

# **Classification of the Natural Communities of Massachusetts**

**Patricia C. Swain  
and  
Jennifer B. Kearsley**

**Natural Heritage & Endangered Species Program  
Massachusetts Division of Fisheries and Wildlife  
Westborough, MA**

**D R A F T**

**2001 – (Version 1.3)**

## ACKNOWLEDGEMENTS

This draft classification is truly the product of the whole Natural Heritage & Endangered Species Program (NHESP) and the cadre of dedicated field ecologists and naturalists in Massachusetts. Many years of many people's fieldwork and observations, with data compiled in species reports and natural community descriptions, contribute to the core information in the draft classification. Bruce Sorrie's extensive field notes, detailed reports from Glenn Motzkin and Tom Rawinski, and Pam Weatherbee's *Flora of Berkshire County* as well as her field forms were particularly helpful in establishing the details of community composition in Massachusetts. Reports submitted to NHESP's Small Research Contracts Program and Ecological Restoration Program also contributed significant information to the classification. Descriptions of communities from classifications from surrounding states and from The Nature Conservancy have also contributed greatly to the information in the draft classification. Brian Reid, Karen Searcy and Sally Shaw responded to our pleas to contribute written descriptions on communities with which they were particularly familiar. We added the animal and synonym information to these, and did some editing for consistency.

Personal communications and community and rare species field forms from the following people provided additional habitat information and site descriptions: Henry Barbour, Michael Batchner, Jesse Bellemare, Robert Bertin, Beverly Brown, David Burg, Fricka Caldwell, Caren Caljouw, Nancy Childs, Frances Clark, Tom Cramer, Peter Dunwiddie, Ted Elliman, Tamara Enz, J. Garcia, Jennifer Garrett, Meryl Goldin, Matthew Hickler, D.W. Holt, David Hunt, Jerry Jenkins, B. Johnson, Jennifer Kearsley, Heather Lanza, Richard LeBlond, Bruce Lindwall, Robert B. Livingston, Roberta Lombardi, J.P. Lortie, David Lovejoy, Frank Lowenstein, Julie Lundgren, Mark Mello, Glenn Motzkin, Carol L. Nilson, Philip Nothnagle, Allison Park, Charlie Quinlan, Lloyd Raleigh, Tom Rawinski, Brian Reid, Christine Reid, Julie Richburg, Steven Roble, Karen Searcy, Sally Shaw, Scott Shumway, Tim Simmons, Darren Singer, Lesley Sneddon, Paul Somers, Bruce Sorrie, Daniel Sperduto, Valerie Stone, Patricia Swain, Elizabeth Thompson, Tom Tynning, Pamela B. Weatherbee, Henry Woolsey, Bob Zaremba, and Tad Zebryk.

Pat Huckery, Matt Burne, Tim Simmons, and Brad Blodget contributed rare animal information, and Matt Burne and Pat Huckery identified communities that can function as vernal pool habitat. Brad Blodget, Tom French, and Tim Simmons supplied information on more common animal species, especially those using terrestrial communities – but the interpretations and restatements of their information should not be held against them.

The data organization and availability reflect the effective management by several data managers and hoards of interns, work-study students, and volunteers over more than 20 years. Preliminary conceptual design and organization was accomplished through meetings of the authors, Julie Lundgren, Henry Woolsey, and Vicki Frey. Vicki Frey and Jean Collins developed the Access database. Jean wrote and enabled the clever 'macro' that italicized the scientific names. David Szczebak and Laura Chaskelson produced the sub-core region distribution maps.

Several people commented on early versions of different sections of this draft classification, but like the zoologists, they shouldn't be held accountable for the use we made, or didn't make, of their input. We are very grateful for the comments from Jesse Bellemare, Russ Hopping, Anne-Marie Kittredge, Glenn Motzkin, Tom Rawinski, Tim Simmons, and Pam Weatherbee. Some of the biggest issues, including names and levels of splitting, remain unresolved, and we hope will be addressed again in comments on this draft. Henry Woolsey, Marea Gabriel, and Darren Singer provided encouragement and editorial comments.



**Natural Heritage &  
Endangered Species  
Program**

Massachusetts Division of Fisheries & Wildlife  
Route 135  
Westborough, MA 01581  
(508) 792-7270 ext. 200  
[www.nhesp.org](http://www.nhesp.org)

Note on reprinting the draft Classification of Natural Communities of Massachusetts  
2001 version 1.3

The draft of the *Natural Communities of Massachusetts* being printed and reposted on the NHESP web site in June 2004, is substantially the same as the previous print and web versions, dated 2000 and 2001 respectively. Typographic errors were corrected as they were identified. Three fields have been removed from each community write up: the Tracked and Inventory Needs and Inventory Comments fields. During NHESP's BioMap project (2000-2001) the tracking protocols were changed to depend on an interaction between the quality of individual occurrences and the overall state rank. Therefore, it is possible to have occurrences of any type of natural community in the database. A review of all the community descriptions and of the occurrence ranks is planned that will clarify how decisions are made and what is included in the conservation database. The BioMap project also resulted in a large increase in the number of records of natural communities in the NHESP database, and greatly changed the perceived inventory needs. In preparing this copy of reprinting, I felt that the old inventory information was now misleading, and could be easily removed.

The contents are mostly the same. Pitch Pine - Oak Forest is now Pitch Pine - Oak Forest / Woodland (which was always the intent). There are slight changes in the write-up on the Spruce - Fir Boreal Swamp, based on a fact sheet Nancy Putnam wrote in 2001. The basic description was not changed. Putnam recognized three associations, which were added. *Linnaea borealis* was added to the list of Associated Rare Plants, Examples with Public Access were added, and Threats and Management Needs were elaborated on. We have also removed any references to "Data Sensitive" species that occur in the community types. The Synonyms have not been updated, but it is worth noting that the USNVC (United States National Vegetation Classification) is now being developed by NatureServe, rather than TNC (The Nature Conservancy), with information available on the NatureServe web site ([www.natureserve.org](http://www.natureserve.org)).

The Appendices are different. The previous summary of Inventory Needs has been removed. Instead, two different lists of the community types are included with their state ranks: one alphabetical within the Terrestrial, Palustrine and Estuarine groups, and the other grouped by rank.

Pat Swain, June 22, 2004

## Introduction

The main purpose of this classification is to provide a useful framework for describing, inventorying, and tracking natural communities in Massachusetts. This natural community classification is designed to describe vegetation at a scale that is meaningful for conservation and land protection. A classification provides a convenient mechanism for reducing the complexity of natural vegetation to a relatively small number -- 105 in this case -- of somewhat homogeneous and relatively easily understood, but abstract and artificial, groups. Any classification requires somewhat arbitrary categories and lines between types and classifications differ on where the lines are drawn. Part of the reason for disseminating a draft is to encourage input into the categories and their delineations. Vegetation classifications are influenced by their intended use -- the use of this one is for conservation, and indeed focuses on the uncommon.

To protect the components of biodiversity, their patterns of distribution and their current patterns of conservation need to be evaluated and tracked. One aspect of this is to evaluate the conditions and distribution of natural communities across the state. Tracking natural communities requires having knowledge of what they are. A beginning of knowing natural communities is to name and describe what is known and give a common parlance for discussing the communities. Such a framework also allows identification of what isn't as well known, and encourages focus on gathering that information.

Our intent is to describe communities that can be identified in the field and to accurately (if arbitrarily) divide the vegetation of Massachusetts into identifiable and useful categories. Terrestrial, Palustrine, and Estuarine communities are included; Aquatic communities have **NOT** been addressed in this classification. In this classification of natural communities, attempts have been made to use community names that are recognizable and meaningful to a broad conservation audience including writers of town open space plans, land managers, environmental reviewers and consultants, and ecologists doing field studies.

In defining the composition and structure of the community types, we have begun identifying variations within those community-types; further information on the variations may lead to further splitting or lumping of the identified types in later versions of the classification. In particular, there is a complex of communities dominated by oak trees and another group (inter-related) dominated by red maple. Increased data may lead to splitting these groups differently than they are now divided. Comments on this public draft should lead to refinements and improved descriptions of the community types. Suggestions on other community types that could be split or consolidated would be considered. Descriptions of types of cultural communities (plant communities planted and maintained by humans for direct use by humans or domesticated animals such as forest plantations, orchards, and pastures) could be expanded, but most are not of conservation focus, so will probably continue to be lumped into a few groups.

Many communities occur with others in mosaics that share conditions and processes, such as water flowing through a wetland complex with no one community-type independent of the others or the unifying conditions. Communities are most effective as units of conservation when the controlling ecological processes can be maintained or restored. Putting communities into the functional systems of which they are a part will be another step in the classification. For now, some of those ideas are addressed in the part of each community description under the header Environmental Conditions. Such functional systems are not actually the same as the hierarchy of a key - that is a rock cliff face may be found in a key under non-forested, open communities, but is found on the ground surrounded by forest.

