources. It can aid land acquisition prioritization, answering questions of rarity and representation in protected areas. Application of the information on the ground can lead to more informed natural resource management on conservation lands and more accurate selection of targets in ecological restoration. Because reference site locations are given, the *Guide* can provide restoration practitioners with an actual site to use as a system of reference. Further, the conservation status rank of communities targeted for restoration can identify the role of a project in regional habitat strategies.

This inventory of the Delaware Estuary's natural communities provides a framework for directing conservation action. Whether through planning or practice, knowing the elements of diversity can help us better protect the most at-risk components of our environment while ensuring that what is common today does not become endangered tomorrow.

ACKNOWLEDGEMENTS

The Partnership for the Delaware Estuary commissioned this work to inform conservation planning and restoration practice in the Estuary region. The Partnership and NatureServe thanks the many people who contributed to this vegetation classification. Countless hours compiling data, photos, reference site information, and edits as well as identifying data gaps to complete this document were contributed by Lesley Sneddon, NatureServe Senior Regional Ecologist; Kathleen Strakosch Walz, New Jersey Natural Heritage Vegetation Ecologist; Stephanie Perles and Greg Podnieszinski; Pennsylvania Natural Heritage Ecologists; William McAvoy, Delaware Natural Heritage Botanist; and Robert Coxe, Delaware Natural Heritage Vegetation Ecologist. Kristin Snow, along with Mary Russo, Donna Reynolds and Carol Fogelsong, data managers at NatureServe, developed a common name function used in this report to translate the scientific plant and animal names into common names. Kristin Snow also implemented the format for this report and Mary Russo edited and entered the data related to this project into the NatureServe conservation database.

Additional contributors include: Dan Salas, (Delaware Riverkeeper Network) and Greg Breese (US Fish & Wildlife Service). Many thanks go to the Society for Ecological Restoration International for providing guidance through the Primer on Ecological Restoration, and specifically, the Chair, Keith Bowers (Biohabitats), Vice-Chair, George Gann (Institute for Regional Conservation) and members, Jim Thorne (Natural Lands Trust), Leslie Sauer, and Andre Clewell for lending this project their collective ears. Sue Gawler (NatureServe Ecologist), Tony Davis, Karl Anderson, Andrew Windisch, Linda Kelly, Nancy Lee Adamson, and David Snyder must also be recognized for their significant contributions.

Established in 1996, the Partnership for the Delaware Estuary is a non-profit organization based in Wilmington, Delaware. The Partnership manages the Delaware Estuary Program (DELEP), one of 28 estuaries recognized by the U.S. Congress for its national significance under the Clean Water Act. DELEP is the only tri-state, multi-agency National Estuary Program in the country. In collaboration with a broad spectrum of governmental agencies, non-profit corporations, businesses, and citizens, the Partnership works to implement the Delaware Estuary's Comprehensive Conservation Management Plan to restore and protect the natural and economic resources of the Delaware Estuary and its tributaries. Lead agency partners include: Delaware Department of Natural Resources and Environmental Control; Delaware River Basin Commission; New Jersey Department of Environmental Protection; Pennsylvania Department of Environmental Protection; City of Philadelphia; National Park Service; National Oceanic and Atmospheric Administration; U.S. Environmental Protection Agency, Regions II and III; and, the U.S. Fish and Wildlife Service.

NatureServe is a non-profit conservation organization that provides scientific information and tools needed to help guide effective conservation action. NatureServe and its network of Natural Heritage programs are the leading source for information about rare and endangered species and threatened ecosystems. NatureServe represents an international network of biological inventories—known as natural heritage programs or Conservation Data Centers—operating in all 50 U.S. states, Canada, Latin America and the Caribbean.

INTRODUCTION

The Delaware Estuary Watershed is comprised of a rich mosaic of natural communities across a diverse landscape. Natural communities are unique assemblages of plants and animals that reoccur within specific environmental settings. These unique assemblages can reflect ecological conditions at a scale broader than the species population, yet more refined than the landscape. Natural communities can address both species and function. In this sense, natural communities can be barometers of ecological health. Communities such as mixed oak forests and serpentine barrens, salt marsh and salt pannes, support a wide array of life and perform important ecological functions. Upland forests help recharge aquifers while lowland wetlands provide natural flood control. When taken as an interconnected whole, the health of our natural communities helps determine the overall well-being of the watershed. When natural communities are threatened, the many species that depend upon these communities for habitat are similarly fated and the ecological services that would be rendered are lost.

