National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Vegetation Inventory Project

Boston Harbor Islands National Recreation Area, Massachusetts

Natural Resource Report NPS/NETN/NRR—2017/1529



ON THE COVER
Beach Strand and Northern Beachgrass vegetation communities on Thompson Island, Boston Harbor Islands National Recreation Area.
Photograph by: Ery Largay, NatureServe

Vegetation Inventory Project

Boston Harbor Islands National Recreation Area, Massachusetts

Natural Resource Report NPS/NETN/NRR—2017/1529

Ery F. Largay[1] and Lesley A. Sneddon[1]

[1] NatureServe
11 Avenue de Lafayette 5th Floor
Boston, MA 02111

Edited and updated by:

Cogan Technology, Inc.
21 Valley Road
Galena, IL 61036

October 2017

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report was prepared by NatureServe staff in Boston, MA, under Cooperative Agreement CA4560-B-0009, Task/Supplemental Agreement Number 10, with assistance from the NPS, and by Cogan Technology, Inc. in Galena, IL, under contract GS10F0274X, order P15PD01783. The statements, findings, conclusions, recommendations, and data in this report are solely those of the author(s), and do not necessarily reflect the views of the U.S. Department of the Interior, National Park Service.

This report is available in digital format from the Northeast Temperate Network website and the Natural Resource Publications Management website. To receive this report in a format that is optimized to be accessible using screen readers for the visually or cognitively impaired, please email irma@nps.gov.

Please cite this publication as:

Largay, E. F., and L. A. Sneddon. 2017. Vegetation Inventory Project: Boston Harbor Islands National Recreation Area, Massachusetts. Natural Resource Report NPS/NETN/NRR—2017/1529. National Park Service, Fort Collins, Colorado.

NPS 035/140366, October 2017

Contents

Page

Figures v

Tables xi

Appendices xiii

Acronyms and Abbreviations xv

Executive Summary xvii

Acknowledgements xix

Introduction 1

NPS Vegetation Inventory Program 1

U.S. National Vegetation Classification 2

Massachusetts Natural Heritage & Endangered Species Program and the USNVC 4

NPS Northeast Temperate Network 5

Project Area and Park-Specific Information 7

Geology 13

Soils 15

Hydrology 15

Land Use 17

Materials and Methods 19

Project Timeline 19

Planning and Scoping 19

Preliminary Data Collection and Review of Existing Information 20

Aerial Photography Acquisition and Processing 24

Photo Interpretation and Preliminary Vegetation Map Production 25

Field Data Collection and Classification 26

Field Survey 28

Vegetation Classification and Characterization 30

2006 Draft Vegetation Map Preparation 31

Contents (continued)

Page

Accuracy Assessment 32
Positional Accuracy Assessment 32
Thematic Accuracy Assessment 32
Thematic Accuracy Assessment Field Methods 35
Data Analysis 36
Final Vegetation Classification and Map Preparation 38
Results 39
Vegetation Classification and Characterization 39
2006 Vegetation Map Production 45
Accuracy Assessment 45
Positional Accuracy 45
Thematic Accuracy 45
Final Vegetation Map Production 53
Vegetation Association Descriptions 57
Project Products 57
Discussion 59
Vegetation Classification and Characterization 59
Vegetation Map Production 65
Conclusions 65
Literature Cited 67
Global Information 26
Local Information 164

Figures

Page

Figure 1. Map of Northeast Temperate Network park units [Source USDI-NPS 2015b]. 6

Figure 2. Boston Harbor Islands National Recreational Area, as situated in Boston Harbor and Quincy, Hingham, and Massachusetts Bays in Massachusetts (from USDI-NPS 2009). 9

Figure 3. Location of Boston Harbor Islands National Recreational Area, Norfolk, Plymouth, and Suffolk Counties, Massachusetts, on the Boston North, MA and Hull, MA 1;24,000 USGS topographic quad maps 10

Figure 4. Location of Boston Harbor Islands National Recreational Area (red square) within Boston Basin Ecoregion (59d) 13

Figure 5. Locations of existing data used to map the vegetation at Boston Harbor Islands National Recreation Area: 134 2001-2002 Elliman community rapid assessment points (blue), 207 2004-2005 Elliman invasive plant assessment points (yellow), and selected vegetated 2002 Bell et al. marine intertidal community polygons (turquoise). 26

Figure 6. Locations of the 47 vegetation plots in Boston Harbor Islands National Recreation Area for vegetation classification and mapping 30

Figure 7. Locations of the 172 accuracy assessment sampling points in Boston Harbor Islands National Recreation Area. 35

Figure 8. Cluster analysis dendrogram of the 47 vegetation classification plots sampled within Boston Harbor Islands National Recreation Area. 40

Figure 9. Non-metric Multidimensional Scaling (NMS) analysis (axes 1 and 2) of the full set of vegetation plots at Boston Harbor Islands National Recreation Area (N=47), showing species composition, structure, and environmental setting relationships among the vegetation types 41

Figure 10. Vegetation associations and land use – land cover categories for Boston Harbor Islands National Recreation Area. 54

Figure F-1. Old-field Eastern Red-cedar Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.010) F-7

Figure F-2. Early-successional Woodland/Forest on Grape Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA057) F-13

Figure F-3. Northeastern Modified Succesional Forest on Peddocks Island in Boston Harbor Island National Recreation Area (plot BOHA.018) F-20

Figures (continued)

Page

Figure F-4. Black Pine Forest on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.014). September 2006 ..... F-24

Figure F-5. Norway Maple Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.025) F-29

Figure F-6. Successional Maritime Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.022-two views of the same plot) F-35

Figure F-7. Maritime Red-cedar Woodland on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.012-two views of same plot) F-40

Figure F-8. Maritime Red-cedar Woodland on World's End in Boston Harbor Islands National Recreation Area (same polygon as AA point BOHA.AA133) F-41

Figure F-9. Staghorn Sumac Shrubland on Long Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA024) F-46

Figure F-10. Staghorn Sumac Shrubland on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA071) F-46

Figure F-11. Staghorn Sumac Shrubland Rocky Headland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.015) F-51

Figure F-12. Staghorn Sumac Shrubland Rocky Headland on Rainsford Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA118) F-51

Figure F-13. Stunted Staghorn Sumac Shrubland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.020) F-56

Figure F-14. Stunted Staghorn Sumac Shrubland on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.043) F-56

Figure F-15. Northeastern Dry Oak-Hickory Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.003). F-62

Figure F-16. Northeastern Dry Oak-Hickory Forest on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA170-two views of the same point) F-63

Figure F-17. Upland/Wetland Transitional Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.021) F-68

Figure F-18. Common Wormwood Gravel Field on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.038). September 2006 ..... F-71

Figures (continued)

Page

Figure F-19. Common Wormwood Gravel Field on Middle Brewster Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA157) F-72

Figure F-20. Northeastern Old Field on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA015)..... F-77

Figure F-21. Northeastern Old Field on Thompson Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA004) F-78

Figure F-22. Little Bluestem Old Field on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.006)..... F-83

Figure F-23. Little Bluestem Old Field on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.029)..... F-83

Figure F-24. Northeastern Successional Shrubland on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.041) F-89

Figure F-25. Northern Beachgrass Vegetation on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.027) F-93

Figure F-26. Northern Beachgrass Vegetation on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.035) F-94

Figure F-27. Overwash Grassland on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.030). September 2006 ..... F-100

Figure F-28. Overwash Grassland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.017) F-100

Figure F-29. Beach Strand on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.016) F-106

Figure F-30. Beach Strand on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.042)..... F-106

Figure F-31. Eastern Cattail Marsh on Middle Brewster Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA178) F-111

Figure F-32. Northeastern Buttonbush Shrub Swamp on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.011) F-116

Figure F-33. Eastern Reed Marsh on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.045) F-120

Figures (continued)

Page

Figure F-34. Reed-grass Tidal Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.007). September 2006 ..... F-125

Figure F-35. Wet Meadow on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.023) F-130

Figure F-36. Wet Meadow on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA176) F-131

Figure F-37. Cattail Brackish Tidal Marsh on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.047) F-136

Figure F-38. Coastal Salt Pond Marsh on Calf Island in Boston Harbor Islands National Recreation Area (Observation point-green fringe surrounding the red Salicornia) F-142

Figure F-39. North Atlantic High Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.001) F-147

Figure F-40. North Atlantic High Salt Marsh on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.032) F-147

Figure F-41. Eastern Tidal Salt Shrub on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.002) F-152

Figure F-42. North Atlantic Low Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.004) F-157

Figure F-43. North Atlantic Low Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA091) F-158

Figure F-44. Salt Panne (Salicornia Type) on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.008) F-163

Figure F-45. North Atlantic Coast Estuarine Intertidal Mudflats on World's End in Boston Harbor Islands National Recreation Area (observation point) F-167

Figure F-46. New England Rocky Intertidal Community on Grape Island in Boston Harbor Islands National Recreation Area (observation point) F-171

Figure F-47. New England Rocky Intertidal Community on World's End in Boston Harbor Islands National Recreation Area (below plot BOHA.012) F-172

Figure F-48. Maritime Rock Cliffs and Outcrops on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA146) F-176

Figures (continued)

Page

Figure F-49. Maritime Erosional Bluffs and Cliffs on Long Island in Boston Harbor Islands National Recreation Area (observation point) F-181

Figure F-50. Maritime Erosional Bluffs and Cliffs on Great Brewster Island in Boston Harbor Island National Recreation Area (AA point BOHA.AA145-two views) F-181

Figure J-1. Vegetation associations and land use - land cover categories of the Great Brewster, Little Brewster, Middle Brewster, Outer Brewster, Calf, Little Calf, and Green Islands and Shag Rocks of Boston Harbor Islands National Recreation Area. J-14

Figure J-2. Vegetation associations and land use - land cover categories of Bumpkin Island of Boston Harbor Islands National Recreation Area. J-15

Figure J-3. Vegetation associations and land use - land cover categories of Snake and Deer Islands of Boston Harbor Islands National Recreation Area. J-16

Figure J-4. Vegetation associations and land use - land cover categories of Grape and Slate Islands and Webb Memorial State Park of Boston Harbor Islands National Recreation Area. J-17

Figure J-5. Vegetation associations and land use - land cover categories of Hangman and Nut Islands of Boston Harbor Islands National Recreation Area. J-18

Figure J-6. Vegetation associations and land use - land cover categories of Lovells, Gallops, and Georges Islands and Nixes Mate of Boston Harbor Islands National Recreation Area. J-19

Figure J-7. Vegetation associations and land use - land cover categories of Peddocks and Sheep Islands of Boston Harbor Islands National Recreation Area. J-20

Figure J-8. Vegetation associations and land use - land cover categories of Raccoon Island of Boston Harbor Islands National Recreation Area. J-21

Figure J-9. Vegetation associations and land use - land cover categories of Spectacle, Long, and Rainsford Islands of Boston Harbor Islands National Recreation Area. J-22

Figure J-10. Vegetation associations and land use - land cover categories of The Graves of Boston Harbor Islands National Recreation Area. J-23

Figure J-11. Vegetation associations and land use - land cover categories of Thompson and Moon Islands of Boston Harbor Islands National Recreation Area. J-24

Figure J-12. Vegetation associations and land use - land cover categories of World's End peninsula and Langlee, Ragged, Sarah, and Button Islands of Boston Harbor Islands National Recreation Area. J-25

Tables

Page

Table 1. Member organizations of the Boston Harbor Islands Partnership. 7

Table 2. Soil map units of Boston Harbor Islands National Recreation Area (USDI-NPS 2011). 16

Table 3. Translation of intertidal vegetated and sparsely vegetated assemblage names described by Bell et al. (2002) and wetland habitats described by Tiner et al. (2003) for Boston Harbor Islands National Recreation Area to U.S. National Vegetation Classification..... 20

Table 4. Translation of plant association names used by Elliman (2005) at Boston Harbor Islands National Recreation Area to U.S. National Vegetation Classification 22

Table 5. Description of mosaic for the Boston Harbor Islands National Recreation Area. 24

Table 6. Location and number of plots sampled (47) for vegetation associations at Boston Harbor Islands National Recreation Area based on Elliman's 2005 preliminary vegetation classification. 27

Table 7. Thematic accuracy assessment sampling strategy for Boston Harbor Islands National Recreation Area. 33

Table 8a. Ecological groupings and component U.S. National Vegetation Classification associations by USNVC macrogroup and land use – land cover map classes at Boston Harbor Islands National Recreation Area. 42

Table 8b. Ecological groupings and component U.S. National Vegetation Classification associations by USNVC macrogroup and land use – land cover map classes at Boston Harbor Islands National Recreation Area. 45

Table 9. Sample contingency table (U.S. National Vegetation Classification association level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.[1] 47

Table 10. Population contingency table (U.S. National Vegetation Classification association level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.[1] 48

Table 11. Population contingency table (U.S. National Vegetation Classification group and macrogroup level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment. 51

Tables (continued)

Page

Table 12. Population contingency table (U.S. National Vegetation Classification division, formation, subclass, and class level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.[1] 52

Table 13. Number of polygons and total mapped hectares and acres of vegetation and land use – land cover map classes for the final association-level vegetation map of Boston Harbor Islands National Recreation Area. 55

Table 14. Summary of products resulting from the Boston Harbor Islands National Recreation Area vegetation classification and mapping project. 58

Table 15. Areas of intertidal vegetation associations mapped in the Bell et al. (2002) study that were incorporated into the Boston Harbor Islands National Recreation Area vegetation map. 60

Table 16. State-ranked and globally-ranked rare, endangered, threatened, and watch list plant associations in Boston Harbor Islands National Recreation Area. 62

Table D-1. Data dictionary for fields in PLOTS 2.0 Database by table. D-1

Table E-1. Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004). E-1

Table J-1. Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula. J-1

Table K-1. NatureServe global conservation status definitions K-1

Table K-2. NatureServe state conservation status definitions. K-2

Appendices

Page

Appendix A. Detailed information about the aerial photography and orthophoto A-1

Appendix B. Photomosaic interpretation key for Boston Harbor Islands National Recreational Area..... B-1

Appendix C. Vegetation plot sampling form. C-1

Appendix D. Data dictionary for Plots 2.0 database..... D-1

Appendix E. Plants observed in Boston Harbor Islands National Recreation Area E-1

Appendix F. Global and local descriptions for the U.S. National Vegetation Classification associations of Boston Harbor Islands National Recreation Area. F-1

Appendix G. Dichotomous field key to the vegetation associations of Boston Harbor Islands National Recreation Area. G-1

Appendix H. Accuracy assessment field data form H-1

Appendix I. Index of representative photographs of USNVC vegetation associations at Boston Harbor Islands National Recreation Area. I-1

Appendix J. Statistics and maps for vegetation and land use-land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula..... J-1

Appendix K. NatureServe global and state conservation status rank definitions. K-1

Appendix L. Bibliography for U. S. National Vegetation Classification global vegetation descriptions for associations of Boston Harbor Islands National Recreation Area. L-1

Acronyms and Abbreviations

AA	Accuracy Assessment
ac	Acre(s)
BOHA	Boston Harbor Islands National Recreation Area
CEGL	Community Element Code – Global
CONUS	Continental United States
DEM	Digital Elevation Model (cartography)
e.g.	for example (exempli gratia)
ERDAS	Earth Resources Data Analysis System
ESRI	Environmental Systems Research Institute
et al.	and others (et alia)
FGDC	Federal Geographic Data Committee
ft	Foot/Feet
GIS	Geographic Information System
GMP	General Management Plan
GPS	Global Positioning System Receiver
ha	Hectare(s)
HTML	Hyper Text Markup Language
I&M	Inventory and Monitoring Program (National Park Service)
i.e.	that is (id est)
in	Inch(es)
km	Kilometer(s)
m	Meter(s)
MA	Massachusetts
Ma	Million Years Ago
mi	Mile(s)
MassGIS	Commonwealth of Massachusetts Office of Geographic and Environmental Information
MMU	Minimum Mapping Unit
MNH&ESP	Massachusetts Natural Heritage and Endangered Species Program
MP	Metadata Compiler Program
MrSID	Multiresolution Seamless Image Database
N/A	Not Applicable
NAD83	North American Datum of 1983
NETN	Northeast Temperate Inventory and Monitoring Network
NMS	Non-metric Multidimensional Scaling
NPS	National Park Service
NRC	Natural Resources Challenge
NVMI	National Vegetation Mapping Inventory (National Park Service)
sp./spp.	Species (singular/plural)
TNC	The Nature Conservancy

TXT	Text Only (no graphics)
UNESCO	United Nations Educational, Scientific, and Cultural Organization
URL	Uniform Resource Locator
U.S.	United States of America
USDA	U.S. Department of Agriculture
USDA-NRCS	U.S. Department of Agriculture-Natural Resources Conservation Service
USDA-SCS	U.S. Department of Agriculture-Soil Conservation Service
USDI	U.S. Department of the Interior
USGS	U.S. Geological Survey
USNVC	U.S. National Vegetation Classification
UTM	Universal Transverse Mercator
XML	Extensible Markup Language

Executive Summary

Vegetation classification and mapping of Boston Harbor Islands National Recreation Area (BOHA) follows established National Park Service (NPS) protocols under an umbrella agreement with NatureServe and its component network of Natural Heritage programs. NatureServe developed an initial vegetation classification for the park based on the U.S. National Vegetation Classification (USNVC), Elliman's (2005) natural community classification, and the Bell et al. (2002) marine intertidal habitat classification. Forty-seven vegetation classification plots were sampled in the summer of 2006. Associations were mapped onto an orthorectified composite aerial photo background from the Commonwealth of Massachusetts Office of Geographic and Environmental Information (MassGIS) using on-screen digitizing. One hundred seventy-two accuracy assessment points were collected to verify the accuracy of the vegetation map in 2008. The final accuracy of the vegetation map is 82% at the level of USNVC association and alliance, 86% at the level of USNVC group and macrogroup and 89% at the level of USNVC division, formation, subclass, and class.

The final vegetation map is composed of 42 map classes. Thirty (30) classes are of vegetation classified to a USNVC association; three classes are of vegetation classes equivalent to a phase of a USNVC association ("sub-associations"), and one class is comprised of a single USNVC association mixed with a land use-land cover class that is equivalent to an Anderson Level II class. The remaining eight classes are land use - land cover classes equivalent to Anderson Level II classes. Altogether, 766 ha (1,894 ac) were mapped. The vegetation associations and land uses are mapped to the shoreline edges of all 34 islands and peninsulas as shown in the 2005 MassGIS orthophotography. In total, 587 ha (1,451 ac) of terrestrial and intertidal vegetation communities including un-vegetated beaches are mapped. Of this total, 179 ha (443 ac) are mapped as solely land use - land cover categories. Thirty 32 (32) USNVC associations were classified and described, with one association comprised of three distinct phases (34 vegetation types total). BOHA supports habitat for three globally rare (G1-G3) and five (S1-S3) state-ranked natural vegetation associations.

The coastal setting and centuries of past land use on each of the islands and peninsulas have influenced the present-day vegetation. Successional forests, woodlands, shrublands, and old fields are the most abundant terrestrial vegetation throughout the park, comprising 251 ha (620 ac). The most abundant native, natural, terrestrial vegetation in BOHA is shrublands dominated by staghorn sumac (*Rhus typhina*). Three variants of staghorn sumac shrubland have become established on 52 ha (128.3 ac) of the park. Beaches, with inclusions of the Beach Strand vegetation association, comprise 123.4 ha (305 ac) of BOHA. Maritime Red-cedar Woodland, a globally rare vegetation association, occurs on the rocky headlands on World's End, Langlee, and Ragged islands in Hingham Harbor. Two other unique vegetation associations are Maritime Rock Cliffs and Outcrops and Maritime Erosional Bluffs and Cliffs. The park provides habitat for diverse vegetation associations including native upland forests, shrub swamp, (fresh, brackish, and salt) marshes, and intertidal rock and mudflat vegetation. Non-native vegetation associations including Norway Maple Forest, Black Pine Forest, Common Wormwood Gravel Field, Eastern Reed Marsh, and Reed-grass Tidal Marsh also occur throughout BOHA, covering a total of 67 ha (164 ac).

Descriptions of the local and global expressions of each vegetation association and a photo-interpretation key, field key, plant species list, metadata for the vegetation plot data, and an index to photographic documentation are included as appendices. The digital vegetation map, geodatabase of the spatial location of vegetation plots and accuracy assessment points, the digital orthophoto developed for the park, and a Microsoft Access database of the vegetation plot and accuracy assessment data are also products of this project.

Keywords: vegetation association, vegetation classification, vegetation mapping, Boston Harbor Islands National Recreation Area (BOHA).

Acknowledgements

The National Park Service is gratefully acknowledged for its funding of this project. Beth Johnson and John Karish of NPS provided funding as well as helpful project oversight. We would also like to thank the following NPS staff for their time and assistance with this project: Sheila Colwell, Fred Dieffenbach, Charles Roman, Nigel Shaw, Brian Mitchell, Marc Albert, Roland Duhaime, Bruce Jacobson, Adam Kozlowski, and Kate Miller. Pat Swain of the Massachusetts Natural Heritage Program who contributed her valuable expertise to this project. We thank Rich Bell and Ted Elliman for providing us with data from previous inventory and mapping work on the islands; their work was extremely helpful for this project. Beth Eastman and Perver Baran from North Carolina State University provided tremendous support with the vegetation map. Judy Teague, Mark Hall, and Jon Hak from NatureServe provided technical guidance with spatial vegetation mapping and imagery. Sue Gawler conducted the accuracy assessment and Mary Russo managed the vegetation classification plot and accuracy assessment data and assisted with the report. The Wadlow family provided a terrific boat. Cottage Park Yacht Club provided overnight dock space during accuracy assessment sampling, which we greatly appreciated. We would also like to thank Stephanie Perles and Gregory Podniesinski (Pennsylvania Natural Heritage) who provided us with NPS vegetation mapping final report templates. In an effort to achieve consistency from state-to-state, sections of the text in this report were adopted from previously completed NPS vegetation mapping reports (e.g., Perles et al. 2006 and the NPS National Vegetation Inventory Program) with permission. The contributions of all these individuals and anyone not mentioned are greatly appreciated.

Chris Lea, Jim Von Loh, and Dan Cogan of Cogan Technology, Inc. edited and updated this report and its associated products to reflect 2016 National Park Service and U.S. National Vegetation Classification standards.

Introduction

Boston Harbor Islands National Recreation Area (BOHA) is a unit of the National Park Service (NPS) that is located east of Boston, Massachusetts (MA) in the temperate northeastern U.S. The park manages 30 islands and four peninsulas whose land area fluctuates from 600 to 1,241 ha (1,483 to 3,067 ac) during the tidal cycle. Terrestrial areas comprise approximately 50% of the park area, while intertidal areas including unvegetated beaches comprise the other half (Bell et al. 2002). The islands and peninsulas were designated as a National Recreation Area by Congress in 1996 to protect and manage natural resources and conserve rare biota (Roman et al. 2005). BOHA is a collaborative park unit owned and administered by various interests including the NPS, U.S. Coast Guard, Commonwealth of Massachusetts, Trustees of Reservations, Island Alliance, Outward Bound, City of Boston, and others, as described in this report chapter (USDI-NPS 2009).

The purpose of this project is to produce a standardized map and classification of the terrestrial and intertidal vegetation associations, un-vegetated beaches, and other land cover of BOHA and to provide thorough baseline data on the park's vegetation. The resulting products will inform natural resource decision-making in the development and implementation of the park management plan, environmental compliance decisions, resource management and research programs, and citizens and other organizations. This project is part of the NPS National Vegetation Mapping Inventory (NVMI), a program to map and describe the vegetation of national parks using the United States National Vegetation Classification (USNVC). Implementation of NVMI vegetation inventories is often handled through agreements with NatureServe, its member natural heritage programs, and other cooperators. For BOHA, NatureServe ecologists planned the vegetation sampling, oversaw the field effort, developed the vegetation map, and integrated the plot data, accuracy assessment data, and field information into the USNVC to produce a standardized final product for the NPS.

NPS Vegetation Inventory Program

In 1998, the United States Congress passed the Omnibus National Parks Management Act, which became Public Law 105-391. Section 204 of this law directs the Secretary of the Department of the Interior to “undertake a program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources” (16 United States Code 5934). Pursuant to this mandate, the Director of the NPS approved the Natural Resource Challenge (NRC) in 1999 to facilitate the preservation of the nation’s natural heritage through science, natural resource inventories, and expanded resource monitoring (USDI-NPS 1999). The NRC provided the funding for 12 baseline inventories to be completed in each of 270 parks with significant natural resources. The NVMI, begun in 1994 as a partnership with the U.S. Geological Survey (USGS), was assimilated into the NRC as one of the inventories, and funding was increased to accelerate Servicewide completion of the inventory. The objectives of the NVMI are to classify, describe, and map vegetation in 270 National Park units. Using vegetation data specific to a park unit enables park managers to conserve biodiversity, manage challenges such as exotic species, insect outbreaks, and diseases, and understand resources and processes such as wildlife habitat relationships and wildland fires, in a more effective and efficient manner. The NVMI is supervised by staff in Fort Collins, Colorado and

funded at the national level of the NPS, but individual NPS unit projects typically are overseen by local NPS staff located in 32 Inventory and Monitoring (I&M) network offices that were also established by the NRC and are more local to clusters of individual park units.

The NVMI uses quality control and methodology procedures for data collection and production of vegetation and land cover maps to ensure the reliability of the vegetation data and encourage the use of resulting maps, reports, and databases at multiple scales (e.g., TNC and ESRI 1994, Lea and Curtis 2010). A complete vegetation classification and mapping project for a park includes, at a minimum, the following products:

- Detailed vegetation report
- Digital vegetation map
- Vegetation classification plot data
- Accuracy assessment data and analysis
- Dichotomous vegetation key
- Photo-interpretation key

Classified vegetation types are described both as they appear locally at individual park units and also in the national context of the USNVC, using recognized USNVC units, whenever feasible (Lea 2011). Vegetation map classes are based on the locally classified vegetation types, Maps are produced in Universal Transverse Mercator (UTM) coordinates (NAD 83) with a 1:24,000 scale and a minimum mapping unit of 0.5 hectares (ha) (1.24 acres (ac)). The vegetation maps must meet the FGDC National Map Accuracy Standards (1998b) for positional accuracy (which specify horizontal errors of less than 40.0 feet (ft) (12.2 meters (m)) on the ground for 1:24,000-scale maps). The overall (entire map) thematic accuracy goal is at least 80%. In addition to assessing overall thematic accuracy, the accuracy of individual map classes that comprise the map is assessed and reported; these estimates allow users to be informed of map limitations (Lea and Curtis 2010). Digital vegetation products are accompanied by FGDC-compliant metadata, which describe the content, quality, condition, and other characteristics of the spatial dataset and are critical elements that expedite the interpretation and exchange of information among users. NVMI products are available through the NPS Data Store (http://science.nature.nps.gov/im/datamgmt/IRMA.cfm).

The goal of the vegetation inventory project for BOHA was to produce an up-to-date digital geospatial vegetation database and to provide a vascular plant species list, a dichotomous key for vegetation associations, and descriptions of the vegetation associations in the park.

U.S. National Vegetation Classification

The USNVC is a hierarchical system for vegetation classification within the United States that was originally developed by The Nature Conservancy (TNC) (Grossman et al. 1998). The Federal Geographic Data Committee adopted the upper hierarchy levels of the original TNC version with

some modifications as a federal standard (FGDC-STD-005) (FGDC 1997) which was, intended to facilitate the sharing and merging of vegetation data throughout the United States. In 2008, the FGDC adopted a new version of the USNVC (FGDC 2008); this version extensively revised the upper levels of the hierarchy into units that were more coherent biogeographically, floristically, and ecologically than were the units of the 1997 version, which were more strongly based on vegetation physiognomy and structure. Since 2008, the FGDC and partners, including the Ecological Society of America Panel on Vegetation Classification, NatureServe, and individual federal agencies including the NPS have supported the development of taxonomic units for the revised hierarchy and the dissemination of the content of the USNVC and its public availability (USNVC 2015).

The upper three hierarchy levels of the USNVC (Class, Subclass, and Formation) are based on vegetation physiognomic characteristics that reflect patterns of climate, hydrology, and substrate that recur globally (USNVC 2015). The fourth level (Division) represents geographic partitions of Formations that vary by major intracontinental climate and biogeographical patterns at the scale of biotic regions, provinces, or sub-provinces (Dice 1943, McLaughlin 2007). Most divisions recognized by the USNVC are unique to North America. The next levels (Macrogroup and Group) subdivide divisions based on broad sets of diagnostic plant species and habitat factors along intraregional topographic, edaphic, and disturbance gradients. Units of the lower two levels (Alliance and Association) are distinguished from one another by differences in local floristic composition. Alliances are physiognomically uniform groupings of plant associations that share dominant or diagnostic species, usually in the uppermost stratum of the vegetation. Alliances are generally more wide-ranging geographically than are associations, although many monotypic alliances have been classified.

The basic unit of vegetation classification in the USNVC is the association (a plant community type that is relatively homogeneous in composition and structure, and occurs in a uniform habitat). Associations are roughly equivalent in taxonomic scale to the plant association of European phytosociologists (Mueller-Dombois and Ellenberg 1974). They are defined from a rangewide perspective and are assigned global rarity ranks as well as ranking specifications to be applied to individual occurrences of associations across their range. A map of associations occurring at a site can provide information about the abundance and distribution of each type, the significance of the individual occurrences, as well as providing surrogate information about the location and abundance of individual species characteristic of the association.

Each association that is recognized by the USNVC (USNVC 2015) is assigned a unique Community Element Global code (CEGL). For example, the Eastern Hemlock - American Beech - Northern Red Oak Forest (CEGL006088) is a widespread association in southern New England that ranges south locally in the northern Piedmont and High Allegheny Mountains. Associations are also assigned global rarity ranks that indicate their conservation status and relative risk of extirpation (Grossman et al.1998). In BOHA, Maritime Red-cedar Woodland (CEGL006212), a globally rare vegetation association, occurs on the rocky headlands on World's End, Langlee, and Ragged islands in Hingham Harbor. Two additional unique vegetation associations of BOHA are Maritime Rock Cliffs and Outcrops (CEGL006619) and Maritime Erosional Bluffs and Cliffs (CEGL006618). Associations

from the USNVC are often equivalent to communities in state-specific vegetation classifications such as Classification of the Natural Communities of Massachusetts (Swain and Kearsley 2011, Version 1.4 described below) and can usually be translated to equivalent units (e.g., associations or community types) of state agency classifications.

Several associations that share one or more dominant or characteristic species can be grouped to form an alliance which is generally more wide-ranging geographically than associations, covering multiple habitats and broader species composition. For example, the Eastern Hemlock - American Beech - Northern Red Oak Forest (CEGL006088) association and the Eastern Hemlock - Yellow Birch - Sugar Maple/Intermediate Woodfern Forest (CEGL006109) are grouped into the Eastern Hemlock - Yellow Birch Forest Alliance. An association with unique species composition or environmental niche can be assigned to its own alliance, such that the alliance only contains one association instead of multiple associations.

Massachusetts Natural Heritage & Endangered Species Program and the USNVC

In 1984, The Nature Conservancy, Eastern Regional Office prepared the unpublished manuscript, the *New England Natural Community Classification* (Rawinski 1984), a classification of natural and human-influenced communities that included Massachusetts. This TNC classification became the primary source for natural community classification in Massachusetts and a contributory reference for natural community classifications in the northeastern U.S. First published in 2001 and updated through 2011, the Massachusetts Natural Heritage and Endangered Species Program (MNH&ESP) developed an updated classification for Massachusetts to provide a useful framework for describing, inventorying, and tracking natural communities (Swain and Kearsley 2011, Version 1.4). This natural community classification was designed to describe vegetation at a scale that is meaningful for conservation and land protection. It reduced the natural vegetation complexity to 105 communities of somewhat homogenous and relatively easily understood, but abstract and artificial, groups. Its intent is to describe communities that can be identified in the field and to accurately (if arbitrarily) divide the vegetation into identifiable and useful categories; attempts were made to use community names that are recognizable and meaningful to a broad conservation audience from local community planners to field ecologists. Swain and Kearsley (2011) encourage input into the classification categories and delineations relative to the intended use for conservation, including a focus on uncommon community types.

More specifically, Swain and Kearsley (2011) is a state-based classification system of ecological habitats that occur within Massachusetts using three major sections: Terrestrial, Palustrine, and Estuarine (Aquatic communities are not addressed in this classification). As the composition and structure of the community types become better defined, future splitting or lumping may occur within currently identified vegetation types. For example, the complex of communities characterized by oak trees and another inter-related group characterized by red maple may be further split as additional data are collected and analyzed.

Swain and Kearsley (2011) did identify recurrent groupings of plant species (and associated animal species) that shared responses to environmental conditions. These natural communities vary in response to soil moisture gradients, temperature gradients, and nutrient gradients in a

multidimensional, rather than linear way resulting in southern and northern versions of dry-to-wet gradients, acidic-to-less acidic, and nutrient poor-to-nutrient rich communities, among other interactions (Swain and Kearsley 2011). Although not generally of conservation focus, cultural plant communities (those planted or maintained by humans, including forest plantations, orchards, pastures, etc.) concepts could be expanded, however at this time they remain lumped into a few groups, typically as land use types. The role of land use history is important to consider relative to plant communities of Massachusetts, as over 300 years of intense land use has occurred.

This classification focuses on the natural communities of Massachusetts which are closely related to regional natural communities of the surrounding states. As such, the Massachusetts community descriptions include lists of synonyms for the surrounding states, each of which has also developed classifications for natural communities within their boundaries. TNC has developed a regional classification under the USNVC and these synonyms are included in the Massachusetts classification, thus allowing some community types to be more finely divided into the vegetation association level of the classification hierarchy. Swain and Kearsley (2011) have also prepared a cross-walk to the earlier classification of Rawinski (1984) and have noted that for northern forest types, there is a lack of precision in this cross-walk (at least partially a result of the lack of clear boundaries between types).

MNH&ESP (2015) is an active participant in NatureServe, the international network of biodiversity data centers. There are currently natural heritage programs in all 50 states and several interstate regions; there are 21 Conservation Data Centers, the international equivalent of natural heritage programs, in Canada, Latin America, and South America. These programs work with NatureServe to develop biodiversity data, maintain compatible standards for data management, and provide information about rare species and natural communities that is consistent across many geographic scales from sites to continents. MNH&ESP collaboration with NatureServe, other states, and nations places local information into a broader regional context. With NatureServe, the MNH&ESP tracks the rarity of species and natural communities at global and state scales, allowing distinguishing the conservation priority for plant species with a few populations in the world with another plant with a few populations in Massachusetts but many populations elsewhere.

NPS Northeast Temperate Network

The Northeast Temperate Network (NETN) (Figure 1) is headquartered in Woodstock, Vermont and is comprised of 13 parks located in seven northeastern states as well as six additional states through which the Appalachian National Scenic Trail passes.

These parks are Acadia National Park, Appalachian National Scenic Trail (from Maine to Maryland), Boston Harbor Islands National Recreation Area, Home of Franklin D. Roosevelt National Historic Site, Eleanor Roosevelt National Historic Site, Marsh-Billings-Rockefeller National Historical Park, Minute Man National Historic Park, Morristown National Historic Park, Saint-Gaudens National Historic Site, Saratoga National Historical Park, Saugus Iron Works National Historic Site, Vanderbilt Mansion National Historic Site, and Weir Farm National Historic Site (USDI-NPS 2015b). Collectively, the 13 park units comprise nearly 57,933 ha (143,156 ac) and range considerably in size (3-to-34,398 ha) (9-to-85,000 ac) and topographic relief. NETN staff oversees

ongoing natural resource monitoring programs and also facilitate the implementation of the nationally funded baseline inventories, as they are implemented at individual parks within the network.



Figure 1. Map of Northeast Temperate Network park units [Source USDI-NPS 2015b].

NETN parks are located within the temperate deciduous forest biome (characteristic trees are broadleaf/deciduous including species of oak, maple, beech, hickory, and chestnut). Deciduous forest regions are exposed to warm and cold air masses, which cause this area to have four distinct seasons. Temperature varies widely from season to season with cold winters and hot, wet summers. The areas in which deciduous forests are located receive from 75-to-150 cm (29.5-to-59.1 inches) of precipitation occurring evenly throughout the year. The diversity of ecological communities established within NETN park units range from tidal wetland and other coastal communities, freshwater wetlands and vernal pools, and deciduous, mixed, and evergreen forests.

Project Area and Park-Specific Information

BOHA is located in Suffolk County and administers some 30 islands under a partnership of federal, state, and local agencies/officials, and private non-profit groups working together under the guidance of a General Management Plan (USDI-NPS 2002). The Boston Harbor Islands Partnership coordinates the activities of the managers of the islands in the development and implementation of the management plan for each island and the national recreation area in its entirety; 12 members are appointed by the Secretary of the Interior and one member is appointed by the Commandant of Coast Guard. Table 1 lists the Partnership member organizations.

Table 1. Member organizations of the Boston Harbor Islands Partnership.

Organization	Logo	Web Site
National Park Service		www.nps.gov/boha
United States Coast Guard		http://www.uscg.mil/
Massachusetts Department of Conservation and Recreation		www.mass.gov/eea/agencies/dcr/massparks/
Massachusetts Port Authority		www.massport.com/visit-boston/things-to-do.html
Massachusetts Water Resources Authority		www.mwra.com/harbor/html/bhisl.htm
City of Boston		www.cityofboston.gov/environment
Boston Redevelopment Authority		www.cityofboston.gov/bra

Table 1 (continued). Member organizations of the Boston Harbor Islands Partnership.

Organization	Logo	Web Site
Thompson Island Outward Bound Education Center		www.thompsonisland.org
The Trustees of Reservations		www.thetrustees.org
Boston Harbor Island Alliance		www.islandalliance.org
Boston Harbor Islands Advisory Council		www.nps.gov/boha

In general terms, the BOHA mission is to make the island system an integral part of the life of the region and the nation by protecting the islands and their associated resources while improving public knowledge and access. More specifically BOHA: (1) preserves and protects a drumlin island system within Boston Harbor, along with associated natural, cultural, and historic resources; (2) tells the islands' individual stories and enhances public understanding and appreciation of the entire island system; and (3) provides public access, where appropriate, to the islands and surrounding waters for education, enjoyment, and scientific research (USDI-NPS 2002).

BOHA is situated in Boston Harbor and in adjacent Quincy, Hingham, and Massachusetts Bay in Suffolk, Norfolk, and Plymouth Counties in eastern Massachusetts (Figure 2, Figure 3). The park includes 1,241 ha (3,067 ac) at low tide and 600 ha (1,483 ac) at high tide and is mapped by the Boston North and Hull 1:24,000 USGS topographic quadrangle maps (Bell et al. 2002).

Boston Harbor itself is a bedrock basin formed by retreating glaciers and filled as sea level rose (Rosen and Fitzgerald 2004). The harbor includes the estuary where salt water mixes with fresh water inflow from the Charles, Mystic, and Neponset rivers and runoff from the adjacent urban lands of East and South Boston, Charlestown, North End, Fort Point, and Dorchester.

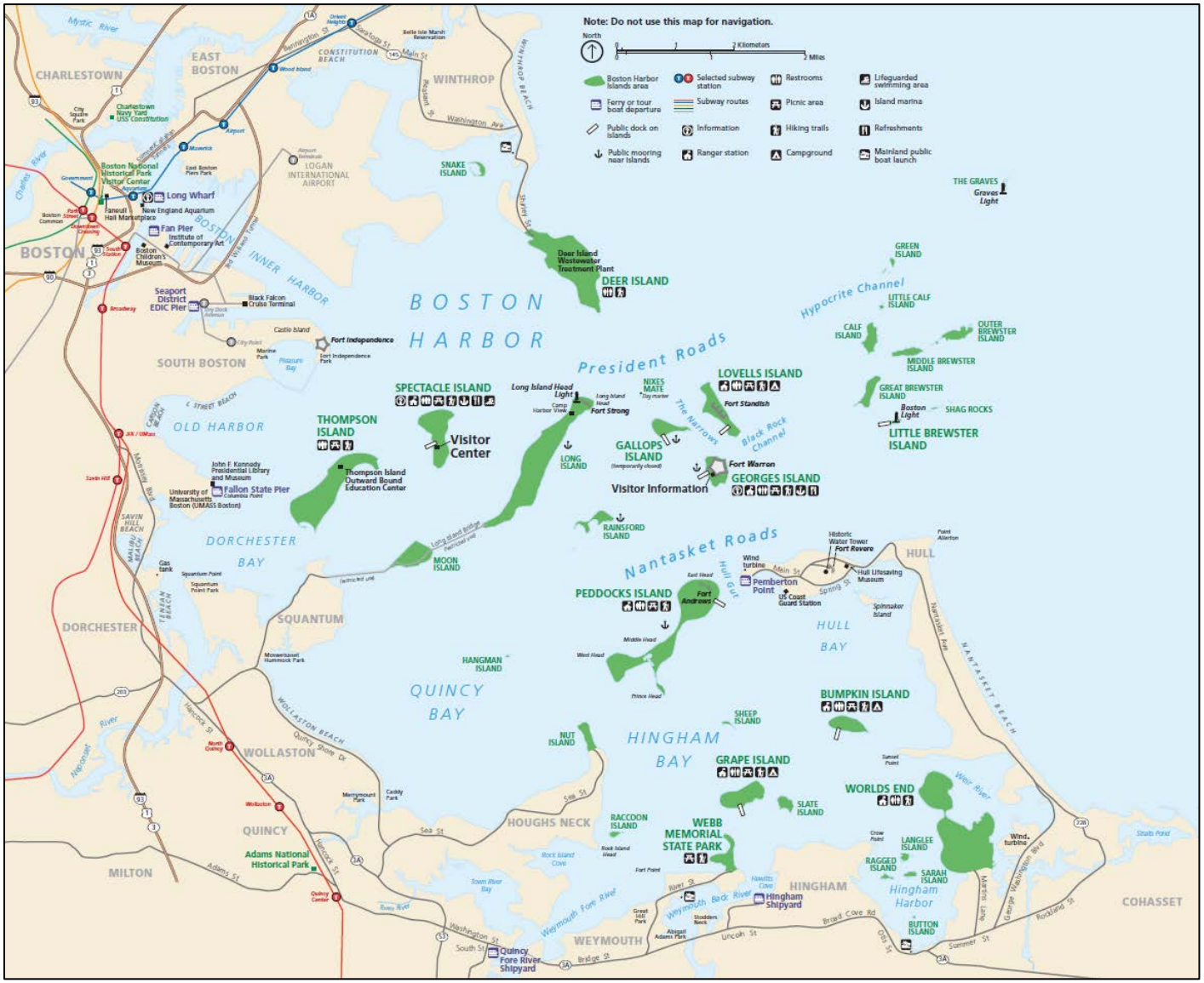


Figure 2. Boston Harbor Islands National Recreational Area, as situated in Boston Harbor and Quincy, Hingham, and Massachusetts Bays in Massachusetts (from USDI-NPS 2009).

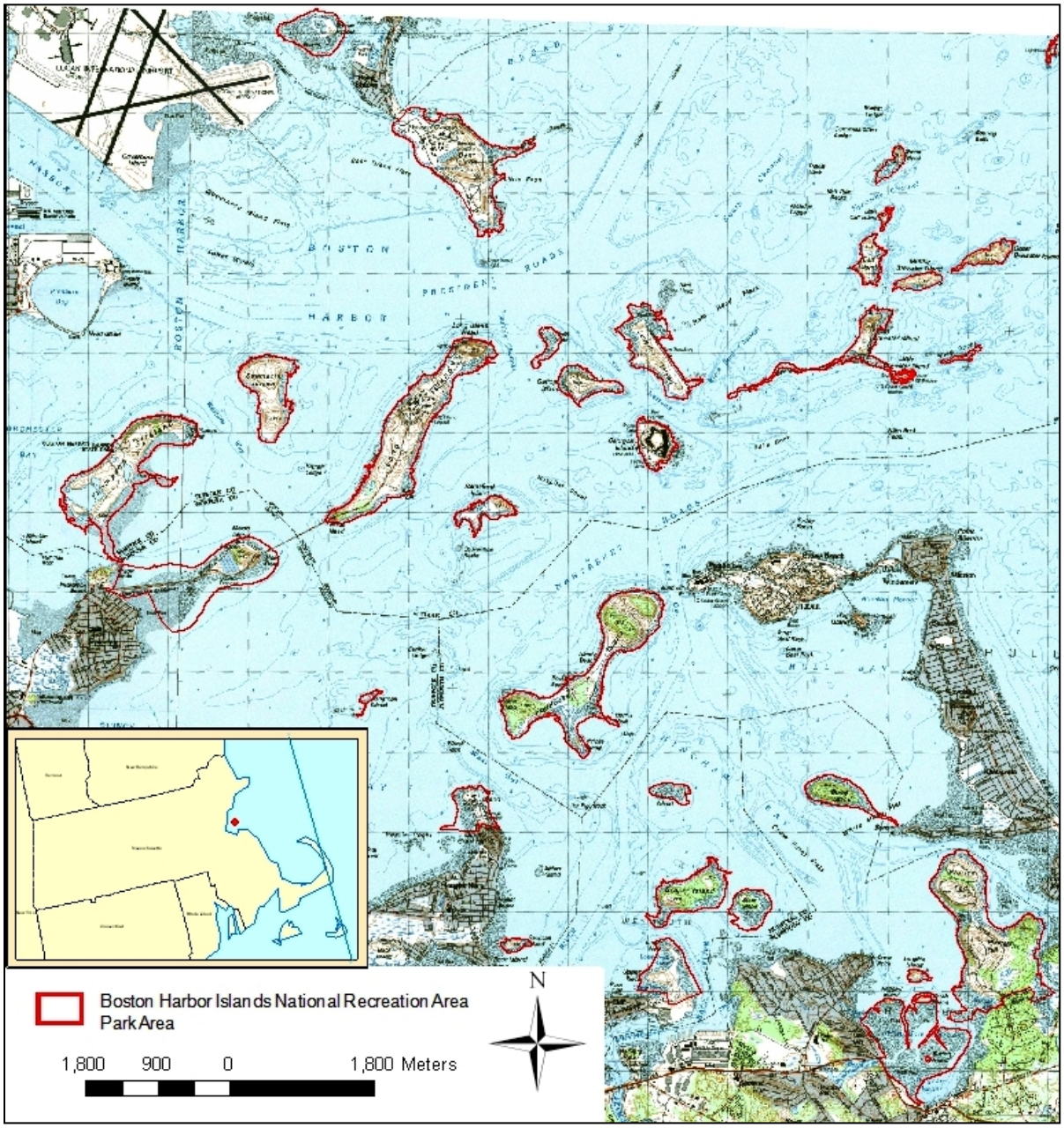


Figure 3. Location of Boston Harbor Islands National Recreational Area, Norfolk, Plymouth, and Suffolk Counties, Massachusetts, on the Boston North, MA and Hull, MA 1;24,000 USGS topographic quad maps. The park area includes terrestrial and intertidal park lands (Bell et al. 2002).

BOHA is unique in its configuration, assemblage of natural, geologic, cultural, and historic features, and proximity to a major metropolitan area. It represents and provides: (1) the only drumlin (an elongate or oval hill of glacial drift) field in the U.S. that intersects a coast (it was formed by glaciers some 15,000 years ago); (2) opportunities for solitude/personal renewal and land- and water-based education/recreation within an urban area; (3) an island complex composed of approximately 1,600 acres (~648 hectares) of land, archeological resources, historic sites, open space, wildlife habitats,

approximately 35 miles (~56 kilometers) of relatively undeveloped shoreline - occurring inside an area of approximately 50 square miles (~130 square kilometers); (4) archeological resources dating from thousands of years of occupation of the islands by American Indians; (5) three National Historic Landmarks—Boston Light, Fort Warren, and Long Wharf (and other historic sites resulting from Euro-American use); and (6) complex natural communities adapted to coastal and island life (USDI-NPS 2002).

The islands are known to have been inhabited for as many as 8,000 years, had been cleared of native vegetation to support agricultural crops, and have been subject to various types of development; presently the vegetation is composed of predominantly successional communities (USDI-NPS 2002). Many of the islands have buildings and structures related to uses including coastal defense, agriculture, commercial fishing, residences, resorts, industry, public health, immigration, and social welfare. Historical structures of the islands number more than 100 (including the three national historic landmarks) and include sea walls, forts, lighthouses, artillery emplacements, concrete bunkers, wood-framed cottages, and brick military and institutional buildings.

Additionally, the islands support cultural landscapes that provide context for the long history and cultures of humans shaping their natural resources. American Indian habitation of the islands is significant such that 21 islands have been designated within an archeological district listed on the National Register of Historic Places (USDI-NPS 2002).

Native and non-native vegetation, mostly grassland and sumac types, presently provide habitat for a variety of biotic species; patches of undisturbed native flora are rare on the islands (USDI-NPS 2002). Historically, the islands are thought to have supported mature forests of hemlock, maple, oak, pine, and hickory that were cleared to provide agricultural land (for apple, pear, grape, chives, garlic, asparagus, and horseradish crops), pastures, and supply construction lumber and firewood. BOHA supports mostly herbaceous upland habitats in addition to wetland, shrubland, and forest/woodland stands comprised of 619 known vascular plant species. Vertebrate inventories conducted at BOHA documented one species of amphibian, three reptile species, 86 bird species, and 11 species of mammals (USDI-NPS 2015c). Six rare species (two threatened and four special concern) listed by the Massachusetts Natural Heritage Program are known to occur on islands within BOHA (USDI-NPS 2002). They include the barn owl (*Tyto alba*), common tern (*Sterna hirundo*), least tern (*Sternula antillarum*), northern harrier *(Circus cyaneus*), seabeach dock (*Rumex pallidus*), and American sea blite (*Suaeda calceoliformis*).

BOHA includes 30 islands and four peninsulas, they are: Bumpkin, Button, Calf, Deer (peninsula), Gallops, Georges, Grape, Great Brewster, Green, Hangman, Langlee, Little Brewster, Little Calf, Long, Lovells, Middle Brewster, Moon, Nixes Mate, Nut (peninsula), Outer Brewster, Peddocks, Raccoon, Ragged, Rainsford, Sarah, Shag Rocks, Sheep, Slate, Snake, Spectacle, The Graves, Thompson, Webb Memorial (peninsula), and World’s End (peninsula). The largest of these features is World’s End at 104.5 terrestrial ha (258.2 ac) and the smallest is Nixes Mate with less than 0.1 terrestrial ha (0.25 ac). The mean tidal range is 2.9 m (9.5 ft) and the land area of BOHA doubles at low tide when all of the intertidal habitats are exposed (Roman et al. 2005; Bell et al. 2002). Geology, topography, soils, exposure to storms, salt spray, and waves, island or peninsula size and

distance from mainland, erosion and sediment deposition, and past and present land use influence the types and distribution of vegetation associations within BOHA. The larger, more protected, less isolated peninsulas and islands of World's End, Long, Thompson, and Peddocks, have the greatest diversity of terrestrial and intertidal plant associations.

The distribution of plant and animal species closely corresponds with eco-regional boundaries, which define areas of ecological homogeneity with similarities in soil, physiography, climate, hydrology, geology, and vegetation. BOHA lies in the Boston Basin Level IV Ecoregion (59D), (which is nested progressively within the Northeastern Coastal Zone (59 or 8.1.7), Mixed Wood Plains (8.1), and Eastern Temperate Forests (8.0) Level III, II, and I Ecoregions) (Figure 4) (Omernik and Griffith 2008). Natural landscapes within the Boston Basin Ecoregion generally are composed of marshlands and rolling uplands dissected by a network of tidally influenced streams and rivers. In its eco-regional classification, the USDA Forest Service attributes the BOHA area to the Humid Temperate Domain; Hot Continental Division (220); and Eastern Broadleaf Forest (Oceanic) Province (221) (Bailey 1997). This ecoregion occupies the low, formerly glaciated, and rolling topography of the mid-Atlantic coastal plain in eastern Massachusetts (Bailey 1997). The ecoregion is characterized by a temperate deciduous forest of the dominant white and northern red oak trees which provides dense canopy cover in the summer; prior to leaf-out in the spring, a dense ground cover of herbaceous species becomes established.

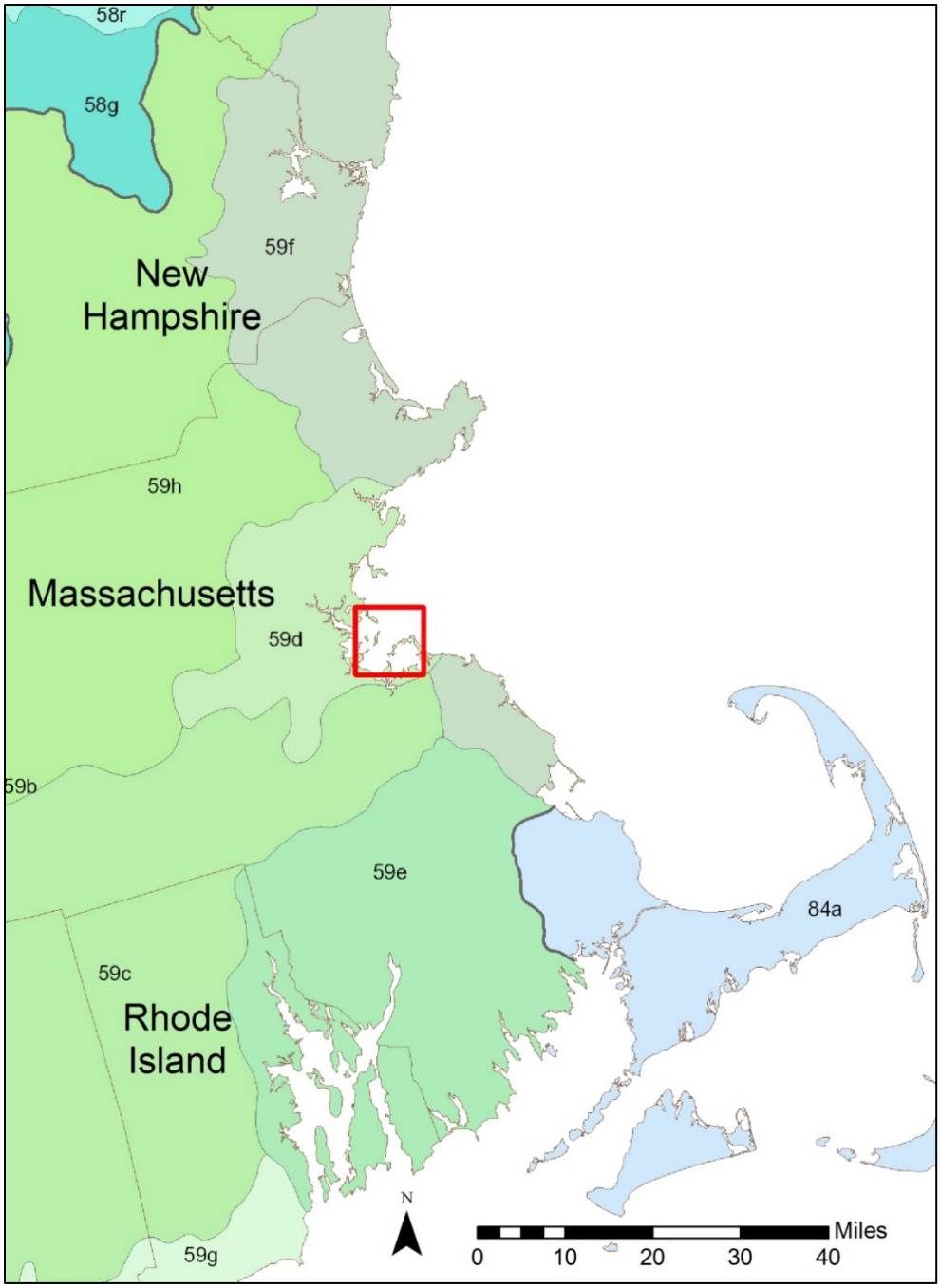


Figure 4. Location of Boston Harbor Islands National Recreational Area (red square) within Boston Basin Ecoregion (59d). Adjoining ecoregions include Southern New England Coastal Plains and Hills (59c), Gulf of Maine Coastal Lowland (59f), and Gulf of Maine Coastal Plain (59h) (USEPA 2015).

Geology

The structurally complex Boston Basin is of late Precambrian age; bedrock within and surrounding Boston Harbor is part of the Avalon terrane (microcontinent), a Precambrian island arc terrane comprised of volcanic and plutonic rocks that formed approximately 600 million years ago (Ma) (Kaye, 1982). Rifting towards the end of the Precambrian (>540 Ma) created what would become the

Boston Basin and the Alleghanian Orogeny, the final major mountain building event along eastern North America (290-250 Ma), is probably responsible for much of the structural framework of the eastern continental margin as it exists today (Hatcher 1989; Hatcher and Goldberg 1991).

Most of the outer harbor islands including Calf, Little Calf, The Graves, Outer Brewster, Little Brewster, and Shag Rocks as well as inner harbor islands Hangman, Slate, Nixes Mate, and Langlee are bedrock outcrops. Where bedrock is exposed in the harbor, it is mostly a shaly-to-slaty formation called Cambridge Argillite which was deposited on the muddy floor of an ocean about 570 Ma (USDI-NPS 2015a). In local areas of exposed bedrock on these islands, outcroppings of Roxbury Conglomerate and Quincy Granite may occur within the dominant Cambridge Argillite exposures.

Bedrock islands are characterized by shallow rocky soils and steep rocky cliffs and outcrops with sparse vegetation, i.e., Langlee Island exhibits puddingstone cliffs and The Graves and Slate Island are comprised of slate bedrock (historic slate quarries exist on some of these islands (Roman et al. 2005)). The outer harbor islands, located the farthest from the mainland, up to 16 km (10 mi), are constantly exposed to wind, high energy waves, and salt spray, more so than the inner harbor islands (Roman et al. 2005). As a result, vegetation is limited to species adapted to such harsh environmental conditions and shallow soils on rocky cliffs and outcrops (predominantly of Staghorn Sumac Shrubland). Paleoecological pollen and microfossils analyzed from Calf Island indicate that this vegetation has persisted on the outer islands for millennia (Patterson et al. 2005; Foley 2005).

During the Quaternary Period (the past 1.8 million years), the Boston Harbor area has been formed by numerous glaciations with the most recent Ice Age reaching its maximum extent south of Cape Cod about 21,000 years ago. By about 14,500 to 10,000 years ago, a warming climate caused the glaciers to retreat past the harbor coastline and leave/deposit till in the inner harbor area which became islands as the sea level rose (Kaye and Barghoorn 1964, Foley 2005; Rosen and Fitzgerald 2004). Most of the inner harbor islands are drumlins or oblong hills of glacial till that formed beneath the ice sheets (i.e., including Peddocks, Thompson, Grape, Lovells, Georges, Raccoon, and Long). Drumlins may occur as scattered single hills or in swarms (many of the islands have more than one drumlin – the connecting land between two drumlins is called a tombolo); the Boston Harbor Islands are a geological rarity, part of the only drumlin swarm in the U.S. that intersects a coastline (USDI-NPS 2015a). This drowned cluster of about 30 of more than 200 drumlins in the Boston Basin are not all elongate in shape, as are most other drumlins (molded in the direction of glacial flow, typically northeast/southwest axes) and likely represent two separate periods of glacial action.

The Boston Harbor drumlins typically have pronounced headlands with characteristic erosive bluffs on their seaward and windward sides that continually erode and slump in response to wave, wind, and precipitation exposure (Himmelstoss et al. 2006). Some drumlins have two or more headlands connected by flat, narrow, low-elevation, gravel spits or necks. Erosive bluffs, gravel spits, drumlin heads, beaches, marshes, and mudflats are characteristic landforms of these drumlin islands and peninsulas that support a diversity of plant associations.

Natural coastal processes continue to reshape the island landforms, from sea level rise (as part of climate changes) to northeast storms (USDI-NPS 2015a). Rates of erosion on the islands can be

dramatic, but generally, the highest rates of beach erosion occur along beaches facing north and east, which are the dominant directions for winds and seas in these storms. The shifting shores of Thompson Island illustrate this process of erosion and sedimentation. Human use of the islands also effects erosion by removal of vegetative cover promoting erosion, or by structures built to prevent erosion.

Every island within BOHA, except for those composed largely of bedrock, has beach deposits along portions of its shoreline (USDI-NPS 2015a). The beaches most used by recreationists are deposited on Spectacle (recently replenished), Long, Lovells, and Gallops islands, are primarily sandy, and support comparatively few biological resources. Rocky beaches as occur on Peddocks provide excellent habitat for invertebrates and the animals that feed on them. Small barrier beaches occur on portions of Great Brewster, Gallops, Peddocks, Bumpkin, Long, Rainsford, and Thompson islands and both Lovells and Long islands have dune deposits. Lovells Island has the more extensive dune system while those deposited on Long Island are confined to the southern shore.

Soils

A detailed account of BOHA soil types was prepared in the Soil Survey of Norfolk and Suffolk Counties, Massachusetts (USDA-SCS 1989). Generally, drumlin soils consist of outwash gravel overlying well drained sandy loam derived from marine clays and glacial till (USDI-NPS 2009; Roman et al. 2005). The islands support beaches and soils of the Newport and Pittstown series. Beaches are typically sand and gravel deposited on shorelines that are subject to wave action; coarse gravel and cobble beaches are more common than sand beaches throughout the drumlin islands due to the deposition of coarse sediments. Newport Series soils (approximately 42% of BOHA) are very deep, well drained, and occur on drumlins and moraines; they formed in friable glacial till overlying a firm substratum derived from conglomerate, shale, or slate bedrock. Pittstown Series soils (approximately 11% of BOHA) are very deep, moderately well drained, and occur on drumlins and moraines; they formed in friable glacial till overlying a firm substratum derived from conglomerate, shale, or slate bedrock. Table 2 lists soil map units that have identified at BOHA (USDI-NPS 2011, adapted from USDA-SCS 1989).

Hydrology

The most influential hydrologic feature within BOHA is the Atlantic Ocean of Boston Harbor, which surrounds the islands (USDI-NPS 2015a). Although the water within Boston Harbor is not part of BOHA managed resources, there are two periods of wave activity on the islands daily. The mean tidal range in Boston Harbor is 10.3 feet (3.2 m), one of the largest tidal ranges in the U.S. Boston Harbor varies in depth from about 3-to-30 feet (0.92-to-9.2 m), however the north and south ship channels may reach 60 feet (18.3 m) in depth. They are located between Logan International Airport and Spectacle Island and between Georges Island and Hull.

Table 2. Soil map units of Boston Harbor Islands National Recreation Area (USDI-NPS 2011).

Map Unit Name	Acres	% of BOHA
Beaches	121.7	8.1%
Canton - Urban land - Rock outcrop complex, 3 to 15 percent slopes	0.3	< 0.1%
Canton - Chatfield - Rock outcrop complex, 8 to 15 percent slopes	55.8	3.7%
Canton - Chatfield - Rock outcrop complex, 15 to 35 percent slopes	8.1	0.5%
Canton fine sandy loam, 3 to 8 percent slopes	7.7	0.5%
Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	7.3	0.5%
Eldridge fine sandy loam, 3 to 8 percent slopes	2.0	0.1%
Freetown peat, 0 to 1 percent slopes, ponded	2.9	0.2%
Hinckley sandy loam, 3 to 8 percent slopes	0.7	< 0.1%
Hinckley loamy sand, 15 to 35 percent slopes	8.6	0.6%
Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes	29.3	2.0%
Hooksan fine sand, 3 to 8 percent slopes	21.5	1.4%
Ipswich - Pawcatuck - Matunuck complex, 0 to 1 percent slopes	13.9	0.9%
Ipswich mucky peat, 0 to 1 percent slopes	24.0	1.6%
Merrimac fine sandy loam, 3 to 8 percent slopes	32.5	2.2%
Newport loam, 3 to 8 percent slopes	15.9	1.1%
Newport loam, 3 to 8 percent slopes, very stony	14.8	1.0%
Newport loam, 8 to 15 percent slopes	99.0	6.6%
Newport loam, 8 to 15 percent slopes, very stony	92.8	6.2%
Newport loam, 15 to 35 percent slopes	33.0	2.2%
Newport loam, 15 to 35 percent slopes, very stony	12.1	0.8%
Newport silt loam, 3 to 8 percent slopes	196.3	13.1%
Newport silt loam, 8 to 15 percent slopes	43.5	2.9%
Newport silt loam, 15 to 25 percent slopes	124.4	8.3%
Pittstown loam, 0 to 3 percent slopes, very stony	12.4	0.8%
Pittstown loam, 3 to 8 percent slopes	36.1	2.4%
Pittstown loam, 3 to 8 percent slopes, very stony	29.4	2.0%
Pittstown silt loam, 2 to 8 percent slopes	94.2	6.3%
Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	7.7	0.5%
Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	16.7	1.1%

Table 2 (continued). Soil map units of Boston Harbor Islands National Recreation Area (USDI-NPS 2011).

Map Unit Name	Acres	% of BOHA
Rock outcrop-Hollis complex, 3 to 25 percent slopes	56.8	3.8%
Sudbury fine sandy loam, 2 to 8 percent slopes	10.7	0.7%
Swansea peat, 0 to 1 percent slopes	1.4	0.1%
Udorthents, loamy or sandy	171.3	11.4%
Udorthents, refuse substratum	39.7	2.6%
Udorthents, wet substratum	25.4	1.7%
Udorthents - Urban land complex, 0 to 8 percent slopes	6.6	0.4%
Urban land, 0 to 15 percent slopes	18.9	1.3%
Walpole sandy loam, 0 to 5 percent slopes	1.0	0.1%
Windsor loamy sand, 8 to 15 percent slopes	2.9	0.2%

On land, surface water is limited with perennial ponds located on Thompson Island and Worlds End peninsula (USDI-NPS 2015a). There are freshwater marshes on Long, Peddocks, and Middle Brewster islands and on Worlds End peninsula; brackish marshes are distributed on several islands as described and mapped in this report.

Land Use

In addition to geology, soils, hydrology, and natural disturbances, the abundance and diversity of associations of BOHA are influenced by the legacy of past land use on each island and peninsula. The islands and peninsulas are cultural landscapes occupied or visited by humans for millennia. Shell middens and artifacts found in archeological digs on 21 of the islands and prehistoric charcoal found in salt marsh peat provide evidence that Native Americans established seasonal hunting, fishing, and shell fishing (oyster, soft shell, bay scallop, quahog) encampments on many of the inner harbor islands during the period of 8,000 B.P. to 1,500 A.D (USDI-NPS 2009; Luedtke and Rosen 1993; Patterson et al. 2005).

Treed islands and peninsulas were cleared in the 1600s by early European settlers to support fuelwood and timber needs in the already deforested and growing city of Boston. Fishing villages and trading posts were established on some of the inner harbor islands and peninsulas (Roman et al. 2005). Land use during the 1700s included farming and cattle and sheep pasturing on some of the islands as evidenced by the appearance of sorrel (*Rumex spp*.) in the pollen record (Patterson et al. 2005; Foley 2005; Roman et al. 2005). Stone walls and recognizable fields remain on Thompson Island, World's End, and Peddocks Island from centuries of agricultural land use. The outer harbor islands supported seasonal fishing colonies but were not farmed because of poor, rocky, shallow soils and isolation from the mainland (Roman et al. 2005). Early military installments were erected on some of the islands and used during the Revolutionary, Civil, and World wars (I and II).

During the 1800s, some of the islands and peninsulas were used as summer retreats and public facilities were developed on others. The deforested World's End and Thompson Island experienced a wave of ornamental tree planting in an effort to reforest the islands and peninsulas as recommend by landscape architect Frederick Law Olmsted (Richburg and Patterson 2005). Species planted included English oak (*Quercus robur*) to improve aesthetics, Norway maple (*Acer plantanoides*) to provide shade, and Austrian pine (*Pinus nigra*) and scotch pine (*P. sylvestris*) plantations to stabilize shorelines. A mature common lilac (*Syringa vulgaris*) hedge persists on Rainsford Island that is identifiable on project digital orthophotography. These species have since naturalized and persist in the shrublands and forests on the islands and peninsulas on which they were introduced.

Throughout the late 1800s and 1900s, cement sea walls and rip-rap, forts, batteries, ammunition test sites, prisons, pump stations, and lighthouses were erected on many of the islands as Boston became a major shipping port and defensive military base (Luedtke and Rosen 1993; Roman et al. 2005, NPS 2009). Long Island transitioned from a resort to a homeless center to hospital by the 1900s. Fort Andrews was constructed on Peddocks Island in 1897 and served as a facility for holding Italian prisoners of war during World War II. Fort Standish was constructed in 1900 on Lovells Island. Rosen and Fitzgerald (2004) describe the establishment of an ammunition test site on Nut (peninsula) that used Prince Head, the southeastern drumlin, on Peddocks Island for target practice. Today, this drumlin head is considerably smaller in size and supports Northeastern Successional Shrubland and Maritime Erosional Bluffs and Cliffs vegetation, while the larger drumlin heads on Peddocks Island support Northeastern Modified Successional Forest. Other islands and peninsulas supported hospitals, schools, prisons, lighthouses, and sewage treatment plants. Deer Island and Moon Island were used for construction of early pump stations for treating sewage from Boston. North Atlantic Low Salt Marsh, dominated by smooth cordgrass (*Spartina alterniflora*), has become established within the abandoned sewage basin infrastructure remnants originally constructed on Moon Island in 1878 (Luedtke and Rosen 1993).

Today, many of the islands and peninsulas continue to be used for various infrastructure/institutional uses: Deer Island supports a waste water treatment center, Long Island supports a homeless shelter and recreational fields; Moon Island supports a shooting range; Thompson Island is used as an Outward Bound outdoor education facility; and Georges Island supports Fort Warren, a National Historic Landmark visited by thousands of tourists each summer (USDI-NPS 2009). Peddocks Island supports a cluster of seasonal homes; and Spectacle Island is a reclaimed, capped landfill, that is now a recreation attraction. Long Island, Little Brewster Island, and The Graves continue to support lighthouses. Other islands and peninsulas exhibit former uses evident as remnants of collapsed walls and abandoned facades and outbuildings. Shag Rocks and Little Calf Island, undeveloped and comprised of rock outcrops, have remained in natural condition for centuries. Successional forests, woodlands, shrublands, and old fields comprised primarily of non-native plant species dominate the terrestrial vegetation associations of many islands and peninsulas due in part to the varied past and present land uses.

Materials and Methods

Project Timeline

This project was undertaken from 2005-2008 and included all the lands administered within BOHA. A preliminary vegetation map was interpreted and automated for these island units and delivered in December 2006 and revised to the final map in 2008. Classification plot sampling, analysis, and accuracy assessment (AA) for these island units were conducted between the years of September 2006 to September 2008.

To complete the final report and geodatabase to the NVMI standards of 2015, Cogan Technology, Incorporated (CTI) was contracted to review the BOHA vegetation inventory project products and create the final submittals. Fifteen tasks were identified to: (1) conduct final project planning between NPS and CTI; (2) review the existing data and reports; (3) conduct a meeting between key staff and plan the project completion; (4) address label discrepancies in vegetation type attribute tables (PLOTS, final report, AA, polygon data, etc.); (5) address plant species nomenclature between PLOTS and the final report; (6) recalculate map class accuracy to comply with NVMI 2010 accuracy standards (Lea and Curtis 2010); (7) review wetland classification in attribute data and report; (8) relabel USNVC hierarchy units to conform to changes specified by the 2008 FGDC standard, using the new upper level USNVC units defined pursuant to that standard (www.usnvc.org): (9) review the draft report and convert it to the current template of the Natural Resources Technical Report series; (10) complete metadata files using the FGDC standard for metadata creation; (11) address geographic data issues; (12) create a complete project geodatabase using current NVMI models; (13) create map graphics for the vegetation map, classification plot distribution, and AA observations; (14) prepare draft project report and NVMI standard products for review; and (15) prepare the final report and products for the BOHA Vegetation Inventory Project.

The following sections provide general details of each phase of the inventory project as it relates to BOHA to create the draft project components prior to the 2015-2016 CTI input. For a schematic timeline of the basic process steps for vegetation classification and mapping using USGS/NPS Vegetation Mapping Program Protocols and NPS Vegetation Inventory Program (NVMI), see Appendix A.

Planning and Scoping

Planning and scoping of this vegetation inventory project began in early 2005 with acquisition of aerial photography occurring in April 2005. The vegetation classification and map were created using a combination of existing sources of information, vegetation sampling, ground-truthing, and remote sources. Spatial data from previous studies on the islands were collected and integrated into the spatial data for the project map. Access issues, park resource management needs, current vegetation management, vegetation types of special interest, and applicable previous research conducted at BOHA were researched. In addition, reconnaissance of the park's vegetation types was conducted to estimate the number and distribution of vegetation associations in BOHA to more effectively plan the sampling design and approach.

Preliminary Data Collection and Review of Existing Information

Previous studies conducted at BOHA were obtained from the park's natural resource manager and reviewed for information pertinent to the extant vegetation. These reports included: (1) marine intertidal habitat classification for 20 islands (Bell et al. 2002); (2) wetland inventory for the islands (Tiner et al. 2003); (3) botanical inventory for the islands (Elliman 2004); (4) preliminary vegetation community map based on 2000 orthophotography completed in 2003 for 18 of the islands (Elliman 2005); (5) and unpublished invasive plant inventories conducted by Ted Elliman in 2004 and 2005. Past studies provided excellent baseline data from which to develop a comprehensive vegetation classification and map for all 30 islands and four peninsulas using the USNVC and adhering to the NVMI standards in place in 2005.

Rich Bell et al. (2002) completed a marine intertidal habitat classification and produced digital maps for the area between the extreme high tide and low spring tides for BOHA in 2002. This study classified the intertidal zone of 20 park islands and peninsulas by substrate type and biotic community, using the National Wetland Classification System (Cowardin et al. 1979) as the foundation for classifying biotic assemblages. The vegetated and sparsely vegetated marine intertidal assemblages including salt marshes, mudflats, and rocky intertidal areas were reviewed and compared to associations in the USNVC and cross-walked where possible (Table 3). Most marine intertidal assemblages (i.e. various marine algae types and un-vegetated substrates) are not covered in the USNVC and were not included in this classification and mapping effort.

Table 3. Translation of intertidal vegetated and sparsely vegetated assemblage names described by Bell et al. (2002) and wetland habitats described by Tiner et al. (2003) for Boston Harbor Islands National Recreation Area to U.S. National Vegetation Classification.

BOHA Park-specific Name	USNVC Code	Marine Intertidal Assemblage(s) in Bell et al. 2002	Wetland Community in Tiner et al. 2003
New England Rocky Intertidal Community	CEGL006341	*Ascophyllum* *Fucus* Brown Algae	Rocky shores with brown macroalgae
North Atlantic Coast Estuarine Intertidal Mudflats	CEGL006614	Mudflat	Intertidal flats
North Atlantic Low Salt Marsh	CEGL004192	*Spartina alterniflora*	*Spartina alterniflora*
North Atlantic High Salt Marsh	CEGL006006	*Spartina patens* *Juncus gerardii* *Suaeda* High marsh	high marsh, *Spartina patens* and *Distichlis spicata*
Salt Panne (Salicornia Type)	CEGL004308	*Salicornia*	–
Eastern Tidal Salt Shrub	CEGL006848	*Iva frutescens*	–
Reed-grass Tidal Marsh	CEGL004187	*Phragmites australis*	*Phragmites australis* brackish conditions

Table 3 (continued). Translation of intertidal vegetated and sparsely vegetated assemblage names described by Bell et al. (2002) and wetland habitats described by Tiner et al. (2003) for Boston Harbor Islands National Recreation Area to U.S. National Vegetation Classification.

BOHA Park-specific Name	USNVC Code	Marine Intertidal Assemblage(s) in Bell et al. 2002	Wetland Community in Tiner et al. 2003
Eastern Reed Marsh	CEGL004141	*Phragmites australis*	–
Coastal Salt Pond Marsh	CEGL006398	Not referenced	Freshwater marsh on Thompson and Oligohaline marsh on Grape

Spatial data from the Bell et al. (2002) study included ground-surveyed intertidal habitat polygons for North Atlantic Low Salt Marsh, North Atlantic High Salt Marsh, Salt Panne (Salicornia Type), New England Rocky Intertidal Community, and North Atlantic Coast Intertidal Estuarine Mudflats. These polygons were adopted and used as the basis of part of the resulting USNVC map. The minimum map unit (MMU for the marine intertidal habitat study was 25 m2 (0.063 ha, 0.15 ac) (Bell et al. 2002). While this MMU is considerably smaller than the NVMI standard MMU of 0.5 ha (1.24 ac), the polygons were adopted because all of the intertidal polygon boundaries were precisely surveyed using a global positioning system (GPS) receiver in the field and mapping the polygons a second time was redundant. Polygons were merged where possible to form larger polygons but in most cases the intertidal polygons were independent small patches. Wetland communities identified by Tiner et al. (2003) were also crosswalked to the USNVC (Table 3). Most of them overlapped with the Bell et al. (2002) units.

Geo-referenced upland vegetation data collected in 2001 and 2002 by Ted Elliman, NPS ecological contractor, was also used for preliminary vegetation classification and mapping. Data included 134 vegetation rapid assessment plots with a 15 m radius and a coarse draft vegetation map developed for 18 of the 34 islands and peninsulas (Elliman 2004; Elliman 2005). Elliman's described communities were close in concept and scale to the USNVC association (Table 4). An additional 207 georeferenced invasive vegetation data points collected by Elliman in 2004 and 2005 contained useful vegetation composition summaries for vegetation mapping (Elliman pers. com. 2006). These data were used to guide polygon delineation and attribution in the NatureServe preliminary vegetation map.