The communities described here are in exemplary condition, the type communities: not all real communities meet the criteria of the abstract, but still qualify as that community type. Many actual communities are disturbed by nature or humans, some are in climatic, topographic, or geological conditions different from the idealized, and others occupy some middle ground between described communities. Because communities are made up of plant species that have individual responses to environmental variables, the communities described grade into other community-types. In addition, the role of land use history is very important in the location and definitions of natural communities in Massachusetts. Three hundred years of intense use of the land in the state appears to have had a homogenizing effect that overrides some of the

influences of climate and landscape position (for example, see Foster et al. 1998, and other papers from the Harvard Forest). Some of this homogenization of communities is reflected in the difficulty of defining distinct community types and in the prevalence of mid-successional species in many of the community descriptions, and in the actual community occurrences.

The community-types that are described here are parts of the habitat for the animal species that use them. Birds may nest in one type of community, feed in another, and then leave entirely. Other animals also move between community types for different needs. Generalist species might have individuals occurring in a variety of different community types.

Despite the problems of classification, we do find recurrent groupings of plant species, and associated animals, that do share responses to environmental conditions. Species that have restricted ranges and particular environmental requirements are often used as indicators of the communities in which they occur. Other species are found in a range of conditions and occur in a variety of community-types, so are less useful as indicators, although they may be characteristically present in a given community type. These natural groupings of species, or natural communities, tend to vary simultaneously in response to soil moisture gradients, temperature gradients, and nutrient gradients, in a multidimensional, rather than linear, way. Thus, there are southern and northern versions of dry to wet gradients, acidic to less acidic, and nutrient poor to nutrient rich communities, and all the other interactions as well. While not all the possible variations result in distinctly different communities, there is a lot of variation in the real world.

### **Relationship to other classifications**

This classification focuses on the natural communities of Massachusetts, but they are closely related to the natural communities of the region and particularly the surrounding states. The Massachusetts community descriptions include lists of synonyms for the surrounding states, all of which have developed individual classifications for their natural communities. The Nature Conservancy (TNC) with the Association for Biodiversity Information (ABI), has been developing a classification for the region within the United States National Vegetation Classification (USNVC) system. We've included the USNVC/TNC synonyms for those who want more finely divided community-types – the TNC Associations. The accuracy of the cross-walk to the synonyms is variable in this draft. Synonymy with other state's classifications are, of course, confounded by geographic differences in species distributions in the states, as well as issues of different levels of definitions. Clarification of these is one goal for the more final version of the classification. We also include synonymy with the previously used names in Massachusetts, some of which are more broadly defined than in the current classification. Many of the cross-walks to the old Massachusetts classification (Rawinski 1984), especially for the northern forest types, lack precision. That is at least partially a result of the lack of clear boundaries between types.

### **Organization of the classification**

This draft classification divides natural community **types** into three major sections: Terrestrial, Palustrine and Estuarine. The Tables of Contents of each section double as keys, but are not dichotomous. Within the sections, the structural dominance – growth form or physiognomy such as forest, shrubland, herbaceous, and open or sparsely vegetated – is used as a division of types. The forested categories in the terrestrial and palustrine sections are subdivided into evergreen, deciduous and mixed.

We used a significant presence of water to define what was palustrine, and the presence of water with some salinity or tide for inclusion in the estuarine category. All tidally influenced communities are in the estuarine category whether the tidal water is saline or fresh. Salt spray communities not influenced by tides are treated as terrestrial.

**Terrestrial:** The vegetation of terrestrial communities is not significantly influenced by standing or moving water. The forested community types have more than about 25% tree canopy (50% in the palustrine section), which includes woodlands of USNVC/TNC and other classifications. If mature trees are absent, and if shrubs are present forming more than about a 25% shrub layer cover overall, the community is considered to be a shrubland. Herbaceous communities are relatively open communities with neither forest nor shrub

canopies and have more than about a 25% vegetated cover. Open or sparsely vegetated communities are divided by their substrate type, rock or sand for convenience.

**Palustrine:** The palustrine section of the Massachusetts natural community classification includes all freshwater, non-tidal wetlands dominated by trees, shrubs, or persistent emergents, including mosses and lichens. This definition is slightly different from Cowardin (1979) who also included small, shallow aquatic beds with submersed and floating-leaved aquatics, and tidal wetlands where salinity due to ocean-derived salts was less than 0.5%. In this draft Massachusetts' classification, submersed and floating-leaved aquatics will be included in an as yet unwritten aquatic section, and all tidal wetlands are included in the estuarine section. The palustrine section does include riverside communities that receive annual or semi-annual overbank flooding, e.g. floodplain forests. High-terrace floodplain forests (although technically terrestrial communities) are included in the palustrine section in order to group them with other floodplain forest communities.

**Estuarine:** Estuarine communities are subject to varying salinity, tidal actions, and wind. Estuaries include tidal habitats and adjacent tidal wetlands in which ocean water is at least occasionally diluted by freshwater from the land. Estuarine areas extend landward and up streams to where oceanic salts (formally defined as above 0.5 ppt (parts per thousand) salinity in an annual average low flow period) or tides (including freshwater tidal areas) have an influence on the vegetation. Hyper salinity (compared to the ocean) may occur temporarily in some areas from evaporation (such as in salt ponds). The estuarine area extends off-shore to areas with freshwater influence on the seawater, called subtidal communities in this classification.

### **Species Nomenclature**

The scientific and common names of organisms are intended to be consistent with the following:

Vascular plants:

Sorrie, Bruce A. and Paul Somers. 1999. The vascular plants of Massachusetts: a County Checklist, Massachusetts Division of Fisheries and Wildlife, Natural Heritage & Endangered Species Program. Westborough, MA.

Mammals:

Cardoza, James E. and Gwilym S. Jones. 1999. MassWildlife's State Mammal List. 4<sup>th</sup> Edition. Available only from <http://www.state.ma.us/dfwele/dfw/dfwmam.htm>

Birds:

Blodget, B.G. 1998. Checklist of the birds of Massachusetts. Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

Reptiles and Amphibians:

Cardoza, James E. and Peter G. Mirick. 1999. List of the reptiles and amphibians of Massachusetts, 3<sup>rd</sup> edition. Massachusetts Division of Fisheries and Wildlife, Fauna of Massachusetts Series No. 3. Westborough, MA.

### **Request for information**

This classification identifies example sites where the community-types can be found, on lands with public access in Massachusetts. Our database does include sites on less accessible land. We are in the process of building our database to include good occurrences of all community-types, with the most common being tracked only by exemplary occurrences (definitions of exemplary are being developed for each community type), and the rarest being tracked by all known occurrences, with a sliding scale of rarity and quality between. We would like to ultimately know what types are on protected - conservation - land, and what types need further protection. Then, with the management and restoration knowledge also being developed and collected, we will be in a better position to continue to protect the biodiversity of Massachusetts. We are asking for examples of additional locations, or better locations of community types; this will not necessarily result in those locations becoming published information. See Appendix A for a list of estimated inventory needs by community type.

Management needs of communities are seldom well known. In the descriptions we have included some of the management issues identified by field biologists who have been to occurrences of the communities

described. We hope to encourage further discussions of the management needs of the described communities by raising the management issues for each type.

**Refinement of described community types**

This draft of the classification of the natural communities of Massachusetts was written in order to provide a basis for discussing and conserving diversity of the types of vegetation in the state. The primary aim is to describe natural communities of conservation interest in Massachusetts, while including all the vegetation of the state. The overall tendency in this classification is to lump rather than to split. However, communities that have been well-studied (e.g. floodplain forests, acidic peatlands, Atlantic white cedar swamps) are usually more finely divided. Mostly, though, the many vegetation associations occurring within broadly defined communities are not described separately. Instead, the variation in vegetation is included within the vegetation description field and referred to as Associations when known and considered subtypes. As more data are accumulated, more divisions and reorganization will undoubtedly occur.

This classification represents the best of our knowledge about Massachusetts' communities from the field data and literature that we have compiled to date. It is by no means complete or absolute. Instead, it should be regarded as a framework that can be field-tested and revised. Communities can be added, deleted, divided, or combined as we expand our knowledge of Massachusetts' natural communities. There are inconsistencies, some fields are incomplete, some community descriptions overlap. Any assistance with refining those issues would be helpful.

The plan is to collect data, have discussions with ecologists state-wide, and consider comments on this draft -- and to produce a more definitive classification. All comments, feedback, and community information are welcome and appreciated. Your help will greatly improve the result.