The *Guide to the Natural Communities of the Delaware Estuary (Guide)* describes 35 ecological systems and 185 natural community types known to occur in the region. The Delaware Estuary Watershed encompasses nearly 7,000 square miles in Delaware, New Jersey, and Pennsylvania. It consists of the entire drainage basin of the Schuylkill River, Lower Delaware River, and Delaware Bay. It includes portions of twenty-two counties, over five hundred townships, and contains three major metropolitan areas: Philadelphia, Pennsylvania; Camden, New Jersey; and Wilmington, Delaware (Figure 1).

The Delaware Estuary's unique assemblage of ecological systems and natural communities indicates a rich diversity across a varied landscape. The significant biological diversity of the region is owed, in part, to its physical location, crossing four eco-regions: the Central Appalachian Forest; the Lower New England/Northern Piedmont; the North Atlantic Coast; and, the Chesapeake Bay Lowlands.

Eco-regions represent geographically distinct assemblages of vegetation types that have similar ecological dynamics, comparable environmental conditions, and share many of the same species (Comer et al. 2003).

Nearly 88% of the Delaware Estuary Watershed is terrestrial, while a little less than 12% is open water. This document focuses on the terrestrial portion of the region, characterizing upland communities, wetland communities, and submerged aquatic vegetation. The *Guide* does not include descriptions of subterranean or deepwater systems.

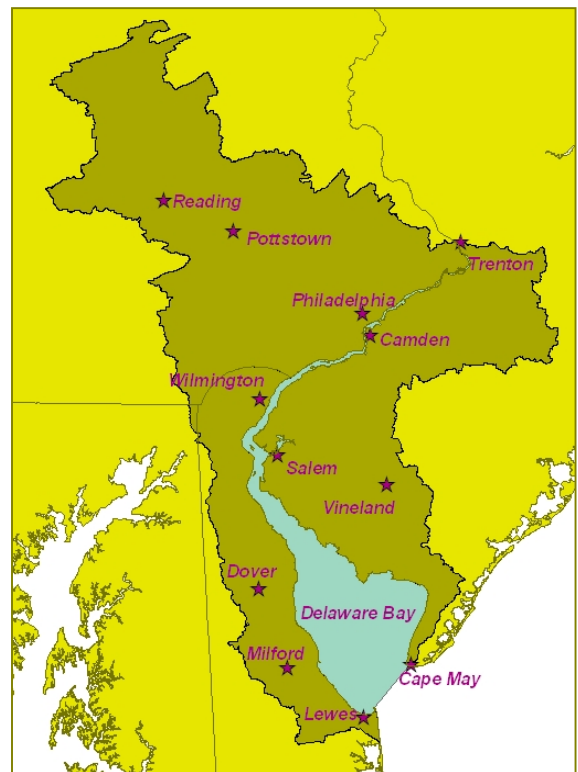


Figure 1. Delaware Estuary Watershed

CLASSIFICATION APPROACH

Two complementary classification systems are used to identify and describe the terrestrial portion of the Delaware Estuary. Ecological systems are identified using the International Terrestrial Ecological Systems Classification and natural communities are identified using the National Vegetation Classification (NVC), a subset of the International Vegetation Classification.

International Terrestrial Ecological Systems Classification

An ecological system represents a recurring group of natural community types that are found in similar physical environments. Ecological systems are defined, in part, by the influences of dynamic processes, such as fire or flooding, environmental features, substrates, and the biological communities associated with them. Multiple environmental factors are evaluated and combined in different ways to explain the spatial co-occurrence of plant communities. These include: bioclimate; biogeographic history; physiography; landform; physical and chemical substrates; dynamic processes; landscape juxtaposition; and, vegetation structure and composition. These factors help explain why particular natural communities tend to be found together in a given ecological system (Comer 2003).

NatureServe and its Natural Heritage program members developed the International Terrestrial Ecological System Classification to provide a reasonable scale for conservation assessment, mapping, land management, monitoring, and species habitat modeling. Ecological systems are practical mid-scale units that can be mapped from remote imagery and are readily identifiable in the field. They use both spatial and temporal scales to define them. The spatial scale of an ecological system ranges from 10s to 1000s of hectares and temporal scales range from 50 to 1000 years. The temporal scale allows typical successional dynamics to be integrated into the concept of each ecological system. Within any given ecological system, associated natural communities may be a representation of various successional stages of development (Comer 2003).