Table 4. Translation of plant association names used by Elliman (2005) at Boston Harbor Islands National Recreation Area to U.S. National Vegetation Classification

Category	Provisional Name (Elliman 2005)	USNVC Equivalent BOHA Park-specific Name	USNVC Code
Forests and Woodlands	Oak-Hickory Forest	Northeastern Dry Oak-Hickory Forest	CEGL006336
	Norway Maple Forest	Norway Maple Forest	CEGL006407
	Mixed Maritime Forest/Woodland	Northeastern Modified Successional Forest	CEGL006599
	Sassafras-Hackberry Maritime Forest	Successional Maritime Forest	CEGL006145
	Aspen-Gray Birch Woodland	Early-successional Woodland/Forest	CEGL006303
	Red Cedar Woodland	Maritime Red-cedar Woodland	CEGL006212
	Black Pine Forest	Black Pine Forest	CEGL006012
Shrublands	Maritime Shrub Community	Staghorn Sumac Shrubland Rocky Headland	CEGL006399
	Dwarf Maritime Shrub Community	Stunted Staghorn Sumac Shrubland	CEGL006399
Fields	Old Field Community	Northeastern Old Field	CEGL006107
	Little Bluestem Grassland	Little Bluestem Grassland	CEGL006333
Wetlands	Transitional Forest	Upland / Wetland Transitional Forest	CEGL006000
	Shrub Swamp	Northeastern Buttonbush Swamp	CEGL006069
	Phragmites australis marsh	Eastern Reed Marsh	CEGL004141
	Phragmites australis marsh	Tidal Reed -grass Marsh	CEGL004187
	Cattail-Rose Mallow Marsh	Cattail Brackish Tidal Marsh	CEGL004201
	Cattail Marsh	Eastern Cattail Marsh	CEGL006153

Table 4 (continued). Translation of plant association names used by Elliman (2005) at Boston Harbor Islands National Recreation Area to U.S. National Vegetation Classification

Category	Provisional Name (Elliman 2005)	USNVC Equivalent BOHA Park-specific Name	USNVC Code
Maritime cliffs, Beaches and Dunes	Maritime Erosional Cliff Community	Maritime Erosional Bluffs and Cliffs	CEGL006618
	Maritime Rock Cliff Community	Maritime Rock Cliffs and Outcrops	CEGL006619
	Maritime Dunes	Northern Beachgrass Vegetation	CEGL006274
	Beach Strand	Beach Strand	CEGL004400

Aerial Photography Acquisition and Processing

High-quality existing photography housed by the Commonwealth of Massachusetts Office of Geographic and Environmental Information (MassGIS) was used as the base for the BOHA vegetation map. The following metadata describe the source of the photography and are excerpted from the MassGIS web site (MassGIS 2007): “A true color orthophotomosaic was developed from a set of digital 1:5,000 scale medium resolution true color aerial images that are considered the new "basemap" for the Commonwealth of Massachusetts by MassGIS and the Executive Office of Environmental Affairs (EOEA) until 2005 DOQs became available in 2006 (MassGIS 2007). The photography for the entire commonwealth was captured in April 2005 when deciduous trees were mostly bare and the ground was generally free of snow. The image type is 4-band (RGBN) natural color (Red, Green, Blue) and Near infrared in 8 bits (values ranging 0-255) per band format.” The tidal phase was not recorded for these images. Appendix A contains detailed information regarding the aerial photography acquired from MassGIS.

Imagery was originally georeferenced to Massachusetts State Plane Mainland (Lambert Conformal Conic Projection), North American Datum of 1983 (NAD83) coordinate system, denominated in meters. NatureServe GIS specialist, Jon Hak, converted the image projection to UTM Zone 19 NAD83 coordinate system. Key information for the mosaic is summarized in Table 5.

Table 5. Description of mosaic for the Boston Harbor Islands National Recreation Area.

Attribute	Specifications
Date aerial photography was acquired	December 31, 2005
Vendor that provided aerial photography	Sanborn Colorado L.L.C.
Scale of photography	1:5,070 m, pixel resolution of 45 cm
Type of photography	True color, leaf-off conditions
Horizontal positional accuracy of mosaic	+/- 3 meters at the 95% confidence level at the nominal scale of 1;5,000; meets Class 1 National Map Accuracy Standard
Method of calculating positional accuracy	Aerial Triangulation using Intergraph ISAT software and BINGO 5.2 software
Scanning specifications	Image type is 4-band (RGBN) natural color (Red, Green, Blue) and Near infrared in 8 Bits (values ranging 0-255) per band format
Title and format of metadata record	Boston Harbor Islands National Recreation Area True Color Orthorectified Photomosaic (ERDAS MrSID (20:1 compression)
Archive location of air photos, airborne GPS/IMU files, mosaic camera calibration certificate, hard copy flight report, and metadata	MassGIS, Massachusetts Executive Office of Environmental Affairs
Publication date of mosaic (from metadata)	April 2005

NatureServe staff prepared a metadata record for the mosaic according to FGDC standards in place in 2005 (FGDC 1998a). Metadata were produced in notepad and parsed using the USGS metadata compiler program (MP) to locate errors and omissions (USDI-USGS 2004). After all errors and omissions were corrected, MP was used to generate final text only (TXT), hypertext markup language (HTML), and extensible markup language (XML) versions of each metadata record which were submitted with the final spatial products to the NPS with the 2009 draft report.

Photo Interpretation and Preliminary Vegetation Map Production

Aerial photograph interpretation is the act of examining aerial photographs to identify vegetation types (Avery 1978). The orthophoto mosaic was initially examined onscreen in ArcGIS 9.1 (ESRI 1992-2006). Digital topographic quad maps, and soil and geology layers were also examined in ArcGIS 9.1. Using information gathered from the orthophoto mosaic, the topographic maps, and field reconnaissance, Elliman's GPS data (2004, 2005), and the Bell et al. (2002) intertidal data set polygons representing different USNVC associations and land uses were digitized onscreen using ArcGIS 9.1 in 2006 (Figure 5). Polygons were drawn to the visible shoreline edge of each island or peninsula in the photography. Line-work delineating the boundaries of salt marshes and other intertidal associations that occurred in the imagery was adopted from the Bell et al. (2002) data set. The polygons were each attributed with a preliminary USNVC association name or, where non-vegetation or heavily managed/modified (cultural) vegetation occurred a land use - land cover category equivalent to an Anderson Level II category (Anderson et al. 1976). An aerial photograph interpretation key to the USNVC associations and land use - land cover map classes is included in Appendix B.

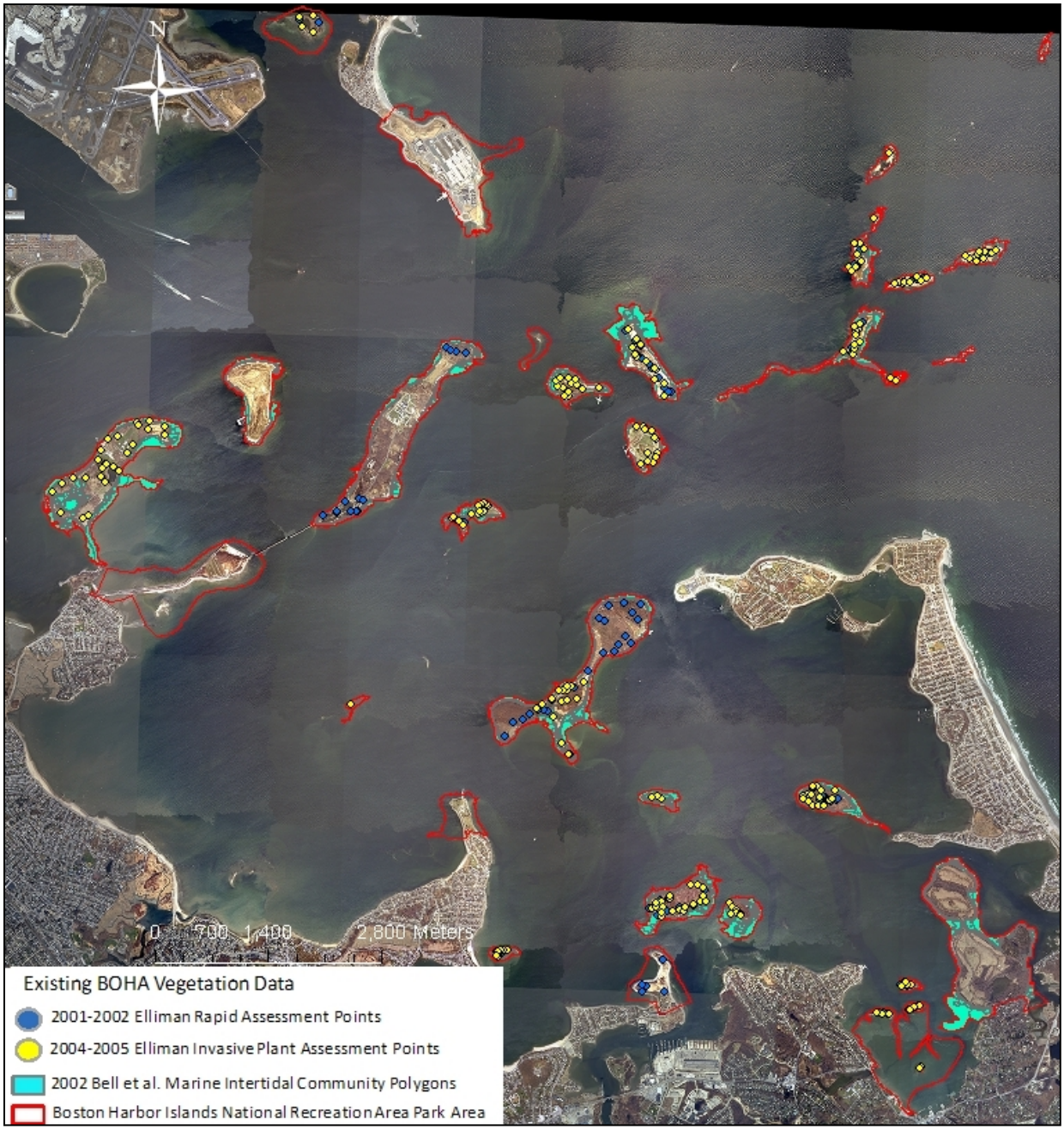


Figure 5. Locations of existing data used to map the vegetation at Boston Harbor Islands National Recreation Area: 134 2001-2002 Elliman community rapid assessment points (blue), 207 2004-2005 Elliman invasive plant assessment points (yellow), and selected vegetated 2002 Bell et al. marine intertidal community polygons (turquoise).

Field Data Collection and Classification

Vegetation plot sampling followed the NVMI protocols (TNC and ESRI 1994). The protocol recommends that each vegetation association should have been sampled at least three times in order to capture the naturally occurring variation within the park. If each of the association-level vegetation types listed in Table 6 represented only one association in BOHA, the minimum number of

classification plots needed would have been 96. Based on the existing vegetation data, our initial reconnaissance of BOHA, and previous vegetation mapping efforts at this and other parks, we concluded that approximately 45 classification plots would be sufficient to classify and describe the vegetation associations at BOHA. Some of the associations including Eastern Reed Marsh, Old-field Eastern Red-cedar Forest, and Northeastern Old Field required less than three plots because they were adequately sampled at other nearby parks and are well described in the USNVC. In the case of Upland/Wetland Transitional Forest, Northeastern Buttonbush Shrub Swamp, Wet Meadow, and Cattail Brackish Tidal Marsh, there was only one example of each association known to occur in the entire park and a single classification plot was the only option. Plots were not sampled for North Atlantic Coast Estuarine Intertidal Mudflats and New England Rocky Intertidal Community because they lack vascular plants and are well described in the USNVC and in Bell et al. 2002. Similarly, Eastern Cattail Marsh, Early-successional Woodland/Forest, Maritime Rock Cliffs and Outcrops, and Coastal Salt Pond Marsh were not sampled in this phase of the project because they are georeferenced, well documented, and described in Elliman (2005). These associations were mapped and sampled during accuracy assessment, however.

The distribution of the 47 plots used to classify and describe by association recognized by Elliman (2004) is depicted by Table 6.

Table 6. Location and number of plots sampled (47) for vegetation associations at Boston Harbor Islands National Recreation Area based on Elliman's 2005 preliminary vegetation classification.

Association Park-specific Name	USNVC Code	Plots	Islands/Peninsulas Sampled
Beach Strand	CEGL004400	3	Peddocks, Long, World's End
Black Pine Forest	CEGL006012	3	Thompson, Long, Peddocks
Cattail Brackish Tidal Marsh	CEGL004201	1	Long
Coastal Salt Pond Marsh	CEGL006398	0	n/a
Common Wormwood Gravel Field[1]	CEGL006617	1	Thompson
Early-successional Woodland/Forest	CEGL006303	0	n/a
Eastern Cattail Marsh	CEGL006153	0	n/a
Eastern Reed Marsh	CEGL004141	1	Long
Eastern Tidal Salt Shrub	CEGL006848	1	World's End
Little Bluestem Old Field	CEGL006333	2	Thompson, World's End
Maritime Erosional Bluffs and Cliffs	CEGL006618	2	Peddocks, Thompson
Maritime Red-cedar Woodland	CEGL006212	2	World's End
Maritime Rock Cliffs and Outcrops	CEGL006619	0	n/a
New England Rocky Intertidal Community	CEGL006341	0	n/a

[1] Originally classified as Northeastern Old Field but reclassified after accuracy assessment.

Table 6 (continued). Location and number of plots sampled (47) for vegetation associations at Boston Harbor Islands National Recreation Area based on Elliman's 2005 preliminary vegetation classification.

Association Park-specific Name	USNVC Code	Plots	Islands/Peninsulas Sampled
North Atlantic Coast Estuarine Intertidal Mudflats	CEGL006614	0	n/a
North Atlantic High Salt Marsh	CEGL006006	2	Thompson, World's End
North Atlantic Low Salt Marsh	CEGL004192	2	Thompson, World's End
Northeastern Buttonbush Shrub Swamp	CEGL006069	1	World's End
Northeastern Dry Oak-Hickory Forest	CEGL006336	2	World's End
Northeastern Modified Successional Forest	CEGL006599	3	Peddocks, World's End, Long
Northeastern Old Field	CEGL006107	1	Thompson
Northeastern Successional Shrubland	CEGL006451	2	Thompson, Long
Northern Beachgrass Vegetation	CEGL006274	2	Thompson
Norway Maple Forest	CEGL006407	2	Thompson, World's End
Old-field Eastern Red-cedar Forest	CEGL006024	1	World's End
Overwash Grassland	CEGL004097	4	Peddocks, Thompson, Long
Reed-grass Tidal Marsh	CEGL004187	1	World's End
Salt Panne (Salicornia Type)	CEGL004308	1	World's End
Staghorn Sumac Shrubland	CEGL006399	3	Peddocks, Thompson, Long
Successional Maritime Forest	CEGL006145	2	Thompson, World's End
Upland/Wetland Transitional Forest	CEGL006000	1	World's End
Wet Meadow	CEGL006571	1	World's End

[1] Originally classified as Northeastern Old Field but reclassified after accuracy assessment.

Field Survey

Classification plot sampling was conducted in September 2006. Within each stand selected for sampling, a plot was established in an area that was assessed to be most representative of the stand (Mueller-Dombois and Ellenberg 1974). All vegetation data were collected following NatureServe's accepted Natural Heritage sampling protocols (Strakosch-Walz 2000), with 20-m x 20-m plots in forests and woodlands, 10-m x 10-m plots in shrublands, and 5-m x 5-m plots in herbaceous vegetation. The classification plot sampling data form used in this project is shown in Appendix C; abbreviated instructions for completing this form and definitions of the fields can be found in the NVMI Field Methods for Vegetation Mapping manual (TNC and ESRI 1994).

The vegetation was visually divided into up to eight strata: emergent trees (variable height), tree canopy (variable height), tree subcanopy (>5m in height), tall shrub (2-5m), short shrub (<2m), herbaceous, non-vascular, and vines. The percent cover was estimated for each species in each stratum using modified Braun – Blanquet cover classes (Strakosch-Walz 2000). Specimens of species

that were not identifiable in the field were collected for later identification. In addition to floristic information, the following environmental data was recorded at each plot: slope, aspect, topographic position, hydrologic regime, soil stoniness, average soil texture, and soil drainage. Any un-vegetated area of the plot was characterized by the exposed substrate. Notes were taken on the plot representativeness of the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance. The vegetation profile and topographic position were sketched in cross-section to represent the location and setting of the plot. A digital photograph of each plot was also acquired to document site conditions. The location of each plot was recorded with a Garmin GPS Map 60CSX global positioning system (GPS) receiver, with the datum set to North American 1983 (CONUS) and the coordinate system set to UTM zone 19. In total, 47 classification plots were sampled throughout BOHA (Figure 6).



Figure 6. Locations of the 47 vegetation plots in Boston Harbor Islands National Recreation Area for vegetation classification and mapping. The park area includes terrestrial and intertidal park lands (Bell et al. 2002).

Vegetation Classification and Characterization

Data from the 47 vegetation classification plots were entered into the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform during January 2007. A data dictionary for the fields in the PLOTS 2.0 database is included in Appendix D.

For this report, some common names listed in the PLANTS 3.5 database (USDA-NRCS 2006) were changed to reflect the common names typically used by ecologists and resource managers in this region. The common and scientific names of plants observed during the vegetation classification plot (and accuracy assessment) sampling are listed in Appendix E and denoted with an asterisk (*). To

provide the park with a more comprehensive plant species list, species identified from Elliman (2004) are also included in the plant list. Some tree and shrub seedlings and immature herbaceous plants could only be identified to the genus level and are therefore listed in the appendix as such. Environmental variables and the species percent cover data were exported from the PLOTS database into Excel in order to be manipulated into a format compatible with PC-ORD version 4.0 Multivariate Analysis software (McCune and Mefford 1999).

The vegetation classification plot data were analyzed using several multivariate statistical techniques available in the PC-ORD software. Different techniques were employed to provide multiple lines of evidence from which to interpret the results. For a detailed discussion of the statistical techniques used in this study, refer to McCune and Grace (2002). To classify the plot data into vegetation associations, a cluster analysis was performed using the percent cover of species data. Cluster analysis successively divides the plots into groups that are similar in species composition (Hill and Gauch 1979). Non-metric multidimensional scaling (NMS) was also performed using both the percent cover of species and the environmental variables from the plots. NMS is an ordination technique well suited to non-normal data sets (Kruskal and Wish 1978).

The results were compared with the USNVC associations. Classification plots were matched to existing associations using expert judgment; if no association existed, new types were created. Because the Global Description includes species from across the range of the association, a park-specific description was included. Any new information about the association was incorporated into the Global Description as appropriate. Global information was then appended to the local descriptions to provide resource managers with a broader context for the vegetation in the park. Environmental data on landscape position, soil characteristics, and flooding regime for each classification plot were used to interpret the results. The soil survey, topographic maps, and aerial photographs were also examined and used in the interpretation. Each vegetation association was assigned a park-specific common name and if none existed the USNVC common name was used. A park-specific common name was created for successional and cultural vegetation types not easily handled by the USNVC and are included as Appendix F.

A park-specific dichotomous key was created for the vegetation associations to guide accuracy assessment and for use by park natural resource managers and others (Appendix G). A dichotomous key is a tool structured by a series of couplets, two statements that describe different, mutually exclusive characteristics of the associations. Choosing the statement that best fits the association in question leads the user to the correct association. The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate.

2006 Draft Vegetation Map Preparation

After the field sampling was complete, aerial photograph signatures were verified for all of the associations using the classification plot data, Bell et al. (2002), and Elliman (2004) and (2005) data (Figure 5, Figure 6). These signatures were extrapolated to other areas within the park boundary that were not sampled. Using ARCGIS 9.1, polygon boundaries in the preliminary vegetation map were further edited and refined to develop a draft association-level vegetation map. Polygons were updated

with USNVC association names and codes based on the classification plot data. Polygons that were attributed with land use - land cover categories in the preliminary vegetation map retained their attributes. The aerial photointerpretation key was updated (Appendix B). The thematic accuracy of this 2006 draft association-level vegetation association and land use map was then assessed for accuracy.

Accuracy Assessment

Two sources of potential error in the vegetation map include: (1) horizontal positional accuracy, in which a location on the photomosaic does not accurately align with the same location on the ground due to errors in orthorectification or triangulation; and (2) thematic accuracy, in which the vegetation type assigned to a particular location on the map does not correctly represent the vegetation at the same location in the park due to mapping error. The NVMI protocols (ESRI et al. 1994, Lea and Curtis 2010) were consulted as guidance to assess the positional and thematic accuracy of the BOHA vegetation map.

Positional Accuracy Assessment

As described previously, the imagery used to map vegetation was obtained from MassGIS. The following information is an excerpt from information on the MassGIS web site (MassGIS 2007): "*The ground control used to support the mapping was collected by photographic identification of strategic points. The ground control coordinates were collected via GPS ground survey techniques. Aerial Triangulation was performed on softcopy workstations using Intergraph ISAT software for photo measurement and matching. The final bundle adjustment was performed using BINGO 5.2 software. MassGIS quality assurance included rigorous independent checks of the spatial accuracy using other datasets of significantly higher accuracy, and field work that included the capture of highly accurate GPS points that were compared to the same locations appearing on the deliverables. MassGIS also assessed the visual quality and appearance of the images* (MassGIS 2007)."

Thematic Accuracy Assessment

Thematic accuracy has several objectives: to assess data suitability for a particular application; to inform the map producers about data errors and improve the mapping process; and to conform to production standards. Sampling methods followed NPS protocols (Lea and Curtis 2010), which recommend 1 AA point (field observation) per 0.6 hectares of area, for each map class, up to a maximum of 30 observations per class and with a minimum of either five observations per class or as many observations as polygon sizes and configurations will accommodate. Map classes that represented land use - land cover classes are assumed to be 100% accurate and not included in the sampling (Lea and Curtis 2010). Small patch associations such as Salt Panne (*Salicornia* Type) and semi-inaccessible intertidal communities such as New England Rocky Intertidal Community and North Atlantic Coast Estuarine Intertidal Mudflats that were adopted from Bell et al. (2002) were eliminated from AA sampling because they had been previously surveyed (boundaries of the associations were walked with a GPS receiver in hand) in the field. For BOHA, these sampling considerations resulted in a potential sample size of 270 AA points in 30 map classes. Logistical challenges such as absences of docks or moorings on some islands further reduced the sample size to 194 in 29 map classes.

Individual AA points to be allocated to each class were placed by first randomly selecting a polygon, then randomly placing a single AA point within the polygon (double stratification) at least 10 meters inside the polygon edge. An additional 11 AA points were removed from the sampling scheme because polygon size or shape would not allow a 10 meter buffer for the full complement of AA points assigned to the class, Finally, 11 more points were rejected for one or more of the following reasons: the AA point fell within an area developed or disturbed since the aerial photographs were acquired; the points occurred at ecotones or along polygon edges; multiple AA points fell into one polygon; the polygon was already represented with classification plot data; the AA point fell within a small patch inclusion below the MMU such as Beach Strand or Salt Panne (Salicornia Type); or GPS receiver error located the field team out of the targeted polygon. A total of 172 AA points in 29 map classes were sample (Table 7, Figure 7).

Table 7. Thematic accuracy assessment sampling strategy for Boston Harbor Islands National Recreation Area.

Park-specific Vegetation Association Name or Land Use - Land Cover Category	Mapped Hectares, Preliminary Map	Number of AA Points from Protocol	Number of AA Points Targeted	Number of AA Points Sampled
Beach	124.3	30	10	2
Beach Strand	10.0	6	6	4
Black Pine Forest	7.2	5	5	6
Cattail Brackish Tidal Marsh	0.1	2	2	1
Coastal Salt Pond Marsh [1]	0	0	0	1
Early-successional Woodland/Forest	46.9	11	11	6
Eastern Cattail Marsh	0.1	2	2	1
Eastern Reed Marsh	1.8	5	4	7
Eastern Tidal Salt Shrub	0.8	5	5	1
Little Bluestem Old Field	0.6	5	5	1
Maritime Erosional Bluffs and Cliffs	5.4	5	5	5
Maritime Red-cedar Woodland	4.0	5	5	5
Maritime Rock Cliffs and Outcrops	14.1	8	4	2
New England Rocky Intertidal Community [2]	12.6	8	0	0
North Atlantic Coast Estuarine Intertidal Mudflats [2]	15.7	10	0	0

[1] Coastal Salt Pond Marsh was identified during the AA and not included in the 2006 draft vegetation map.

[2] These three classes were not included in sampling because classes were assumed to be 100% correct.

[3] Common Wormwood Gravel Field was split out from the Northeastern Old Field map class after AA.

[4] This total does not include most land use - land cover map classes.

Table 7 (continued). Thematic accuracy assessment sampling strategy for Boston Harbor Islands National Recreation Area.

Park-specific Vegetation Association Name or Land Use - Land Cover Category	Mapped Hectares, Preliminary Map	Number of AA Points from Protocol	Number of AA Points Targeted	Number of AA Points Sampled
North Atlantic High Salt Marsh	5.0	5	5	7
North Atlantic Low Salt Marsh	19.3	12	12	10
Northeastern Buttonbush Shrub Swamp	0.2	2	2	2
Northeastern Dry Oak-Hickory Forest	5.8	3	3	4
Northeastern Modified Successional Forest	63.3	30	20	15
Northeastern Old Field [3]	77.1	30	20	28
Northeastern Successional Shrubland	75.2	30	20	16
Northern Beachgrass Vegetation	1.4	5	5	6
Old-field Eastern Red-cedar Forest	3.8	2	2	3
Norway Maple Forest	12.9	8	7	6
Overwash Grassland	3.4	5	5	4
Pond	0.3	2	0	0
Reed-grass Tidal Marsh	4.2	5	5	4
Salt Panne (Salicornia Type) [2]	0.3	5	0	0
Staghorn Sumac Shrubland	33.5	20	15	16
Successional Maritime Forest	7.9	5	5	5
Upland/Wetland Transitional Forest	0.2	1	1	1
Wet Meadow	0.2	3	3	3
TOTALS	**557.6** [4]	**270**	**194**	**172**

[1] Coastal Salt Pond Marsh was identified during the AA and not included in the 2006 draft vegetation map.

[2] These three classes were not included in sampling because classes were assumed to be 100% correct.

[3] Common Wormwood Gravel Field was split out from the Northeastern Old Field map class after AA.

[4] This total does not include most land use - land cover map classes.



Figure 7. Locations of the 172 accuracy assessment sampling points in Boston Harbor Islands National Recreation Area.

Thematic Accuracy Assessment Field Methods

AA field work was conducted in September 2008 by Sue Gawler and Lesley Sneddon, NatureServe vegetation ecologists. A Garmin GPSMap60CSX receiver was programmed with coordinates of the selected AA sampling locations. The datum on the GPS receivers was set to North American 1983 (CONUS) and the coordinate system was set to Universal Transverse Mercator (UTM) zone 19. Using the GPS receiver and the aerial photographs with unlabeled polygons, ecologists navigated to each point. The vegetation association at the point was then determined using the dichotomous key and the detailed vegetation descriptions. The minimum area of observation around the sampling point was 0.5 hectares (usually a circular plot, 40 m in radius), the size of the MMU.

For small patch and linear map classes, such as those adopted from the Bell et al. (2002) study, a 0.25 ha observation area (usually a circular plot, 30 m in radius) was recorded. The dominant plant species in each stratum, environmental attributes, surrounding vegetation associations, rationale for classification and other comments were noted on a standardized field form (Appendix H). The community was assigned to the appropriate association as described in the key (hereafter referred to as the "first call"). If the classification decision was ambiguous, a "second call" was recorded in order to assist understanding of mapping errors. Other map units or associations within 50 m of the point were also noted. The ecologists also indicated whether the sampling point was characteristic of the polygon as a whole or whether the point was atypical of the polygon.

Notable examples of associations observed in the field, but lacking an AA point, were documented in the field with an observation point. An observation point includes GPS receiver-generated coordinates, photograph, and short list of dominant species.

Observation points were recorded for communities described in Elliman (2005) and/or Bell et al. (2002) including Coastal Salt Pond Marsh, Maritime Erosional Bluffs and Cliffs, New England Rocky Intertidal Community, and North Atlantic Coast Estuarine Intertidal Mudflats.

Data Analysis

Data from the 172 AA points were entered into the AA form of the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform during the winter of 2008. In the PLOTS database, species were assigned standardized codes based on the PLANTS 3.5 database (USDA- NRCS 2006). The common and scientific names of plants observed during thematic AA (and vegetation classification plot) sampling are listed in Appendix E (denoted with an asterisk (*)). GPS receiver data coordinates were downloaded into an ArcGIS shapefile to compare the field identification of each point to the mapped identity. The point coverage was overlain on the vegetation layer and comparisons were made between the association name on the field form and the corresponding association name on the draft vegetation map. An Excel table was produced, illustrating the comparisons for every plot. Every field data sheet was reviewed to ensure that the classification concept was correctly applied. Additional columns were added to the table to record second calls where the initial identification was ambiguous.

Although the sample size allocation for each map class followed NPS protocols, the assignment of points randomly to individual polygons, rather than randomly throughout the map class, constitutes a polygon-based sampling design. Such a design varies from the point-based (or minimum mapping unit-based) design that is recommended by either the original (ESRI et al. 1994) or revised (Lea and Curtis 2010) NPS protocol (see Lea and Curtis 2010, Appendix A). The polygon-based design introduced an additional layer of stratification that, if not accounted for, would bias the results in favor of observations made within smaller polygons. To correct this bias, each AA point was weighted by the size of its assigned polygon in the computation of accuracy rates. Thus, individual observations for this analysis were often tabulated and listed as decimal fractions of whole numbers of observations, rather than as single observations.

AA points allocated to the map classes Beach Strand and Beach were consolidated after sampling in order to create a more accurate map class since the sparse vegetation of Beach Strand could not be easily discerned from the Beach signature in the orthophoto.

A thematic accuracy assessment seeks to estimate quantitatively (1) the overall accuracy (percentage of correctly mapped sites in the study, regardless of the map class present at the sites and (2) the accuracy of the individual classes that have been mapped. There are two aspects of accuracy for individual classes that are of interest to a map user. User's accuracy is the probability that the class, wherever depicted by the map, has been mapped accurately (as observed on the ground) and is equivalent to 100% minus the estimated rate of errors of commission, for observations that were placed and made within that map class. Producer's accuracy for a class is the probability that the class, wherever it may be encountered on the ground, will have been depicted correctly by the map and is equivalent to 100% minus the estimated rate of errors of omission, for all observations that were identified as the class on the ground.

Individual class accuracy rates are of interest to a map user because resource management activities often are directed toward individual map classes or smaller sets of classes of interest, rather than toward the entire map (Lea and Curtis 2010). User's and producer's accuracy rates lend insight into which classes are confused with which other classes into the rate of over-mapping or under-mapping for individual classes. In order to allow relatively robust per-class estimation, the AA observations are stratified by map class to ensure a reasonably large sample size for each class.

Overall accuracy is the probability that any individual site depicted by the map will have been mapped accurately (i.e., the probability that the class depicted by the map and the class observed on the ground will match). Such an estimate pertains to the entire map, regardless of the identity of the classes involved in the errors, and is a simplified metric that lends insight into the overall quality and reliability of the map. When AA observations are stratified by map class, the individual class samples typically are pooled to yield an overall map accuracy estimate.

Since the sampling design to obtain individual class user's accuracies constitutes simple random sampling within each class, the user's accuracy for a class is estimated simply as the number of observations for which the ground observation is a match with the map class. Calculation of producer's accuracies is more complex, since the occurrence of any class as it occurs on the ground cannot be predicted a priori. Therefore, individual observations must be weighted by the size of the map class (sampling stratum) in which they were observed, since the different strata have different sizes and, therefore, observations between strata will have different probabilities of inclusion (Czaplewski 1992, 2003; Congalton and Green 2009; Lea and Curtis 2010).

Similarly, individual observations that are pooled in order to estimate overall accuracy have unequal probabilities of inclusion because they are sampled from map class strata of different sizes. The subsample from each individual map class must be weighted by its map class size when it is pooled with the other subsamples. The calculations of Lea and Curtis (2010) for simple random sampling (for user's accuracies) and for stratified random sampling (for producer's accuracies and overall accuracy) were applied. The results were displayed as (1) a sample contingency table, which is a

matrix that depicts the total raw counts of AA observations having sample data (map class) values and reference data (field call) values and as (2) a population (or proportional) contingency table, which is a matrix of the same sample/reference value data adjusted to their estimated representative proportion of the entire map (Lea and Curtis 2010).

Final Vegetation Classification and Map Preparation

Based on the results of the AA analyses, the 2006 draft vegetation map was revised to correct attribution errors and provide the park with an accurate final product that met NVMI vegetation mapping standards. In this final 2008 revision, AA data, classification plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon attributes, map classes, and the final vegetation classification.

Results

Vegetation Classification and Characterization

The 47 classification plots were analyzed using cluster analysis and NMS ordination in order to determine groups of similar plots based on species composition. The dendrogram produced by the cluster analysis shows the higher-level divisions in the vegetation into forests, woodlands, tall shrublands, open shrublands, and herbaceous and sparse vegetation (Figure 8). Classification plot data were not collected for Eastern Cattail Marsh, Early-successional Woodland/Forest, New England Rocky Intertidal Community, Maritime Rock Cliffs, and North Atlantic Coast Estuarine Intertidal Mudflats.

The relationships of the associations can also be seen in the scatter plot produced by the NMS ordination, which plots individual classification plots along the first and second axes of maximum variation (Figure 9). The scatter plot of all 47 plots shows the separation of some groups, but shows overlap in the modified successional forested plots and the successional shrubland plots. Vegetation associations occurring on or near the beaches of the Boston Harbor islands, including Overwash Grassland, Beach Strand, Northern Beachgrass Vegetation, and Common Wormwood Gravel Field, grouped together on the top left side of the graph. Salt marsh and salt shrub associations grouped together at the top middle, sharing cordgrass (*Spartina* spp.) plots. Fresh and brackish marsh and shrub swamp associations grouped together on the top right of the graph, grouping together as non-forested wetlands. Native forests grouped together in the middle right of the graph. Successional and non-native forests and shrublands grouped based on the dominance of non-native and/or successional species along the bottom middle and right of the graph. Altered herbaceous old field associations including Northeastern Old Field, Little Bluestem Grassland, and Wet Meadow grouped together in the lower left. Finally, Staghorn Sumac Shrubland grouped with Maritime Erosional Bluffs and Cliffs as staghorn sumac (*Rhus typhina*) was the dominant shrub in the Maritime Erosional Bluffs and Cliffs plots.

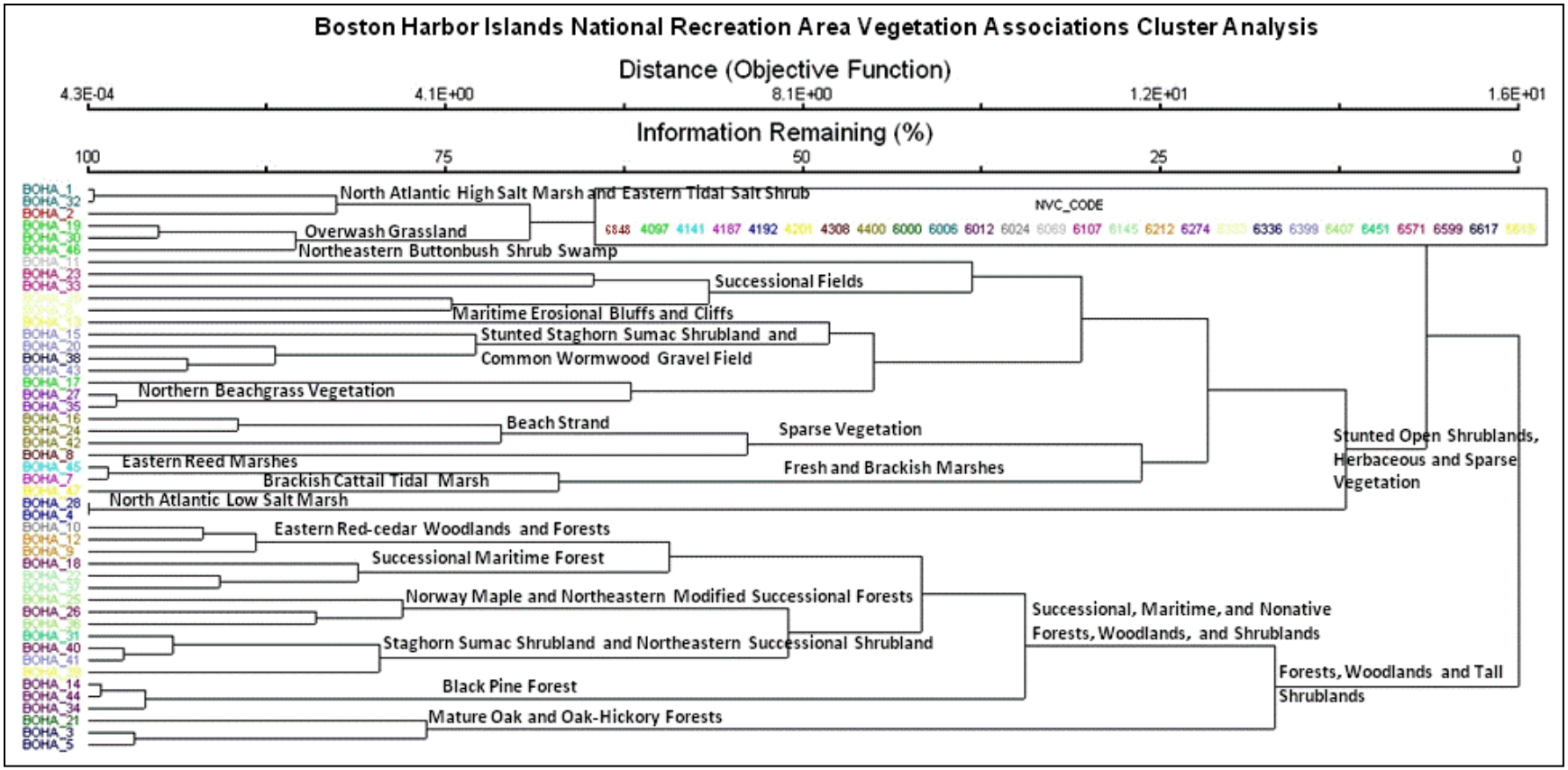


Figure 8. Cluster analysis dendrogram of the 47 vegetation classification plots sampled within Boston Harbor Islands National Recreation Area.

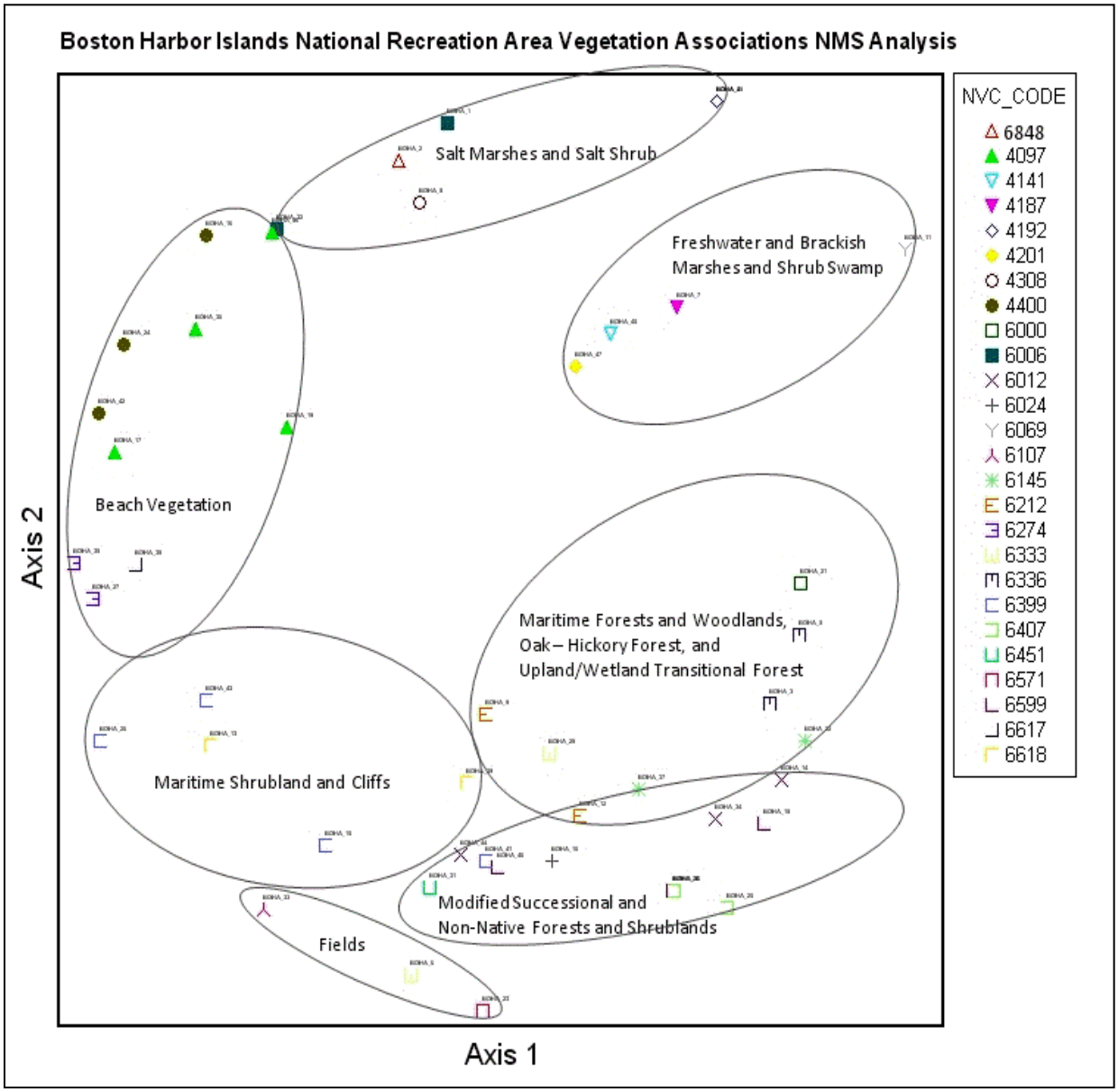


Figure 9. Non-metric Multidimensional Scaling (NMS) analysis (axes 1 and 2) of the full set of vegetation plots at Boston Harbor Islands National Recreation Area (N=47), showing species composition, structure, and environmental setting relationships among the vegetation types. Numbers in the figure key to the last four digits of the USNVC association code.

Based on these analyses and the evaluation of the results, it was determined that the vegetation established within BOHA can be described by 32 vegetation associations: Black Pine Forest, Old-field Eastern Red-cedar Forest, Norway Maple Forest, Northeastern Modified Successional Forest, Northeastern Successional Shrubland, Successional Maritime Forest, Northeastern Dry Oak-Hickory Forest, Upland/Wetland Transitional Forest, Maritime Red-cedar Woodland, Early-successional Woodland/Forest, Wet Meadow, Northeastern Buttonbush Shrub Swamp, Eastern Tidal Salt Shrub, Staghorn Sumac Shrubland (with the accuracy assessment revealing three different variants or "sub-

associations" of this unit), Northern Beachgrass Vegetation, Northeastern Old Field, Little Bluestem Old Field, Common Wormwood Gravel Field, Overwash Grassland, Eastern Reed Marsh, Eastern Cattail Marsh, Reed-grass Tidal Marsh, Coastal Salt Pond Marsh, North Atlantic Low Salt Marsh, North Atlantic High Salt Marsh, Cattail Brackish Tidal Marsh, Salt Panne (Salicornia Type), New England Rocky Intertidal Community, Maritime Erosional Bluffs and Cliffs, Maritime Rock Cliffs and Outcrops, Beach Strand, and North Atlantic Coast Estuarine Intertidal Mudflats (Table 8a). Land use / land cover classes at Boston Harbor Islands National Recreation Area are presented in Table 8b.

Table 8a. Ecological groupings and component U.S. National Vegetation Classification associations by USNVC macrogroup and land use – land cover map classes at Boston Harbor Islands National Recreation Area.

USNVC Macrogroup	Park-specific Common Name	USNVC Association	USNVC Code
Eastern North American Ruderal Forest (M013)	Black Pine Forest	*Pinus thunbergiana - (Pinus nigra)* Forest	CEGL006012
	Old-field Eastern Red-cedar Forest	*Juniperus virginiana* Forest	CEGL006024
	Norway Maple Forest	*Acer platanoides* Forest	CEGL006407
	Northeastern Modified Successional Forest	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest	CEGL006599
	Early-successional Woodland/Forest	*Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera)* Woodland	CEGL006303
Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)	Maritime Red-cedar Woodland	*Juniperus virginiana* var. *virginiana / Morella pensylvanica* Woodland	CEGL006212
	Successional Maritime Forest	*Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia* Forest	CEGL006145
	Northeastern Dry Oak-Hickory Forest	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest	CEGL006336
	Staghorn Sumac Shrubland (all 3 variants)	*Prunus serotina - Rhus typhina* Scrub Forest	CEGL006399

[1] All units in this table are represented by a single map class, except USNVC class "Beach Strand" and land use - land cover class "Beach," which are merged into a single map class.

Table 8a (continued). Ecological groupings and component U.S. National Vegetation Classification associations by USNVC macrogroup and land use – land cover map classes at Boston Harbor Islands National Recreation Area.

USNVC Macrogroup	Park-specific Common Name	USNVC Association	USNVC Code
Appalachian, Interior & Northeastern Mesic Forest (M883)	Upland / Wetland Transitional Forest	*Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest	CEGL006000
Eastern North American Dune & Coastal Grassland & Shrubland (M057)	Northern Beachgrass Vegetation	*Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation	CEGL006274
	Overwash Grassland	*Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation	CEGL004097
Eastern North American Coastal Beach (M060)	Beach Strand [1]	*Cakile edentula* ssp. *edentula - Chamaesyce polygonifolia* Sparse Vegetation	CEGL004400
Eastern North American Ruderal Grassland & Shrubland (M123)	Northeastern Old Field	*Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation	CEGL006107
	Little Bluestem Old Field	*Schizachyrium scoparium - (Andropogon virginicus) - Solidago* spp. Herbaceous Vegetation	CEGL006333
	Northeastern Successional Shrubland	*Elaeagnus umbellata - Cornus racemosa - Rosa multiflora - Juniperus virginiana* Shrubland	CEGL006451
	Common Wormwood Gravel Field	*Artemisia vulgaris* Herbaceous Vegetation	CEGL006617
Eastern North American Wet Meadow and Marsh (M069)	Northeastern Buttonbush Shrub Swamp	*Cephalanthus occidentalis - Decodon verticillatus* Shrubland	CEGL006069
	Wet Meadow	*Spiraea tomentosa - Rubus* spp*. / Phalaris arundinacea* Shrubland	CEGL006571
	Eastern Cattail Marsh	*Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Eastern Herbaceous Vegetation	CEGL006153

[1] All units in this table are represented by a single map class, except USNVC class “Beach Strand” and land use - land cover class “Beach,” which are merged into a single map class.

Table 8a (continued). Ecological groupings and component U.S. National Vegetation Classification associations by USNVC macrogroup and land use – land cover map classes at Boston Harbor Islands National Recreation Area.

USNVC Macrogroup	Park-specific Common Name	USNVC Association	USNVC Code
Eastern North American Ruderal Wet Meadow and Marsh (M303)	Eastern Reed Marsh	*Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation	CEGL004141
	Reed-grass Tidal Marsh	*Phragmites australi*s Tidal Herbaceous Vegetation	CEGL004187
North American Atlantic & Gulf Coast Salt Marsh (M079)	Cattail Brackish Tidal Marsh	*Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation	CEGL004201
	Coastal Salt Pond Marsh	*Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation	CEGL006398
	North Atlantic Low Salt Marsh	*Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation	CEGL004192
	North Atlantic High Salt Marsh	*Spartina patens - Distichlis spicata - (Juncus gerardii*) Herbaceous Vegetation	CEGL006006
	Salt Panne (Salicornia Type)	*Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation	CEGL004308
	Eastern Tidal Salt Shrub	*Iva frutescens / Spartina patens* Shrubland	CEGL003921
Temperate Atlantic Intertidal Shore (M104)	New England Rocky Intertidal Community	*Ascophyllum nodosum - Fucus vesiculosus* Tidal Algal Nonvascular Vegetation	CEGL006341
	North Atlantic Coast Estuarine Intertidal Mudflats	Intertidal Mudflats Sparse Vegetation	CEGL006614
Eastern North American Cliff, Scree & Rock Vegetation (M111)	Maritime Erosional Bluffs and Cliffs	Maritime Erosional Cliffs	CEGL006618
	Maritime Rock Cliffs and Outcrops	Maritime Rock Cliffs	CEGL006619

[1] All units in this table are represented by a single map class, except USNVC class “Beach Strand” and land use - land cover class “Beach,” which are merged into a single map class.

Table 8b. Ecological groupings and component U.S. National Vegetation Classification associations by USNVC macrogroup and land use – land cover map classes at Boston Harbor Islands National Recreation Area.

Land Use / Land Cover Class	Anderson Level II Code
Bare Exposed Rock	74
Bays, Estuaries, and Other Tidal Waters	54
Beach 1	72
Commercial and Services	12
Other Urban or Built-up Land	17
Pond	52
Recreational	N/A
Residential	11
Transportation, Communication & Utilities	14

[1] All units in this table are represented by a single map class, except USNVC class “Beach Strand” and land use - land cover class “Beach,” which are merged into a single map class.

2006 Vegetation Map Production

Using the results of the cluster and NMS ordinations analyses, the groups of similar plots were used to inform the USNVC association assignments for individual plots (i.e. convert provisional community name assignments determined during field work to classified community name assignments; PLOTS 2.0 database). Polygons of the preliminary vegetation map containing plots were updated with the USNVC association as determined by the data analyses. Photosignatures of the polygons assigned an association based on plot data were extrapolated to attribute the remaining polygons (without plots) in the preliminary vegetation map.

Accuracy Assessment

Positional Accuracy

The final horizontal positional accuracy of the BOHA (boha_main_utm19.sid) image is +/-3 meters at the 95% confidence level at the nominal scale of 1:5,000 (MassGIS 2005), which meets Class 1 National Map Accuracy Standards (FGDC 1998b).

Thematic Accuracy

The results of the per class accuracy assessment are displayed in a contingency table (Lea and Curtis 2010) or “confusion matrix” of two types: sample contingency table and proportional contingency table.

Rows of the sample contingency table (Table 9) represent all possible map classes in which AA points were allocated (sample data values), and columns of the table represent all possible classes to which AA points were assigned field calls (reference data values), in the same order. Counts in table cells represent numbers (raw counts) of AA points that have a sample data value represented by the

cell's row and a reference data value represented by the cell's column. Cells with sample data value matching the reference data value are consider correctly mapped observations and appear along a diagonal from the top left to the bottom right of the table. AA points are summed by sample data value (row) in the righthand column of the table.

The population contingency table (Table 10), also known as the proportional contingency table, is arranged by map classes, with rows representing sample data values and columns representing reference data values, as in the sample contingency table. The raw AA point count for each cell is replaced by the proportion of the map (out of 100%) that is estimated to fall into each intersection of sample data value (row) and reference data value (column). Correctly mapped proportions appear along the upper left to lower right diagonal cells. Proportions are calculated using the raw counts and the individual map class sizes (Lea and Curtis 2010). The estimates of the individual map class user's accuracies are the proportion with sample data value = reference data value (the proportion in the diagonal cell for that class) divided by the sum of all proportions in that row (all proportions assigned to that class). Estimated user's accuracies for individual map classes (by row) appear in the righthand column. Similarly, the estimates of the individual map class producer's accuracies are the proportion with sample data value = reference data value (the proportion in the diagonal cell for that class) divided by the sum of all proportions in that column (all proportions with field calls assigned to that class). Estimated producer's accuracies for individual map classes (by column) appear in the bottom row.

Table 9. Sample contingency table (U.S. National Vegetation Classification association level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.[1]

LOCAL NAME	Code	6024	6303	6599	6012	6407	6145	6212	6399	6336	6000	6617	6107	6333	6451	6274	4097	4400+	6153	6069	4141	4187	6571	4201	6006	6398	4192	4308	4308	6614	6341	6619	6618	Total
Old-field Eastern Red-cedar Forest	6024	3.0																																3
Early-succ. Woodland/Forest	6303		1.3	1.6					5.0																									8
Northeastern Modified Successional. Forest	6599		0.1	18.2						0.2					0.5																			19
Black Pine Forest	6012				6.0																													6
Norway Maple Forest	6407					3.0																												3
Successional Maritime Forest	6145						5.0																											5
Maritime Red-cedar Woodland	6212	1.8						2.2																										4
Staghorn Sumac Shrubland	6399								13.6			0.3			0.5	1.7					0.8													17
North. Dry Oak-Hickory Forest	6336	0.2				1.2				4.5																								6
Upland/Wetland Transit. Forest	6000										1.0																							1
Common Wormwood Grav. Fld.	6617											5.4	3.6																					9
Northeastern Old Field	6107								1.3				16.1		0.6																			18
Little Bluestem Old Field	6333													1.0																				1
Northeastern Succ. Shrubland	6451			9.1								0.2	0.6		3.2																			13
Northern Beachgrass Vegetation	6274															4.0																		4
Overwash Grassland	4097																4.0																	4
Beach and Beach Strand	4400+ Beach															0.1		6.9																7
Eastern Cattail Marsh	6153																		1.0															1
Northstn. Buttonbush S. Swamp	6069																			2.0														2
Eastern Reed Marsh	4141																				6.0													6
Reed-grass Tidal Marsh	4187																					4.0												4
Wet Meadow	6571												0.5										2.5											3
Cattail Brackish Tidal Marsh	4201																							1.0										1
North Atlantic High Salt Marsh	6006																								6.0									6
Coastal Salt Pond Marsh	6398																									1.0								1
Eastern Tidal Salt Shrub	6848																										1.0							1
North Atl. Low Salt Marsh	4192																								0.2			10.8						11
Salt Panne (*Salicornia* Type)[2]	4308																																	0[2]
North Atlantic Coast Estuarine Intertidal[2]	6614																																	0[2]
New England Rocky Intertidal Community[2]	6341																																	0[2]
Marit. Rock Cliffs & Outcrops	6619																																2.0	2
Marit. Erosional Bluffs & Cliffs	6618								1.2							0.6																	4.2	6
Total		5.0	1.4	28.9	6.0	4.2	5.0	2.2	21.1	4.7	1.0	5.9	20.8	1.0	4.9	6.4	4.0	6.9	1.0	2.0	6.8	4.0	2.5	1.0	6.2	1.0	1.0	10.8	0	0	0	2.0	4.2	172

[1]Rows indicate map class to which sample points were allocated (sample data value). Columns indicate class to which sample points were found in the field (reference data value). Cell numbers indicate numbers of accuracy assessment sample points (individual observations) for each combination of sample data value (rows) and reference data value (columns). Fractional numbers of observations occur from weighting (see methods).

[2]Map classes representing Salt Panne (*Salicornia* Type), New England Rocky Intertidal Community, and North Atlantic Coast Estuarine Intertidal Mudflats were not sampled in accuracy assessment because the polygon boundaries were walked in the Boston Harbor Islands intertidal study with a handheld GPS (Bell et al. 2002) and were, therefore, assumed to be 100% correct.

Table 10. Population contingency table (U.S. National Vegetation Classification association level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.[1]

LOCAL NAME	Field Call	6024	6303	6599	6012	6407	6145	6212	6399	6336	6000	6617	6107	6333	6451	6274	4097	4400 + Beach	6153	6069	4141	4187	6571	4201	6006	6398	6848	4192	4308	6614	6341	6619	6618	% Correct User's Accur.
Old-fld. Eastern Red-cedar For.	6024	**0.8**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Early-succ. Woodland/Forest	6303	–	**0.5**	**0.6**	–	–	–	–	**1.9**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**17**
Northeastern Mod. Succ. Forest	6599	–	**0.1**	**14.0**	–	–	–	–	–	**0.2**	–	–	–	–	**0.4**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**96**
Black Pine Forest	6012	–	–	–	**1.4**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Norway Maple Forest	6407	–	–	–	–	**2.2**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Successional Maritime Forest	6145	–	–	–	–	–	**1.4**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Maritime Red-cedar Woodland	6212	**0.3**	–	–	–	–	–	**0.3**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**55**
Staghorn Sumac Shrubland	6399	–	–	–	–	–	–	–	**7.2**	–	–	**0.2**	–	–	**0.3**	**0.9**	–	–	–	–	**0.4**	–	–	–	–	–	–	–	–	–	–	–	–	**80**
Northst. Dry Oak-Hickory For.	6336	**TR**	–	–	–	**0.2**	–	–	–	**0.7**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**76**
Upland/Wetland Trans. Forest	6000	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Common Wormwood Grv. Fld.	6617	–	–	–	–	–	–	–	–	–	–	**3.9**	**2.6**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**60**
Northeastern Old Field	6107	–	–	–	–	–	–	–	**0.9**	–	–	–	**11.8**	–	**0.5**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**89**
Little Bluestem Old Field	6333	–	–	–	–	–	–	–	–	–	–	–	–	**0.1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Northeastern Succ. Shrubland	6451	–	–	**7.6**	–	–	–	–	–	–	–	**0.1**	**0.5**		**2.7**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**25**
Northern Beachgrass Veg.	6274	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.3**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Overwash Grassland	4097	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.3**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Beach and Beach Strand	4400	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.2**	–	**20.9**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**99**
Eastern Cattail Marsh	6153	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Northt. Buttonbush S. Swamp	6069	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Eastern Reed Marsh	4141	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.6**	–	–	–	–	–	–	–	–	–	–	–	–	**100**
Reed-grass Tidal Marsh	4187	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.5**	–	–	–	–	–	–	–	–	–	–	–	**100**
Wet Meadow	6571	–	–	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	–	–	–	**82**
Cattail Brackish Tidal Marsh	4201	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	–	–	**100**
North Atl. High Salt Marsh	6006	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**1.1**	–	–	–	–	–	–	–	–	**100**
Coastal Salt Pond Marsh	6398	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**TR**	–	–	–	–	–	–	–	**100**
Eastern Tidal Salt Shrub	6848	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.1**	–	–	–	–	–	–	**100**
North Atl. Low Salt Marsh	4192	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.1**	–	–	**3.3**	–	–	–	–	–	**98**
Salt Panne (*Salicornia* Type)[2]	4308	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.1**	–	–	–	–	**100**
North Atlantic Coast Estuarine Intertidal[2]	6614	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**1.9**	–	–	–	**100**
New England Rocky Intertidal Community[2]	6341	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**1.8**	–	–	**100**
Marit. Rock Cliffs & Outcrops	6619	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**3.0**	–	**100**
Marit. Erosion. Bluffs & Cliffs	6618	–	–	–	–	–	–	–	**0.2**	–	–	–	–	–	–	**0.1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**0.7**	**69**
% Correct Producer's Accuracy	%	**72**	**89**	**63**	**100**	**92**	**100**	**100**	**70**	**82**	**100**	**93**	**79**	**100**	**70**	**19**	**100**	**100**	**100**	**100**	**60**	**100**	**100**	**100**	**95**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**–**

[1]Point estimate of overall accuracy: 81.8% (90% confidence interval: 77.8% - 85.7%) at association level (82.5% at alliance level).
[2]All map classes representing Salt Panne (Salicornia Type), North Atlantic Coast Estuarine Intertidal, and New England Rocky Intertidal Community were not sampled and are assumed to be 100% correct. Cells assigned to combinations of groups within individual macrogroups are enclosed within solid boxes.

Since the polygon boundaries for the Salt Panne (Salicornia Type), New England Rocky Intertidal Community, and North Atlantic Coast Estuarine Intertidal Mudflats were delineated in the Boston Harbor islands intertidal study with a handheld GPS receiver (Bell et al. 2002), the proportions of these classes were assumed to be 100% accurate (rather than a proportion estimated from observations) for purposes of estimating class and overall accuracies.

The overall accuracy (all assessed classes pooled) of the aggregated, final map is estimated at 81.8% for the association level (90% confidence interval of 77.8% to 85.7%). Six of the 29 assessed map classes at this level had less than 80% estimated user's accuracy, and seven of the 29 assessed map classes at this level had less than 80% estimated producer's accuracy.

Generally, individual map classes had acceptable levels of accuracy. A recurring source of thematic error was between and among successional upland shrublands (e.g., Northeastern Successional Shrubland (CEGL006451) and Staghorn Sumac Shrubland (CEGL006399, in part)) and early successional woodlands and forests, (e.g., Early-successional Woodland/Forest (CEGL006303) and Northeastern Modified Successional Forest (CEGL006599) when young trees were present in shrublands in later successional stages and provided enough cover to question whether the association was a shrubland or woodland or, in some cases, a forest. Additional criteria have since been added to the vegetation key (Appendix G) to help clarify these successional associations in the field. The polygon-based sampling scheme exacerbated the effect of these errors on accuracy rates by creating variability between the effect of individual observations with polygon size. Two such errors, one each in a particularly large polygon (16.9 hectares and 9.7 hectares) accounted for an estimated 14.1% of the total estimated 18.8% error for the entire map at the association level map classes. Had large polygons received a proportional number of AA points, as with a point-based scheme, internal variability might have been recorded and the effect of individual observations mitigated.

In addition to thematic mapping errors, other occasional sources of error included:

- Locational, on-the-ground error introduced from the GPS receiver, which sometimes occurred when navigating to very small polygons adopted from the intertidal study. These polygons were often narrower than the accuracy of the GPS receiver, leading map users to ecotones between associations or out of the targeted polygon.

- Identifying small patch inclusions within large vegetation polygons rather than the larger targeted polygon.

- Ambiguities in the vegetation key, which led to identification of the wrong association.

- Discovery of an association not represented in the key or classification. In this case, the new association was added to the key and classification following AA.

Coastal Salt Pond Marsh was identified in AA but not included in the 2006 draft vegetation map. While described in Elliman (2005) and Tiner et al. (2003), this association was not located during classification plot sampling or identified in photo-interpretation due to its invasion by common reed (*Phragmites australis*). The association was added to the classification and 2008 final vegetation map

after it was identified during AA. Additional data from the AA allowed for the division of the Northeastern Old Field polygons into two associations: (1) the typical Northeastern Old Field dominated by orchard grass (*Dactylis glomerata*) and goldenrods (*Solidago* spp.) occurring on deep, loamy soils such as those on World's End and Thompson; and (2) the Common Wormwood Gravel Field, dominated by common wormwood (Artemisia vulgaris) occurs on gravel flats, rocky substrates and reclaimed habitats, such as those at Webb State Park and Spectacle. These discoveries during AA brought the association count for BOHA to 32.

Three variants of the single association, Staghorn Sumac Shrubland, were identified from the AA data and are now mapped in the final 2008 vegetation map. One variant occurring on the sandy necks of drumlins was called Dwarf Maritime Shrubland by Elliman (2005), but upon further review of the data, this association was most appropriately classified as a stunted variant rather than a new association. While shorter and more open than the typical Staghorn Sumac Shrubland Rocky Headland (the second variant), the overall species composition tends to match that of the typic type and so these variants were described based on environmental setting. A third variant, a monoculture staghorn sumac "forest", was also recognized from the AA data.

The table proportions for the association level of the USNVC can be pooled by higher levels of the USNVC, to estimate overall map accuracies at these levels, including alliance (82.5%), group (86.1%), macrogroup (86.2%), division, formation, subclass, and class (all 89.0%). The individual class accuracies are shown only for association, group, and division (Tables 10-12), since these accuracies vary very little at the immediately higher levels. For BOHA, small gains in accuracy are realized by lumping association map classes to higher levels, relative to the loss in thematic resolution experienced at the higher levels.

Table 11. Population contingency table (U.S. National Vegetation Classification group and macrogroup level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.

USNVC MACROGROUP NAME AND IDENTIFIER (Cells assigned to combinations of groups within individual macrogroups are enclosed within solid boxes.)	USNVC GROUP AND IDENTIFIER	M013		M502		M883	M123	M057	M060	M069		M303	M079				M104	M111	
		Northern & Central Native Ruderal Forest (G030)	Northern & Central Exotic Ruderal Forest (G032)	Noh Atlantic Maritime Scrub Forest (G495)	Northeastern Oak - Hickory Forest & Woodland (G650)	Appalachian & Allegheny Northern Hardwood - Conifer Forest (G742)	Northern & Central Ruderal Meadow & Shrubland (G059)	North Atlantic Coastal Shrub & Grass Dune (G493)	North Atlantic Coastal Beach (G660)	Eastern North American Freshwater Marsh (G125)	Northern & Central Shrub Swamp (G167)	Northern and Central Ruderal Wet Meadow & Marsh (G556)	Atlantic & Gulf Coast Brackish Tidal Marsh (G120)	Atlantic & Gulf Coast High Salt Marsh (G121)	Atlantic & Gulf Coast Low Salt Marsh (G122)	Atlantic & Gulf Coast Saline Flat & Panne (G123)	North American North Atlantic Intertidal Shore (G387)	Eastern North American Talus & Bluff (G340)	% Correct User's Accuracy
Eastern North American Ruderal Forest (M013)	Northern & Central Native Ruderal Forest (G030)	16.0	–	1.9	0.2	–	0.4	–	–	–	–	–	–	–	–	–	–	–	86
	Northern & Central Exotic Ruderal Forest (G032)	–	3.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	100
Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)	North Atlantic Maritime Scrub Forest (G495)	0.3	–	8.9	–	–	0.5	0.9	–	–	–	0.4	–	–	–	–	–	–	81
	Northeastern Oak - Hickory Forest & Woodland (G650)	TR	0.2	–	0.7	–	–	–	–	–	–	–	–	–	–	–	–	–	76
Appalachian, Interior & Northeastern Mesic Forest (M883)	Appalachian & Allegheny Northern Hardwood - Conifer Forest (G742)	–	–	–	–	TR	–	–	–	–	–	–	–	–	–	–	–	–	100
Eastern North American Ruderal Grassland & Shrubland (M123)	Northern & Central Ruderal Meadow & Shrubland (G059)	7.6	–	0.9	–	–	22.2	–	–	–	–	–	–	–	–	–	–	–	72
Eastern North American Dune & Coastal Grassland & Shrubland (M057)	North Atlantic Coastal Shrub & Grass Dune (G493)	–	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	100
Eastern North American Coastal Beach (M060)	North Atlantic Coastal Beach (G660)	–	–	–	–	–	–	0.2	20.9	–	–	–	–	–	–	–	–	–	99
Eastern North American Wet Meadow and Marsh (M069)	Eastern North American Freshwater Marsh (G125)	–	–	–	–	–	–	–	–	TR	–	–	–	–	–	–	–	–	100
	Northern & Central Shrub Swamp (G167)	–	–	–	–	–	–	–	–	–	TR	–	–	–	–	–	–	–	100
Eastern North American Ruderal Wet Meadow & Marsh (M303)	Northern and Central Ruderal Wet Meadow & Marsh (G556)	–	–	–	–	–	TR	–	–	–	–	1.2	–	–	–	–	–	–	99
North American Atlantic & Gulf Coast Salt Marsh (M079)	Atlantic & Gulf Coast Brackish Tidal Marsh (G120)	–	–	–	–	–	–	–	–	–	–	–	TR	–	–	–	–	–	100
	Atlantic & Gulf Coast High Salt Marsh (G121)	–	–	–	–	–	–	–	–	–	–	–	–	1.2	–	–	–	–	100
	Atlantic & Gulf Coast Low Salt Marsh (G122)	–	–	–	–	–	–	–	–	–	–	–	–	0.1	3.3	–	–	–	98
	Atlantic & Gulf Coast Saline Flat & Panne (G123)[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1	–	–	100
Temperate Atlantic Intertidal Shore (M104)	North American North Atlantic Intertidal Shore (G387)[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.8	–	100
Eastern North American Cliff, Scree & Rock Vegetation (M111)	Eastern North American Talus & Bluff (G340)	–	–	0.2	–	–	–	0.1	–	–	–	–	–	–	–	–	–	3.7	92
% Correct Producer's Accuracy		67	95	74	82	100	96	31	100	100	100	74	100	96	100	100	100	100	–

[1]Point estimate of overall accuracy: 86.1% at group level, 86.2% at macrogroup level. Rows indicate map class to which sample points were allocated (sample data value). Columns indicate class to which sample points were found in the field (reference data value). Cell numbers indicate percentages of map estimated for each combination of sample data value and reference data value data value (TR = < 0.05%).

[2]Map classes representing Atlantic & Gulf Coast Saline Panne & Flat and North American North Atlantic Temperate Intertidal Shore were not sampled and are assumed to be 100% correct. Cells assigned to combinations of groups within individual macrogroups are enclosed within solid boxes.

Table 12. Population contingency table (U.S. National Vegetation Classification division, formation, subclass, and class level map classes) for the Boston Harbor Islands National Recreation Area vegetation map accuracy assessment.[1]

Class	Subclass	Formation	Division	D008	D024	D026	D323	D034	D047	D051	% Correct User's Accuracy
Forest & Woodland (1)	Temperate & Boreal Forest & Woodland (1.B)	Cool Temperate Forest & Woodland (1.B.2)	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)	31.9	0.9	0.9	0.4	–	–	–	94
Shrub & Herb Vegetation (2)	Temperate & Boreal Shrubland & Grassland (2.B)	Temperate Grassland & Shrubland (2.B.2)	Eastern North American Grassland & Shrubland (D024)	–	22.2	–	–	–	–	–	72
		Temperate & Boreal Scrub & Herb Coastal Vegetation (2.B.4)	Eastern North American Dune & Coastal Grassland & Shrubland (D026)	–	–	21.6	–	–	–	–	100
	Shrub & Herb Wetland (2.C)	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)	Eastern North American Freshwater Wet Meadow, Riparian, & Marsh (D323)	–	TR	–	1.3	–	–	–	99
		Salt Marsh (2.C.5)	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)[2]	–	–	–		4.6	–	–	100
Aquatic Vegetation (5)	Saltwater Aquatic Vegetation (5.A)	Benthic Macroalgae Saltwater Vegetation (5.A.2)	Temperate Intertidal Shore (D047)[2]	–	–	–	–	–	3.8	–	100
Open Rock Vegetation (6)	Temperate and Boreal Open Rock Vegetation (6.B)	Temperate & Boreal Cliff, Scree & Other Rock Vegetation (6.B.1)	Eastern North American Temperate Cliff, Scree & Rock Vegetation (D051)	0.2		0.1	–	–	–	3.7	92
% Correct User's Accuracy				79	96	96	74	100	100	100	–

[1]Point estimate of overall accuracy: 88.97% at division and formation levels, 88.98% at subclass and class levels. Rows indicate map class to which sample points were allocated (sample data value). Columns indicate class to which sample points were found in the field (reference data value). Cell numbers indicate percentages of map estimated for each combination of sample data value and reference data value data value (TR = < 0.05%).
[2]All map classes representing Temperate Intertidal Shore and one map class representing Temperate & Boreal Atlantic Coastal Salt Marsh were not sampled and are assumed to be 100% correct. Cells assigned to combinations of divisions/formations within individual subclasses are enclosed within dashed boxes. Cells assigned to combinations of divisions/formations within individual classes are enclosed within solid boxes.

Final Vegetation Map Production

All polygons visited during AA were updated with the correct attributions (field call 1 or 2) to produce the final 2008 vegetation map (Figure 10). Larger scale vegetation maps of individual islands and peninsulas are shown in Figures 61-72 in Appendix J. These figures show the difference in plant association abundance and distribution between a large, close-to-the-mainland, protected inner harbor drumlin peninsula and smaller, more isolated, exposed, outer rocky outcrop islands.

The final 2008 vegetation map uses local (park-specific) names for the vegetation associations found in BOHA. The vegetation map is composed of 42 map classes, including 34 vegetation classes (32 vegetation associations, with one association having three variants) and eight cultural categories. One map class consists of an aggregated vegetation association and land use unit, Beach and Beach Strand. Three vegetation map classes represent three variants of one Staghorn Sumac Shrubland association. A summary of the distribution and abundance of the map classes for the entire park is provided in Table 13. A summary of the distribution and abundance of the map classes for the each island is provided in Appendix J.

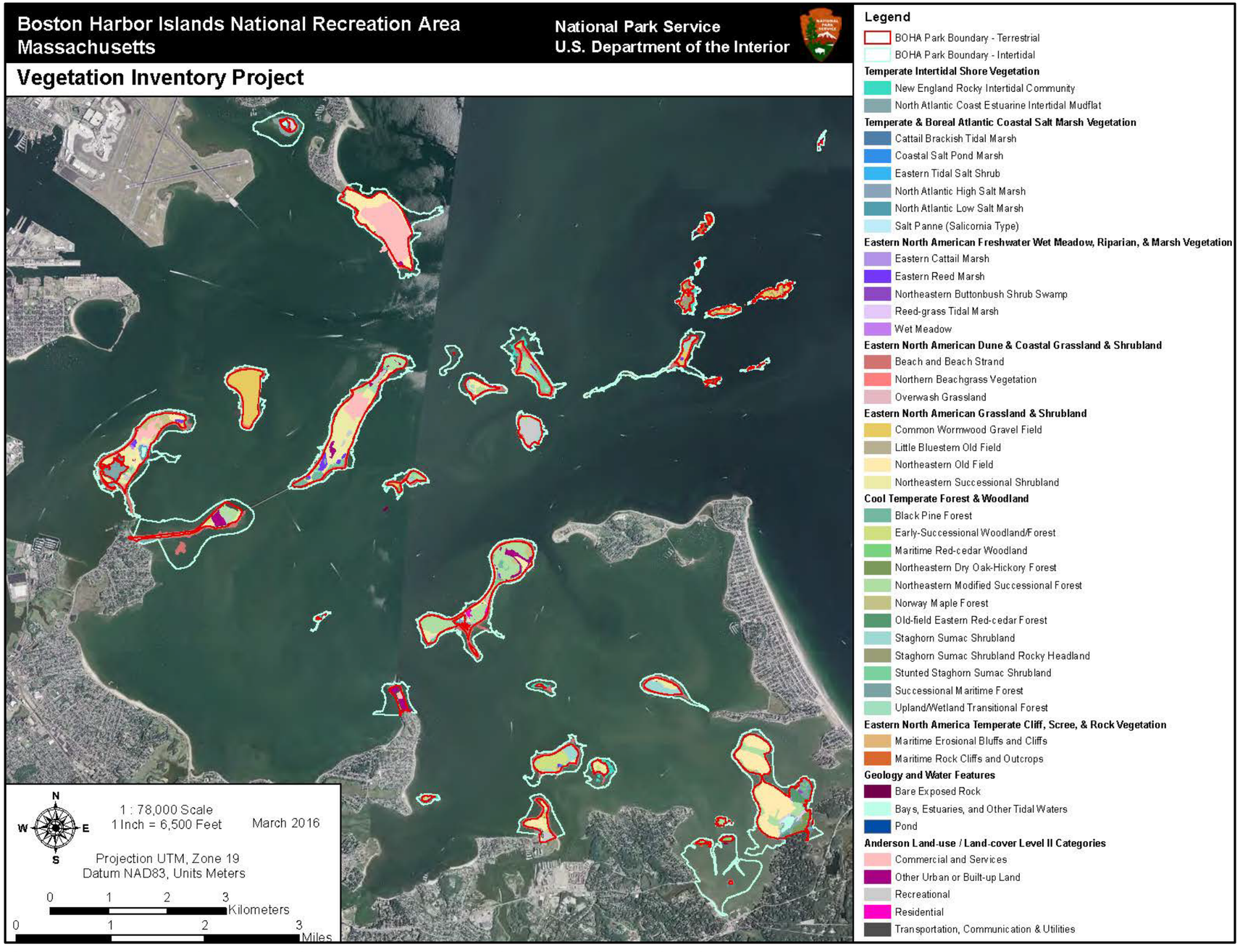


Figure 10. Vegetation associations and land use – land cover categories for Boston Harbor Islands National Recreation Area.

Table 13. Number of polygons and total mapped hectares and acres of vegetation and land use – land cover map classes for the final association-level vegetation map of Boston Harbor Islands National Recreation Area.

Vegetation Association Park-specific Name / Land Use – Land Cover Category	Polygons	Hectares Mapped	Acres Mapped
Beach and Beach Strand	103	123.4	305.0
Black Pine Forest	12	8.2	20.2
Cattail Brackish Tidal Marsh	2	0.1	0.3
Coastal Salt Pond Marsh	3	0.8	1.9
Common Wormwood Gravel Field	55	38.4	94.8
Early-successional Woodland/Forest	20	18.3	45.3
Eastern Cattail Marsh	1	0.1	0.2
Eastern Reed Marsh	12	3.8	9.3
Eastern Tidal Salt Shrub	10	0.8	1.9
Little Bluestem Old Field	9	0.7	1.8
Maritime Erosional Bluffs and Cliffs	15	6.0	14.9
Maritime Red-cedar Woodland	10	3.5	8.6
Maritime Rock Cliffs and Outcrops	41	17.7	43.7
New England Rocky Intertidal Community	54	10.6	26.1
North Atlantic Coast Estuarine Intertidal Mudflats	19	11.4	28.2
North Atlantic High Salt Marsh	52	6.2	15.4
North Atlantic Low Salt Marsh	129	19.4	48.0
Northeastern Buttonbush Shrub Swamp	2	0.1	0.2
Northeastern Dry Oak-Hickory Forest	4	6.0	14.8
Northeastern Modified Successional Forest	46	86.1	212.7
Northeastern Old Field	55	77.5	191.5
Northeastern Successional Shrubland	61	63.8	157.7
Northern Beachgrass Vegetation	12	1.6	4.0
Norway Maple Forest	12	13.0	32.1
Old-field Eastern Red-cedar Forest	5	4.6	11.3
Overwash Grassland	11	1.5	3.6
Reed-grass Tidal Marsh	19	3.2	7.9

Table 13 (continued). Number of polygons and total mapped hectares and acres of vegetation and land use – land cover map classes for the final association-level vegetation map of Boston Harbor Islands National Recreation Area.

Vegetation Association Park-specific Name / Land Use – Land Cover Category	Polygons	Hectares Mapped	Acres Mapped
Salt Panne (Salicornia Type)	7	0.3	0.7
Staghorn Sumac Shrubland	34	28.6	70.6
Staghorn Sumac Shrubland Rocky Headland	9	9.6	23.7
Stunted Staghorn Sumac Shrubland	17	13.7	33.8
Successional Maritime Forest	11	7.9	19.5
Upland/Wetland Transitional Forest	1	0.2	0.5
Wet Meadow	4	0.3	0.8
Vegetation Association Total	857	587.4	1,451
Bare Exposed Rock	66	3.8	9.4
Bays, Estuaries, and Other Tidal Waters	7	8.7	21.6
Commercial and Services	4	76.1	188.0
Other Urban or Built-up Land	47	38.3	94.7
Pond	2	0.3	0.8
Recreational	43	30.9	76.3
Residential	6	2.7	6.7
Transportation, Communication & Utilities	26	18.2	45.0
Land Use - Land Cover Total	201	179	442.5
Grand Total	1,058	766.4	1,893.5

The vegetation map classes in the 2008 final vegetation map are equivalent to the association level of the USNVC, with one exception; i.e., Beach Strand, known globally as North Atlantic Upper Ocean Beach, has been lumped with the land use - land cover Beach map class because AA could not tease out these very small patch sparse vegetation units that occur on nearly every island (all Beach polygons have a Beach Strand inclusion within them). USNVC attributions for 172 polygons sampled in AA were updated where needed to match the first or second call generated in the AA data. The 47 polygons sampled in vegetation classification plot sampling were also confirmed to match the USNVC attributions. These data are provided as point shapefiles in the final products.

The vegetation and land cover of BOHA was divided into a total of 1058 polygons in the map classes described above. Many of the polygons are smaller than the standard NVMI MMU size of 0.5 ha (1.2 ac) because: many of the islands are <0.5 ha in size; the mapper was able to see

considerable detail in the orthophotos; the mapper had over 300 reconnaissance GPS receiver-verified coordinates (data points) and the classified marine intertidal habitat polygon linework; and because the MMU for the intertidal polygons adopted from the Boston Harbor islands marine intertidal study was 25m2 (0.063 ha, 0.15 ac) (Bell et al.2002).