**TABLE OF CONTENTS**

**ACKNOWLEDGEMENTS**

**TABLE OF CONTENTS** .....  
 Introduction ..... v  
 Page Guide ..... ix

**TERRESTRIAL COMMUNITIES**

**OPEN (sparse vegetation, less than about 25% tree, shrub, and herbaceous cover)**

**Rock Substrate:**

**Summits and Rock Outcrops**

Acidic Rocky Summit / Rock Outcrop ..... T - 2  
 Circumneutral Rocky Summit / Rock Outcrop ..... T - 4  
 Calcareous Rocky Summit / Rock Outcrop ..... T - 6  
 Serpentine Outcrop ..... T - 8  
 Riverside Rock Outcrop ..... T - 16

**Rock Cliff**

Acidic Rock Cliff ..... T - 10  
 Circumneutral Rock Cliff ..... T - 12  
 Calcareous Rock Cliff ..... T - 14  
 Maritime Rock Cliff ..... T - 20

**Unconsolidated Substrate:**

Maritime Erosional Cliff ..... T - 22  
 Maritime Beach Strand ..... T - 24  
 Maritime Dune ..... T - 26

**HERBACEOUS (dominated by herbaceous vegetation, with less than about 25% tree and shrub cover)**

Dry Riverside Bluff ..... T - 18  
 Sandplain Grassland ..... T - 28  
 Cultural Grassland ..... T - 30

**SHRUB communities (less than about 25% tree canopy)**

Sandplain Heathland ..... T - 32  
 Maritime Shrubland ..... T - 34  
 Maritime Pitch Pine on Dunes ..... T - 36  
 Maritime Juniper Woodland / Shrubland ..... T - 38  
 Scrub Oak Shrubland ..... T - 40  
 Pitch Pine - Scrub Oak Community (may be more than 25% pitch pine) ..... T - 42  
 Ridgetop Pitch Pine - Scrub Oak Community (may be more than 25% pitch pine) ..... T - 44

**FOREST / WOODLAND (Greater than about 25% tree cover)**

**Talus Forest / Woodland**

Acidic Talus Forest / Woodland ..... T - 46  
 Circumneutral Talus Forest / Woodland ..... T - 48  
 Calcareous Talus Forest / Woodland ..... T - 50

**Central Hardwoods Region:**

**Mixed Coniferous – Deciduous Forest / Woodland:**

Maritime Oak - Holly Forest / Woodland ..... T - 52  
 Coastal Forest / Woodland ..... T - 54  
 Pitch Pine - Oak Forest ..... T - 56  
 White Pine – Oak Forest ..... T - 58  
 Oak – Hemlock - White Pine Forest ..... T - 60

**Conifer Forest / Woodland:**

Successional White Pine Forest ..... T - 62  
 Hemlock Ravine ..... T - 78

**Deciduous Forest / Woodland:**

Mixed Oak Forest ..... T - 64  
 Ridgetop Chestnut Oak Forest / Woodland ..... T - 66  
 Black Oak - Scarlet Oak Forest / Woodland ..... T - 68  
 Oak - Hickory Forest ..... T - 70  
 Hickory – Hop Hornbeam Forest / Woodland ..... T - 72  
 Dry, Rich Acidic Oak Forest ..... T - 74  
 Yellow Oak Dry Calcareous Forest ..... T - 76



Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

Northern Hardwoods Region:

**Mixed Forest:**

Northern Hardwoods – Hemlock – White Pine Forest ..... T - 80  
Spruce – Fir – Northern Hardwood Forest ..... T - 92

**Conifer Forest:**

Hemlock Ravine ..... T - 78  
High Elevation Spruce - Forest ..... T - 94

**Deciduous Forest:**

Successional Northern Hardwood Forest ..... T - 82  
Red Oak – Sugar Maple Transition Forest ..... T - 84  
Rich, Mesic Forest Community ..... T - 86  
Forest Seep Community ..... T - 88  
Calcareous Forest Seep Community ..... T - 90

**Riverside Communities**

Riverside Rock Outcrop ..... T - 16  
Dry Riverside Bluff ..... T - 18  
Floodplain Forests ..... See Palustrine Section

**Maritime Salt Spray Zone:**

..... See also Estuarine Section  
Maritime Rock Cliff ..... T - 20  
Maritime Erosional Cliff ..... T - 22  
Maritime Beach Strand ..... T - 24  
Maritime Dune ..... T - 26  
    Coastal interdunal marsh/swale [Palustrine] ..... P - 40  
Sandplain Grassland ..... T - 28  
    Cultural Grassland ..... T - 30  
Sandplain Heathland ..... T - 32  
Maritime Shrubland ..... T - 34  
Maritime Pitch Pine on Dunes ..... T - 36  
Maritime Juniper Woodland / Shrubland ..... T - 38  
Maritime Oak / Holly Forest / Woodland ..... T - 52

**PALUSTRINE COMMUNITIES**

**PALUSTRINE INTRODUCTION** ..... P - ii

**FORESTED WETLANDS**

**Conifer-dominated:**

Spruce-fir boreal swamp ..... P - 2  
Hemlock-hardwood swamp ..... P - 4  
Atlantic white cedar swamps  
    i. Coastal Atlantic white cedar swamp ..... P - 6  
    ii. Inland Atlantic white cedar swamp ..... P - 8  
    iii. Northern Atlantic white cedar swamp ..... P - 10  
    iv. Alluvial Atlantic white cedar swamp ..... P - 12  
    v. Atlantic white cedar bog ..... P - 14  
Spruce-tamarack bog ..... P - 16

**Hardwood-dominated:**

Red maple swamp ..... P - 18  
    i. Alluvial red maple swamp ..... P - 20  
Black ash swamp ..... P - 22  
Black ash-red maple-tamarack calcareous seepage swamp ..... P - 24  
Black gum-pin oak-swamp white oak “perched” swamp ..... P - 26  
Black gum swamp ..... P - 28  
Floodplain forests  
    i. Major-river floodplain forest ..... P - 30  
    ii. Transitional floodplain forest ..... P - 32  
    iii. Small-river floodplain forest ..... P - 34  
    iv. High-terrace floodplain forest ..... P - 36  
    v. Cobble bar forest ..... P - 38

**NON-FORESTED WETLANDS**

**Marshes/Wet meadows:**

Coastal interdunal marsh/swale.....	P - 40
Deep emergent marsh.....	P - 42
Shallow emergent marsh.....	P - 44
Wet meadow.....	P - 46
i.    Kettlehole wet meadow.....	P - 48

**Pondshores/lakeshores:**

Inland acidic pondshore/lakeshore.....	P - 50
Coastal plain pondshore.....	P - 52
Calcareous pondshore/lakeshore.....	P - 54

**Riversides/Streamsides:**

Mud flat.....	P - 56
Riverside seep.....	P - 58
Low-energy riverbank.....	P - 60
High-energy riverbank.....	P - 62
Riverine pointbar and beach.....	P - 64

**Shrub swamps:**

Shrub swamp.....	P - 66
------------------	--------

**Peatlands (bogs and fens):**

**Calcareous peatlands:**

Calcareous sloping fen.....	P - 68
Calcareous seepage marsh.....	P - 70
Calcareous basin fen.....	P - 72

**Acidic peatlands:**

Acidic graminoid fen.....	P - 74
Acidic shrub fen.....	P - 76
Sea-level fen.....	P - 78
Level bog.....	P - 80
i.    Kettlehole level bog.....	P - 82
ii.   Highbush blueberry thicket.....	P - 84

**Vernal pools:**

Woodland vernal pool.....	P - 86
---------------------------	--------

**ESTUARINE COMMUNITIES**

**MARINE**

**Marine Subtidal:**

Flats.....	E - 2
------------	-------

**Marine Intertidal:**

Rocky Shore.....	E - 4
Gravel / Sand Beach.....	E - 6
Flats.....	E - 8

**ESTUARINE**

**Estuarine Subtidal:**

Saline / Brackish Flats.....	E - 10
Fresh / Brackish Flats.....	E - 12
Coastal Salt Pond.....	E - 14

**Estuarine Intertidal:**

Saline / Brackish Flats.....	E - 16
Fresh / Brackish Flats.....	E - 18
Coastal Salt Pond Marsh.....	E - 20
(Palustrine) Sea-level Fen.....	E - 22
Salt Marsh.....	E - 24
Brackish Tidal Marsh.....	E - 26
Freshwater Tidal Marsh.....	E - 28
Fresh / Brackish Tidal Shrubland.....	E - 30
Fresh / Brackish Tidal Swamp.....	E - 32

**REFERENCES**

**APPENDIX A** – Community Ranks (draft)- Alphabetical within groups (Terrestrial, Palustrine, and Estuarine)

**APPENDIX B** – Community Types By Rank

## PAGE GUIDE

<b>Community Name:</b>	Name used to describe the community in Massachusetts
<b>Community ELCODE:</b>	Unique ten digit alphanumeric element code (ELCODE) assigned to the community.
<b>SRANK:</b>	Community state rank (SRANK) that reflects the community's rarity and threat within Massachusetts, with regard to its regional rarity and threat. The SRank system was developed for Natural Heritage programs by The Nature Conservancy. The SRANKs are as follows: <b>S1=</b> Typically 5 or fewer occurrences, very few remaining acres or miles of stream, or especially vulnerable to extirpation in Massachusetts for other reasons. <b>S2=</b> Typically 6-20 occurrences, few remaining acres or miles of stream, or very vulnerable to extirpation in Massachusetts for other reasons. <b>S3=</b> Typically 21-100 occurrences, limited acreage or miles of stream in Massachusetts. <b>S4=</b> Apparently secure in Massachusetts. <b>S5=</b> Demonstrably secure in Massachusetts. <b>SU=</b> Status unknown in Massachusetts.