National Vegetation Classification System

Natural communities in this document refer to the plant association level of the National Vegetation Classification System (NVC). The NVC provides a complete, standardized listing and description of all the vegetation types that represent the variation in biological diversity at the community level. It is a comprehensive system that classifies all terrestrial vegetation in the country under a common framework (Grossman et al. 1998). It identifies vegetation units based on both qualitative and quantitative data at a scale that is practical for conservation.

The NVC was adopted by the Federal Geographic Data Committee as the reporting standard for all federal agencies involved in the management of vegetation. This standardization allows for the comparison of vegetation types across political, jurisdictional, and geographic boundaries. This is incredibly important to conservation professionals working in multiple states. It provides a common language for ecological communities, thereby making it possible to assess, monitor, compare, and evaluate across jurisdictions.

Natural communities can be thought of as unique assemblages of species that co-occur in defined areas at certain times and that have the potential to interact with one another (Maybury 1999). A natural community has also been defined as "a recurring plant association with a characteristic range in species composition, specific diagnostic species, and a defined range in habit conditions and physiognomy or structure"

(Vegetation Classification Panel, Ecological Society of America, 2002). All types of vegetation—natural and cultural—may be classified by the NVC, but efforts have been focused on mid-to late-seral, natural/near natural vegetation. Less-natural and earlier seral vegetation are classified on an as-needed basis for use in various applications (Grossman et al 1998).

The NVC uses a systematic approach to classifying a continuum. It uses a combined physiognomic-floristic hierarchy to organize vegetation types. There are seven levels in the NVC. Five levels are based on physiognomic classifiers including vegetation structure (forest, woodland, shrubland, dwarf shrubland, herbaceous vegetation, and sparse vegetation); leaf phenology (evergreen, deciduous, mixed); leaf characteristics (needle-leaf, broad-leaf); natural/semi-natural or cultural vegetation; and, environmental setting. The two lower levels of the classification, the alliance and the association, are based on floristics. Both levels are based on dominant or diagnostic species. The alliance is a group of associations and of wider geographic extent than the association. The basic unit of the classification is the association, or natural community.

DATA COLLECTION & MAINTENANCE

The *Guide to the Communities of the Delaware Estuary* represents the compilation of existing data from Natural Heritage Programs in New Jersey, Pennsylvania, and Delaware. Information is entered into NatureServe's database where it is updated regularly and queried for periodic reports.

NatureServe

NatureServe is the parent organization of the Natural Heritage Programs in all 50 states, plus the Conservation Data Centres in Canada, Latin America, and the Caribbean. NatureServe maintains data collected through the heritage network in their biological conservation database and serves as a clearinghouse for scientific conservation information. NatureServe maintains a searchable database on their website at www.natureserve.org.

Data Gaps

The *Guide to the Natural Communities of the Delaware Estuary* is the product of an iterative process that will continue to be refined and updated. This document represents the initial iteration of the Estuary's vegetation classification. Additional ecological inventory is needed to identify vegetation communities that may occur in the Estuary but have not been classified or described in this report. Further, some community types that have been classified are missing information and require further inventory to fill in the gaps. Some of the data gaps on the existing communities in the Estuary that may be pertinent to restoration efforts include information on successional trajectory, management concerns, noteworthy species, and reference site locations. In this report, 88% of the reference site fields are complete, 63% of the dynamics/successional trajectory fields are complete, and 57% of the management concerns fields are complete. Additional iterations will be published periodically as mapping of the Estuary's ecological systems proceeds and further ecological inventories are carried out.

FORMAT OF THIS REPORT

The *Guide* contains descriptions of the ecological systems and natural communities that are confirmed to occur, or in some cases, potentially occur in the Delaware Estuary from existing Natural Heritage data. The natural communities are arranged in this document by ecological systems. Community descriptions have photographs (where available), vegetation and environmental descriptions, reference site locations, links to raw plot data, and conservation ranks. The data for this report was extracted from NatureServe's database,

Biotic 4, and are current as of April 2006. Nomenclature for plants follows Kartesz 1999. The Appendices include: a glossary of terms (Appendix A); a table of similar NVC associations for the community types identified in the *Guide* (Appendix B); a crosswalk table of the NVC associations to state community classifications (Appendix C); and, a description of the methodology of Natural Heritage Programs (Appendix D).