Metadata for the vegetation association shapefile, the plot location shapefile, the AA sampling point location shapefile, and the digital photomosaic were prepared according to FGDC standards and have been provided as products with this report.

Vegetation Association Descriptions

The association descriptions contain information on the USNVC associations present at BOHA ("Local Description") and range-wide ("Global Information") (Appendix F). The local descriptions are specific to their expressions at the park. Sources cited in the local and global vegetation descriptions are included in the literature section at the end of this appendix. Representative photographs of the vegetation associations are provided after the descriptions when available.

A list of the plants recorded and observed during the vegetation classification plot sampling, AA sampling, and known to occur in the park from Elliman's inventory (2004) is presented in Appendix E. Vascular plant species nomenclature in the local and global descriptions follows the nationally standardized list of Kartesz (1999), with very few exceptions. This nomenclature differs from PLANTS 3.5 Database (USDA-NRCS 2006) in only a very few cases, and when this difference occurs, synonymy is indicated parenthetically in the local description information. Nomenclature for nonvascular plants (mosses) follows Anderson (1990) and Anderson et al. (1990).

English names for associations and alliances use NatureServe Central Ecology-accepted names and may differ slightly from PLANTS 3.5 Database (USDA-NRCS 2006) common names that are used in the local description information and throughout the rest of the report.

A dichotomous key was developed for the classified vegetation associations (Appendix G). The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate. This key and the park-specific vegetation association descriptions were used in the thematic AA and may be used by park resource managers and others to identify vegetation associations in the park.

An index to the association photos in the vegetation descriptions is provided in Appendix I. A table with the areas of the vegetation associations on each island and peninsula is included in Appendix J. Global and state conservation status rank definitions are provided in Appendix K. A bibliography for the sources cited in the USNVC global vegetation descriptions is provided in Appendix L.

Project Products

Products of the vegetation mapping project are shown in Table 14. All original products have been delivered to the NPS by NatureServe with the draft report prepared in 2008.

Table 14. Summary of products resulting from the Boston Harbor Islands National Recreation Area vegetation classification and mapping project.

Product	FGCD-complaint spatial metadata
Aerial photos, including flight line map and photoindex housed at MassGIS	Yes
Photomosaic in digital format	Yes
Annotated field forms with vegetation plot sampling data	Not applicable
Vegetation plot sampling data in the PLOTS 2.0 database	Yes
Differentially corrected GPS locations of vegetation plots	Yes
Annotated field forms with thematic accuracy assessment Data	Not applicable
Thematic accuracy assessment data in the PLOTS 2.0 Database	Yes
Differentially corrected GPS locations of thematic accuracy assessment sampling points	Yes
Digital photos representative of vegetation types	Not applicable
Final map of vegetation associations in digital format	Yes
Final report in digital format	Yes

Discussion

The BOHA vegetation classification and mapping project completed by NatureServe staff and associates should provide an effective context for interpreting the vegetation resources and a baseline for future research. This project provides the most detailed study to date of the distribution and diversity of plant associations in BOHA. As with previous studies in the region, vegetation inventory within BOHA demonstrates the floristic diversity of the islands and peninsulas' intertidal areas, beaches, rock outcrops and cliffs, adjacent uplands, and managed and developed lands. This section provides a discussion of the significant floristic resources and plant communities; project limitations; possibilities for improving the classification and map accuracy; and the study's implications for natural resource management, interpretive goals, and future research.

Vegetation Classification and Characterization

This vegetation and land use study at BOHA identified 32 vegetation associations (34 total vegetation types, if the three variants of the Staghorn Sumac Shrubland are counted) and the field work documented the occurrence of 262 vascular plant species within the park, the associations are: Black Pine Forest, Old-field Eastern Red-cedar Forest, Norway Maple Forest, Northeastern Modified Successional Forest, Successional Maritime Forest, Northeastern Dry Oak-Hickory Forest, Upland/Wetland Transitional Forest, Maritime Red-cedar Woodland, Early-successional Woodland/Forest, Wet Meadow, Northeastern Buttonbush Shrub Swamp, Eastern Tidal Salt Shrub, Staghorn Sumac Shrubland, Northeastern Successional Shrubland, Northern Beachgrass Vegetation, Northeastern Old Field, Common Wormwood Gravel Field, Little Bluestem Old Field, Overwash Grassland, Eastern Reed Marsh, Eastern Cattail Marsh, Reed-grass Tidal Marsh, Coastal Salt Pond Marsh, North Atlantic Low Salt Marsh, North Atlantic High Salt Marsh, Cattail Brackish Tidal Marsh, Salt Panne (Salicornia Type), New England Rocky Intertidal Community, Maritime Erosional Bluffs and Cliffs, Maritime Rock Cliffs and Outcrops, Beach Strand, and North Atlantic Coast Estuarine Intertidal Mudflats. These vegetation types are influenced by the environmental settings and past land uses in the park. Coastal erosion, sea level rise, and invasive plants pose constant threats to the ecological integrity of these associations.

This project mapped a total of 766 ha (1,894 ac) of the BOHA; the mapping extended to the visible outer edge of the islands and peninsulas as seen in the 2005 MassGIS orthophotography. A total of 587 ha (1,451 ac) of terrestrial and intertidal plant associations and un-vegetated beach were mapped. Beach with inclusions of Beach Strand vegetation comprise 25% of this area, covering 123 ha (305 ac), and extending 55 km (34 mi) (Roman et al. 2005). Intertidal vegetation associations including Eastern Tidal Salt Shrub, New England Rocky Intertidal Community, North Atlantic Coast Estuarine Intertidal Mudflat, North Atlantic High Salt Marsh, North Atlantic Low Salt Marsh, Reed-grass Tidal Marsh, and Salt Panne (Salicornia Type) comprise 52 ha (128 ac). Most of these intertidal polygons were adopted from the Bell et al. (2002) marine intertidal habitat mapping and classification effort;

additional vegetated intertidal polygons were photo-interpreted where needed.[1] A comparison of the final areas of the intertidal vegetation associations from the Bell et al. (2002) and this study is provided in Table 15. Land use - land cover categories cover 179 ha (443 ac) and include: Bare Exposed Rock; Bays, Estuaries, and Other Tidal Waters; Ponds; Commercial and Services; Other Urban or Built-up Land; Recreational; Residential; and Transportation, Communication & Utilities.

Table 15. Areas of intertidal vegetation associations mapped in the Bell et al. (2002) study that were incorporated into the Boston Harbor Islands National Recreation Area vegetation map.

Marine Intertidal Assemblage(s) Bell et al. 2002	USNVC Equivalent BOHA Park-specific Name	USNVC Code	Mapped Hectares Bell et al. (2002)	Mapped Hectares this study
Ascophyllum *Fucus* Brown Algae	New England Rocky Intertidal Community	CEGL006341	10.7	10.6
Mudflat	North Atlantic Coast Estuarine Intertidal Mudflats	CEGL006614	22.5	11.4[1]
Spartina alterniflora	North Atlantic Low Salt Marsh	CEGL004192	15	19.4
Spartina patens *Juncus gerardii* *Suaeda* High marsh	North Atlantic High Salt Marsh	CEGL006006	3.2	6.2
Salicornia	Salt Panne (Salicornia Type)	CEGL004308	0.1	0.3
Iva frutescens	Eastern Tidal Salt Shrub	CEGL006848	0.04	0.8
Phragmites australis	Reed-grass Tidal Marsh	CEGL004187	0.3	3.2

[1] North Atlantic Coast Estuarine Intertidal Mudflats extends beyond the water's edge of the islands and was only partially visible in the 2005 orthophotography. The Bell et al. (2002) data are more accurate.

The varied terrain of the islands and peninsulas ranges from steep drumlin bluffs and rock cliffs to extensive flat salt marshes and cobble and beaches. Each island or peninsula has a unique assemblage of terrestrial and intertidal vegetation associations (Appendix J). The larger islands and peninsulas closer to the mainland and are therefore more protected from high wave energy and salt spray, support more vegetation associations than the smaller, more exposed islands and peninsulas.

Land use also plays a role in the abundance and distribution of vegetation communities (Elliman 2005). Islands and peninsulas heavily disturbed over time provide habitat to fewer natural plant

[1] The Bell et al. 2002 study mapped 20 of the 34 Boston Harbor Islands. Photointerpretation of intertidal vegetation communities was required (where applicable) for the remaining 14 islands.

associations, more nonnative and successional associations, and more land use - land cover map classes than islands and peninsulas that have experienced less human disturbance.

The predominant terrestrial native vegetation throughout the park is Staghorn Sumac Shrubland dominated by staghorn sumac (*Rhus typhina*) (52 ha [128 ac]). Staghorn sumac tolerates the coastal conditions, shallow soils, and disturbed settings common throughout BOHA. The pollen of this species in the Boston Harbor islands dates back many centuries (Patterson et al. 2005). This association occurs in various stages of development from open stunted shrublands with many old field grasses and forbs to closed-canopied monoculture thickets to more diverse maritime shrublands. These three variants are described and mapped for the park.

The Stunted Staghorn Sumac Shrubland occurs on gravelly or sandy flats between drumlin heads and has stunted staghorn sumac and rugosa rose (*Rosa rugosa*) shrubs and high herbaceous cover. While common in the park, this variant is less common state-wide and has a state rank of S3 as this community is typically lost to coastal development. The Staghorn Sumac Shrubland consists of a staghorn sumac thicket or "forest" over an understory of grasses, blackberries (*Rubus* spp.) or goldenrods (*Solidago* spp.). The third variant, Staghorn Sumac Shrubland Rocky Headland, is the most closely related to the USNVC described global type. This maritime shrubland occurs on rocky headlands throughout the islands and peninsulas. Scattered black cherry (*Prunus serotina*) trees are typically present and northern bayberry (*Morella pensylvanica*) joins staghorn sumac in the shrub canopy. This maritime shrubland can be distinguished from the Northeastern Successional Shrubland by the clear dominance of staghorn sumac (*Rhus typhina*) often with black cherry (*Prunus serotina*) and northern bayberry (*Morella pensylvanica*) and low cover (<20%) of non-native invasive shrubs and vines. On Calf, Outer Brewster, and Little Brewster, the dense cover of this maritime shrubland supports some of the southern-most breeding pairs of common eider (*Somateria mollissima*) in the Atlantic (Paton et al. 2005; Foley 2005; Trocki and Paton 2007).

Salt marshes and intertidal mudflats persist in lower wave energy environments on islands and peninsulas with flat terrain (Bell et al. 2005). Consequently, these associations are most abundant on the larger, protected, inner harbor drumlins including World's End, Peddocks, Long, and Thompson islands. These and other islands and peninsulas provide habitat for approximately 36 ha (89 ac) of intertidal mudflats and salt marsh associations including North Atlantic Low Salt Marsh, North Atlantic High Salt Marsh, and Salt Panne (Salicornia Type). Salt marshes are habitat for two plant species regarded to be rare by the Massachusetts Natural Heritage and Endangered Species Program (MDNHP 2015), Pursh seepweed (*Suaeda calceoliformis*) (S2S3) and Rich's seepweed (*Suaeda maritima* ssp. *richii*) (S2S3) (Elliman 2005). Appendix K defines the global and state ranks. Salt marsh restoration projects eradicating common reed (*Phragmites australis*) are ongoing at Thompson Island and World's End. Small-patch fringe North Atlantic Low Salt Marshes are found on the outer rocky islands in low abundance. New England Rocky Intertidal Community is the predominant intertidal vegetation of the outer harbor islands covering 10.6 mapped ha (26.1 ac). Many of the outer islands are comprised of bedrock outcrops and are exposed to the strongest waves. Salt marshes and mudflats are uncommon on these islands.

BOHA landforms support three globally rare (G1-G3) and six state-ranked (S1-S3) natural vegetation associations (Table 16). These natural associations deserve the highest level of protection from fragmentation, development, invasion by non-native species, and other disturbances that might threaten the ecological integrity of the associations. Typically there are many rare, threatened and endangered plant and often animal species associated with rare natural associations.

Table 16. State-ranked and globally-ranked rare, endangered, threatened, and watch list plant associations in Boston Harbor Islands National Recreation Area.

Park-Specific Common Name	State Rank	Global Rank
Beach Strand	S3	G3G4
Maritime Erosional Bluffs and Cliffs	S2	GNR
Maritime Red-cedar Woodland	S1	G2
Maritime Rock Cliff and Outcrops	S2	GNR
Northern Beachgrass Vegetation	S2	G4?
Overwash Grassland	SNR	G2G3
Successional Maritime Forest	SNR	G2G3
Staghorn Sumac Shrubland (all 3 variants)	S3	GNR

The rarest association is the Maritime Red-cedar Woodland which occurs on the rocky headlands on World's End, Langlee, and Ragged islands in Hingham Harbor. While small in total area (3.5 ha [8.6 ac]), this community is ranked S1 (rare) in Massachusetts and G2 (imperiled globally) by NatureServe (Swain and Kearsley 2001; Elliman 2005; NatureServe 2008). This association may be confused with Old-field Eastern Red-cedar Forest which is an old-field successional association also dominated by eastern redcedar (*Juniperus virginiana*) but lacking an ericaceous understory and herbaceous layer dominated by native grasses.

Maritime Erosional Bluffs and Cliffs (S2, GNR) occur on eroding drumlin heads throughout the park. Bluff faces continually erode and slump, contributing sediment to the drumlin beaches. Some, such as those on Great Brewster Island, have sheer, unvegetated sand and gravel faces 30 m in height. This sand-dune-like signature was obvious in the orthophoto and observable from commercial airliners using Logan International Airport, adjacent to Boston Harbor. Other examples of Maritime Erosional Bluffs and Cliffs are located on Peddocks, Thompson, and Long islands. These islands are also vegetated with weedy Northeastern Old Field herbaceous species and occasionally Staghorn Sumac Shrubland. Plant species such as Bebb willow (*Salix bebbiana*) and jewelweed (*Impatiens capensis*) often become established at the bases of these cliffs and are indicators of groundwater seepage (Elliman 2005).

Maritime Rock Cliffs and Outcrops (S2, GNR) occur primarily on the outer islands including Calf, Green, Little Brewster, Middle Brewster, Outer Brewster, and Little Calf, and inner harbor islands

Langlee, Ragged, and Slate. These cliffs are typically sparsely vegetated, but some are home to interesting plants. The state watch list plant, Carolina geranium (*Geranium carolinianum* var. *carolinianum*) grows on the puddingstone cliffs on Langlee (Elliman 2005). Although not threatened, unique plants including red columbine (*Aquilegia canadensis*) and Scottish licorice-root (*Ligusticum scotcium*) grow on the slate cliffs of Slate Island (Elliman 2005). Maritime Rock Cliffs and Outcrops provide the required substrate and perches for cormorant and gull rookeries as seen on Middle Brewster Island (Paton et al. 2005; Foley 2005). This map class differs from the Bare Exposed Rock land use - land cover map class in that sparse vegetation and a cliff or outcrop setting with steep sides are typically present. Bare Exposed Rock was mapped where singular or very small clusters of rocks that lacked vegetation occurred offshore of islands. Shag Rocks, for example, is completely mapped as Bare Exposed Rock.

Northern Beachgrass Vegetation (S2, G4?) occurs on Lovells, Spectacle, and Long islands. Lovells Island, a drumlin positioned in the outer harbor and more exposed to high energy waves, has sandy beaches and small dune formations that support northern beachgrass (*Ammophila brevigulata*) vegetation (Rosen and Fitzgerald 2004; Elliman 2005). A state-listed moth, coastal heathland cutworm (*Abagrostis nefascia*), occurs in this habitat on Lovells Island (Elliman 2004; Mello 2005). Most other examples of Northern Beachgrass Vegetation in the park do not occur on dunes, but rather occur on mixed coarse substrate (sand, gravel, and cobble) along the upper edges of beaches and on sand fill in the case of the planted restoration site on Spectacle.

Another vegetation association occurring on or adjacent to beaches in BOHA is Beach Strand (S3, G3G4). This sparse vegetation occurs above the high tide line on nearly every island. Beach Strand provides habitat for the rare plant (S2, G4) seabeach dock (*Rumex pallidus*), which has established on a few of the islands (Elliman 2005). On many of the islands, common wormwood (*Artemisia vulgaris*) is invading Beach Strand stands. Overwash Grassland also occurs in the upper beach environmental setting, with seaside goldenrod (*Solidago sempervirens*) and saltmeadow cordgrass (*Spartina patens*) sharing dominance. In some cases this association occurs landward of North Atlantic High Salt Marsh. Overwash is a regular maritime disturbance caused by high energy waves at high tide that washes in a layer of sand or gravel that often smothers existing vegetation, but provides new substrate for vegetation to colonize (Patterson et al. 2005).

The various gravel, cobble, and sand beaches and the associated vegetation associations, Northern Beachgrass Vegetation, Overwash Grassland, and Beach Strand, provide important feeding grounds and nesting sites for shorebirds including one of the northern-most breeding populations of American oystercatchers (*Haematopus palliatus*), a shorebird species of high concern (Foley 2005; Schulte et al. 2007). Sandy beaches on Lovells and Rainsford Islands support a nesting colony of least terns (*Sterna antillarum*) (Trocki and Paton 2007). Beach habitat also supports a population of the state-rare (S2) plant, seacoast angelica (*Angelica lucida*) (Elliman 2005; MANHESP 2017).

Freshwater wetlands are uncommon throughout the park. Tiner et al. (2003) mapped only 2% freshwater wetlands in a wetland inventory conducted in 2003. A total of 4 ha (9.8 ac) were mapped, including Eastern Cattail Marsh (Middle Brewster Island only), Northeastern Buttonbush Shrub Swamp (World's End only), and Wet Meadow (Outer Brewster Island, Thompson Island, Calf

Island, and World's End), and Eastern Reed Marsh (Great Brewster, Thompson, Grape, Peddocks, Long, and Slate Islands). Eastern Reed Marsh comprises 3.8 hectares (9.3 ac) or 95% of the freshwater wetland total area of coverage. Freshwater wetlands have been filled and altered over the centuries of human alteration of the islands, creating the conditions favorable for common reed (*Phragmites australis*) invasion. The restoration of invaded and altered freshwater wetlands and the protection of the existing ones are highly recommended management strategies.

Three brackish marshes are mapped (4.1 ha [10.1 ac]) and most are classified Reed-grass Tidal Marsh, but Cattail Brackish Tidal Marsh and Coastal Salt Pond Marsh are also present. Cattail Brackish Tidal Marsh occurs only on Long Island and is dominated by narrowleaf cattail (*Typha angustifolia*) with interspersed patches of crimsoneyed rosemallow (*Hibiscus moscheutos* ssp. *moscheutos*). Coastal Salt Pond Marsh occurs on Thompson, Calf, and Grape islands. Both freshwater and saltwater plant species are present in this association which is isolated from regular tidal flooding, but may receive irregular tidal flooding in storms (some stands are heavily invaded by purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*). The vegetation map can be used to identify the locations and acreages of brackish marsh associations and the USNVC can be used to identify target vegetation associations for restoration efforts.

Upland forests are common on the inner islands that are most protected from salt spray. While mature stands of Northeastern Dry Oak –Hickory Forest occur on the southeastern corner of World's End (6 ha [14.8 ac]), and Successional Maritime Forest occurs on Webbs State Park, World's End, and Thompson (8 ha [19.5 ac]), very little native forest remains on the islands. Centuries of past land use has resulted in a relatively large number of fragmented and successional terrestrial upland communities including Northeastern Modified Successional Forest (86 ha [213 ac]), Early-successional Woodland/Forest (18 ha [45 ac]), Northeastern Successional Shrubland (64 ha [158 ac]), and Northeastern Old Field (78 ha [192 ac]). These associations harbor many invasive plants.

A total of 66 ha (164.2 ac) of the mapped park area is comprised of non-native plant-dominated associations including Norway Maple Forest, Black Pine Forest, Common Wormwood Gravel Field, Eastern Reed Marsh, and Reed-grass Tidal Marsh. Non-native invasive plant species are the main threat to the native vegetation at BOHA, comprising 50% or more of the flora on all of the islands and peninsulas with the exception of six: World's End, Button, Ragged, Sarah, Grape, and Slate (Elliman 2005). The same trend is evident in the composition of the native plant-dominated associations of the islands and peninsulas. Non-native plants are particularly abundant in the abandoned old fields, on forest edges, in successional shrublands, and along trails and roads. The most common and problematic terrestrial upland species include Norway maple (*Acer platanoides*), common wormwood (*Artemisia vulgaris*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), and oriental bittersweet (*Celastrus orbiculatus*) established on nearly all of the islands. Common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*) are the most problematic non-native species established in wetlands.

Northeastern Successional Shrublands and Northeastern Modified Successional Forests can be targeted for management. Park managers have been active in invasive species control efforts and this

work should continue, especially where non-native species threaten populations of rare plant and animal species and high quality vegetation associations.

Interestingly, the Black Pine Forest association, a non-native forest plantation dominated by Austrian pine (*Pinus nigra*), does not appear to be regenerating as evidenced by the lack of pine seedlings and saplings (Elliman 2005). These trees were planted historically for shoreline erosion control. No management is required for this association, as it will likely succeed over time into a Successional Maritime Forest or Modified Successional Forest once the pines die back.

Vegetation Map Production

The final vegetation and land use map for BOHA includes 42 map classes (Figure 10). This map is based on aerial photography that was flown in April 2005. Since that time, the vegetation in the park continues to change due to natural and human related disturbances. Continued natural succession in the Northeastern Old Field, Northeastern Successional Shrubland, and Early-successional Woodland / Forest associations will influence the mapped vegetation. Future development on the islands and peninsulas and/or any management of invasive species will also alter the vegetation. Coastal storms, overwash, sea level rise, and effects related to climate change will influence the terrestrial and intertidal vegetation of the islands and peninsulas. BOHA vegetation associations will have continual changes, however the vegetation map produced by this project provides crucial baseline data for park resource managers from which to interpret the amount and trend of future changes.

It is important to note that the associations listed in the attribute table of the final vegetation association / map class shapefile are the base units of the USNVC hierarchy. As a result, each polygon was attributed with the appropriate formation, formation code, alliance code, alliance scientific and English names, association code, scientific and English names, and local park-specific names for each polygon's USNVC association. These attributes allow for the production of maps at different hierarchical levels (for example, a map of all deciduous forests can be generated using the Lowland or submontane cold-deciduous forest formation attribute). The names of the individual islands and peninsulas are also included as polygon attributes, allowing for creation of island-specific vegetation maps.

Conclusions

Even with the long history of human settlement and habitat manipulation on BOHA, natural vegetation does occur and is maintained by natural processes. The natural vegetation occurs in patches of sufficient size to monitor and manage. Although there is a high incidence of invasive plant species, natural succession as well as selective management and restoration may increase the more native aspect of at least some of the vegetation types over time. Unique and rare associations deserve protection in perpetuity.

The USNVC vegetation map and photo-interpretive key, detailed vegetation association descriptions, and dichotomous key are essential tools for managing and monitoring the natural associations in the park. These standardized products provide a baseline for assessing the ecological integrity, acreages, and locations of BOHA vegetation associations. Keeping the map up to date should be a high priority

for park resource managers because the vegetation will change in response to various disturbances, natural succession, and management.

The vegetation map can be used to develop interpretive trails and field guides, and will help resource managers identify priority areas for resource protection, restoration, scientific research, and environmental education. The USNVC can also be used in conjunction with the vegetation map to help describe desired vegetation associations for future vegetation management projects and provide a framework for ecological integrity assessments.

Literature Cited

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. Geological Survey Professional Paper 964. United States Government Printing Office, Washington, DC. 28 pp.

Anderson, L. E. 1990. A checklist of Sphagnum in North America north of Mexico. The Bryologist 93:500-501.

Anderson, L. E., H. A. Crum, and W. R. Buck. 1990. List of mosses of North America north of Mexico. The Bryologist 93: 448-499.

Avery, T. E. 1978. Forester's guide to aerial photo interpretation. U.S. Department of Agriculture, U.S. Forest Service. Agriculture Handbook 308. 40pp.

Bailey, R. 1997. Map: Ecoregions of North America [revised]. Washington, DC, USDA Forest Service in cooperation with The Nature Conservancy and the U.S. Geological Survey.

Bell, R., M. Chandler, R. Buschsbaum, and C. Roman. 2002. Inventory of intertidal habitats, Boston Harbor Islands, a National Park area. Technical Report NPS/NERBOST/NRTR—2004/1.

Bell, R., R. Buschsbaum, C. Roman, and M. Chandler. 2005. Inventory of intertidal marine habitats, Boston Harbor Islands National Recreation Area. Northeastern Naturalist 12 (Special Issue 3):169-200.

Congalton, R. G., and K. Green. 2009. Assessing the accuracy of remotely sensed data: Principles and practices, 2nd ed. CRC Press, Boca Raton, FL.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetland and deepwater habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS79/31.

Czaplewski, R. L. 1992. Misclassification bias in areal estimates. Photogrammetric Engineering and Remote Sensing 58:189–192.

Czaplewski, R. L. 2003. Accuracy assessment of maps of forest condition: Statistical design and methodological considerations. Pages 115-140 *in* M. A. Wulder and S. E. Franklin, editors. Remote sensing of forest environments: Concepts and case studies. Kluwer Academic Publishers, Boston, MA.

Dice, L. R. 1943. The biotic provinces of North America. University of Michigan Press, Ann Arbor, MI.

Elliman, T. 2004. A vascular plant survey of the Boston Harbor Islands National Park area: Final report. A report for the Island Alliance, Massachusetts Natural Heritage and Endangered Species Program, and National Park Service. 166 pp.

Elliman, T. 2005. Vascular flora and plant communities of the Boston Harbor Islands. Northeastern Naturalist 12 (Special Issue 3): 49-74.

Environmental Systems Research Institute, Inc. (ESRI). 1992-2006. ArcGIS 9. Environmental Systems Research Institute, Redlands, CA.

Environmental Systems Research Institute, Inc. (ESRI), National Center for Geographic Information and Analysis and The Nature Conservancy. 1994. NBS/NPS Vegetation Mapping Program: Accuracy assessment procedures. Report to the National Biological Survey and the National Park Service. Environmental Systems Research Institute, Inc., Redlands, CA. National Center for Geographic Information and Analysis, University of California, Santa Barbara, CA. The Nature Conservancy, Arlington, VA. Available on line: http://biology.usgs.gov/npsveg/standards.html.

Federal Geographic Data Committee (FGDC). 1996. FGDC vegetation classification and information standards. Federal Geographic Data Committee, Reston, VA. 31 pp.

Federal Geographic Data Committee (FGDC). 1997. Vegetation classification standard. Vegetation Subcommittee. FGDC-STD-005-1997.

Federal Geographic Data Committee (FGDC). 1998a. Content standard for digital geospatial metadata (FGDC-STD-001-1998). Available online: http://www.fgdc.gov/metadata/contstan.html (accessed October 2001).

Federal Geographic Data Committee (FGDC). 1998b. Geospatial positioning accuracy standards, Part 3: National Standard for Spatial Data Accuracy. (FGDC-STD-007.3-1998). Available online: http://www.fgdc.gov/standards/status/sub1_3.html (accessed October 2001).

Federal Geographic Data Committee (FGDC). 2008. National Vegetation Classification Standard, Version 2. Vegetation Subcommittee. FGDC-STD-005-2008 (Version 2).

Foley, M. K. 2005. Significant natural resources of the Brewster Island cluster: Boston Harbor Islands National Park Area. Technical Report NPS/NER/NRTR—2005/024.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status and applications. The Nature Conservancy, Arlington, VA, USA. 126 pp.

Hatcher, R. D., Jr. 1989. Tectonic synthesis of the U.S. Appalachians. *In* R. D. Hatcher, Jr., W. A. Thomas, and G. W. Viele, eds. The Appalachian – Ouachita Orogen in the United States: Geological Society of America Decade of North American Geology, v. F2, 29-41.

_____ and S. A. Goldberg. 1991. The Blue Ridge Geologic Province. Pages 11-35 *in* J. W. Horton, and V. A. Zullo. The geology of the Carolinas: Carolina Geological Society 50th Anniversary Volume. University of Tennessee Press, Knoxville, TN.

Hill, M. O., and H. G. Gauch. 1979. TWINSPAN – A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell University. Ithaca, NY.

Himmelstoss, E. A., D. M. Fitzgerald, P. S. Rosen and J. R. Allen. 2006. Bluff evolution along coastal drumlins: Boston Harbor Islands, Massachusetts. Journal of Coastal Research 22(5):1230–1240. West Palm Beach, FL, ISSN 0749-0208.

Kartesz, J. T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. *In*: J. T. Kartesz and C. A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

Kaye, C. A. 1982. Bedrock and Quaternary geology of the Boston area, Massachusetts. Geological Society of America, Reviews of Engineering Geology 5:24-40.

_____ and E. S. Barghoorn. 1964. Late Quaternary sea-level change and crustal rise at Boston, Massachusetts, with a note on the autocompaction of peat. Geological Society of America Bulletin 75:63-80.

Kruskal, J. B., and M. Wish. 1978. Multidimensional scaling. Sage Publications, Beverly Hills, CA.

Lea, C., and A. C. Curtis. 2010. Thematic accuracy assessment procedures: National Park Service Vegetation Inventory, version 2.0. Natural Resource Report NPS/2010/204. National Park Service, Fort Collins, CO.

Luedtke, B. E., and P. S. Rosen, 1993. Archaeological geology on Long Island, Boston Harbor. Pages T-1 - T-15 *in*: Field trip guidebook for the Northeastern United States, Volume 2. Geological Society of America, Boston, MA.

MassGIS. 2005. Datalayers/GIS Database. 1:5,000 color ortho imagery- April 2005. Commonwealth of Massachusetts Office of Geographic and Environmental Information. Executive Office of Environmental Affairs. Boston, MA. Available online: http://www.mass.gov/mgis/colororthos2005.htm.

Massachusetts Office of Energy and Environmental Affairs, Department of Fish and Game, Fisheries and Wildlife, Massachusetts Natural Heritage Program and Endangered Species Program (MNHP). 2015. Accessed online at: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/.

McCune, B., and J.B. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, Version 4. MjM Software Design. Gleneden Beach, OR.

McCune, B., and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design, Gleneden Beach, OR. 300pp.

McLaughlin, S. P. 2007. Tundra to tropics: The floristic plant geography of North America. Sida Miscellany Publication 30:1-58. Botanical Research Institute of Texas, Fort Worth, TX.

Mello, M. J. 2005. Inventory of Macrolepidoptera and other insects in the Boston Harbor Islands National Park area. Northeastern Naturalist 12 (Special Issue 3):99-144.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and methods of vegetation ecology. Wiley, New York, NY.

NatureServe. 2008. International ecological classification standard: Terrestrial ecological classifications. NatureServe Central Databases. Arlington, VA.

Omernik, J., and G. Griffith. 2008. Ecoregions of the United States-Level IV (EPA). Retrieved from http://www.eoearth.org/view/article/152243.

Paton, P. W. C., R. J. Harris, and C. L. Trocki. 2005. Distribution and abundance of breeding birds in Boston Harbor. Northeastern Naturalist 12 (Special Issue 3):145-168.

Patterson, W. A., J. A. Richburg, K. H. Clark, and S. Shaw. 2005. Paleoecology of Calf Island in Boston's Outer Harbor. Northeastern Naturalist 12 (Special Issue 3):31-48.

Perles, S. J., G. S. Podneisinski, E. A. Zimmerman, W. A. Millinor, and L. A. Sneddon. 2006. Vegetation classification and mapping at Friendship Hill National Historic Site. Technical Report NPS/NER/NRTR--2006/041. National Park Service. Philadelphia, PA.

Rawinski, T. J. 1984. New England natural community classification. Unpublished report. The Nature Conservancy, Eastern Regional Office, Boston, MA..

Richburg, J. A., and W. A. Patterson. 2005. Historical description of the vegetation of the Boston Harbor Islands: 1600-2000. Northeastern Naturalist 12 (Special Issue 3):13-30.

Roman, C. T., B. Jacobsen, and J. Wiggen. 2005. Introduction to a special issue Boston Harbor Islands National Park Area: Natural resources overview. Northeastern Naturalist 12 (Special Issue 3): 3-12.

Rosen, P. S., and D. M. Fitzgerald. 2004. Processes and evolution of Boston Harbor Islands: Peddocks and Lovells Islands. Pages 197-210 *in* L. Hansen (ed.). Guidebook for field trips in the eastern Massachusetts Region. New England Intercollegiate Geological Conference, 96th Annual meeting, October 9.

Schulte, S., S. Brown, D. Reynolds, and the American Oystercatcher Working Group. 2007. Version 2.0. American Oystercatcher Conservation Action Plan for the United States Atlantic and Gulf Coasts.

Strakosch-Walz, K., Editor. 2000. Instruction manual on Heritage field methodology: Documenting ecological communities. New Jersey Natural Heritage Program. Trenton, NJ. 86pp.

Swain, P. C., and J. B. Kearsley. 2001. Classification of the natural communities of Massachusetts. Version 1.3. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

_____. 2011. Classification of the natural communities of Massachusetts. Version 1.4. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA. Available online: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/natural-communities/classification-of-natural-communities.html#.

The Nature Conservancy (TNC) and Environmental Systems Research Institute (ESRI). 1994. NBS/NPS Vegetation Mapping Program: Field methods for vegetation mapping. 92pp. Report to the National Biological Survey and the National Park Service. Arlington, VA and Redlands, CA. Available online: http://biology.usgs.gov/npsveg/standards.html.

Tiner, R. W., J. Q. Swords, and H. C. Bergquist. 2003. Wetlands of the Boston Harbor Islands National Recreation Area. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Hadley, MA. NWI technical report. 26 pp. plus appendices.

Trocki, C. L., and P. W. C. Paton. 2007. Boston Harbor Islands coastal breeding bird monitoring: 2007. Field season summary. Natural Resources Report NPS/NER/NRR--2007/16. National Park Service. Boston, MA.

United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). 2006. The PLANTS Database, Version 3.5 (http://plants.usda.gov). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA.

_____. Soil Conservation Service (USDA-SCS) in cooperation with the Massachusetts Agricultural Experiment Station. 1989. Soil Survey of Norfolk and Suffolk Counties, Massachusetts.

United States Department of the Interior, United States Geological Survey (USDI-USGS). 2004. Tools for creation of formal metadata, a compiler for formal metadata. Available online: http://geology.usgs.gov/tools/metadata/tools/doc/mp.html (accessed June 2004).

United States Department of the Interior, National Park Service (USDI-NPS). 1999. Natural resource challenge: The National Park Service's action plan for preserving natural resources. Available online: http://www.nature.nps.gov/challengedoc. Washington, D.C.

_____. 2002. Boston Harbor Islands, a National Park Area, General Management Plan. Boston Support Office, Northeast Region, NPS for the Boston Harbor Islands Partnership. Boston, MA.

_____. 2009. Boston Harbor Islands National Recreation Area. Available online: http://www.nps.gov/boha/index.htm.

_____. 2011. Soil survey geographic (SSURGO) for Boston Harbor Islands National Recreation Area, Massachusetts. Digital GIS database. National Park Service Inventory & Monitoring

Program. Project-2170701. Fort Collins, CO. Available online: https://irma.nps.gov/App/Reference/Profile/2170701.

_____. 2015a. Boston Harbor Islands National Recreation Area. Accessed online: http://www.nps.gov/boha/index.htm.

_____. 2015b. Northeast Temperate Network Website. Available online: http://science.nature.nps.gov/im/units/netn/ (accessed September 2015).

_____. 2015c. NPSpecies: Information on species in National Parks, part of IRMA. Accessed online: https://irma.nps.gov/npspecies.

United States National Vegetation Classification (USNVC). 2015. Your guide to inventorying natural and cultural vegetation: Hierarchy Explorer. Available online: http://usnvc.org/ (accessed various days between August-December 2015).

Appendix A. Detailed information about the aerial photography and orthophoto

From http://www.mass.gov/mgis/colororthos2005.htm.

An orthophoto mosaic developed from a set of digital 1:5,000 scale medium resolution true color aerial images that are considered to be the new “basemap” for the Commonwealth of Massachusetts was used as the base for the vegetation mapping project. Sanborn Colorado L.L.C. of Colorado Springs, CO, performed all work for the "basemap" project. The source imagery was acquired with a Vexcel Ultracam digital camera at a flying height of 5,070 meters above mean terrain and an approximate pixel resolution of 45 cm. Forward overlap was approximately 60%, except 80% in areas with tall structures (downtown Boston, Worcester, and Springfield), in order to reduce building lean, with sidelap of 33%. The entire state was covered by about 5,500 image frames, captured over seven days from April 9 through April 17, 2005.

The ground control used to support the mapping was collected by photographic identification of strategic points. The ground control coordinates were collected via GPS ground survey techniques. Aerial Triangulation was performed on softcopy workstations using Intergraph ISAT software for photo measurement and matching. The final bundle adjustment was performed using BINGO 5.2 software.

A new digital elevation model (DEM) was stereo compiled for the entire State from the newly acquired 2005 imagery. The DEM includes mass points, soft breaklines and hard breaklines. The images were ortho-rectified using METRO, Sanborn's proprietary software. Bridges were modeled in 3-D using standard photogrammetric stereo-compilation techniques on softcopy workstations. Sanborn's Metro process rectifies the bridges using the 3-Dimensional model using similar methodologies for correcting the positional accuracy of other ground features. The bridges were uniquely coded and later removed from the final DEM file.

Color balancing was performed using METRO_NICE software. The resulting images were mosaicked into one seamless database of imagery and extracted to match the existing MassGIS Orthophoto Index Grid tile layout (each image tile covers 4,000 × 4,000 meters on the ground.). Images were quality-controlled by Sanborn using Adobe PhotoShop software. Final products included 1/2-meter pixel resolution GeoTiff images with supplementary tfw files and metadata.

MassGIS quality assurance included rigorous independent checks of the spatial accuracy using other datasets of significantly higher accuracy, and field work that included the capture of highly accurate GPS points that were compared to the same locations appearing on the images. MassGIS also assessed the visual quality and appearance of the images.

Appendix B. Photomosaic interpretation key for Boston Harbor Islands National Recreational Area

(for 2005 orthophotography)

1

Signature is of naturally occurring areas of vegetation including forests, woodlands, shrublands, fields, marshes, beaches, mudflats, rocky intertidal areas, bluffs, cliffs, and rock outcrops 2
Signature is of developed areas including roads, buildings and natural unvegetated areas such as beaches and ponds 34

2

Tree crowns are evident; visible as gray, black, or green signatures of varying architecture; trees cover greater than 25% of the area 3
Tree crowns cover less than 25% of the area or are absent 12

3

Matrix tree signatures are bright green and conical, indicating evergreen trees; occur in patches of continuous green 4
Matrix tree signatures are light to dark gray, blue or purple with gray boles and branches, indicating cold-deciduous trees 6

4

Dark green globular patches of conical crowns with dark gray to black shadows on edges of patches ..... Black Pine Forest
Brown-green pyramidal shaped crowns with round bases; open field or exposed rock may be present 5

5

Brown green pyramidal to cylindrical in shape; trees interspersed with patches of tan indicative of old fields or interspersed with gray-blue silhouettes of cold deciduous trees ..... Old-field Eastern Red-cedar Forest
Brown green pyramidal trees on gray rocky outcrops and along shorelines; smaller in size than old field red-cedar signatures and more open canopy ..... Maritime Red-cedar Woodland

6

Trees have somewhat consistent mature height and regular spacing and individual tree architecture can be identified; groundstory varies from tan to brown to pinkish purple 7
Canopy is more open, understory more visible, scrub forest has dense bumpy gray-purple signature 11

7

Forest occurs adjacent to a dark depression or wetland; dark purple-gray canopy signature in depression ..... Upland/Wetland Transitional Forest
Forest occurs in an upland setting..... 8

8

Homogeneous closed canopy patches with even, spreading blue-gray clumpy crowns and boles; many stems all the same size; understory has a purple tinge..... Norway Maple Forest
Signature not homogenous; diversity of tree species visible 9

9

Deciduous forest purple-gray diverse canopy signature with pyramidal, tightly branched dark green eastern red-cedar crowns visible..... 10
Deciduous forest purple-gray diverse canopy signature with emergent, more loosely branched, open crowned, medium green signature of white pine visible over a pinkish-purple understory; scattered rock outcrops apparent from above; limited to the southeastern corner of World's End..... Northeastern Dry Oak-Hickory Forest*

10

Forest has dense bumpy gray signature of young trees as well as some individual larger boles with spreading branches; scattered green conifers (eastern redcedar) may be present along with occasional, small, interspersed patches of white-to-tan open herbaceous vegetation or purple shrub vegetation; on majority of islands..... Northeastern Modified Successional Forest*
Same signature as above, but more eastern red cedars present with pyramidal dark green crowns; more oaks present with broader crowns and larger diameter boles; stands within close proximity to shoreline only at World's End, Thompson, and Webb State Park ..... Successional Maritime Forest*
(*These signatures are very similar on orthophoto)

11

Dense bumpy gray signature of young trees and shrubs; cannot see individual architecture of trees; open variants have tan areas of herbaceous vegetation while closed variants are densely packed gray-purple mounds..... Staghorn Sumac Shrubland
Brown, oval even-textured clusters of even aged aspen clones boles appear as gray specks..... arly-successional Woodland/Forest

12

Dense bumpy dark gray-purple, tan, or brown-green-gray signature of shrubs; typically located in the interior of islands 13

Yellow, green, brown, relatively smooth signatures of open herbaceous associations, beaches, intertidal areas, rock outcrops, bluffs and cliffs..... 18

13

Polygons occur in distinct depressions or as linear fringes adjacent to marshes or Ponds 14
Matrix upland shrublands; scattered trees (<25%) may be visible 16

14

Polygons adjacent to ponds or old fields 15
Yellow or light gray with dark gray patches; small, linear polygons along upper edge of high salt marshes ..... Eastern Tidal Salt Shrub

15

Gray linear signature fringing along pond at World's End..... Northeastern Buttonbush Shrub Swamp
Dark gray and light gray matrix with black specks at lowest point in depression; tan openings visible; adjacent to fields ..... Wet Meadow

16

Dense bumpy brown-green-gray signature – shrubs with occasional pink hue; open variants have tan areas of herbaceous vegetation ..... Staghorn Sumac Shrubland
Densely packed, closed canopy, gray-purple mounds ..... Northeastern Successional Shrubland

17

Interior signatures of fields and freshwater marshes 18
Exterior signatures along shoreline, including intertidal areas 23

18

Upland fields 19
Inland marshes 22

19

Dark tan-to-green, expansive open fields; mow lines often visible ..... Northeastern Old Field
Yellow signatures 20

20

Light tan-to-yellow signature; small fields and edges ..... Little Bluestem Grassland
Yellow signature underlain by rock or gravel ..... Common Wormwood Gravel Field

21

Smooth dark brown with tan or gray flecks; depressional marsh on many islands ..... Eastern Reed Marsh
Small brown or gray oval depressions limited to Long Island and Middle Brewster 22

22

Dark brown oval depression on Middle Brewster ..... Eastern Cattail Marsh
Dark purple-light purple with some brown, depressional marshes on Long Island.....Cattail Brackish Tidal Marsh

23

Signatures of bluffs, cliffs, rock outcrops.....24
Signatures of beach vegetation, salt marshes, and intertidal areas 25

24

Distinct break along outer edges of drumlin heads; exposed sand or gravel often visible on steep bluffs or cliffs; most often yellow or yellow-brown .....Maritime Erosional Bluffs and Cliffs
Signatures appear to lack vegetation; rocky outcrops and cliffs..... Maritime Rock Cliffs and Outcrops

25

Signatures adjacent to beach signature 26
Signatures of salt marshes and intertidal areas 28

26

Yellow-gray-brown signatures with small specks of white.....27
Gray signature with white or light gray overwash fan visible adjacent to beach and marsh.....Overwash Grassland

27

Small patches of yellow-gray with specks of white along upper edges of beaches.....Northern Beachgrass Vegetation
Large patches of yellow or yellow-brown signature underlain by rock or gravel.....Common Wormwood Gravel Field

28

Clumps and/or expanses of vegetation along shoreline or adjacent to tidally influenced water bodies 29
Vegetation is not visible in signatures; bare substrate 33

29

Signatures are gray-yellow with brown speckled inclusions or brown with tan flecks; tidally influenced water bodies such as ponds or creeks often visible 30
Signatures of salt marshes (dark brown-green and light green-tan) and salt pannes along Shoreline 31

30

Tidal ponds or impounded tidal ponds often visible; variable signature with gray-brown speckled inclusions; adjacent to marshes and low flat areas subject to restricted tidal flooding; limited to Thompson, Grape, Calf and Outer Brewster..... oastal Salt Pond Marsh
Signature is brown with tan-brown flecks; tidally influenced .....Reed-grass Tidal Marsh

31

Linear or clumpy brown and green-tan signatures along shoreline, salt marsh associations 32
Gray-to-black smooth depressions within or alongside salt marshes ..... Salt Panne (Salicornia Type)

32

Dark green gray or green-brown smooth signature outer edges of islands and peninsulas..... North Atlantic Low Salt Marsh
Light gray-green-tan smooth signature landward of low salt marsh..... North Atlantic High Salt Marsh

34

Developed, disturbed, and built-up lands..... 35
Natural landscape features such as beaches, ponds, exposed rock, and tidally influenced water bodies 39

35

Areas with buildings, parking lots, roads, utilities, light houses, seawalls, disturbed areas without vegetation..... 36
Areas with maintained recreational fields, trails, cart paths, rope courses .....Recreational

36

Disturbed areas without vegetation such as seawalls, rip-rap, abandoned developed land..... Other Urban or Built-up Land
Developed areas 37

37

Single family dwellings present..... Residential
Homes absent 38

38

Buildings, campuses, waste water treatment facilities, hospitals, forts, etc.....Commercial and Services

Roads, docks, parking lots, lighthouses.....Transportation, Communications, and Utilities

39

Water bodies 40

Beach and rock.....41

40

Tidal bays, rivers, creeks, ponds.....Bays, Estuaries, and Other Tidal Waters

Freshwater ponds .....Pond

41

Bright white, gray, tan, bands along outer edges of islands and peninsulas.....Beach and Beach Strand

Black and gray blocky rock outcrops..... Bare Exposed Rock

Appendix C. Vegetation plot sampling form.

Natureserve National Park Vegetation Mapping Program: Plot Survey Form

Park Name: Boston Harbor Islands **(BOHA)** State: **MA**

Plot Code _____ Polygon Code _____ Airphoto #_____ Park sublocation (Surveysite) _____ Quad Name _____ Quad Code _____ Survey Date: 2006-_____ Surveyors: _____ Sourcecode: _____
Provisional Community Name Classified Community Name _____ GELCODE: **CEGL00**_____ Ecological System type
Directions to Plot:
Plot length_____ width_____ shape_____ Permanent (y/n) ____ Plot Photos (y/n) ___ Roll# _____ Frame# _____
Plot representativeness
GPS file name_____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N GPS unit used_____ datum_____ Error +/-_____ m Corrected UTM X___ ___ ___ ___ ___ ___ m E Corrected UTM Y___ ___ ___ ___ ___ ___ ___ m N UTM Zone_____

ENVIRONMENTAL DESCRIPTION

Elevation:		m / ft *include units!*	**Aspect** (*use true, not magnetic, value*):			
Slope	**Degr**	**%**	**Topographic Position**	**Landform**		**Geology: Bedrock**	**Geology: Surficial**
Flat	0	0%	Crest/Summit/Ridge	Bar	Kame		
Gentle	1-5	1-9%	Upper/Shoulder Slope	Basin	Kettle		
Modt.	6-14	10-25%	High Plateau	Beach.	Lake /pond	Igneous	Bedrock
Som. Steep	15-26	26-49%	Middle Slope	Bluff/bank	Ledge	Granitic	Talus
Steep	27-45	50-100%	Slope step (terracette)	Channel	Moraine	Dioritic	Glacial till
V. Steep	46-69	101-275%	Lower Slope	Cliff	Mountain	Gabbroic	Moraine
Abrupt	70-95	276-300%	Toe Slope	Cove	Outwash	Metamorphic	Esker/outwash
Overhang	>100	>300%	Low level/terrace	Delta	plain		Glacial delta
			Channel wall	Dome	Oxbow	Slate/phyllite	Lacustrine/
			Channel bed	Drumlin	Plain	Schist	fluvial
Record			Depression	Dune	Plateau	Gneiss	Marine
more exact				Escarpment	Ravine	Marble	Aeolian
measures				Esker	Ridge	Serpentine	
if taken:				Estuary	Saddle	Sedimentary	Other
				Flat	Swale	Shale	
				Floodplain	Talus	Limestone	
				Gorge	Terrace	/Dolomite	
				Hill	Valley		
					Other_____	Other	

Cowardin System	**Hydrologic regime**		**Salinity**
___Upland	___Permanently Flooded	___Saturated (& may be seas. flooded)	Coastal salt (>30 ppt)
	___Semipermanetly Flooded	___Temporarily Flooded	Coastal brackish (5-30 ppt)
___Riverine	___Seasonally Flooded	___Intermittently Flooded	Fresh tidal (< 5 ppt)
___Palustrine		___Tidally Flooded	Inland salt
___Lacustrine			Inland brackish
___Estuarine			

Soil Taxon/Description:			Soil Profile notes Depth examined:_____ Horizons, colors, depth to obstruction, depth to water table, depth to mottling, etc.
Soil Texture ___ sand ___ sandy loam ___ loam ___ silt loam ___ silt ___ clay loam ___ clay ___ peat ___ muck	Soil Drainage ___ Rapidly drained ___ Well drained ___ Moderately well drained ___ Somewhat poorly drained ___ Poorly drained ___ Very poorly drained	Unvegetated Surface: (please use the cover scale below) _____Bedrock _____Large rocks (cobbles, boulders >10 cm) _____Small rocks/gravel (0.2-10 cm) _____Sand (0.1-2 mm) _____Litter, duff _____Wood (>1 cm) _____Bare soil _____Water _____Other:_____	
Soil pH:	Soil stoniness ____v. little (<1%) ____moderate (2-20%) ____very stony (20-50%) ____exceedingly stony (>50%)		
Additional environment notes:			

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	**Leaf Type** (of dominant stratum)	**Physiognomic class**	**Cover Classes for Strata & Unvegetated Surface**	**Height Classes for Strata**
Trees and Shrubs		___Forest		
% Evergreen:_____	___Broad-leaved	___Woodland	5%	<0.5 m
% Deciduous:_____	___Needle-leaved	___Shrubland	10%	0.5-1m
___Evergreen	___Microphyllous	___Dwarf Shrubland	20%	1-2 m
___Cold-deciduous	___Graminoid	___Herbaceous	30%	2-5 m
___Mixed	___Forb	___Nonvascular	40%	5-10 m
	___Pteridophyte	___Sparsely Vegetated	50%	10-15 m
Herbs	___Non-vascular		60%	15-20 m
___Annual			70%	20-35 m
___Perennial			80%	35-50 m
			90%	>50 m
			100%	

Stratum	**Height***	**Cover***	**Characteristic / diagnostic species** **please use height and cover classes from table above*
T1 Emergent			
T2 Canopy			
T3 Sub-canopy			
S1 Tall Shrub			
S2 Short Shrub			
H Herbaceous			
N Non-vascular			
V Vine/liana			

SPECIES/COVER VALUES

Starting with the uppermost stratum, list each species within the plot and its cover class. For forests and woodlands, on a separate line below each tree species, list the DBH of all trees >10 cm dbh, separating measurements with a comma. Circle DBH units: cm / in

Species name or unique code	stratum	cover	Species name or unique code	stratum	cover

***species cover classes** (midpoint): **< 1** 1 / **1-5%** 3 / **6-10%** 8 / **11-25%** 18 / **26-50%** 38 / **51-75%** 63 / **76-100%** 87

ADDITIONAL NOTES (***continue as needed on reverse***)

Brief word picture of community:
Topographic sketch:
Adjacent vegetation type(s):
Known/inferred land-use history:
Animal use evidence
Natural disturbance evidence:
Invasive species notes:
Other anthropogenic disturbance comments
Other Comments

Appendix D. Data dictionary for Plots 2.0 database

Table D-1. Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots	Plot Code	unique identifier assigned by PLOTS using 4-letter park code and sequential numbers	BOHA
Plots	Field Plot Name	plot as identified on field form	–
Plots	County	–	–
Plots	SubPlot	was plot a sub-unit of a larger plot?	–
Plots	SubPlot Parent Code	identifier of larger plot if this is a subplot	–
Plots	Air Photo Number	reference number for aerial photo that covers the plot area	–
Plots	Polygon Code	identifier of polygon on vegetation map in which plot falls	–
Plots	Map Unit	name of map class for polygon in which plot falls	–
Plots	Classified Community Name	standard association name from the US National Vegetation Classification	–
Plots	USNVC ELCODE	standard element code from the US National Vegetation Classification	–
Plots	Sublocation	narrative for location of plot within the park	–
Plots	Quad Name	name of USGS 7.5’ quadrangle in which plot falls	–
Plots	Quad Code	standardized code for USGS quadrangle	–
Plots	Coord System	coordinates used for plot geographic location: “1” if UTM, “2” if lat/long	–
Plots	GPS File	name of file in which coordinates are stored	–
Plots	GPS Techniques	type of GPS unit used to secure location plus any applicable comments	–

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots	Field UTM X	X UTM coordinate as recorded in field	–
Plots	Field UTM Y	Y UTM coordinate as recorded in field	–
Plots	UTM Zone	UTM zone	–
Plots	Survey Date	date field data were taken	–
Plots	Surveyors	field personnel	–
Plots	Plot Directions	detailed directions to plot using ground landmarks	–
Plots	X Dimension	length of side of plot in m	–
Plots	Y Dimension	width of plot in m	–
Plots	Plot Shape	square, rectangular, round, etc.	Combination
Plots	Photos	yes/no	–
Plots	Roll Number	roll number for film photos	–
Plots	Frame Number	frame number for film photos; file name for digital photos	–
Plots	Permanent	is plot permanent? Yes/no	–
Plots	Representativeness	narrative for how representative of community plot seems to be	–
Plots	Elevation	plot average elevation above mean sea level	in meters
Plots	Elevation Units	“1” = meters, “2” = feet	–
Plots	GPS Datum	Datum used by GPS	NAD83
Plots	GPS Accuracy	as recorded in field	–
Plots	Slope	slope category (pick-list)	Flat = 0º; Gentle = 0-5º; Moderate = 6-14º; Somewhat steep = 15-25º; Steep = 27-45º; Very steep = 45-69º; Abrupt = 70-100º; Overhanging/sheltered = 100º

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots	Precise Slope	slope measurement	in degrees
Plots	Slope range	range of slope, where uphill and downhill values are given	–
Plots	Aspect	aspect category (pick-list)	Flat; Variable; N 338-22º; NE 23-67º; E 68-112º; SE 113-157º; S 158-202º; SW 203-247º; W 248-292º; NW 293-337º
Plots	Precise Aspect	measured aspect in True degrees	–
Plots	Topo Position	topographic position of plot (pick-list)	Crest/Summit/Ridge; Upper/Shoulder Slope High Plateau; Middle Slope; Slope step; Lower Slope; Toe slope; Low level/terrace; Channel wall; Channel bed; Depression
Plots	Landform	landform on which plot occurs (pick-list)	Bar; Basin; Beach; Bluff /bank; Channel; Cliff; Cove; Delta; Dome; Drumlin; Dune; Escarpment; Esker; Estuary; Flat; Floodplain; Gorge; Hill; Kame; Kettle; Lake /pond; Ledge; Moraine; Mountain; Outwash plain; Oxbow; Plain; Plateau; Ravine; Ridge; Saddle; Swale; Talus; Terrace; Valley; Other
Plots	Surficial Geology	geologic setting (pick-list)	Bedrock; Talus; Glacial till; Moraine; Esker/outwash; Glacial delta; Lacustrine/; fluvial; Marine; Aeolian; Other
Plots	Cowardin System	broad wetland classification from Cowardin 1979	Upland, Palustrine, Estuarine, Riverine, Lacustrine
Plots	Hydro Regime	hydrologic regime (wetlands only)	Permanently Flooded; Semipermanently Flooded; Seasonally Flooded; Saturated; Temporarily Flooded; Intermittently Flooded; Tidally Flooded
Plots	Salinity/Halinity	–	–

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots	Hydrology Evidence	notes on evidence used to deduce hydrologic regime	–
Plots	Environmental Comments	narrative description of the habitat	–
Plots	Landscape Comments	narrative description of the surrounding area	–
Plots	Soil Taxon/Description	narrative of soil profile	–
Plots	Soil Texture	soil texture class	sand; sandy loam; loam; silt loam; silt; clay loam; clay; peat; muck
Plots	Soil Depth	depth to obstruction	–
Plots	Soil Depth Units	1=meters, 2=cm, 3=feet, 4=inches	cm
Plots	Soil Drainage	drainage category (pick-list)	rapidly drained; well drained; moderately well drained; somewhat poorly drained; poorly drained; very poorly drained
Plots	% Bedrock	% unvegetated ground surface covered	–
Plots	% Large Rocks	% unvegetated ground surface covered	–
Plots	% Small Rocks	% unvegetated ground surface covered	–
Plots	% Sand	% unvegetated ground surface covered	–
Plots	% Litter, Duff	% unvegetated ground surface covered	–
Plots	% Wood	% unvegetated ground surface covered	–
Plots	% Water	% unvegetated ground surface covered	–
Plots	% Bare Soil	% unvegetated ground surface covered	–
Plots	% Other	if “other” is used as a ground surface cover category	–
Plots	% Other Description	if “other” is used as a ground surface cover category	–

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots	Leaf Phenology	Of dominant stratum	Evergreen, Cold-deciduous, Mixed evergreen-cold-deciduous, Herb – annual, Herb – perennial
Plots	Leaf Type	Of dominant stratum	Broad-leaved, Needle-leaved, Microphyllous, Graminoid, Broad-leaved herbaceous, Pteridophyte, Nonvascular
Plots	Physio Class	physiognomic Class according to USNVC hierarchy; applies to dominant stratum (highest stratum with at least 25% cover)	Forest (>60% tree canopy), Woodland (25%-60% open tree canopy), Shrubland (<25% trees, and shrubby cover >0.5 m tall greater than other strata), Dwarf Shrubland (<25% trees, and shrubby cover <0.5 m tall greater than other strata), Herbaceous (herb cover exceeds other strata), Nonvascular (nonvascular cover exceeds that of other strata), or Sparse vegetation (total vegetation <25%)
Plots	T1 Hgt	height of emergent tree layer	in meters if applicable
Plots	T1 Cover	% cover of emergent tree layer	cover classes (for all strata): 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%
Plots	T2 Hgt	height of tree canopy layer	–
Plots	T2 Cover	% cover of tree canopy layer	–
Plots	T3 Hgt	height of tree subcanopy layer	–
Plots	T3 Cover	% cover of tree subcanopy layer	–
Plots	S1 Hgt	height of tall shrub layer	–
Plots	S1 Cover	% cover of tall shrub layer	–
Plots	S2 Hgt	height of short shrub layer	–
Plots	S2 Cover	% cover of short shrub layer	–
Plots	S3 Hgt	height of dwarf shrub layer	–

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots	S3 Cover	% cover of dwarf shrub layer	–
Plots	H Hgt	height of herb layer	–
Plots	H Cover	% cover of herb layer	–
Plots	N Cover	% cover of non-vascular layer	–
Plots	V Hgt	height of vine layer, if present	–
Plots	V Cover	% cover of vine layer	–
Plots	Other Measure1 Defined	Explanation of other measure of species presence	–
Plots	Other Measure2 Defined	Explanation of other measurement used for species presence	–
Plots	Animal Use Evidence	–	–
Plots	Disturbance Comments	narrative on natural and anthropogenic disturbance	–
Plots	Other Comments	–	–
Plots	Update	When record was last updated (using Plots 2.0 interface)	does not apply to values directly manipulated in tables
Plots	User	initials of person entering record	–
Plots	Species Counter	number of plant species recorded in plot	–
Plots	Optional Fields Defined	narrative defining any optional fields that are used	–
Plots	Opt1	narrative defining any optional fields that are used	–
Plots	Provisional Community Name	community name assigned in field or before final analyses	–

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots-Species	Plot Code	unique identifier assigned by PLOTS using 4-letter park code and sequential numbers	provides link to Plots table
Plots-Species	Plot Species Counter	Unique integer sequence for species within this plot	–
Plots-Species	Plant Symbol	from USDA Plants db table	–
Plots-Species	Scientific Name	Accepted Latin name of the plant species	–
Plots-Species	Common Name	–	–
Plots-Species	Family	–	–
Plots-Species	Specimen Number	if collected	–
Plots-Species	Used PLANTS	Yes if name came from the PLANTS database	–
Plots-Species	Source	From Plant List table: SS or NS	–
Plots-Species	Within Plot	yes/no: Species is present within the Plot boundaries	–
Plots-Species	Stratum Sort	Major sort order of strata	to sort from highest to lowest or vice versa
Plots-Species	Stratum	Stratum this species being recorded in	T1 = Emergent; T2 = Tree Canopy; T3 = Tree Subcanopy; S1 = Tall Shrub; S2 = Short Shrub; H = Herbaceous; N = Nonvascular plant; V = Vine/liana
Plots-Species	Strat-Simple	simplified stratum	Tree, Shrub, Herb, Non-vasc, Vine
Plots-Species	Diagnostic	yes/no: Species is a known diagnostic for the community	–
Plots-Species	Range Cover	midpoint of cover class	cover classes (for all strata): < 1 / 1-5% / 6-10% / 11-25% / 26-50% / 51-75% / 76-100%
Plots-Species	Real Cover	if % cover measured directly	not used at BOHA
Plots-Species	Other Measure1	Other measure of species presence	–
Plots-Species	Other Measure2	Other measure of species presence	–

Table D-1 (continued). Data dictionary for fields in PLOTS 2.0 Database by table.

Table	Field	Definition	Comment
Plots-Species	DBH	Diameter at breast height for all trees above 10 cm diameter (comma delimited)	recorded on field forms
Plots-Species	Update	When record was last updated (using Plots 2.0 interface)	does not apply to values directly manipulated in tables
Plots-Species	User	initials of person entering record	–
Plots-Species	SciName-Field	scientific name used on field form	names standardized to Kartesz 1999 (updated NPS common names are in “Scientific Name” field)

Appendix E. Plants observed in Boston Harbor Islands National Recreation Area

Nomenclature follows the PLANTS 3.5 Database developed by the Natural Resources Conservation Service in cooperation with the Biota of North America Program (USDA-NRCS 2006). For this report, some common names listed in the PLANTS database were changed to reflect the common names typically used by ecologists and resource managers in this region. The common and scientific names of plants observed during the vegetation plot and thematic accuracy assessment sampling are listed below. Plants observed in plot and accuracy assessment sampling during this study are denoted with an asterisk (*). Plants without an asterisk (*) were identified by T. Elliman's floristic inventory of the Boston Harbor Islands in 2004. Non-native (exotic) species are denoted with the superscript letter (e).

Table E-1. Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Aceraceae	*Acer* spp.[2]	maple
	Acer negundo	boxelder
	Acer platanoides[2, 3]	Norway maple
	Acer pseudoplatanus[2, 3]	sycamore maple
	Acer rubrum[2]	red maple
	Acer saccharinum	silver maple
	Acer saccharum	sugar maple
Amaranthaceae	*Amaranthus retroflexus*[3]	redroot amaranth
Anacardiaceae	*Rhus copallinum*[2]	flameleaf sumac
	Rhus glabra	smooth sumac
	Rhus typhina[2]	staghorn sumac
	Toxicodendron radicans[2]	eastern poison ivy
Apiaceae	*Angelica lucida*	seacoast angelica
	Cicuta maculata	spotted water hemlock
	Daucus carota[2, 3]	Queen Anne's lace
	Heracleum maximum	common cowparsnip
	Ligusticum scoticum	Scottish licorice-root
	Pastinaca sativa[3]	wild parsnip

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Apocynaceae	*Apocynum androsaemifolium*	spreading dogbane
	Apocynum cannabinum	Indianhemp
	Apocynum × floribundum	hybrid dogbane[1]
Aquifoliaceae	*Ilex glabra*	inkberry
	Ilex opaca[2]	American holly
	Ilex verticillata	common winterberry
Araliaceae	*Aralia nudicaulis*[2]	wild sarsaparilla
Asclepiadaceae	*Asclepias incarnata*	swamp milkweed
	Asclepias syriaca[2]	common milkweed
	Cynanchum (Vincetoxicum) sp.[2, 3]	swallow-wort
	Cynanchum louiseae (Vincetoxicum nigrum)[3]	Black or Louis' swallow-wort
Aspleniaceae	*Asplenium platyneuron*[2]	ebony spleenwort
Asteraceae	*Achillea millefolium*[2]	common yarrow
	Ageratina altissima	white snakeroot
	Ambrosia artemisiifolia[2]	annual ragweed
	Ambrosia trifida	great ragweed
	Anthemis arvensis[3]	corn chamomile
	Anthemis cotula[3]	stinking chamomile
	Arctium lappa[3]	greater burdock
	Arctium minus[2, 3]	lesser burdock
	Artemisia sp.[2]	sagebrush
	Artemisia campestris ssp. *caudata*[2]	field sagewort
	Artemisia stelleriana[2]	oldwoman
	Artemisia vulgaris[2, 3]	common wormwood
	Aster sp.[2]	aster
	Baccharis halmifolia	eastern baccharis
	Bidens frondosa[2]	devil's beggartick
	Centaurea jacea[3]	brownray knapweed
	Centaurea stoebe ssp. *micranthos*[3]	spotted knapweed

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Asteraceae (continued)	*Cichorium intybus*[2, 3]	chicory
	Cirsium arvense[2, 3]	Canada thistle
	Cirsium vulgare[2, 3]	bull thistle
	Conyza canadensis[2]	Canadian horseweed
	Coreopsis lanceolata[3]	lanceleaf tickseed
	Crepis capillaris[, 3]	smooth hawksbeard
	Erechtites hieraciifolius[2]	American burnweed
	Erigeron annuus[2]	eastern daisy fleabane
	Erigeron philadelphicus	Philadelphia fleabane
	Erigeron pulchellus	robin's plantain
	Erigeron strigosus	prairie fleabane
	Eurybia divaricata[2]	white wood aster
	Euthamia caroliniana	slender goldentop
	Euthamia graminifolia	flat-top goldentop
	Eutrochium dubium	coastalplain joepyeweed
	Eutrochium maculatum[2]	spotted joepyeweed
	Galinsoga quadriradiata[3]	shaggy-soldier
	Helianthus tuberosus[2]	Jerusalem artichoke
	Hieracium sp.[2]	hawkweed
	Hieracium aurantiacum[3]	orange hawkweed
	Hieracium canadense[2]	Canadian hawkweed
	Hieracium gronovii[2]	queendevil
	Hieracium lachenalii[3]	common hawkweed
	Hieracium pilosella[3]	mouseear hawkweed
	Hieracium × *flagellare*	hybrid hawkweed[2]
	Iva frutescens[2]	Jesuit's bark
	Lactuca sp.	lettuce
	Lactuca biennis	tall blue lettuce
	Lactuca canadensis	Canada lettuce

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Asteraceae (continued)	*Lactuca serriola*[3]	prickly lettuce
	Lapsana communis[3]	common nipplewort
	Leontodon autumnalis[3]	fall dandelion
	Leucanthemum vulgare[3]	oxeye daisy
	Matricaria discoidea[3]	disc mayweed
	Onopordum acanthium[3]	Scotch cotton-thistle
	Petradoria pumila ssp. *Graminea*[2, 3]	giant rock goldenrod
	Prenanthes trifoliolata	gall of the earth
	Pseudognaphalium obtusifolium[2]	Rabbit-tobacco
	Rudbeckia hirta	Black-eyed Susan
	Senecio jacobaea[3]	stinking willie
	Senecio vulgaris[3]	old-man-in-the-spring
	Solidago sp.	Goldenrod
	Solidago altissima [2]	tall goldenrod
	Solidago canadensis	Canada goldenrod
	Solidago bicolor	white goldenrod
	Solidago caesia	wreath goldenrod
	Solidago juncea	early goldenrod
	Solidago nemoralis	gray goldenrod
	Solidago rugosa[2]	wrinkleleaf goldenrod
	Solidago sempervirens[2]	seaside goldenrod
	Solidago puberula	downy goldenrod
	Solidago speciosa	showy goldenrod
	Solidago ulmifolia[2]	elmleaf goldenrod
	Sonchus arvensis[3]	field sowthistle
	Sonchus asper[3]	spiny sowthistle
	Symphyotrichum cordifolium[2]	common blue wood aster
	Symphyotrichum divaricatum	southern annual saltmarsh aster
	Symphyotrichum dumosum[2]	rice button aster

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Asteraceae (continued)	*Symphyotrichum ericoides*[2]	white heath aster
	Symphyotrichum lateriflorum[2]	calico aster
	Symphyotrichum novae-angliae[2]	New England aster
	Symphyotrichum novi-belgii[2]	New York aster
	Symphyotrichum puniceum	purplestem aster
	Symphyotrichum undulatum	waxyleaf aster
	Tanacetum vulgare[2, 3]	common tansy
	Taraxacum officinale[2, 3]	common dandelion
	Tragopogon porrifolius[3]	Salsify
	Tragopogon pratensis[3]	Jack-go-to-bed-at-noon
	Tussilago farfara[2, 3]	coltsfoot
	Xanthium strumarium[2]	rough cocklebur
	Xanthium strumarium var. *canadense*	Canada cocklebur
Balsaminaceae	*Impatiens capensis*[2]	jewelweed
Berberidaceae	*Berberis thunbergii*[2, 3]	Japanese barberry
	Berberis vulgaris[2, 3]	common barberry
Betulaceae	*Alnus glutinosa*[2, 3]	European alder
	Betula papyrifera	paper birch
	Betula populifolia[2]	gray birch
	Corylus cornuta[2]	beaked hazelnut
	Ostrya virginiana[2]	hophornbeam
Bignoniaceae	*Catalpa bignonioides*[3]	southern catalpa
Boraginaceae	*Cynoglossum officinal*[3]	gypsyflower
	Myosotis strict[3]	strict forget-me-not
Brassicaceae	*Alliaria petiolata*[2, 3]	garlic mustard
	Barbarea vulgaris[3]	garden yellowrocket
	Berteroa incan[3]	hoary false madwort
	Brassica nigra[2, 3]	black mustard
	Cakile edentula ssp. *edentula*[2]	American searocket

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Brassicaceae (continued)	*Capsella bursa-pastoris*[3]	shepherd's purse
	Hesperis matronalis[3]	dames rocket
	Lepidium sp.	pepperweed
	Lepidium campestre[3]	field pepperweed
	Lepidium latifolium[2, 3]	broadleaved pepperweed
	Lepidium virginicum	Virginia pepperweed
	Lunaria annu[3]	annual honesty
	Raphanus raphanistru[3]	wild radish
	Sisymbrium altissimu[3]	tall tumblemustard
	Sisymbrium officinal[3]	hedgemustard
	Teesdalia nudicaulis[2, 3]	barestem teesdalia
	Thlaspi arvens[3]	field pennycress
Cannabaceae	*Humulus japonicu*[3]	Japanese hop
Caprifoliaceae	*Lonicera* sp.	honeysuckle
	Lonicera japonica[2, 3]	Japanese honeysuckle
	Lonicera morrowii[2, 3]	Morrow's honeysuckle
	Lonicera tataric[3]	Tatarian honeysuckle
	Lonicera xylosteu[3]	dwarf honeysuckle
	Sambucus sp.[2]	Elderberry
	Sambucus nigra ssp. *canadensis*	common elderberry
	Symphoricarpos albu[3]	common snowberry
	Viburnum sp.	Viburnum
	Viburnum acerifolium[2]	mapleleaf viburnum
	Viburnum dentatum[2]	southern arrowwood
	Viburnum lentago	Nannyberry
	Viburnum opulus var. *americanum*[2]	American cranberrybush
	Viburnum recognitum[2]	southern arrowwood
Caryophyllaceae	*Arenaria serpyllifolia*[2, 3]	thymeleaf sandwort
	Cerastium fontanum ssp. *vulgare*[2, 3]	big chickweed

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Caryophyllaceae (continued)	*Dianthus armeri*[3]	Deptford pink
	Moehringia lateriflora	bluntleaf sandwort
	Saponaria officinalis[2, 3]	Bouncingbet
	Silene antirrhina	sleepy silene
	Silene latifoli[3]	bladder campion
	Silene vulgari[3]	Maidenstears
	Spergularia maritim[3]	media sandspurry
	Spergularia rubr[3]	red sandspurry
	Spergularia salina	salt sandspurry
	Stellaria gramine[3]	grasslike starwort
	Stellaria medi[3]	common chickweed
Celastraceae	*Celastrus orbiculatus*[2, 3]	oriental bittersweet
	Euonymus alatus[2, 3]	winged burning bush
Chenopodiaceae	*Atriplex patula*[2]	spear saltbush
	Bassia hirsut[3]	hairy smotherweed
	Bassia scopari[3]	Mexican-fireweed
	Chenopodium sp.	Goosefoot
	Chenopodium album[2, 3]	Lambsquarters
	Chenopodium rubrum	red goosefoot
	Dysphania ambrosioide[3]	Mexican tea
	Salicornia sp.[2]	Pickleweed
	Salicornia bigelovii[2]	dwarf saltwort
	Salicornia depressa[2]	Virginia grasswort
	Salicornia maritima	slender glasswort
	Salsola kali[2, 3]	Russian thistle
	Sarcocornia perennis[2]	Chickenclaws
	Suaeda sp.[2]	Seepweed
	Suaeda linearis[2]	annual seepweed
	Suaeda maritima	herbaceous seepweed

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Cistaceae	*Hudsonia ericoides*	pinebarren goldenheather
Cladoniaceae	*Cladonia* sp.[2]	cup lichen
Clusiaceae	*Hypericum gentianoides*	Orangegrass
	Hypericum perforatu[3]	common St. Johnswort
Convolvulaceae	*Calystegia sepium*[2]	hedge false bindweed
	Convolvulus sp.[2]	Bindweed
	Convolvulus arvensi[3]	field bindweed
Cornaceae	*Cornus* sp.	Dogwood
	Cornus amomum	silky dogwood
	Cornus racemosa	gray dogwood
	Cornus rugosa	roundleaf dogwood
	Cornus sericea	redosier dogwood
	Nyssa sylvatica[2]	Blackgum
Crassulaceae	*Sedum acr*[3]	goldmoss stonecrop
Cucurbitaceae	*Echinocystis lobata*	wild cucumber
Cupressaceae	*Chamaecyparis thyoides*	Atlantic white cedar
	Juniperus sp.	Juniper
	Juniperus communis	common juniper
	Juniperus virginiana[2]	eastern red-cedar
	Thuja occidentali[3]	Arborvitae
Cuscutaceae	*Cuscuta gronovii*	Scaldweed
Cyperaceae	*Bolboschoenus maritimus*	cosmopolitan bulrush
	Bolboschoenus robustus[2]	sturdy bulrush
	Bulbostylis capillaris[2]	densetuft hairsedge
	Carex sp.[2]	Sedge
	Carex annectens	yellowfruit sedge
	Carex cephalophora[2]	oval-leaf sedge
	Carex hormathodes	marsh straw sedge
	Carex lurida	shallow sedge

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Cyperaceae (continued)	*Carex pensylvanica*[2]	Pennsylvania sedge
	Carex scoparia[2]	broom sedge
	Carex silicea[2]	beach sedge
	Carex spicat[3]	prickly sedge
	Carex stipata	owlfruit sedge
	Carex swanii	Swan's sedge
	Carex tonsa var. *rugosperma*[2]	parachute sedge
	Carex vulpinoidea	fox sedge
	Cyperus sp.	flatsedge
	Cyperus esculentus	chufa flatsedge
	Cyperus lupulinus	Great Plains flatsedge
	Cyperus strigosus[2]	strawcolored flatsedge
	Eleocharis sp.	spikerush
	Eleocharis acicularis	needle spikerush
	Fimbristylis castanea	marsh fimbry
	Rhynchospora capitellata	brownish beaksedge
	Schoenoplectus americanus	chairmaker's bulrush
	Scirpus atrovirens	green bulrush
	Scirpus cyperinus	woolgrass
Dennstaedtiaceae	*Dennstaedtia punctilobula*[2]	eastern hayscented fern
	Pteridium aquilinum[2]	western brackenfern
Dipsacaceae	*Knautia arvensi*[3]	field scabiosa
Dryopteridaceae	*Athyrium filix-femina*	common ladyfern
	Dryopteris intermedia	intermediate woodfern
	Dryopteris marginalis	marginal woodfern
	Onoclea sensibilis[2]	sensitive fern
Elaeagnaceae	*Elaeagnus angustifoli*[3]	Russian olive
	Elaeagnus umbellata[2, 3]	autumn olive
Equisetaceae	*Equisetum* sp.	horsetail
	Equisetum arvense[2]	field horsetail

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Ericaceae	*Gaylussacia baccata*[2]	black huckleberry
	Vaccinium angustifolium[2]	lowbush blueberry
	Vaccinium corymbosum[2]	highbush blueberry
	Vaccinium pallidum[2]	Blue Ridge blueberry
Euphorbiaceae	*Chamaesyce maculata*	spotted sandmat
	Chamaesyce nutans	eyebane
	Chamaesyce polygonifolia[2]	seaside sandmat
	Euphorbia cyparissia[3]	cypress spurge
	Euphorbia esul[3]	leafy spurge
Fabaceae	*Amorpha fruticosa*[2, 3]	desert false indigo
	Apios americana	groundnut
	Gleditsia triacanthos[2, 3]	Honeylocust
	Lathyrus japonicus[2]	beach pea
	Lespedeza capitata[2]	roundhead lespedeza
	Lespedeza hirta	hairy lespedeza
	Lotus corniculatu[3]	birdfoot deervetch
	Medicago lupulina[2, 3]	black medick
	Medicago sativ[3]	Alfalfa
	Melilotus officinali[3]	yellow sweetclover
	Pueraria montana var. *lobat*[3]	Kudzu
	Robinia pseudoacacia[2, 3]	black locust
	Strophostyles helvola	trailing fuzzybean
	Trifolium arvense[2, 3]	rabbitfoot clover
	Trifolium aureu[3]	golden clover
	Trifolium hybridu[3]	alsike clover
	Trifolium pratense[2, 3]	red clover
	Trifolium repens[2, 3]	white clover
	Vicia sp.[2]	vetch
	Vicia cracca[2, 3]	bird vetch