NHESP tracks examples of communities that are ranked S1-S3, that is we maintain records of known occurrences in our database and actively search for new occurrences. Communities that are ranked S4 or S5 generally are not tracked, except for exemplary occurrences. Definitions of quality of occurrences are being developed.

### Map of the ecoregions and sub-ecoregions of Massachusetts:

Ecoregions (or ecological regions) are areas of relatively homogeneous ecological systems, including vegetation, soils, climate, geology, and patterns of human uses. Ecoregion boundaries have been developed for the United States to provide an ecological framework for inventorying and assessing environmental resources. Massachusetts falls within two ecoregions of the United States—the **Northeastern Highlands** and the **Northeastern Coastal Zone**. Sub-ecoregions of Massachusetts have been delineated (Figure 1; Griffith et al. 1994), and they are particularly useful for statewide ecological inventory and assessment activities, including vegetation classification.

There are thirteen sub-ecoregions in Massachusetts. Complete descriptions are given in Griffith et al. (1994), but a brief synopsis of their descriptions is given below:

#### **Northeastern Highlands:**

The **Taconic Mountains** sub-ecoregion is a hilly and mountainous region of western Massachusetts that includes Mt. Greylock, the highest elevation in the state (3491 feet). Streams are generally small and high-gradient, and there are few lakes. The vegetation is primarily northern hardwoods (maple-beech-birch) with spruce-fir at higher elevations. The **Western New England Marble Valleys**, also known as the Berkshire Valley, consists of calcitic and dolomitic marbles and limestones bedrock. Surface water alkalinity values in the area are the highest in Massachusetts (>1000 µeq/L; Griffith et al. 1994) due to the underlying limestone and marble. Alkaline groundwater results in mineral-rich and species-rich wetlands in the region, particularly calcareous fens. The Hoosic and Housatonic Rivers are the major drainages. The **Green Mountains/Berkshire Highlands** includes the southern extent of the Green Mountains and the Berkshire Hills; elevations range from 1000 to 2500 feet. Northern hardwoods and spruce-fir characterize the forested uplands. The Deerfield and upper Westfield Rivers are the main river basins. The **Lower Berkshire Hills** is similar to the Green Mountains/Berkshire Highlands sub-ecoregion except that it has an overall lower elevation, generally 1000 to 1700 feet. Spruce-fir is generally lacking, and northern hardwoods are mixed with transition hardwoods (maple-beech-birch, oak-hickory). Lakes and ponds are abundant compared to the rest of western Massachusetts. The **Berkshire Transition** ranges in elevation from 400-1400 feet, and forest types are transition hardwoods and northern hardwoods. Surface waters drain to the Westfield and Connecticut River basins. The **Vermont Piedmont** has a similar elevation range as the Berkshire Transition, but underlying limestone and marble result in surface waters with higher alkalinity (500-1000 µeq/L). Surface waters drain into the Deerfield and Connecticut River basins. The **Worcester/Monadnock Plateau** contains the most hilly and mountainous area of Massachusetts' central upland. Elevations range from 500 to 1400 feet with some peaks above 1800 feet (Mt. Watatic and Mt. Wachusett). Transition hardwoods are common, but

Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

northern hardwoods also occur. Forested wetlands are common, and forested and non-forested peatlands are abundant. Surface waters are acidic with alkalinity values less than 50 µeq/L.

**Northeastern Coastal Zone:**

The ***Connecticut Valley*** is characterized by thick outwash, alluvial, and lake bottom deposits overlaying sedimentary bedrock. Surface water alkalinity values are generally above 500 µeq/L. Central hardwoods (oak-hickory) and transition hardwoods are the major forest types. The ***Lower Worcester Plateau/Eastern Connecticut Upland*** ranges in elevation from 500 to 1200 feet. The soils of the area developed primarily on glacial till in the uplands, and on stratified sand, gravel, and silt deposits in the valleys. Surface waters are acidic and drain primarily into the Chicopee and Quinebaug River systems. The ***Southern New England Coastal Plains and Hills*** is the largest sub-ecoregion in southern New England and is variable in its topography and bedrock. Bedrock types are mostly granites, schist and gneiss. Surface water alkalinity values are generally lower than in the Connecticut Valley, ranging from less than 50 to 500 µeq/L. Central hardwoods are dominant. The ***Boston Basin*** has low, rolling topography that is dominated by urban and suburban land. The ***Narragansett Bristol Lowlands*** are similar to the Coastal Plains and Hills, but bedrock outcrops are uncommon, and thick glacial till and outwash deposits cover the area. The lowlands are flat to gently rolling with elevations less than 200 feet. Surface water alkalinity values are generally between 100 to 300 µeq/L, but several areas have values less than 50 µeq/L. The vegetation is mostly central hardwoods. The ***Cape Cod/Long Island*** sub-ecoregion is characterized by terminal moraines and outwash plains left by the glaciers, and by coastal deposits. The landscape is influenced by wind and water. Elevations are less than 200 feet. There is a moderate maritime climate, and stunted oak and pine forests are typical. Surface water alkalinity values are low (less than 50 µeq/L).

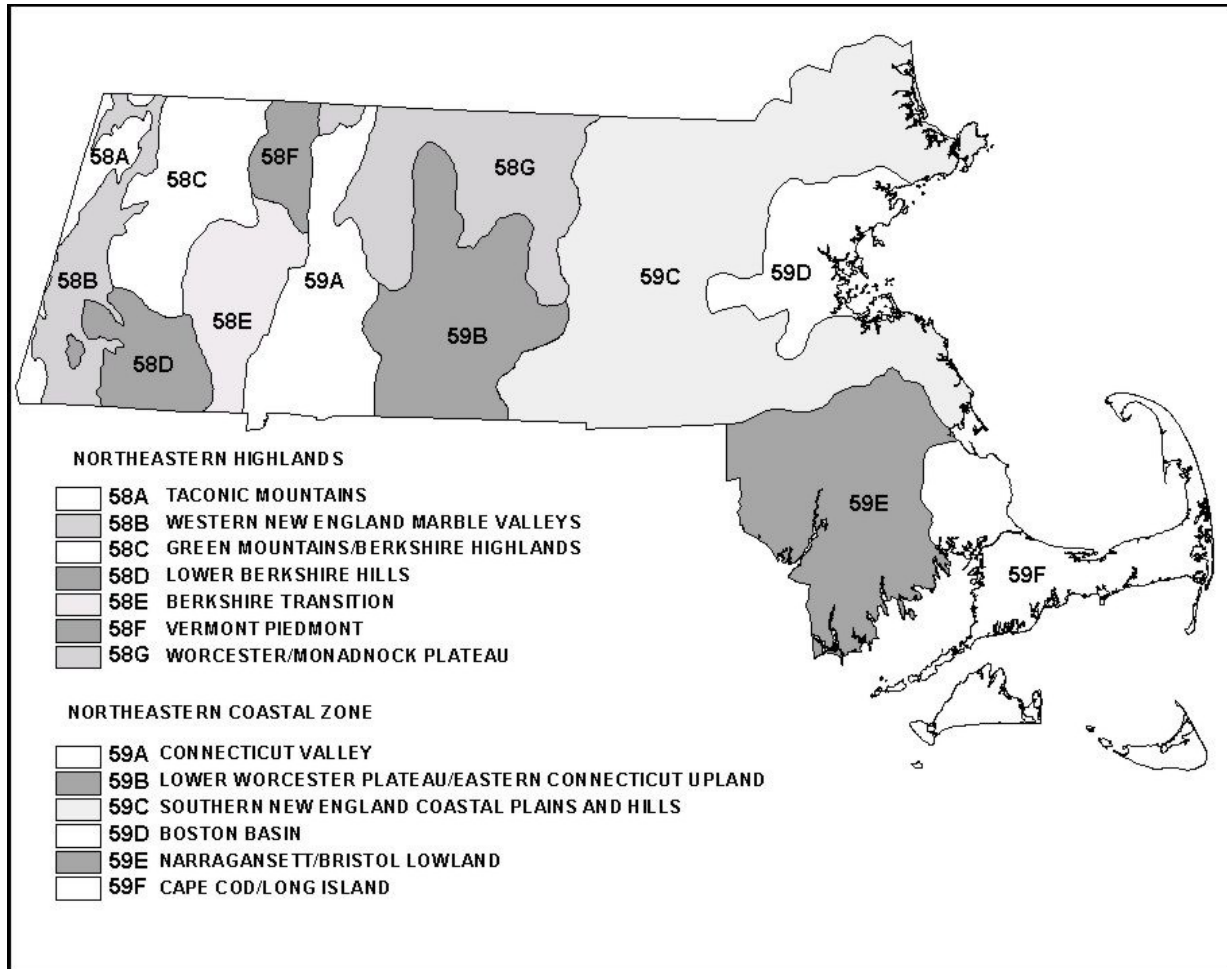


Figure 1. Ecoregions and sub-ecoregions of Massachusetts (Griffith et al. 1994)

## Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

In the vegetation classification, each community description is accompanied by a sub-ecoregion line map showing the sub-ecoregion boundaries. Sub-ecoregions in which the community type is known to occur (i.e., NHESP has field data for the community including vegetation descriptions and/or plot data) are shaded in dark gray, and the sub-ecoregions with probable occurrences (i.e., field data are currently lacking but the community has been observed in the sub-ecoregion or the sub-ecoregion is known to have the appropriate physical conditions) are shaded in light gray. If the community is not believed to occur in a certain sub-ecoregion, then that sub-ecoregion is left white.