Ecological Systems

The International Terrestrial Ecological Systems Classification includes components that communicate aspects of the system's characteristics. Below is an explanation of the information contained in the ecological system descriptions in the *Guide*.

Name of Ecological System: The nomenclature for the classification includes three primary components that communicate aspects of the system's characteristics, including its regional distribution (predominant Ecological Division), vegetation physiognomy and composition, and/or environmental setting. The final name used is a combination of these ecological characteristics, with consideration given to local usage and practicality (e.g. length of name).

Summary: This is a brief description of the range, structure, composition, environmental setting, and dynamics associated with the ecological system.

High-Ranked Species: This field reports at-risk species that are closely associated with an ecological system. High-ranked species are considered animals, vascular plants, non vascular plants, and US-NVC plant associations ranked as critically imperiled (G1), imperiled (G2), or vulnerable (G3). Relationships between species, communities, and ecological systems were determined by expert review conducted by NatureServe and Natural Heritage zoologists, botanists, and ecologists as well as available data on element occurrences (Comer et al. 2005). It should be noted that the database was queried for the global range of the ecological systems, so not all species listed will be known from the Delaware Estuary Watershed. Common names are included for the plant and animal species, however some of the non-vascular species (liverworts, mosses, lichen) do not have common names assigned to them.

Range: This field is a verbal description of the current total extent of the ecological system, and also lists the subnations (states) and other geographic areas where the system is known to occur.

Classifier: Spatial Scale and Pattern

One of four spatial categories defined by Anderson et al. 1999 and Poiani et al. 2000 to describe the spatial pattern of the ecological system within the landscape:

Matrix: Systems that form extensive and contiguous cover and have wide ecological tolerances. Disturbance patches typically occupy a relatively small percentage (e.g. <5%) of the total occurrence. In disturbed conditions, typical occurrences range in size from 2,000 to 10,000 ha.

Large-patch: Systems that form large areas of interrupted cover and have narrower ranges of ecological tolerances than matrix types. Individual disturbance events tend to occupy patches that can encompass a large portion of the overall occurrence (e.g. >20%). Given common disturbance dynamics, these types may tend to shift somewhat in location within large landscapes over time spans of several hundred years. In undisturbed conditions, typical occurrences range from 50 to 2,000 ha.

Small patch: Systems that form small, discrete areas of vegetation cover typically limited in distribution by localized environmental features. In undisturbed conditions, typical occurrences range from 1 to 50 ha.

Linear: Systems that occur as linear strips. They are often ecotonal between terrestrial and aquatic ecosystems. In undisturbed conditions, typical occurrences range in linear distance from 0.5 to 100 km.

Figure 2. Categories used to describe the spatial pattern of an ecological system within the landscape.

Delaware Estuary Associations: The communities listed have been identified as occurring or potentially occurring in the Delaware Estuary within a specified ecological system. These communities are a group of plant association types that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients.

Classifiers: Classifiers help with the identification of an ecological system. They impart classification information including: primary division, an assigned sub-continental ecological landscape area reflecting both climate and bio-geographic history; land cover class, a general vegetation type that corresponds with the National Land Cover Data; spatial scale and pattern (see Figure 2); required classifiers, the environmental factors always contained within an ecological system; diagnostic classifiers; and, non-diagnostic classifiers.

Similar Ecological Systems in the Delaware Estuary: These are often adjacent or related ecological systems also located within the watershed.

Natural Communities

Community types are classified under the NVC using Natural Heritage methodology (see Appendix D). The terms Community and NVC Association are used interchangeably and refer to the plant association scale of the NVC hierarchy. Below is an explanation of the information contained in the natural community descriptions.

Name of Community Type: The first name listed in each description is the common or colloquial name of the association used by NatureServe. The scientific name is listed next. Scientific names are based on the dominant and diagnostic species. Species occurring in the same stratum are separated by a hyphen (-). Those occurring in different strata are separated by a slash (/). Species occurring in the uppermost strata are listed first, followed successively by those in lower strata. Within the same stratum, the order of species names generally reflects decreasing levels of dominance, constancy, or indicator value. In types where there is a dominant herbaceous layer with a scattered woody layer, names can be based on species found in either the herbaceous layer or the woody layer, whichever is more diagnostic of the type. If both layers are used, then the uppermost layer is always listed first, regardless of which may be more diagnostic. Species found less consistently are placed in parentheses (). In cases where a particular genus is dominant or diagnostic, but individual species of the genus may vary among occurrences, only the specific epithets are placed in parentheses.