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Fabaceae (continued)	*Vicia sativ*[3]	garden vetch
	Vicia tetrasperm[3]	lentil vetch
Fagaceae	*Fagus sylvatic*[3]	European beech
	Quercus alba[2]	white oak
	Quercus bicolor	swamp white oak
	Quercus cerri[3]	European turkey oak
	Quercus coccinea[2]	scarlet oak
	Quercus montana	chestnut oak
	Quercus palustris	pin oak
	Quercus robur[2, 3]	English oak
	Quercus rubra[2]	northern red oak
	Quercus stellata	post oak
	Quercus velutina[2]	black oak
Fucaceae	*Ascophyllum nodosum*[2]	yellow tang
	Fucus vesiculosus[2]	black tang
Fumariaceae	*Fumaria officinali*[3]	drug fumitory
Gentianaceae	*Sabatia stellaris*	rose of Plymouth
Geraniaceae	*Geranium carolinianum* v. *carolinianum*	Carolina geranium
	Geranium maculatum	spotted geranium
	Geranium robertianum[2]	Robert geranium
Grossulariaceae	*Ribes cynosbati*	eastern prickly gooseberry
	Ribes rubru[3]	cultivated currant
Hamamelidaceae	*Hamamelis virginiana*	American witchhazel
Hippocastanaceae	*Aesculus hippocastanu*[3]	horse chestnut
Hydrangeaceae	*Philadelphus coronariu*[3]	sweet mock orange
Iridaceae	*Iris* sp.	iris
	Iris pseudacoru[3]	paleyellow iris
	Iris versicolor	harlequin blueflag
	Sisyrinchium angustifolium	narrowleaf blue-eyed grass
	Sisyrinchium atlanticum	eastern blue-eyed grass

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Juglandaceae	*Carya* sp.[2]	hickory
	Carya cordiformis[2]	bitternut hickory
	Carya glabra[2]	pignut hickory
	Carya ovata[2]	shagbark hickory
	Carya pallid[3]	sand hickory
	Juglans nigra[2, 3]	black walnut
Juncaceae	*Juncus* sp.[2]	rush
	Juncus bufonius	toad rush
	Juncus effusus[2]	common rush
	Juncus gerardii[2]	saltmeadow rush
	Juncus greenei[2]	Greene's rush
	Juncus tenuis	poverty rush
	Luzula multiflora	common woodrush
Juncaginaceae	*Triglochin maritima*	seaside arrowgrass
Lamiaceae	*Galeopsis tetrahi*[3]	brittlestem hempnettle
	Glechoma hederace[3]	ground ivy
	Hedeoma pulegioides	American false pennyroyal
	Leonurus cardiac[3]	common motherwort
	Lycopus sp.[2]	waterhorehound
	Lycopus americanus	American water horehound
	Lycopus uniflorus[2]	northern bugleweed
	Lycopus virginicus	Virginia water horehound
	Mentha arvensis[2]	wild mint
	Nepeta catari[3]	catnip
	Prunella vulgaris	common selfheal
	Scutellaria galericulata	marsh skullcap
	Teucrium canadense	Canada germander
	Trichostema dichotomum	forked bluecurls
Lauraceae	*Sassafras albidum*[2]	sassafras

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Liliaceae	*Allium canadense*	meadow garlic
	Allium vineal[3]	wild garlic
	Asparagus officinali[3]	garden asparagus
	Convallaria majali[3]	European lily of the valley
	Hemerocallis fulv[3]	orange daylily
	Hypoxis hirsuta	common goldstar
	Lilium lancifoliu[3]	tiger lily
	Maianthemum canadense	Canada mayflower
	Maianthemum racemosum	feathery false lily of the vally
	Maianthemum stellatum	starry false lily of the vally
	Medeola virginiana	Indian cucumber
	Polygonatum biflorum[2]	smooth Solomon's seal
	Polygonatum pubescens[2]	hairy Solomon's seal
	Uvularia sessilifolia[2]	sessileleaf bellwort
Linaceae	*Linum usitatissimu*[3]	common flax
Lythraceae	*Lythrum salicaria*[2, 3]	purple loosestrife
Magnoliaceae	*Liriodendron tulipifera*[2]	tuliptree
Malvaceae	*Hibiscus moscheutos*[2]	crimsoneyed rosemallow
	Malva sylvestris[2, 3]	high mallow
	Malva neglect[3]	common mallow
Monotropaceae	*Monotropa uniflora*[2]	Indianpipe
Moraceae	*Morus alb*[3]	white mulberry
Myricaceae	*Comptonia peregrina*	sweet fern
	Morella pensylvanica[2]	northern bayberry
Nyctaginaceae	*Mirabilis nyctaginea* [, 3]	heartleaf four o'clock
Oleaceae	*Forsythia viridissim*[3]	greenstem forsythia
	Fraxinus sp.	ash
	Fraxinus americana[2]	white ash
	Fraxinus excelsior [, 3]	European ash
	Fraxinus pennsylvanica[2]	green ash

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Oleaceae (continued)	*Ligustrum vulgare*[2, 3]	European privet
	Syringa vulgaris[2, 3]	common lilac
Onagraceae	*Circaea lutetiana* ssp. *canadensis*[2]	broadleaf enchanter's nightshade
	Epilobium sp.	Willowherb
	Epilobium ciliatum	fringed willowherb
	Epilobium coloratum	purpleleaf willowherb
	Epilobium hirsutu[3]	codlins and cream
	Ludwigia palustris	marsh seedbox
	Oenothera biennis[2]	common evening-primrose
Orchidaceae	*Epipactis helleborin*[3]	broadleaf helleborine
Osmundaceae	*Osmunda cinnamomea*[2]	cinnamon fern
	Osmunda claytoniana[2]	interrupted fern
	Osmunda regalis	royal fern
Oxalidaceae	*Oxalis stricta*[2]	common yellow oxalis
Papaveraceae	*Chelidonium maju*[3]	Celandine
Phytolaccaceae	*Phytolacca americana*[2]	American pokeweed
Pinaceae	*Larix decidu*[3]	European larch
	Picea sp.	Spruce
	Picea abie[3]	Norway spruce
	Picea glauca [, 3]	white spruce
	Picea pungens [, 3]	blue spruce
	Pinus nigra[2, 3]	Austrian pine
	Pinus strobus[2]	eastern white pine
	Pinus sylvestris[2, 3]	Scotch pine
	Tsuga canadensis[2]	eastern hemlock
Plantaginaceae	*Plantago aristata* [, 3]	largebracted plantain
	Plantago lanceolata[2, 3]	narrowleaf plantain
	Plantago major [, 3]	common plantain
	Plantago maritima var. *juncoides*	goose tongue
	Plantago rugelii	blackseed plantain

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Platanaceae	*Platanus occidentalis*	American sycamore
Plumbaginaceae	*Limonium carolinianum*[2]	Carolina sealavender
Poaceae	*Agrostis* sp.[2]	bentgrass
	Agrostis capillari[3]	colonial bentgrass
	Agrostis gigantea[2, 3]	redtop
	Agrostis hyemalis[2]	winter bentgrass
	Agrostis perennans[2]	upland bentgrass
	Agrostis scabra	rough bentgrass
	Agrostis stolonifera[2]	creeping bentgrass
	Alopecurus pratensi[3]	meadow foxtail
	Ammophila breviligulata[2]	American beachgrass
	Andropogon gerardii[2]	big bluestem
	Anthoxanthum odoratum[2, 3]	sweet vernalgrass
	Bromus sp.	brome
	Bromus inermi[3]	smooth brome
	Bromus tectorum[2, 3]	cheatgrass
	Calamagrostis canadensis	bluejoint
	Cenchrus tribuloides	sanddune sandbur
	Corynephorus canescens[2, 3]	gray clubawn grass
	Dactylis glomerata[2, 3]	orchardgrass
	Danthonia spicata[2]	poverty oatgrass
	Deschampsia flexuosa	wavy hairgrass
	Dichanthelium sp.[2]	rosette grass
	Dichanthelium acuminatum	tapered rosette grass
	Dichanthelium clandestinum	deertongue
	Dichanthelium depauperatum[2]	starved panicgrass
	Digitaria sp.[2]	crabgrass
	Digitaria ischaemu[3]	smooth crabgrass
	Digitaria sanguinalis [, 3]	hairy crabgrass

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Poaceae (continued)	*Distichlis spicata*[2]	inland saltgrass
	Echinochloa sp.	cockspur grass
	Echinochloa crus-gall[3]	barnyardgrass
	Echinochloa walteri	coast cockspur grass
	Elymus repens[2, 3]	Quackgrass
	Eragrostis sp.	Lovegrass
	Eragrostis cilianensi[3]	Stinkgrass
	Eragrostis pectinacea	tufted lovegrass
	Eragrostis spectabilis	purple lovegrass
	Festuca sp.[2]	Fescue
	Festuca brevipil[3]	hard fescue
	Festuca ovina	sheep fescue
	Festuca rubra[2]	red fescue
	Glyceria sp.[2]	Mannagrass
	Glyceria canadensis	rattlesnake mannagrass
	Holcus lanatus[2, 3]	common velvetgrass
	Hordeum jubatum	foxtail barley
	Leersia oryzoides	rice cutgrass
	Lolium perenn[3]	perennial ryegrass
	Panicum sp.	panicgrass
	Panicum capillare	witchgrass
	Panicum dichotomiflorum	fall panicgrass
	Panicum virgatum[2]	switchgrass
	Pennisetum glaucu[3]	pearl millet
	Phalaris arundinacea[2]	reed canarygrass
	Phleum pratense[2, 3]	timothy
	Phragmites australi[32]	common reed
	Poa sp.[2]	bluegrass
	Poa annu[3]	annual bluegrass

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Poaceae (continued)	*Poa compress*[3]	Canada bluegrass
	Poa pratensis[2]	Kentucky bluegrass
	Puccinellia maritima	seaside alkaligrass
	Schedonorus pratensi[3]	meadow fescue
	Schizachyrium scoparium[2]	little bluestem
	Setaria sp.[2]	bristlegrass
	Setaria parviflora (syn. *S. geniculata*)	marsh bristlegrass
	Setaria viridi[3]	green bristlegrass
	Sorghastrum nutans	Indiangrass
	Spartina sp.[2]	Cordgrass
	Spartina alterniflora[2]	smooth cordgrass
	Spartina patens[2]	saltmeadow cordgrass
	Spartina pectinata[2]	prairie cordgrass
	Sporobolus cryptandrus	spike dropseed
	Thinopyrum pycnanthu[3]	tick quackgrass
	Triplasis purpurea	purple sandgrass
Polygalaceae	*Polygala sanguinea*	purple milkwort
Polygonaceae	*Polygonum* spp.[2]	Knotweed
	Polygonum amphibium	water knotweed
	Polygonum avicular[3]	prostrate knotweed
	Polygonum convolvulus[2, 3]	black bindweed
	Polygonum cuspidatu[3]	Japanese knotweed
	Polygonum hydropipe[3]	marshpepper knotweed
	Polygonum lapathifolium	curlytop knotweed
	Polygonum pensylvanicum	Pennsylvania smartweed
	Polygonum persicari[3]	spotted ladysthumb
	Polygonum sagittatum	arrowleaf tearthumb
	Polygonum scandens	climbing false buckwheat
	Rumex acetosella[2, 3]	common sheep sorrel

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Polygonaceae	*Rumex crispu*[3]	curly dock
	Rumex obtusifoliu[3]	bitter dock
	Rumex obtusifoliu[3]	bitter dock
	Rumex pallidus	seaside dock
	Rumex salicifolius	willow dock
Polypodiaceae	*Polypodium virginianum*[2]	rock polypody
Polytrichaceae	*Polytrichum commune*[2]	polytrichum moss
Portulacaceae	*Portulaca oleracea*	little hogweed
Primulaceae	*Anagallis arvensi*[3]	scarlet pimpernel
	Lysimachia quadriflora	fourflower yellow loosestrife
	Lysimachia quadrifolia	whorled yellow loosestrife
	Lysimachia terrestris[2]	earth loosestrife
Pyrolaceae	*Chimaphila maculata*[2]	striped prince's pine
	Chimaphila umbellata[2]	Pipsissewa
	Pyrola americana	American wintergreen
Ranunculaceae	*Anemone quinquefolia*	Nightcaps
	Aquilegia canadensis	red columbine
	Ranunculus acri[3]	tall buttercup
	Ranunculus bulbosu[3]	St. Anthony's turnip
	Ranunculus repen[3]	creeping buttercup
	Ranunculus sceleratus	cursed buttercup
	Thalictrum pubescens	king of the meadow
Rhamnaceae	*Frangula alnu*[3]	glossy buckthorn
	Rhamnus alnifolia[2]	alderleaf buckthorn
	Rhamnus cathartica[2, 3]	common buckthorn
Rosaceae	*Amelanchier* sp.	Serviceberry
	Amelanchier arborea[2]	common serviceberry
	Amelanchier canadensis[2]	Canadian serviceberry
	Amelanchier stolonifera	running serviceberry

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Rosaceae (continued)	*Argentina anserina*	silverweed cinquefoil
	Aronia arbutifolia[2]	red chokeberry
	Aronia melanocarpa	black chokeberry
	Crataegus sp.[2]	Hawthorn
	Crataegus monogyn[3]	oneseed hawthorn
	Fragaria virginiana	Virginia strawberry
	Geum canadense[2]	white avens
	Malus spp[2].	Apple
	Malus pumila[2, 3]	paradise apple
	Malus sylvestris[2, 3]	European crabapple
	Physocarpus opulifolius [, 3]	common ninebark
	Potentilla argente[3]	silver cinquefoil
	Potentilla canadensis[2]	dwarf cinquefoil
	Potentilla norvegica	Norwegian cinquefoil
	Potentilla rect[3]	sulphur cinquefoil
	Potentilla simplex[2]	common cinquefoil
	Prunus sp.	Plum
	Prunus cerasu[3]	sour cherry
	Prunus maritima[2]	beach plum
	Prunus pensylvanica[2]	pin cherry
	Prunus persic[3]	Peach
	Prunus serotina[2]	black cherry
	Prunus virginiana[2]	Chokecherry
	Pyrus sp.	Pear
	Pyrus communi[3]	common pear
	Rosa sp.	Rose
	Rosa multiflora[2, 3]	multiflora rose
	Rosa rugosa[2, 3]	rugosa rose
	Rosa virginiana[2]	Virginia rose

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Rosaceae (continued)	*Rubus* sp.[2]	Blackberry
	Rubus allegheniensis[2]	Allegheny blackberry
	Rubus flagellaris[2]	northern dewberry
	Rubus hispidus	bristly dewberry
	Rubus idaeus[2]	American red raspberry
	Rubus laciniatus[2, 3]	cutleaf blackberry
	Rubus pensilvanicus[2]	Pennsylvania blackberry
	Rubus phoenicolasius[2, 3]	wine raspberry
	Sorbaria sorbifoli[3]	false spiraea
	Sorbus aucupari[3]	European mountain ash
	Spiraea alba var. *latifolia*	white meadowsweet
	Spiraea tomentosa	Steeplebush
Rubiaceae	*Cephalanthus occidentalis*[2]	common buttonbush
	Galium sp.[2]	Bedstraw
	Galium aparine[2]	Stickywilly
	Galium mollug[3]	false baby's breath
	Galium palustre	common marsh bedstraw
	Galium tinctorium	stiff marsh bedstraw
	Galium trifidum	threepetal bedstraw
	Mitchella repens[2]	Partridgeberry
Salicaceae	*Populus alba*[2, 3]	white poplar
	Populus deltoides[2]	eastern cottonwood
	Populus grandidentata	bigtooth aspen
	Populus tremuloides[2]	quaking aspen
	Salix sp.	Willow
	Salix alb[3]	white willow
	Salix bebbiana[2]	Bebb willow
	Salix discolor[2]	pussy willow
	Salix nigra	black willow

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Salicaceae (continued)	*Salix sericea*	silky willow
	Salix × *sepulcralis*	weeping willow
Santalaceae	*Comandra umbellata*	bastard toadflax
Scrophulariaceae	*Linaria vulgaris*[2, 3]	butter and eggs
	Nuttallanthus canadensis[2]	Canada toadflax
	Rhinanthus minor[, 3]	little yellowrattle
	Scrophularia lanceolata	lanceleaf figwort
	Verbascum blattari[3]	moth mullein
	Verbascum thapsus[2, , 3]	common mullein
	Veronica officinalis[, 3]	common gypsyweed
Simaroubaceae	*Ailanthus altissima*[2, 3]	tree of heaven
Smilacaceae	*Smilax* sp.	Greenbrier
	Smilax herbacea[2]	smooth carrionflower
	Smilax rotundifolia[2]	roundleaf greenbrier
Solanaceae	*Datura stramonium*[2, 3]	Jimsonweed
	Physalis heterophylla	clammy groundcherry
	Solanum spp.	nightshade
	Solanum dulcamara[2, 3]	climbing nightshade
	Solanum nigru[3]	black nightshade
	Solanum rostratum[2, , 3]	buffalobur nightshade
Tamaricaceae	*Tamarix gallic*[3]	French tamarisk
Taxaceae	*Taxus* sp.	yew
Thelypteridaceae	*Thelypteris noveboracensis*	New York fern
	Thelypteris palustris	eastern marsh fern
Tiliaceae	*Tilia americana* var. *americana*[2]	American basswood
	Tilia cordata[2, 3]	littleleaf linden
Typhaceae	*Typha angustifolia*[2]	narrowleaf cattail
	Typha latifolia	broadleaf cattail
Ulmaceae	*Celtis occidentalis*[2]	common hackberry
	Ulmus sp.	elm

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Table E-1 (continued). Plants observed in Boston Harbor Islands National Recreation Area during vegetation plot sampling, accuracy assessment, and botanical inventory (Elliman, 2004).

Family	Scientific Name	Common name
Ulmaceae (continued)	*Ulmus americana*	American elm
	Ulmus pumil[3]	Siberian elm
	Ulmus rubra[2]	slippery elm
Urticaceae	*Boehmeria cylindrica*[2]	smallspike false nettle
	Pilea pumila[2]	Canadian clearweed
	Urtica dioic[3]	stinging nettle
Verbenaceae	*Verbena hastata*[2]	swamp verbena
Violaceae	*Viola* sp.[2]	violet
	Viola lanceolata	bog white violet
	Viola × *palmata*	early blue violet
Vitaceae	*Parthenocissus quinquefolia*[2]	Virginia creeper
	Parthenocissus tricuspidat[3]	Boston ivy
	Vitis sp.	grape
	Vitis aestivalis	summer grape
	Vitis labrusca	fox grape
	Vitis riparia	riverbank grape

[1] This hybrid is not listed in Plants 3.5.

[2] No common name listed for this hybrid.

[3] Identified during peer review process as a possible misidentification. Found in southwestern USA.

Appendix F. Global and local descriptions for the U.S. National Vegetation Classification associations of Boston Harbor Islands National Recreation Area.

Table of Contents to Vegetation Association Descriptions

Page

Old-field Eastern Red-cedar Forest F-3

Early-successional Woodland/Forest F-8

Northeastern Modified Successional Forest F-14

Black Pine Forest F-21

Norway Maple Forest F-25

Successional Maritime Forest F-30

Maritime Red-cedar Woodland F-36

Staghorn Sumac Shrubland F-42

Staghorn Sumac Shrubland Rocky Headland F-47

Stunted Staghorn Sumac Shrubland F-52

Northeastern Dry Oak-Hickory Forest F-57

Upland/Wetland Transitional Forest F-64

Common Wormwood Gravel Field F-69

Northeastern Old Field F-73

Little Bluestem Old Field F-79

Northeastern Successional Shrubland F-84

Northern Beachgrass Vegetation F-90

Overwash Grassland F-95

Beach Strand F-101

Eastern Cattail Marsh F-107

Northeastern Buttonbush Shrub Swamp F-112

Eastern Reed Marsh F-117

Reed-grass Tidal Marsh F-121

Table of Contents to Vegetation Association Descriptions (continued)

Page

Wet Meadow F-126

Cattail Brackish Tidal Marsh F-132

Coastal Salt Pond Marsh F-137

North Atlantic High Salt Marsh F-143

Eastern Tidal Salt Shrub F-148

North Atlantic Low Salt Marsh F-153

Salt Panne (Salicornia Type) F-159

North Atlantic Coast Estuarine Intertidal Mudflats F-164

New England Rocky Intertidal Community F-168

Maritime Rock Cliffs and Outcrops F-173

Maritime Erosional Bluffs and Cliffs F-177

Common Name (Park-specific): Old-field Eastern Red-cedar Forest

Synonyms

USNVC English Name: Eastern Red-cedar Ruderal Forest
USNVC Scientific Name: *Juniperus virginiana* Ruderal Forest
USNVC Identifier: CEGL006024

Local information

Environmental Description: This old-field successional forest association occurs in a variety of environmental settings, typically on former agricultural land and other disturbed or degraded environmental settings. Soils are sandy and well-drained with a dense network of grass roots.

Vegetation Description: *Juniperus virginiana* (eastern redcedar) dominates the canopy. Canopy closure is variable. Tall non-native shrubs such as *Rosa multiflora* (multiflora rose), *Lonicera morrowii* (Morrow's honeysuckle), and *Rhamnus cathartica* (common buckthorn) are prominent throughout the understory. Vines, including *Celastrus orbiculatus* (oriental bittersweet), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper), are also common. Native shrubs, including *Crataegus* sp. (hawthorn), *Rosa virginiana* (Virginia rose), and *Morella pensylvanica* (northern bayberry) may be present. The herbaceous layer is typically depauperate under closed canopy stands. Old-field herbs and grasses such as *Alliaria petiolata* (garlic mustard), *Daucus carota* (Queen Anne's lace), *Schizachyrium scoparium* (little bluestem), and *Deschampsia flexuosa* (wavy hairgrass) are more common under open canopies.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
		Rhamnus cathartica (common buckthorn)
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Short shrub/sapling	Broad-leaved deciduous shrub	*Morella pensylvanica* (northern bayberry)
Herb (field)	Forb	*Daucus carota* (Queen Anne's lace)
	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Celastrus orbiculatus* (oriental bittersweet), *Juniperus virginiana* (eastern redcedar), *Lonicera morrowii* (Morrow's honeysuckle)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNA	–	–	[not crosswalked]	–

Local Range: This association occurs on World's End in Boston Harbor Islands National Recreation Area.
Classification Comments: This association is distinguished from Maritime Red-cedar Woodland in that it has a higher coverage of non-native and early-successional species. It lacks a native, dwarf ericaceous shrub layer dominated by *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry). It occurs on old-field sites with sandy soils that were formerly plowed, rather than on rocky outcrops. The canopy in the Old-Field Eastern Red-cedar Forest tends to be more closed. Old fenceposts and stone walls may delineate the edges of these former old fields.

Other Comments: None.
Local Description Authors: E. Largay
Plots: BOHA.010.
AA Points: BOHA.AA140, BOHA.AA171, BOHA.AA173
Boston Harbor Islands National Recreation Area Inventory Notes: Only one plot was sampled in this association on World's End. It stands out on the orthophoto from the "grid-like" signature of old fields, now dominated by *Juniperus virginiana* (eastern redcedar).

Global information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	*Juniperus virginiana - Pinus virginiana - Pinus echinata* Ruderal Forest Alliance (A3227)
Alliance (English name)	Eastern Red-cedar - Virginia Pine - Shortleaf Pine Ruderal Forest Alliance
Association	*Juniperus virginiana* Ruderal Forest
Association (English name)	Eastern Red-cedar Ruderal Forest
Ecological System(s)	Information not available.

Global Description
Concept Summary: This association is a broadly defined old-field early-successional association occurring in a variety of environmental settings. Canopy closure and height are variable, as are shrub and herbaceous associates. *Juniperus virginiana* (eastern redcedar) dominates the canopy layer. Common associates, typically occurring as scattered individuals, may include *Pinus strobus* (eastern white pine), *Acer rubrum* (red maple), *Quercus* spp. (oaks), and *Prunus serotina* (black cherry). Shrub cover varies, with the most forested stands having little or no shrub cover. Exotic shrubs such as *Elaeagnus umbellata* (autumn olive), *Lonicera morrowii* (Morrow's honeysuckle), and *Rosa*

multiflora (multiflora rose) are characteristic, along with *Rubus* sp. (blackberry). Herbaceous cover likewise varies. Common species in the more open-canopy stands include old-field denizens such as *Schizachyrium scoparium* (little bluestem), *Festuca rubra* (red fescue), *Anthoxanthum odoratum* (sweet vernalgrass), *Agrostis gigantea* (redtop), *Elymus repens* (quackgrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Monarda fistulosa* (wild bergamot), *Toxicodendron radicans* (eastern poison ivy), *Achillea millefolium* (common yarrow), and *Daucus carota* (Queen Anne's lace). In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as *Alliaria petiolata* (garlic mustard) and *Allium vineale* (wild garlic), and *Dennstaedtia punctilobula* (eastern hayscented fern). These forests are often young and result from the colonization of old agricultural fields by *Juniperus virginiana* (eastern redcedar) over native and exotic forbs and grasses. These stands may eventually succeed to other forest types as mid- and late-successional canopy species colonize and subsequently overtop the *Juniperus* (juniper).

Environmental Description: This is a broadly defined old-field early-successional association occurring in a variety of environmental settings, typically on former agricultural land and other disturbed or degraded environmental settings. Soils are mesic to dry-mesic and moderately well-drained to well-drained.

Vegetation Description: *Juniperus virginiana* (eastern redcedar) dominates the canopy layer in stands of this type, which range from broadly spaced woodlands to dense and nearly impenetrable thickets. Common associates, typically occurring as scattered individuals, may include *Pinus strobus* (eastern white pine), *Acer rubrum* (red maple), *Quercus* spp. (oaks), and *Prunus serotina* (black cherry). Shrub cover varies according to canopy closure, with the most forested stands having little or no shrub cover. Exotic shrubs such as *Elaeagnus umbellata* (autumn olive), *Lonicera morrowii* (Morrow's honeysuckle), and *Rosa multiflora* (multiflora rose) are most characteristic, along with *Rubus* sp. (blackberry). Herbaceous cover likewise varies. Common species in the more open-canopy stands include old-field denizens such as *Schizachyrium scoparium* (little bluestem), *Festuca rubra* (red fescue), *Anthoxanthum odoratum* (sweet vernalgrass), *Agrostis gigantea* (redtop), *Elymus repens* (quackgrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Monarda fistulosa* (wild bergamot), *Toxicodendron radicans* (eastern poison ivy), *Achillea millefolium* (common yarrow), and *Daucus carota* (Queen Anne's lace). In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as *Alliaria petiolata* (garlic mustard), *Allium vineale* (wild garlic), and *Dennstaedtia punctilobula* (eastern hayscented fern).

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lonicera morrowii* (Morrow's honeysuckle)
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
	Broad-leaved deciduous shrub	*Elaeagnus umbellata* (autumn olive)

Most Abundant Species (continued)

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
	Graminoid	*Schizachyrium scoparium* (little bluestem)

Characteristic Species: *Elaeagnus umbellata* (autumn olive), *Juniperus virginiana* (eastern redcedar), *Lonicera morrowii* (Morrow's honeysuckle), *Rosa multiflora* (multiflora rose), *Schizachyrium scoparium* (little bluestem), *Solidago rugosa* (wrinkleleaf goldenrod)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association is of broad distribution, occurring widely throughout the northeastern U.S. It has been documented from only a limited range but is undoubtedly more widely distributed.

States/Provinces: DC, DE, MA, MD?, NJ, NY, PA, VA, WV
Federal Lands: NPS (Antietam?, Appomattox Court House, Bluestone, Boston Harbor Islands, C&O Canal, Cape Cod, Delaware Water Gap, Fire Island, Fredericksburg-Spotsylvania, George Washington Birthplace, Harpers Ferry, Manassas?, National Capital-East, Richmond); USFS (Monongahela); USFWS (Cape May, E.B. Forsythe, Supawna Meadows)

Conservation Status
Rank: GNA (ruderal) (10-Oct-2001)
Reasons: This forest represents early-successional, modified, or silviculturally managed vegetation and is thus not of conservation concern and does not receive a conservation status rank. This vegetation may be easily restorable by either management, time, or restoration of ecological processes.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: This association is currently very generally defined.
Similar Associations: Information not available.
Related Concepts: Information not available.

Sources
Description Authors: L.A. Sneddon, mod. R.E. Zaremba, M. Pyne, S.C. Gawler
References: Clark 1986, Eastern Ecology Working Group n.d., Lea 2004, Sneddon and Lundgren 2001, Vanderhorst et al. 2008.



Figure F-1. Old-field Eastern Red-cedar Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.010). September 2006. NAD 1983 / UTM easting 345697, northing 4680861.

Common Name (Park-specific): Early-successional Woodland/Forest

Synonyms

USNVC English Name: (Quaking Aspen, Bigtooth Aspen) - (Gray Birch, Paper Birch) Ruderal Woodland

USNVC Scientific Name: Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera) Ruderal Woodland

USNVC Identifier: CEGL006303

Local Information

Environmental Description: This association occurs in various settings over thin glacial till. Elevation and aspect vary. The association includes vegetation developing after severe disturbance, such as forest clearing, fires, severe hurricanes, or simply heavily fragmented land development and/or old field abandonment.

Vegetation Description: This early-successional woodland is comprised mainly of native trees and occurs on a number of the Boston Harbor Islands. The best examples of this woodland association occur on Grape, Lovells, and Peddock's islands, where woodlands are succeeding shrub thickets. *Betula populifolia* (gray birch) and/or *Populus tremuloides* (quaking aspen) are typically dominant and *Populus deltoides* (eastern cottonwood), *Prunus serotina* (black cherry), and *Juniperus virginiana* (eastern redcedar) may also be present, growing 4.5 to 10 m in height forming a dispersed canopy over variable amounts of undergrowth often including *Lonicera morrowii* (Morrow's honeysuckle), *Rosa multiflora* (multiflora rose), *Morella pensylvanica* (northern bayberry), poison ivy (*Toxicodendron radicans*), *Frangula alnus* (glossy buckthorn), *Rhus typhina* (staghorn sumac), *Rosa rugosa* (rugosa rose). *Rubus idaeus* (American red raspberry), *Salix bebbiana* (Bebb willow), *Sambucus nigra* ssp. *canadensis* (common elderberry), and *Viburnum recognitum* (southern arrowwood). Herbaceous plants such as *Achillea millefolium* (common yarrow), *Alopecurus pratensis* (meadow foxtail), *Artemisia vulgaris* (common wormwood), *Asclepias syriaca* (common milkweed), *Hieracium canadense* (Canadian hawkweed), *Tanacetum vulgare* (common tansy), *Solidago rugosa* (wrinkleleaf goldenrod), and *Solanum dulcamera* (climbing nightshade) grow on thicket edges and grassy trail openings.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula populifolia* (gray birch)
		Populus tremuloides (quaking aspen)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
Vine	Broad-leaved deciduous vine	*Toxicodendron radicans* (poison ivy)
Herb (field)	Forb	*Achillea millefolium* (common yarrow)
		Solidago rugose (wrinkleleaf goldenrod)

Characteristic Species: *Betula populifolia* (gray birch), *Populus tremuloides* (quaking aspen)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	–	Successional northern hardwoods	Swain and Kearsley 2001

Local Range: The central and northern drumlins of Lovells have good examples of this woodland association. Examples also occur on Grape, Gallops, Long, Moon, Middle Brewster, Great Brewster, Peddock's, Raccoon, Nut, Sarah, Snake (east side), and Slate islands.

Classification Comments: This association differs from Northeastern Modified Successional Forest in the dominance of early-successional tree species, such as *Betula populifolia* (gray birch) and *Populus tremuloides* (quaking aspen), and by having a dispersed, relatively open canopy.

Other Comments: A photograph is not available of this association.
Local Description Authors: T. Elliman and E. Largay
Plots: None.
AA Points: BOHA.AA033, BOHA.AA055, BOHA.AA057, BOHA.AA101, BOHA.AA103, BOHA.AA104

Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	*Acer rubrum - Prunus serotina - Pinus strobus* Ruderal Forest Alliance (A3229)
Alliance (English name)	Red Maple – Black Cherry – Eastern White Pine Ruderal Forest Alliance
Association	*Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera)* Woodland
Association (English name)	(Quaking Aspen, Bigtooth Aspen) - (Gray Birch, Paper Birch) Woodland
Ecological System(s)	Boreal Aspen-Birch Forest (CES103.020),
	Laurentian-Acadian Northern Hardwoods Forest (CES201.564)

Global Description

Concept Summary: This is a common successional deciduous forest of the northern Appalachian Mountains, from New England, New York and adjacent Canada across to the northern Great Lakes.

Small patches of this type are found on the Coastal Plain but are dominated by one or more of the following: *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen) or the non-native *Populus alba* (white poplar), and *Betula populifolia* (gray birch). It occurs in various settings, often over thin glacial till. Elevation and aspect vary. The association is broadly defined and includes vegetation developing after severe disturbance such as logging, fires, severe hurricanes, or simply heavily fragmented residential development. This association can occur as closed-canopy forest or open woodland; in a few very exposed areas, it has been seen to grade to shrubland. Understory shrub cover varies from sparse to well-developed depending primarily on canopy closure. Herbs are typically sparse but may be locally dense. Bryoids are typically minor. The tree canopy is a heterogeneous mixture of light-requiring, wind-dispersed trees usually composed of several codominant species, including *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), *Betula papyrifera* (paper birch), *Betula populifolia* (gray birch), *Populus balsamifera* (balsam poplar), *Acer rubrum* (red maple), *Prunus serotina* (black cherry), and/or *Prunus pensylvanica* (pin cherry). More minor components can include *Pinus strobus* (eastern white pine), *Picea rubens* (red spruce), *Abies balsamea* (balsam fir), *Acer saccharum* (sugar maple), *Quercus rubra* (northern red oak), *Fraxinus americana* (white ash), *Fraxinus pennsylvanica* (green ash), or *Ulmus americana* (American elm) in the northern portions of the range. Scattered individuals of *Juniperus virginiana* (eastern redcedar) may occur in southern examples of this association. The shrub layer can include *Viburnum dentatum* (southern arrowwood), *Lonicera morrowii* (Morrow's honeysuckle), *Frangula alnus* (glossy buckthorn), *Rhus typhina* (staghorn sumac), *Rhus copallinum* (flameleaf sumac), *Morella pensylvanica* (northern bayberry), *Rubus* spp. (blackberry), and/or *Viburnum dentatum* (southern arrowwood), in the southern portion of the range, or *Sorbus americana* (American mountain ash), *Acer pensylvanicum* (striped maple), *Viburnum nudum var. cassinoides* (withe-rod), or *Hamamelis virginiana* (American witchhazel). *Vaccinium angustifolium* (lowbush blueberry), *Kalmia angustifolia* (sheep laurel), *Gaylussacia baccata* (black huckleberry), and *Comptonia peregrina* (sweet fern) may form a dwarf-shrub layer in the northern portion of the range. Associated herbs to the north typically include *Pteridium aquilinum* (western brackenfern), *Deschampsia flexuosa* (wavy hairgrass), *Festuca brevipila* (hard fescue), *Cornus canadensis* (bunchberry dogwood), *Doellingeria umbellata* (parasol whitetop), *Eurybia macrophylla* (bigleaf aster), *Danthonia spicata* (poverty oatgrass), *Carex lucorum* (Blue Ridge sedge) and related species, and *Maianthemum canadense* (Canada mayflower). Typical bryoids include *Polytrichum commune* (polytrichum moss), *Polytrichum juniperinum* (juniper polytrichum moss), *Dicranum* sp. (dicranum moss), and *Cladonia* sp. (cup lichen). Herbs in southern examples of this association are typically old-field grasses and *Solidago* spp. (goldenrods). In the absence of major disturbance, these forests mostly succeed to northern hardwood, spruce-fir, mixed northern hardwood-spruce-fir, or red oak - northern hardwood forests in the northern portion of the range.

Environmental Description: It occurs in various settings, often over thin glacial till. Elevation and aspect vary. The association is broadly defined, and includes vegetation developing after severe disturbance such as logging, fires, severe hurricanes, or simply heavily fragmented residential development.

Vegetation Description: This association can occur as closed-canopy forest or open woodland; in a few very exposed areas, it has been seen to grade to shrubland. Understory shrub cover varies from sparse to well-developed depending primarily on canopy closure. Herbs are typically sparse, but may be locally dense. Bryoids are typically minor. The tree canopy is a heterogeneous mixture of light-requiring, wind-dispersed trees usually composed of several codominant species including *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), *Betula papyrifera* (paper birch), *Betula populifolia* (gray birch), *Populus balsamifera* (balsam poplar), *Acer rubrum* (red maple), *Prunus serotina* (black cherry), and/or *Prunus pensylvanica* (pin cherry). More minor components can include *Pinus strobus* (eastern white pine), *Picea rubens* (red spruce), *Abies balsamea* (balsam fir), *Acer saccharum* (sugar maple), *Quercus rubra* (northern red oak), *Fraxinus americana* (white ash), *Fraxinus pennsylvanica* (green ash), or *Ulmus americana* (American elm). The shrub layer in the northern portion of the range includes *Sorbus americana* (American mountain ash), *Acer pensylvanicum* (striped maple), *Viburnum nudum var. cassinoides* (withe-rod), or *Hamamelis virginiana* (American witchhazel). *Vaccinium angustifolium* (lowbush blueberry), *Kalmia angustifolia* (sheep laurel), *Gaylussacia baccata* (black huckleberry), and *Comptonia peregrina* (sweet fern) may form a dwarf-shrub layer. Associated herbs to the north typically include *Pteridium aquilinum* (western brackenfern), *Deschampsia flexuosa* (wavy hairgrass), *Festuca brevipila* (hard fescue), *Cornus canadensis* (bunchberry dogwood), *Doellingeria umbellata* (parasol whitetop), *Eurybia macrophylla* (bigleaf aster), *Danthonia spicata* (poverty oatgrass), *Carex lucorum* (Blue Ridge sedge) and related species, and *Maianthemum canadense* (Canada mayflower). Typical bryoids include *Polytrichum commune* (polytrichum moss), *Polytrichum juniperinum* (juniper polytrichum moss), *Dicranum* sp. (dicranum moss), and *Cladonia* sp. (cup lichen). Herbs in southern examples of this association are typically old-field grasses and *Solidago* spp. (goldenrods). Small patches of this type are found on the Coastal Plain but are dominated by one or more of the following: *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), or the non-native *Populus alba* (white poplar), and *Betula populifolia* (gray birch) (usually not *Betula lenta* (sweet birch) or *Betula alleghaniensis* (yellow birch)).

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula papyrifera* (paper birch),
		Betula populifolia (gray birch)
		Populus grandidentata (bigtooth aspen)
		Populus tremuloides (quaking aspen)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Viburnum dentatum* (southern arrowwood)
		Viburnum nudum var. *cassinoides* (withe-rod)
Herb (field)	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)
		Festuca brevipila (hard fescue)

Characteristic Species: *Betula populifolia* (gray birch), *Populus grandidentata* (bigtooth aspen)

Other Noteworthy Species

Species	GRank	Type	Note
Dendroica pensylvanica (chestnut-sided warbler)	–	animal	–
Sphyrapicus varius (yellow-bellied sapsucker)	–	animal	–
Vermivora ruficapilla (nashville warbler)	–	animal	–

USFWS Wetland System: Not applicable.

Distribution
Range: Information not available.
States/Provinces: MA, ME:S5, NB, NH, NY, VT
Federal Lands: NPS (Acadia, Boston Harbor Islands, Gateway); USFWS (Aroostook, Assabet River, Carlton Pond?, Moosehorn, Nulhegan Basin)

Conservation Status
Rank: G5 (20-Apr-2000)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts:

- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984) B
- Mesic Northern Hardwood Forest (Beech-Birch-Maple Forest) (Thompson 1996) B

Sources
Description Authors: S.C. Gawler, mod. E. Largay
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Gawler 2002, USDA-NRCS 2001, Rawinski 1984, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.



Figure F-2. Early-successional Woodland/Forest on Grape Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA057). September 2008. NAD 1983 / UTM easting 341205, northing 4681355.

Common Name (Park-specific): Northeastern Modified Successional Forest

Synonyms

USNVC English Name: Black Cherry - Tuliptree - Red Maple - White Ash – (Black Locust) Ruderal Forest

USNVC Scientific Name: Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana - (Robinia pseudoacacia) Ruderal Forest

USNVC Identifier: CEGL006599

Local Information

Environmental Description: This vegetation occurs on a variety of sites from upper slopes to flat areas that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have small seepage inclusions in some examples. The soils consist of very fine sandy loam.

Vegetation Description: Many islands and peninsulas have small patches of mature forest with a mixed association of native and naturalized non-native trees. This association can have an admixture of species in the canopy, including *Acer platanoides* (Norway maple), *Acer pseudoplatanus* (sycamore maple), *Acer rubrum* (red maple), *Prunus serotina* (black cherry), *Ailanthus altissima* (tree of heaven), *Quercus rubra* (northern red oak), *Pinus nigra* (Austrian pine), *Pinus sylvestris* (Scotch pine), *Robinia pseudoacacia* (black locust), *Ulmus pumila* (Siberian elm), *Gleditsia triacanthos* (honeylocust), *Betula populifolia* (gray birch), *Fraxinus americana* (white ash), *Fraxinus excelsior* (European Ash), *Juniperus virginiana* (eastern redcedar), *Quercus velutina* (black oak) and *Quercus robur* (English Oak). *Tilia americana* var. *americana* (American basswood) occurs in shoreline areas on the edges of this association. Common shrubs and vines include *Lonicera morrowii* (Morrow's honeysuckle), *Rosa multiflora* (multiflora rose), *Frangula alnus* (glossy buckthorn), *Rubus allegheniensis* (Allegheny blackberry), *Morella pensylvanica* (northern bayberry), *Celastrus orbiculatus* (Oriental bittersweet), *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), and *Smilax rotundifolia* (roundleaf greenbrier). The herbaceous layer is typically sparse in cover; species may include *Dactylis glomerata* (orchardgrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Hieracium canadense* (Canadian hawkweed), and *Circaea lutetiana ssp. canadensis* (broadleaf enchanter's nightshade).

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
		Acer rubrum (red maple)
		Prunus serotina (black cherry)
		Quercus robur (English oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Prunus serotina (black cherry)

Most Abundant Species (continued)

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Vine/Liana	*Celastrus orbiculatus* (Oriental bittersweet)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
	Vine/Liana	*Smilax rotundifolia* (roundleaf greenbrier)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis* (Allegheny blackberry)
Herb (field)	Forb	*Hieracium canadense* (Canadian hawkweed)
		Solidago rugosa (wrinkleleaf goldenrod)

Characteristic Species: *Acer platanoides* (Norway maple), *Ailanthus altissima* (tree of heaven), *Acer pseudoplatanus* (sycamore maple), *Celastrus orbiculatus* (Oriental bittersweet), *Quercus robur* (English oak), *Rosa multiflora* (multiflora rose), *Rubus allegheniensis* (Allegheny blackberry)

Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data: Information not available.
Local Range: World's End, Langlee, Raccoon, Peddock's, Long, Thompson, Rainsford, and Ragged islands have good examples of this forest association. It also occurs on Button Island.

Classification Comments: This association is different from native forest associations in the dominance of naturalized non-native tree species in the canopy. It differs from Early-Successional Woodland/Forest in that it is not dominated by early-successional species such as *Populus alba* (white poplar) and *Betula populifolia* (gray birch) and has a defined forest structure rather than an open woodland structure. It differs from the globally described USNVC type in that it lacks tuliptree (*Liriodendron tulipifera*).

Other Comments: The canopy dominants vary from island to island; however, they are almost always comprised of a mixture of non-native and native tree species.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.018, BOHA.026, BOHA.040.
AA Points: BOHA.AA010, BOHA.AA016, BOHA.AA018, BOHA.AA019, BOHA.AA021, BOHA.AA034, BOHA.AA036, BOHA.AA040, BOHA.AA046, BOHA.AA053, BOHA.AA096, BOHA.AA099, BOHA.AA100, BOHA.AA102, BOHA.AA105, BOHA.AA113, BOHA.AA143
Boston Harbor Islands National Recreation Area Inventory Notes: This is the most common forest association in Boston Harbor Islands.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)

USNVC Classification (continued)

Classification Level	Description
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Native Ruderal Forest (G030)
Alliance	*Acer rubrum - Prunus serotina – Pinus strobus* Ruderal Forest Alliance (A3229)
Alliance (English name)	Red Maple - Black Cherry – Eastern White Pine Ruderal Forest Alliance
Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* - (*Robinia pseudoacacia*) Ruderal Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash – (Black Locust) Ruderal Forest
Ecological System(s)	Central Appalachian Dry Oak-Pine Forest (CES202.591), Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

Global Description

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that are becoming reforested after having been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern redcedar), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree of heaven), *Ulmus americana* (American elm), *Quercus* spp. (oaks), *Betula lenta* (sweet birch), *Amelanchier* sp. (serviceberry), *Pinus strobus* (eastern white pine), and *Populus grandidentata* (bigtooth aspen). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. (blackberry) such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* sp. (hawthorn), *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima var. altissima* (white snakeroot), *Polygonum persicaria* (spotted ladysthumb), *Impatiens capensis* (jewelweed), *Glechoma hederacea* (ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium ssp. sepium* (hedge false bindweed), *Galium aparine* (stickywilly), *Oxalis stricta* (common yellow oxalis), *Polygonum virginianum* (jumpseed), *Dennstaedtia punctilobula* (eastern hayscented fern), *Arisaema*

triphyllum (Jack in the pulpit), *Allium vineale* (wild garlic), and *Veronica officinalis* (common gypsyweed), among many others. The invasive species *Alliaria petiolata* (garlic mustard), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb) can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis labrusca* (fox grape), and the invasive vines *Celastrus orbiculatus* (Oriental bittersweet) and *Lonicera japonica* (Japanese honeysuckle). These forests are often young and resulted from the colonization of old agricultural fields by woody species. Recent disturbance or abundant invasive species give these forest stands a weedy character. It is unlikely that these stands will succeed to a natural plant association dominated by native species.

Environmental Description: This vegetation occurs on sites that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have small seepage inclusions in some examples. Occasionally this type may occur in formerly agricultural bottomlands, in which case the soils may be temporarily flooded or saturated.

Vegetation Description: Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern redcedar), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree of heaven), *Ulmus americana* (American elm), *Quercus* spp. (oaks), *Betula lenta* (sweet birch), *Amelanchier* (serviceberry) spp., *Pinus strobus* (eastern white pine), and *Populus grandidentata* (bigtooth aspen). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. (blackberry) such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* sp. (hawthorn), *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima var. altissima* (white snakeroot), *Polygonum persicaria* (spotted ladysthumb), *Impatiens capensis* (jewelweed), *Glechoma hederacea* (ground ivy), *Polystichum acrostichoides* (Christmas fern), *Calystegia sepium ssp. sepium* (hedge false bindweed), *Galium aparine* (stickywilly), *Oxalis stricta* (common yellow oxalis), *Polygonum virginianum* (jumpseed), *Dennstaedtia punctilobula* (eastern hayscented fern), *Arisaema triphyllum* (Jack in the pulpit), *Allium vineale* (wild garlic), and *Veronica officinalis* (common gypsyweed), among many others. The invasive species *Alliaria petiolata* (garlic mustard), *Microstegium vimineum* (Nepalese browntop), and *Polygonum caespitosum* (oriental ladysthumb) can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure

can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis labrusca* (fox grape), and the invasive vines *Celastrus orbiculatus* (Oriental bittersweet) and *Lonicera japonica* (Japanese honeysuckle).

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Fraxinus americana (white ash)
		Liriodendron tulipifera (tuliptree)
		Prunus serotina (black cherry)
		Robinia pseudoacacia (black locust)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
Tall shrub/sapling	Broad-leaved deciduous tree	*Carpinus caroliniana* (American hornbeam)
	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
		Rosa multiflora (multiflora rose)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard)
		Polygonum persicaria (spotted ladysthumb)
	Graminoid	*Microstegium vimineum* (Nepalese browntop)

Characteristic Species: *Acer rubrum* (red maple), *Alliaria petiolata* (garlic mustard), *Berberis thunbergii* (Japanese barberry), *Elaeagnus umbellata* (autumn olive), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Liriodendron tulipifera* (tuliptree), *Microstegium vimineum* (Nepalese browntop), *Polygonum persicaria* (spotted ladysthumb), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust), *Rosa multiflora* (multiflora rose), *Rubus allegheniensis* (Allegheny blackberry)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This vegetation is currently described from Pennsylvania, New York, and New Jersey but is of broader distribution in the northeastern U.S.

States/Provinces: CT, DE, MA, NJ, NY, PA
Federal Lands: NPS (Allegheny Portage Railroad, Boston Harbor Islands, C&O Canal, Delaware Water Gap, Fort Necessity, Friendship Hill, Gateway, George Washington Parkway, Gettysburg, Harpers Ferry, Indiana Dunes, Johnstown Flood, Manassas, Morristown, Sagamore Hill, Saratoga, Saugus Iron Works, Shenandoah, Upper Delaware, Valley Forge, Weir Farm); USFWS (Cape May, E.B. Forsythe, Erie, Great Meadows?, Montezuma, Prime Hook, Supawna Meadows)

Conservation Status
Rank: GNA (ruderal) (29-Nov-2004)

Reasons: This vegetation is modified by human activity and not of conservation concern.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.

Similar Associations:

- *Liriodendron tulipifera - Quercus* spp. Forest (CEGL007221)--is more strongly dominated by *Liriodendron* and is generally in a later successional state as evidenced by taller trees and more closed canopy.
- *Prunus serotina - Sassafras albidum - (Fraxinus americana) / Juniperus virginiana* Forest (CEGL004133)
- *Robinia pseudoacacia* Forest (CEGL007279)

Related Concepts: Information not available.

Sources
Description Authors: L.A. Sneddon, mod. S.C. Gawler and E. Largay
References: Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999, USDA-NRCS 2001, Perles et al. 2005c, Podniesinski et al. 2006.



Figure F-3. Northeastern Modified Succesional Forest on Peddocks Island in Boston Harbor Island National Recreation Area (plot BOHA.018). September 2006. NAD 1983 / UTM easting 340260, northing 4683982.

Common Name (Park-specific): Black Pine Forest

Synonyms

USNVC English Name: Black Pine - (Austrian Pine) Ruderal Forest
USNVC Scientific Name: *Pinus thunbergiana - (Pinus nigra)* Ruderal Forest
USNVC Identifier: CEGL006012

Local information

Environmental Description: This non-native black pine forest occurs on well-drained fine-textured sandy soils, usually on glacial tills of drumlins. A thick layer of pine needles covers the forest floor. This association is exposed to salt spray and coastal storms.

Vegetation Description: *Pinus nigra* (Austrian pine)-dominated woodlands and forests occur on some of the islands. *Pinus sylvestris* (Scotch pine), *Prunus serotina* (black cherry), *Quercus rubra* (northern red oak), *Acer pseudoplatanus* (sycamore maple), *Populus tremuloides* (quaking aspen), and *Rhus typhina* (staghorn sumac) are the successional tree and shrub species in this disturbed association. *Toxicodendron radicans* (eastern poison ivy) is rampant on the ground and also climbs trees. *Parthenocissus quinquefolia* (Virginia creeper) and *Smilax rotundifolia* (roundleaf greenbrier) are typically present. Herbs are sparse to absent and may include *Hieracium canadense* (Canadian hawkweed) and/or *Solidago rugosa* (wrinkleleaf goldenrod).

Most Abundant Species

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus nigra* (Austrian pine)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Prunus serotina* (black cherry)
	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)

Characteristic Species: *Pinus nigra* (Austrian pine), *Toxicodendron radicans* (eastern poison ivy)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNA	–	–	[not crosswalked]	–

Local Range: *Pinus nigra* (Austrian pine) stands occur on West Head and Long Island Head on Long Island, scattered throughout the matrix Northeastern Modified Successional Forest on the East Head of Peddock's Island and along the southeastern side of Thompson Island.

Classification Comments: None.
Other Comments: The large *Pinus nigra* (Austrian pine) trees are not regenerating on any of the Boston Harbor Islands.

Local Description Authors: E. Largay and T. Elliman
Plots: BOHA.014, BOHA.034, BOHA.044.

AA Points: BOHA.AA006, BOHA.AA028, BOHA.AA142, BOHA.AA148, BOHA.AA150, BOHA.AA153

Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Exotic Ruderal Forest (G032)
Alliance	*Acer platanoides - Ailanthus altissima - Pinus* spp. Exotic Ruderal Forest Alliance (A.3230)
Alliance (English name)	Norway Maple - Tree-of-Heaven - Pine species Exotic Ruderal Forest Alliance
Association	*Pinus thunbergiana - (Pinus nigra)* Ruderal Forest
Association (English name)	Black Pine - (Austrian Pine) Ruderal Forest
Ecological System(s)	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)

Global Description

Concept Summary: This non-native black pine forest of the northeastern coastal region occurs on well-drained to xeric sandy soils, usually on sand dunes or near-coastal glacial tills. Stands are of variable canopy height and closure and dominated by *Pinus thunbergiana* (Japanese black pine) or *Pinus nigra* (Austrian pine). A frequent canopy associate can be *Pinus rigida* (pitch pine). The shrub layer is not well-developed, and the herbaceous layer is of variable composition, sometimes containing *Panicum virgatum* (switchgrass) and other herbaceous associates. *Toxicodendron radicans* (eastern poison ivy) is common in all strata of this association.

Environmental Description: This non-native black pine forest of the northeastern coastal region occurs on well-drained to xeric sandy soils, usually on sand dunes or near-coastal glacial tills.

Vegetation Description: These planted stands are of variable canopy height and closure and dominated by *Pinus thunbergiana* (Japanese black pine) or less commonly by *Pinus nigra* (Austrian pine). A frequent canopy associate is *Pinus rigida* (pitch pine). The shrub layer is not well-developed, however, it may contain *Prunus serotina* (black cherry) and *Morella pensylvanica* (northern bayberry). The herbaceous layer is of variable composition, sometimes containing *Panicum virgatum* (switchgrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Hieracium canadense* (Canadian hawkweed), and other herbaceous associates. Vines, including *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), *Celastrus orbiculatus* (oriental

bittersweet), *Smilax rotundifolia* (roundleaf greenbrier), and *Lonicera japonica* (Japanese honeysuckle), can be common in this association.

Most Abundant Species

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus nigra* (Austrian pine)
		Pinus thunbergiana (Japanese black pine)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Prunus serotina* (black cherry)
	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)

Characteristic Species: *Pinus nigra* (Austrian pine), *Pinus thunbergiana* (Japanese black pine)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: These plantations occur on Cape Cod National Seashore and Boston Harbor Islands National Recreation Area, Massachusetts; Block Island, Rhode Island, Fire Island National Seashore and Gateway National Recreation Area, New York, and Cape May National Wildlife Refuge, NJ.

States/Provinces: MA, NJ, NY, RI
Federal Lands: NPS (Boston Harbor Islands, Fire Island, Gateway); USFWS (Parker River?, Cape May)

Conservation Status
Rank: GNA (modified/managed) (10-Oct-2001)
Reasons: This planted non-native association is not a conservation priority and therefore does not receive a conservation rank.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This association was originally described from Fire Island National Seashore. The description was expanded from data from National Park Service vegetation mapping projects completed for Cape Cod National Seashore, Block Island, Rhode Island, Gateway National Recreation Area, New York, and Boston Harbor Islands National Recreation Area, Massachusetts.

Similar Associations: Information not available.
Related Concepts: Information not available.

Sources
Description Authors: L.A. Sneddon, mod. E. Largay
References: Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., USDA-NRCS 2001, Sneddon and Lundgren 2001, TNC 1995c.



Figure F-4. Black Pine Forest on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.014). September 2006. NAD 1983 / UTM easting 340491, northing 4684894.

Common Name (Park-specific): Norway Maple Forest

Synonyms

USNVC English Name: Norway Maple Ruderal Forest
USNVC Scientific Name: *Acer platanoides* Ruderal Forest
USNVC Identifier: CEGL006407

Local Information

Environmental Description: This association is associated with disturbance. It occurs on very fine sandy loam soils on the drumlins on some of the Boston Harbor Islands.

Vegetation Description: *Acer platanoides* (Norway maple) is dominant in the canopy and in some areas it forms a virtual monoculture, casting deep shade over an understory of *Acer platanoides* (Norway maple) saplings. *Quercus rubra* (northern red oak) may be in the subcanopy. The invasive vine and shrubs *Celastrus orbiculatus* (oriental bittersweet), *Rosa multiflora* (multiflora rose), *Berberis thunbergii* (Japanese barberry), *Lonicera morrowii* (Morrow's honeysuckle), and *Rhamnus cathartica* (common buckthorn) are abundant. *Prunus serotina* (black cherry), *Malus pumila* (paradise apple), and *Toxicodendron radicans* (eastern poison ivy) may also be present. Weedy herbs such as *Poa pratensis* (Kentucky bluegrass) and *Hieracium canadense* (Canadian hawkweed) may also be present.

Most Abundant Species

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
Herb (field)	Graminoid	*Poa pratensis* (Kentucky bluegrass)

Characteristic Species: *Acer platanoides* (Norway maple)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNA	–	–	[not crosswalked]	–

Local Range: The East Head drumlin on Peddock's Island has the best example of this association in Boston Harbor Islands National Recreation Area. Thompson Island has *Acer platanoides* (Norway maple) stands along the top of the ridge on the island's west side and on lower drumlin slopes on the east side. World's End has small patches of this non-native forest association on the south-facing slope of the northern drumlin.

Classification Comments: This association can be distinguished from Northeastern Modified Successional Forest by the complete canopy dominance of *Acer platanoides* (Norway maple).

Other Comments: Studies have demonstrated that Norway maple tends to succeed itself and reduce the diversity of forest areas where it has been introduced or invaded (Wycoff and Webb 1996, Anderson 1999).

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.025, BOHA.036.

AA Points: BOHA.AA001, BOHA.AA107, BOHA.AA108, BOHA.AA109, BOHA.AA112
Boston Harbor Islands National Recreation Area Inventory Notes: Norway Maple Forest on the northeastern portion of Thompson Island has a ropes course strung throughout the stand; this is associated with the Outward Bound Program on the island. The Norway maples in the southeastern portion of Thompson Island may have been planted for shade at a picnic area and have since naturalized.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Eastern North American Ruderal Forest (M013)
Group	Northern & Central Exotic Ruderal Forest (G032)
Alliance	*Acer platanoides - Ailanthus altissima - Pinus* spp. Exotic Ruderal Forest Alliance (A3230)
Alliance (English name)	Norway Maple - Tree-of-Heaven - Pine species Exotic Ruderal Forest Alliance
Association	*Acer platanoides* Ruderal Forest
Association (English name)	Norway Maple Ruderal Forest
Ecological System(s)	Information not available.

Global Description

Concept Summary: This association represents forests in the northeastern United States strongly dominated by the invasive tree *Acer platanoides* (Norway maple), often to the exclusion of virtually all other canopy species. Most documented stands are at low elevations, on flat or rolling topography both above and below the glacial boundary. *Acer platanoides* (Norway maple) is the overwhelmingly dominant tree, typically forming a closed or nearly closed canopy. In some stands native trees, including *Fraxinus americana* (white ash) and *Acer saccharum* (sugar maple) (the latter especially susceptible to exclusion by Norway maple), may be present in very limited amounts. Other stands may have non-native associates, including *Pinus nigra* (Austrian pine), *Pinus sylvestris* (Scotch pine), or *Robinia pseudoacacia* (black locust). The deep shade cast by *Acer platanoides* (Norway maple) limits understory growth, aside from regeneration of *Acer platanoides* (Norway maple), or

incursions by non-native shrubs such as *Rosa multiflora* (multiflora rose), *Berberis vulgaris* (common barberry), *Lonicera japonica* (Japanese honeysuckle), or *Lonicera morrowii* (Morrow's honeysuckle). Native herbs are few, especially compared to more natural deciduous forests in similar settings. A few native or exotic herbaceous species or vines may occupy the ground layer, such as *Alliaria petiolata* (garlic mustard), *Eurybia divaricata* (white wood aster), *Toxicodendron radicans* (eastern poison ivy), and *Vinca minor* (common periwinkle). This is a very species-poor vegetation type.

Environmental Description: Most documented stands are at low elevations, on flat or rolling topography both above and below the glacial boundary.

Vegetation Description: This association represents forests in the northeastern United States strongly dominated by the invasive tree *Acer platanoides* (Norway maple), often to the exclusion of virtually all other canopy species. *Acer platanoides* (Norway maple) is the overwhelmingly dominant tree, typically forming a closed or nearly closed canopy. In some stands native trees, including *Fraxinus americana* (white ash) and *Acer saccharum* (sugar maple) (the latter especially susceptible to exclusion by Norway maple), may be present in very limited amounts. Other stands may have non-native associates, including *Pinus nigra* (Austrian pine) (black pine), *Pinus sylvestris* (Scotch pine) (Scotch pine), or *Robinia pseudoacacia* (black locust) (black locust). The deep shade cast by *Acer platanoides* (Norway maple) limits understory growth, aside from regeneration of *Acer platanoides* (Norway maple), or incursions by non-native shrubs such as *Rosa multiflora* (multiflora rose), *Berberis vulgaris* (common barberry), *Lonicera japonica* (Japanese honeysuckle), or *Lonicera morrowii* (Morrow's honeysuckle). Native herbs are few, especially compared to more natural deciduous forests in similar settings. A few native or exotic herbaceous species or vines may occupy the ground layer, such as *Alliaria petiolata* (garlic mustard), *Eurybia divaricata* (white wood aster), *Toxicodendron radicans* (eastern poison ivy), and *Vinca minor* (common periwinkle). This is a very species-poor vegetation type.

Most Abundant Species

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer platanoides* (Norway maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard)

Characteristic Species: *Acer platanoides* (Norway maple)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association is found in the northeastern United States, perhaps extending into southern Ontario, Canada. Its westward extent has not been determined, but it may extend to Wisconsin.

States/Provinces: CT?, MA, MD?, NJ, NY, ON?, PA?, VA?

Federal Lands: NPS (Boston Harbor Islands, Minute Man)

Conservation Status
Rank: GNA (invasive) (6-Dec-2005)
Reasons: This is a non-native vegetation type dominated by an invasive tree species.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: This association is intended for those forests so invaded by *Acer platanoides* (Norway maple) that the pre-invasion forest type cannot be distinguished. Forests that have been invaded, but where sufficient native trees and other flora still exist to determine the pre-invasion forest type, are classified as degraded examples of those pre-invasion types.

Similar Associations: Information not available.
Related Concepts: Information not available.

Sources
Description Authors: S.C. Gawler
References: Anderson 1999, Eastern Ecology Working Group n.d., Elliman 2005, Soil Conservation Service 1987, Thompson and Jenkins 1992, Wyckoff and Webb 1996.



Figure F-5. Norway Maple Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.025). September 2006. NAD 1983 / UTM easting 344960, northing 4681292.

Common Name (Park-specific): Successional Maritime Forest

Synonyms

USNVC English Name: Black Cherry - Sassafras - Canada Serviceberry - Black Oak / Roundleaf Greenbrier Forest

USNVC Scientific Name: Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia Forest

USNVC Identifier: CEGL006145

Local Information

Environmental Description: This forest association is subject to varying degrees of wind and salt spray. Soils are coarse, well-drained till and sand deposits of drumlins.

Vegetation Description: Three examples of this association were observed in Boston Harbor Islands. One is a unique 1.5- hectare area of closed-canopy forest on the lower slopes of Webb State Park's Upper Neck Cove. *Celtis occidentalis* (common hackberry) and *Sassafras albidum* (sassafras) are the primary canopy trees in this forest. *Prunus serotina* (black cherry), *Quercus velutina* (black oak), and *Tilia cordata* (littleleaf linden) are associates in the canopy. A weedy and impenetrable shrub thicket dominated by *Berberis thunbergii* (Japanese barberry), *Lonicera japonica* (Japanese honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Rhamnus cathartica* (common buckthorn), *Rosa multiflora* (multiflora rose), and *Toxicodendron radicans* (eastern poison ivy) grows beneath the canopy. Saplings and seedlings of the canopy are present in the stand, but the density of shrubs limits the potential for the regeneration of these native trees. A similar association occurs on World's End and Thompson Island, but oaks are more prominent in the tree canopy. *Quercus velutina* (black oak) and *Quercus alba* (white oak) along with a mixture of *Prunus serotina* (black cherry), *Juniperus virginiana* (eastern redcedar), *Sassafras albidum* (sassafras) and *Amelanchier canadensis* (Canadian serviceberry) occur in the canopy and sub canopy. The shrub layer is dominated by *Viburnum dentatum* (southern arrowwood), *Rhamnus cathartica* (common buckthorn), and *Gaylussacia baccata* (black huckleberry). A dense vine layer dominated by *Smilax rotundifolia* (roundleaf greenbrier) and *Parthenocissus quinquefolia* (Virginia creeper) is also present. Scattered herbs and grasses include *Maianthemum canadense* (Canada mayflower), *Deschampsia flexuosa* (wavy hairgrass), *Solidago rugosa* (wrinklelef goldenrod) and *Carex pensylvanica* (Pennsylvania sedge).

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry)
		Quercus velutina (black oak)
		Sassafras albidum (sassafras)
Shrub/sapling (tall & short)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)
		Smilax rotundifolia (roundleaf greenbrier)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Sassafras albidum* (sassafras), *Celtis occidentalis* (common hackberry), *Smilax rotundifolia* (roundleaf greenbrier), *Amelanchier canadensis* (Canadian serviceberry)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	–	Maritime Shrubland Community	Swain and Kearsley 2001

Local Range: This association occurs on the southeastern side of World's End adjacent to Damde Meadows, on the southwestern side of Thompson Island, and on the lower slopes of Webb State Park's Upper Neck Cove.

Classification Comments: This association differs from Northeastern Modified Successional Forest by the dominance of native tree, shrub, and vine species, including *Sassafras albidum* (sassafras), *Amelanchier canadensis* (Canadian serviceberry), ericaceous shrubs, *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper).

Other Comments: Invasive shrubs may be a problem in this association.
Local Description Authors: E. Largay and T. Elliman
Plots: BOHA.022, BOHA.037.
AA Points: BOHA.AA134, BOHA.AA141, BOHA.AA149, BOHA.AA122, BOHA.AA139
Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)
Group	North Atlantic Maritime Scrub Forest (G495)
Alliance	*Prunus serotina - Amelanchier* spp. - *Juniperus virginiana* Maritime Scrub Forest Alliance (A0237)
Alliance (English name)	Black Cherry – Serviceberry species - Eastern Red-cedar Maritime Scrub Forest Alliance
Association	*Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia* Forest

USNVC Classification (continued)

Classification Level	Description
Association (English name)	Black Cherry - Sassafras - Canada Serviceberry - Black Oak / Roundleaf Greenbrier Forest
Ecological System(s)	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)

Global Description

Concept Summary: This maritime forest association of the North Atlantic Coast Ecoregion occurs on sheltered backdunes, bluffs, or more interior coastal areas not directly influenced by overwash but affected by salt spray and wind-pruning. Vegetation in these sheltered areas is sometimes referred to as "sunken forest." This name refers to the topographic position of these examples, which are found in large depressions, lower in elevation (by 1-3 m) than the interdunes. These examples are shielded from strong prevailing winds and salt spray, which permits lush growth of broadleaf shrub and vine species. Soils are coarse, well-drained sand subject to considerable shifting during coastal storms, or till and sand deposits of terminal moraines. Physiognomy is variable and ranges from closed-canopy forest to open woodland to dense tall shrubland, and may be more accurately called scrub. Trees found in this association are usually stunted and flat-topped; the canopy may be only 3-7 m tall. Dominant trees vary locally and include *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Amelanchier canadensis* (Canadian serviceberry), with admixtures of *Celtis occidentalis* (common hackberry), *Quercus velutina* (black oak), *Pinus rigida* (pitch pine), *Juniperus virginiana* (eastern redcedar), *Acer rubrum* (red maple), *Amelanchier stolonifera* (running serviceberry), and in southern occurrences *Quercus coccinea* (scarlet oak), *Quercus falcata* (southern red oak), *Liquidambar styraciflua* (sweetgum), and *Ilex opaca* (American holly). Additional shrub species may also contribute substantially to the canopy and include *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), *Viburnum recognitum* (southern arrowwood), *Viburnum dentatum* (southern arrowwood), and *Rosa virginiana* (Virginia rose). A true shrub layer is generally not present. Lianas are common and can be dense in the canopy or the ground layer; species include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Smilax glauca* (cat greenbrier). The understory is generally sparse with tree or vine seedlings plus herbaceous species, including *Aralia nudicaulis* (wild sarsaparilla), *Moehringia lateriflora* (bluntleaf sandwort), *Maianthemum stellatum* (starry false lily of the vally), and *Maianthemum canadense* (Canada mayflower). Several invasive species can be prevalent in this association, including *Lonicera morrowii* (Morrow's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Ligustrum vulgare* (European privet), *Berberis vulgaris* (common barberry), and *Celastrus orbiculatus* (oriental bittersweet).

Environmental Description: This association occurs most often on stabilized backdunes, generally leeward of secondary dunes or in protected hollows. It also occurs on bluffs or in more interior coastal areas. It is subject to varying degrees of wind and salt spray. Soils are coarse, well-drained sand subject to considerable shifting during coastal storms, or till and sand deposits of terminal moraines.

Vegetation Description: This association is generally a maritime forest or scrub forest, although physiognomy can vary considerably. Trees found in this association are usually stunted and flat-topped; the canopy may be only 3-7 m tall. Dominant trees vary locally but often include *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Amelanchier canadensis* (Canadian serviceberry), with admixtures of *Celtis occidentalis* (common hackberry), *Quercus velutina* (black oak), *Pinus rigida* (pitch pine), *Juniperus virginiana* (eastern redcedar), *Acer rubrum* (red maple), *Amelanchier stolonifera* (running serviceberry), and in southern occurrences *Quercus coccinea* (scarlet oak), *Quercus falcata* (southern red oak), *Liquidambar styraciflua* (sweetgum), and/or *Ilex opaca* (American holly). Additional shrub species may also contribute substantially to the canopy and include *Vaccinium corymbosum* (highbush blueberry), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), *Prunus maritima* (beach plum), *Viburnum recognitum* (southern arrowwood), *Viburnum dentatum* (southern arrowwood), and *Rosa virginiana* (Virginia rose). A true shrub layer is generally not present. Lianas are common and can be dense in the canopy or in the ground layer; species include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Smilax glauca* (cat greenbrier). The understory is generally sparse with tree or vine seedlings plus herbaceous species, including *Aralia nudicaulis* (wild sarsaparilla), *Moehringia lateriflora* (bluntleaf sandwort), *Maianthemum stellatum* (starry false lily of the vally) and *Maianthemum canadense* (Canada mayflower). Several invasive species can be prevalent in this association, including *Lonicera morrowii* (Morrow's honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Ligustrum vulgare* (European privet), *Berberis vulgaris* (common barberry), and *Celastrus orbiculatus* (oriental bittersweet).

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Amelanchier canadensis* (Canadian serviceberry)
		Prunus serotina (black cherry)
		Quercus velutina (black oak)
		Sassafras albidum (sassafras)
Shrub/sapling (tall & short)	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper),
		Smilax rotundifolia (roundleaf greenbrier)
		Toxicodendron radicans (eastern poison ivy)

Characteristic Species: *Amelanchier canadensis* (Canadian serviceberry), *Ilex opaca* (American holly), *Parthenocissus quinquefolia* (Virginia creeper), *Prunus serotina* (black cherry), *Quercus velutina* (black oak), *Sassafras albidum* (sassafras), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution

Range: The range of this association (estimated at 400 square km) is from southern New Hampshire to Delaware but is restricted to the coast.

States/Provinces: CT, DE, MA, NH, NJ:S1S2, NY, RI
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Fire Island, Gateway); USFWS (Parker River, Prime Hook)

Conservation Status

Rank: G2G3 (31-Jan-2007)
Reasons: This maritime forest association is restricted in range to the coastal areas of seven northeastern states. Average occurrence size is estimated to be 20-100 acres, but many are substantially below this in size. The potential habitat of this association is naturally restricted to areas directly affected by maritime processes, e.g., salt spray and winds. Northeastern coastal areas in general are under significant threat from housing development.

Classification Information

Status: Standard
Confidence: 2 - Moderate
Comments: *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319) is the southern analog of this association and is differentiated by having species of more southern affinity such as *Morella cerifera* (wax myrtle) and *Pinus taeda* (loblolly pine). This association is floristically similar to *Amelanchier canadensis - Viburnum* spp. - *Morella pensylvanica* (northern bayberry) Scrub Forest (CEGL006379), which is a successional type.

Similar Associations:

- *Amelanchier canadensis - Viburnum* spp. - *Morella pensylvanica* Scrub Forest (CEGL006379)
- *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319)

Related Concepts:

- Dune woodland/dune shrubland (Breden 1989)
- High dune thicket (Martin 1959)
- High mesic thicket (Martin 1959)
- High xeric thicket (Martin 1959)
- Maritime Forest, Dune Subtype, Deciduous Forest (Rawinski 1984)
- Oak-Mixed Shrub-Herb Forest (Greller 1977)
- SNE Maritime Forest on Dunes/Maritime Juniper Forest (Rawinski 1984)
- SNE Maritime Forest on Uplands/Maritime Oak Forest (Rawinski 1984)
- SNE coastal rocky headland community (Rawinski 1984)
- Scrub Forest (McDonnell 1979)
- Southern New England forest on dunes (Rawinski 1984)
- Tall thicket (Dunlop and Crow 1985)

Sources

Description Authors: S.L. Neid and L.A. Sneddon, mod. E. Largay

References: Art 1987, Bellis 1992, Breden 1989, Breden et al. 2001, Burk 1968, Dowhan and Rozsa 1989, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Greller 1977, Martin 1959, McDonnell 1979, Metzler and Barrett 2001, USDA-NRCS 2001, Rawinski 1984, Reschke 1990, Sperduto 1997b, Stalter 1979, Svenson 1970, Swain and Kearsley 2001.



Figure F-6. Successional Maritime Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.022-two views of the same plot). September 2006. NAD 1983 / UTM easting 345737, northing 4681055.

Common Name (Park-specific): Maritime Red-cedar Woodland

Synonyms

USNVC English Name: Eastern Red-cedar / Northern Bayberry Woodland
USNVC Scientific Name: Juniperus virginiana var. virginiana / Morella pensylvanica Woodland
USNVC Identifier: CEGL006212

Local Information

Environmental Description: This maritime woodland association occurs on steep rocky headlands and puddingstone outcrops along the shorelines of World's End, Langlee, and Ragged islands. It occurs less commonly on the upper edges of salt marshes. It is influenced by onshore winds and salt spray. The soil consists of very shallow sand overlying exposed bedrock.

Vegetation Description: *Juniperus virginiana* (eastern redcedar) dominates the tree and subcanopy. Less common canopy and subcanopy associates include *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), *Quercus velutina* (black oak), and/or *Quercus alba* (white oak). Shrubs include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium corymbosum* (highbush blueberry), *Amelanchier canadensis* (Canadian serviceberry), *Morella pensylvanica* (northern bayberry), *Amelanchier stolonifera* (running serviceberry) and *Viburnum dentatum* (southern arrowwood). The herbaceous flora found in these woodlands varies but may include *Aquilegia canadensis* (red columbine), *Bulbostylis capillaris* (densetuft hairsedge), *Hedeoma pulegioides* (American false pennyroyal), *Hypericum gentianoides* (orangegrass), *Solidago bicolor* (white goldenrod), *Solidago sempervirens* (seaside goldenrod), and *Trichostema dichotomum* (forked bluecurls). *Danthonia spicata* (poverty oatgrass), *Schizachyrium scoparium* (little bluestem), and *Deschampsia flexuosa* (wavy hairgrass) also occur on outcrops in this association. Degraded examples may have low cover of *Lonicera morrowii* (Morrow's honeysuckle) and *Rhamnus cathartica* (common buckthorn).

Most Abundant Species

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum* (highbush blueberry)
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium angustifolium* (lowbush blueberry)
Herb (field)	Graminoid	*Danthonia spicata* (poverty oatgrass)
		Deschampsia flexuosa (wavy hairgrass)

Characteristic Species: *Amelanchier stolonifera* (running serviceberry), *Juniperus virginiana* (eastern redcedar), *Morella pensylvanica* (northern bayberry)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S1	–	1	Maritime Juniper Woodland/Shrubland	Swain and Kearsley 2001

Local Range: Langlee and Ragged islands and the Rocky Neck section of World's End have small patches of semi-open red-cedar stands growing on outcrops above the shoreline.
Classification Comments: This association is distinguished from Old-field Eastern Red-cedar Forest by the environmental setting on rocky outcrops along the shoreline and absence or low abundance of early successional, weedy and non-native shrubs and herbs in the understory. It typically has a more open tree canopy, dwarf ericaceous shrub layer, and native herbs.

Other Comments: This association type is ranked as S1 (extremely rare and vulnerable to extirpation) in Massachusetts. These associations have a high percentage of native species.
Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.009, BOHA.012.
AA Points: BOHA.AA131, BOHA.AA132, BOHA.AA133, BOHA.AA180, BOHA.AA181
Boston Harbor Islands National Recreation Area Inventory Notes: This association was mapped by identifying the signature of *Juniperus virginiana* (eastern redcedar) crowns occurring on rocky outcrops along the shorelines of Boston Harbor Islands.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)
Group	North Atlantic Maritime Scrub Forest (G495)
Alliance	*Prunus serotina - Amelanchier* spp. - *Juniperus virginiana* Maritime Scrub Forest Alliance (A0237)
Alliance (English name)	Black Cherry – Serviceberry species - Eastern Red-cedar Maritime Scrub Forest Alliance
Association	*Juniperus virginiana* var. *virginiana* / *Morella pensylvanica* Woodland
Association (English name)	Eastern Red-cedar / Northern Bayberry Woodland
Ecological System(s)	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)

Global Description

Concept Summary: This maritime woodland association dominated by *Juniperus virginiana* (eastern redcedar) occurs on sand dunes, upper edges of salt marshes, and less commonly on rocky headlands of the northern and mid-Atlantic coast. The physiognomy of this association is variable, ranging from dense tall-shrub thickets to open woodlands; trees are generally shorter than 4 m. Canopy trees are stunted and salt-pruned. *Juniperus virginiana* (eastern redcedar) may form pure

stands, but more often grows in association with *Pinus rigida* (pitch pine), *Quercus stellata* (post oak), *Prunus serotina* (black cherry), *Amelanchier canadensis* (Canadian serviceberry), *Ilex opaca* (American holly), *Celtis occidentalis* (common hackberry), or *Quercus velutina* (black oak), which tend to have low percent cover. In the southern portion of the range *Pinus taeda* (loblolly pine), *Quercus falcata* (southern red oak), *Sassafras albidum* (sassafras), *Diospyros virginiana* (common persimmon), and *Quercus phellos* (willow oak) can be infrequent canopy associates. A shrub layer may be well-developed where the canopy is more open and include *Morella pensylvanica* (northern bayberry), *Morella cerifera* (wax myrtle) (at the southern end of the range), *Juniperus communis* (common juniper), *Baccharis halimifolia* (groundsel-tree), *Iva frutescens* (Jesuit's bark), *Prunus maritima* (beach plum), or *Vaccinium corymbosum* (highbush blueberry). Vines can be dense in the shrub layer and extend into the canopy; species include *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper). Herbs are usually patchily distributed in openings and include many species from the surrounding dune associations among others. They include *Opuntia humifusa* (devil's-tongue), *Dichanthelium ovale* (eggleaf rosette grass), *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (wavy hairgrass), *Cyperus grayi* (Gray's flatsedge), *Polygonella articulata* (coastal jointweed), *Hieracium gronovii* (queendevil), *Panicum amarum var. amarulum* (bitter panicgrass), *Solidago sempervirens* (seaside goldenrod), *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), and *Lechea intermedia* (largepod pinweed).