The community sub-ecoregion maps are intended to give the user an idea of where s/he may encounter a certain community type and also to identify sub-ecoregions for which community data are needed. Readers are encouraged to look in sub-ecoregions identified as having probable occurrences of the community (light gray). All new data and distribution information is welcome and much appreciated.

<b>Concept:</b>	Brief general description or word-picture of the community.
<b>Environmental setting:</b>	Detailed description of the landscape setting, soils, water chemistry, and other physical characteristics of the community.
<b>Vegetation Description:</b>	Detailed description of the vegetation structure and characteristic plant species of the community.
<b>Associations:</b>	List of the vegetation associations that have been described in Massachusetts that are either equivalent to the community or included within the community. For example, Motzkin (1991) described six Atlantic white cedar (AWC) associations in Massachusetts. Coastal AWC Swamps are equivalent to his Coastal AWC type, while Inland AWC swamps include both his Mixed hemlock-AWC-red maple-yellow birch type and his Spruce-hemlock-AWC type.
<b>Habitat values for: Associated Fauna</b>	Description of the habitat that the community provides for animals, including birds, small mammals, amphibians, invertebrates, etc.
<b>Associated rare plants:</b>	A list of rare plants that are known to occur in the community type. Rare plants include those that are state-protected under the Massachusetts Endangered Species Act and those that are on the state watch list. Plants on the watch list are not legally protected, but they are believed to be uncommon or rare. They are species for which information is lacking on number of sites and severity of population decline, or species that have been delisted.

Plant Latin name

Plant common name

Plant state status

E= State Endangered

T= State Threatened

SC= State Special Concern

WL= State Watch List

H= State Historic

**Associated rare animals:** A list of rare animals that are known to occur in the community type. Rare animals include those that are state-protected under the Massachusetts Endangered Species Act (birds on the bird watch list are also included). Format and abbreviations follow those used for Associated rare plants (see above).

**Examples: OR  
Examples with  
Public Access:** List of representative examples of the community in areas with public access. For particularly sensitive communities, specific examples are not listed.

**Threats:** A description of known threats to the community.

**Management needs:** A description of management activities that may be necessary to maintain community occurrences and the quality of those occurrences.

**Synonyms** Names used for the Massachusetts community in other natural community classifications. If a synonym is listed without any modifier, then the Massachusetts community is basically equivalent to the synonym. Sometimes the following modifiers are used: "includes" means that the Massachusetts community includes the communities listed, "included within" means that the Massachusetts community is included within the community listed, "similar to" means that the Massachusetts community is similar but not equivalent to the communities listed, and "not

## Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

described” is used when the Massachusetts community has no synonym in that classification. Question marks indicate uncertainty about synonyms.

### **USNVC/TNC:**

Synonyms in the National Vegetation Classification. Sneddon, L., M. Anderson, and J. Lundgren eds. 1998. International classification of ecological communities: terrestrial vegetation of the Northeastern United States (July 1998 working draft). The Nature Conservancy, Eastern Conservation Science and Natural Heritage Programs of the northeastern U.S. Boston, MA. [Association codes are written in brackets.] and subsequent descriptions added by NatureServe.

### **MA (old name):**

Old name used by the Massachusetts Natural Heritage Program. Rawinski, T.J. 1984. New England natural community classification. The Nature Conservancy, Eastern Regional Office, Boston, MA. [old EOCODES are written in brackets].

### **ME:**

Synonyms in the Maine vegetation classification.  
Gawler, Susan C. 2001. Natural Community Profiles, Open (non-forested) types. Maine Natural Areas Program, Department of Conservation, Augusta, Maine.  
Maine Natural Heritage Program. 1991. Natural Landscapes of Maine: A Classification of Ecosystems and Natural Communities. Department of Economic and Community Development, State House Station 130, Augusta, ME.

### **VT:**

Synonyms in the Vermont vegetation classification.  
Thompson, E. 1995. Natural Communities of Vermont: Uplands and Wetlands. Vermont Nongame and Natural Heritage Program, Department of Fish and Wildlife, Agency of Natural Resources. Waterbury, VT.

### **NH:**

Synonyms in the New Hampshire vegetation classification.  
Sperduto, D.D. 1994. A Classification of the Natural Communities of New Hampshire. New Hampshire Natural Heritage Inventory, Dept. of Resources and Economic Development. Concord, NH. (used for palustrine) AND  
Sperduto, D.D. 1997. The Natural Communities of New Hampshire: A Guide and Classification. Draft. November 21, 1997. New Hampshire Natural Heritage Inventory, Dept. of Resources and Economic Development. Concord, NH.

### **NY:**

Synonyms in the New York vegetation classification.  
Reschke, C. 1990. Ecological Communities of New York State. New York Natural Heritage Program, N.Y.S. Dept. of Environmental Conservation. Latham, NY.  
and subsequent descriptions by NY Natural Heritage Program, since 1990.

### **CT:**

Synonyms in the Connecticut vegetation classification.  
Metzler, K.J. & J.P. Barrett. 1996. Vegetation classification for Connecticut, Organized into the modified UNESCO hierarchy. Draft report, Connecticut Natural Diversity Database. Hartford, CT.

### **RI:**

Synonyms in the Rhode Island vegetation classification.  
Enser, R. 1995. Natural Communities of Rhode Island. Rhode Island Natural Heritage Program, Providence, RI.

### **Golet & Larson, 1974:**

Synonyms in Golet, F.C. and J.S. Larson. 1974. Classification of freshwater wetlands in the glaciated Northeast. US Fish and Wildlife Service Resource Publication 116, Washington D.C. [Used in Palustrine section.]

### **Weatherbee:**

Synonyms in Weatherbee, P.B. 1996. Flora of Berkshire County. The Berkshire Museum, The Studley Press, Inc. Dalton, MA. 123 pp. [Used in Terrestrial section.]

### **Other:**

Synonyms in other miscellaneous vegetation classifications.