Range: This is a description of the total range (present and historic) of the community, using names of nations, subnations or states, ecoregions, etc.

Environmental Description: This is a summary field that describes environmental site factors including aspect, elevation, landform, slope, topographic position, soil type, soil moisture, and hydrologic modifiers. Landscape context and geology may also be included. In general, the flow of information is from the broad to the specific.

Vegetation Description: This is a summary of information available on the leaf type and phenology, species composition and structure, and variability of the vegetation within the community.

Noteworthy Associated Plant and/or Animal Species: These are plants and animals that may occur within the community or use the community as habitat. Typically these are rare, endangered, or threatened species at the state or national level.

Characteristic Species: This field lists plant species that are almost always found in a particular community and are used in establishing the boundary of that community. It may include the more analytical concepts of diagnostic species, indicator species, and differential species.

Dynamics/Successional Trajectory: This summarizes important natural disturbance regimes, successional status, and temporal dynamics of a community.

Management Concerns: This is a summary of existing information on the challenges related to maintaining the integrity of an ecological community. This includes threats such as invasive species, browsing, pests, diseases, etc.

Reference Sites: This field identifies locations of high quality examples of communities located on public lands. This field is especially useful to restoration practitioners interested in locating systems of reference, validating restoration targets, establishing performance standards based on the reference state, and monitoring based on performance standards (Society for Ecological Restoration International, 2004).

Global and State Conservation Rank and Reasons: This field refers to the relative rarity or imperilment of the community type and summarizes the reasons why the rank was assigned. G ranks refer to the conservation status of the community type from a range-wide global perspective. S ranks refer to the status of the community type throughout its range in a state. State and global ranks are used to prioritize conservation efforts so that the rarest natural communities receive more immediate protection. Ranks are determined by the number of known occurrences of a particular natural community, field investigations, and consensus in the scientific community. S ranks are demarcated along the same scale as G ranks (Figure 3).

VegBank Link for Plot Data: This is a web link to the plot data for the specific community where the data exists. VegBank is the vegetation plot database of the Ecological Society of America's Panel on Vegetation Classification. VegBank consists of three linked databases that contain (1) the actual plot records, (2) vegetation types recognized in the U.S. National Vegetation Classification and other vegetation types submitted by users, and (3) all plant taxa recognized by ITIS/USDA as well as all other plant taxa recorded in plot records. Vegetation records, community types, and plant taxa may be submitted to VegBank and may be subsequently searched, viewed, annotated, revised, interpreted, downloaded, and cited. The website for VegBank is: <http://vegbank.org> (ESA 2005).

Global/State Conservation Status Ranks	
G1/S1	= Critically imperiled globally/statewide, generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range
G2/S2	= Imperiled globally/statewide, generally 6-20 occurrences
G3/S3	= Rare or uncommon, generally 21-100 occurrences
G4/S4	= Apparently secure
G5/S5	= Demonstrably widespread, abundant and secure
GH/SH	= Historical, presumed eliminated throughout its range
GX/SX	= Extirpated
GNA	= Rank not applicable
GNR/SNR	= Not ranked

Figure 3. Global ranks indicate the relative rarity or imperilment of an ecological community or species at a global scale.

References: This field provides a list of references that have contributed directly to the concept of the described community. Full-text citations are listed at the end of the report.

Most Abundant Species: This is a summary table naming the most abundant species of each strata for the community. These tables should be updated in future iterations of this report as more plot data is collected on vegetation communities.

Appendices

The Appendices include: a glossary; a table of the NVC associations and their similar associations in the Delaware Estuary Watershed; a crosswalk table of NVC associations to related or equivalent communities identified in the Delaware, New Jersey, and Pennsylvania state vegetation classifications; and, a description of the Natural Heritage methodology with a standardized plot-sampling field form.

Dichotomous Key

A Key to the Delaware Estuary Ecological Systems and Natural Communities was produced as a companion to the Guide. This document is published separately and is downloadable from www.delawareestuary.org (PDE Report No. 06-03).