Environmental Description: This maritime woodland association occurs on sand dunes, the upper edges of salt marshes, and less commonly on rocky headlands. It is influenced by onshore winds and salt spray, plus infrequent sand deposition and tidal overwash from severe storms.

Vegetation Description: The physiognomy of this association is variable, ranging from dense tall-shrub thickets to open woodlands; trees are generally shorter than 4 m. Canopy trees are stunted and salt-pruned. *Juniperus virginiana* (eastern redcedar) may form pure stands, but more often grows in association with *Pinus rigida* (pitch pine), *Quercus stellata* (post oak), *Prunus serotina* (black cherry), *Amelanchier canadensis* (Canadian serviceberry), *Ilex opaca* (American holly), *Celtis occidentalis* (common hackberry), or *Quercus velutina* (black oak), which tend to have low percent cover. In the southern portion of the range *Pinus taeda* (loblolly pine), *Quercus falcata* (southern red oak), *Sassafras albidum* (sassafras), *Diospyros virginiana* (common persimmon), and *Quercus phellos* (willow oak) can be infrequent canopy associates. A shrub layer may be well-developed where the canopy is more open and include *Morella pensylvanica* (northern bayberry), *Morella cerifera* (wax myrtle) (at the southern end of the range), *Juniperus communis* (common juniper), *Baccharis halimifolia* (groundsel-tree), *Iva frutescens* (Jesuit's bark), *Prunus maritima* (beach plum), or *Vaccinium corymbosum* (highbush blueberry). Vines can be dense in the shrub layer and extend into the canopy; species include *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper). Herbs are usually patchily distributed in openings and include many species from the surrounding dune associations among others. They include *Opuntia humifusa* (devil's-tongue), *Dichanthelium ovale* (eggleaf rosette grass), *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (wavy hairgrass), *Cyperus grayi* (Gray's flatsedge), *Polygonella articulata*

(coastal jointweed), *Hieracium gronovii* (queendevil), *Panicum amarum var. amarulum* (bitter panicgrass), *Solidago sempervirens* (seaside goldenrod), *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), and *Lechea intermedia* (largepod pinweed).

Most Abundant Species

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Juniperus virginiana* (eastern redcedar)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Morella pensylvanica* (northern bayberry)
Short shrub/sapling	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)

Characteristic Species: *Juniperus virginiana* (eastern redcedar), *Toxicodendron radicans* (eastern poison ivy)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs along the northern and mid-Atlantic coast from Delaware to Massachusetts.

States/Provinces: CT, DE:S1, MA:S1, MD, NJ:S1, NY:S1, VA
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Gateway); USFWS (Prime Hook)

Conservation Status
Rank: G2 (18-Nov-1997)
Reasons: This maritime woodland association is naturally restricted to major coastal dune systems. An estimated maximum of 30 occurrences exist, ranging in size from less than an acre up to a maximum of 100, with an average size of less than 10 acres. The habitat is threatened by many of the same threats common to coastal dune systems: dune stabilization, commercial and residential development. This association is further threatened even on "protected" lands in some cases by a lack of recognition that this vegetation is a unique association.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.

Similar Associations:

- *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399)

Related Concepts:

- Coastal dune woodland (Breden 1989)
- High red cedar thicket, Red cedar woodland, Red cedar-pine woodland (Martin 1959)
- Maritime Forest on Dunes: Maritime Red Cedar Forest/Woodland Variant (Lundgren 2000)

- Red Cedar Maritime Forest (Greller 1977)
- SNE Maritime Forest on Dunes/Maritime Juniper Forest (Rawinski 1984)

Sources

Description Authors: S.L. Neid and L.A. Sneddon, mod. E. Largay

References: Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming et al. 2004, Greller 1977, Harrison 2004, Lundgren 2000, Martin 1959, Rawinski 1984, Reschke 1990, Swain and Kearsley 2001.



Figure F-7. Maritime Red-cedar Woodland on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.012-two views of same plot). September 2006. NAD 1983 / UTM easting 345696, northing 4681015.



Figure F-8. Maritime Red-cedar Woodland on World's End in Boston Harbor Islands National Recreation Area (same polygon as AA point BOHA.AA133). September 2008. NAD 1983 / UTM easting 345861, northing 4681050.

Common Name (Park-specific): Staghorn Sumac Shrubland[1]

Synonyms

USNVC English Name: Black Cherry - Staghorn Sumac Scrub Forest
USNVC Scientific Name: *Prunus serotina - Rhus typhina* Scrub Forest
USNVC Identifier: CEGL006399

Local Information

Environmental Description: This variant of the Black Cherry - Staghorn Sumac Scrub Forest is common throughout the outer islands and on the larger inner islands. It consists of dry, closed to open shrublands occurring on shallow, well-drained, acidic sandy and rocky soils. Vegetation is continuously exposed to onshore winds and salt spray. Most examples occur on former old fields that are no longer intensively mowed, plowed or managed.

Vegetation Description: This shrubland is completely dominated by *Rhus typhina* (staghorn sumac), which forms a canopy 3-4 m in height. These stands have few other shrub species and a low diversity of herbaceous plants. Calf and Sheep islands have excellent examples of these *Rhus typhina* (staghorn sumac) "forests." This variant can also have tall sumacs over an understory of *Rubus idaeus* (American red raspberry), *Phytolacca americana* (American pokeweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Alopecurus pratensis* (meadow foxtail), and/or *Elymus repens* (quackgrass).

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
	Graminoid	*Elymus repens* (quackgrass) or *Alopecurus pratensis* (meadow foxtail)

Characteristic Species: *Rhus typhina* (staghorn sumac)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	I	–	Maritime Shrubland Community	Swain and Kearsley 2001

Local Range: This variant occurs on Gallops, Bumpkin, Grape, Calf, Georges, Great Brewster, Lovells, Outer Brewster, Rainsford, Peddock's, Long, and Thompson islands.

[1] There are three variants of the *Prunus serotina – Rhus typhina* Scrub Forest described from Boston Harbor Islands National Recreational Area (Staghorn Sumac Shrubland Rocky Headland, Staghorn Sumac Shrubland, Stunted Staghorn Sumac Shrubland); they are all considered to be the same association; the global description is repeated for variants Staghorn Sumac Shrubland and Stunted Staghorn Sumac Shrubland.

Classification Comments: This variant differs from the Northeastern Successional Shrubland and the other variants of CEGL006399 (Stunted Staghorn Sumac Shrubland and Staghorn Sumac Rocky Headland) at BOHA in that there is a monoculture of *Rhus typhina* (staghorn sumac) and no other dominant shrub species. It was sampled in accuracy assessment.

Other Comments: None.
Local Description Authors: T. Elliman and E. Largay
Plots: None.
AA Points: BOHA.AA024, BOHA.AA030, BOHA.AA032, BOHA.AA050, BOHA.AA052, BOHA.AA054, BOHA.AA056, BOHA.AA067, BOHA.AA068, BOHA.AA071, BOHA.AA106

Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)
Group	North Atlantic Maritime Scrub Forest (G495)
Alliance	*Prunus serotina - Amelanchier* spp. - *Juniperus virginiana* Maritime Scrub Forest Alliance (A0237)
Alliance (English name)	Black Cherry – Serviceberry species - Eastern Red-cedar Maritime Scrub Forest Alliance
Association	*Prunus serotina - Rhus typhina* Scrub Forest
Association (English name)	Black Cherry - Staghorn Sumac Scrub Forest
Ecological System(s)	Acadian-North Atlantic Rocky Coast (CES201.573)

Global Description

Concept Summary: This association represents maritime shrublands or scrub forests of northern New England rocky shorelines, headlands, and bluffs. Vegetation is continuously exposed to onshore winds and salt spray and grows in thin, dry, acidic soils. The constant disturbance and environmental conditions maintain an early-successional shrubland or scrub forest that tends to be patchy and variable, and often sparse. Characteristic shrubs include *Prunus serotina* (black cherry), *Morella pensylvanica* (northern bayberry), *Rosa virginiana* (Virginia rose), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), *Amelanchier canadensis* (Canadian serviceberry), *Rhus typhina* (staghorn sumac), and stunted *Juniperus virginiana* (eastern redcedar). *Toxicodendron radicans* (eastern poison ivy) is a common vine. Herbs are also patchy and may include *Solidago sempervirens* (seaside goldenrod), *Plantago maritima* (goose tongue), *Cakile edentula* ssp. *edulenta* (American

searocket), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Euthamia graminifolia* (flat-top goldentop), *Baptisia tinctoria* (horseflyweed), *Sericocarpus asteroides* (toothed whitetop aster), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum novi-belgii* (New York aster), as well as *Tanacetum vulgare* (common tansy), *Achillea millefolium* (common yarrow), *Juncus effusus* (common rush), and *Lonicera morrowii* (Morrow's honeysuckle). In more protected areas and where there is more moisture, vegetation can be more diverse and abundant.

Environmental Description: This association occurs on rocky shorelines and headlands exposed to onshore winds and salt spray. Vegetation grows in crevices or on thin, dry, acidic soils of ledges.

Vegetation Description: This is an early-successional shrubland or scrub forest that tends to be patchy and variable, and often sparse. Characteristic shrubs include *Prunus serotina* (black cherry), *Morella pensylvanica* (northern bayberry), *Juniperus virginiana* (eastern redcedar), *Rosa virginiana* (Virginia rose), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), *Amelanchier canadensis* (Canadian serviceberry), and *Rhus typhina* (staghorn sumac). *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper) can be common vines. Herbs are also patchy and may include *Solidago sempervirens* (seaside goldenrod), *Plantago maritima* (goose tongue), *Cakile edentula* ssp. *edulenta* (American searocket), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum novi-belgii* (New York aster), *Juncus* sp. (rush), as well as *Tanacetum vulgare* (common tansy), *Achillea millefolium* (common yarrow), *Juncus effusus* (common rush), and *Lonicera morrowii* (Morrow's honeysuckle). In more protected areas and where there is more moisture, vegetation can be more diverse and abundant. For example, in wetter crevices, *Aronia* spp. (chokeberries) and *Clethra alnifolia* (coastal sweetpepperbush) can occur.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Prunus serotina* (black cherry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs from Maine to Rhode Island.
States/Provinces: CT?, MA, ME, NH, RI
Federal Lands: NPS (Boston Harbor Islands)

Conservation Status
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: The species composition of this association is comparable to maritime shrublands on dunes, but is distinguished by having sparse vegetation on exposed rocky headlands and cliffs that typically lack coastal dune species. The relationship between this association and *Juniperus virginiana* (eastern redcedar) var. *virginiana / Morella pensylvanica* Woodland (CEGL006212) needs to be determined.

Similar Associations:

- *Juniperus virginiana* var. *virginiana / Morella pensylvanica* Woodland (CEGL006212)
- *Morella pensylvanica - Prunus maritima* Shrubland (CEGL006295)

Related Concepts:

- SNE coastal rocky headland community (Rawinski 1984)
- Southern New England coastal rocky headland community (Rawinski 1984)

Sources
Description Authors: S.L. Neid
References: Eastern Ecology Working Group n.d., Enser 1999, Gawler 2002, Rawinski 1984, Sperduto 1997b, Sperduto 2000a, Swain and Kearsley 2001.



Figure F-9. Staghorn Sumac Shrubland on Long Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA024). September 2008. NAD 1983 / UTM easting 338500 northing 4687800.



Figure F-10. Staghorn Sumac Shrubland on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA071). September 2008. NAD 1983 / UTM easting 343769, northing 4689250.

Common Name (Park-specific): Staghorn Sumac Shrubland Rocky Headland

Synonyms

USNVC English Name: Black Cherry - Staghorn Sumac Scrub Forest
USNVC Scientific Name: *Prunus serotina - Rhus typhina* Scrub Forest
USNVC Identifier: CEGL006399

Local Information

Environmental Description: This variant of the Black Cherry – Staghorn Sumac Scrub Forest occurs on the outer harbor islands and small exposed rocky inner harbor islands. It includes upland, closed-to-open shrublands and scrub forests occurring on shallow, well-drained, acidic rocky and/or sandy soils. Vegetation is continuously exposed to onshore winds and salt spray.

Vegetation Description: This variant is common on many of the islands. In addition to *Rhus typhina* (staghorn sumac) and *Prunus serotina* (black cherry), a combination of other native species is present, including *Morella pensylvanica* (northern bayberry), *Juniperus virginiana* (eastern redcedar), *Rubus allegheniensis* (Allegheny blackberry), *Rubus flagellaris* (northern dewberry), *Rubus pensilvanicus* (Pennsylvania blackberry), *Rubus idaeus* (American red raspberry), *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper) and *Smilax rotundifolia* (roundleaf greenbrier). Nonnative invasive plants including *Celastrus orbiculatus* (oriental bittersweet), *Lonicera morrowii* (Morrow's honeysuckle), *Forsythia viridissima* (greenstem forsythia), *Euonymus alatus* (winged burning bush), *Frangula alnus* (glossy buckthorn), *Rosa multiflora* (multiflora rose), and/or *Malus pumila* (paradise apple) may be present, but less than 15% in overall cover. The herbaceous layer is variable, depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites such as *Alopecurus pratensis* (meadow foxtail), *Ammophila breviligulata* (American beachgrass), *Agrostis* sp. (bentgrass), *Artemisia vulgaris* (common wormwood), *Euthamia caroliniana* (slender goldentop), *Festuca rubra* (red fescue), *Festuca ovina* (sheep fescue), *Hieracium canadense* (Canadian hawkweed), *Solidago canadensis* (Canada goldenrod), *Solidago sempervirens* (seaside goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), and scattered patches of *Cladonia* sp. (cup lichen).

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
		Rubus spp. (blackberry)
		Morella pensylvanica (northern bayberry)
Shrub/sapling (tall & short)	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
	Graminoid	*Festuca rubra* (red fescue)
		Agrostis sp. (bentgrass),
		Alopecurus pratensis (meadow foxtail)

Characteristic Species: *Rhus typhina* (staghorn sumac), *Rubus* spp. (blackberry), *Prunus serotina* (black cherry), *Alopecurus pratensis* (meadow foxtail)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S2*	F	–	Maritime Rock Cliff Community	Swain and Kearsley 2001
MA	S3*	I	–	Maritime Shrubland Community	Swain and Kearsley 2001

Local Range: This association occurs on Raccoon, Rainsford, Calf, Outer Brewster, and Middile Brewster islands.

Classification Comments: The physiognomy of this variant is complex and variable, ranging from shrub thicket to herbaceous shrubland with scattered *Prunus serotina* (black cherry) trees. It differs from the Northeastern Successional Shrubland by the dominance of native *Rhus typhina* (staghorn sumac) and less than 15% cover of non native shrubs and vines. It differs from Staghorn Sumac Shrubland by having a diversity of native shrub species and is not a pure monoculture thicket of *Rhus typhina* (staghorn sumac). It differs from Open Staghorn Sumac Shrubland Sandy Neck as it does not have *Rosa rugosa* (rugosa rose) and the shrubs are not stunted.

Other Comments: The structure of this variant ranges from closed-canopy shrubland to open patchy shrub-herbaceous vegetation. Despite differences in structure, the species composition is the same among the various plots with some varation in herbaceous species present.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.015
AA Points: BOHA.AA073, BOHA.AA118
Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)
Group	North Atlantic Maritime Scrub Forest (G495)
Alliance	*Prunus serotina - Amelanchier* spp. - *Juniperus virginiana* Maritime Scrub Forest Alliance (A0237)
Alliance (English name)	Black Cherry – Serviceberry species - Eastern Red-cedar Maritime Scrub Forest Alliance

USNVC Classification (continued)

Classification Level	Description
Association	*Prunus serotina - Rhus typhina* Scrub Forest
Association (English name)	Black Cherry - Staghorn Sumac Scrub Forest
Ecological System(s)	Acadian-North Atlantic Rocky Coast (CES201.573)

Global Description

Concept Summary: This association represents maritime shrublands or scrub forests of northern New England rocky shorelines, headlands, and bluffs. Vegetation is continuously exposed to onshore winds and salt spray and grows in thin, dry, acidic soils. The constant disturbance and environmental conditions maintain an early-successional shrubland or scrub forest that tends to be patchy and variable, and often sparse. Characteristic shrubs include *Prunus serotina* (black cherry), *Morella pensylvanica* (northern bayberry), *Rosa virginiana* (Virginia rose), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), *Amelanchier canadensis* (Canadian serviceberry), *Rhus typhina* (staghorn sumac), and stunted *Juniperus virginiana* (eastern redcedar). *Toxicodendron radicans* (eastern poison ivy) is a common vine. Herbs are also patchy and may include *Solidago sempervirens* (seaside goldenrod), *Plantago maritima* (goose tongue), *Cakile edentula* ssp. *edulenta* (American searocket), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Euthamia graminifolia* (flat-top goldentop), *Baptisia tinctoria* (horseflyweed), *Sericocarpus asteroides* (toothed whitetop aster), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum novi-belgii* (New York aster), as well as *Tanacetum vulgare* (common tansy), *Achillea millefolium* (common yarrow), *Juncus effusus* (common rush), and *Lonicera morrowii* (Morrow's honeysuckle). In more protected areas and where there is more moisture, vegetation can be more diverse and abundant.

Environmental Description: This association occurs on rocky shorelines and headlands exposed to onshore winds and salt spray. Vegetation grows in crevices or on thin, dry, acidic soils of ledges.

Vegetation Description: This is an early-successional shrubland or scrub forest that tends to be patchy and variable, and often sparse. Characteristic shrubs include *Prunus serotina* (black cherry), *Morella pensylvanica* (northern bayberry), *Juniperus virginiana* (eastern redcedar), *Rosa virginiana* (Virginia rose), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), *Amelanchier canadensis* (Canadian serviceberry), and *Rhus typhina* (staghorn sumac). *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper) can be common vines. Herbs are also patchy and may include *Solidago sempervirens* (seaside goldenrod), *Plantago maritima* (goose tongue), *Cakile edentula* ssp. *edulenta* (American searocket), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum novi-belgii* (New York aster), *Juncus* sp. (rush), as well as *Tanacetum vulgare* (common tansy), *Achillea millefolium* (common yarrow), *Juncus effusus* (common rush), and *Lonicera morrowii* (Morrow's honeysuckle). In more protected areas and where there is more moisture, vegetation can be more diverse and abundant. For example,

in wetter crevices, *Aronia* spp. (chokeberries) and *Clethra alnifolia* (coastal sweetpepperbush) can occur.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Prunus serotina* (black cherry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs from Maine to Rhode Island.
States/Provinces: CT?, MA, ME, NH, RI
Federal Lands: NPS (Boston Harbor Islands)

Conservation Status
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: The species composition of this association is comparable to maritime shrublands on dunes, but is distinguished by having sparse vegetation on exposed rocky headlands and cliffs that typically lack coastal dune species. The relationship between this association and *Juniperus virginiana* (eastern redcedar) var. *virginiana / Morella pensylvanica* Woodland (CEGL006212) needs to be determined.

Similar Associations:
- *Juniperus virginiana* var. *virginiana / Morella pensylvanica* Woodland (CEGL006212)
- *Morella pensylvanica - Prunus maritima* Shrubland (CEGL006295)

Related Concepts:
- SNE coastal rocky headland community (Rawinski 1984)
- Southern New England coastal rocky headland community (Rawinski 1984)

Sources
Description Authors: S.L. Neid
References: Eastern Ecology Working Group n.d., Enser 1999, Gawler 2002, Rawinski 1984, Sperduto 1997b, Sperduto 2000a, Swain and Kearsley 2001.



Figure F-11. Staghorn Sumac Shrubland Rocky Headland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.015). September 2006. NAD 1983 / UTM easting 340574, northing 4684621.



Figure F-12. Staghorn Sumac Shrubland Rocky Headland on Rainsford Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA118). September 2008. NAD 1983 / UTM easting 339073, northing 4686210.

Common Name (Park-specific): Stunted Staghorn Sumac Shrubland

Synonyms

USNVC English Name: Black Cherry - Staghorn Sumac Scrub Forest
USNVC Scientific Name: *Prunus serotina - Rhus typhina* Scrub Forest
USNVC Identifier: CEGL006399

Local Information

Environmental Description: This open, stunted, variant of the Black Cherry - Staghorn Sumac Scrub Forest grows in sandy flats between drumlins on Boston Harbor Islands. It is exposed to ocean spray and may experience occasional overwash during large coastal storms. The soil consists of well-drained sand and gravel. Other examples occur on gravelly old fields that are no longer intensively mowed, plowed or managed.

Vegetation Description: Scattered stunted shrubs (0.5 m) including *Rhus typhina* (staghorn sumac) and *Rosa rugosa* (rugosa rose) dominate this variant. *Morella pensylvanica* (Northern bayberry) is typically present. Herbaceous plants associated with these stunted shrubs include *Artemisia vulgaris* (common wormwood), *Rumex acetosella* (common sheep sorrel), *Carex silicea* (beach sedge), *Bromus tectorum* (cheatgrass), *Festuca rubra* (red fescue), *Mirabilis nyctaginea* (heartleaf four o'clock), *Poa compressa* (Canada bluegrass), *Silene antirrhina* (sleepy silene), *Solidago sempervirens* (seaside goldenrod), *Tanacetum vulgare* (common tansy) , *Elymus repens* (quackgrass), *Oenothera biennis* (common evening-primrose), *Euthamia graminifolia* (flat-top goldentop) and *Verbascum thapsus* (common mullein). *Cladonia* sp. (cup lichen) are also common in the open examples of this variant.

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
		Rosa rugosa (rugosa rose)
Herb (field)	Graminoid	*Elymus repens* (quackgrass)
	Forb	*Solidago sempervirens* (seaside goldenrod)
		Artemisia vulgaris (common wormwood)

Characteristic Species: *Rhus typhina* (staghorn sumac), *Rosa rugosa* (rugosa rose)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	I	–	Maritime Shrubland Community	Swain and Kearsley 2001

Local Range: Peddock's Island has the largest examples of this variant in the sandy necks between drumlins. Lovells Island, Webb State Park, the west side of Rainsford Island, and the eastern foot of West Head on Long Island have smaller examples of this variant.

Classification Comments: This variant grouped with herbaceous associations in the ordination. Given the characteristic coverage of *Rhus typhina* (staghorn sumac) and *Rosa rugosa* (rugosa rose), it was classified as a shrubland. This variant differs from the Northeastern Successional Shrubland and the other variants of CEGL006399 (Staghorn Sumac Shrubland and Staghorn Sumac Rocky Headhland Shrubland) at BOHA in that *Rosa rugosa* (rugosa rose) is charteristic; the shrubs are stunted by salt spray; and the shrubs are scattered with high herbaceous cover (up to 60%).

Local Description Authors: T. Elliman and E. Largay
Other Comments: *Rosa rugosa* (rugosa rose) is non-native and has naturalized throughout the Boston Harbor Islands.

Plots: BOHA.020, BOHA.043
AA Points: BOHA.AA048, BOHA.AA049, BOHA.AA066, BOHA.AA069, BOHA.AA070, BOHA.AA125, BOHA.AA130

Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)
Group	North Atlantic Maritime Scrub Forest (G495)
Alliance	*Prunus serotina - Amelanchier* spp. - *Juniperus virginiana* Maritime Scrub Forest Alliance (A0237)
Alliance (English name)	Black Cherry – Serviceberry species - Eastern Red-cedar Maritime Scrub Forest Alliance
Association	*Prunus serotina - Rhus typhina* Scrub Forest
Association (English name)	Black Cherry - Staghorn Sumac Scrub Forest
Ecological System(s)	Acadian-North Atlantic Rocky Coast (CES201.573)

Global Description

Concept Summary: This association represents maritime shrublands or scrub forests of northern New England rocky shorelines, headlands, and bluffs. Vegetation is continuously exposed to onshore winds and salt spray and grows in thin, dry, acidic soils. The constant disturbance and environmental conditions maintain an early-successional shrubland or scrub forest that tends to be patchy and variable, and often sparse. Characteristic shrubs include *Prunus serotina* (black cherry), *Morella pensylvanica* (northern bayberry), *Rosa virginiana* (Virginia rose), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), *Amelanchier canadensis* (Canadian serviceberry), *Rhus typhina*

(staghorn sumac), and stunted *Juniperus virginiana* (eastern redcedar). *Toxicodendron radicans* (eastern poison ivy) is a common vine. Herbs are also patchy and may include *Solidago sempervirens* (seaside goldenrod), *Plantago maritima* (goose tongue), *Cakile edentula* ssp. *edulenta* (American searocket), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Euthamia graminifolia* (flat-top goldentop), *Baptisia tinctoria* (horseflyweed), *Sericocarpus asteroides* (toothed whitetop aster), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum novi-belgii* (New York aster), as well as *Tanacetum vulgare* (common tansy), *Achillea millefolium* (common yarrow), *Juncus effusus* (common rush), and *Lonicera morrowii* (Morrow's honeysuckle). In more protected areas and where there is more moisture, vegetation can be more diverse and abundant.

Environmental Description: This association occurs on rocky shorelines and headlands exposed to onshore winds and salt spray. Vegetation grows in crevices or on thin, dry, acidic soils of ledges.

Vegetation Description: This is an early-successional shrubland or scrub forest that tends to be patchy and variable, and often sparse. Characteristic shrubs include *Prunus serotina* (black cherry), *Morella pensylvanica* (northern bayberry), *Juniperus virginiana* (eastern redcedar), *Rosa virginiana* (Virginia rose), *Rosa rugosa* (rugosa rose), *Prunus maritima* (beach plum), *Amelanchier canadensis* (Canadian serviceberry), and *Rhus typhina* (staghorn sumac). *Toxicodendron radicans* (eastern poison ivy), *Smilax rotundifolia* (roundleaf greenbrier), and *Parthenocissus quinquefolia* (Virginia creeper) can be common vines. Herbs are also patchy and may include *Solidago sempervirens* (seaside goldenrod), *Plantago maritima* (goose tongue), *Cakile edentula* ssp. *edulenta* (American searocket), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Solidago rugosa* (wrinkleleaf goldenrod), *Symphyotrichum novi-belgii* (New York aster), *Juncus* sp. (rush), as well as *Tanacetum vulgare* (common tansy), *Achillea millefolium* (common yarrow), *Juncus effusus* (common rush), and *Lonicera morrowii* (Morrow's honeysuckle). In more protected areas and where there is more moisture, vegetation can be more diverse and abundant. For example, in wetter crevices, *Aronia* spp. (chokeberries) and *Clethra alnifolia* (coastal sweetpepperbush) can occur.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Prunus serotina* (black cherry)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)

Characteristic Species: *Morella pensylvanica* (northern bayberry), *Prunus serotina* (black cherry)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs from Maine to Rhode Island.

States/Provinces: CT?, MA, ME, NH, RI
Federal Lands: NPS (Boston Harbor Islands)

Conservation Status
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: The species composition of this association is comparable to maritime shrublands on dunes, but is distinguished by having sparse vegetation on exposed rocky headlands and cliffs that typically lack coastal dune species. The relationship between this association and *Juniperus virginiana* (eastern redcedar) var. *virginiana / Morella pensylvanica* Woodland (CEGL006212) needs to be determined.

Similar Associations:

- *Juniperus virginiana var. virginiana* / *Morella pensylvanica* Woodland (CEGL006212)
- *Morella pensylvanica - Prunus maritima* Shrubland (CEGL006295)

Related Concepts:

- SNE coastal rocky headland community (Rawinski 1984)
- Southern New England coastal rocky headland community (Rawinski 1984)

Sources
Description Authors: S.L. Neid
References: Eastern Ecology Working Group n.d., Enser 1999, Gawler 2002, Rawinski 1984, Sperduto 1997b, Sperduto 2000a, Swain and Kearsley 2001.



Figure F-13. Stunted Staghorn Sumac Shrubland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.020). September 2006. NAD 1983 / UTM easting 340441, northing 4684288.



Figure F-14. Stunted Staghorn Sumac Shrubland on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.043). September 2006. NAD 1983 / UTM easting 337728, northing 4686484.

Common Name (Park-specific): Northeastern Dry Oak-Hickory Forest

Synonyms

USNVC English Name: (White Oak, Northern Red Oak, Black Oak) / Mapleleaf Viburnum Forest

USNVC Scientific Name: *Quercus (alba, rubra, velutina) / Viburnum acerifolium* Forest
USNVC Identifier: CEGL006336

Local Information

Environmental Description: This dry-mesic forest type occurs on shallow, well-drained loamy sand of midslopes and ridges. Rocky outcrops are present throughout the association.

Vegetation Description: *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) share canopy dominance with *Carya ovata* (shagbark hickory) and *Carya cordiformis* (bitternut hickory). *Pinus strobus* (eastern white pine) and *Tsuga canadensis* (eastern hemlock) occur as canopy associates and in patches throughout the matrix deciduous stand. *Acer rubrum* (red maple) and *Ostrya virginiana* (hophornbeam) are dominant in the subcanopy and in the forest understory along with scattered individuals of *Carya glabra* (pignut hickory) and *Prunus serotina* (black cherry). *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Corylus cornuta* (beaked hazelnut), *Viburnum acerifolium* (mapleleaf viburnum), and *Vaccinium angustifolium* (lowbush blueberry) are common shrubs in the oak forest. Vines including *Parthenocissus quinquefolia* (Virginia creeper) and *Toxicodendron radicans* (eastern poison ivy) may be present but not prominent. The association's herbaceous flora has many native species characteristic of mature oak forests, including *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Mitchella repens* (partridgeberry), *Maianthemum racemosum* (feathery false lily of the valley), *Smilax herbacea* (smooth carrionflower), *Solidago caesia* (wreath goldenrod), *Thelypteris noveboracensis* (New York fern), and *Uvularia sessilifolia* (sessileleaf bellwort). *Polypodium virginianum* (rock polypody) occurs on rocky outcrops and boulders. Most of these species do not occur on any of the other Boston Harbor Islands.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy and subcanopy	Broad-leaved deciduous tree	*Carya ovata* (shagbark hickory)
		Quercus alba (white oak)
		Quercus montana (chestnut oak)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Ostrya virginiana* (hophornbeam)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Carya ovata* (shagbark hickory), *Ostrya virginiana* (hophornbeam), *Quercus velutina* (black oak)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	–	Oak - Hickory Forest	Swain and Kearsley 2001

Local Range: This oak-hickory forest occurs only on the southeastern portion of World's End, east of Damde Meadows in Boston Harbor Islands National Recreation Area.
Classification Comments: This association can be distinguished from Successional Maritime Forest by the unimportance of *Smilax rotundifolia* (roundleaf greenbrier), *Sassafras albidum* (sassafras), *Prunus serotina* (black cherry), and *Juniperus virginiana* (eastern redcedar), and the presence of *Carya cordiformis* (bitternut hickory) in the canopy. A small patch of Upland/Wetland Transitional Forest occurs within the oak-hickory forest matrix and is distinguished by *Nyssa sylvatica* (blackgum), more prominent *Acer rubrum* (red maple) and a dense understory of ferns.

Other Comments: None.
Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.003, BOHA.005.
AA Points: BOHA.AA111, BOHA.AA110, BOHA.AA170, BOHA.AA179
Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian & Northeastern Oak - Hardwood & Pine Forest (M502)
Group	Northeastern Oak - Hickory Forest & Woodland (G650)
Alliance	*Quercus alba - Carya* spp. - *Fraxinus americana* Forest Alliance (A2053)
Alliance (English name)	White Oak - Hickory species – White Ash Forest Alliance
Association	*Quercus (alba, rubra, velutina) / Viburnum acerifolium* Forest
Association (English name)	(White Oak, Northern Red Oak, Black Oak) / Mapleleaf Viburnum Forest
Ecological System(s)	Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475)
	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

Global Description

Concept Summary: This oak-hickory forest occurs on well-drained loamy sand of midslopes in the northeastern United States. This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. *Quercus montana* (chestnut oak) and *Quercus coccinea* (scarlet oak) are canopy associates in the southern portion of the range. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). At the northern range limit of this type, *Pinus strobus* (eastern white pine) and *Betula lenta* (sweet birch) also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common, but is generally not abundant, and is characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Carex rosea* (rosy sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Aureolaria* sp. (false foxglove), *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed).

Environmental Description: This forest type occurs on well-drained loamy sand of midslopes and other dry-mesic sites.

Vegetation Description: This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak-species-poor forests. *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus velutina* (black oak) are prominent in the canopy. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Quercus montana* (chestnut oak), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and *Betula lenta* (sweet birch) may also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is typically rather sparse and characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Kalmia latifolia* (mountain laurel), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be

common but generally not abundant, characterized by *Vaccinium pallidum* (Blue Ridge blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Maianthemum racemosum* (feathery false lily of the valley), *Dryopteris marginalis* (marginal woodfern), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnakeweed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Desmodium paniculatum* (panicledleaf ticktrefoil), *Melampyrum lineare* (narrowleaf cowwheat), *Chimaphila maculata* (striped prince's pine), *Eurybia divaricata* (white wood aster), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Dennstaedtia punctilobula* (eastern hayscented fern), *Aureolaria* sp. (false foxglove), *Pteridium aquilinum* (western brackenfern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Helianthemum canadense* (longbranch frostweed). The invasive species *Microstegium vimineum* (Nepalese browntop) and *Berberis thunbergii* (Japanese barberry) may also be present in this forest type.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak),
		Quercus montana (chestnut oak),
		Quercus rubra (northern red oak),
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Cornus florida* (flowering dogwood)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Aralia nudicaulis* (wild sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Cornus florida* (flowering dogwood), *Gaylussacia baccata* (black huckleberry), *Maianthemum racemosum* (feathery false lily of the valley), *Quercus montana* (chestnut oak), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs from Maine to Maryland.
States/Provinces: CT, DE:S3?, MA, MD, ME, NH, NJ:S4S5, NY:S3, PA, RI, VT
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Delaware Water Gap, Fort Necessity, Gettysburg, Minute Man, Morristown, Upper Delaware, Weir Farm); USFWS (Assabet River, Cape May, Great Meadows)

Conservation Status
Rank: G4G5 (24-Jan-2005)

Reasons: This type is not naturally rare and has a wide geographic distribution. Mature stands, however, are uncommon and most stands are subject to logging disturbances or even complete destruction if located in rapidly developing suburban areas.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.

Similar Associations:

- *Acer saccharum - Betula alleghaniensis - Quercus rubra* / *Viburnum acerifolium* Forest (CEGL006943)
- *Carya* (*glabra, ovata*) - *Fraxinus americana - Quercus* spp. Forest (CEGL006236)
- *Pinus strobus - Quercus* (*rubra, velutina*) - *Fagus grandifolia* Forest (CEGL006293)--can intergrade with this type in New England but is characterized by *Fagus grandifolia* (more or less absent in CEGL006336), a greater amount of *Pinus strobus* in the canopy (usually >20%), and little or no *Carya*.
- *Quercus alba - Quercus rubra - Carya* (*alba, ovata*) / *Cornus florida* Acid Forest (CEGL002067)--also contains *Actaea racemosa* and can occur on cherty limestone, and *Quercus velutina* is not characteristic.
- *Quercus alba - Quercus rubra - Carya alba* / *Cornus florida* / *Vaccinium stamineum* / *Desmodium nudiflorum* Piedmont Forest (CEGL008475)--southern analogue of CEGL006336; is more diverse and occupies soils with slightly higher base status. *Quercus velutina* is not as characteristic of this type. A number of southern herbs such as *Aristolochia serpentaria* are not found in CEGL006336; northern species such as *Corylus cornuta, Vaccinium angustifolium,* and *Aralia nudicaulis* are not found in CEGL008475.
- *Quercus coccinea - Quercus velutina* / *Sassafras albidum* / *Vaccinium pallidum* Forest (CEGL006375)--lacks *Viburnum acerifolium* and *Cornus florida* and in general is less diverse and occurring on relatively more nutrient-poor soils.
- *Quercus prinus - Quercus* (*rubra, velutina*) / *Vaccinium angustifolium* Forest (CEGL006282)
- *Quercus velutina - Quercus alba - Carya* (*glabra, ovata*) Forest (CEGL002076)--also contains *Quercus ellipsoidalis* or *Quercus macrocarpa* and is of shorter stature and more open canopy.
- *Quercus velutina* / *Carex pensylvanica* Forest (CEGL002078)--is drier and more infertile, and lacks *Viburnum acerifolium, Hamamelis virginiana* and other shrubs.

Related Concepts:

- *Quercus* (*alba, rubra, velutina*) / *Cornus florida - Viburnum acerifolium* Forest (Bartgis 1986)
- Mesic Coastal Plain mixed oak forest (Breden 1989)
- SNE mesic central hardwood forest on acidic till (Rawinski 1984)

Sources

Description Authors: S.L. Neid and L.A. Sneddon, mod. S.C. Gawler

References: Bartgis 1986, Berdine 1998, Breden 1989, Breden et al. 2001, Clancy 1996, Damman 1977, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Fleming et al. 2004, Fleming pers. comm., Gawler 2002, Harrison 2004, Hunt 1997, MENHP 1991, McCoy and Fleming 2000, Metzler and Barrett 2001, Patterson pers. comm., Rawinski 1984, Sperduto 1997b, Sperduto and Nichols 2004, Swain and Kearsley 2001, VDNH 2003.



Figure F-15. Northeastern Dry Oak-Hickory Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.003). September 2006. NAD 1983 / UTM easting 345743, northing 4680316.



Figure F-16. Northeastern Dry Oak-Hickory Forest on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA170-two views of the same point). September 2008. NAD 1983 / UTM easting 345617, northing 4680308.

Common Name (Park-specific): Upland/Wetland Transitional Forest

Synonyms

USNVC English Name: Northern Red Oak - Yellow Birch / Cinnamon Fern Forest
USNVC Scientific Name: *Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest
USNVC Identifier: CEGL006000

Local Information

Environmental Description: This small patch mesic upland/wetland transitional forest occurs in a hollow between two rocky outcrops in the southeastern portion of World's End and on the north side of Grape Island. There is a thick leaf litter layer overlying a thick organic horizon. The very fine sandy loam soil is moderately well-drained.

Vegetation Description: On World's End, a combination of *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), and *Acer rubrum* (red maple) dominate the forest canopy, while *Nyssa sylvatica* (blackgum) and *Carya glabra* (pignut hickory) dominate the subcanopy. On Grape Island, *Acer rubrum* (red maple) dominates the transitional upland/wetland forest canopy. The understories and herbaceous species composition is the same on both islands with *Vaccinium corymbosum* (highbush blueberry) is the dominant tall shrub. *Viburnum dentatum* (southern arrowood) is also present. A dense understory of ferns is present and dominated by *Osmunda claytoniana* (interrupted fern), *Thelypteris noveboracensis* (New York fern), and scattered *Osmunda cinnamomea* (cinnamon fern), *Pteridium aquilinum* (western brackenfern) and *Onoclea sensibilis* (sensitive fern). *Aralia nudicaulis* (wild sarsaparilla), *Eurybia divaricata* (white wood aster), and *Medeola virginiana* (Indian cucumber) are the dominant forest herbs.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak)
		Quercus velutina (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Nyssa sylvatica (blackgum)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Vaccinium corymbosum* (highbush blueberry)
Herb (field)	Forb	*Aralia nudicaulis* (wild sarsaparilla)
		Eurybia divaricata (white wood aster)
	Fern or fern ally	*Osmunda claytoniana* (interrupted fern),
		Osmunda cinnamomea (cinnamon fern)
		Thelypteris noveboracensis (New York fern)

Characteristic Species: *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Osmunda claytoniana* (interrupted fern), *Thelypteris noveboracensis* (New York fern)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNR	–	–	[not crosswalked]	–

Local Range: This association was observed only on the southeastern portion of World's End and northern side of Grape Island.

Classification Comments: Northeastern Dry Oak-Hickory Forest surrounds this association at World's End and Staghorn Sumac Shrubland and Early-Successional Woodland/Forest surround the small patch on Grape Island. The Grape Island example was too small map. In the field, it can be distinguished by the dominance of ferns in the understory and the presence of *Nyssa sylvatica* (blackgum) and *Acer rubrum* (red maple) in the subcanopy. Lower New England Red-Maple Blackgum Swamp (CEGL006156) was considered as the USNVC crosswalk for the Red Maple Forest described by Elliman (2005) at Grape Island and for a Red Maple fringe Forest described by Hopping (2000) at World's End, but after plot and AA sampling and after upon further review of Elliman's (2005) description with species composition, this crosswalk (CEGL006000) was more appropriate and CEGL006156 was removed from the classification. *Betula alleghaniensis* (yellow birch) does not occur in Boston Harbor Islands National Recreation Area.

Other Comments: None.
Local Description Authors: E. Largay
Plots: BOHA.021.
AA Points: BOHA.AA172
Boston Harbor Islands National Recreation Area Inventory Notes: Both examples of this association are very small patch (<0.5 ha); the one sampled at World's End was just large enough for a 20x20-m plot and is mapped. The example on Grape is not mapped.

Global Information

USNVC Classification

Classification Level	Description
Class	Forest & Woodland (1)
Subclass	Temperate & Boreal Forest & Woodland (1.B)
Formation	Cool Temperate Forest & Woodland (1.B.2)
Division	Eastern North American & Great Plains Cool Temperate Forest & Woodland (D008)
Macrogroup	Appalachian, Interior & Northeastern Mesic Forest Macrogroup (M883)
Group	Appalachian & Allegheny Northern Hardwood - Conifer Forest (G742)
Alliance	*Quercus rubra - Acer saccharum – Betula lenta* Forest Alliance (A3303)
Alliance (English name)	Northern Red Oak - Sugar Maple – Sweet Birch Forest Alliance
Association	*Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest
Association (English name)	Northern Red Oak - Yellow Birch / Cinnamon Fern Forest
Ecological System(s)	Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475)

Global Description

Concept Summary: This lower slope, wetland transitional forest of southern New England to New Jersey generally occurs immediately upslope from seasonally flooded acidic swamps or small drainages. It occurs on somewhat poorly drained mineral soils, with a soil moisture regime of moist to somewhat wet. The tree canopy is nearly closed, with tree height reflecting moisture availability. Dominant species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak). Occasionally *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Fagus grandifolia* (American beech), and *Tsuga canadensis* (eastern hemlock) may occur. The shrub layer includes *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Kalmia latifolia* (mountain laurel), and *Lindera benzoin* (northern spicebush). The herbaceous layer is nearly continuous and dominated by *Osmunda cinnamomea* (cinnamon fern), *Thelypteris noveboracensis* (New York fern), *Arisaema triphyllum* (Jack in the pulpit), and *Uvularia sessilifolia* (sessileleaf bellwort).

Environmental Description: This vegetation occurs on lower slopes, generally adjacent to wetlands. Mineral soils are somewhat poorly drained and moist to somewhat wet sandy loams. The substrate is often rocky.

Vegetation Description: The tree canopy is nearly closed, with tree height reflecting moisture availability. Dominant species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), and *Quercus velutina* (black oak). Occasionally *Quercus alba* (white oak), *Quercus palustris* (pin oak), *Fagus grandifolia* (American beech), and *Tsuga canadensis* (eastern hemlock) may occur. *Liriodendron tulipifera* (tuliptree) is a common associate in the southern portion of the range. The shrub layer includes *Hamamelis virginiana* (American witchhazel), *Vaccinium corymbosum* (highbush blueberry), *Clethra alnifolia* (coastal sweetpepperbush), *Kalmia latifolia* (mountain laurel), and *Lindera benzoin* (northern spicebush). The herbaceous layer is nearly continuous and dominated by *Osmunda cinnamomea* (cinnamon fern), *Thelypteris noveboracensis* (New York fern), *Arisaema triphyllum* (Jack in the pulpit), and *Uvularia sessilifolia* (sessileleaf bellwort). *Impatiens capensis* (jewelweed), *Veratrum viride* (green false hellebore), and *Symplocarpus foetidus* (skunk cabbage) may also occur where this vegetation grades into a wetland forest.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple)
		Betula alleghaniensis (yellow birch)
		Quercus velutina (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Clethra alnifolia* (coastal sweetpepperbush)
		Hamamelis virginiana (American witchhazel)

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short) (continued)	Broad-leaved deciduous shrub (continued)	*Lindera benzoin* (northern spicebush)
		Vaccinium corymbosum (highbush blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Kalmia latifolia* (mountain laurel)
Herb (field)	Forb	*Arisaema triphyllum* (Jack in the pulpit)
		Uvularia sessilifolia (sessileleaf bellwort)
	Fern or fern ally	*Osmunda cinnamomea* (cinnamon fern)
		Thelypteris noveboracensis (New York fern)

Characteristic Species: *Arisaema triphyllum* (Jack in the pulpit), *Betula alleghaniensis* (yellow birch), *Osmunda cinnamomea* (cinnamon fern), *Quercus rubra* (northern red oak), *Thelypteris noveboracensis* (New York fern), *Uvularia sessilifolia* (sessileleaf bellwort)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: The association occurs in Connecticut, Massachusetts, New Hampshire, New Jersey, and Rhode Island.

States/Provinces: CT, MA, NH, NJ, RI
Federal Lands: NPS (Boston Harbor Islands, Morristown); USFWS (Assabet River, Great Meadows, Oxbow)

Conservation Status
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: The lack of surface water and drier soil conditions during the growing season (relative to adjacent, seasonally flooded wetlands) make this forest suitable for species found more frequently in uplands.

Similar Associations:

- *Fagus grandifolia - Betula lenta - Quercus* (*alba*, *rubra*) / *Carpinus caroliniana* Forest (CEGL006921)

Related Concepts:

- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984) B
- Stream thicket community (Ehrenfeld 1977) B

Sources

Description Authors: S.L. Neid, mod. L.A. Sneddon

References: Damman and Kershner 1977, Eastern Ecology Working Group n.d., Ehrenfeld 1977, Golet et al. 1993, Metzler and Barrett 2001, Rawinski 1984, Sperduto 2000b, Sperduto and Nichols 2004.



Figure F-17. Upland/Wetland Transitional Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.021). September 2006. NAD 1983 / UTM easting 345832, northing 4680443.

Common Name (Park-specific): Common Wormwood Gravel Field

Synonyms

USNVC English Name: Common Wormwood Herbaceous Vegetation
USNVC Scientific Name: *Artemisia vulgaris* Herbaceous Vegetation
USNVC Identifier: CEGL006617

Local Information

Environmental Description: This herbaceous vegetation association occurs on gravel substrate throughout the Boston Harbor Isladnds. It can occur in the same environmental setting as Beach Strand and Northeastern Old Field, but is distinguished by gravel substrate and the dominance of *Artemisia vulgaris* (common wormwood). In some settings it appears that the topsoil has been mechanically scraped away. In other settings, irregular overwash prevents topsoil accumulation. It is a common association in areas that have been disturbed and/or reclaimed. It has a high proportion of non-native plants.

Vegetation Description: *Artemisia vulgaris* (common wormwood) is the dominant forb and in some examples the only plant present. *Symphyotrichum ericoides* (white heath aster), *Rumex acetosella* (common sheep sorrel), *Brassica nigra* (black mustard), *Carex silicea* (beach sedge), *Achillea millefolium* (common yarrow), and *Tanacetum vulgare* (common tansy) are typical associates. Also present are *Oenothera biennis* (common evening-primrose), *Trifolium repens* (white clover), *Andropogon gerardii* (big bluestem), *Panicum virgatum* (switchgrass), *Ambrosia artemisiifolia* (annual ragweed), *Trifolium arvense* (rabbitfoot clover), *Solidago sempervirens* (seaside goldenrod), *Bassia hirsuta* (hairy smotherweed), and *Lepidium latifolium* (broadleaved pepperweed). Scattered (<15% cover total) short *Rhus typhina* (staghorn sumac), *Rosa rugosa* (rugosa rose), and/or *Prunus serotina* (black cherry) may be present.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Artemisia vulgaris* (common wormwood)
		Symphyotrichum ericoides (white heath aster)
		Brassica nigra (black mustard)
	Graminoid	*Elymus repens* (quackgrass)

Characteristic Species: *Artemisia vulgaris* (common wormwood)
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk Data: Not crosswalked.
Local Range: This association occurs on rugged, rocky headlands on the outer harbor islands and Hangman and Grape, in sandy flats on World's End, Snake, Long, Sheep, and Peddocks islands and on reclaimed sites on Webb State Park, Deer, Georges, Rainsford, Spectacle, and Moon islands.

Classification Comments: This association is distinguished from Little Bluestem Old Field and Northeastern Old Field by the dominance of an admixture of non-native perennial forbs. It occurs on coarse, gravel substrate and while the other successional old field associations occur on deep loamy

or sandy soils. This association can occur in the environmental setting of Beach Strand, in overwash areas, back fields, developed and abandoned areas on the islands. Gravel substrate and the dominance of *Artemisia vulgaris* (common wormwood) are diagnostic. With the rapid recovery of woody vegetation throughout the Boston Harbor Islands the association, will likely succeed to a shrubland, woodland, or forest association.

Other Comments: This association was originally a part of Northeastern Old Field during preliminary classification work and plot sampling, but this association was observed and sampled sufficiently during accuracy assessment and was subsequently recognized as separate from Northeastern Old Field.

Local Description Authors: E. Largay
Plots: BOHA.038
AA Points: BOHA.AA044, BOHA.AA051, BOHA.AA064, BOHA.AA067, BOHA.AA072, BOHA.AA074, BOHA.AA114, BOHA.AA115, BOHA.AA157

Boston Harbor Islands National Recreation Area Inventory Notes: In the draft vegetation map (2006) polygons attributed to this association were all called Northeastern Old Field. Accuracy assessment provided more data that allowed for the splitting of the two types given their different species composition and environmental setting.

Global Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Shrubland & Grassland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Eastern North American Grassland & Shrubland (D024)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	None recognized
Alliance (English name)	None recognized
Association	*Artemisia vulgaris* Herbaceous Vegetation
Association (English name)	Common Wormwood Herbaceous Vegetation
Ecological System(s)	None recognized

This is a non-standard park-specific vegetation association created for Boston Harbor Islands National Recreation Area. The USNVC CEGL identifier was assigned to track the community in database records so it can be elevated to standard should other examples be identified on the landscape. The association is also placed in the appropriate USNVC hierarchy units.

Sources
Description Authors: E. Largay

References: Eastern Ecology Working Group n.d.



Figure F-18. Common Wormwood Gravel Field on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.038). September 2006. NAD 1983 / UTM easting 335194, northing 4687180.



Figure F-19. Common Wormwood Gravel Field on Middle Brewster Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA157). September 2008. NAD 1983 / UTM easting 344525, northing 4689184.

Common Name (Park-specific): Northeastern Old Field

Synonyms

USNVC English Name: Orchard Grass - Timothy - Fescue species - Goldenrod species Ruderal Herbaceous Vegetation

USNVC Scientific Name: *Dactylis glomerata* - *Phleum pratense* - *Festuca* spp. - *Solidago* spp. Ruderal Herbaceous Vegetation

USNVC Identifier: CEGL006107

Local Information

Environmental Description: Open associations of perennial grasses and forbs are ubiquitous to Boston Harbor Islands National Recreation Area. The best known fields are the large meadows on World's End, but most of the islands and peninsulas have at least small areas of open uplands. These field associations without exception have a high proportion of non-native plants. They occur on deep loamy soils and are typically mowed or managed annually.

Vegetation Description: Abundant old-field species include *Agrostis* sp. (bentgrass), *Anthoxanthum odoratum* (sweet vernalgrass), *Ambrosia artemisiifolia* (annual ragweed), *Arctium minus* (lesser burrdock), *Asclepias syriaca* (common milkweed), *Cerastium fontanum ssp. vulgare* (big chickweed), *Dactylis glomerata* (orchardgrass), *Elymus repens* (quackgrass), *Erigeron annuus* (eastern daisy fleabane), *Hypericum perforatum* (common St. Johnswort), *Linaria vulgaris* (butter and eggs), *Panicum virgatum* (switchgrass), *Potentilla argentea* (silver cinquefoil), *Onopordum acanthium* (Scotch cottonthistle), *Artemisia vulgaris* (common wormwood), *Brassica nigra* (black mustard), *Cichorium intybus* (chicory), *Phleum pratense* (timothy), *Hieracium canadense* (Canadian hawkweed), *Festuca rubra* (red fescue), *Verbascum thapsus* (common mullein), *Rumex acetosella* (common sheep sorrel), *Schizachyrium scoparium* (little bluestem), *Setaria viridis* (green bristlegrass), *Stellaria graminea* (grasslike starwort), and *Rumex crispus* (curly dock). *Rubus hispidus* (bristly dewberry), *Rubus flagellaris* (northern dewberry), and other scattered shrubs may be present. Scattered shrubs and vines are common throughout the Northeastern Old Field association, including *Rhus typhina* (staghorn sumac), *Juniperus virginiana* (eastern redcedar), *Elaeagnus umbellata* (autumn olive), *Toxicodendron radicans* (eastern poison ivy), and others.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Asclepias syriaca* (common milkweed)
		Solidago spp. (goldenrods)
		Linaria vulgaris (butter and eggs)
	Graminoid	*Dactylis glomerata* (orchardgrass)
		Anthoxanthum odoratum (sweet vernalgrass)
		Agrostis sp. (bentgrass)

Characteristic Species: *Dactylis glomerata* (orchardgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNR*	B	1	Cultural Grassland	Swain and Kearsley 2000

Local Range: This association occurs on World's End, Webb State Park, Thompson, Deer, Grape, Lovells, Georges and Rainsford islands.

Classification Comments: This association is distinguished from Little Bluestem Old Field by the dominance of an admixture of native and non-native perennial grasses and forbs, rather than the dominance of *Schizachyrium scoparium* (little bluestem). It is distinguished from Common Wormwood Gravel Field by its deep loamy soils and low cover of *Artemisia vulgaris* (common wormwood).

Other Comments: There are many AA points with additional data for this association.
Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.033.
AA Points: BOHA.AA002, BOHA.AA004, BOHA.AA007, BOHA.AA008, BOHA.AA015, BOHA.AA022, BOHA.AA023, BOHA.AA026, BOHA.AA027, BOHA.AA029, BOHA035, BOHA.AA037, BOHA.AA045, BOHA.AA061, BOHA.AA070, BOHA.AA144

Boston Harbor Islands National Recreation Area Inventory Notes: Only one plot of this association was sampled during sampling because it is well-described in the USNVC and T. Elliman described it very well in his Boston Harbor Islands Botanical Survey Report (Elliman 2004).

Global Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Shrubland & Grassland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Eastern North American Grassland & Shrubland (D024)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	*Dactylis glomerata - Festuca* spp. - *Solidago canadensis* Mesic Ruderal Meadow Alliance (A1190)
Alliance (English name)	Orchardgrass - Fescue species - Canada Goldenrod Mesic Ruderal Meadow Alliance
Association	*Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Ruderal Herbaceous Vegetation

USNVC Classification (continued)

Classification Level	Description
Association (English name)	Orchard Grass - Timothy - Fescue species - Goldenrod species Ruderal Herbaceous Vegetation
Ecological System(s)	Information not available.

Global Description

Concept Summary: This broadly defined vegetation type includes pastures and post-agricultural fields and is largely composed of non-native cool-season grasses and herbs (generally of European origin) in the early stages of succession. The fields are typically mowed at least annually. Physiognomically, these grasslands are generally comprised of mid-height (1-3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general this vegetation is quite wide-ranging in northeastern and midwestern states and at higher elevations (610-1220 m [2000-4000 feet]) in the southeastern states. Dominant grasses vary from site to site but generally feature the nominal species. Other graminoid associates may include *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* sp. (hawkweed), *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *Solidago altissima* (tall goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* sp. (clover), and many others.

Environmental Description: This association occurs on pastures and land that has been tilled. Generally the fields are mowed at least annually.

Vegetation Description: In addition to *Dactylis glomerata* (orchardgrass) and *Phleum pratense* (timothy), these grassy fields are characterized by graminoids including *Agrostis stolonifera* (creeping bentgrass), *Agrostis hyemalis* (winter bentgrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Bromus tectorum* (cheatgrass), *Lolium perenne* (perennial ryegrass), *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (Canada bluegrass), *Schizachyrium scoparium* (little bluestem) (not in abundance), and *Anthoxanthum odoratum* (sweet vernalgrass). Forbs scattered among the grasses are varied but include *Hieracium* sp. (hawkweed), *Oxalis stricta* (common yellow oxalis), *Achillea millefolium* (common yarrow), *Asclepias syriaca* (common milkweed), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago juncea* (early goldenrod), *Solidago canadensis* (Canada goldenrod), *altissima* (tall goldenrod), *Euthamia*

graminifolia (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* sp. (clover), and many others.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella* (common sheep sorrel)
	Graminoid	*Dactylis glomerata* (orchardgrass)
		Festuca rubra (red fescue)
		Phleum pratense (timothy)

Characteristic Species: *Achillea millefolium* (common yarrow), *Anthoxanthum odoratum* (sweet vernalgrass), *Dactylis glomerata* (orchardgrass), *Euthamia graminifolia* (flat-top goldentop), *Phleum pratense* (timothy), *Rumex acetosella* (common sheep sorrel), *Solidago altissima* (tall goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This vegetation is quite wide-ranging in northeastern and midwestern states and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, DE, KY, MA, MD, ME, NB?, NH, NJ, NS?, NY, PA, QC?, RI, TN, VA, VT, WV

Federal Lands: NPS (Allegheny Portage Railroad, Appomattox Court House, Booker T. Washington, Boston Harbor Islands, Cape Cod, Colonial, Delaware Water Gap, Fire Island, Fort Necessity, Fredericksburg-Spotsylvania, Friendship Hill, Gateway, George Washington Birthplace, Gettysburg, Johnstown Flood, Marsh-Billings-Rockefeller, Minute Man, Morristown, Petersburg, Richmond, Saint-Gaudens, Saratoga, Upper Delaware, Valley Forge, Weir Farm); USFWS (Aroostook, Assabet River, Cape May, Carlton Pond, E.B. Forsythe, Erie, Great Meadows, Iroquois, Montezuma, Moosehorn, Nulhegan Basin, Oxbow, Parker River, Supawna Meadows)

Conservation Status
Rank: GNA (modified/managed) (8-Dec-2005)
Reasons: This vegetation type includes pasture and post-agricultural fields and is largely composed of non-native grasses and herbs (generally of European origin).

Classification Information
Status: Standard
Confidence: 3 - Weak

Comments: *Schizachyrium scoparium - (Andropogon virginicus) - Solidago* spp. Herbaceous Vegetation (CEGL006333) is similar to this type but is dominated by warm-season grasses.

Similar Associations:

- *Lolium (arundinaceum, pratense)* Herbaceous Vegetation (CEGL004048)
- *Phleum pratense - Bromus pubescens - Helenium autumnale* Herbaceous Vegetation (CEGL004018)
- *Schizachyrium scoparium - (Andropogon virginicus) - Solidago* spp. Herbaceous Vegetation (CEGL006333)

Related Concepts: Information not available.

Sources

Description Authors: S.C. Gawler

References: Clark 1986, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ehrenfeld 1977, Elliman 2004, Keever 1979, Newbold et al. 1988, Perles et al. 2005a, Perles et al. 2005b, Perles et al. 2005c, Podniesinski et al. 2006, Sneddon et al. 1995, TDNH unpubl. Data.



Figure F-20. Northeastern Old Field on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA015). September 2008. NAD 1983 / UTM easting 345117, northing 4681344.



Figure F-21. Northeastern Old Field on Thompson Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA004). September 2008. NAD 1983 / UTM easting 334141, northing 4686270.

Common Name (Park-specific): Little Bluestem Old Field

Synonyms

USNVC English Name: Little Bluestem - (Broomsedge Bluestem) - Goldenrod species Ruderal Herbaceous Vegetation

USNVC Scientific Name: *Schizachyrium scoparium - (Andropogon virginicus) - Solidago spp.* Ruderal Herbaceous Vegetation

USNVC Identifier: CEGL006333

Local Information

Environmental Description: This vegetation occurs on well-drained soils, either on sandy flats or on dry knolls with shallow soils.

Vegetation Description: This is a predominantly native grassland association dominated by *Schizachyrium scoparium* (little bluestem). *Solidago canadensis* (Canada goldenrod), *Solidago juncea* (early goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago nemoralis* (gray goldenrod), *Apocynum androsaemifolium* (spreading dogbane), *Asclepias syriaca* (common milkweed), *Agrostis stolonifera* (creeping bentgrass), *Carex pensylvanica* (Pennsylvania sedge), *Daucus carota* (Queen Anne's lace), *Festuca ovina* (sheep fescue), *Hieracium canadense* (Canadian hawkweed), *Oxalis stricta* (common yellow oxalis), *Panicum* sp. (panicgrass), *Juncus greenei* (Greene's rush), *Rudbeckia hirta* (blackeyed Susan) and/or *Symphyotrichum novi belgii* (New York aster) may also be present. Scattered shrubs and vines include *Rubus flagellaris* (northern dewberry), *Prunus serotina* (black cherry), *Vaccinium angustifolium* (lowbush blueberry), and *Toxicodendron radicans* (eastern poison ivy). Tree seedlings may also be common.

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Rubus flagellaris* (northern dewberry)
Herb (field)	Forb	*Solidago rugosa* (wrinkleleaf goldenrod)
	Graminoid	*Schizachyrium scoparium* (little bluestem)

Characteristic Species: *Schizachyrium scoparium* (little bluestem)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNA	–	–	[not crosswalked]	–

Local Range: This association occurs on World's End, Grape, and Thompson islands.
Classification Comments: This association may be distinguished from Northeastern Old Field by the dominance of *Schizachyrium scoparium* (little bluestem) and low proportion of non-native grasses and forbs.

Other Comments: Shrub thickets may be succeeding into this grassland association throughout Boston Harbor Islands.
Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.006, BOHA.029
AA Points: BOHA.AA138
Boston Harbor Islands National Recreation Area Inventory Notes: Many examples of this association in Boston Harbor Islands are below minimum map unit size (0.5 ha); however, areas with a distinctive *Schizachyrium scoparium* (little bluestem) signature were mapped despite the size limitation.

Global Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Shrubland & Grassland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Eastern North American Grassland & Shrubland (D024)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	*Poa compressa - Solidago nemoralis - Centaurea biebersteinii* Ruderal Dry Meadow & Shrubland Alliance (A3934)
Alliance (English name)	Canada Bluegrass - Gray Goldenrod - Spotted Knapweed Ruderal Dry Meadow & Shrubland Alliance
Association	*Schizachyrium scoparium - (Andropogon virginicus) - Solidago* spp. Ruderal Herbaceous Vegetation
Association (English name)	Little Bluestem - (Broomsedge Bluestem) - Goldenrod species Ruderal Herbaceous Vegetation
Ecological System(s)	Information not available.

Global Description

Concept Summary: This broadly defined vegetation type includes old fields of well-drained soils, either sandy or shallow to bedrock. They are characterized by dominance of warm-season grasses. *Schizachyrium scoparium* (little bluestem) is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus* (broomsedge bluestem), *Eragrostis spectabilis* (purple lovegrass), *Festuca rubra* (red fescue), *Deschampsia flexuosa* (wavy hairgrass), *Danthonia spicata* (poverty oatgrass), *Nuttallanthus canadensis* (Canada toadflax), *Rubus flagellaris* (northern dewberry), *Panicum virgatum* (switchgrass), *Dichanthelium depauperatum* (starved panicgrass), *Potentilla simplex* (common cinquefoil), *Dichanthelium meridionale* (matting rosette grass), *Dichanthelium dichotomum* (cypress panicgrass), *Solidago rugosa* (wrinkleleaf goldenrod), and *Carex pensylvanica* (Pennsylvania sedge). Scattered shrubs are often present, including *Comptonia*

peregrina (sweet fern), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), and scattered tree saplings, such as *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Juniperus virginiana* (eastern redcedar). *Polytrichum juniperinum* (juniper polytrichum moss) and other *Polytrichum* sp. (polytrichum moss) are common bryophytes.

Environmental Description: This vegetation occurs on well-drained soils, either on sandy flats or on dry knolls with shallow soils. The vegetation arises spontaneously after soil disturbance.

Vegetation Description: *Schizachyrium scoparium* (little bluestem) is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general, this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus* (broomsedge bluestem), *Eragrostis spectabilis* (purple lovegrass), *Festuca rubra* (red fescue), *Deschampsia flexuosa* (wavy hairgrass), *Centaurea stoebe* ssp. *micranthos* (=*Centaurea biebersteinii*) (spotted knapweed), *Danthonia spicata* (poverty oatgrass), *Hypericum perforatum* (common St. Johnswort), *Nuttallanthus canadensis* (Canada toadflax), *Rubus flagellaris* (northern dewberry), *Panicum virgatum* (switchgrass), *Dichanthelium depauperatum* (starved panicgrass), *Potentilla simplex* (common cinquefoil), *Dichanthelium meridionale* (matting rosette grass), *Dichanthelium dichotomum* (cypress panicgrass), *Solidago juncea* (early goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Hieracium* sp. (hawkweed), and *Carex pensylvanica* (Pennsylvania sedge). Scattered shrubs are often present, including *Comptonia peregrina* (sweet fern), *Morella pensylvanica* (northern bayberry), *Gaylussacia baccata* (black huckleberry), and scattered tree saplings, such as *Prunus serotina* (black cherry), *Sassafras albidum* (sassafras), and *Juniperus virginiana* (eastern redcedar).

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Rubus flagellaris* (northern dewberry)
Herb (field)	Forb	*Solidago juncea* (early goldenrod)
		Solidago nemoralis (gray goldenrod)
		Solidago rugosa (wrinkleleaf goldenrod)
	Graminoid	*Schizachyrium scoparium* (little bluestem)

Characteristic Species: *Andropogon virginicus* (broomsedge bluestem), *Schizachyrium scoparium* (little bluestem), *Solidago juncea* (early goldenrod), *Solidago nemoralis* (gray goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This vegetation is quite wide-ranging in northeastern and midwestern states, and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, MA, ME, NH, NJ, NY, PA, RI, VT
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Delaware Water Gap, Fire Island, Gateway, Saratoga, Upper Delaware, Weir Farm); USFWS (Great Swamp)

Conservation Status
Rank: GNA (invasive) (19-Jan-2006)
Reasons: This vegetation type includes pasture and post-agricultural fields.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: This type is distinguished, in theory, from the very similar *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* (goldenrod) spp. Herbaceous Vegetation (CEGL006107) by the dominance of warm-season grasses as opposed to cool-season grasses (*Phleum* (Timothy), *Festuca* (fescue)) dominating CEGL006017. Additional data will be required to see how this distinction holds up and what geographic differences might accompany such a distinction.

Similar Associations:

- *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation (CEGL006107)
- *Lolium* (*arundinaceum, pratense*) Herbaceous Vegetation (CEGL004048)
- *Phleum pratense - Bromus pubescens - Helenium autumnale* Herbaceous Vegetation (CEGL004018)

Related Concepts: Information not available.

Sources
Description Authors: L.A. Sneddon, mod. S.C. Gawler
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, House 1917, USDA-NRCS 2001, Newbold et al. 1988, Niering et al. 1970.



Figure F-22. Little Bluestem Old Field on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.006). September 2006. NAD 1983 / UTM easting 345728, northing 4680477.



Figure F-23. Little Bluestem Old Field on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.029). September 2006. NAD 1983 / UTM easting 334068, northing 4686617.

Common Name (Park-specific): Northeastern Successional Shrubland

Synonyms

USNVC English Name: Autumn-olive - Gray Dogwood - Multiflora Rose – Eastern Red-cedar Ruderal Shrubland

USNVC Scientific Name: *Elaeagnus umbellata - Cornus racemosa - Rosa multiflora -Juniperus virginiana* Ruderal Shrubland

USNVC Identifier: CEGL006451

Local Information

Environmental Description: This thicket occurs on old fields, pastures, and/or modified lands.

Vegetation Description: Invaded, diverse, closed-canopy shrubland characterized by a dense tangle of non-native and native shrubs and vines; **Characteristic Species** include a combination of *Rosa multiflora* (multiflora rose), *Rhus typhina*, (staghorn sumac), *Rhamnus cathartica* (common buckthorn), *Rubus allegheniensis* (Allegheny blackberry), *Rubus idaeus* (American red raspberry), *Malus pumila* (paradise apple), *Lonicera morrowii* (Morrow's honeysuckle), *Celastrus orbiculatus* (Oriental bittersweet), *Lonicera japonica* (Japanese honeysuckle), *Ligustrum vulgare* (European privet), *Juniperus virginiana* (eastern redcedar), *Prunus serotina* (black cherry), *Quercus robur* (English oak) and other small trees (<25% in cover) may be present. Old field grasses and forbs can be common in more open-canopied variants where tall and short shrubs cover at least 25% of the field.

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa multiflora* (multiflora rose)
		Rhus typhina, (staghorn sumac)
		Rhamnus cathartica (common buckthorn)
		Rubus allegheniensis (Allegheny blackberry)
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* (eastern redcedar)
Herb (field)	Vine/Liana	*Celastrus orbiculatus* (Oriental bittersweet)
		Lonicera japonica (Japanese honeysuckle)

Characteristic Species: *Rosa multiflora* (multiflora rose), *Celastrus orbiculatus* (Oriental bittersweet), *Lonicera japonica* (Japanese honeysuckle)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNA	–	–	[not crosswalked]	–

Local Range: This shrubland is common on Long, Thompson, and Middle Brewster islands.

Classification Comments: This association is characterized by non-native and native shrubs. *Rhus typina* (staghorn sumac) may be present, but is not dominant. Exotic shrubs and vines are diagnostic. It is distinguished from successional forest and woodland associations by the dominance of shrub species. It is distinguished from the variants of Staghorn Sumac Shrubland by the predominance of exotic shrubs and typically a closed canopy.

Other Comments: Information not available.
Local Description Authors: E. Largay
Plots: BOHA.031, BOHA.041
AA Points: BOHA.AA003, BOHA.AA009, BOHA.AA010, BOHA.AA025, BOHA.AA038, BOHA.AA039, BOHA.AA041, BOHA.AA042, BOHA.AA043, BOHA.AA047, BOHA.AA059, BOHA.AA060, BOHA.AA097, BOHA.AA098, BOHA.AA177

Boston Harbor Islands National Recreation Area Inventory Notes: None.

GLOBAI Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Shrubland & Grassland (2.B)
Formation	Temperate Grassland & Shrubland (2.B.2)
Division	Eastern North American Grassland & Shrubland (D024)
Macrogroup	Eastern North American Ruderal Grassland & Shrubland (M123)
Group	Northern & Central Ruderal Meadow & Shrubland (G059)
Alliance	*Rhamnus cathartica - Rosa multiflora - Elaeagnus umbellata* Ruderal Mesic Shrubland Alliance (A3558)
Alliance (English name)	Common Buckthorn - Multiflora Rose - Autumn-olive Ruderal Mesic Shrubland Alliance
Association	*Elaeagnus umbellata - Cornus racemosa - Rosa multiflora - Juniperus virginiana* Ruderal Shrubland
Association (English name)	Autumn Olive - Gray Dogwood - Multiflora Rose – Eastern Red-cedar Ruderal Shrubland
Ecological System(s)	Semi-natural / Altered Vegetation and Conifer Plantations (CES203.074)

Global Description

Concept Summary: This association comprises shrubby old fields dominated by thickets of *Elaeagnus angustifolia* (Russian olive), *Cornus racemosa* (gray dogwood), *Viburnum prunifolium* (blackhaw), *Lonicera japonica* (Japanese honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Ligustrum vulgare* (European privet), *Euonymus alatus*(winged burning bush), *Rosa multiflora* (multiflora rose), *Rhus glabra* (smooth sumac), and *Rhus typhina* (staghorn sumac), with patches of herbaceous vegetation among the shrubs. Shorter shrubs include *Berberis thunbergii* (Japanese barberry) and *Rubus* sp. (blackberry), and in some fields *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry), and/or *Vaccinium*

angustifolium (lowbush blueberry). Small trees are often present but form <25% cover; they include *Juniperus virginiana* (eastern red-cedar), *Betula populifolia* (gray birch), *Prunus virginiana* (chokecherry), *Cornus florida* (flowering dogwood), *Acer rubrum* (red maple), *Juglans nigra* (black walnut), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust), and *Fraxinus americana* (white ash). The herbaceous layer is variable depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites. Common species include *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Solidago nemoralis* (gray goldenrod), *Monarda fistulosa* (wild bergamot), *Anthoxanthum odoratum* (sweet vernalgrass), *Poa pratensis* (Kentucky bluegrass), *Oxalis stricta* (common yellow oxalis), *Viola sororia* (common blue violet), *Euthamia graminifolia* (flat-top goldentop), *Festuca rubra* (red fescue), *Schizachyrium scoparium* (little bluestem), *Pycnanthemum virginianum* (Virginia mountainmint), *Alliaria petiolata* (garlic mustard), *Galium mollugo* (false baby's breath), *Potentilla simplex* (common cinquefoil), *Achillea millefolium* (common yarrow), *Daucus carota* (Queen Anne's lace), *Trifolium repens* (white clover), *Bromus inermis* (smooth brome), *Agrostis gigantea* (redtop), and *Elymus repens* (quackgrass), among many others. Vines can be absent or dominant, sometimes covering the tall and short shrubs. Common vines are *Vitis aestivalis* (summer grape), *Vitis labrusca* (fox grape), *Toxicodendron radicans* (eastern poison-ivy), *Celastrus orbiculata* (Oriental bittersweet), *Parthenocissus quinquefolia* (Virginia creeper), and *Lonicera japonica* (Japanese honeysuckle).

Environmental Description: This association occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed. These sites contain moderately well-drained to well-drained soils. The shrublands are flat to gently sloping, often bounded by stonewalls or fencerows.

Vegetation Description: The structure of this association varies from open fields with scattered tall and short shrubs covering 25% of the field, with herbaceous vegetation in the interstices, to dense "closed-canopy" tall shrublands with sparse ground layer vegetation. Common shrubs include *Elaeagnus angustifolia* (Russian olive), *Cornus racemosa* (gray dogwood), *Viburnum prunifolium* (blackhaw), *Lonicera japonica* (Japanese honeysuckle), *Lonicera morrowii* (Morrow's honeysuckle), *Ligustrum vulgare* (European privet), *Euonymus alatus* (winged burning bush), *Rosa multiflora* (multiflora rose), *Rhus glabra* (smooth sumac), and *Rhus typhina* (staghorn sumac), with patches of herbaceous vegetation among the shrubs. Shorter shrubs include *Berberis thunbergii* (Japanese barberry) and *Rubus* sp. (blackberry), and in some fields *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry), and/or *Vaccinium angustifolium* (lowbush blueberry). Small trees are often present but form <25% cover; they include *Juniperus virginiana* (eastern red-cedar), *Betula populifolia* (gray birch), *Prunus virginiana* (chokecherry), *Cornus florida* (flowering dogwood), *Acer rubrum* (red maple), *Juglans nigra* (black walnut), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust), and *Fraxinus americana* (white ash). The herbaceous layer is variable depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites. Common species include *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Solidago nemoralis* (gray goldenrod), *Monarda fistulosa* (wild bergamot), *Anthoxanthum odoratum*

(sweet vernalgrass), *Poa pratensis* (Kentucky bluegrass), *Oxalis stricta* (common yellow oxalis), *Viola sororia* (common blue violet), *Euthamia graminifolia* (flat-top goldentop), *Festuca rubra* (red fescue), *Schizachyrium scoparium* (little bluestem), *Pycnanthemum virginianum* (Virginia mountainmint), *Alliaria petiolata* (garlic mustard), *Galium mollugo* (false baby's breath), *Potentilla simplex* (common cinquefoil), *Achillea millefolium* (common yarrow), *Daucus carota* (Queen Anne's lace), *Trifolium repens* (white clover), *Bromus inermis* (smooth brome), *Agrostis gigantea* (redtop), and *Elymus repens* (quackgrass), among many others. Vines can be absent or dominant, sometimes covering the tall and short shrubs. Common vines are *Vitis aestivalis* (summer grape), *Vitis labrusca* (fox grape), *Toxicodendron radicans* (eastern poison-ivy), *Celastrus orbiculata* (Oriental bittersweet), *Parthenocissus quinquefolia* (Virginia creeper), and *Lonicera japonica* (Japanese honeysuckle).

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus racemosa* (gray dogwood),
		Elaeagnus umbellata (autumn olive)
		Rhus glabra (smooth sumac)
		Rosa multiflora (multiflora rose)
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana* (eastern red cedar)
Herb (field)	Vine/Liana	*Celastrus orbiculata* (oriental bittersweet)
		Vitis aestivalis (summer grape)
		Vitis labrusca (fox grape)
	Forb	*Monarda fistulosa* (wild bergamot)
		Solidago altissima (tall goldenrod)
		Solidago rugosa (wrinkleleaf goldenrod)
	Graminoid	*Anthoxanthum odoratum* (sweet vernalgrass)
		Schizachyrium scoparium (little bluestem)

Characteristic Species: *Anthoxanthum odoratum* (sweet vernalgrass), *Celastrus orbiculata* (Oriental bittersweet), *Cornus racemosa* (gray dogwood), *Elaeagnus umbellata* (autumn olive), *Juniperus virginiana* (eastern red-cedar), *Monarda fistulosa* (wild bergamot), *Rhus glabra* (smooth sumac), *Rhus typhina* (staghorn sumac), *Rosa multiflora* (multiflora rose), *Solidago altissima* (tall goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Vitis aestivalis* (summer grape)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association is common in former agricultural areas in the northeastern U.S.
States/Provinces: CT, DE, MA, NJ, NY, PA

Federal Lands: NPS (Boston Harbor Islands, Delaware Water Gap, Gateway, Saratoga, Upper Delaware, Valley Forge); USFWS (Cape May, E.B. Forsythe, Iroquois, Montezuma, Prime Hook, Supawna Meadows)

Conservation Status
Rank: GNA (ruderal) (23-Jun-2006)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This is a broadly defined type intended for shrubby vegetation on abandoned cropland or pasture.

Similar Associations:

- *Cornus* (*amomum*, *sericea*) - *Viburnum dentatum* - *Rosa multiflora* Shrubland (CEGL006576)
- *Gaylussacia baccata* - *Vaccinium pallidum* - *Vaccinium corymbosum* Dwarf-shrubland (CEGL006622)

Related Concepts: Information not available.

Sources
Description Authors: S.C. Gawler
References: Eastern Ecology Working Group n.d., Keever 1979, USDA-NRCS 2001, USDA-NRCS 2004, Newbold et al. 1988, Overlease 1987.



Figure F-24. Northeastern Successional Shrubland on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.041). September 2006. NAD 1983 / UTM easting 337815, northing 4686699.