**Author:** Person responsible for writing community description. **Date:** Date last revised.

## References

- Aizen, M.A. & W.A. Patterson III. 1995. Leaf phenology and herbivory along a temperature gradient: a spatial test of the phenological window hypothesis. *J Veg. Sci.* 6:543-550.
- Backman, A.E. 1984. 1000-year record of fire-vegetation interactions in the northeastern United States: a comparison between coastal and inland regions. MS Thesis. University of Massachusetts, Amherst.
- Baptista, T.L. & S.W. Shumway. 1998. A comparison of the seed banks of sand dunes with different disturbance histories on Cape Cod National Seashore. *Rhodora* 100:298-313.
- Batcher, Michael S. 2000. Final report on survey of Three Mile Pond Wildlife Management Area. Report to: Mass. Dept. Fisheries, Wildlife & Environmental Law Enforcement. BDI & NHESP.
- Bechtel, D.A. and D.D. Sperduto. 1998. Floodplain forest natural communities along major rivers in New Hampshire. Unpublished report to the U.S. Environmental Protection Agency. New Hampshire Natural Heritage Inventory, Concord, NH.
- Bellis, Vincent J. 1995. Ecology of maritime forests of the southern Atlantic Coast: a community profile. USDI, National Biological Service. *Biol. Rpt* 30. 95pp.
- Bertin, Robert in conjunction with Brian Butler. 1998. Floristic and herpetological inventories of Quaboag Wildlife Management Area and Wolf Swamp Wildlife Management Area. Report to BDI & MNHESP.
- Bertin, Robert. 1999. Floristic inventory of Bolton Flats Wildlife Management Area. Report to BDI & MNHESP.
- Blodget, Bradford G. 1998. Checklist of the birds of Massachusetts. Massachusetts Division of Fisheries & Wildlife. Westborough, MA 25pp.
- Braker, N.C. 1986. Draft. Stewardship plan for Katama Plains Conservation Area. The Nature Conservancy. Dec. 1986. and Peter Dunwiddie burn plan and comments from Mark Heillinger.
- Brooks, Robert Richard. 1987. *Serpentine and its vegetation: a multidisciplinary approach*. Dioscorides Press, Portland, OR. 454pp.
- Buttrick, S. 1994. Interagency memo re. ranking pine barrens types. The Nature Conservancy. Eastern Regional Office. Boston, MA.
- Caldwell, F.A. & G.E. Crow. 1992. A floristic and vegetation analysis of a freshwater tidal marsh on the Merrimack River, West Newbury, Massachusetts. *Rhodora* 94:63-97.
- Caldwell, F.A. 1990. A floristic and vegetation analysis of a freshwater tidal marsh on the Merrimack River, West Newbury, Massachusetts. MS Thesis, University of New Hampshire. 98 pp.
- Cardoza, J.E. & P.G. Mirick. 1999. List of the reptiles and amphibians of Massachusetts. 3rd Ed. Massachusetts Division of Fisheries & Wildlife, Fauna of Massachusetts Series: No. 3. Westborough, MA.
- Cardoza, J.E., G.S. Jones, & T.W. French. 1999. MassWildlife's State Mammal List, 4th ed. Published electronically at: <http://www.state.ma.us/dfwele/dfw/dfwmam.htm> 15 pp.
- Center for Natural Areas, Office of International and Environmental Programs, Smithsonian Institution. 1974. Survey of Natural Areas of the Atlantic Coastal Plain Vol. 5., National Natural Landmark theme study for National Park Service, US Dept. of the Interior.
- Clark, F.H., J. MacDougall, F. Goodwin, C. Mom, R. Hopping, B. Speare, and L. Vernegaard. 1998. Biological survey of Crane Pond Wildlife Management Area, Essex County, Massachusetts. Unpublished report to the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, Biodiversity Initiative, Ecological Restoration Program. Westborough, MA.
- Clark, Frances & David Lovejoy. 1996. East Brimfield Lake, Endangered plant species and natural communities survey. Part of Report to Army Corps of Engineers, New England Division, from MA Natural Heritage & Endangered Species Program.
- Coastal Zone Management. 1977. MA Coastal Zone Management Program. Vol. 1/ 2. MA Executive Office of Environmental Affairs.
- Conkling, Philip W. 1978. Old growth white pine (*Pinus strobus* L.) stands in Maine and their relevance to the Critical Areas Program. Planning Report No. 61, Critical Areas Program, Maine State Planning Office.

## Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Dept. of the Interior – Fish & Wildlife Service. Washington, D.C.
- Cramer, T.K. 1999. A floristic inventory of the salt marshes, islands, and tidal communities of Salisbury, Mass. Report to Massachusetts Natural Heritage & Endangered Species Program, Division of fisheries and Wildlife, Westborough, MA.
- Crum, H. 1992. A focus on peatlands and peat mosses. The University of Michigan Press. Ann Arbor, MI.
- Damman, A.W.H. & B. Kershner. 1977. Floristic composition and topographical distribution of the forest communities of the gneiss areas of Western Connecticut. *Le Naturaliste Canadien* 104:23-45.
- Damman, A.W.H. and T.W. French. 1987. The ecology of peat bogs of the glaciated northeastern United States: a community profile. *Biol. Report* 85 (7.16). U.S. Fish and Wildlife Service, Washington, D.C.
- DeGraaf, R.M. & D.D. Rudis. 1981. Forest habitat for reptiles & amphibians of the northeast. Northeastern forest experiment Station and Eastern Region, Forest Service, US Dept. Agriculture, Amherst, MA.239pp.
- DeGraaf, R.M. & D.D. Rudis. 1983. Amphibians and reptiles of New England: habitats and natural history. The University of Massachusetts Press, Amherst. 83pp.
- Dehler-Seter, E. 1996. Cover type inventory and preliminary investigation of ecologically significant areas on land of the Mount Grace Land Conservation Trust, Massachusetts. MS Paper, Antioch-New England, Keene, NH.
- Dept. of Natural Resources. 1974. Massachusetts landscape and natural areas survey.
- DiGregorio, M. & P. Polloni. 1995. A floristics survey of Cape Cod Canal for rare and protected species and uncommon or exemplary plant communities. Report to NHESP & USACOE.
- Dunwiddie, P.W.. 1997. Long-term effects of sheep grazing on coastal sandplain vegetation. *Nat. Areas J.* 17:261-264.
- Dunwiddie, P.W. and R.T. Leverett. 1996. Survey of old-growth forest in Massachusetts. *Rhodora* 98:419-444.
- Dunwiddie, P.W., R.E. Zaremba, & K.A. Harper. 1996. A classification of coastal heathlands and sandplain grasslands in Massachusetts. *Rhodora* 98:117-145.
- Egler, Frank E. 1940. Berkshire Plateau vegetation, Massachusetts. *Ecol Monogr* 10(2):145-192.
- Elliman, Edward. 1999. Biological survey of Jug End WMA (1998). Report to BDI & MNHESP.
- Enser, R. 1995. Natural communities of Rhode Island. Rhode Island Natural Heritage Program, Providence, RI.
- Eyre, F.H., Editor. Forest cover types of the United States and Canada. Society of American Foresters, Washington, D.C. 148pp.
- Favour, P.G. 1974. Natural National Landmark brief on Hawley Bog.
- Findlay, S. K. Howe, & H.K. Austin. 1990. Comparison of detritus dynamics in two tidal freshwater wetlands. *Ecology* 71:288-295.
- Finton, A.D. 1998. Succession and plant community development in pitch pine – scrub oak barrens of the glaciated northeast United States. MS Thesis, University of Massachusetts, Amherst.
- Flaccus, E. 1972. Vegetation of natural areas of the hemlock-white pine-northern hardwood region of the eastern deciduous forest. (thesis) prepared for the U.S. Department of the Interior, NPS.
- Foster, D.R., G. Motzkin, and B. Slater. 1998. Land-use history as long-term broad-scale disturbance: regional forest dynamics in Central New England. *Ecosystems* 1:96-119.
- Foster, D.R. & G. Motzkin. 1999. Historical influences on the landscape of Martha's Vineyard: perspectives on the management of the Manuel F. Correllus State Forest. Harvard Forest Paper No. 23. Harvard University, Petersham, MA.
- Gawler, S.C. 2002. Natural landscapes of Maine: a classification of vegetated natural communities and ecosystems. Maine Natural Areas Program, Augusta, ME. 80pp.
- Geist, M.A. 1996. Waquoit Bay National Estuarine Research Reserve. National Oceanic & Atmospheric Administration and Mass. Dept of Environmental Management.
- Godfrey, P.J. & K.B. Searcy. 1996. Continuation of a 1994 study of the status of balds & primary succession on the Holyoke Range, Connecticut River Valley, MA. Report to NHESP.
- From: Swain, P.C. & J.B. Kearsley. 2001. Classification of the Natural Communities of Massachusetts. Version 1.3. Natural Heritage & Endangered Species Program, Division of Fisheries & Wildlife. Westborough, MA.



Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

- Godfrey, P.J. 1976. Barrier beaches of the east coast. *Oceanus* 19:27-40.
- Godfrey, P.J. 1976. Barrier islands and beaches. In Tech. Proc. 1976 Barrier Islands Workshop. The Conservation Foundation.
- Godfrey, P.J., M.M. Godfrey, & D. Disraeli. 1982. North America, coastal ecology. P. 580-593 In Schwartz, M.L. ed. *The Encyclopedia of beaches and coastal environments*. Hutchinson Ross Publishing Co. Stroudsburg, PA.
- Goldstein, P.Z. 1997. Lepidopteran assemblages and the management of sandplain communities on Martha's Vineyard, Massachusetts. In Vickery, P & P. Dunwiddie, eds. *Grasslands of eastern North America*. Massachusetts Audubon Society.
- Golet, F.C. and J.S. Larson. 1974. Classification of freshwater wetlands in the glaciated Northeast. US Fish and Wildlife Service Resource Publication 116, Washington D.C.
- Golet, F.C., A.J.K. Calhoun, W.R. DeRagon, D.J. Lowry, and A.J. Gold. 1993. Ecology of red maple swamps in the glaciated Northeast: A community profile. Biological Report 12. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.
- Goodwin, R. and W. Niering. 1975. Inland wetlands of the U.S. U.S. Dept. of the Interior, National Park Service. Natural History theme series no. 2, Washington, D.C.
- Griffith, G.E., J.M. Omernik, S.M. Pierson, and C.W. Kiilsgaard. 1994. The Massachusetts ecological regions project. United States Environmental Protection Agency, Publication No. 17587-74-6/94-DEP, Washington, D.C.
- Hammer, S. 1994. A preliminary report on the lichens of Myles Standish State Forest with a focus on the potential impact of non-designated off-road vehicle trails on the lichen flora at sensitive sites. Report to the MNHESP.
- Hickler, M.G., K.B. Searcy, J. Bellemare, M. Winhold, L. Higgins, and D. Small. 1999. Satan's Kingdom Wildlife Management Area Natural Resource Inventory. Unpublished report to the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, Biodiversity Initiative, Ecological Restoration Program, Westborough, MA.
- Holland, M.M. and C.J. Burk. 1984. The herb strata of three Connecticut River oxbow swamp forests. *Rhodora* 86: 397-413.
- Jenkins, Jerry and Elizabeth Thompson. 1992. The vegetation of Minuteman National Park: Concord, Lincoln, and Lexington, Massachusetts. Report to NHESP and NPS.
- Jones, A.L. & P.D. Vickery. No date. Conserving grassland birds: managing large grasslands, including conservation lands, airports, and landfills over 75 acres for grassland birds. Mass. Audubon Society.
- Jones, A.L. & P.D. Vickery. No date. Conserving grassland birds: managing small grasslands including conservation lands, corporate headquarters, recreation fields, and small landfills for grassland birds. Massachusetts Audubon Society. Lincoln, MA.
- Jorgensen, Neil. 1978. A Sierra Club Naturalist's guide to Southern New England. Sierra Club Books, San Francisco. 417pp.
- Judd, W.S. 1980. Bryophytes of the peat mat at Ponkapoag Pond, eastern Massachusetts, with taxonomic and ecological notes on Sphagnum. *Rhodora*. 82:563-578.
- Kearsley, J.B. 1998. Inventory and vegetation classification of floodplain forest communities in Massachusetts. Unpublished report to the U.S. Environmental Protection Agency. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Kearsley, J.B. 1999a. Inventory and vegetation classification of floodplain forest communities in Massachusetts. *Rhodora* 906:105-135.
- Kearsley, J.B. 1999b. Rare and non-native plants of Massachusetts' floodplain forests. *Rhodora* 906: 200-205.
- Kearsley, J.B. 1999c. Inventory and vegetation classification of non-forested acidic peatlands in Massachusetts. Unpublished report to the U.S. Environmental Protection Agency. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.

## Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

- Keever, Catherine. 1971. Study of the mixed mesophytic, western mesophytic, & oak chestnut regions of the eastern deciduous forest including a rev. of vegetation and sites recommended as potential Natural Landmarks, for National Park Service, U.S. Dept. of the Interior.
- Klemens, Michael W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut Bulletin 112. Connecticut Dept. Environmental Protection, Hartford, CT. 318pp.
- Kuriger, W.E. and P. Rezendes. 1991. The botany, habitats, and wildlife of the 1000 Acre Swamp, Athol and Phillipston, Massachusetts. Unpublished report.
- Lee, C. 1985. West Rock to the Barndoor Hills. The Traprock Ridges of Connecticut. State Geological and Natural History Survey of Connecticut. DeLee, C. 1985. West Rock to the Barndoor Hills. Traprock Ridges. Geology & Natural History Survey of Connecticut. Vegetation of Connecticut Natural Areas #4.
- Livingston, R. B. and B. E. Lund. (unpublished manuscript ca. 1975). Microclimates and Vegetation of the Holyoke Range, Massachusetts.
- Lortie, J.P., B.A. Sorrie and D.W. Holt. 1991. Flora of the Monomoy Island, Chatham, Massachusetts. *Rhodora*. 93: 361-389.
- Ludwig, J.C. 1995. An overview of sea-level fens. Virginia Division of Natural Heritage. URL: <http://www.dcr.state.va.us/dnh/wfens.htm>
- Lundgren, J.A. 1989. Distribution and phenology of pondshore vegetation at a coastal plain pond in Plymouth, MA. M.S. Thesis. Botany Department. University of Massachusetts, Amherst, MA.
- Lundgren, J.A. 1998. Natural communities of coastal Massachusetts: inventory and assessment 1997-1998. Report to the Massachusetts Natural Heritage and Endangered Species Program. Westborough, MA.
- Lundgren, J. A. ed. 2000. Plant communities of the Lower New England - Northern Piedmont Ecoregion. The Nature Conservancy / Association for Biodiversity. Boston, MA.
- Maine Natural Heritage Program. 1991. Natural Landscapes of Maine: A Classification of Ecosystems and Natural Communities. Department of Economic and Community Development, State House Station 130, Augusta, ME. 77pp.
- Massachusetts Coastal Zone Management. 1994. Guidelines for Barrier Beach Management in Massachusetts. A report of the Massachusetts Barrier Beach Task force. Massachusetts Executive Office of Environmental Affairs, Boston, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1995. Cape Cod Canal Rare and protected species and uncommon or exemplary natural communities survey. Unpublished report to the Department of Army, New England Division Corps of Engineers. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1995. Inventory of Westover ARB for rare and protected species and uncommon or exemplary plant communities 1994-1995. Unpublished report to the Department of Army, New England Division Corps of Engineers. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1996. Conant Brook Dam Property rare or protected species and exemplary natural communities survey. Unpublished report to the US Air Force. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1996. East Brimfield Lake Property rare or protected species and exemplary natural communities survey. Unpublished report to the Department of Army, New England Division Corps of Engineers. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1998. Ecological assessment of the Shawsheen and Spicket River Corridors in the Lawrence USGS Topographic Quad. Report prepared for the National Park Service, Boston, MA. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.

## Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

- Massachusetts Natural Heritage and Endangered Species Program. 1998. Knightville Dam Property rare or protected species and priority natural communities survey. Report to the Department of Army, New England Division Corps of Engineers. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1998. West Hill Dam Property rare or protected species and priority natural communities survey. Report to the Department of Army, New England Division Corps of Engineers. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Massachusetts Natural Heritage and Endangered Species Program. 1998. Westville Lake Property rare or protected species and priority natural communities survey. Report to the Department of Army, New England Division Corps of Engineers. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Mawson, J.C., W. Rivers, & B. Fischer. 1985. A forest land classification system for Massachusetts. Cooperative Extension Service C-175. University of Massachusetts, Amherst, MA.
- Metzler, K.J. & J.P. Barrett. 1996. Vegetation classification for Connecticut, Organized into the modified UNESCO hierarchy. Draft report, Connecticut Natural Diversity Database. Hartford, CT.
- Motzkin, G. 1990a. Age structure and successional status of the Marconi Atlantic white cedar swamp, Cape Cod National Seashore, South Wellfleet, MA. M.S. thesis. University of Massachusetts, Amherst, MA.
- Motzkin, G. 1990b. Atlantic white cedar wetlands of Massachusetts. Unpublished report submitted to the Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Motzkin, G. 1991. Atlantic white cedar wetlands of Massachusetts. Research Bulletin 731. Massachusetts Agricultural Experiment Station, University of Massachusetts, Amherst, MA.
- Motzkin, G. 1993. Uncommon plant communities of the Connecticut Valley, Massachusetts. Unpublished report to the Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Motzkin, G. 1994. Calcareous fens of western New England and adjacent New York state. *Rhodora* 96: 44-68.
- Motzkin, G. 1995. Inventory of uncommon plant communities of western Massachusetts: 1993-1994. Unpublished report to the Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Motzkin, G., D.R. Foster, A. Allen, J. Harrod, & R. Boone. 1996. Controlling site to evaluate history: vegetation patterns of a New England sand plain. *Ecol. Monogr.* 66:345-365.
- Motzkin, G., W.A. Patterson III, and D.R. Foster, 1999. A historical perspective on Pitch Pine-Scrub Oak communities in the Connecticut Valley of Massachusetts. *Ecosystems* 2:255-273.
- Motzkin, G., W.A. Patterson III, and N.E.R. Drake. 1993. Fire history and vegetation dynamics of a *Chamaecyparis thuyoides* wetland on Cape Cod, Massachusetts. *Journal of Ecology* 81: 391-402.
- Natural Heritage Program. 1982. Ecological significance of the Katama Plains, Edgartown, Martha's Vineyard. Massachusetts Natural Heritage Program, Boston, MA.
- Nichols, G. E. 1914. The vegetation of Connecticut. III Plant societies on uplands. *Torreyia* 14: 167-194.
- Niering, W. A. & R.S. Warren. 1980. Vegetation patterns and processes in New England salt marshes. *BioScience* 30:301-307.
- Nixon, S.W. 1982. The ecology of New England high salt marshes: a community profile. USFWS, OBS, Washington, DC. FWS / OBS-81/55. 70 pp.
- Nothnagle, P., P. Goldstein and T. Simmons. 1994. *Cicindela dorsalis* population and habitat conditions on Martha's Vineyard 1990-1993. 1993 final report submitted to the Massachusetts Natural Heritage & Endangered Species Program. Feb. 2, 1994.
- Odum, W.E., T.J. Smith III, J.K. Hoover, & C.C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States east coast: a community profile. USFWS. FWS/OBS - 83/17. 177pp.
- Ogden, J. Gordon III. 1961. Forest history of Martha's Vineyard, Massachusetts 1. Modern and pre-colonial forests. *Amer. Midl. Natur.* 66:417-430.
- Oliver, C.D. and E. P. Stephens. 1977. Reconstruction of a mixed-species forest in Central New England. *Ecology* 58:562-572.
- From: Swain, P.C. & J.B. Kearsley. 2001. Classification of the Natural Communities of Massachusetts. Version 1.3. Natural Heritage & Endangered Species Program, Division of Fisheries & Wildlife. Westborough, MA.

## Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

- Oltch, F.M. 1974. The bogs of Berkshire County, Massachusetts: a habitat evaluation and vegetation analysis with emphasis on value for preservation. M.S. Special Problem Report. University of Massachusetts, Amherst, MA.
- Putnam, N. 2001. Spruce-Fir Boreal Swamps. Fact Sheet. Natural Heritage & Endangered Species Program, Westborough, MA.
- Rawinski, T.J. 1984a. New England natural community classification. Unpublished report, The Nature Conservancy, Eastern Regional Office, Boston, MA.
- Rawinski, T.J. 1984b. Natural community description abstract-Southern New England calcareous seepage swamp. Unpublished report, The Nature Conservancy, Eastern Regional Office, Boston, MA.
- Rawinski, T.J. 1988. Atlantic white cedar wetlands in central Massachusetts: locations and preliminary observations. Unpublished report, The Nature Conservancy, Eastern Regional Office, Boston, MA.
- Rawinski, Thomas J. 2000. Fire-maintained oak woodlands in the area of Worcester, MA: Vegetation ecology, wildlife, and conservation. Report to: Mass. Dept. Fisheries, Wildlife & Environmental Law Enforcement. BDI & NHESP.
- Reed, C.B. 1986. Floras of the serpentine formations in eastern North America. Baltimore. 858pp.
- Reid, B. and M. Anderson-Hill. 1999. 1998 Natural resource inventory of the Noquochoke wetlands. Unpublished report to the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, Biodiversity Initiative, Ecological Restoration Program. Westborough, MA.
- Reschke, C. 1990. Ecological Communities of New York State. New York Natural Heritage Program, N.Y.S. department of Environmental Conservation. Latham, NY. 96 pp.
- Roberts, E. A. 1914. The plant succession of the Holyoke Range. *Botanical Gazette* 58: 432-444.
- Searcy, K., H. Lanza, and A. Park. 1993. Inventory and characterization of natural communities with tupelo-swamp white oak-pin oak association in the Connecticut River Valley, Hampshire and Franklin Counties, Massachusetts. Unpublished report to the Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA.
- Searcy, K.B. and M.G. Hickler. 1999. The plant communities and vascular flora of the peatland within Poutwater Pond Nature Preserve. *Rhodora* 101:341-359.
- Searcy, K.B., B. Lindwall and T. Enz. 1993. Critical habitats and floristic survey of Fort Devens, Massachusetts.
- Searcy, K.B., Heather Lanza, and Allison Park. 1993. Inventory and characterization of natural communities with a tupelo-swamp white oak-pin oak association in the Connecticut River Valley. Hampshire & Franklin Counties, Ma. Report to NHESP.
- Shaw, Sally & Lowenstein. 1999. Classification of western Massachusetts pitch pine - scrub oak ridgetops and natural community inventory of Mount Tekoa in Russell, Massachusetts. Final report to the USFWS, Conte grant. The Nature Conservancy, Boston, MA.
- Shaw, Sally. 1998. Final report in fulfillment of challenge cost share grant for Stacy Mountain plant community mapping and trail building project (Req. no. CNWR-7-0020). The Nature Conservancy, prepared for Silvio O. Conte National FWR.
- Shifflet, C. 1981. Potential National Natural Landmarks. *Geologic Themes*.
- Slezak, W. 1975. An ecological analysis of the White Cedar Swamp Conservation Area, Wilbraham, Massachusetts. Unpublished report to the Wilbraham Conservation Commission Environmental Internship Program, Wilbraham, MA.
- Sneddon, L., M. Anderson, and J. Lundgren, eds. 1998. International classification of ecological communities: terrestrial vegetation of the Northeastern United States (July 1998 working draft). Unpublished report. The Nature Conservancy, Eastern Conservation Science and Natural Heritage Programs of the northeastern U.S., Boston, MA.
- Somers, P. T. Elliman, C. Quinlan, B. Windmiller, K. Sadighi, & F. Lowenstein. 2000. Biological and ecological features of the Appalachian Trail Corridor in Massachusetts. Final Report to the Appalachian Trail Conference and National Park Service from the Massachusetts Natural Heritage & Endangered Species Program, Division of Fisheries and Wildlife, Westborough, MA.

Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife

- Sorenson, E., M. Lapin, B. Engstrom, and R. Popp. 1998. Floodplain forests of Vermont: some sites of ecological significance. Unpublished report to the U.S. Environmental Protection Agency, Vermont Nongame and Natural Heritage Program, Waterbury, VT.
- Sorrie, B.A. & P. Somers. 1999. The vascular plants of Massachusetts: a county checklist. Massachusetts Division of Fisheries & Wildlife, Natural Heritage & Endangered Species Program, Westborough, MA 187 pp.
- Sperduto, D.D. 1994. A Classification of the Natural Communities of New Hampshire. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development. Concord, NH.
- Sperduto, D.D. 1997. The natural communities of New Hampshire: a guide and classification. Draft document 11-21-97, update 6-98. New Hampshire Natural Heritage Program. Concord, NH.
- Svenson, H.K.. 1970. A linden (*Tilia*) forest on Cape Cod (with extended notes on *Tilia neglecta*, *Bromus pubescens*, and *Ribes hirtellum*). *Rhodora* 72:339-350.
- Teal, J.M. 1986. The ecology of regularly flooded salt marshes of New England: a community profile. USFWS. Biol. Rep. 85(7.4). 61pp.
- Thayer, G.W., W.J. Kenworthy, & M.S. Fonseca. 1984. The ecology of eelgrass meadows of the Atlantic coast: a community profile. USFWS. FWS/OBS-84/02. 147pp.
- Thompson, E. 1995. Natural Communities of Vermont: Uplands and Wetlands. Vermont Nongame and Natural Heritage Program, Department of Fish and Wildlife, Agency of Natural Resources. Waterbury, VT.
- Thompson, E. and R. Popp. 1995. Calcareous open fens and riverside seeps of Vermont: some sites of ecological importance. Unpublished report, Vermont Nongame and Natural Heritage Program, Department of Fish and Wildlife, Agency of Natural Resources. Waterbury, VT.
- Tiner, Ralph W. 1998. In search of swampland: a wetland sourcebook and field guide. Rutgers University Press. 264pp.
- Tofte-Dorr, Leah. 1998. Vegetative inventory & classification of Martha's Vineyard's Coastal Pond Cove Wetlands. MS Thesis, Antioch New England.
- Veit, R.R. & W.R. Petersen. 1993. Birds of Massachusetts. Massachusetts Audubon Society, Lincoln, MA. 514pp.
- Vickery, P.D. & P.W. Dunwiddie, eds. 1997. Grasslands of northeastern North America: ecology and conservation of native and agricultural landscapes. Proceedings from a conference, 1994. Massachusetts Audubon Society. Lincoln, MA.
- Weatherbee, Pamela B. 1992. Natural plant communities of Berkshire County, Massachusetts. *Rhodora* 94:171-209.
- Weatherbee, Pamela B. 1996. Flora of Berkshire County. The Berkshire Museum, The Studley Press, Inc. Dalton, MA. 123 pp.
- Weatherbee, Pamela B. and G.E. Crow. 1990. Phytogeography of Berkshire County, Massachusetts. *Rhodora* 92: 232-256.
- Whitlach, R.B. 1982. The ecology of New England tidal flats: a community profile. USFWS FWS/OBS-81/01. 125pp.
- Whitney, G.G. & D.R. Foster. 1988. Overstorey composition and age as determinants of the understorey flora of woods of central New England. *Jour. Ecol.* 76:867-876.
- Zebryk, T.M. 1994. Vegetation and site characteristics of a *Nyssa*-dominated wetland in central New England. Unpublished report.
- Zebryk, T.M. 1998. Biological surveys of East Mountain Wildlife Management Area and vicinity. Holyoke-West Springfield-Westfield, Hampden County, Massachusetts. Unpublished report to the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, Biodiversity Initiative, Ecological Restoration Program. Westborough, MA.
- Zika, Peter and K.T. Dunn. 1985. Rare plants on ultramafic soils in Vermont. *Rhodora* 87:293-304.