Common Name (Park-specific): Northern Beachgrass Vegetation

Synonyms

USNVC English Name: American Beachgrass - Beach Pea Herbaceous Vegetation
USNVC Scientific Name: *Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation
USNVC Identifier: CEGL006274

Local Information

Environmental Description: This association occurs on open sand, gravel flats, and sand dunes that are exposed to onshore winds and salt spray, as well as on more protected interdunes. This grassland generally occurs beyond the influence of storm tides. The substrate consists of sand or gravel with no soil profile development. In the Boston Harbor Islands National Recreation Area it occurs adjacent to Beach Strand on gravel shores and on sand.

Vegetation Description: *Ammophila breviligulata* (American beachgrass) dominates this association. Associated species include *Artemisia stelleriana* (oldwoman), *Lathyrus japonicus* (beach pea), *Solidago sempervirens* (seaside goldenrod), *Cakile edentula* ssp. *edulenta* (American searocket), *Elymus repens* (quackgrass), *Oenothera biennis* (common evening-primrose), *Brassica nigra* (black mustard), and *Artemisia vulgaris* (common wormwood). Scattered individuals of *Rosa rugosa* (rugosa rose) may be present.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: *Ammophila breviligulata* (American beachgrass)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	–	Maritime Dune Community	Swain and Kearsley 2001

Local Range: Lovells Island is the only one of the Boston Harbor Islands with a large area of sand dunes and a large population of *Ammophila breviligulata* (American beachgrass). Most of the dunes are on the island's southwest side. Long Island's southeastern shoreline, Thompson Island's southwestern and southern shorelines, and Snake's eastern and southern shorelines also have small *Ammophila breviligulata* (American beachgrass)-dominated areas. It has also been planted on Spectacle.

Classification Comments: This association is distinguished from Beach Strand by the dominance of *Ammophila breviligulata* (American beachgrass).

Other Comments: Maritime Dune Community (Swain and Kearsley 2001) is listed as a rare community (S2) by the Massachusetts Natural Heritage and Endangered Species Program.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.027, BOHA.035.
AA Points: BOHA.AA076, BOHA.AA.152, BOHA.AA117, BOHA.AA154, BOHA.AA155, BOHA.AA185, BOHA.AA152

Boston Harbor Islands National Recreation Area Inventory Notes: Information not available.

Global Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Shrubland & Grassland (2.B)
Formation	Temperate & Boreal Scrub & Herb Coastal Vegetation (2.B.4)
Division	Eastern North American Dune & Coastal Grassland & Shrubland (D026)
Macrogroup	Eastern North American Dune & Coastal Grassland & Shrubland (M057)
Group	North Atlantic Coastal Shrub & Grass Dune (G493)
Alliance	*Ammophila breviligulata* Dune Grassland Alliance (A1207)
Alliance (English name)	American Beachgrass Dune Grassland Alliance
Association	*Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation
Association (English name)	American Beachgrass - Beach Pea Herbaceous Vegetation
Ecological System(s)	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264)

Global Description

Concept Summary: This dune grassland of maritime beaches occurs along the North Atlantic coast from New Jersey north to central Maine. This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. The substrate is wind-deposited sand with no soil development. *Ammophila breviligulata* (American beachgrass) is the dominant species, often occurring monotypically. *Lathyrus japonicus* (beach pea) is a common associate and can be codominant. Other associated species include *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), *Aristida tuberculosa* (seaside threeawn), *Schizachyrium scoparium* (little bluestem), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), and *Artemisia stelleriana* (oldwoman). Dwarf-shrubs, such as *Hudsonia tomentosa* (woolly beachheather), can occur sporadically and form locally dominant patches. Vegetation cover is often sparse, and bare sand is usually evident.

Environmental Description: This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. This grassland generally occurs beyond the influence of storm tides. Substrate is sand with no soil profile development.

Vegetation Description: This association is characterized and dominated by *Ammophila breviligulata* (American beachgrass), which can occur monotypically, especially on foredunes or

other areas of active and rapid sand deposition. *Lathyrus japonicus* (beach pea) is the most common associate and can be codominant. Other associated species include *Solidago sempervirens* (seaside goldenrod), *Lechea maritima* (beach pinweed), *Aristida tuberculosa* (seaside threeawn), *Schizachyrium scoparium* (little bluestem), *Carex silicea* (beach sedge), *Polygonella articulata* (coastal jointweed), and *Artemisia stelleriana* (oldwoman). Dwarf-shrubs, such as *Hudsonia tomentosa* (woolly beachheather), *Rosa rugosa* (rugosa rose), *Morella pensylvanica* (northern bayberry), or stunted *Prunus maritima* (beach plum), can occur sporadically and form locally dominant patches within the grassland.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Lathyrus japonicus* (beach pea)
	Graminoid	*Ammophila breviligulata* (American beachgrass)

Characteristic Species: *Ammophila breviligulata* (American beachgrass)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs along the northern Atlantic Coast from Maine to New Jersey.
States/Provinces: CT, DE, MA, ME:S2, NH:S1, NJ:S2S3, NY, RI
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island); USFWS (Monomoy, Nomans Land Island, Parker River)

Conservation Status
Rank: G4? (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: The southern analog of this dune grassland association is *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043), which is differentiated by having *Panicum amarum* (bitter panicgrass) as a codominant species in addition to the presence of more southern species such as *Cenchrus tribuloides* (sanddune sandbur) and *Oenothera humifusa* (seabeach evening-primrose), plus the absence of *Lathyrus japonicus* (beach pea). These two *Ammophila breviligulata* (American beachgrass)-dominated associations overlap geographically in New Jersey. This association is often adjacent to *Hudsonia tomentosa* (woolly beachheather) dwarf-shrublands and they have much species overlap; when dwarf-shrub cover exceeds 25%, the association is considered *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143).

Similar Associations:

- *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043)
- *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143)

Related Concepts:

- Coastal dune community (Rawinski 1984)
- Coastal dune grass community (Breden 1989)
- Dune grass community (Nelson and Fink 1980)
- Dunegrass (Martin 1959)

Sources

Description Authors: S.L. Neid

References: Breden 1989, Breden et al. 2001, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2001, Gawler 2002, Johnson 1981b, Johnson 1985b, Martin 1959, Metzler and Barrett 2001, Moul 1969, USDA-NRCS 2001, Nelson and Fink 1980, Rawinski 1984, Reschke 1990, Sperduto 1997a, Swain and Kearsley 2001, Zaremba and Leatherman 1984.



Figure F-25. Northern Beachgrass Vegetation on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.027). September 2006. NAD 1983 / UTM easting 334358, northing 4686932.



Figure F-26. Northern Beachgrass Vegetation on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.035). September 2006. NAD 1983 / UTM easting 334201, northing 4686114.

Common Name (Park-specific): Overwash Grassland

Synonyms

USNVC English Name: Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation

USNVC Scientific Name: S*partina patens – (Schoenoplectus pungens) - Solidago sempervirens* Herbaceous Vegetation

USNVC Identifier: CEGL004097

Local Information

Environmental Description: This association typically occurs in shallow depressions and gravel overwash flats located on the landward side of Beach, Beach Strand, North Atlantic Low Marsh and North Atlantic High Salt Marsh. The substrate consists of coarse gravel or sand overwash overlying poorly drained fine sand or peat and lacking horizon development. It is intermittently flooded by spring and storm tides and exposure to high energy waves at high tide, making it a brackish association.

Vegetation Description: The dominant vegetation of this overwash association typically consists of a mixture of *Spartina patens* (saltmeadow cordgrass) and *Solidago sempervirens* (seaside goldenrod). In some examples, *Spartina patens* (saltmeadow cordgrass) is absent and in other examples vegetation can be sparse. Species diversity is variable and usually low. *Juncus gerardii* (saltmeadow rush), *Sarcocornia perennis* (chickenclaws), *Distichilis spicata* (inland saltgrass), *Suaeda linearis* (annual seepweed), and *Bassia hirsuta* (hairy smotherweed), may be locally dominant. Associated species that sporadically occur include *Juncus gerardii* (saltmeadow rush), *Festuca rubra* (red fescue), *Elymus repens* (quackgrass), *Corynephorus canescens* (gray clubawn grass), *Arenaria serpyllifolia* (thymeleaf sandwort), *Limonium carolinianum* (Carolina sealavender), *Puccinellia maritima* (seaside alkaligrass), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Sabatia stellaris* (rose of Plymouth), *Ammophila breviligulata* (American beachgrass), *Atriplex patula* (spear saltbush), *Fimbristylis castanea* (marsh fimbry), and *Cakile edentula* ssp. *edentula* (American searocket).

Maritime shrubs, such as *Morella pensylvanica* (northern bayberry), *Juniperus virginiana* (eastern redcedar), *Amelanchier canadensis* (Canadian serviceberry), and *Rhus typhina* (staghorn sumac), are often located on the landward edge of this association. On Grape Island, Tiner (2003) describes this as "a slightly brackish(oligohaline) wetland inundated by salt water during overwash events: *Schoenoplectus pungens, Lythrum salicaria, Scirpus robustus, Verbena hastata, Galium* sp., *S. patens, Scirpus cyperinus, Epilobium* sp., *Agrostis palustris, Onoclea sensibilis,* and *C. canadense.*"

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNR	–	–	[not crosswalked]	–

Local Range: This association was observed on Peddock's, Thompson and Grape islands and likely occurs on others.

Classification Comments: This association occurs landward of Beach Strand and seaward of Atlantic Maritime Salt Shrub. Unlike the global description, in Boston Harbor Islands National Recreation Area, this association does not occur in a dune setting and does not have *Schoenoplectus pungens* (common threesquare).

Other Comments: AA point BOHA.AA120 did not have *Spartina patens* (saltmeadow cordgrass) present.

Local Description Authors: E. Largay, T. Elliman, R. Tiner.
Plots: BOHA.017, BOHA.019, BOHA.030.
AA Points: BOHA.AA75, BOHA.AA119, BOHA.AA120, BOHA.AA121
Boston Harbor Islands National Recreation Area Inventory Notes: Evidence of overwash and broken patches of vegetation help delineate this association and distinguish it from North Atlantic High Salt Marsh, which is dominated by *Spartina patens* (saltmeadow cordgrass).

Global Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate & Boreal Shrubland & Grassland (2.B)
Formation	Temperate & Boreal Scrub & Herb Coastal Vegetation (2.B.4)
Division	Eastern North American Dune & Coastal Grassland & Shrubland (D026)
Macrogroup	Eastern North American Dune & Coastal Grassland & Shrubland (M057)
Group	North Atlantic Coastal Shrub & Grass Dune (G493)
Alliance	*Spartina patens - Schoenoplectus pungens* Atlantic Overwash Dune Herbaceous Alliance (A1274)
Alliance (English name)	Saltmeadow Cordgrass - Common Threesquare Atlantic Overwash Dune Herbaceous Alliance
Association	*Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation

USNVC Classification (continued)

Classification Level	Description
Association (English name)	Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation
Ecological System(s)	Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)
	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)
	Northern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.264)

Global Description

Concept Summary: This association is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces ranging from Massachusetts to North Carolina. It forms a drier, later successional phase beginning from water-deposited sand of storm overwash. Sand movement, plant burial, and dune formation rates are not so high as to form *Ammophila breviligulata* (American beachgrass)-dominated primary dunes, but can be found as a fringe around the outer edge of those dunes. *Spartina patens* (saltmeadow cordgrass) is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens* (common threesquare) or *Solidago sempervirens* (seaside goldenrod). Less common associates can include *Cyperus grayi* (Gray's flatsedge), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Festuca rubra* (red fescue), *Schizachyrium littorale* (shore little bluestem), *Pseudognaphalium obtusifolium* (rabbittobacco), and occasional scattered individuals of *Toxicodendron radicans* (eastern poison ivy) and seedlings of *Baccharis halimifolia* (groundsel-tree). Bare sand is often visible through the vegetation, and there is no soil profile development. *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats) may invade from the surrounding dunes. This association appears to be a successional step between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Environmental Description: This association is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces. The plants of this association are influenced by water-deposited sand caused by storm surges. They differ ecologically from dune grasslands dominated by *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats), which are primarily impacted by wind-deposited sand. Storm overwash is a prevalent natural disturbance to this association.

Vegetation Description: *Spartina patens* (saltmeadow cordgrass) is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens* (common threesquare) or *Solidago sempervirens* (seaside goldenrod). Less common associates can include *Cyperus grayi* (Gray's flatsedge), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Festuca rubra* (red fescue), *Schizachyrium littorale* (shore little bluestem), *Pseudognaphalium obtusifolium* (rabbittobacco), and occasional scattered individuals of *Toxicodendron radicans* (eastern poison ivy) and seedlings of *Baccharis halimifolia* (groundsel-tree). *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats) may invade from the

surrounding dunes. This association is characterized by upland maritime dune grassland vegetation. *Spartina patens* (saltmeadow cordgrass), and sometimes *Schoenoplectus pungens* (common threesquare), or both are dominant on dunes or overwash terraces. Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Bare sand is often visible through the vegetation, and there is no soil profile development. Species diversity is variable; although it may be quite low and confined to the nominate species in the northern part of the range, it may be of greater diversity, including *Strophostyles helvola* (trailing fuzzybean), *Solidago sempervirens* (seaside goldenrod), *Cenchrus tribuloides* (sanddune sandbur), *Setaria parviflora* (marsh bristlegrass), *Distichlis spicata* (inland saltgrass), *Sabatia stellaris* (rose of Plymouth), *Ammophila breviligulata* (American beachgrass), *Suaeda linearis* (annual seepweed), *Bassia hirsuta* (hairy smotherweed), *Atriplex patula* (spear saltbush), *Fimbristylis castanea* (marsh fimbry), and *Cakile edentula* ssp. *edentula* (American searocket).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Solidago sempervirens* (seaside goldenrod)
	Graminoid	*Schoenoplectus pungens* (common threesquare)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Schoenoplectus pungens* (common threesquare), *Solidago sempervirens* (seaside goldenrod), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association is an upland dune grassland or overwash area of Atlantic barrier islands from Massachusetts to North Carolina.

States/Provinces: DE:S2S3, MA, MD, NC, NJ, NY, VA
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Fire Island, Gateway); USFWS (Back Bay?, Prime Hook)

Conservation Status
Rank: G2G3 (4-Nov-1998)
Reasons: This dune grassland association is restricted to overwash areas of major maritime dune systems. It is typically small in extent, not usually more than a few acres in size. It is best developed on barrier islands of Delaware, Maryland, Virginia, and North Carolina; it extends sporadically farther north to Massachusetts. As part of a dynamic system, the association is in a sense ephemeral, being buried over time by sand deposition, and being formed anew in other areas subjected to overwash. Because of the dynamic forces structuring the association, it requires sufficient area in large dune systems to accommodate this shifting mosaic. Although not extremely rare (an estimated 100-200 occurrence exist rangewide), the association is restricted to a specialized habitat and is

threatened by a number of activities, including dune stabilization, and outright destruction of habitat through human activities.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This association differs ecologically from dune grasslands dominated by *Ammophila breviligulata* (American beachgrass) or *Uniola paniculata* (seaoats), which are primarily impacted by wind-deposited sand. This association is impacted by wave-deposited sand. It is drier than brackish swales and vegetation that immediately colonizes water-borne sand from storm overwash, such as *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342). *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445) is a southern analog of this association that occurs along the Gulf Coast.

Similar Associations:
- *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342)
- *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445)

Related Concepts:
- Dry community of barrier flats (Travis and Godfrey 1976)
- Dry maritime grassland (Lea 2002)
- Dunegrass community (Higgins et al. 1971)
- Grassland community (Baumann 1978)
- Low dune community (Boule 1979)
- Maritime Dry Grassland (Typic Subtype) (Schafale 2000)
- Secondary dunes (Klotz 1986)
- Wash (Hill 1986)
- Wash (Higgins et al. 1971)

Sources
Description Authors: L.A. Sneddon

References: Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming et al. 2004, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, Klotz 1986, Lea 2002, USDA-NRCS 2001, Reschke 1990, Schafale 2000, Schafale 2003, Schafale and Weakley 1990, TNC 1995b, Travis and Godfrey 1976, Zaremba and Leatherman 1984.



Figure F-27. Overwash Grassland on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.030). September 2006. NAD 1983 / UTM easting 334046, northing 4686654.



Figure F-28. Overwash Grassland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.017). September 2006. NAD 1983 / UTM easting 340406, northing 4684193.

Common Name (Park-specific): Beach Strand

Synonyms

USNVC English Name: Sea-rocket - Northern Seaside Spurge Sparse Vegetation
USNVC Scientific Name: *Cakile edentula* ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation
USNVC Identifier: CEGL004400

Local Information

Environmental Description: Almost every island has a sandy, pebbly, stony, or gravel shoreline with a sparsely vegetated, linear band of herbaceous, salt-tolerant species growing at the upper tideline. The soil typically consists of unconsolidated sand, gravel, or cobble with no profile development. The beach substrate varies from island to island, but this association is more influenced by periodic flooding, overwash, tidal surges, coastal storms, and wind than it is by the underlying substrate.

Vegetation Description: Beach Strand species include *Artemisia campestris* ssp. *caudata* (field sagewort), *Artemisia vulgaris* (common wormwood), *Atriplex patula* (spear saltbush), *Bassia hirsuta* (hairy smotherweed), *Cakile edentula* ssp. *edulenta* (American searocket), *Chenopodium album* (lambsquarters), *Lathyrus japonicus* (beach pea), *Lepidium latifolium* (broadleaved pepperweed), *Oenothera biennis* (common evening-primrose), *Polygonum convolvulus* (black bindweed), *Raphanus raphanistrum* (wild radish), *Salsola kali* (Russian thistle), *Rumex crispus* (curly dock), *Solidago sempervirens* (seaside goldenrod), and *Xanthium strumarium* (rough cockleburr). The state rare (S2) *Rumex pallidus* (seaside dock) is also a beach strand species.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Artemisia campestris* ssp. *caudata* (field sagewort)
		Artemisia vulgaris (common wormwood)
		Xanthium strumarium (rough cockleburr)

Characteristic Species: *Atriplex patula* (spear saltbush), *Cakile edentula* ssp. *edentula* (American searocket)

Other Noteworthy Species

Species	GRank	Type	Note
Rumex pallidus (seaside dock)	–	plant	–

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3	–	1	Maritime Beach Strand Community	Swain and Kearsley 2001

Local Range: This association occurs on almost all of the Boston Harbor islands and peninsulas, including World's End, Grape, Thompson, Peddock's, and Long.

Classification Comments: This association is sparsely vegetated (<10% vegetation cover). It is often invaded by *Artemisia vulgaris* (common wormwood), and when this species is clearly dominant and abundant, the correct classification is Common Wormwood Gravel Field. It can be distinguished from the Overwash Grassland by the absence of *Spartina patens* (saltmeadow cordgrass) and the sparse cover of vegetation.

Other Comments: Maritime Beach Strand Community (Swain and Kearsley 2001) is ranked as an S3 community by the Massachusetts Natural Heritage and Endangered Species Program.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.016, BOHA.024, BOHA.042.
AA Points: BOHA.AA083
Boston Harbor Islands National Recreation Area Inventory Notes: This is a small patch association and it is mapped as an inclusion within the Beach map class in the vegetation map except where there is AA or Plot data.

Global Information

USNVC Classification

Classification Level	Description
Class	Mesomorphic Shrub & Herb Vegetation (2)
Subclass	Temperate and Boreal Shrubland & Grassland (2.B)
Formation	Temperate & Boreal Scrub & Herb Coastal Vegetation (2.B.4)
Division	Eastern North American Dune & Coastal Grassland & Shrubland (D026)
Macrogroup	Eastern North American Coastal Beach (M060)
Group	North Atlantic Coastal Beach (G660)
Alliance	*Cakile edentula ssp. edentula* Atlantic Beach Alliance (A3649)
Alliance (English name)	American Sea-rocket Atlantic Beach Alliance
Association	*Cakile edentula* ssp. *edentula - Chamaesyce polygonifolia* Sparse Vegetation
Association (English name)	Sea-rocket - Northern Seaside Spurge Sparse Vegetation
Ecological System(s)	Northern Atlantic Coastal Plain Sandy Beach (CES203.301)
	Central Atlantic Coastal Plain Sandy Beach (CES203.064)

Global Description

Concept Summary: This is a sparsely vegetated upper beach association occurring on unstable sands and often gravels and cobbles just above mean high tide on maritime beaches and foredunes along the middle and northern Atlantic coast. This association occurs at the wrack line; there is regular deposition of wave-deposited flotsam. They are irregularly flooded by spring or storm tides. Vegetation cover is variable, depending on the amount of exposure to wave and wind action, but is generally sparse and characterized by annuals and biennials. Species composition can change

dramatically from year to year but frequently includes *Cakile edentula* ssp. *edentula* (American searocket), as well as *Salsola kali* ssp. *kali* (Russian thistle), *Chamaesyce polygonifolia* (seaside sandmat), *Honckenya peploides* (seaside sandplant), *Cenchrus tribuloides* (sanddune sandbur), *Amaranthus retroflexus* (redroot amaranth), *Chenopodium album* (lambsquarters), *Erechtites hieraciifolius* (American burnweed), *Xanthium strumarium* (rough cockleburr), and *Atriplex cristata* (crested saltbush). Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. Sparse *Ammophila breviligulata* (American beachgrass) can occur sporadically as a common associate, colonizing from the adjacent beachgrass association. Diagnostic species are *Cakile edentula* ssp. *edentula* (American searocket), *Salsola kali* ssp. *kali* (Russian thistle), *Atriplex cristata* (crested saltbush), and *Chamaesyce polygonifolia* (seaside sandmat). This association occurs in maritime coastal areas from southern Maine to Cape Hatteras, North Carolina.

Environmental Description: This association occurs on unstable sands and often gravels and cobbles just above mean high tide on beaches and foredunes washed over by spring and storm tides and impacted by wind erosion.

Vegetation Description: This is a sparsely vegetated association characterized by annuals and biennials. Species composition is variable, but frequently includes *Cakile edentula* ssp. *edentula* (American searocket), *Arenaria peploides* (seaside sandplant), *Salsola kali* (Russian thistle), *Atriplex patula* (spear saltbush), *Cenchrus tribuloides* (sanddune sandbur), *Chamaesyce polygonifolia* (seaside sandmat), *Atriplex cristata* (crested saltbush), *Xanthium strumarium* (rough cockleburr), and *Chenopodium* sp. (goosefoot). Globally rare species such as *Polygonum glaucum* (seaside knotweed) and *Amaranthus pumilus* (seaside amaranth) occur in this habitat. *Ammophila breviligulata* (American beachgrass) can occur sporadically, colonizing from the adjacent beachgrass association. Additional infrequent species can include *Chenopodium rubrum* (red goosefoot), *Chenopodium album* (lambsquarters), *Chenopodium berlandieri var. macrocalycium* (pitseed goosefoot), *Cyperus filicinus* (fern flatsedge), *Triplasis purpurea* (purple sandgrass), and *Sesuvium maritimum* (slender seapurslane). Bare substrate can comprise greater than 95% cover in this association.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Atriplex cristata* (crested saltbush)
		Cakile edentula ssp. *edentula* (American searocket)
		Chamaesyce polygonifolia (seaside sandmat)
		Salsola kali ssp. *kali* (Russian thistle)

Characteristic Species: *Atriplex cristata* (crested saltbush), *Cakile edentula* ssp. *edentula* (American searocket), *Chamaesyce polygonifolia* (seaside sandmat), *Salsola kali* ssp. *kali* (Russian thistle)

Other Noteworthy Species

Species	GRank	Type	Note
Amaranthus pumilus (seaside amaranth)	G2	plant	-
Polygonum glaucum (seaside knotweed)	G3	plant	-

USFWS Wetland System: Not applicable.

Distribution
Range: This association ranges from southern Maine to North Carolina.
States/Provinces: CT, DE, MA:S3, MD, ME, NC, NH, NJ:S1S2, NY, RI, VA
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Muskeget Island); USFWS (Back Bay, Chesapeake Marshlands, Monomoy, Parker River)

Conservation Status
Rank: G4G5 (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This association is common on maritime dunes of the Northeast but is vulnerable to development and shifting wave action due to jetties. J. Harrison (pers. comm. 2006): "In the Chesapeake Marshlands, in Maryland, a small patch of this vegetation was observed on South Marsh Island [see Observation Point CM-15]. Please note many of the associated "maritime" species are not present in the refuge. Although not as well-developed in estuarine environments, consider expanding concept to include narrow sandy shorelines on bay islands."

Similar Associations:
- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162)
- *Cakile edentula* ssp. *edentula* - *Mertensia maritima* Sparse Vegetation (CEGL006106)
- *Cakile edentula* ssp. *harperi* Sparse Vegetation (CEGL004401)

Related Concepts:
- *Cakile edentula* - *Chenopodium album* community (Metzler and Barrett 1992)
- *Cakile edentula* ssp. *edentula* - *Salsola caroliniana* Sparse Vegetation (Bartgis 1986)
- *Cakiletum edentula* (Conard 1935)
- Beach (Fender 1937)
- Beach (McDonnell 1979)
- Beach (Higgins et al. 1971)
- Beach community (Johnson 1985b)
- Beach community (Hill 1986)
- Beach community (Baumann 1978)
- Beach strand community (MENHP 1991)

- Beach vegetation (Moul 1973)
- Coastal beach strand (Sperduto 1994)
- Coastal beach strand community (Rawinski 1984)
- Dune and swale community (Stalter 1990)
- Dune community (Jenkins 1974)
- Dune-strand area (Clovis 1968)
- Embryo dune (Klotz 1986)
- Marine intertidal gravel/sand beach community (Breden 1989)
- Marine sandy beach (Clancy 1993)
- Maritime beach (Reschke 1990)
- Middle beach (Nichols 1920)
- Middle beach (Shreve et al. 1910)
- Pioneer beach community (Boule 1979)
- Sea-strand vegetation, beach formation (Harshberger 1900)

Sources

Description Authors: S.L. Neid

References: Bartgis 1986, Baumann 1978, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Fleming et al. 2004, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Harrison 2004, Harshberger 1900, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Jenkins 1974, Johnson 1985b, Klotz 1986, MENHP 1991, McDonnell 1979, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, Nichols 1920, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1990, Swain and Kearsley 2001.



Figure F-29. Beach Strand on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.016). September 2006. NAD 1983 / UTM easting 340498, northing 4684486.



Figure F-30. Beach Strand on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.042). September 2006. NAD 1983 / UTM easting 337971, northing 4686510.

Common Name (Park-specific): Eastern Cattail Marsh

Synonyms

USNVC English Name: (Narrowleaf Cattail, Broadleaf Cattail) - (Bulrush species) Eastern Herbaceous Vegetation

USNVC Scientific Name: *Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation

USNVC Identifier: CEGL006153

Local Information

Environmental Description: Only one freshwater cattail marsh occurs in a low basin between rocky headlands on the east end of Middle Brewster Island in Boston Harbor Islands National Recreation Area. The substrate is muck over mineral soil. This association was dry when surveyed.

Vegetation Description: *Typha angustifolia* (narrowleaf cattail) is almost a monoculture in this small (0.25 ha) association situated in a low basin between rocky headlands. *Calystegia sepium* (hedge false bindweed), *Impatiens capensis* (jewelweed), *Solanum dulcamara* (climbing nightshade), *Datura stramonium* (jimsonweed), *Phytolacca americana* (American pokeweed), *Lycopus americanus* (American water horehound), and *Polygonum lapathifolium* (curlytop knotweed) are scattered beneath the cattails.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Typha angustifolia* (narrowleaf cattail)

Characteristic Species: *Typha angustifolia* (narrowleaf cattail)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	–	Deep emergent marsh	Swain and Kearsley 2001

Local Range: This association occurs on Middle Brewster Island.
Classification Comments: This association is distinguished from Cattail Brackish Tidal Marsh in that it is a freshwater association dominated by a monoculture of *Typha angustifolia* (narrowleaf cattail) and lacks *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow).

Other Comments: None.
Local Description Authors: T. Elliman and E. Largay
Plots: None.
AA Point: BOHA.AA178
Boston Harbor Islands National Recreation Area Inventory Notes: The one occurrence of this association is below the minimum map unit size.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
Division	Eastern North American Freshwater Wet Meadow, Riparian, & Marsh (D323)
Macrogroup	Eastern North American Wet Meadow and Marsh (M069)
Group	Eastern North American Freshwater Marsh (G125)
Alliance	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Deep Marsh Herbaceous Alliance (A1436)
Alliance (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Dep Marsh Herbaceous Alliance
Association	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation
Association (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation
Ecological System(s)	Laurentian-Acadian Freshwater Marsh (CES201.594)

Global Description

Concept Summary: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), or their hybrid *Typha X glauca* (blue cattail) dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis* (water sedge), *Carex lurida* (shallow sedge), *Carex rostrata* (beaked sedge), *Carex pellita* (woolly sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), and bulrushes, such as *Schoenoplectus americanus* (chairmaker's bulrush) and *Schoenoplectus acutus* (hardstem bulrush), occur along with patchy grasses, such as *Calamagrostis canadensis* (bluejoint). Broad-leaved herbs include *Thelypteris palustris* (eastern marsh fern), *Asclepias incarnata* (swamp milkweed), *Onoclea sensibilis* (sensitive fern), *Symplocarpus foetidus* (skunk cabbage), *Calla palustris* (water arum), *Impatiens capensis* (jewelweed), *Sagittaria latifolia* (broadleaf arrowhead), *Scutellaria lateriflora* (blue skullcap), *Sparganium eurycarpum* (broadfruit bur-reed), and *Verbena hastata* (swamp verbena). Floating aquatics, such as *Lemna minor* (common duckweed), may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale* (sweetgale), *Ilex verticillata* (common winterberry), and *Spiraea alba* (white

meadowsweet) are common. The invasive exotic plants *Lythrum salicaria* (purple loosestrife) and *Phragmites australis* (common reed) may be abundant in parts of some occurrences. This association is distinguished from other northeastern freshwater marshes by the strong dominance of *Typha* spp. (cattail).

Environmental Description: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. This association is often found in impounded waters.

Vegetation Description: Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail), or their hybrid *Typha X glauca* (blue cattail) dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis* (water sedge), *Carex lurida* (shallow sedge), *Carex rostrata* (beaked sedge), *Carex pellita* (woolly sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), and bulrushes, such as *Schoenoplectus americanus* (chairmaker's bulrush) and *Schoenoplectus acutus* (hardstem bulrush), occur along with patchy grasses, such as *Calamagrostis canadensis* (bluejoint). Broad-leaved herbs include *Thelypteris palustris* (eastern marsh fern), *Asclepias incarnata* (swamp milkweed), *Onoclea sensibilis* (sensitive fern), *Symplocarpus foetidus* (skunk cabbage), *Calla palustris* (water arum), *Impatiens capensis* (jewelweed), *Sagittaria latifolia* (broadleaf arrowhead), *Scutellaria lateriflora* (blue skullcap), *Sparganium eurycarpum* (broadfruit bur-reed), and *Verbena hastata* (swamp verbena). Floating aquatics, such as *Lemna minor* (common duckweed), may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale* (sweetgale), *Ilex verticillata* (common winterberry), and *Spiraea alba* (white meadowsweet) are common. The invasive exotic plants *Lythrum salicaria* (purple loosestrife) and *Phragmites australis* (common reed) may be abundant in parts of some occurrences.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Typha angustifolia* (narrowleaf cattail)
		Typha latifolia (broadleaf cattail)
		Typha x *glauca* (blue cattail)

Characteristic Species: *Onoclea sensibilis* (sensitive fern), *Schoenoplectus acutus* (hardstem bulrush), *Schoenoplectus americanus* (chairmaker's bulrush), *Typha angustifolia* (narrowleaf cattail), *Typha latifolia* (broadleaf cattail)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

Distribution
Range: This association occurs throughout the northeastern U.S. from Maine to North Carolina.
States/Provinces: CT, DE, MA, MD, ME:S5, NC, NH:S4?, NJ:S5, NY, PA:S5, RI, VA, VT, WV
Federal Lands: NPS (Acadia, Blue Ridge Parkway?, Boston Harbor Islands, Cape Cod, Delaware Water Gap, Johnstown Flood, Minute Man, Saint-Gaudens, Upper Delaware); USFS (Nantahala?, Pisgah?); USFWS (Aroostook, Assabet River, Carlton Pond?, Erie, Great Meadows, Great Swamp, Moosehorn, Nomans Land Island, Nulhegan Basin, Oxbow, Pondicherry?, Prime Hook)

Conservation Status
Rank: G5 (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: *Typha angustifolia* (narrowleaf cattail) can grow in deeper water compared to *Typha latifolia* (broadleaf cattail), although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). *Typha* (cattail) often occurs in pure stands and can colonize areas recently exposed by either natural or human causes.

Similar Associations:
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233)

Related Concepts:
- Cattail Marsh (Thompson 1996)
- Cattail marsh (CAP pers. comm. 1998)
- Palustrine Narrow-leaved Persistent Emergent Wetland, Permanently Flooded (PEM5H) (Cowardin et al. 1979)
- Robust Emergent Marsh (Breden 1989)
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984)
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984)

Sources
Description Authors: S.C. Gawler
References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Grace and

Wetzel 1981, Harrison 2004, Metzler and Barrett 2001, Northern Appalachian Ecology Working Group 2000, Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.



Figure F-31. Eastern Cattail Marsh on Middle Brewster Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA178). September 2006. NAD 1983 / UTM easting 344574, northing 4689137.

Common Name (Park-specific): Northeastern Buttonbush Shrub Swamp

Synonyms

USNVC English Name: Common Buttonbush - Swamp-loosestrife Shrubland
USNVC Scientific Name: *Cephalanthus occidentalis* - *Decodon verticillatus* Shrubland
USNVC Identifier: CEGL006069

Local Information

Environmental Description: This association occurs along the edges of an artificial ice pond on the northeast side of World's End. The pond was constructed over 100 years ago and occurs as an isolated depression. The pond is flooded for much of the growing season with the water table receding below the soil surface only during drought or very late in the growing season. The soil consists of organic muck.

Vegetation Description: The artificial ice pond on the northeast side of World's End has a dense growth of *Cephalanthus occidentalis* (common buttonbush) on its edges. *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Lythrum salicaria* (purple loosestrife), and *Rhynchospora capitellata* (brownish beaksedge) occur alongside the pond. Scattered *Acer rubrum* (red maple) trees fringe the edge of the perimeter of the pond.

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis* (common buttonbush)

Characteristic Species: *Cephalanthus occidentalis* (common buttonbush)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S5*	B	–	Shrub Swamp	Swain and Kearsley 2001

Local Range: This association was only observed once and is associated with the ice pond at World's End in Boston Harbor Islands National Recreation Area.

Classification Comments: A small fringe of red maple (*Acer rubrum*) and *Vaccinium corymbosum* (highbush blueberry) occurs adjacent to this association on World's End but is very small patch and not mappable.

Other Comments: This artificial pond was constructed in the early 20th century. Hopping (2000) suggests that this pond may function as a vernal pool, but Karanaukas (2001) did not find aquatic species characteristic of vernal pools there (Elliman 2005).

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.011.
AA Points: BOHA.AA166, BOHA.AA167

Boston Harbor Islands National Recreation Area Inventory Notes: This association is below minimum map size but is still depicted on the vegetation map.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
Division	Eastern North American Freshwater Wet Meadow, Riparian, & Marsh (D323)
Macrogroup	Eastern North American Wet Meadow and Marsh (M069)
Group	Northern & Central Shrub Swamp (G167)
Alliance	*Cephalanthus occidentalis - Decodon verticillatus* Semipermanently Flooded Shrub Swamp Alliance (A3670)
Alliance (English name)	Common Buttonbush – Swamp-loosestrife Semipermanently Flooded Shrub Swamp Alliance
Association	*Cephalanthus occidentalis - Decodon verticillatus* Shrubland
Association (English name)	Common Buttonbush - Swamp-loosestrife Shrubland
Ecological System(s)	Laurentian-Acadian Floodplain Forest (CES201.587)
	Central Appalachian River Floodplain (CES202.608)

Global Description

Concept Summary: This buttonbush swamp occurs in the northeastern United States. These swamps experience prolonged or semipermanent flooding for much of the growing season, with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings, including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small, isolated depressions where water levels recede very slowly, such as those with perched water tables. The substrate is typically loose muck. *Cephalanthus occidentalis* (common buttonbush) is dominant and often monotypic. Occasional associates depend on the environmental setting and most often occur in drier areas. They include *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), *Acer rubrum* (red maple), *Cornus* sp. (dogwood) closer to upland borders, or *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), and *Viburnum dentatum* (southern arrowwood) where adjacent to floodplains, or *Decodon verticillatus* (swamp loosestrife), *Chamaedaphne calyculata* (leatherleaf), and *Spiraea alba var. latifolia* (white meadowsweet) in more stagnant basins. Herbaceous species tend to be sparse but can include *Glyceria canadensis* (rattlesnake mannagrass), *Dulichium arundinaceum* (threeway sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), *Thelypteris palustris* (eastern marsh fern), *Leersia oryzoides* (rice cutgrass), *Acorus calamus* (calamus), *Alisma plantago-aquatica* (American waterplantain), *Polygonum* sp. (knotweed), *Sparganium* sp. (bur-reed), and floating or submerged aquatic species such as *Lemna minor* (common duckweed), *Potamogeton natans* (floating pondweed), and *Nuphar lutea ssp. variegata*

(varigated yellow pond-lily). Bryophytes, if present, cling to shrub bases and include *Warnstorfia fluitans* (warnstorfia moss), *Drepanocladus aduncus* (drepanocladus moss), or *Sphagnum fallax* (sphagnum). In disturbed areas, these wetland may be invaded by *Lythrum salicaria* (purple loosestrife).

Environmental Description: This association includes buttonbush swamps that experience prolonged or semipermanent flooding for much of the growing season with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small, isolated depressions where water levels recede very slowly, such as those with perched water tables. Soils are often organic mucks or silt loams.

Vegetation Description: This association includes buttonbush swamps of the eastern and northeastern United States. These swamps experience prolonged or semipermanent flooding for much of the growing season with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small isolated depressions where water levels recede very slowly, such as those with perched water tables. *Cephalanthus occidentalis* (common buttonbush) is dominant and often monotypic. Scattered *Acer rubrum* (red maple) trees may be present in the wetland. Occasional associates depend on the environmental setting, and some only occur in drier areas. They include *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), *Acer rubrum* (red maple), *Salix* sp. (willow), *Cornus amomum* (silky dogwood) or *Cornus sericea* (redosier dogwood) closer to upland borders, or *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), or *Viburnum dentatum* (southern arrowwood) where adjacent to floodplains, or *Decodon verticillatus* (swamp loosestrife), *Chamaedaphne calyculata* (leatherleaf), and *Spiraea alba var. latifolia* (white meadowsweet) in more stagnant basins. Herbaceous species tend to be sparse but can include *Glyceria canadensis* (rattlesnake mannagrass), *Dulichium arundinaceum* (threeway sedge), *Carex stricta* (upright sedge), *Scirpus cyperinus* (woolgrass), *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Bidens* sp. (beggarticks), *Sium suave* (hemlock waterparsnip), *Scutellaria lateriflora* (blue skullcap), *Alisma plantago-aquatica* (American waterplantain), *Polygonum* spp. (knotweed), *Sparganium* sp. (bur-reed), and floating or submerged aquatic species such as *Lemna minor* (common duckweed), *Potamogeton natans* (floating pondweed), and *Nuphar lutea ssp. variegata* (varigated yellow pond-lily). Bryophytes, if present, cling to shrub bases and include *Warnstorfia fluitans* (warnstorfia moss), *Drepanocladus aduncus* (drepanocladus moss), or *Sphagnum fallax* (sphagnum).

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis* (common buttonbush)
Herb (field)	Graminoid	*Dulichium arundinaceum* (threeway sedge)

Characteristic Species: *Cephalanthus occidentalis* (common buttonbush), *Dulichium arundinaceum* (threeway sedge), *Osmunda regalis* (royal fern), *Sparganium americanum* (American bur-reed), *Vaccinium corymbosum* (highbush blueberry)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

Distribution
Range: This association is found throughout the northeastern United States (an estimated 450,000 square km based on subsection attribution).

States/Provinces: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV?
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Delaware Water Gap, Minute Man, Weir Farm); USFWS (Assabet River?, Chesapeake Marshlands, Great Meadows, Great Swamp, Oxbow)

Conservation Status
Rank: G4G5 (31-Jan-2007)
Reasons: This association is widely distributed in the northeastern U.S. and relatively common in its small-patch setting. It is vulnerable to groundwater disruption, agricultural runoff, and adjacent forest clearing.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This type may be synonymous with *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190), although it also ranges south of the glaciation boundary in the east. CEGL002190 is distributed from the Western Allegheny Plateau (TNC Ecoregion 49) and Great Lakes (TNC Ecoregion 48) west to the Central Tallgrass Prairie (TNC Ecoregion 36), while this type occurs from the Central Appalachian Forest (TNC Ecoregion 59) and High Allegheny Plateau (TNC Ecoregion 60) east.

Similar Associations:

- *Cephalanthus occidentalis* - (*Leucothoe racemosa*) / *Carex joorii* Shrubland (CEGL004075)
- *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191)
- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190)

Related Concepts:

- Buttonbush Swamp (Kettle Basin Shrub Swamp) (Thompson 1996)
- Buttonbush semipermanently flooded shrub swamp (CAP pers. comm. 1998)
- Palustrine Broad-leaved Deciduous Scrub-Shrub Wetland, Seasonally Flooded (PSS1C) (Cowardin et al. 1979)

Sources
Description Authors: S.L. Neid, mod. E. Southgate, L.A. Sneddon, S.C. Gawler, E. Largay

References: Bowman 2000, Breden et al. 2001, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Elliman 2004, Enser 1999, Fike 1999, Fleming et al. 2004, Gawler 2002, Harrison 2004, Hopping 2000, J. Harrison pers. comm., Karanaukas 2001, Metzler and Barrett 2001, Nichols et al. 2001, Sperduto 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.



Figure F-32. Northeastern Buttonbush Shrub Swamp on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.011). September 2006. NAD 1983 / UTM easting 345756, northing 4680919.

Common Name (Park-specific): Eastern Reed Marsh

Synonyms

USNVC English Name: Common Reed Eastern North America Temperate Ruderal Herbaceous Vegetation
USNVC Scientific Name: *Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation
USNVC Identifier: CEGL004141

Local Information

Environmental Description: This freshwater-influenced marsh association occurs in areas associated with disturbance. These marshes are seasonally flooded. Soils consist of peat with dense *Phragmites australis* (common reed) rhizome networks holding the substrate together.

Vegetation Description: *Phragmites australis* (common reed) dominates the vegetation of this marsh and typically forms monocultures. Associated species may include *Phalaris arundinacea* (reed canarygrass) and *Lythrum salicaria* (purple loosestrife).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: Phragmites australis (common reed)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	–	Deep emergent marsh	Swain and Kearsley 2001

Local Range: *Phragmites australis* (common reed) marshes are located on Grape, Great Brewster, Long, Lovells, Thompson islands and Webb State Park.

Classification Comments: This association differs from Reed-grass Tidal Marsh in that it is not tidally influenced.

Other Comments: Some examples of this association have overtaken and outcompeted salt marsh grasses in depressions that have been impounded by roads and are no longer tidally influenced.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.045.
AA Points: BOHA.AA058, BOHA.AA126, BOHA.AA127, BOHA.AA160, BOHA.AA164, BOHA.AA174, BOHA.AA175

Boston Harbr Islands National Park Area Inventory Notes: Polygons attributed to the *Phragmites australis* (common reed) Assemblage in the Bell et al. (2002) study were adopted into

the vegetation map. Evidence for tidal influence was observed in the orthophotos and ancillary data to assign the polygons to the freshwater-influenced association (CEGL004141) or the tidally influenced association (CEGL004187).

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
Division	Eastern North American Freshwater Wet Meadow, Riparian, & Marsh (D323)
Macrogroup	Eastern North American Ruderal Wet Meadow and Marsh (M303)
Group	Northern and Central Ruderal Wet Meadow and Marsh (G556)
Alliance	*Phragmites australis* Ruderal Herbaceous Alliance (A1431)
Alliance (English name)	Common Reed Ruderal Herbaceous Alliance
Association	*Phragmites australis* Eastern North America Temperate Ruderal Herbaceous Vegetation
Association (English name)	Common Reed Eastern North America Temperate Ruderal Herbaceous Vegetation
Ecological System(s)	Southeastern Coastal Plain Interdunal Wetland (CES203.258)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
	Laurentian-Acadian Freshwater Marsh (CES201.594)
	North-Central Interior Freshwater Marsh (CES202.899)

Global Description

Concept Summary: This reed marsh type is found across the east-temperate regions of the United States and Canada. Stands occur in semipermanently flooded marshes, ditches, impoundments, etc., that have often been disturbed by human activity. The vegetation is variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural associations present on the site. Once firmly established, this association is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

Environmental Description: Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

Vegetation Description: The vegetation is often variable, as *Phragmites australis* (common reed) will often invade into existing natural or semi-natural associations present on the site. Once firmly established, this association is usually strongly dominated by *Phragmites australis* (common reed), with few or no other vascular plants present.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine

Distribution
Range: This reed marsh type is found across the east-temperate regions of the United States and Canada, ranging from Maine west to the eastern Dakotas and Manitoba, south to Texas and east to Florida.

States/Provinces: AL, AR, CT, DE, FL, GA, IA, IN, LA, MA, MD, ME, MI, MN, MS, NC, NH, NJ, NY, OH, ON, PA, RI, SC, TX, VA, VT, WI, WV

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Indiana Dunes, Minute Man, Upper Delaware, Voyageurs); USFWS (Alligator River, Aransas, Bon Secour, Brazoria, Great Dismal Swamp, Great Meadows, Great Swamp, Matagorda Island, Nomans Land Island?, Oxbow, Parker River, Prime Hook)

Conservation Status
Rank: GNA (invasive) (23-Nov-1997)
Reasons: Although almost always occurring as a naturalized type that arises from human disturbance, some stands in northern Minnesota and further north in Canada may be native. If so, they should be tracked as a separate type.

Classification Information
Status: Standard
Confidence: 1 - Strong
Comments: This is not a native association but is the result of the invasion of alien *Phragmites australis* (common reed) into natural or semi-natural vegetation. The vegetation has variable hydrology and, unless *Phragmites australis* (common reed) is clearly dominant, is often treated as part of other marsh and meadow types. The geographic distribution of the type is arbitrarily limited to Bailey's Humid Temperate Domain in eastern North America (Bailey 1997, 1998). Stands in northern Minnesota and farther north in Canada may represent native stands. If so, they should be tracked as a different type. Tidal vegetation of the Gulf Coast of Louisiana and Texas dominated by *Phragmites australis* (common reed) is classified in the *Phragmites australis* (common reed) Tidal Herbaceous Alliance (A.1477).

Similar Associations:

- *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475)

Related Concepts:

- *Phragmites australis* community (Metzler and Barrett 1992)
- *Phragmites australis* tidal marsh association (Clancy 1993)
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984)
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984)

Sources

Description Authors: D. Faber-Langendoen

References: Bailey 1997, Bailey 1998, Bell et al. 2002, Clancy 1993, Harris et al. 1996, INAI unpubl. data, Metzler and Barrett 1992, Metzler and Barrett 2001, Nelson 1986, Rawinski 1984, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001.



Figure F-33. Eastern Reed Marsh on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.045). September 2006. NAD 1983 / UTM easting 337525, northing 4686420.

Common Name (Park-specific): Reed-grass Tidal Marsh

Synonyms

USNVC English Name: Common Reed Tidal Ruderal Herbaceous Vegetation
USNVC Scientific Name: *Phragmites australis* Tidal Ruderal Herbaceous Vegetation
USNVC Identifier: CEGL004187

Local Information

Environmental Description: This tidally influenced brackish association occurs in large patches at the head of Damde Meadows on World's End, on Thompson, Peddocks and Snake islands. It also occurs in small patches at bases of steep drumlin heads. This temporarily, tidally flooded association occurs on muck soils.

Vegetation Description: *Phragmites australis* (common reed) dominates the marsh and typically forms a monoculture. *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow) grows sporadically intermixed amongst *Phragmites australis* (common reed) at World's End.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	–	Brackish Tidal Marsh	Swain and Kearsley 2001

Local Range: This tidally influenced brackish association occurs at the head of Damde Meadows on World's End, Thompson, Snake, and Peddocks islands and in small patches on Calf, Moon, and Bumpkin islands.

Classification Comments: The associations described in the MA vegetation classification and the USNVC are not equivalent in concept. The MA community type, Brackish Tidal Marsh, is broader in concept than the USNVC association Reed-grass Tidal Marsh. Under the MA classification, Brackish Tidal Marsh is ranked as a S1 type and it can include multiple USNVC associations that occur in the same environmental setting. Reed-grass Tidal Marsh, although invasive and not of conservation concern with a Grank of GNA (invasive) invades and persists in what is called Brackish Tidal Marsh in the MA classification; therefore, it is crosswalked to the MA classification unit. This association differs from Eastern Reed Marsh because it is tidally influenced and brackish.

Other Comments: The examples of this association on Thompson Island and World's End are active salt marsh restoration sites, where tidal gates are opened for prolonged periods of time in an effort to increase tidal flushing and expose *Phragmites australis* (common reed) to higher salinity levels and encourage the re-establishment of *Spartina* (cordgrass) species.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.007.
AA Points: BOHA.AA123, BOHA.AA135, BOHA.AA137, BOHA.AA169
Boston Harbor Islands National Recreation Area Inventory Notes: This association was mapped where it was known to occur from past studies and from one plot. It is possible some of the mapped Eastern Reed Marsh is actually Reed-grass Tidal Marsh, but sites were not visited in the field to confirm. The signatures of the two *Phragmites australis* (common reed) associations are the same in the orthophotos. Polygons attributed to the *Phragmites* (common reed) Assemblage in the Bell et al. (2002) study were adopted into the vegetation map. Evidence for tidal influence was observed in the orthophotos and ancillary data to assign the polygons to the freshwater-influenced association (CEGL004141) or the tidally influenced association (CEGL004187).

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)
Division	Eastern North American Freshwater Wet Meadow, Riparian, & Marsh (D323)
Macrogroup	Eastern North American Ruderal Wet Meadow and Marsh (M303)
Group	Northern and Central Ruderal Wet Meadow and Marsh (G556)
Alliance	Phragmites australis Ruderal Herbaceous Alliance (A1431)
Alliance (English name)	Common Reed Ruderal Herbaceous Alliance
Association	Phragmites australis Tidal Ruderal Herbaceous Vegetation
Association (English name)	Common Reed Tidal Ruderal Herbaceous Vegetation
Ecological System(s)	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)
	Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

Global Description

Concept Summary: This association is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the association that has been invaded. Spreading in large colonies, *Phragmites australis* (common reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia*

(narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent, but typically occur at low cover. This association has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

Environmental Description: This association is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity.

Vegetation Description: This association is a broadly defined reed-grass marsh. It is characterized by dense stands of *Phragmites australis* (common reed), a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the association that has been invaded. Spreading in large colonies, *Phragmites australis* (common reed) eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera* (wax myrtle) shrubs, *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Calystegia sepium* (hedge false bindweed), *Boehmeria cylindrica* (smallspike false nettle), *Typha angustifolia* (narrowleaf cattail), *Apocynum cannabinum* (Indianhemp), *Rosa palustris* (swamp rose), *Polygonum* (knotweed) sp., and *Mikania scandens* (climbing hempvine). Vines of *Toxicodendron radicans* (eastern poison ivy) are also frequent but typically occur at low cover.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phragmites australis* (common reed)

Characteristic Species: *Phragmites australis* (common reed)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution
Range: This association has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

States/Provinces: AL, CT, DE, FL, GA, LA, LB?, MA, MD, ME, MS, NC, NF?, NH, NJ, NS?, NY, PA, PE?, QC?, RI, SC, TX, VA

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Colonial, Fire Island, Gateway, George Washington Birthplace, George Washington Parkway, National Capital-East?, Saugus Iron Works); USFWS (Back Bay, Bon Secour, Cape May, Chesapeake Marshlands, E.B. Forsythe, Supawna Meadows)

Conservation Status
Rank: GNA (invasive) (22-Nov-1997)
Reasons: Information not available.

Classification Information

Status: Standard

Confidence: 1 - Strong

Comments: Although *Phragmites australis* (common reed) rhizomes have been noted in salt marsh sediments exceeding three thousand years in age (Niering and Warren 1977) and is thus a native component of salt marshes in some areas in North America, the growth of the species in its native condition was likely to have been significantly different than the dense monotypic stands that characterize this association in parts of its range today. The invasive, non-native strain has been labeled haplotype M (Saltonstall 2002). The presence of the *Phragmites australis* (common reed) association in wetlands today generally indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. Historically, without alteration, these sites would generally be more saline. In New England, *Phragmites australis* (common reed) tends to invade behind artificial/man-made levees where regular salt input is blocked, making the sites more brackish and less saline than prior to levee construction and anthropogenic modification. In cases where *Phragmites australis* (common reed) is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that original association. Where *Phragmites australis* (common reed) cover is so high that native species have been excluded and the original association is no longer recognizable, the occurrence is then treated as an example of *Phragmites australis* (common reed) Tidal Herbaceous Vegetation (CEGL004187).

Similar Associations:

- *Phragmites australis* - (*Sagittaria platyphylla, Vigna luteola*) Tidal Herbaceous Vegetation (CEGL007891)
- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141)

Related Concepts:

- *Phragmites australis* Association (Fleming 1998)
- *Phragmites australis* community (Metzler and Barrett 1992)
- *Phragmites australis* tidal marsh association (Clancy 1993)
- Brackish Tidal Marsh (Rawinski 1984)
- Salt Marsh Complex (Breden 1989)

Sources

Description Authors: R.E. Zaremba

References: Bell et al. 2002, Bowman 2000, Breden 1989, Clancy 1993, Edinger et al. 2002, Fleming 1998, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, USDA-NRCS 2001, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Rawinski 1984, Saltonstall 2002, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001.



Figure F-34. Reed-grass Tidal Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.007). September 2006. NAD 1983 / UTM easting 345680, northing 4680472.

Common Name (Park-specific): Wet Meadow

Synonyms

USNVC English Name: Steeplebush - Blackberry species / Reed Canarygrass Ruderal Shrubland

USNVC Scientific Name: *Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Ruderal Shrubland

USNVC Identifier: CEGL006571

Local Information

Environmental Description: This wet meadow association occurs frequently in low-lying areas of old fields or pastures. It typically floods early in the growing season and may be saturated to near the surface for some of the growing season, but they are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface.

Vegetation Description: This association ranges in physiognomy from shrub thicket to herbaceous meadow with scattered shrubs. The example at World's End occurs at the bottom of a Northeastern Old Field that is mowed annually. It is dominated by an admixture of *Scirpus atrovirens* (green bulrush), *Solidago rugosa* (wrinkleleaf goldenrod), *Lycopus uniflorus* (northern bugleweed), *Eutrochium maculatum* (spotted joepyeweed), and *Symphyotrichum novi-belgii* (New York aster). Scattered individuals of *Onoclea sensibilis* (sensitive fern), *Carex scoparia* (broom sedge), *Poa pratensis* (Kentucky bluegrass), and *Impatiens capensis* (jewelweed) are also present. Scattered shrubs, including *Viburnum dentatum* (southern arrowwood) and *Rosa multiflora* (multiflora rose), occur throughout the meadow. Webb State Park has one depressional "freshwater marsh" in the central part of the island. *Phragmites australis* (common reed) and *Phalaris arundinacea* (reed canarygrass) dominate this disturbed habitat. *Carex scoparia* (broom sedge), *Eutrochium maculatum* (spotted joepyeweed), *Impatiens capensis* (jewelweed), *Spiraea alba var. latifolia* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and *Teucrium canadense* (Canada germander) also grow in this meadow, along with *Solidago* spp. (goldenrods), *Toxicodendron radicans* (eastern poison ivy), and other typically upland plants. Thompson has a similar wet meadow formed from *Phragmites australis* (common reed) and *Lythrum salicaria* (purple loosestrife) eradication. Small moist thicket/wet meadows also occur on Outer Brewster Island and Calf. They are dominated by *Salix bebbiana* (Bebb willow) and *Rhus typhina* (staghorn sumac) along with *Apios americana* (groundnut), *Epilobium hirsutum* (codlins and cream), *Impatiens capensis* (jewelweed), *Lycopus americanus* (American water horehound) and *Iris versicolor* (harliquin blueflag).

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus* spp. (blackberry)
		Viburnum dentatum (southern arrowwood)
		Salix bebbiana (Bebb willow)

Most Abundant Species (continued)

Stratum	Lifeform	Species
Herb (field)	Forb	*Eutrichium maculatum* (spotted joepyeweed)
		Impatiens capensis (jewelweed)
		Lycopus americanus (American water horehound)
		Solidago rugosa (wrinkleleaf goldenrod)
Herb (field)	Graminoid	*Carex scoparia* (broom sedge)
		Phalaris arundinacea (reed canarygrass)
Herb (field)	Fern or fern ally	*Onoclea sensibilis* (sensitive fern)

Characteristic Species: *Onoclea sensibilis* (sensitive fern), *Carex scoparia* (broom sedge), *Lycopus americanus* (American water horehound)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNR	–	–	[not crosswalked]	–

Local Range: This wet meadow association has been identified on World's End, Thompson, Calf, and Outer Brewster islands. A small patch occurs on Webb State Park. It likely occurs on other islands and peninsulas in association with wet Northeastern Old Field.

Classification Comments: This association differs from Northeastern Old Field in that the soils are seasonally flooded for part of the growing season and the association has facultative and obligate wetland species.

Other Comments: None.
Local Description Authors: E. Largay and T. Elliman
Plots: BOHA.023.
AA Points: BOHA.AA161, BOHA.AA176, BOHA.AA186
Boston Harbor Islands National Recreation Area Inventory Notes: This association may undergo the same management as Northeastern Old Field. The signature on the orthophoto for this association is very hard to distinguish from Northeastern Old Field. The example at Webb State Park described by Elliman 2004 is not mapped as it was not observed during accuracy assessment.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland (2.C.4)

USNVC Classification (continued)

Classification Level	Description
Division	Eastern North American Freshwater Wet Meadow, Riparian, & Marsh (D323)
Macrogroup	Eastern North American Ruderal Wet Meadow and Marsh (M303)
Group	Northern and Central Ruderal Wet Meadow and Marsh (G556)
Alliance	*Spiraea tomentosa - Rubus* spp. Shrubland Alliance (A4106)
Alliance (English name)	Steeplebush - Blackberry species Shrubland Alliance
Association	*Spiraea tomentosa - Rubus* spp. / *Phalaris arundinacea* Ruderal Shrubland
Association (English name)	Steeplebush - Blackberry species / Reed Canarygrass Ruderal Shrubland
Ecological System(s)	High Allegheny Wetland (CES202.069)

Global Description

Concept Summary: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, headwater basins, or beaver-impacted wetlands. The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Shrub species usually include *Spiraea tomentosa* (steeplebush), *Spiraea alba var. alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Rubus allegheniensis* (Allegheny blackberry), *Rubus hispidus* (bristly dewberry), *Salix* sp. (willow), and others. *Hypericum densiflorum* (bushy St. Johnswort) often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* (Morrow's honeysuckle) and *Rosa multiflora* (multiflora rose) may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea* (reed canarygrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Solidago canadensis* (Canada goldenrod), *Juncus effusus* (common rush), *Scirpus cyperinus* (woolgrass), *Scirpus expansus* (woodland bulrush), *Leersia oryzoides* (rice cutgrass), *Calamagrostis canadensis* (bluejoint), *Carex scoparia* (broom sedge), *Carex folliculata* (northern long sedge), *Carex lurida* (shallow sedge), *Carex lupulina* (hop sedge), *Carex vulpinoidea* (fox sedge), *Carex trichocarpa* (hairyfruit sedge), *Vernonia noveboracensis* (New York ironweed), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Lycopus uniflorus* (northern bugleweed), *Impatiens capensis* (jewelweed), *Eutrochium maculatum* (spotted joepyeweed), *Polygonum sagittatum* (arrowleaf tearthumb), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Eleocharis* sp. (spikerush), and others. The invasive species *Microstegium vimineum* (Nepalese browntop), *Lythrum salicaria* (purple loosestrife), and *Phragmites australis* (common reed) can be abundant or form monocultures in these wetlands.

Environmental Description: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, headwater basins, or beaver-impacted wetlands. These wetlands typically flood early in the growing season and may be saturated to near the surface for some of the growing season, but they are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface.

Vegetation Description: The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Within each wetland, species may be locally abundant and often have patchy distribution. Shrub species usually include *Spiraea tomentosa* (steeplebush), *Spiraea alba var. alba* (white meadowsweet), *Cornus amomum* (silky dogwood), *Rubus allegheniensis* (Allegheny blackberry), *Rubus hispidus* (bristly dewberry), *Salix* sp. (willow), and others. *Hypericum densiflorum* (bushy St. Johnswort) often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* (Morrow's honeysuckle) and *Rosa multiflora* (multiflora rose) may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea* (reed canarygrass), *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Solidago canadensis* (Canada goldenrod), *Juncus effusus* (common rush), *Scirpus cyperinus* (woolgrass), *Scirpus expansus* (woodland bulrush), *Leersia oryzoides* (rice cutgrass), *Calamagrostis canadensis* (bluejoint), *Carex scoparia* (broom sedge), *Carex folliculata* (northern long sedge), *Carex lurida* (shallow sedge), *Carex lupulina* (hop sedge), *Carex vulpinoidea* (fox sedge), *Carex trichocarpa* (hairyfruit sedge), *Vernonia noveboracensis* (New York ironweed), *Triadenum virginicum* (Virginia marsh St. Johnswort), *Lycopus uniflorus* (northern bugleweed), *Impatiens capensis* (jewelweed), *Eutrochium maculatum* (spotted joepyeweed), *Polygonum sagittatum* (arrowleaf tearthumb), *Thelypteris palustris* (eastern marsh fern), *Onoclea sensibilis* (sensitive fern), *Eleocharis* sp. (spikerush), and others. *Sphagnum* (sphagnum) spp. are often abundant along with lesser amounts of other nonvascular species. The invasive species *Microstegium vimineum* (Nepalese browntop), *Lythrum salicaria* (purple loosestrife), and *Phragmites australis* (common reed) can be abundant in these wetlands.

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis* (Allegheny blackberry)
		Spiraea alba var. *alba* (white meadowsweet)
		Spiraea tomentosa (steeplebush)
Herb (field)	Forb	*Solidago canadensis* (Canada goldenrod)
		Solidago rugosa (wrinkleleaf goldenrod)
	Graminoid	*Leersia oryzoides* (rice cutgrass)
		Phalaris arundinacea (reed canarygrass)

Characteristic Species: *Rubus allegheniensis* (Allegheny blackberry), *Spiraea tomentosa* (steeplebush)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: Although this vegetation is widespread, its range has not been evaluated. It is known from the Central Appalachian ecoregion, the High Alleghany Plateau, Western Alleghany Plateau, North Atlantic Coast, and the Lower New England / Northern Piedmont ecoregions, and is likely in others.

States/Provinces: CT, MA, NJ, NY, PA, WV:S2

Federal Lands: NPS (Allegheny Portage Railroad, Boston Harbor Islands, Cape Cod, Delaware Water Gap, Johnstown Flood, Upper Delaware, Weir Farm); USFS (Monongahela); USFWS (Assabet River?, Erie, Great Meadows?, Great Swamp, Parker River?)

Conservation Status
Rank: GNR (8-Jul-1999)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: Information not available.
Similar Associations:

- *Cornus* (*amomum*, *sericea*) - *Viburnum dentatum* - *Rosa multiflora* Shrubland (CEGL006576)

Related Concepts: Information not available.

Sources
Description Authors: L.A. Sneddon, mod. S.C. Gawler
References: Byers et al. 2007, Decker 1955, Eastern Ecology Working Group n.d., Fike 1999, NatureServe and Russell 2003.



Figure F-35. Wet Meadow on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.023). September 2006. NAD 1983 / UTM easting 345567, northing 4680817.



Figure F-36. Wet Meadow on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA176). September 2008. NAD 1983 / UTM easting 343726, northing 4689330.

Common Name (Park-specific): Cattail Brackish Tidal Marsh

Synonyms

USNVC English Name: Narrowleaf Cattail - Eastern Rosemallow Herbaceous Vegetation
USNVC Scientific Name: *Typha angustifolia* - *Hibiscus moscheutos* Herbaceous Vegetation
USNVC Identifier: CEGL004201

Local Information

Environmental Description: This brackish association occurs only at the upland border of a *Phragmites australis* (common reed) marsh that invaded a salt marsh after it was impounded by a road and isolated from regular tidal flooding. There is significant freshwater input from the adjacent upland, and it receives irregular tidal flooding only during high spring tides. Substrate is muck or peat.

Vegetation Description: *Typha angustifolia* (narrowleaf cattail) and a spectacular stand of *Hibiscus moscheutos* ssp. *moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow) dominate the marsh. *Boehmeria cylindrica* (smallspike false nettle), *Ludwigia palustris* (marsh seedbox), *Phragmites australis* (common reed), *Lythrum salicaria* (purple loosestrife), *Ranunculus sceleratus* (cursed buttercup) also grow in this marsh.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow)
	Graminoid	*Typha angustifolia* (narrowleaf cattail)

Characteristic Species: *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Typha angustifolia* (narrowleaf cattail)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S1*	B	–	Brackish Tidal Marsh	Swain and Kearsley 2001

Local Range: This association occurs on Long Island's West Head.
Classification Comments: This association differs from Eastern Cattail Marsh with the codominance of *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow).

Other Comments: None.
Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.047.
AA Points: BOHA.AA128
Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)
Macrogroup	North American Atlantic & Gulf Coast Salt Marsh (M079)
Group	Atlantic & Gulf Coast Brackish Tidal Marsh (G120)
Alliance	*Spartina alterniflora - Spartina cynosuroides* Brackish Tidal Marsh Alliance (A4013)
Alliance (English name)	Smooth Cordgrass – Big Cordgrass Tidal Marsh Alliance
Association	*Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation
Association (English name)	Narrowleaf Cattail - Eastern Rosemallow Herbaceous Vegetation
Ecological System(s)	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894)
	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)
	Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)
	Acadian Estuary Marsh (CES201.579)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

Global Description

Concept Summary: This association is a brackish tidal marsh of the northern to central Atlantic coast, occurring along the margin of tidal rivers and at the upper margins of some high salt marshes and coastal salt ponds where water salinity ranges from 0.5-18.0 ppt. Brackish marshes are most extensive on large tidal rivers, but smaller marshes of this alliance also occur at the upper limits of larger tidal creeks. The vegetation of this tall grassland is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia* (narrowleaf cattail). *Phragmites australis* (common reed) and/or *Typha latifolia* (broadleaf cattail) can be codominant. The *Phragmites australis* (common reed) component is the native strain. Common associates include *Hibiscus moscheutos* ssp. moscheutos (crimsoneyed rosemallow), *Schoenoplectus pungens* (common threesquare), *Impatiens capensis* (jewelweed), *Amaranthus cannabinus* (tidalmarsh amaranth), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), and *Bidens* sp. (beggarticks), plus *Spartina cynosuroides* (big cordgrass) in the south. Other infrequent associates include *Mikania scandens* (climbing hempvine), *Polygonum punctatum* (dotted smartweed), *Pluchea odorata* (sweetscent), *Eleocharis* sp. (spikerush), and *Bulboschoenus robustus* (sturdy bulrush), plus *Schoenoplectus americanus* (chairmaker's bulrush) farther south. Species from adjacent high salt marsh may also be present. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter.

Environmental Description: This association occurs in oligohaline to mesohaline areas of tidal marshes (0.5-18 ppt). In estuarine systems, it can occur in the uppermost zone of brackish marshes where there is freshwater influence; it receives diurnal tidal flooding of brackish water. In salt

marshes behind barrier beaches it can occur in the upper reaches of larger tidal creeks within brackish areas and also at the upland border where there is significant freshwater input from the adjacent upland; here it receives irregular tidal flooding only during high spring tides. Substrate is muck or peat, and there is often an accumulation of *Typha* (cattail) litter.

Vegetation Description: The vegetation of this tall grassland is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia* (narrowleaf cattail). *Phragmites australis* (common reed), *Typha latifolia* (broadleaf cattail), *Spartina cynosuroides* (big cordgrass), or *Schoenoplectus pungens* (common threesquare) can codominate. The *Phragmites australis* (common reed) component is the native strain (Saltonstall 2002). Common associates include *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Schoenoplectus pungens* (common threesquare), *Impatiens capensis* (jewelweed), *Amaranthus cannabinus* (tidalmarsh amaranth), *Peltandra virginica* (green arrow arum), *Pontederia cordata* (pickerelweed), and *Bidens* sp. (beggarticks), plus *Spartina cynosuroides* (big cordgrass) in the south. Other infrequent associates include *Mikania scandens* (climbing hempvine), *Pluchea odorata* (sweetscent), *Polygonum punctatum* (dotted smartweed), *Eleocharis* sp., (spikerush), and *Bulboschoenus robustus* (sturdy bulrush), plus *Schoenoplectus americanus* (chairmaker's bulrush) farther south. Species from adjacent high salt marsh may also be present.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow)
	Graminoid	*Schoenoplectus pungens* (common threesquare)
		Typha angustifolia (narrowleaf cattail)
Floating aquatic	Aquatic herb (floating & submergent)	*Pontederia cordata* (pickerelweed)

Characteristic Species: *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), *Typha angustifolia* (narrowleaf cattail)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution
Range: This association occurs along the Atlantic coast from Maine to Virginia and possibly to South Carolina.

States/Provinces: CT, DE:S4, MA, MD:S4, ME, NC?, NH, NJ:S4, NY, RI, SC?, VA
Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Saugus Iron Works); USFWS (Back Bay?, Cape May, Chesapeake Marshlands, Chincoteague, E.B. Forsythe, Monomoy?, Parker River?, Prime Hook, Supawna Meadows)

Conservation Status
Rank: G4G5 (19-Jan-2006)

Reasons: This common small-patch association occurs in the estuarine areas of up to 13 northeastern states, several of which rank this vegetation as S4. It is threatened by pollution and by encroachment of *Phragmites australis* (common reed).

Classification Information

Status: Standard

Confidence: 2 - Moderate

Comments: A non-tidal barrier wetland documented at the Cove Point Wetland, Calvert County, Maryland (Steury 1999), appears to fit this concept.

Similar Associations:

- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456)

Related Concepts:

- *Hibiscus* marsh (Cahoon and Stevenson 1986)
- *Typha (angustifolia, latifolia) - Hibiscus moscheutos* Herbaceous Vegetation (Harrison 2001)
- *Typha angustifolia - Hibiscus palustris* community (Metzler and Barrett 1992)
- *Typha angustifolia* community (Good and Good 1975)
- *Typha angustifolia* type (Ferren et al. 1981)
- *Typha* association (Shreve et al. 1910)
- Brackish Tidal Marsh (Rawinski 1984)
- Brackish marsh (Sperduto 1994)
- Brackish tidal marsh (Reschke 1990)
- Brackish tidal marsh community (MENHP 1991)
- Brackish tidal marsh complex (Breden 1989)
- Cattail Community Type (Odum et al. 1984)
- Fresh-brackish marsh (Klotz 1986)
- Narrowleaf cattail type (McCormick and Ashbaugh 1972)
- Tidal Freshwater Marsh (Narrowleaf Cattail Subtype) (Schafale 2000)
- Transitional fresh marsh (Hill 1986)

Sources

Description Authors: S.L. Neid

References: Bowman 2000, Breden 1989, Breden et al. 2001, Cahoon and Stevenson 1986, Coulling 2002, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ferren et al. 1981, Fleming 2001, Fleming and Moorhead 1998, Fleming et al. 2004, Gawler 2002, Good and Good 1975, Harrison 2001, Harrison 2004, Hill 1986, Klotz 1986, MENHP 1991, McCormick and Ashbaugh 1972, Metzler and Barrett 1992, Metzler and Barrett 2001, Odum et al. 1984, Rawinski 1984, Reschke 1990, Saltonstall 2002, Schafale 2000, Schafale 2003, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 1997a, Sperduto 2000b, Steury 1999, Swain and Kearsley 2001.



Figure F-37. Cattail Brackish Tidal Marsh on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.047). September 2006. NAD 1983 / UTM easting 337637, northing 4686516.

Common Name (Park-specific): Coastal Salt Pond Marsh

Synonyms

USNVC English Name: Common Threesquare - Dwarf Spikerush Herbaceous Vegetation
USNVC Scientific Name: *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation
USNVC Identifier: CEGL006398

Local Information

Environmental Description: The coastal salt ponds on Thompson, Calf, and Grape islands are separated from the ocean by a barrier beach and are closed off from regular tidal flooding. The soils consist of muck. Freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions.

Vegetation Description: The marsh located on the east side of the landing on Grape Island and the "skating pond" marsh on Thompson Island are the most diverse of the islands' freshwater wetlands. The Grape Island marsh has abundant populations of *Lythrum salicaria* (purple loosestrife), *Lepidium latifolium* (broadleaved pepperweed), and *Phragmites australis* (common reed). *Fumaria officinalis* (drug fumitory), a small, delicate non-native plant, also occurs there. Native plants include *Lycopus americanus* (American water horehound), *Carex stipata* (owlfruit sedge), *Epilobium coloratum* (purpleleaf willowherb), *Galium tinctorium* (stiff marsh bedstraw), *Solidago altissima* (tall goldenrod), and *Verbena hastata* (swamp verbena). Two salt marsh species, *Juncus gerardii* (saltmeadow rush) and *Spartina patens* (saltmeadow cordgrass), are abundant in this marsh. The skating pond wetland on Thompson Island is one of the few palustrine associations that has standing water. *Phragmites australis* (common reed) is dominant, but a number of other species, including *Echinochloa walteri* (coast cockspur grass), *Eleocharis acicularis* (needle spikerush), *Lythrum salicaria* (purple loosestrife), *Panicum dichotomiflorum* (fall panicgrass), *Polygonum pensylvanicum* (Pennsylvania smartweed), *Schoenoplectus americanus* (chairmaker's bulrush), and *Bulboschoenus robustus* (sturdy bulrush), have large populations. The Calf Island marsh includes *Schoenoplectus americanus* (chairmaker's bulrush), *Typha latifolia* (broadleaf cattail), *Lythrum salicaria* (purple loosestrife), *Phragmites australis* (common reed), and *Spartina patens* (saltmeadow cordgrass).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Echinochloa walteri* (coast cockspur grass)
		Juncus gerardii (saltmeadow rush)
		Phragmites australis (common reed)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Eleocharis acicularis* (needle spikerush), *Schoenoplectus americanus* (chairmaker's bulrush), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S2*	I	–	Coastal Salt Pond	Swain and Kearsley 2001
MA	S2*	I	–	Coastal Salt Pond Marsh	Swain and Kearsley 2001

Local Range: This occurs on Thompson, Calf, and Grape islands.
Classification Comments: This association can be distinguished from Eastern Reed Marsh by the presence of a diverse assemblage of native wetland species. It can be distinguished from the seasonally flooded and often dry Wet Meadow by the presence of saturated muck soils and the presence of *Spartina patens* (saltmeadow cordgrass).

Other Comments: Neither *Schoenoplectus pungens* (common threesquare) or *Eleocharis parvula* (dwarf spikerush), were observed in vegetation sampling. This association is decreasing in size over time as the non-native invasives *Phragmites australis* (common reed), *Lythrum salicaria* (purple loosestrife), and *Lepidium latifolium* (broadleaved pepperweed) continue to expand into the marshes and outcompete the native wetland plants. The marsh on Grape Island was formerly a salt marsh, but changes in the configuration of the beach have blocked the infusion of saltwater into the depressional area (Island Alliance 2001). Karanaukas (2001) found that this Grape Island wetland had one of the most healthy and diverse aquatic invertebrate populations found on Boston Harbor Islands.

Local Description Authors: T. Elliman and E. Largay
Plots: None.
AA Points: BOHA.AA165
Boston Harbor Islands National Recreation Area Inventory Notes: Ted Elliman did a plot in this association in his 2005 study on Thompson and Ralph Tiner described it in his wetland inventory of the islands on Grape in 2003.This association looks like Eastern Reed Marsh and Wet Meadow on the orthophoto; additional field inventory of these areas to confirm the occurrence of other potential Coastal Salt Pond Marshes in the Boston Harbor Islands National Recreation Area is recommend. An observation point was taken on Calf in September 2008 during accuracy assessment noting the dominant species and gps location. A photograph was also taken.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)
Macrogroup	North American Atlantic & Gulf Coast Salt Marsh (M079)
Group	Atlantic & Gulf Coast High Salt Marsh (G121)
Alliance	*Spartina patens* High Tidal Marsh Alliance (A1481)

USNVC Classification (continued)

Classification Level	Description
Alliance (English name)	Eastern Saltmeadow Cordgrass High Tidal Marsh Alliance
Association	*Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation
Association (English name)	Common Threesquare - Dwarf Spikerush Herbaceous Vegetation
Ecological System(s)	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)

Global Description

Concept Summary: This association encompasses the brackish marshes of coastal salt ponds of the northeastern Atlantic coast. Coastal salt ponds are ponds separated from the ocean by a barrier beach. They generally form when a lagoon or bay is closed off from regular tidal flooding by a sand spit or other barrier. Salinity depends on the length of time since enclosure of the lake/pond; freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions. Depending on the distance from the ocean, saltwater input is infrequent and a result of tidal breaches or storm overwash, although there can be some saltwater seepage across the barrier beach. Shorelines usually have gentle slopes that magnify gradients of salinity and saturation. Depending on local water balance, ponds can draw down to a certain degree exposing mud or sand flats. Substrate ranges from sand to mud to peat. Vegetation of coastal salt ponds is highly variable both spatially and temporally given the variable nature of the habitat and processes affecting it. Although not constant, vegetation zonation often occurs along shores of coastal salt ponds along gradients of salinity and flooding or saturation. Dominant species can be variable depending on local conditions but are generally characterized by *Schoenoplectus pungens* (common threesquare), *Eleocharis parvula* (dwarf spikerush), and/or *Spartina patens* (saltmeadow cordgrass), *Spartina pectinata* (prairie cordgrass), or *Panicum virgatum* (switchgrass). Where salinity is less *Typha angustifolia* (narrowleaf cattail) can be common. Mud flat habitat can develop in lower areas that tend to be exposed later in the season with *Eleocharis parvula* (dwarf spikerush), *Eleocharis halophila* (saltmarsh spikerush), *Eleocharis flavescens* (yellow spikerush), *Bulboschoenus maritimus* (cosmopolitan bulrush), *Crassula aquatica* (water pygmyweed), *Spergularia salina* (salt sandspurry), *Cyperus filicinus* (fern flatsedge), or others. In higher zones, vegetation can be similar to high salt marsh habitat; *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), or *Spartina pectinata* (prairie cordgrass) can be characteristic, plus *Schoenoplectus smithii* (Smith's bulrush), *Echinochloa walteri* (coast cockspur grass), *Cladium mariscoides* (smooth sawgrass), *Distichlis spicata* (inland saltgrass), or *Chenopodium* sp. (goosefoot). Species found farther south include *Ptilimnium capillaceum* (herbwilliam), *Pluchea odorata* (sweetscent), *Schoenoplectus americanus* (chairmaker's bulrush), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), plus scattered individuals of *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (groundsel-tree). Ponds often support aquatic plants that are tolerant of brackish/saline conditions, such as *Ruppia maritima* (widgeongrass), *Stuckenia pectinata* (sago pondweed), *Potamogeton perfoliatus* (claspingleaf pondweed), or *Zannichellia palustris* (horned pondweed), plus some marine algal species. Several associations may be warranted in these highly variable systems; collection of further data will likely support the division of more associations.

Environmental Description: Coastal salt ponds are ponds separated from the ocean by a barrier beach. They generally form when a lagoon or bay is closed off from regular tidal flooding by a sand spit or other barrier. However, some ponds have a permanent, often artificially maintained, inlet/outlet and thus have regular saltwater exchange. Salinity depends on the length of time since enclosure of the lake/pond; freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions. Depending on the distance from the ocean, saltwater input is infrequent and a result of tidal breaches or storm overwash, although there can be some saltwater seepage across the barrier beach. Shorelines usually have gentle slopes that magnify gradients of salinity and saturation. Depending on local water balance, ponds can draw down to a certain degree exposing mud or sand flats. Substrate ranges from sand to mud to peat. These ponds occur in glaciated areas in moraine or outwash deposits.

Vegetation Description: Vegetation of coastal salt ponds is highly variable both spatially and temporally given the variable nature of the habitat and processes affecting it. Although not constant, vegetation zonation often occurs along shores of coastal salt ponds along gradients of salinity and flooding or saturation. Dominant species can be variable depending on local conditions but are generally characterized by *Schoenoplectus pungens* (common threesquare), *Eleocharis parvula* (dwarf spikerush), and/or *Spartina patens* (saltmeadow cordgrass), *Spartina pectinata* (prairie cordgrass), or *Panicum virgatum* (switchgrass). Where salinity is less *Typha angustifolia* (narrowleaf cattail) can be common. Mud flat habitat can develop in lower areas that tend to be exposed later in the season with *Eleocharis parvula* (dwarf spikerush), *Eleocharis halophila* (saltmarsh spikerush), *Eleocharis flavescens* (yellow spikerush), *Bulboschoenous maritimus* (cosmopolitan bulrush), *Crassula aquatica* (water pygmyweed), *Spergularia salina* (salt sandspurry), or others. In higher zones, vegetation can be similar to high salt marsh habitat; *Panicum virgatum* (switchgrass), *Spartina patens* (saltmeadow cordgrass), or *Spartina pectinata* (prairie cordgrass) can be characteristic, plus *Schoenoplectus smithii* (Smith's bulrush), *Echinochloa walteri* (coast cockspur grass), *Cladium mariscoides* (smooth sawgrass), *Distichlis spicata* (inland saltgrass), and *Chenopodium* sp. (goosefoot). Species found farther south include *Ptilimnium capillaceum* (herbwilliam), *Pluchea odorata* (sweetscent), *Schoenoplectus americanus* (chairmaker's bulrush), *Hibiscus moscheutos* ssp. *moscheutos* (crimsoneyed rosemallow), plus scattered individuals of *Iva frutescens* (Jesuit's bark) or *Baccharis halimifolia* (groundsel-tree). Ponds often support aquatic plants that are tolerant of brackish/saline conditions, such as *Ruppia maritima* (widgeongrass), *Stuckenia pectinata* (sago pondweed), *Potamogeton perfoliatus* (claspingleaf pondweed), or *Zannichellia palustris* (horned pondweed), plus some marine algal species.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Eleocharis parvula* (dwarf spikerush)
		Schoenoplectus pungens (common threesquare)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Eleocharis parvula* (dwarf spikerush), *Schoenoplectus pungens* (common threesquare)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution
Range: Coastal salt ponds occur in a limited geomorphological setting in New Hampshire, Massachusetts, Rhode Island, and Long Island, New York.

States/Provinces: MA, ME, NH:S1, NY:S1S2, RI
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Gateway)

Conservation Status
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This association encompasses a highly variable and shifting vegetation mosaic in a variable and dynamic habitat. Several associations may be warranted; collection of further data will likely support the division of this type into more associations.

Similar Associations:

- *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL006150)
- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188)
- *Spartina patens* - *Eleocharis parvula* Herbaceous Vegetation (CEGL006342)

Related Concepts:

- Coastal Salt Pond (Rawinski 1984)
- Coastal Salt Pond Marsh (Rawinski 1984)

Sources
Description Authors: S.L. Neid
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Elliman 2004, Gawler 2002, Island Alliance 2001, Karanaukas 2001, Lundgren 1998, Lundgren 2000, USDA-NRCS 2001, Rawinski 1984, Reschke 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2000, Swain and Kearsley 2001, Thorne-Miller et al. 1983, Zaremba 1999.



Figure F-38. Coastal Salt Pond Marsh on Calf Island in Boston Harbor Islands National Recreation Area (Observation point-green fringe surrounding the red Salicornia). September 2008. NAD 1983 / UTM easting 343823, northing 4689432.

Common Name (Park-specific): North Atlantic High Salt Marsh

Synonyms

USNVC English Name: Saltmeadow Cordgrass - Saltgrass - (Black-grass) Herbaceous Vegetation

USNVC Scientific Name: *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation

USNVC Identifier: CEGL006006

Local Information

Environmental Description: This high salt marsh association occupies the irregularly flooded zone extending from mean high tide landward to the limit of spring tides. The substrate is peat overlying bedrock.

Vegetation Description: This association is dominated by *Spartina patens* (saltmeadow cordgrass) and *Distichlis spicata* (inland saltgrass). *Juncus gerardii* (saltmeadow rush) is also common. Additional species include *Limonium carolinianum* (Carolina sealavender), *Suaeda linearis* (annual seepweed), *Suaeda maritima* (herbaceous seepweed), *Thinopyrum pycnanthum* (tick quackgrass), and *Puccinellia maritima* (seaside alkaligrass). Scattered individuals of *Spartina alterniflora* (smooth cordgrass) and/or *Iva frutescens* (Jesuit's bark) may also be present.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	–	Salt Marsh	Swain and Kearsley 2001

Local Range: This association occurs on many of the Boston Harbor Islands, including World's End, Peddock's, Thompson, Long, Moon, Raccoon, Snake islands, and Upper Neck Cove at Webb State Park.

Classification Comments: This association is distinguished from North Atlantic Low Salt Marsh by its landscape position from mean high tide landward to the limit of spring tides and dominance of *Spartina patens* (saltmeadow cordgrass) and lack of dominance by *Spartina alterniflora* (smooth cordgrass).

Other Comments: None.
Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.001, BOHA.032, BOHA.046.
AA Points: BOHA.AA093, BOHA.AA094, BOHA.AA124, BOHA.AA151, BOHA.AA163, BOHA.AA182, BOHA.AA183

Boston Harbor Islands National Recreation Area Inventory Notes: The polygons delineating North Atlantic High Salt Marsh in the vegetation map for the Boston Harbor Islands National Recreation Area were adopted from the Bell et al. (2002) Boston Harbor Islands intertidal spatial data and adjusted slightly to reflect existing boundaries of the association as observed in the 2005 MassGIS orthophotos. Polygons include those attributed to the *Spartina patens* (saltmeadow cordgrass) Assemblage, *Suaeda* (seepweed) Assemblage, *Juncus gerardii* (blackgrass) Assemblage, and High Marsh Assemblage in Bell et al. (2002).

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)
Macrogroup	North American Atlantic & Gulf Coast Salt Marsh (M079)
Group	Atlantic & Gulf Coast High Salt Marsh (G121)
Alliance	*Spartina patens* High Tidal Marsh Alliance (A1481)
Alliance (English name)	Eastern Saltmeadow Cordgrass High Tidal Marsh Alliance
Association	*Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation
Association (English name)	Saltmeadow Cordgrass - Saltgrass - (Black-grass) Herbaceous Vegetation
Ecological System(s)	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Acadian Coastal Salt Marsh (CES201.578

Global Description

Concept Summary: This high salt marsh vegetation dominated by *Spartina patens* (saltmeadow cordgrass) or codominated by *Distichlis spicata* (inland saltgrass) forms distinct "cowlicked" meadows above low salt marsh associations. This high marsh association generally occurs behind barrier beaches along the north Atlantic coast from the Canadian maritime provinces south to New Jersey. It occupies the irregularly flooded zone extending from mean high tide landward to the limit of spring tides. The substrate is peat overlying sand, silt, or bedrock. Vegetation of this marsh association occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), or *Juncus gerardii* (saltmeadow rush). Other characteristic associates that occur in low abundance include *Symphyotrichum*

tenuifolium (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Polygonum ramosissimum* (bushy knotweed), *Argentina anserina* (silverweed cinquefoil), *Atriplex patula* (spear saltbush), *Lythrum lineare* (wand lythrum), and *Panicum virgatum* (switchgrass). Salt pannes are often a prominent feature within this association.

Environmental Description: This high salt marsh association generally occurs behind barrier beaches, but also in the outer reaches of estuaries, occupying the zone extending from mean high tide landward approximately to the limit of spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (smooth cordgrass) (tall form), which are regularly flooded by diurnal tides. *Spartina patens* (saltmeadow cordgrass)-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.

Vegetation Description: Vegetation of this marsh association occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), or *Juncus gerardii* (saltmeadow rush). Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium* (perennial saltmarsh aster), *Limonium carolinianum* (Carolina sealavender), *Solidago sempervirens* (seaside goldenrod), *Symphyotrichum subulatum* (eastern annual saltmarsh aster), *Polygonum ramosissimum* (bushy knotweed), *Argentina anserina* (silverweed cinquefoil), *Atriplex patula* (spear saltbush), *Lythrum lineare* (wand lythrum), and *Panicum virgatum* (switchgrass).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Distichlis spicata* (inland saltgrass)
		Juncus gerardii (saltmeadow rush)
		Spartina patens (saltmeadow cordgrass)

Characteristic Species: *Distichlis spicata* (inland saltgrass), *Juncus gerardii* (saltmeadow rush), *Spartina patens* (saltmeadow cordgrass)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution
Range: This high salt marsh association occurs from the Canadian maritime provinces south to Delaware.

States/Provinces: CT, DE, MA, MD, ME, NH, NJ:S5, NY:S3S4, RI
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Sagamore Hill); USFWS (Cape May, E.B. Forsythe, Moosehorn, Muskeget Island?, Parker River?, Prime Hook)

Conservation Status
Rank: G5 (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: This association is differentiated from *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197) to the south by the importance of *Juncus gerardii* (saltmeadow rush), *Plantago maritima* (goose tongue), and *Triglochin maritima* (seaside arrowgrass) and absence or relatively infrequent occurrence of species of southern distribution such as *Borrichia frutescens* (bushy seaside tansy), *Kosteletzkya virginica* (Virginia saltmarsh mallow), *Fimbristylis castanea* (marsh fimbry), and *Lythrum lineare* (wand lythrum).

Similar Associations:

- *Spartina patens - Agrostis stolonifera* Herbaceous Vegetation (CEGL006365)
- *Spartina patens - Distichlis spicata* - (*Juncus roemerianus*) Herbaceous Vegetation (CEGL004197)

Related Concepts:

- *Spartina patens - Distichlis spicata* Herbaceous Vegetation (Harrison 2001)
- Salt Marsh (Rawinski 1984)
- Salt marsh complex, high marsh (Breden 1989)

Sources
Description Authors: S.L. Neid
References: Bell et al. 2002, Bertness et al. 1992, Breden 1989, Breden et al. 2001, Coulling pers. comm., Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Gawler 2001, Gawler 2002, Harrison 2001, Hill 1923, Metzler and Barrett 2001, Nixon 1982, Rawinski 1984, Reschke 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001.



Figure F-39. North Atlantic High Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.001). September 2006. NAD 1983 / UTM easting 345823, northing 4680710.



Figure F-40. North Atlantic High Salt Marsh on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.032). September 2006. NAD 1983 / UTM easting 333923, northing 4686511.

Common Name (Park-specific): Eastern Tidal Salt Shrub

Synonyms

USNVC English Name: Jesuit's-bark / Saltmeadow Cordgrass Shrubland
USNVC Scientific Name: *Iva frutescens / Spartina patens* Shrubland
USNVC Identifier: CEGL006848

Local Information

Environmental Description: This association occurs adjacent to and landward of North Atlantic High Salt Marsh in Boston Harbor Islands National Recreation Area. This shrubland occurs above mean high tide but can be flooded by storm tides. Substrate is organic peat over glacial till, sand, or sandy loam.

Vegetation Description: This association is dominated by *Iva frutescens* (Jesuit's bark) and has scattered individuals of *Spartina patens* (saltmeadow cordgrass), *Distichlis spicata* (inland saltgrass), and *Juncus gerardii* (saltmeadow rush) underneath the shrub canopy. *Baccharis halimifolia* (groundsel-tree) was not observed in examples of this association in Boston Harbor Islands.

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Semi-shrub	*Iva frutescens* (Jesuit's bark)
Herb (field)	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Iva frutescens* (Jesuit's bark)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	–	Salt Marsh	Swain and Kearsley 2001

Local Range: This association was sampled on the eastern side of World's End.
Classification Comments: This association occurs landward of North Atlantic High Salt Marsh. It differs from other shrub-dominated associations in that it has species tolerant to saline and brackish environmental conditions.

Other Comments: Scattered individuals of *Phragmites australis* (common reed) were observed outside of the plot on World's End and may be a target for management.

Local Description Authors: E. Largay
Plots: BOHA.002.
AA Points: BOHA.AA136.
Boston Harbor Islands National Recreation Area Inventory Notes: Small patches of this association were observed in the field on other islands, but many were not large enough to sample and were below the minimum map unit size (0.5 ha). Polygons attributed to the *Iva* Assemblage in the Bell et al. (2002) study were crosswalked to this association and adopted into the vegetation map.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)
Macrogroup	North American Atlantic & Gulf Coast Salt Marsh (M079)
Group	Atlantic & Gulf Coast High Salt Marsh (G121)
Alliance	*Iva frutescens* Tidal Shrubland Alliance (A1023)
Alliance (English name)	Jesuit's-bark Tidal Shrubland Alliance
Association	*Iva frutescens* / *Spartina patens* Shrubland
Association (English name)	Jesuit's-bark / Saltmeadow Cordgrass Shrubland
Ecological System(s)	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Atlantic Coastal Plain Northern Salt Pond Marsh (CES203.892)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Global Description

Concept Summary: This maritime shrubland of the eastern Atlantic states occurs in association with salt marshes. In its natural condition, this association forms the ecotone between high salt marsh and adjacent upland vegetation. It also occurs in patches on areas of slightly higher elevation within the salt marsh or on spoil mounds adjacent to ditches. *Iva frutescens* (Jesuit's bark) is the most characteristic and dominant shrub species. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually abundant grass, often occurring as a monoculture beneath the shrub canopy. Other common herbaceous associates include *Distichlis spicata* (inland saltgrass) and *Spartina alterniflora* (smooth cordgrass); *Juncus gerardii* (saltmeadow rush) may also occur at the northern end of the range. Other less common associates may include *Cuscuta gronovii* (scaldweed), *Limonium carolinianum* (Carolina sealavender), *Lythrum lineare* (wand lythrum), and *Solidago sempervirens* (seaside goldenrod). The vegetation is characterized by an open and relatively evenly spaced shrub stratum of short stature, rarely exceeding one meter in height, with a well-developed herbaceous layer, reflecting an intergrading of this association with the adjacent high salt marsh. Storm-induced disturbance causes periodic die-back of the shrubs restricting the extent of their spread.

Environmental Description: This maritime and estuarine shrubland of the eastern Atlantic states occurs in association with salt marshes. It forms an ecotone between the high salt marsh and adjacent upland vegetation. It also occurs in patches on areas of slightly higher elevation within the salt marsh or on spoil mounds adjacent to ditches. This shrubland occurs above mean high tide but can be flooded by storm tides. Substrate is organic peat over glacial till, sand, or sandy loam.

Vegetation Description: *Iva frutescens* (Jesuit's bark) is the most characteristic and dominant shrub species. *Spartina patens* (saltmeadow cordgrass) is a characteristic and usually abundant grass, often occurring as a monoculture beneath the shrub canopy. Other common herbaceous associates include *Distichlis spicata* (inland saltgrass) and *Spartina alterniflora* (smooth cordgrass); *Juncus gerardii* (saltmeadow rush) may also occur at the northern end of the range. Other less common associates may include *Cuscuta gronovii* (scaldweed), *Limonium carolinianum* (Carolina sealavender), *Lythrum lineare* (wand lythrum), and *Solidago sempervirens* (seaside goldenrod). The vegetation is characterized by an open and relatively evenly spaced shrub stratum of short stature, rarely exceeding one meter in height, with a well-developed herbaceous layer, reflecting an intergrading of this association with the adjacent high salt marsh.

Most Abundant Species

Stratum	Lifeform	Species
Short shrub/sapling	Semi-shrub	*Iva frutescens* (Jesuit's bark)
Herb (field)	Graminoid	*Spartina patens* (saltmeadow cordgrass)

Characteristic Species: *Iva frutescens* (Jesuit's bark)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution
Range: This association ranges from Massachusetts to South Carolina.
States/Provinces: CT, DE:S5, MA, MD:S5, NC, NJ:S2S3, NY:S4, RI, SC, VA:S5
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Fire Island, Gateway, George Washington Birthplace); USFWS (Back Bay?, Chesapeake Marshlands, Chincoteague, E.B. Forsythe, Monomoy?, Parker River, Prime Hook)

Conservation Status
Rank: G5 (1-Dec-1997)
Reasons: This vegetation occurs commonly in salt marshes of the eastern seaboard.

Classification Information
Status: Standard
Confidence: 2 - Moderate
Comments: As shrub cover decreases, the association often grades into high salt marsh associations such as *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150) or *Spartina patens* (saltmeadow cordgrass)-dominated high marsh associations. Southern analogs of this salt marsh-upland border shrubland include *Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria)* Shrubland (CEGL003920) along the southern Atlantic Coast from the Carolinas to Florida west to Louisiana and *Iva frutescens ssp. frutescens - Baccharis halimifolia / Spartina spartinae* Shrubland (CEGL004616) along the Texas Gulf Coast. This association is differentiated from *Morella cerifera - Baccharis halimifolia / Spartina patens* Shrubland (CEGL003809) by the presence of *Iva frutescens* (Jesuit's bark) and by the influence of tidal flooding. It is differentiated

from *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL006063) by a relatively lower species composition, lower elevation and more gradual transition to the adjacent high salt marsh, and by the unimportance of *Baccharis halimifolia* (groundsel-tree) and *Panicum virgatum* (switchgrass).

Similar Associations:

- *Baccharis halimifolia - Iva frutescens - Morella cerifera* - (*Ilex vomitoria*) Shrubland (CEGL003920)
- *Baccharis halimifolia - Iva frutescens* / *Panicum virgatum* Shrubland (CEGL006063)
- *Eleocharis rostellata - Spartina patens* Herbaceous Vegetation (CEGL006611)
- *Iva frutescens* / *Spartina cynosuroides* Tidal Shrubland (CEGL006847)
- *Iva frutescens ssp. frutescens - Baccharis halimifolia* / *Spartina spartinae* Shrubland (CEGL004616)
- *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL006150)

Related Concepts:

- *Baccharis halimifolia - Iva frutescens* ssp. *oraria* / *Spartina patens* Shrubland (Bartgis 1986)
- *Iva frutescens - Baccharis halimifolia* / *Spartina patens - Distichlis spicata* Tidal Shrubland (VDNH 2003)
- *Iva frutescens - Baccharis halimifolia* (Good 1965)
- *Iva frutescens* / *Spartina patens* Tidal Shrubland (Harrison and Stango 2003)
- *Iva frutescens* and *Baccharis halimifolia* (Klemas et al. 1973)
- Estuarine scrub-shrub wetland (Tiner 1985a)
- Estuarine scrub-shrub wetland (Tiner 1985b)
- Salt Marsh (Rawinski 1984)
- Salt Marsh Complex, marsh-upland border (Breden 1989)
- Salt Shrub (High Subtype) (Schafale 2000)
- Salt bush - salt meadow marsh (Daiber et al. 1976)
- Salt grass - marsh elder savanna (Martin 1959)
- Salt marsh and upper border (Barry 1980)
- Salt marsh community (Hill 1986)
- Salt shrub (Reschke 1990)
- Saltbush zone (Boule 1979)
- Shrub succession community (Higgins et al. 1971)
- Swamp thicket (Klotz 1986)

Sources

Description Authors: S.L. Sneid, E.F. Largay, mod. L.A. Sneddon

References: Barry 1980, Bartgis 1986, Bell et al. 2002, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Coulling 2002, Coulling pers. comm., Daiber et al. 1976, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2004, Fleming pers. comm., Good 1965, Harrison 2004, Harrison

and Stango 2003, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Klemas et al. 1973, Klotz 1986, Martin 1959, Metzler and Barrett 2001, USDA-NRCS 2001, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sneddon et al. 1995, Swain and Kearsley 2001, TNC 1995b, Tiner 1984, Tiner 1985a, Tiner 1985b, VDNH 2003.



Figure F-41. Eastern Tidal Salt Shrub on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.002). September 2006. NAD 1983 / UTM easting 345823, northing 4680720.

Common Name (Park-specific): North Atlantic Low Salt Marsh

Synonyms

USNVC English Name: Saltmarsh Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation

USNVC Scientific Name: *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation

USNVC Identifier: CEGL004192

Local Information

Environmental Description: This low salt marsh association is tidally flooded twice daily and occurs in areas sheltered from direct wave action, such as behind barrier beaches, at the heads of bays, or in the outer reaches of estuaries. Low salt marshes occur landward of intertidal flats and subtidal associations and seaward of high salt marsh associations. The substrate consists of peat that is held tightly together by *Spartina* (cordgrass) rhizomes. Ribbed mussels are usually a prominent component of the peat.

Vegetation Description: *Spartina alterniflora* (smooth cordgrass) is the dominant and typically only species present in this association.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Spartina alterniflora* (smooth cordgrass)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	–	Salt Marsh	Swain and Kearsley 2001

Local Range: North Atlantic Low Salt Marsh occurs on many of the Boston Harbor Islands, including World's End, Thompson, Peddock's, Long, Hangman, Raccoon, and Snake islands.

Classification Comments: This association is distinguished from North Atlantic Low Salt Marsh by the dominance of *Spartina alterniflora* (smooth cordgrass) and landscape position along the seaward edge.

Other Comments: None.
Local Description Authors: E. Largay
Plots: BOHA.004, BOHA.028.
AA Points: BOHA.AA085, BOHA.AA086, BOHA.AA087, BOHA.AA088, BOHA.AA089, BOHA.AA090, BOHA.AA091, BOHA.AA092, BOHA.AA158, BOHA.AA159, BOHA.AA184

Boston Harbor Islands National Recreation Area Inventory Notes: The polygons delineating North Atlantic Low Salt Marsh in the 2008 vegetation map for Boston Harbor Islands were adopted from the Bell et al. (2002) Boston Harbor Islands intertidal spatial data and adjusted slightly to reflect current boundaries of the association as observed in the 2005 MassGIS orthophotos and from field observations. These polygons include those attributed to the *Spartina alterniflora* (smooth cordgrass) Assemblage in Bell et al. (2002).

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)
Macrogroup	North American Atlantic & Gulf Coast Salt Marsh (M079)
Group	Atlantic & Gulf Coast Low Salt Marsh (G122)
Alliance	*Spartina alterniflora* Low Tidal Marsh Alliance (A1471)
Alliance (English name)	Saltmarsh Cordgrass Low Tidal Marsh Alliance
Association	*Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation
Association (English name)	Saltmarsh Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation
Ecological System(s)	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Acadian Coastal Salt Marsh (CES201.578)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

Global Description

Concept Summary: This tall grassland dominated by *Spartina alterniflora* (smooth cordgrass) forms the low salt marsh of the north and mid-Atlantic coast. It is diurnally flooded by tides, occurring in the intertidal zone between mean high tide and mean sea level in protected inlets behind barrier beaches or in the seaward reaches of drowned river valleys. It forms a coarse peat over sandy substrate. The low salt marsh occurs elevationally between high marsh that occurs landward and subtidal associations that occur seaward. *Spartina alterniflora* (smooth cordgrass) is limited to the low marsh zone by interspecific competition and by moderate salinity; it can withstand longer submergence than other salt marsh grasses but still requires periodic exposure of the substrate. *Spartina alterniflora* (smooth cordgrass) forms nearly monotypic stands with little variation across the geographic range of the association. Tall form *Spartina alterniflora* (smooth cordgrass) occurs adjacent to salt water and colonizes unvegetated flats. This association also grades into short form *Spartina alterniflora* (smooth cordgrass) landward. Associated species occur in low abundance and commonly include *Limonium carolinianum* (Carolina sealavender), *Salicornia depressa* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Spergularia maritima* (media sandspurry),

Spergularia canadensis (Canadian sandspurry), and *Suaeda maritima* (herbaceous seepweed). Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum, Fucus vesiculosus, Enteromorpha* spp., and *Ulva* spp. Macroalgae associates may be sparse or absent at the southern edge of the range. This association occurs from Nova Scotia to Cape Hatteras, North Carolina. Low marshes at the northern edge of the geographic range are far less extensive in size than those farther south due to differences in geomorphology and time since last glaciation.

Environmental Description: This low salt marsh association occurs in the regularly flooded intertidal zone, approximately from mean high tide to mean sea level; they are diurnally flooded by tides and are classified as polyhaline (18-30 ppt). This low marsh occurs in areas sheltered from direct wave action, such as behind barrier beaches, as pocket marshes at the heads of bays, or in the outer reaches of estuaries. Low salt marshes occur landward of intertidal flats and subtidal associations and seaward of high salt marsh associations. Low salt marshes dominated by *Spartina alterniflora* (smooth cordgrass) generally occur on mucky silt to silty coarse fibrous peat, often with high organic matter content. However, peat in the low marsh is generally less dense than farther landward (Bertness 1988). Peat depth ranges from a few feet, if the association formed over a mud flat, to 80 feet in drowned river valleys at the mouths of estuaries.

Vegetation Description: This association is a tall grassland dominated by *Spartina alterniflora* (smooth cordgrass) occurring in regularly flooded intertidal zones. *Spartina alterniflora* (smooth cordgrass) dominates this physically stressful zone due to limited competition and its ability to tolerate salinity and flooding. It also requires moderately high levels of iron (7-15 ppm) (Adams 1963). *Spartina alterniflora* (smooth cordgrass) is strongly dominant, forming a nearly monotypic tallgrass layer. There is little variation in vascular plant composition across the range. Tall-form *Spartina alterniflora* (smooth cordgrass) occurs adjacent to saltwater and colonizes unvegetated flats. This association also grades into short-form *Spartina alterniflora* (smooth cordgrass) landward where tidal range is more restricted. Common associates, occurring in low abundance, include *Limonium carolinianum* (Carolina sealavender), *Salicornia depressa* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Spergularia maritima* (media sandspurry), *Spergularia canadensis* (Canadian sandspurry), and *Suaeda maritima* (herbaceous seepweed). *Distichlis spicata* (inland saltgrass), *Agalinis maritima* (saltmarsh false foxglove), *Symphyotrichum tenuifolium* (perennial saltmarsh aster), and *Spartina patens* (saltmeadow cordgrass) can also sporadically occur, but are more common in the high salt marsh. Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum*, *Fucus vesiculosus*, and *Ulva* spp. *Enteromorpha* spp. can occur early in the growing season. Macroalgae associates may be sparse or absent at the southern edge of the range. Microscopic algae, especially diatoms, can be abundant on the marsh surface (Teal 1986).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Spartina alterniflora* (smooth cordgrass)
Other Noteworthy Species: Information not available.

USFWS Wetland System: Estuarine

Distribution

Range: This association occurs along the Atlantic coastline from Nova Scotia and New Brunswick south to Cape Hatteras, North Carolina.

States/Provinces: CT, DE:S5, MA, MD:S5, ME, NB, NC, NH, NJ:S5, NS, NY:S3S4, RI, VA
Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Sagamore Hill); USFWS (Back Bay?, Cape May, Chesapeake Marshlands, E.B. Forsythe, Monomoy, Moosehorn?, Muskeget Island, Parker River, Prime Hook)

Conservation Status

Rank: G5 (1-Dec-1997)
Reasons: Information not available.

Classification Information

Status: Standard
Confidence: 1 - Strong
Comments: The northern limit of this type occurs where there is a slower accumulation of silt and corresponding absence of algal species (Chapman 1937). The southern limit corresponds with the southern limit of the Virginian province of the American Atlantic Temperate Region, a transitional area harboring animal species of both southern and northern affinities (Gosner 1979, Cowardin 1979). Southern occurrences, where *Ascophyllum nodosum* (yellow tang) may be sparse or absent, are placed within this type because of the associated characteristic faunal assemblage, including *Uca pugnax* (Atlantic marsh fiddler), *Littorina saxatilis* (rough periwinkle), *Littorina obtusata* (smooth periwinkle), and *Brachidontes demissus* (ribbed mussel). Analogous low salt marsh associations in other geographic areas include *Spartina alterniflora* (smooth cordgrass) Carolinian Zone Herbaceous Vegetation (CEGL004191) and *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190) for the Atlantic Coast of the southeastern U.S. (Cape Hatteras, North Carolina, to Florida) and the Gulf Coast (Florida to Texas), respectively [see Cowardin (1979) for regional boundaries]. *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193) is a *Spartina alterniflora* (smooth cordgrass)-dominated association occurring in the mid-tidal range of tidal rivers that have a minimum tidal range of one meter.

Similar Associations:

- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190)
- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193)
- *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191)

Related Concepts:

- *Spartina alterniflora* Tidal Herbaceous Vegetation (Harrison 2001)
- *Spartina alterniflora* community (Metzler and Barrett 1992)

- *Spartina alterniflora* salt marsh (Clancy 1993)
- Cordgrass saltmarsh community (MENHP 1991)
- Low salt marsh (Reschke 1990)
- Low salt marsh (Enser 1993)
- Low salt marsh community (Sperduto 1994)
- Salt Marsh (Rawinski 1984)
- Salt Marsh (Virginian Subtype) (Schafale 2000)
- Salt marsh (Higgins et al. 1971)
- Salt marsh community (Hill 1986)
- Salt marsh complex, low marsh (Breden 1989)

Sources

Description Authors: S.L. Neid

References: Adams 1963, Bell et al. 2002, Bertness 1988, Bowman 2000, Breden 1989, Breden et al. 2001, Chapman 1937, Clancy 1993, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Enser 1999, Fleming et al. 2004, Gawler 2001, Gawler 2002, Gosner 1979, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, MENHP 1991, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, USDA-NRCS 2001, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003, Schafale and Weakley 1990, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1979, Swain and Kearsley 2001, Teal 1986.



Figure F-42. North Atlantic Low Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.004). September 2006. NAD 1983 / UTM easting 345925, northing 4680326.



Figure F-43. North Atlantic Low Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA091). September 2008. NAD 1983 / UTM easting 345441, northing 4680161.

Common Name (Park-specific): Salt Panne (Salicornia Type)

Synonyms

USNVC English Name: (Virginia Glasswort, Dwarf Glasswort, Sea Saltwort) - Saltmarsh Cordgrass Herbaceous Vegetation

USNVC Scientific Name: Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora Herbaceous Vegetation

USNVC Identifier: CEGL004308

Local Information

Environmental Description: Salt pannes form in shallow depressions lower than the elevation of the salt marsh. The depressions are regularly to irregularly flooded by tides, and as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Substrate is soft, silty muck.

Vegetation Description: This association is dominated by *Salicornia maritima* (slender grasswort). Associated species include *Suaeda linearis* (annual seepweed), *Atriplex patula* (spear saltbush), and *Phragmites australis* (common reed). There are large patches of bare muck throughout the association.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Salicornia maritima* (slender grasswort)

Characteristic Species: *Salicornia maritima* (slender grasswort)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S3*	B	–	Salt Marsh	Swain and Kearsley 2001

Local Range: This association occurs throughout the salt marshes in the Boston Harbor Islands National Recreation Area. This example is described from the eastern side of Damde Meadows on World's End that is tidally flooded in association with salt marsh restoration efforts. This association also occurs on Raccoon and Snake islands and was mapped during the 2002 mapping efforts of the Boston Harbor Islands intertidal habitats by Bell et al. (2002) on World's End and Thompson Island.

Classification Comments: None.
Other Comments: None.
Local Description Authors: E. Largay
Plots: BOHA.008.
AA Points: None.

Boston Harbor Islands National Recreation Area Inventory Notes: *Salicornia* (pickleweed)-delineated polygons from the Bell et al. (2002) intertidal habitat mapping study were adopted into the vegetation map and retain their *Salicornia* (pickleweed) attribution. In general, the patch size of this association is below minimum map unit size, and smaller examples were lumped into North Atlantic High Salt Marsh and North Atlantic Low Salt Marsh map classes in the vegetation map depending on where the salt panned occurred.

Global Information

USNVC Classification

Classification Level	Description
Class	Shrub & Herb Vegetation (2)
Subclass	Shrub & Herb Wetland (2.C)
Formation	Salt Marsh (2.C.5)
Division	Temperate & Boreal Atlantic Coastal Salt Marsh (D034)
Macrogroup	North American Atlantic & Gulf Coast Salt Marsh (M079)
Group	Atlantic & Gulf Coast Saline Flat & Panne (G123)
Alliance	*Batis maritima - Sarcocornia* spp. - *Salicornia* spp. Salt Flat & Panne Alliance (A3955)
Alliance (English name)	Turtleweed - Swampfire species - Saltwort species Salt Flat & Panne Alliance
Association	*Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation
Association (English name)	(Virginia Glasswort, Dwarf Glasswort, Sea Saltwort) - Saltmarsh Cordgrass Herbaceous Vegetation
Ecological System(s)	Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
	Central Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)
	Acadian Coastal Salt Marsh (CES201.578)

Global Description

Concept Summary: This association represents tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs, including *Salicornia depressa* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), and stunted *Spartina alterniflora* (smooth cordgrass), that occur in salt marshes of the Atlantic Coast. Vegetation of this association tends to develop in shallow depressions within high or salt marshes where drainage is poor. The depressions are regularly to irregularly flooded by high tides, but as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Formation of the pannes may result from ice-scouring, rafting flotsam, peat compaction, mosquito ditch levees, or erosion of tidal creek banks, which create small, sparsely vegetated to unvegetated impoundments. Bare peat and/or mucky soils are prevalent (up to 85% bare soils). Total vegetative cover is variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia depressa* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender

grasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sealavender), *Plantago maritima var. juncoides* (goose tongue), *Triglochin maritima* (seaside arrowgrass), *Spartina patens* (saltmeadow cordgrass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* sp. (saltbush). Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the association than do vascular species. Diagnostic species include *Salicornia bigelovii* (dwarf saltwort) and *Salicornia depressa* (Virginia glasswort).

Environmental Description: Vegetation of this association tends to develop in shallow depressions in salt marshes where drainage is poor. They tend to occur more frequently on the high marsh but occur within low marsh as well. Pannes form in depressions that range from 2-30 cm lower than the elevation of the marsh. The depressions are regularly to irregularly flooded by tides, and as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Substrate is soft, silty muck or peat of variable density.

Vegetation Description: This association includes tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs. Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia depressa* (Virginia glasswort), *Salicornia bigelovii* (dwarf saltwort), *Salicornia maritima* (slender grasswort), *Sarcocornia perennis* (chickenclaws), or *Spartina alterniflora* (smooth cordgrass) (short form). Common associates include *Limonium carolinianum* (Carolina sealavender), *Plantago maritima var. juncoides* (goose tongue), *Triglochin maritima* (seaside arrowgrass), *Spartina patens* (saltmeadow cordgrass), *Suaeda maritima* (herbaceous seepweed), and *Atriplex* sp. (saltbush). Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the association than do vascular species. The following algae were noted to occur in association with *Spartina alterniflora* (smooth cordgrass) in the littoral zone of a Massachusetts salt marsh: *Oscillatoria subuliformis*, *Oscillatoria amphibia*, *Lyngbea* spp., *Microcoleus chthonoplastes*, *Nodularia harveyana*, *Hydrocoleum lyngbyaceum*, and *Symploca* spp. (Webber 1967).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Semi-shrub	*Salicornia depressa* (Virginia glasswort)
		Sarcocornia perennis (chickenclaws)
	Forb	*Salicornia bigelovii* (dwarf saltwort)
	Graminoid	*Spartina alterniflora* (smooth cordgrass)

Characteristic Species: *Salicornia bigelovii* (dwarf saltwort), *Salicornia depressa* (Virginia glasswort), *Sarcocornia perennis* (chickenclaws)

Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution

Range: This association occurs along the Mid- and North Atlantic Coast from the Canadian maritime provinces south to North Carolina.

States/Provinces: CT, DE:S3, MA, MD, ME, NB, NC, NH, NJ:S3S4, NS, NY, RI, SC?, VA
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Lookout, Fire Island, Fort Frederica?, Gateway); USFWS (Cape May, E.B. Forsythe, Parker River, Prime Hook)

Conservation Status

Rank: G5 (1-Dec-1997)
Reasons: Information not available.

Classification Information

Status: Standard
Confidence: 2 - Moderate
Comments: This association occurs in coastal salt marshes from Nova Scotia to the Carolinas, north of the range of *Batis maritima* (turtleweed). Salt pannes can potentially be classified based on morphology, salinity gradients, or substrate (Godfrey et al. 1978), which may elucidate further variation.

Similar Associations:

- *Batis maritima - Sarcocornia perennis* Dwarf-shrubland (CEGL003956)
- *Sarcocornia perennis* - (*Batis maritima*, *Distichlis spicata*) Dwarf-shrubland (CEGL002278)
- *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation [Provisional] (CEGL006586)

Related Concepts:

- *Salicornia - Bassia* salt flat (Harvill 1965)
- *Salicornia europaea - Spartina alterniflora* community (Metzler and Barrett 1992)
- *Salicornia* tidal flat (Clovis 1968)
- *Salicornietum ambiguae* (Conard 1935)
- *Sarcocornia perennis - (Distichlis spicata, Spartina alterniflora)* Dwarf-shrubland (Bartgis 1986)
- *Spartina alterniflora / Salicornia europaea* community (Clancy 1993)
- Pan (Nichols 1920)
- Panne (Good 1965)
- Panne marsh (Baumann 1978)
- Pans (Hill 1986)
- Pans (Higgins et al. 1971)
- Salt Flat (Schafale 2000)
- Salt Marsh (Rawinski 1984)
- Salt marsh complex, pannes (Breden 1989)
- Salt pan (Klotz 1986)

- Salt panne (Clancy 1993)
- Salt panne (Reschke 1990)
- Salt panne (Miller and Egler 1950)
- Stunted *Spartina alterniflora* community (Miller and Egler 1950)

Sources

Description Authors: S.L. Neid

References: Bartgis 1986, Baumann 1978, Bell et al. 2002, Berdine 1998, Bertness et al. 1992, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993, Clancy 1996, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001, Fleming et al. 2004, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Good 1965, Harrison 2004, Harvill 1965, Higgins et al. 1971, Hill 1986, Klotz 1986, Metzler and Barrett 1992, Metzler and Barrett 2001, Miller and Egler 1950, USDA-NRCS 2001, Nichols 1920, Niering and Warren 1980, Peet et al. unpubl. data 2002, Rawinski 1984, Redfield 1972, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sperduto 2000b, Swain and Kearsley 2001, VDNH 2003, Webber 1967.



Figure F-44. Salt Panne (Salicornia Type) on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.008). September 2006. NAD 1983 / UTM easting 345699, northing 4680469.

Common Name (Park-specific): North Atlantic Coast Estuarine Intertidal Mudflats

Synonyms

USNVC English Name: Intertidal Mudflats Sparse Vegetation
USNVC Scientific Name: Intertidal Mudflats Sparse Vegetation
USNVC Identifier: CEGL006614

Local Information

Environmental Description: This saline intertidal mudflat association lacks vegetation, but is often comprised of recently living rhizomes. The substrate consists of fine sediments that are rich in organic matter and poorly drained at low tide.

Vegetation Description: There is no vegetation on these mudflats.
Most Abundant Species: Vegetation is absent.
Characteristic Species: Vegetation is absent.

Other Noteworthy Species

Species	GRank	Type	Note
Mya arenaria (softshell)	–	animal	–
Mytilus edulis (blue mussel)	–	animal	–

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S4*	B	–	Marine Intertidal, Flats	Swain and Kearsley 2001

Local Range: This association occurs on most of the islands in protected areas with low flow rates such as small bays, coves and estuaries. Examples include the southern end of Thompson, Slate, Grape islands and World's End.

Classification Comments: None.
Other Comments: None.
Local Description Authors: R. Bell and E. Largay
Plots: None.
AA Points: None.
Boston Harbor Islands National Recreation Area Inventory Notes: This association was mapped by Bell et al. (2002) in the Boston Harbor Islands marine intertidal classification and mapping project. The polygons from the intertidal shape file were adopted into the vegetation map shapefile. An observation point was taken in September 2008 on World’s End during accuracy assessment noting the dominant species and gps location. A photograph was also taken.

Global Information

USNVC Classification

Classification Level	Description
Class	Aquatic Vegetation (5)
Subclass	Saltwater Aquatic Vegetation (5.A)
Formation	Benthic Macroalgae Saltwater Vegetation (5.A.2)
Division	Temperate Intertidal Shore (D047)
Macrogroup	Temperate Atlantic Intertidal Shore (M104)
Group	North American North Atlantic Intertidal Shore (G387)
Alliance	North Atlantic Intertidal Mudflat Alliance (A4132)
Alliance (English name)	North Atlantic Intertidal Mudflat Alliance
Association	Intertidal Mudflats Sparse Vegetation
Association (English name)	Intertidal Mudflats Sparse Vegetation
Ecological System(s)	Information not available.

Global Description

Concept Summary: This is a saline (>18.0 ppt) intertidal mudflat association that typically lacks vegetation. *Ulva lactuca* (sea-lettuce) may be present or prominent. The substrate consists of silt or sand that is rich in organic matter and poorly drained at low tide. These saline intertidal mudflats extend along the North Atlantic Coast from Maine to New York.

Environmental Description: This association occurs on saline mudflats located between the highest high tide and the lowest low tide along the North Atlantic Coast. Salinity levels are greater than 18.0 parts per thousand of ocean-derived salts. They are completely exposed at low tide and are tidally flooded twice daily. The substrate consists of silt or sand that is poorly drained at low tide and rich in organic matter. These areas are subject to moderated fluctuations in salinity and moisture and are washed by low-energy waves. The substrate may be covered with algae.

Vegetation Description: This association typically does not have vegetation. However, some examples have dense cover of the green algae *Ulva lactuca*.

Most Abundant Species

Stratum	Lifeform	Species
Floating aquatic	Alga	*Ulva lactuca* (sea-lettuce)

Characteristic Species: *Ulva lactuca* (sea-lettuce)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution

Range: These intertidal mudflats extend along the Atlantic Coast from Maine to New York and possibly New Jersey.

States/Provinces: CT, MA, ME, NH, NY:S4, RI
Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Gateway)

Conservation Status
Rank: G5 (23-Mar-2007)
Reasons: This is a very common intertidal maritime association along the Atlantic Coast.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: This type is likely covered by the marine classification; however, this mudflat association occurs in coastal vegetation mapping projects, and it seems appropriate to classify it under sparse vegetation for the time being, until the marine classification can be applied to vegetation mapping projects.

Similar Associations:

- *Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation (CEGL004473)--is a brackish intertidal mudflat association with salinity levels ranging from 0.5-18.0 and lacks the macroalgae component of CEGL006614.

Related Concepts: Information not available.

Sources
Description Authors: E. Largay and G. Edinger
References: Anderson et al. 1976, Bell et al. 2002, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser and Lundgren 2005, MNAP 1991, Metzler and Barrett 2004, Swain and Kearsley 2001, Welsh 1980, Whitlatch 1982.



Figure F-45. North Atlantic Coast Estuarine Intertidal Mudflats on World's End in Boston Harbor Islands National Recreation Area (observation point). September 2008. NAD 1983 / UTM easting 345429, northing 4680215.

Common Name (Park-specific): New England Rocky Intertidal Community

Synonyms

USNVC English Name: Yellow Tang - Black Tang Tidal Algal Nonvascular Vegetation
USNVC Scientific Name: *Ascophyllum nodosum* - *Fucus vesiculosus* Tidal Algal Nonvascular Vegetation

USNVC Identifier: CEGL006341

Local Information

Environmental Description: This algal community typically occurs on mid-intertidal boulders, rip-rap and bedrock in medium- to low-exposure areas often surrounded with cobble and gravel or on slate and shale fragments.

Vegetation Description: Algae are the dominant vegetation, including *Ascophyllum nodosum* and *Fucus* sp. They make up more than 75% of the total biota. Either species may dominate, or they are codominant.

Most Abundant Species

Stratum	Lifeform	Species
Nonvascular	Alga	*Ascophyllum nodosum* (yellow tang)
		Fucus vesiculosus (black tang)
Floating aquatic	Alga	*Ascophyllum nodosum* (yellow tang)
		Fucus vesiculosus (black tang)

Characteristic Species: *Ascophyllum nodosum* (yellow tang), *Fucus vesiculosus* (black tang)
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	–	Marine Intertidal, Rocky Shore	Swain and Kearsley 2001

Local Range: This community occurs on the southwest side of Rainsford Island, the north side of Slate Island, the east side of World's End and Grape Island in areas of boulders and bedrock, the north side of Georges Island on rip-rap, along the southern boulder field on Calf Island, sheltered areas on the eastern side of Outer and Little Brewster islands and most of Langlee Island.

Classification Comments: None.
Other Comments: None.
Local Description Authors: R. Bell and E. Largay
Plots: None.
AA Points: None.
Boston Harbor Islands National Recreation Area Inventory Notes: This association was mapped by Bell et al. (2002) in Boston Harbor Islands intertidal mapping project. The polygons delineating the boundaries of the Brown Algae Assemblage, the *Fucus* Assemblage, and the *Ascophyllum*

Assemblage in the intertidal shape file were adopted into the vegetation map shape file. An observation point was taken in September 2008 during accuracy assessment noting the dominant species and gps location. A photograph was also taken.

Global Information

USNVC Classification

Classification Level	Description
Class	Aquatic Vegetation (5)
Subclass	Saltwater Aquatic Vegetation (5.A)
Formation	Benthic Macroalgae Saltwater Vegetation (5.A.2)
Division	Temperate Intertidal Shore (D047)
Macrogroup	Temperate Atlantic Intertidal Shore (M104)
Group	North American North Atlantic Intertidal Shore (G387)
Alliance	North Atlantic Tidal Rocky Shoreline Alliance (A4133)
Alliance (English name)	North Atlantic Tidal Rocky Shoreline Alliance
Association	*Ascophyllum nodosum - Fucus vesiculosus* Tidal Algal Nonvascular Vegetation
Association (English name)	Yellow Tang - Black Tang Tidal Algal Nonvascular Vegetation
Ecological System(s)	Acadian Coastal Salt Marsh (CES201.578)

Global Description

Concept Summary: This algal vegetation occurs on rocky intertidal habitats of the north Atlantic coast. It spans the littoral zone between mean high tide and mean low tide and can locally extend into the upper sublittoral. This habitat is characterized by alternating submergence by tidal flooding and exposure to air. Substrate is composed of rocks, boulders, and cobbles. *Ascophyllum nodosum* and *Fucus* spp. are the most characteristic algae, with other associates including *Enteromorpha* spp., *Ulva lactuca*, *Porphyra laciniata*, *Phyllitis fascia*, and *Cladophora* spp. There is seasonal and geographic variability in species composition between areas north versus south of Cape Cod, which forms a major boundary between colder waters to the north fed by arctic currents and warmer waters to the south fed by the Gulf Stream. Distinct species zonation can reflect upper littoral, lower littoral and sublittoral zones, but species often intergrade. Invertebrates are important members of this community, including *Mytilus edulis* (blue mussel), *Balanus balanoides* (barnacles), *Littorina* spp., (periwinkles), and *Acmaea testudinalis* (limpets), as well as species of *Asterias* (starfish).

Environmental Description: This association occurs most commonly along rocky coastal shorelines spanning the littoral zone between mean high tide and mean low tide. The littoral zone is characterized by alternating submergence by tidal flooding and exposure to air. It is roughly subdivided into two zones on either side of average neap tide level; organisms that can tolerate a greater degree of exposure occur in the upper littoral zone. Substrate is rocky, stony, or cobbly reflecting relatively high wave energy and erosion-resistant bedrock. Artificial jetties and dikes also provide appropriate habitat for this vegetation. This association spans geographically across

Cape Cod, which forms a major boundary between colder waters to the north fed by arctic currents and warmer waters to the south fed by the Gulf Stream.

Vegetation Description: This association encompasses algal vegetation of the littoral and upper sublittoral zones of rocky coasts. Vegetation is a compilation of both cold-water and warm-water species that do not necessarily occur together throughout the year; there is seasonal variability in species occurrence. Generalist species common throughout the year and in both warm and cold water include *Ascophyllum nodosum* and *Fucus vesiculosus*, which are dominant and tend to grow profusely. Other conspicuous species can include *Fucus spiralis* and *Fucus distichus*, and, depending on local wave energy, other algal species like *Enteromorpha clathrata*, *Enteromorpha intestinalis*, *Ulva lactuca*, *Porphyra laciniata*, and *Phyllitis fascia*. Distinct species zonation can reflect upper littoral, lower littoral and sublittoral zones, but species often intergrade. In the upper littoral zone, species such as *Enteromorpha minima*, *Enteromorpha prolifera*, *Urospora penicilliformis*, *Rhizoclonium* spp., and *Ulothrix* spp. occur. In the lower littoral region, in deeper water, additional species can include *Ectocarpus* spp., *Hildenbrandtia prototypus*, *Nemalion multifidum*, *Bryopsis plumosa*, and *Cladophora* spp. (Nichols 1920). Species diversity fluctuates seasonally based on water temperature affiliations of individual species. Several additional algal species can occur as epiphytes.

Most Abundant Species

Stratum	Lifeform	Species
Floating aquatic	Alga	*Ascophyllum nodosum* (yellow tang)
		Fucus vesiculosus (black tang)

Characteristic Species: *Ascophyllum nodosum* (yellow tang), *Fucus vesiculosus* (black tang)
Other Noteworthy Species: Information not available.
USFWS Wetland System: Estuarine

Distribution
Range: This association occurs along the northern Atlantic coast from New York to Labrador.
States/Provinces: CT, MA, ME, NB?, NH:S3, NY:S1S2, ON?, QC?, RI
Federal Lands: NPS (Acadia, Boston Harbor Islands)

Conservation Status
Rank: GNR (1-Dec-1997)
Reasons: Information not available.

Classification Information
Status: Standard
Confidence: 3 - Weak
Comments: Invertebrates are important members of this community, including *Mytilus edulis* (blue mussel), *Balanus balanoides* (barnacles), *Littorina* spp., (periwinkles), and *Acmaea testudinalis* (limpets), as well as species of *Asterias* (starfish).

Similar Associations:

- *Laminaria agardhii* Tidal Algal Nonvascular Vegetation (CEGL006344)

Related Concepts:

- Brown algae zone (Berrill and Berrill 1981)
- Rockweed zone (Gawler 1991)
- Rockweed-barnacle community (Godfrey et al. 1978)
- Rocky shore (Godfrey et al. 1978)

Sources

Description Authors: S.L. Neid

References: Bell et al. 2002, Berrill and Berrill 1981, Coleman and Mathieson 1975, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 1991, Godfrey et al. 1978, Metzler and Barrett 2001, Metzler and Barrett 2004, Nichols 1920, Reschke 1990, Sperduto 2000b, Swain and Kearsley 2001.



Figure F-46. New England Rocky Intertidal Community on Grape Island in Boston Harbor Islands National Recreation Area (observation point). September 2008. NAD 1983 / UTM easting 341732, northing 4681350.



Figure F-47. New England Rocky Intertidal Community on World's End in Boston Harbor Islands National Recreation Area (below plot BOHA.012). September 2006. NAD 1983 / UTM easting 345696, northing 4681015.

Common Name (Park-specific): Maritime Rock Cliffs and Outcrops

Synonyms

USNVC English Name: Maritime Rock Cliffs and Outcrops
USNVC Scientific Name: Maritime Rock Cliffs and Outcrops
USNVC Identifier: CEGL006619

Local Information

Environmental Description: This association occurs on a variety of settings, including steep slate cliffs, puddingstone cliffs, and tall blocky rock outcrops with no or very sparse vegetation. They are exposed to salt spray and coastal storms.

Vegetation Description: The north side of Slate Island has steep slate cliffs with a mixture of native and non-native plants. The most unusual and striking plants here are *Aquilegia canadensis* (red columbine) and *Ligusticum scoticum* (Scottish licorice-root). Both species, which are rare on the islands, are abundant on these cliffs. Other native species include *Deschampsia flexuosa* (wavy hairgrass), *Festuca rubra* (red fescue), *Nuttallanthus canadensis* (Canada toadflax), and *Solidago sempervirens* (seaside goldenrod). Several of the outer islands have high rock cliffs with no or very sparse vegetation. Green, Little Calf, Middle Brewster, and Outer Brewster islands have steep rock outcroppings exposed to spray. The scattered plants (<5% cover) on these forbidding outcrops are primarily tough, herbaceous, non-native perennials growing in soil pockets nourished by gull and cormorant droppings. Species include *Artemisia vulgaris* (common wormwood), *Brassica nigra* (black mustard), *Malva neglecta* (common mallow), *Polygonum lapathifolium* (curlytop knotweed), *Solidago sempervirens* (seaside goldenrod), *Solanum dulcamara* (climbing nightshade) and *Rumex crispus* (curly dock).

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Artemisia vulgaris* (common wormwood)
		Brassica nigra (black mustard)

Characteristic Species: Species are variable depending on substrate composition.

Other Noteworthy Species

Species	GRank	Type	Note
Aquilegia canadensis (red columbine)	–	plant	–
Geranium carolinianum var. *confertiflorum* (Carolina geranium)	–	plant	MA watch-list plant that grows in puddingstone crevices on Langlee Island.
Ligusticum scoticum (Scottish licorice-root)	–	plant	–

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	S2*	B	1	Maritime Rock Cliffs	Swain and Kearsley 2001

Local Range: The north side of Slate has slate cliffs; Langlee and Ragged islands in Hingham Harbor have steep puddingstone cliffs on their south sides. Green, Little Calf, Middle Brewster, and Outer Brewster islands have steep rock outcroppings exposed to spray.

Classification Comments: This association is distinguished from the Maritime Erosional Bluffs and Cliffs in that they consist of consolidated rock substrate rather then loosely consolidated to unconsolidated sand and gravel. They are typically sparsely vegetated; however, species that comprise Common Wormwood Gravel Field can occasionally occur in this association. When steep rock cliffs and outcrops are present, then the association is mapped and classified as Maritime Rock Cliff and Outcrop rather than Common Wormwood Gravel Field.

Other Comments: Maritime Rock Cliffs (Swain and Kearsley 2001) is listed as an S2 community by the Massachusetts Natural Heritage and Endangered Species Program.

Local Description Authors: T. Elliman and E. Largay
Plots: None.
AA Points: BOHA.AA146, BOHA.AA147
Boston Harbor Islands National Recreation Area Inventory Notes: None.

Global Information

USNVC Classification

Classification Level	Description
Class	Open Rock Vegetation (6)
Subclass	Temperate & Boreal Open Rock Vegetation (6.B)
Formation	Temperate & Boreal Cliff, Scree & Other Rock Vegetation (6.B.1)
Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (D051)
Macrogroup	Eastern North American Cliff, Scree & Rock Vegetation (M111)
Group	Eastern North American Talus & Bluff (G340)
Alliance	Open Cliff Sparsely Vegetated Alliance (A1836)
Alliance (English name)	Open Cliff Sparsely Vegetated Alliance
Association	Maritime Rock Cliffs
Association (English name)	Maritime Rock Cliffs
Ecological System(s)	Information not available.

Global Description

Concept Summary: This is a sparsely vegetated consolidated rock cliff association that occurs along the North Atlantic Coast. Vegetation occurs within rock crevices and cracks where soil collects. The cliffs are exposed to salt spray and coastal storms. It is currently only described for Boston Harbor Islands National Recreation Area and includes steep slate cliffs, puddingstone cliffs, and high rock cliffs with no or very sparse vegetation.

Environmental Description: This association includes steep slate cliffs, puddingstone cliffs, and high rock cliffs with no or very sparse vegetation in Boston Harbor Islands. The cliffs are exposed to salt spray and coastal storms.

Vegetation Description: The cliffs are sparsely vegetated, and the most unusual and striking plants are *Aquilegia canadensis* (red columbine) and *Ligusticum scoticum* (Scottish licorice-root). Other native species include *Deschampsia flexuosa* (wavy hairgrass), *Festuca rubra* (red fescue), *Nuttallanthus canadensis* (Canada toadflax), and *Solidago sempervirens* (seaside goldenrod). Several of the outer islands have high rock cliffs with no or very sparse vegetation. The scattered plants on these forbidding outcrops are primarily tough, herbaceous, non-native perennials growing in soil pockets nourished by gull and cormorant droppings. Species include *Artemisia vulgaris* (common wormwood), *Brassica nigra* (black mustard), *Malva neglecta* (common mallow), *Polygonum lapathifolium* (curlytop knotweed), and *Rumex crispus* (curly dock).

Most Abundant Species: Species composition is highly variable depending on substrate. In many examples the vegetation is sparse or absent.

Characteristic Species: Species composition is highly variable depending on substrate. In many examples the vegetation is sparse or absent.

Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs along the ocean side of rocky headlands along the North Atlantic Coast.

States/Provinces: MA, ME, NH
Federal Lands: NPS (Boston Harbor Islands)

Conservation Status
Rank: GNR (12-May-2007)
Reasons: Information not available.

Classification Information
Status: Nonstandard
Confidence: 3 - Weak
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

Sources
Description Authors: T. Elliman and E. Largay
References: Eastern Ecology Working Group n.d., Elliman 2004, Swain and Kearsley 2001.

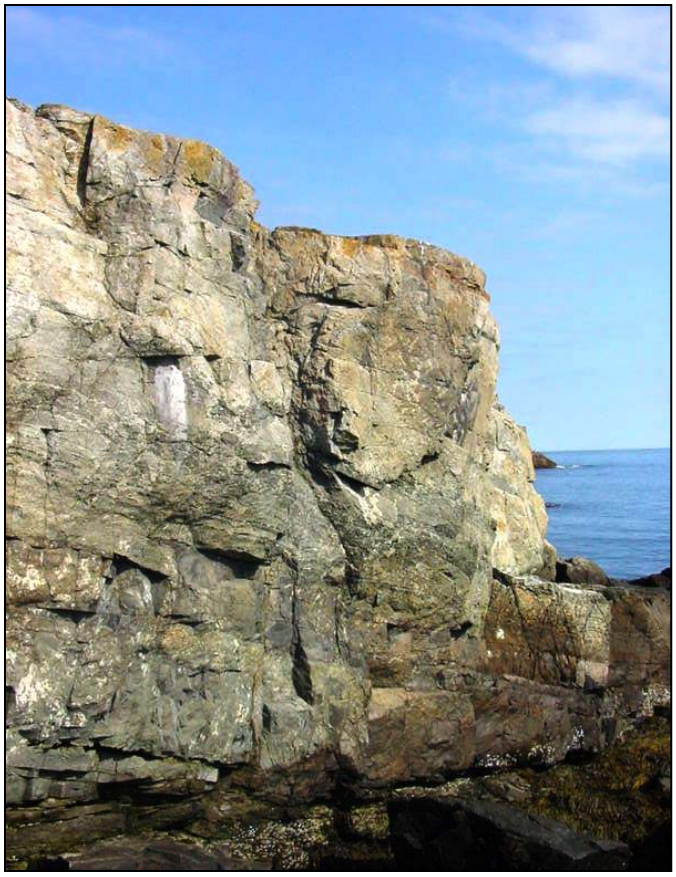


Figure F-48. Maritime Rock Cliffs and Outcrops on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA146). September 2008. NAD 1983 / UTM easting 343896, northing 4689321.

Common Name (Park-specific): Maritime Erosional Bluffs and Cliffs

Synonyms

USNVC English Name: Maritime Erosional Bluffs and Cliffs Sparse Vegetation

USNVC Scientific Name: Maritime Erosional Bluffs and Cliffs Sparse Vegetation

USNVC Identifier: CEGL006618

Local Information

Environmental Description: Eroding cliffs, bluffs, and slopes are common features on the Boston Harbor Islands with steep-sided drumlins. These sheer cliffs and slopes consist of loosely consolidated to unconsolidated sand and stone. Some have little to no vegetation while others have vegetation typical of a Northeastern Old Field, Common Wormwood Gravel Field, or Staghorn Sumac Shrubland. They are exposed to salt spray and coastal storms. The soils are poorly developed. Landslides and erosional blowouts are common features on the faces of the cliffs and slopes.

Vegetation Description: Plants that do occur on cliff and bluff faces, such as *Achillea millefolium* (common yarrow), *Artemisia vulgaris* (common wormwood), *Symphyotrichum ericoides* (white heath aster), *Bromus tectorum* (cheatgrass), *Cirsium arvense* (Canada thistle), *Linaria vulgaris* (butter and eggs), *Poa compressa* (Canada bluegrass), *Verbascum thapsus* (common mullein), *Hieracium caespitosum* (meadow hawkweed), *Conyza canadensis* (Canadian horseweed) and *Solidago rugosa* (wrinkleleaf goldenrod), are typically weedy species that are also common in old fields. Scattered shrubs and small trees may also be present or dominant, including *Rhus typhina* (staghorn sumac), *Prunus serotina* (black cherry), *Elaeagnus umbellata* (autumn olive), *Rosa multiflora* (multiflora rose), *Rubus allegheniensis* (Allegheny blackberry), *Celastrus orbiculatus* (oriental bittersweet), and *Morella pensylvanica* (northern bayberry). The bases of the erosional cliffs are often seepy, and moisture-tolerant species are frequently found there. Species found in moist soils at the foot of cliffs include *Amelanchier canadensis* (Canadian serviceberry), *Salix bebbiana* (Bebb willow), *Equisetum arvense* (field horsetail), *Impatiens capensis* (jewelweed), *Lespedeza capitata* (roundhead lespedeza), *Scutellaria galericulata* (marsh skullcap), *Teucrium canadense* (Canada germander), and *Tussilago farfara* (coltsfoot). Scattered individuals of *Phragmites australis* (common reed) occur in some examples of this association.

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
Herb (field)	Forb	*Symphyotrichum ericoides* (white heath aster)
		Conyza canadensis (Canadian horseweed)
		Lespedeza capitata (roundhead lespedeza)
		Solidago rugosa (wrinkleleaf goldenrod)
	Graminoid	*Bromus tectorum* (cheatgrass)
		Poa compressa (Canada bluegrass)

Characteristic Species: *Conyza canadensis* (Canadian horseweed), *Lespedeza capitata* (roundhead lespedeza)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data

State	SRank	Rel	Conf	SName	Reference
MA	SNR	–	1	Maritime Erosional Cliff Community	Swain and Kearsley 2001

Local Range: The north side of Thompson Island, Prince Head on Peddock's Island, the north side of Great Brewster Island, Gallops, Grape, West Head on Long Island, and Rainsford Island have sheer cliffs and bluffs of sand.

Classification Comments: This association is different from Maritime Rock Cliffs mapped in Boston Harbor Islands in that the soils consist of unconsolidated to loosely consolidated sand and show evidence of active erosion. This association typically occurs above Beach Strand.

Other Comments: Maritime Erosional Cliff Community (Swain and Kearsley 2001) is listed as an S2 community by the Massachusetts Natural Heritage and Endangered Species Program.

Local Description Authors: T. Elliman and E. Largay
Plots: BOHA.013, BOHA.039, BOHA.AA129
AA Points: BOHA.AA130, BOHA.AA065, BOHA.AA145, BOHA.AA156
Boston Harbor Islands National Recreation Area Inventory Notes: Plots were taken at the midslope and lower slope positions of the cliffs. Combinations of plant species that typically comprise Northeastern Old Field, Common Wormwood Gravel Field, and Staghorn Sumac Shrubland species can occur in this association, which is always characterized by the presence of steep erosional bluffs, cliffs, or blowouts. When this characteristic environmental setting is present, then the association is mapped and classified as Maritime Erosional Bluffs and Cliffs rather than Northeastern Old Field, Common Wormwood Gravel Field, or Staghorn Sumac Scrub Forest. An observation point was taken in September 2008 on Long during accuracy assessment noting the dominant species and gps location. A photograph was also taken.

Global Information

USNVC Classification

Classification Level	Description
Class	Open Rock Vegetation (6)
Subclass	Temperate and Boreal Open Rock Vegetation (6.B)
Formation	Temperate & Boreal Cliff, Scree & Other Rock Vegetation (6.B.1)
Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (D051)
Macrogroup	Eastern North American Cliff, Scree & Rock Vegetation (M111)
Group	Eastern North American Talus & Bluff (G340)

USNVC Classification (continued)

Classification Level	Description
Alliance	Erosional Bluffs Alliance (A3992)
Alliance (English name)	Erosional Bluffs Alliance
Association	Maritime Erosional Cliffs
Association (English name)	Maritime Erosional Cliffs
Ecological System(s)	Information not available.

Global Description

Concept Summary: This association includes steep erosional cliffs with sparse vegetation occurring on the North Atlantic Coast. The coarse sand and gravel substrate is unconsolidated. This association is currently only described for Boston Harbor Islands National Recreation Area.

Environmental Description: Eroding cliffs are common features on Boston Harbor Islands with steep-sided drumlins. These sheer cliffs consist of unconsolidated sand, gravel and stone. Most have little vegetation and are exposed to salt spray and coastal storms. The soils are poorly developed. Landslides and erosional blowouts are common features on the faces of the cliffs.

Vegetation Description: Plants that do occur on cliff faces, such as *Achillea millefolium* (common yarrow), *Artemisia vulgaris* (common wormwood), *Bromus tectorum* (cheatgrass), *Cirsium arvense* (Canada thistle), *Linaria vulgaris* (butter and eggs), *Poa compressa* (Canada bluegrass), *Verbascum thapsus* (common mullein), *Hieracium caespitosum* (meadow hawkweed), *Conyza canadensis* (Canadian horseweed), and *Solidago rugosa* (wrinkleleaf goldenrod), are typically weedy species that are also common in old fields. Scattered shrubs and small trees may be present, including *Rhus typhina* (staghorn sumac), *Prunus serotina* (black cherry), *Elaeagnus umbellata* (autumn olive), *Rosa multiflora* (multiflora rose), *Rubus allegheniensis* (Allegheny blackberry), *Celastrus orbiculatus* (Oriental bittersweet), and *Morella pensylvanica* (northern bayberry). The bases of the erosional cliffs are often seepy, and moisture-tolerant species are frequently found there. Species found in moist soils at the foot of cliffs include *Amelanchier canadensis* (Canadian serviceberry), *Salix bebbiana* (Bebb willow), *Equisetum arvense* (field horsetail), *Impatiens capensis* (jewelweed), *Lespedeza capitata* (roundhead lespedeza), *Scutellaria galericulata* (marsh skullcap), *Teucrium canadense* (Canada germander), and *Tussilago farfara* (coltsfoot). Scattered individuals of *Phragmites australis* (common reed) occur in some examples of this association.

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhus typhina* (staghorn sumac)
Herb (field)	Forb	*Conyza canadensis* (Canadian horseweed)
		Lespedeza capitata (roundhead lespedeza)
		Solidago rugosa (wrinkleleaf goldenrod)
	Graminoid	*Bromus tectorum* (cheatgrass)

Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

Distribution
Range: This association occurs along the North Atlantic Coast.
States/Provinces: CT, MA, ME, NH, NY, RI
Federal Lands: NPS (Boston Harbor Islands)

Conservation Status
Rank: GNR (12-May-2007)
Reasons: Information not available.

Classification Information
Status: Nonstandard
Confidence: 3 - Weak
Comments: *Smilax glauca - Toxicodendron radicans* Vine-Shrubland (CEGL003886) may occur as inclusions within this cliff association.

Similar Associations: Information not available.
Related Concepts: Information not available.

Sources
Description Authors: T. Elliman and E. Largay
References: Eastern Ecology Working Group n.d., Elliman 2004, Swain and Kearsley 2001.



Figure F-49. Maritime Erosional Bluffs and Cliffs on Long Island in Boston Harbor Islands National Recreation Area (observation point). September 2006. NAD 1983 / UTM easting 337120, northing 4686197.



Figure F-50. Maritime Erosional Bluffs and Cliffs on Great Brewster Island in Boston Harbor Island National Recreation Area (AA point BOHA.AA145-two views). September 2008. NAD 1983 / UTM easting 343811, northing 4688620.

Appendix G. Dichotomous field key to the vegetation associations of Boston Harbor Islands National Recreation Area.

The vegetation association field keys prepared for BOHA have been divided into four individual dichotomous keys to vegetation associations and two initial couplets to select one of the four association keys to aid the user. The broad field key divisions are based primarily on physiognomy (Forests and Woodlands, Shrublands, Herbaceous Vegetation, and Sparse Vegetation) and upland versus wetland habitat.

1

Vegetation primarily woody (trees or tall shrubs exhibiting tree-like growth dominant; canopy closed to partially open – includes "shrubland" and “woodland” class of USNVC) 2

Vegetation primarily herbaceous, sparse, or aquatic 22

2

Forests and Woodlands 3

Shrublands 13

Forests and Woodlands

3

Forests and woodlands of uplands 4

Transitional upland/wetland forest occurring in a basin setting with a canopy codominated red maple (*Acer rubrum*), northern red oak (*Quercus rubra*) and/or black oak (*Quercus velutina*), and blackgum (*Nyssa sylvatica*), with blackgum dominant in the subcanopy; cinnamon fern (*Osmunda cinnamomea*), interrupted fern (*Osmunda claytoniana*), New York fern (*Thelypteris noveboracensis*), and wild sarsaparilla (*Aralia nudicaulis*) common in the herb layer ..... **Upland/Wetland Transitional Forest**

Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea Forest (CEGL006000)

4

Former plantations, Austrian pine (*Pinus nigra*) dominant, Scotch pine (*Pinus sylvestris*) may be present; black cherry (*Prunus serotina*) may be common in the subcanopy; successional and weedy often with a dense understory dominated by eastern poison ivy (*Toxicodendron radicans* ..... **Black Pine Forest**

Pinus thunbergiana - (Pinus nigra) Ruderal Forest (CEGL006012)

Trees occurring naturally; not planted 5

5

Evergreen (dominated by conifers) or mixed forests and woodlands: deciduous trees < 20-25% of the total canopy cover 6

Deciduous forests, woodlands and scrub forests: deciduous trees > 50% of canopy cover 7

6

Old-field successional forest dominated by eastern red-cedar (*Juniperus virginiana*); canopy closure and height are variable; black cherry (*Prunus serotina*) may be common; scattered oaks (*Quercus* spp.) possible but atypical; the understory is dominated by invasive shrubs and vines such as multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), Autumn olive (*Eleagnus umbellatus*) and Morrow's honeysuckle (*Lonicera morrowii*); garlic mustard (*Alliaria petiolata*)/or old field grasses dominate the herb layer..... **Old-field Eastern Red-cedar Forest**
Juniperus virginiana Ruderal Forest (CEGL006024)

Semi-open eastern red-cedar (*Juniperus virginiana*) woodland occurring on rocky headlands, outcrops and bluffs; other trees in the canopy can include Canadian serviceberry (*Amelanchier canadensis*), black oak (*Quercus velutina*), and sassafras *(Sassafras albidum)*; ericaceous shrubs including black huckleberry (*Gaylussacia baccata*), highbush blueberry (*Vaccinium corymbosum*), northern bayberry (*Morella pensylvanica*), running serviceberry (*Amelanchier stolonifera*), and lowbush blueberry (*Vaccinium angustifolium*) are common as well as native herbs such as wavy hairgrass (*Deschampsia flexuosa*), poverty oatgrass (*Danthonia spicata*), Pennsylvania sedge (*Carex pensylvanica*), little bluestem (*Schizachyrium scoparium*), and white goldenrod (*Solidago bicolor* ..... **Maritime Red-cedar Woodland**
Juniperus virginiana var. *virginiana / Morella pensylvanica* Woodland (CEGL006212)

7

Native oaks (*Quercus* spp.) or hickories (*Carya* spp.) are abundant in canopy, >25% cover 8

Oaks (*Quercus* spp.) may be present in canopy (<25% cover) or are absent, maples (*Acer* spp.), cherries (*Prunus* spp.), aspens (*Populus* spp.), and nonnative trees are more prominent..... 10

8

Transitional upland/wetland forest occurring in a basin setting with a canopy codominated by blackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*), northern red oak (*Quercus rubra*) and/or black oak (*Quercus velutina*), with blackgum and pignut hickory (*Carya glabra*) dominant in the subcanopy; a dense herbaceous layer of ferns is characteristic with cinnamon fern (*Osmunda cinnamomea*), interrupted fern (*Osmunda claytoniana*), and New York fern (*Thelypteris noveboracensis*); wild sarsaparilla (*Aralia nudicaulis*) also common..... **Upland/Wetland Transitional Forest**
Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea Forest(CEGL006000)

Dry maritime oak or oak-hickory forests lacking dense fern herbaceous layer..... 9

9

Oak-hickory forest on World's End dominated by black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), and bitternut hickory (*Carya cordiformis*); eastern white pine (*Pinus strobus*) may occur as a canopy associate; hophornbeam (*Ostrya virginiana*), pignut hickory (*Carya glabra*), and red maple (*Acer rubrum*) are common in the understory; herbaceous flora has native species characteristic of mature oak forests, including but not limited to wild sarsaparilla (*Aralia nudicaulis*), Pennsylvania sedge (*Carex pensylvanica*), striped prince's pine (*Chimaphila maculata*), white wood aster (*Eurybia divaricata*), and Canada mayflower (*Maianthemum canadense*); degraded examples may have Norway maple (*Acer platanoides*)..... **Northeastern Dry Oak-Hickory Forest**

Quercus (alba, rubra, velutina) / Viburnum acerifolium Forest (CEGL006336)

Successional maritime forest with a mixture of primarily native species; hickories (*Carya* spp.) absent; black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), black oak (*Quercus velutina*), eastern red-cedar (*Juniperus virginiana*), and/or black gum (*Nyssa sylvatica*) and at Webb State Park, common hackberry (*Celtis occidentalis*); blueberries (*Vaccinium* spp.) are common in addition to eastern poison ivy (*Toxicodendron radicans*), roundleaf greenbrier (*Smilax rotundifolia*), and Virginia creeper (*Parthenocissus quinquefolia*). ..... **Successional Maritime Forest**

Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia Forest (CEGL006145)

10

Canopy consists of >50 % cover of native species 11

Canopy consists of >50% cover of non-native species..... 15

11

Transitional upland/wetland forest occurring in a basin setting with a canopy codominated byblackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*), northern red oak (*Quercus rubra*) and/or black oak (*Quercus velutina*), with blackgum and pignut hickory (*Carya glabra*) dominant in the subcanopy; a dense herbaceous layer of ferns is characteristic with cinnamon fern (*Osmunda cinnamomea*), interrupted fern (*Osmunda claytoniana*), and New York fern (*Thelypteris noveboracensis*); wild sarsaparilla (*Aralia nudicaulis*) also common.....**Upland/Wetland Transitional Forest**

Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea Forest (CEGL006000)

Successional upland forests, woodlands and scrub forests..... 12

12

Successional maritime forest with a mixture of primarily native species including black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), black oak (*Quercus velutina*), eastern red-cedar (*Juniperus virginiana*), and/or black gum (*Nyssa sylvatica*); common hackberry (*Celtis occidentalis*) may also be present; heath shrubs are common as well as eastern poison ivy (*Toxicodendron radicans*), roundleaf greenbrier (*Smilax rotundifolia*), and Virginia creeper (*Parthenocissus quinquefolia*) .....**Successional Maritime Forest**

Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia Forest *(*CEGL006145)

Early-successional woodland, or scrub forest.....13

13

Open-canopied, early-successional woodland dominated by quaking aspen (*Populus tremuloides*) and/or gray birch (*Betula populifolia)*; big toothed aspen (*Populus grandidentata*), eastern cottonwood (*Populus deltoides*), and white poplar (*Populus alba*) are sometimes present; staghorn sumac (*Rhus typhina*) and eastern poison ivy (*Toxicodendron radicans*) are common in the understory, along with sparse-to-dense herbaceous layer dominated by wrinkleleaf goldenrod (*Solidago rugosa*), climbing nightshade (*Solanum dulcamera*), and grasses such as Kentucky bluegrass (*Poa pratensis*).....**Early-successional Woodland/Forest**

Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera) Ruderal Woodland (CEGL006303)

Tall shrubland or scrub forest dominated by staghorn sumac (*Rhus typhina*), not heavily invaded (>20% cover) by exotic shrub and vine species.....14

14

Staghorn sumac (*Rhus typhina*) monoculture thicket over a carpet of old field grasses and/or with an 'understory' of blackberries (*Rubus* spp.), wrinkleleaf goldenrod (*Solidago rugosa*), yarrow (*Achillea millefolium*), American pokeweed (*Phytolacca americana*), and grasses such as quackgrass (*Elymus repens*) and red fescue (*Festuca rubra*)..... **Staghorn Sumac Shrubland**

Prunus serotina - Rhus typhina Scrub Forest (CEGL006399, in part)

Staghorn sumac (*Rhus typhina*) dominated shrubland (2-4 m tall) with occasional (but not always) black cherry (*Prunus serotina*) trees; northern bayberry (*Morella pensylvanica*) may be codominant; eastern poison ivy (*Toxicodendron radicans*) is common.....**Staghorn Sumac Shrubland Rocky Headland**

Prunus serotina - Rhus typhina Scrub Forest (CEGL006399, in part)

15

Norway maple (*Acer platanoides*) is in the canopy, often forming a monoculture; sparse shrub layer present.....**Norway Maple Forest**

Acer platanoides Ruderal Forest (CEGL006407)

Closed canopy, relatively mature forest consisting of an admixture of native and non-native species including black cherry (*Prunus serotina*), black oak (*Quercus velutina*), eastern red-cedar (*Juniperus virginiana*), Norway maple (*Acer platanoides*), sycamore maple (*Acer pseudoplatanus*), tree of heaven (*Ailanthus altissima*), English oak (*Quercus robur*), Siberian elm (*Ulmus pumila*), honeylocust (*Gleditsia triacanthos*), European ash (*Fraxinus excelsior*), American basswood (*Tilia americana* var. *americana*) and others; nonnative shrubs and vines are often prolific in the shrub layer; occurs on a variety of sites from upper slopes to flat areas that have been cleared or otherwise heavily modified in the past.....**Northeastern Modified Successional Forest**

Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana
Ruderal Forest (CEGL006599)

Shrublands

16

Shrublands of wetlands and/or tidal areas.....17

Shrublands of uplands10.....19

17

Shrub swamp or wet meadow/shrubland influenced by fresh water 18

Shrubland influenced by salt water or tidal flooding; dominated by Jesuit's bark (*Iva frutescens*) and forms an ecotone between high salt marsh and adjacent upland vegetation; saltmeadow cordgrass (*Spartina patens*) is a characteristic and usually abundant grass; associated shrub/grass species include eastern baccharis (*Baccharis halimifolia*), northern bayberry (*Morella pensylvanica*), and switchgrass (*Panicum virgatum*)..... **Eastern Tidal Salt Shrub**
Iva frutescens / Spartina patens Shrubland (CEGL006848)

18

Freshwater shrub swamp dominated entirely by common buttonbush (*Cephalanthus occidentalis*); open water and semi-permanently flooded soil conditions are typically present during growing season..... **Northeastern Buttonbush Shrub Swamp**
Cephalanthus occidentalis - Decodon verticillatus Shrubland (CEGL006069)

Wet meadow vegetation occurring in low-lying areas of old fields or pastures dominated by a diversity of species including green bulrush (*Scirpus atrovirens*), spotted joepyeweed (*Eutrochium maculatum*), wrinkleleaf goldenrod (*Solidago rugosa*), New York aster (*Symphyotrichum novi-belgii*), northern bugleweed (*Lycopus uniflorus*), sensitive fern (*Onoclea sensibilis*) and others; southern arrowwood (*Viburnum dentatum*) ..... **Wet Meadow**
Spiraea tomentosa - Rubus spp. */ Phalaris arundinacea* Ruderal Shrubland (CEGL006571)

19

Vegetation of flat and hilly areas; steep slopes, bluffs, or cliffs absent.....20

Vegetation of maritime erosional cliffs, bluffs, and steep side slopes of drumlins with exposed sand, cobble, and gravels; vegetation varies from sparse to patchy to dense and weedy with any combination of old field, beachstrand, and maritime shrubland species; willows (*Salix* spp.), staghorn sumac (*Rhus typhina*), northern bayberry (*Morella pensylvanica*), multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), butter and eggs *(Linaria vulgaris*), meadow hawkweed (*Hieracium caespitosum*), wrinkleleaf goldenrod (*Solidago rugosa*), common yarrow (*Achillea millefolium*), white heath aster (*Symphyotrichum ericoides*), seaside goldenrod (*Solidago sempervirens*), common wormwood (*Artemisia vulgaris*), and Canadian horseweed (*Conyza canadensis*); seepy vegetation may occur at the base of the cliffs; occur on Thompson, Peddocks, Rainsford, Long, Gallops, Grape, and the north side of

Great Brewster ..... **Maritime Erosional Bluffs and Cliffs** (CEGL006618)

20

Invaded, diverse, tall closed-canopy shrubland characterized by a dense tangle of non-native and native shrubs and vines; thicket occurring on old fields, pastures, or modified lands; characteristic species include a combination of multiflora rose (*Rosa multiflora*), staghorn sumac (*Rhus typhina*), Allegheny blackberry (*Rubus allegheniensis*), Morrow's honeysuckle (*Lonicera morrowii*), oriental bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), European privet (*Ligustrum vulgare*), eastern red-cedar (*Juniperus virginiana*), English oak (*Quercus robur*), and other trees (<25% in cover); old field grasses and forbs are common in more open-canopied variants where tall and short shrubs cover at least 25% of the field ..... **Northeastern Successional Shrubland** *Elaeagnus umbellata - Cornus racemosa – Rosa multiflora - Juniperus virginiana* Ruderal Shrubland (CEGL006451)

Shrubland dominated by staghorn sumac (*Rhus typhina*), 3 variants present none of which are heavily invaded (>20% cover) by exotic shrub and vine species 21

21

Open canopy stunted (1-2 m) shrub-herbaceous association occurring on gravelly necks between drumlins; staghorn sumac (*Rhus typhina*) is dominant; northern bayberry (*Morella pensylvanica*) and rugosa rose (*Rosa rugosa*), are typically present; beach-adapted herbs such as seaside goldenrod (*Solidago sempervirens),* American beachgrass *(Ammophila breviligulata),* common wormwood (*Artemisia vulgaris*), quackgrass (*Elymus repens*), common evening-primrose (*Oenothera biennis*), and flat-top goldentop *(Euthamia graminifolia*) common; herbaceous cover can reach up to 50% ..... **Stunted Staghorn Sumac Shrubland** *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399, in part)

Staghorn sumac (*Rhus typhina*) monoculture thicket over a carpet of old field grasses and/or with an ‘understory’ of blackberries (*Rubus* spp.), wrinkleleaf goldenrod (*Solidago rugosa*), common yarrow (*Achillea millefolium*), American pokeweed (*Phytolacca americana*), and grasses such as quackgrass (*Elymus repens*) and red fescue (*Festuca rubra*) ..... **Staghorn Sumac Shrubland** *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399, in part)

Staghorn sumac (*Rhus typhina*) dominated shrubland (2-4 m tall) with occasional (but not always) black cherry (*Prunus serotina*), northern bayberry (*Morella pensylvanica*), blackberries (*Rubus* spp.), and eastern poison ivy (*Toxicodendron radicans*)..... **Staghorn Sumac Shrubland Rocky Headland** *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399, in part)

Herbaceous Vegetation

22

Herbaceous vegetation 23

Sparsely vegetated beaches, bluffs, cliff, mudflats, and rocky intertidal areas with seaweed..... 48

23

Vegetation of wetlands 24

Vegetation of uplands 38

24

Vegetation influenced by fresh water 25

Vegetation influenced by salt water, includes brackish associations 28

25

Vegetation dominated by one species 26

Vegetation dominated by a diversity of species 27

26

Fresh water marsh dominated by narrowleaf cattail (*Typha angustifolia*) or broadleaf cattail (*Typha latifolia*); lacks swamp rose mallow (*Hibiscus moscheutos*) ..... **Eastern Cattail Marsh**

Typha (angustifolia, latifolia) - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153)

Fresh water marsh dominated by common reed (*Phragmites australis*) occurring in disturbed and weedy areas ..... **Eastern Reed Marsh**

Phragmites australis Eastern North America Temperate Ruderal Herbaceous Vegetation (CEGL004141)

27

Wet meadow vegetation in low-lying areas of old fields or pastures; woolgrass bulrush (*Scirpus atrovirens*), spotted joepyeweed (*Eutrochium maculatum*), wrinkleleaf goldenrod (*Solidago rugosa*), New York aster (*Symphyotrichum novi-belgii*), northern bugleweed (*Lycopus uniflorus*), purple loosestrife (*Lythrum salicaria*), smartweeds (*Polygonum* spp.), and common reed (*Phragmites australis*) ..... **Wet Meadow**

Spiraea tomentosa - *Rubus* spp. */ Phalaris arundinacea* Ruderal Shrubland (CEGL006571)

Marsh with shallow peat or muck and has both freshwater and saltwater species on Thompson, Calf, and Grape Islands; separated from regular tidal flooding but may receive irregular tidal flooding in storms; variable composition, may include sturdy bulrush (*Bulboschoenus robustus*), American water horehound (*Lycopus americanus*), purpleleaf willowherb (*Epilobium coloratum*), stiff marsh bedstraw (*Galium tinctorium*), tall goldenrod (*Solidago altissima*), and swamp verbena (*Verbena hastata*); saltmeadow rush (*Juncus gerardii*) and saltmeadow cordgrass (*Spartina patens*) may be present; some examples heavily invaded by purple loosestrife (*Lythrum salicaria*), broadleaved pepperweed (*Lepidium latifolium*), and common reed (*Phragmites australis*) ..... **Coastal Salt Pond Marsh**

Schoenoplectus pungens - *Eleocharis parvula* Herbaceous Vegetation (CEGL006398)

28

Vegetation of regularly tidally flooded salt marshes, salt pannes, ponds, mudflats, and rocky

intertidal areas 29

Vegetation of irregularly tidally flooded areas, overwash and brackish marshes..... 35

29

Vegetation dominated by *Spartina* species 30

Vegetation not dominated by *Spartina* species 31

30

Low salt marsh; smooth cordgrass (*Spartina alterniflora*) strongly dominant, often a Monoculture ..... **North Atlantic Low Salt Marsh**
Spartina alterniflora / (Ascophyllum nodosum) Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192)

High salt marsh; saltmeadow cordgrass (*Spartina patens*) strongly dominant ..... **North Atlantic High Salt Marsh**
Spartina patens - Distichlis spicata - (Juncus gerardii) Herbaceous Vegetation (CEGL006006)

31

Low diversity and/or sparse vegetation; often monoculture of one species 32

Marsh with shallow peat or muck, both freshwater and saltwater species on Thompson,Calf, and Grape Islands; separated from regular tidal flooding but may receive irregular tidal flooding in storms; variable composition, sturdy bulrush (*Bulboschoenus robustus*), American water horehound (*Lycopus americanus*), purpleleaf willowherb (*Epilobium coloratum*), stiff marsh bedstraw (*Galium tinctorium*), tall goldenrod (*Solidago altissima*), and swamp verbena (*Verbena hastata*); saltmeadow rush (*Juncus gerardii*) and saltmeadow cordgrass (*Spartina patens*) may be present; some examples heavily invaded by purple loosestrife (*Lythrum salicaria*), broadleaved pepperweed (*Lepidium latifolium*), and common reed (*Phragmites australis*) ..... **Coastal Salt Pond Marsh**
Schoenoplectus pungens - Eleocharis parvula Herbaceous Vegetation (CEGL006398)

32

Salt pannes and tidal common reed (*Phragmites australis*) 33

Sparse vegetation of intertidal areas 34

33

Salt pannes dominated by slender glasswort (*Salicornia maritima*)..... **Salt Panne (Salicornia Type)**
Salicornia (*virginica, bigelovii, maritima*) - *Spartina alterniflora* Herbaceous Vegetation (CEGL004308)

Common reed is dominant; association is tidally influenced; occurring in association with salt marshes and brackish waters ..... **Reed-grass Tidal Marsh**
Phragmites australis Tidal Ruderal Herbaceous Vegetation CEGL004187

34

Intertidal mudflats lacking vegetation or having scattered patches of the seaweed, sea lettuce (*Ulva lactuca*); salinity levels are greater than 18.0 ppt ..... **North Atlantic Coast Estuarine Intertidal Mudflats**
Intertidal Mudflats Sparse Vegetation (CEGL006614)

Seaweed vegetation characterized by kelp (*Ascophyllum nodosum)* and rockweed (*Fucus* spp.) occurring on rocky intertidal habitats; substrate is composed of rocks, boulders, and cobbles; often occurring at base of rocky cliffs and outcrops ..... **New England Rocky Intertidal Community**
Ascophyllum nodosum - Fucus vesiculosus Tidal Algal Nonvascular Vegetation (CEGL006341)

35

Brackish vegetation dominated by one species..... 36

Overwash and marsh vegetation with a diversity of species 37

36

Brackish marsh dominated by narrow-leaved cattail (*Typha angustifolia*) with patches of crimsoneyed rosemallow (*Hibiscus moscheutos* ssp. *moscheutos*) ..... **Cattail Brackish Tidal Marsh**
Typha angustifolia – Hibiscus moscheutos Herbaceous Vegetation CEGL004201

Common reed (*Phragmites australis*) is dominant..... **Reed-grass Tidal Marsh**
Phragmites australis Tidal Herbaceous Vegetation CEGL004187

37

Overwash area dominated by seaside goldenrod (*Solidago sempervirens*) and usually salt meadow cordgrass (*Spartina patens*); saltmeadow rush (*Juncus gerardii*) may also be abundant; some examples have sparse vegetation but overwash is diagnostic; occurs in gravelly or sandy depressions, some with peat, and flats landward of Beach Strand and High Salt Marsh associations ..... **Overwash Grassland**
Spartina patens – (*Schoenoplectus pungens*) - *Solidago sempervirens* Herbaceous Vegetation (CEGL004097)

Marsh with shallow peat or muck, both freshwater and saltwater species on Thompson, Calf, and Grape Islands; separated from regular tidal flooding but may receive irregular tidal flooding in storms; variable composition, sturdy bulrush (*Bulboschoenus robustus*), American water horehound (*Lycopus americanus*), purpleleaf willowherb (*Epilobium coloratum*), stiff marsh bedstraw (*Galium tinctorium*), tall goldenrod (*Solidago altissima*), and swamp verbena (*Verbena hastata*); saltmeadow rush (*Juncus gerardii*) and saltmeadow cordgrass (*Spartina patens*) may be present; some examples heavily invaded by purple loosestrife (*Lythrum salicaria*), broadleaved pepperweed (*Lepidium latifolium*), and common reed (*Phragmites australis*) ..... **Coastal Salt Pond Marsh**
Schoenoplectus pungens - Eleocharis parvula Herbaceous Vegetation (CEGL006398)

38

Herbaceous vegetation of old fields and meadows 39

Herbaceous vegetation of beaches, overwash, rock cliffs, outcrops, and bluffs, may be sparse 43

39

Wet meadow vegetation occurring in low-lying areas of old fields or pastures dominated by a diversity of species including green bulrush (*Scirpus atrovirens*), spotted joepyeweed (*Eutrochium maculatum*), wrinkleleaf goldenrod (*Solidago rugosa*), New York aster (*Symphyotrichum novi-belgii*), northern bugleweed (*Lycopus uniflorus*), sensitive fern (*Onoclea sensibilis*), and others; scattered shrubs including multiflora rose (*Rosa multiflora)* and southern arrowwood (*Viburnum dentatum*) may be present ..... **Wet Meadow**

Spiraea tomentosa - *Rubus* spp. / *Phalaris arundinacea* Ruderal Shrubland (CEGL006571)

Upland old field vegetation occurring as abandoned agricultural fields, pastures, and along side trails 40

40

Open canopy stunted (1-2 m) shrub-herbaceous association occurring on gravelly necks between drumlins; staghorn sumac (*Rhus typhina*) is dominant; northern bayberry (*Morella pensylvanica*) and rugosa rose (*Rosa rugosa*), present; beach-adapted herbs such as seaside goldenrod (*Solidago sempervirens),* American beachgrass *(Ammophila breviligulata),* common wormwood (*Artemisia vulgaris*), quackgrass (*Elymus repens*), common evening-primrose (*Oenothera biennis*), and flat-top goldentop *(Euthamia graminifolia*) common; herbaceous cover can reach up to 50% ..... **Stunted Staghorn Sumac Shrubland**

Prunus serotina - *Rhus typhina* Scrub Forest (CEGL006399, in part)

Herbaceous vegetation of gravelly flats, rocky headlands, old fields, and meadows 41

41

Vegetation dominated by little bluestem (*Schizachyrium scoparium*); goldenrods (*Solidago* spp.), Pennsylvania sedge (*Carex pensylvanica*) and/or and Greene's rush (*Juncus greenei*) may be common..... **Little Bluestem Old Field**

Schizachyrium scoparium - *Solidago* spp. Ruderal Herbaceous Vegetation (CEGL006333)

Vegetation not dominated by little bluestem (*Schizachyrium scoparium*..... 42

42

Gravelly old fields found on many islands, especially those exposed to salt spray and coastal influences; overwash possible; dominated by common wormwood (*Artemisia vulgaris*), and with white heath aster (*Symphyotrichum ericoides*), quackgrass *(Elymus repens*), red fescue (*Festuca rubra*), black mustard (*Brassica nigra*), common evening primrose (*Oenethera biennis*), common tansy (*Tanacetum* spp.), panicgrass (*Panicum* spp.), and goldenrods (*Solidago* spp.); bare patches of gravel often present on surface ..... **Common Wormwood Gravel Field**

Artemisia vulgaris Herbaceous Vegetation (CEGL006617)

Fields and pastures occurring on loamy soils with a diversity of grasses and forbs typicallyof European origin such as orchard grass (*Dactylis glomerata*), sweet vernal grass (*Anthoxomum odoratum*), green bristlegrass (*Setaria viridis*), winter bentgrass (*Agrostis hyemalis*), common milkweed (*Asclepias syriaca*), and a diversity of forbs; little bluestem (*Schizachyrium scoparium*) may be present, but not dominant; overwash not possible; typically mowed/managed annually..... **Northeastern Old Field**

Dactylis glomerata - Phleum pratense - Festuca spp. - Solidago spp. Herbaceous Vegetation (CEGL006107)

43

Vegetation of beaches, overwash flats, and gravelly old fields 44

Vegetation of bluffs, cliffs, steep slopes, and rock outcrops 47

44

American beachgrass (*Ammophila brevligulata*) is the dominant vegetation; associates include seaside goldenrod (*Solidago sempervirens*) and rugosa rose *(Rosa rugosa)*; occurs on sand and gravel substrates along upper boundary of beaches and on primary dunes ..... N**orthern Beachgrass Vegetation**

Ammophila breviligulata - Lathyrus japonicus Herbaceous Vegetation (CEGL006274)

American beachgrass (*Ammophila breviligulata*) not dominant 45

45

Overwash area dominated by seaside goldenrod (*Solidago sempervirens*) and usually saltmeadow cordgrass (*Spartina patens*); saltmeadow rush (*Juncus gerardii*) may also be abundant; some examples have sparse vegetation but overwash is diagnostic; occurs in gravelly or sandy depressions some with peat, and flats landward of Beach Strand and North Atlantic High Salt Marsh associations ..... **Overwash Grassland**

Spartina patens – (*Schoenoplectus pungens*) - *Solidago sempervirens* Herbaceous Vegetation (CEGL004097)

Combination of saltmeadow cordgrass (*Spartina patens*) and seaside goldenrod (*Solidago sempervirens* absent; vegetation of upper beaches 46

46

Sparsely vegetated to 50% vegetated upper beach association occurring on unstable sands, gravel, and cobbles just above the mean high tide on maritime beaches; dominant vegetation includes field sagewort (*Artemisia campestris* ssp. *caudata*), rough cocklebur (*Xanthium strumarium*), spear saltbush (*Atriplex patula*), and American searocket (*Cakile edentula* ssp. *edentula*); common wormwood (*Artemisia vulgaris*) may be common ..... **Beach Strand**

Cakile edentula ssp. *edentula - Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400)

Gravelly old fields found on many islands, especially those exposed to salt spray and coastal influences; overwash possible; dominated by common wormwood (*Artemisia vulgaris*), and with white heath aster (*Symphyotrichum ericoides*), quackgrass *(Elymus repens*), red fescue (*Festuca*

rubra), black mustard (*Brassica nigra*), common evening primrose (*Oenethera biennis*), common tansy (*Tanacetum* spp.), panicgrass (*Panicum* spp.) and goldenrods (*Solidago* spp.); bare patches of gravel often present on surface ..... **Common Wormwood Gravel Field**
Artemisia vulgaris Herbaceous Vegetation (CEGL006617)

47

Vegetation of maritime erosional cliffs, bluffs, and steep side slopes of drumlins with exposed sand, cobble, and gravels; vegetation varies from sparse to patchy to dense and weedy with any combination of old field, beachstrand, and maritime shrubland species; can include willows (*Salix* spp.), staghorn sumac (*Rhus typhina*), northern bayberry (*Morella pensylvanica*), multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), butter and eggs *(Linaria vulgaris*), meadow hawkweed (*Hieracium caespitosum*), wrinkleleaf goldenrod (*Solidago rugosa*), common yarrow (*Achillea millefolium*), white heath aster (*Symphyotrichum ericoides*), seaside goldenrod (*Solidago sempervirens*), common wormwood (*Artemisia vulgaris*), and Canadian horseweed (*Conyza canadensis*); seepy vegetation may occur at the base of the cliffs; occur on Thompson, Peddocks, Rainsford, Long, Gallops, Grape, and the north side of Great Brewster ..... **Maritime Erosional Bluffs and Cliffs**
Maritime Erosional Bluffs and Cliffs Sparse Vegetation (CEGL006618)

Vegetation of rock cliffs and outcrops; may be sparse; includes slate cliffs of Slate Island with red columbine (*Aquilegia canadense*) and Scottish licorice-root (*Ligusticum scothicum*); puddingstone cliffs on Langlee and Ragged with wavy hairgrass (*Deschampsia flexuosa*) and red fescue (*Festuca rubra*); and rock cliffs on Outer Brewster, Calf, and other outer harbor islands with common wormwood (*Artemisia vulgaris)* and seaside goldenrod (*Solidago sempervirens*) ..... **Maritime Rock Cliffs and Outcrops** (CEGL006619)

Sparse And Rocky Intertidal Vegetation

48

Sparse vegetation of sand, gravel and cobble beaches and intertidal habitats; including seaweed vegetation of rocky intertidal zones 49

Sparse vegetation of bluffs, cliffs, steep slopes and terrestrial rock outcrops 52

49

Vegetation occurs on bare sand, gravel or cobble on upper edge of beach 50

Sparse vegetation of intertidal mudflat and seaweed vegetation of rocky intertidal zones 51

50

Upper beach association occurring on unstable sands just above the mean high tide on maritime beaches; dominant vegetation includes field sagewort (*Artemisia campestris* ssp. *caudata*), rough cocklebur (*Xanthium strumarium*), spear saltbush (*Atriplex patula*), and American searocket (*Cakile edentula* ssp. *edentula*); common wormwood (*Artemisia vulgaris*) may

be common.....**Beach Strand**
Cakile edentula ssp. *edentula - Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400)

Overwash area dominated by seaside goldenrod (*Solidago sempervirens*) and usually salt meadow cordgrass (*Spartina patens*); saltmeadow rush (*Juncus gerardii*) may also be abundant; some examples have sparse vegetation but overwash is diagnostic; occurs in gravelly or sandy depressions and flats landward of Beach Strand and North Atlantic High Salt Marsh associations ..... **Overwash Grassland**
Spartina patens - Schoenoplectus pungens - Solidago sempervirens Herbaceous Vegetation (CEGL004097)

51

Intermittently flooded mudflats lacking vegetation or having scattered patches of the seaweed, sea lettuce (*Ulva lactuca*); salinity levels are greater than 18.0 ppt .....**North Atlantic Coast Estuarine Intertidal Mudflats**
Intertidal Mudflats Sparse Vegetation (CEGL006614)

Seaweed vegetation characterized by kelp (*Ascophyllum nodosum)* and rockweed (*Fucus* spp.) occurring on rocky intertidal habitats ..... **New England Rocky Intertidal Community**
Ascophyllum nodosum - Fucus vesiculosus Tidal Algal Nonvascular Vegetation (CEGL006341)

52

Maritime erosional cliffs, bluffs and on the sides of steep drumlins with exposed sand, cobble, and gravels; vegetation varies from sparse to patchy to dense and weedy with any combination of old field, beachstrand, and maritime shrubland species; can include willows (*Salix* spp.), staghorn sumac (*Rhus typhina*), northern bayberry (*Morella pensylvanica*), multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), butter and eggs *(Linaria vulgaris*), meadow hawkweed (*Hieracium caespitosum*), wrinkleleaf goldenrod (*Solidago rugosa*), common yarrow (*Achillea millefolium*), white heath aster (*Symphyotrichum ericoides*), seaside goldenrod (*Solidago sempervirens*), common wormwood (*Artemisia vulgaris*) and Canadian horseweed (*Conyza canadensis*); seepy vegetation may occur at the base of the cliffs; occur on Thompson, Peddocks, Rainsford, Long, Gallops, Grape, and the north side of Great Brewster ..... **Maritime Erosional Bluffs and Cliffs**
Maritime Erosional Bluffs and Cliffs Sparse Vegetation (CEGL006618)

Rock cliffs with sparse to patchy native and non-native vegetation; includes slate cliffs of Slate Island with red columbine (*Aquilegia canadense*) and scotch lovage (*Ligusticum scothicum*); puddingstone cliffs on Langlee and Ragged with wavy hairgrass (*Deschampsia flexuosa*) and red fescue (*Festuca rubra*); and rock cliffs on Outer Brewster, Calf, and other outer harbor islands with common wormwood (*Artemisia vulgaris)* and seaside goldenrod (*Solidago sempervirens*) ..... **Maritime Rock Cliffs and Outcrops** (CEGL006619)

Appendix H. Accuracy assessment field data form

NATIONAL PARK VEGETATION MAPPING PROGRAM: ACCURACY ASSESSMENT POINT

IDENTIFIERS/LOCATORS - **Boston Harbor Islands National Recreation Area (BOHA), Massachusetts**

Field Point Code _____ Database Point Code _____

Primary Map Unit _____ Assoc Code/Name _____

Secondary Map Unit _____ Assoc Code/Name _____

Other Map Unit / Assoc within 50 m _____

Key or Classification Comments:

GPS file name_____ UTM X___ ___ ___ ___ ___ ___ m E UTM Y___ ___ ___ ___ ___ ___ ___ m N

GPS Error _____ m GPS unit: Garmin GPSMAP 60CSx, WAAS enabled UTM Zone____19_

Survey Date_____Sept 2008 Surveyors__SCG__LAS_____

Island or Unit:_____

Quad Name_____ Quad Code_____

Area surveyed: 25 m radius circle ____
other (describe)_____

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	
Trees and Shrubs			
___Evergreen	___Broad-leaved	___Forest	
___Cold-deciduous	___Needle-leaved	___Woodland	
___Mixed evergreen - cold-deciduous	___Mixed Broad/Needle leaved	___Shrubland	
____% evergreen	___Graminoid	___Dwarf Shrubland	
____% deciduous	___Forb	___Herbaceous	
Herbs	___Pteridophyte	___Nonvascular	
___Annual		___Sparsely Vegetated	
___Perennial			

Appendix I. Index of representative photographs of USNVC vegetation associations at Boston Harbor Islands National Recreation Area.

Index of Plot Photos

Page

Figure F-1. Old-field Eastern Red-cedar Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.010). September 2006. NAD 1983 / UTM easting 345697, northing 4680861. 7

Figure F-2. Early-successional Woodland/Forest on Grape Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA057). September 2008. NAD 1983 / UTM easting 341205, northing 4681355. 13

Figure F-3. Northeastern Modified Succesional Forest on Peddocks Island in Boston Harbor Island National Recreation Area (plot BOHA.018). September 2006. NAD 1983 / UTM easting 340260, northing 4683982. 20

Figure F-4. Black Pine Forest on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.014). September 2006. NAD 1983 / UTM easting 340491, northing 4684894. 24

Figure F-5. Norway Maple Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.025). September 2006. NAD 1983 / UTM easting 344960, northing 4681292. 29

Figure F-6. Successional Maritime Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.022-two views of the same plot). September 2006. NAD 1983 / UTM easting 345737, northing 4681055. 35

Figure F-7. Maritime Red-cedar Woodland on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.012-two views of same plot). September 2006. NAD 1983 / UTM easting 345696, northing 4681015. 40

Figure F-8. Maritime Red-cedar Woodland on World's End in Boston Harbor Islands National Recreation Area (same polygon as AA point BOHA.AA133). September 2008. NAD 1983 / UTM easting 345861, northing 4681050. 41

Figure F-9. Staghorn Sumac Shrubland on Long Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA024). September 2008. NAD 1983 / UTM easting 338500 northing 4687800. 46

Index of Plot Photos (continued)

Page

Figure F-10. Staghorn Sumac Shrubland on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA071). September 2008. NAD 1983 / UTM easting 343769, northing 4689250. 46

Figure F-11. Staghorn Sumac Shrubland Rocky Headland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.015). September 2006. NAD 1983 / UTM easting 340574, northing 4684621. 51

Figure F-12. Staghorn Sumac Shrubland Rocky Headland on Rainsford Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA118). September 2008. NAD 1983 / UTM easting 339073, northing 4686210. 51

Figure F-13. Stunted Staghorn Sumac Shrubland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.020). September 2006. NAD 1983 / UTM easting 340441, northing 4684288. 56

Figure F-14. Stunted Staghorn Sumac Shrubland on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.043). September 2006. NAD 1983 / UTM easting 337728, northing 4686484. 56

Figure F-15. Northeastern Dry Oak-Hickory Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.003). September 2006. NAD 1983 / UTM easting 345743, northing 4680316. 62

Figure F-16. Northeastern Dry Oak-Hickory Forest on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA170-two views of the same point). September 2008. NAD 1983 / UTM easting 345617, northing 4680308. 63

Figure F-17. Upland/Wetland Transitional Forest on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.021). September 2006. NAD 1983 / UTM easting 345832, northing 4680443. 68

Figure F-18. Common Wormwood Gravel Field on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.038). September 2006. NAD 1983 / UTM easting 335194, northing 4687180. 71

Figure F-19. Common Wormwood Gravel Field on Middle Brewster Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA157). September 2008. NAD 1983 / UTM easting 344525, northing 4689184. 72

Figure F-20. Northeastern Old Field on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA015). September 2008. NAD 1983 / UTM easting 345117, northing 4681344. 77

Index of Plot Photos (continued)

Page

Figure F-21. Northeastern Old Field on Thompson Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA004). September 2008. NAD 1983 / UTM easting 334141, northing 4686270. 78

Figure F-22. Little Bluestem Old Field on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.006). September 2006. NAD 1983 / UTM easting 345728, northing 4680477. 83

Figure F-23. Little Bluestem Old Field on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.029). September 2006. NAD 1983 / UTM easting 334068, northing 4686617. 83

Figure F-24. Northeastern Successional Shrubland on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.041). September 2006. NAD 1983 / UTM easting 337815, northing 4686699. 89

Figure F-25. Northern Beachgrass Vegetation on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.027). September 2006. NAD 1983 / UTM easting 334358, northing 4686932. 93

Figure F-26. Northern Beachgrass Vegetation on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.035). September 2006. NAD 1983 / UTM easting 334201, northing 4686114. 94

Figure F-27. Overwash Grassland on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.030). September 2006. NAD 1983 / UTM easting 334046, northing 4686654. 100

Figure F-28. Overwash Grassland on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.017). September 2006. NAD 1983 / UTM easting 340406, northing 4684193. 100

Figure F-29. Beach Strand on Peddocks Island in Boston Harbor Islands National Recreation Area (plot BOHA.016). September 2006. NAD 1983 / UTM easting 340498, northing 4684486. 106

Figure F-30. Beach Strand on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.042). September 2006. NAD 1983 / UTM easting 337971, northing 4686510 106

Figure F-31. Eastern Cattail Marsh on Middle Brewster Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA178). September 2006. NAD 1983 / UTM easting 344574, northing 4689137. 111

Index of Plot Photos (continued)

Page

Figure F-32. Northeastern Buttonbush Shrub Swamp on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.011). September 2006. NAD 1983 / UTM easting 345756, northing 4680919. 116

Figure F-33. Eastern Reed Marsh on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.045). September 2006. NAD 1983 / UTM easting 337525, northing 4686420. 120

Figure F-34. Reed-grass Tidal Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.007). September 2006. NAD 1983 / UTM easting 345680, northing 4680472. 125

Figure F-35. Wet Meadow on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.023). September 2006. NAD 1983 / UTM easting 345567, northing 4680817. 130

Figure F-36. Wet Meadow on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA176). September 2008. NAD 1983 / UTM easting 343726, northing 4689330. 131

Figure F-37. Cattail Brackish Tidal Marsh on Long Island in Boston Harbor Islands National Recreation Area (plot BOHA.047). September 2006. NAD 1983 / UTM easting 337637, northing 4686516. 136

Figure F-38. Coastal Salt Pond Marsh on Calf Island in Boston Harbor Islands National Recreation Area (Observation point-green fringe surrounding the red Salicornia). September 2008. NAD 1983 / UTM easting 343823, northing 4689432. 142

Figure F-39. North Atlantic High Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.001). September 2006. NAD 1983 / UTM easting 345823, northing 4680710. 147

Figure F-40. North Atlantic High Salt Marsh on Thompson Island in Boston Harbor Islands National Recreation Area (plot BOHA.032). September 2006. NAD 1983 / UTM easting 333923, northing 4686511. 147

Figure F-41. Eastern Tidal Salt Shrub on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.002). September 2006. NAD 1983 / UTM easting 345823, northing 4680720. 152

Figure F-42. North Atlantic Low Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.004). September 2006. NAD 1983 / UTM easting 345925, northing 4680326. 157

Index of Plot Photos (continued)

Page

Figure F-43. North Atlantic Low Salt Marsh on World's End in Boston Harbor Islands National Recreation Area (AA point BOHA.AA091). September 2008. NAD 1983 / UTM easting 345441, northing 4680161. 158

Figure F-44. Salt Panne (Salicornia Type) on World's End in Boston Harbor Islands National Recreation Area (plot BOHA.008). September 2006. NAD 1983 / UTM easting 345699, northing 4680469. 163

Figure F-45. North Atlantic Coast Estuarine Intertidal Mudflats on World's End in Boston Harbor Islands National Recreation Area (observation point). September 2008. NAD 1983 / UTM easting 345429, northing 4680215. 167

Figure F-46. New England Rocky Intertidal Community on Grape Island in Boston Harbor Islands National Recreation Area (observation point). September 2008. NAD 1983 / UTM easting 341732, northing 4681350. 171

Figure F-47. New England Rocky Intertidal Community on World's End in Boston Harbor Islands National Recreation Area (below plot BOHA.012). September 2006. NAD 1983 / UTM easting 345696, northing 4681015. 172

Figure F-48. Maritime Rock Cliffs and Outcrops on Calf Island in Boston Harbor Islands National Recreation Area (AA point BOHA.AA146). September 2008. NAD 1983 / UTM easting 343896, northing 4689321. 176

Figure F-49. Maritime Erosional Bluffs and Cliffs on Long Island in Boston Harbor Islands National Recreation Area (observation point). September 2006. NAD 1983 / UTM easting 337120, northing 4686197. 181

Figure F-50. Maritime Erosional Bluffs and Cliffs on Great Brewster Island in Boston Harbor Island National Recreation Area (AA point BOHA.AA145-two views). September 2008. NAD 1983 / UTM easting 343811, northing 4688620. 181

Appendix J. Statistics and maps for vegetation and land use-land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Table J-1. Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Bumpkin Island	Beach and Beach Strand	1	10.7	4.3
	Maritime Erosional Bluffs and Cliffs	1	0.7	0.3
	North Atlantic High Salt Marsh	1	0.1	0.1
	North Atlantic Low Salt Marsh	3	0.5	0.2
	Northeastern Successional Shrubland	1	7.5	3.0
	Other Urban or Built-up Land	2	0.4	0.1
	Recreational	4	0.6	0.3
	Reed-grass Tidal Marsh	1	0.0	0.0
	Staghorn Sumac Shrubland	4	20.0	8.1
	Transportation, Communication & Utilities	1	0.1	0.0
	Bumpkin Island Totals	**19**	**40.6**	**16.4**
Button Island	Beach and Beach Strand	1	1.0	0.4
	North Atlantic Low Salt Marsh	4	0.6	0.2
	Northeastern Modified Successional Forest	1	0.5	0.2
	Button Island Totals	**6**	**2.2**	**0.9**
Calf Island	Bare Exposed Rock	6	0.2	0.1
	Beach and Beach Strand	4	2.1	0.8
	Coastal Salt Pond Marsh	1	0.3	0.1
	Common Wormwood Gravel Field	5	2.3	0.9
	Maritime Rock Cliffs and Outcrops	5	6.7	2.7
	New England Rocky Intertidal Community	5	6.3	2.6
	North Atlantic High Salt Marsh	2	0.4	0.1
	North Atlantic Low Salt Marsh	7	0.3	0.1
	Other Urban or Built-up Land	1	0.2	0.1
	Reed-grass Tidal Marsh	1	0.2	0.1

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Calf Island (continued)	Salt Panne (Salicornia Type)	1	0.1	0.0
	Staghorn Sumac Shrubland	1	0.2	0.1
	Staghorn Sumac Shrubland Rocky Headland	2	10.5	4.2
	Wet Meadow	1	0.2	0.1
	Calf Island Totals	**42**	**29.9**	**12.1**
Deer Island	Beach and Beach Strand	5	7.5	3.0
	Black Pine Forest	1	0.9	0.4
	Commercial and Services	1	126.2	51.1
	Common Wormwood Gravel Field	1	0.1	0.0
	Northeastern Old Field	15	45.4	18.4
	Other Urban or Built-up Land	5	15.0	6.1
	Recreational	1	0.8	0.3
	Transportation, Communication & Utilities	2	9.4	3.8
	Deer Island Totals	**31**	**205.4**	**83.1**
Gallops Island	Beach and Beach Strand	3	7.4	3.0
	Early-successional Woodland/Forest	4	1.4	0.5
	Maritime Erosional Bluffs and Cliffs	1	1.7	0.7
	Northeastern Modified Successional Forest	2	3.9	1.6
	Northeastern Old Field	5	3.3	1.3
	Northeastern Successional Shrubland	1	0.2	0.1
	Northern Beachgrass Vegetation	1	0.1	0.0
	Other Urban or Built-up Land	1	4.3	1.7
	Staghorn Sumac Shrubland	6	8.6	3.5
	Transportation, Communication & Utilities	1	0.1	0.0
	Gallops Island Totals	**25**	**30.9**	**12.5**
Georges Island	Beach and Beach Strand	2	3.9	1.6
	Common Wormwood Gravel Field	1	0.2	0.1
	Maritime Erosional Bluffs and Cliffs	1	0.4	0.2
	Northeastern Modified Successional Forest	1	1.1	0.4

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Georges Island (continued)	Other Urban or Built-up Land	1	5.3	2.1
	Recreational	1	31.2	12.6
	Staghorn Sumac Shrubland	1	3.3	1.3
	Transportation, Communication & Utilities	2	0.8	0.3
	Georges Island Totals	**10**	**46.2**	**18.7**
Grape Island	Bare Exposed Rock	1	0.1	0.1
	Beach and Beach Strand	2	13.6	5.5
	Coastal Salt Pond Marsh	1	0.2	0.1
	Common Wormwood Gravel Field	1	0.7	0.3
	Early-successional Woodland/Forest	6	29.5	11.9
	Eastern Reed Marsh	1	0.4	0.1
	Little Bluestem Old Field	1	0.1	0.0
	New England Rocky Intertidal Community	2	0.2	0.1
	North Atlantic Low Salt Marsh	7	1.6	0.6
	Northeastern Old Field	1	0.8	0.3
	Overwash Grassland	1	0.2	0.1
	Recreational	1	0.6	0.3
	Staghorn Sumac Shrubland	3	19.2	7.8
	Transportation, Communication & Utilities	1	0.1	0.0
	Grape Island Totals	**29**	**67.3**	**27.2**
Great Brewster Island	Bare Exposed Rock	1	0.2	0.1
	Beach and Beach Strand	3	13.5	5.5
	Common Wormwood Gravel Field	3	5.3	2.1
	Early-successional Woodland/Forest	1	0.2	0.1
	Eastern Reed Marsh	2	0.2	0.1
	Maritime Erosional Bluffs and Cliffs	2	3.4	1.4
	Other Urban or Built-up Land	1	0.0	0.0
	Recreational	1	0.8	0.3
	Staghorn Sumac Shrubland	3	5.0	2.0
	Great Brewster Island Totals	**17**	**28.7**	**11.6**

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Green Island	Bare Exposed Rock	14	0.3	0.1
	Maritime Rock Cliffs and Outcrops	7	9.4	3.8
	Green Island Totals	**21**	**9.7**	**3.9**
Hangman Island	Bare Exposed Rock	2	0.2	0.1
	Beach and Beach Strand	1	0.8	0.3
	Common Wormwood Gravel Field	1	0.1	0.1
	New England Rocky Intertidal Community	3	0.4	0.2
	North Atlantic Low Salt Marsh	3	0.1	0.0
	Hangman Island Totals	**10**	**1.7**	**0.7**
Langlee Island	Beach and Beach Strand	4	0.3	0.1
	Maritime Red-cedar Woodland	2	0.3	0.1
	Maritime Rock Cliffs and Outcrops	3	0.9	0.4
	New England Rocky Intertidal Community	5	0.9	0.3
	North Atlantic High Salt Marsh	1	0.0	0.0
	North Atlantic Low Salt Marsh	4	0.4	0.2
	Northeastern Modified Successional Forest	1	2.9	1.2
	Langlee Island Totals	**20**	**5.8**	**2.3**
Little Brewster Island	Beach and Beach Strand	2	0.7	0.3
	Maritime Rock Cliffs and Outcrops	5	2.0	0.8
	New England Rocky Intertidal Community	3	1.5	0.6
	Other Urban or Built-up Land	3	0.9	0.4
	Transportation, Communication & Utilities	2	0.2	0.1
	Little Brewster Island Totals	**15**	**5.3**	**2.2**
Little Calf Island	Bare Exposed Rock	9	0.1	0.04
	Maritime Rock Cliffs and Outcrops	5	2.6	1.1
	Little Calf Island Totals	**14**	**2.7**	**1.1**
Long Island	Beach and Beach Strand	4	33.8	13.7
	Black Pine Forest	6	11.0	4.5
	Cattail Brackish Tidal Marsh	2	0.3	0.1

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Long Island (continued)	Commercial and Services	1	34.5	14.0
	Common Wormwood Gravel Field	5	1.1	0.4
	Eastern Reed Marsh	5	6.2	2.5
	Maritime Erosional Bluffs and Cliffs	4	2.1	0.8
	North Atlantic Coast Estuarine Intertidal Mudflats	1	0.3	0.1
	Northeastern Modified Successional Forest	5	22.3	9.0
	Northeastern Old Field	1	1.1	0.5
	Northeastern Successional Shrubland	9	80.9	32.7
	Northern Beachgrass Vegetation	2	0.4	0.2
	Norway Maple Forest	1	0.6	0.2
	Other Urban or Built-up Land	10	13.3	5.4
	Overwash Grassland	1	0.2	0.1
	Recreational	4	12.0	4.9
	Staghorn Sumac Shrubland	1	0.5	0.2
	Stunted Staghorn Sumac Shrubland	4	9.3	3.8
	Transportation, Communication & Utilities	2	5.3	2.2
	Long Island Totals	**68**	**235.4**	**95.3**
Lovells Island	Beach and Beach Strand	1	31.6	12.8
	Early-successional Woodland/Forest	3	3.9	1.6
	Maritime Erosional Bluffs and Cliffs	1	0.9	0.4
	New England Rocky Intertidal Community	1	4.3	1.8
	Northeastern Modified Successional Forest	3	7.4	3.0
	Northern Beachgrass Vegetation	2	0.6	0.2
	Northern Beachgrass Vegetation	2	0.6	0.2
	Other Urban or Built-up Land	3	2.2	0.9
	Recreational	2	1.9	0.8
	Staghorn Sumac Shrubland	3	4.0	1.6
	Stunted Staghorn Sumac Shrubland	4	15.1	6.1

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Lovellls Island (continued)	Transportation, Communication & Utilities	1	0.1	0.0
	Lovells Island Totals	**24**	**72**	**29.1**
Middle Brewster Island	Common Wormwood Gravel Field	5	3.6	1.5
	Eastern Cattail Marsh	1	0.2	0.1
	Maritime Rock Cliffs and Outcrops	4	7.3	2.9
	New England Rocky Intertidal Community	2	1.8	0.7
	Northeastern Modified Successional Forest	1	0.6	0.2
	Northeastern Successional Shrubland	1	0.1	0.0
	Staghorn Sumac Shrubland Rocky Headland	1	4.2	1.7
	Middle Brewster Island Totals	**15**	**17.7**	**7.2**
Moon Island	Beach and Beach Strand	5	28.1	11.4
	Common Wormwood Gravel Field	1	0.2	0.1
	Early-successional Woodland/Forest	1	1.7	0.7
	North Atlantic Coast Estuarine Intertidal Mudflats	1	5.6	2.3
	North Atlantic Low Salt Marsh	1	1.1	0.4
	Northeastern Modified Successional Forest	3	11.6	4.7
	Northeastern Successional Shrubland	10	11.5	4.7
	Other Urban or Built-up Land	4	11.4	4.6
	Recreational	2	3.6	1.5
	Reed-grassTidal Marsh	2	0.4	0.2
	Transportation, Communication & Utilities	3	10.1	4.1
	Moon Island Totals	**33**	**85.4**	**34.5**
Nixes Mate island	Bare Exposed Rock	1	0.2	0.1
	Transportation, Communication & Utilities	1	0.1	0.0
	Nixes Mate Island Totals	**2**	**0.3**	**0.1**
Nut Island	Beach and Beach Strand	2	1.9	0.8
	Commercial and Services	1	2.9	1.2
	Early-successional Woodland/Forest	1	0.9	0.3

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Nut Island (continued)	Other Urban or Built-up Land	3	12.7	5.1
	Transportation, Communication & Utilities	2	1.5	0.6
	Nut Island Totals	**9**	**19.8**	**8.0**
Outer Brewster Island	Beach and Beach Strand	1	0.3	0.1
	Common Wormwood Gravel Field	4	7.1	2.9
	Maritime Rock Cliffs and Outcrops	6	13.5	5.4
	New England Rocky Intertidal Community	1	0.6	0.2
	Northeastern Modified Successional Forest	1	0.2	0.1
	Other Urban or Built-up Land	5	0.6	0.2
	Staghorn Sumac Shrubland	1	0.4	0.1
	Staghorn Sumac Shrubland Rocky Headland	2	4.7	1.9
	Wet Meadow	1	0.1	0.0
	Outer Brewster Island Totals	**22**	**27.4**	**11.1**
Peddocks Island	Bays, Estuaries, and Other Tidal Waters	3	3.4	1.4
	Beach and Beach Strand	1	52.7	21.3
	Black Pine Forest	2	5.9	2.4
	Common Wormwood Gravel Field	2	0.4	0.1
	Eastern Reed Marsh	1	0.1	0.0
	Eastern Tidal Salt Shrub	3	0.6	0.2
	Maritime Erosional Bluffs and Cliffs	3	4.1	1.7
	North Atlantic High Salt Marsh	14	4.3	1.8
	North Atlantic Low Salt Marsh	8	0.8	0.3
	Northeastern Modified Successional Forest	4	88.2	35.7
	Northeastern Old Field	1	3.7	1.5
	Northeastern Successional Shrubland	11	13.8	5.6
	Northern Beachgrass Vegetation	1	0.0	0.0
	Norway Maple Forest	4	10.3	4.2
	Other Urban or Built-up Land	4	19.5	7.9
	Overwash Grassland	2	1.5	0.6

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Peddocks Island (continued)	Reed-grass Tidal Marsh	3	0.5	0.2
	Residential	6	6.7	2.7
	Staghorn Sumac Shrubland	1	0.8	0.3
	Staghorn Sumac Shrubland Rocky Headland	1	2.2	0.9
	Stunted Staghorn Sumac Shrubland	7	8.5	3.4
	Transportation, Communication & Utilities	3	1.6	0.7
	Peddocks Island Totals	**85**	**229.5**	**92.9**
Raccoon Island	Beach and Beach Strand	2	1.1	0.4
	Early-successional Woodland/Forest	1	1.4	0.6
	New England Rocky Intertidal Community	2	1.6	0.6
	North Atlantic High Salt Marsh	3	0.1	0.0
	North Atlantic Low Salt Marsh	5	1.3	0.5
	Staghorn Sumac Shrubland	1	0.7	0.3
	Staghorn Sumac Shrubland Rocky Headland	2	0.5	0.2
	Raccoon Island Totals	**16**	**6.7**	**2.7**
Ragged Island	Beach and Beach Strand	4	0.8	0.3
	Maritime Red-cedar Woodland	1	1.4	0.6
	Maritime Rock Cliffs and Outcrops	5	0.9	0.4
	North Atlantic Low Salt Marsh	4	0.4	0.1
	Northeastern Modified Successional Forest	1	0.9	0.4
	Ragged Island Totals	**15**	**4.4**	**1.8**
Rainsford Island	Bare Exposed Rock	1	0.5	0.2
	Beach and Beach Strand	1	10.2	4.1
	Common Wormwood Gravel Field	1	2.0	0.8
	Maritime Erosional Bluffs and Cliffs	1	1.2	0.5
	New England Rocky Intertidal Community	3	1.1	0.5
	North Atlantic Low Salt Marsh	2	0.1	0.1
	Northeastern Modified Successional Forest	2	4.2	1.7
	Overwash Grassland	1	0.2	0.1

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Rainsford Island (continued)	Staghorn Sumac Shrubland	1	1.9	0.8
	Staghorn Sumac Shrubland Rocky Headland	1	1.6	0.6
	Stunted Staghorn Sumac Shrubland	1	1.7	0.7
	Rainsford Island Totals	**15**	**24.6**	**10.0**
Sarah Island	Bare Exposed Rock	2	1.6	0.7
	Early-successional Woodland/Forest	1	2.1	0.8
	Maritime Red-cedar Woodland	2	1.1	0.4
	North Atlantic Low Salt Marsh	3	0.3	0.1
	Sarah Island Totals	**8**	**5.1**	**2.1**
Shag Rocks	Bare Exposed Rock		11	2.5
	Shag Rocks Totals	**11**	**2.5**	**1.0**
Sheep Island	Beach and Beach Strand	1	2.9	1.2
	Common Wormwood Gravel Field	2	0.1	0.0
	New England Rocky Intertidal Community	1	1.5	0.6
	North Atlantic High Salt Marsh	1	0.0	0.0
	North Atlantic Low Salt Marsh	3	0.8	0.3
	Staghorn Sumac Shrubland	1	0.6	0.2
	Sheep Island Totals	**9**	**5.9**	**2.4**
Slate Island	Beach and Beach Strand	11	3.4	1.4
	Early-successional Woodland/Forest	1	2.1	0.8
	Eastern Reed Marsh	1	0.0	0.0
	Maritime Rock Cliffs and Outcrops	1	0.3	0.1
	New England Rocky Intertidal Community	8	3.5	1.4
	North Atlantic High Salt Marsh	3	0.9	0.4
	North Atlantic Low Salt Marsh	10	2.7	1.1
	Northeastern Successional Shrubland	1	8.4	3.4
	Overwash Grassland	2	0.4	0.1
	State Island Totals	**38**	**21.7**	**8.8**

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Snake Island	Bays, Estuaries, and Other Tidal Waters	1	2.7	1.1
	Beach and Beach Strand	2	1.6	0.6
	Common Wormwood Gravel Field	1	0.1	0.1
	Early-successional Woodland/Forest	1	2.3	0.9
	North Atlantic Coast Estuarine Intertidal Mudflats	1	6.0	2.4
	North Atlantic High Salt Marsh	1	1.5	0.6
	North Atlantic Low Salt Marsh	6	4.6	1.9
	Reed-grassTidal Marsh	1	2.1	0.9
	Salt Panne (Salicornia Type)	1	0.2	0.1
	Staghorn Sumac Shrubland	3	1.9	0.8
	Snake Isand Totals	**18**	**23.0**	**9.3**
Spectacle Island	Beach and Beach Strand	3	12.7	5.1
	Common Wormwood Gravel Field	13	65.7	26.6
	Northern Beachgrass Vegetation	1	1.3	0.5
	Other Urban or Built-up Land	1	8.7	3.5
	Recreational	1	0.9	0.4
	Transportation, Communication & Utilities	2	12.3	5.0
	Spectacle Island Totals	**21**	**101.6**	**41.1**
The Graves	Bare Exposed Rock	11	2.8	1.1
	The Graves Totals	**11**	**2.8**	**1.1**
Thompson Island	Bays, Estuaries, and Other Tidal Waters	1	4.3	1.7
	Beach and Beach Strand	18	43.3	17.5
	Black Pine Forest	3	2.4	1.0
	Coastal Salt Pond Marsh	1	1.4	0.6
	Commercial and Services	1	24.5	9.9
	Common Wormwood Gravel Field	2	2.9	1.2
	Eastern Reed Marsh	2	2.3	0.9
	Little Bluestem Old Field	6	0.9	0.4

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Thomson Island (continued)	North Atlantic Coast Estuarine Intertidal Mudflats	5	13.1	5.3
	North Atlantic High Salt Marsh	12	3.6	1.4
	North Atlantic Low Salt Marsh	20	17.2	7.0
	Northeastern Modified Successional Forest	6	7.7	3.1
	Northeastern Old Field	12	18.9	7.6
	Northeastern Successional Shrubland	20	25.3	10.2
	Northern Beachgrass Vegetation	5	1.5	0.6
	Norway Maple Forest	6	18.4	7.4
	Other Urban or Built-up Land	3	0.2	0.1
	Overwash Grassland	4	1.2	0.5
	Recreational	13	6.1	2.5
	Reed-grass Tidal Marsh	2	1.4	0.6
	Salt Panne (Salicornia Type)	1	0.2	0.1
	Staghorn Sumac Shrubland	1	0.3	0.1
	Stunted Staghorn Sumac Shrubland	2	0.9	0.4
	Successional Maritime Forest	1	1.7	0.7
	Transportation, Communication & Utilities	2	0.5	0.2
	Wet Meadow	1	0.4	0.2
	Thompson Island Totals	**150**	**200.6**	**81.2**
Webb State Park	Beach and Beach Strand	1	0.5	0.2
	Common Wormwood Gravel Field	4	1.8	0.7
	Maritime Erosional Bluffs and Cliffs	1	0.4	0.2
	North Atlantic Coast Estuarine Intertidal Mudflats	1	1.0	0.4
	North Atlantic High Salt Marsh	1	0.4	0.1
	North Atlantic Low Salt Marsh	6	1.0	0.4
	Northeastern Old Field	4	5.1	2.1
	Northeastern Successional Shrubland	9	10.5	4.3
	Old-field Eastern Red-cedar Forest	1	0.3	0.1

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
Webb State Park (continued)	Pond	1	0.5	0.2
	Recreational	10	8.8	3.6
	Staghorn Sumac Shrubland	2	1.6	0.6
	Successional Maritime Forest	1	1.3	0.5
	Transportation, Communication & Utilities	1	2.8	1.1
	Webb State Park Totals	**43**	**35.9**	**14.5**
World's End	Bare Exposed Rock	7	0.7	0.3
	Bays, Estuaries, and Other Tidal Waters	2	11.2	4.5
	Beach and Beach Strand	18	18.7	7.6
	Common Wormwood Gravel Field	3	1.1	0.5
	Eastern Tidal Salt Shrub	7	1.3	0.5
	Little Bluestem Old Field	2	0.7	0.3
	Maritime Red-cedar Woodland	5	5.7	2.3
	New England Rocky Intertidal Community	19	2.5	1.0
	North Atlantic Coast Estuarine Intertidal Mudflats	10	2.3	0.9
	North Atlantic High Salt Marsh	13	4.1	1.7
	North Atlantic Low Salt Marsh	33	14.1	5.7
	Northeastern Buttonbush Shrub Swamp	2	0.2	0.1
	Northeastern Dry Oak-Hickory Forest	4	14.8	6.0
	Northeastern Modified Successional Forest	12	60.6	24.5
	Northeastern Old Field	16	113.1	45.8
	Northeastern Successional Shrubland	1	0.1	0.1
	Norway Maple Forest	1	2.8	1.1
	Old-field Eastern Red-cedar Forest	4	11.1	4.5
	Pond	1	0.3	0.1
	Recreational	3	8.9	3.6
	Reed-grass Tidal Marsh	9	3.3	1.3
	Salt Panne (Salicornia Type)	4	0.2	0.1

Table J-1 (continued). Statistics for vegetation and land use - land cover map classes at Boston Harbor Islands National Recreation Area by island or peninsula.

Island / Peninsula	Land Use – Land Cover Map Class	# Polygons	Acres	Hectares
World's End (continued)	Successional Maritime Forest	9	16.5	6.7
	Upland/Wetland Transitional Forest	1	0.5	0.2
	Wet Meadow	1	0.1	0.1
	World's End Totals	**187**	**294.9**	**119.3**
Boston Harbor Islands Grand Totals		**1,059**	**1,893.6**	**766.3**

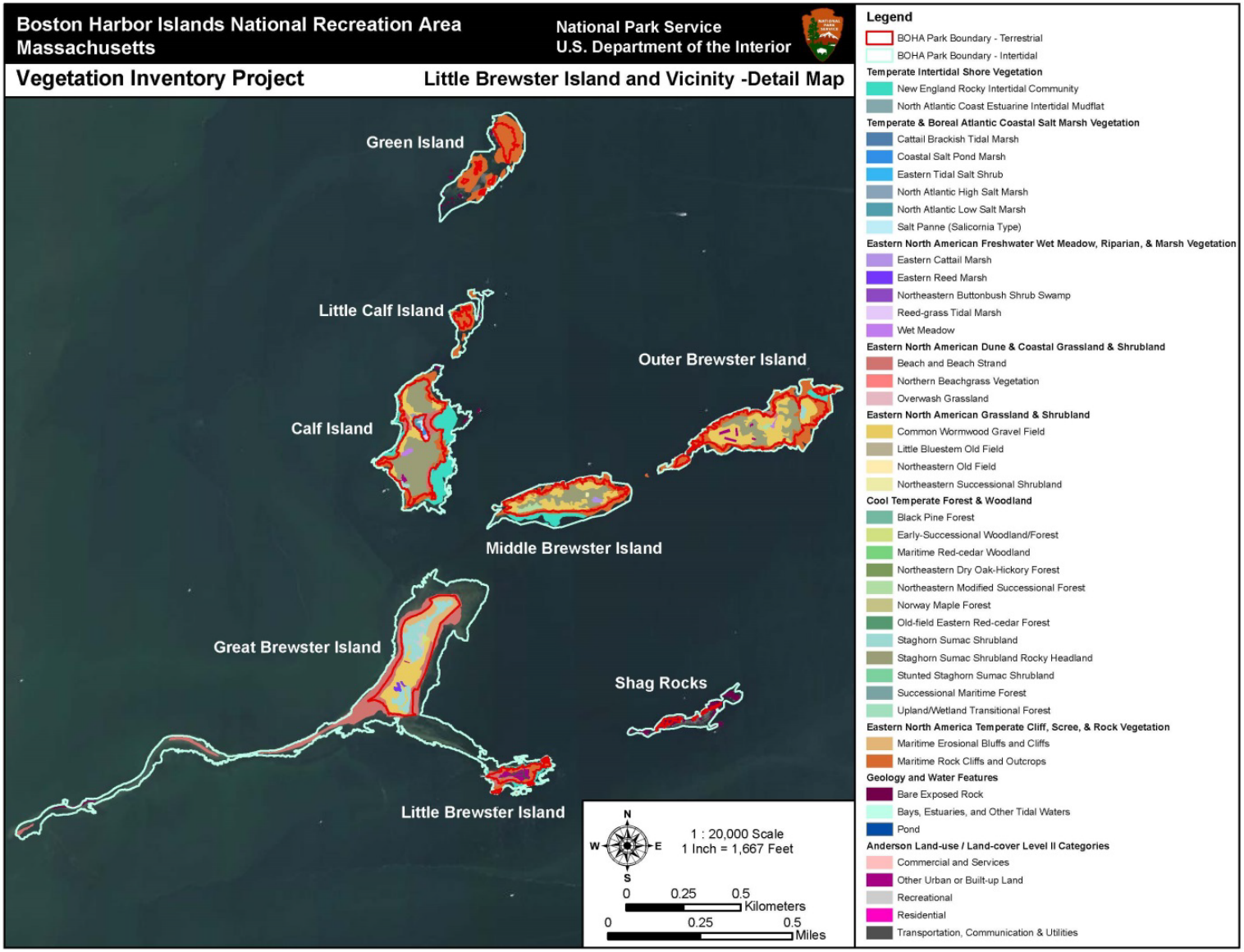


Figure J-1. Vegetation associations and land use - land cover categories of the Great Brewster, Little Brewster, Middle Brewster, Outer Brewster, Calf, Little Calf, and Green Islands and Shag Rocks of Boston Harbor Islands National Recreation Area.

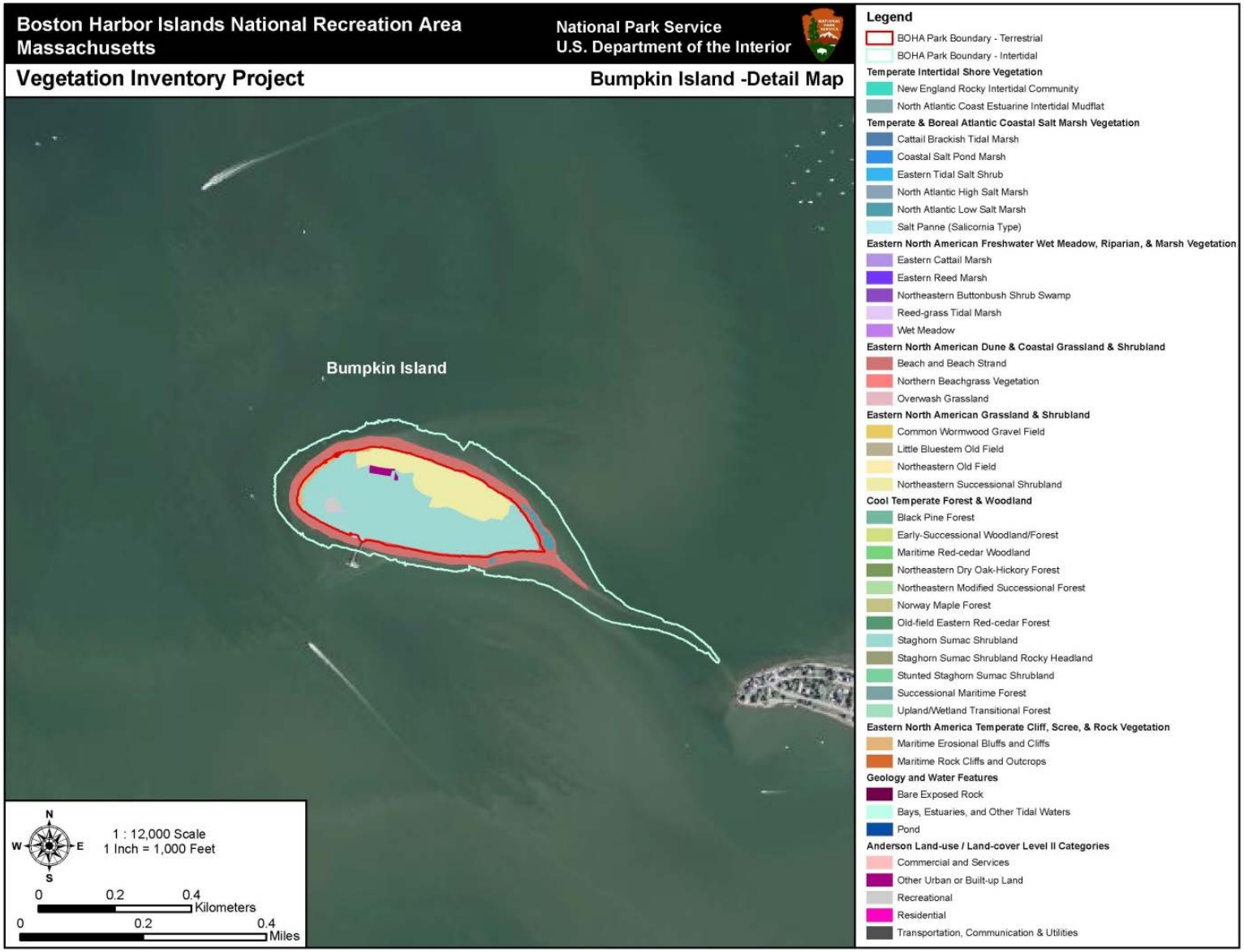


Figure J-2. Vegetation associations and land use - land cover categories of Bumpkin Island of Boston Harbor Islands National Recreation Area.

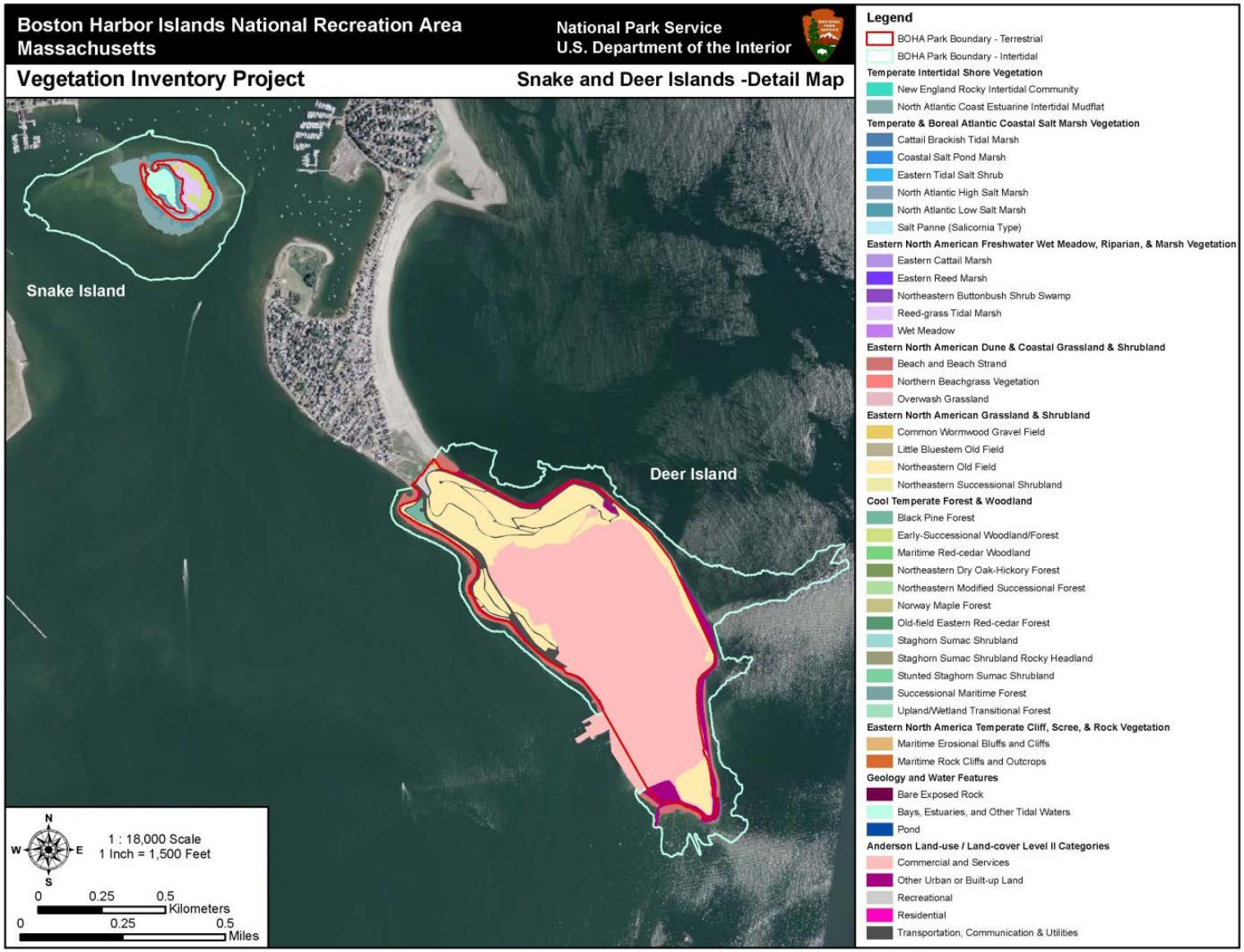


Figure J-3. Vegetation associations and land use - land cover categories of Snake and Deer Islands of Boston Harbor Islands National Recreation Area.

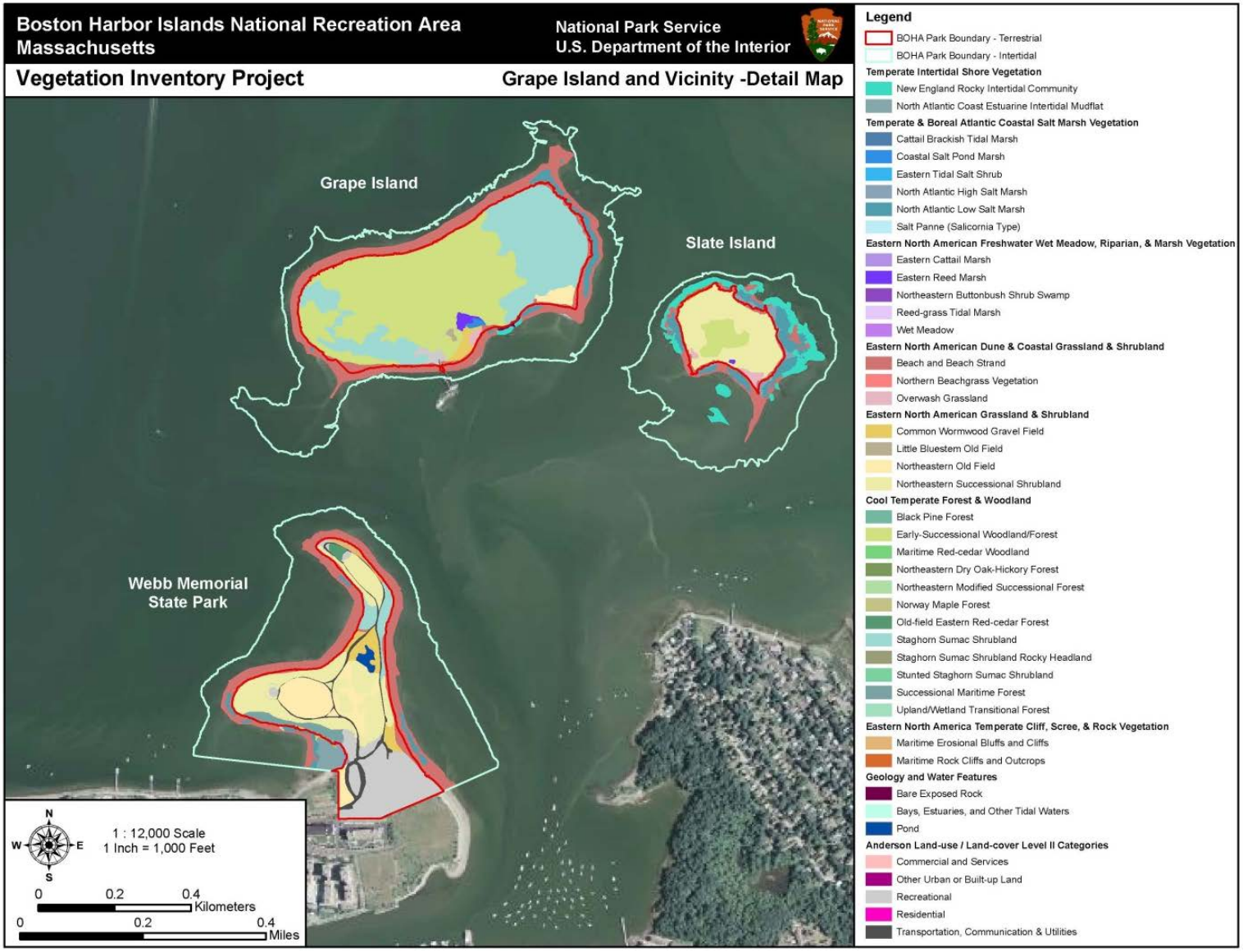


Figure J-4. Vegetation associations and land use - land cover categories of Grape and Slate Islands and Webb Memorial State Park of Boston Harbor Islands National Recreation Area.

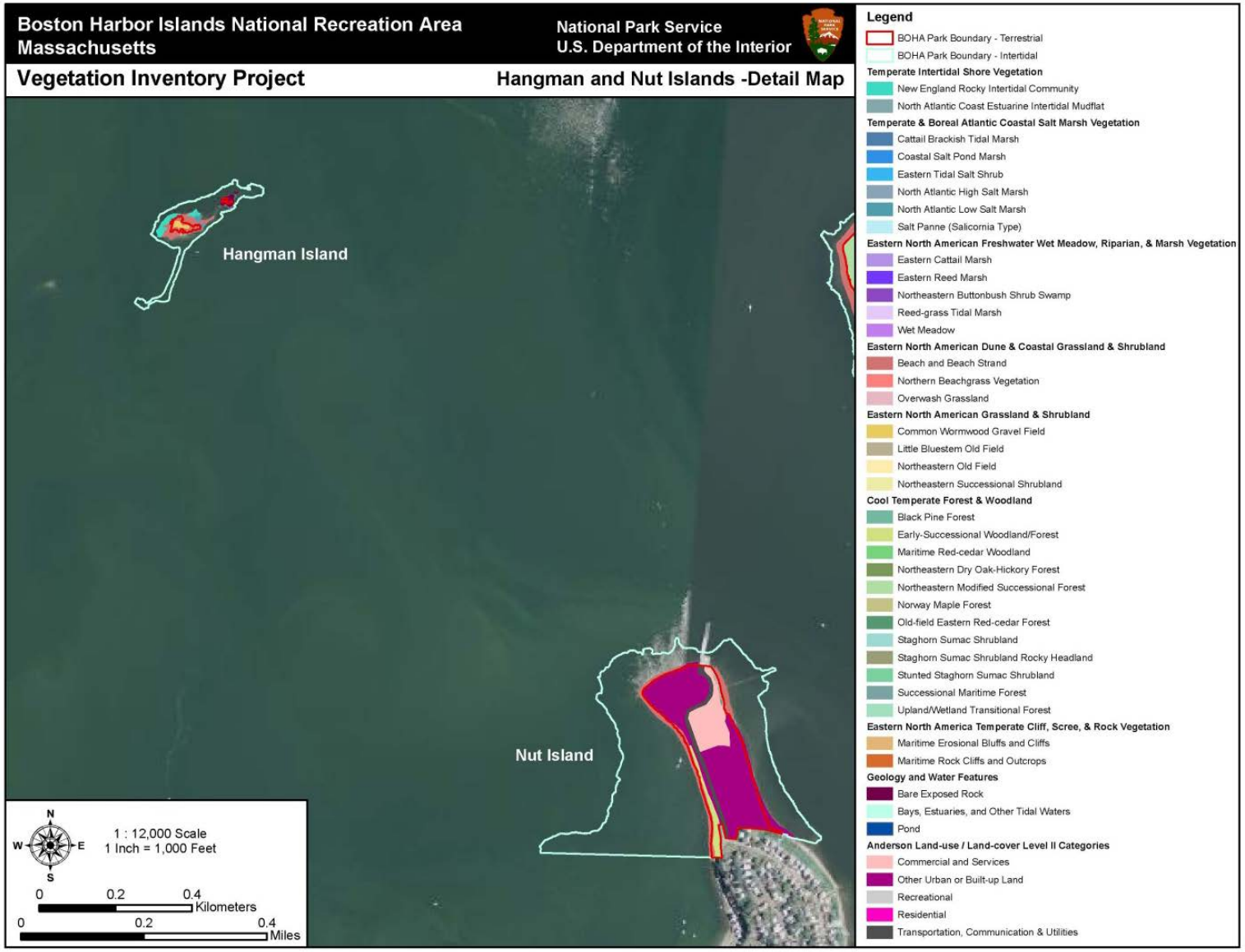


Figure J-5. Vegetation associations and land use - land cover categories of Hangman and Nut Islands of Boston Harbor Islands National Recreation Area.

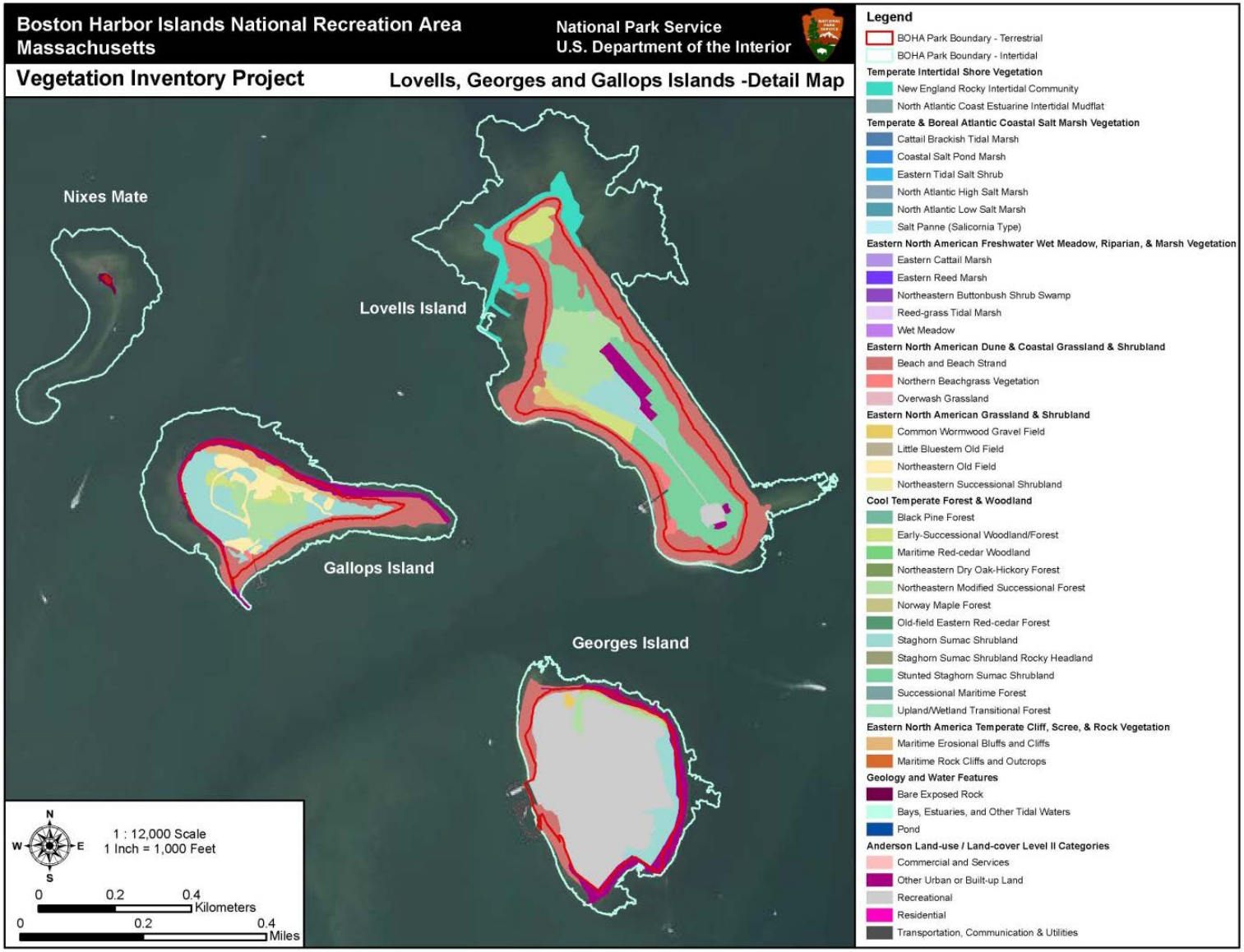


Figure J-6. Vegetation associations and land use - land cover categories of Lovells, Gallops, and Georges Islands and Nixes Mate of Boston Harbor Islands National Recreation Area.

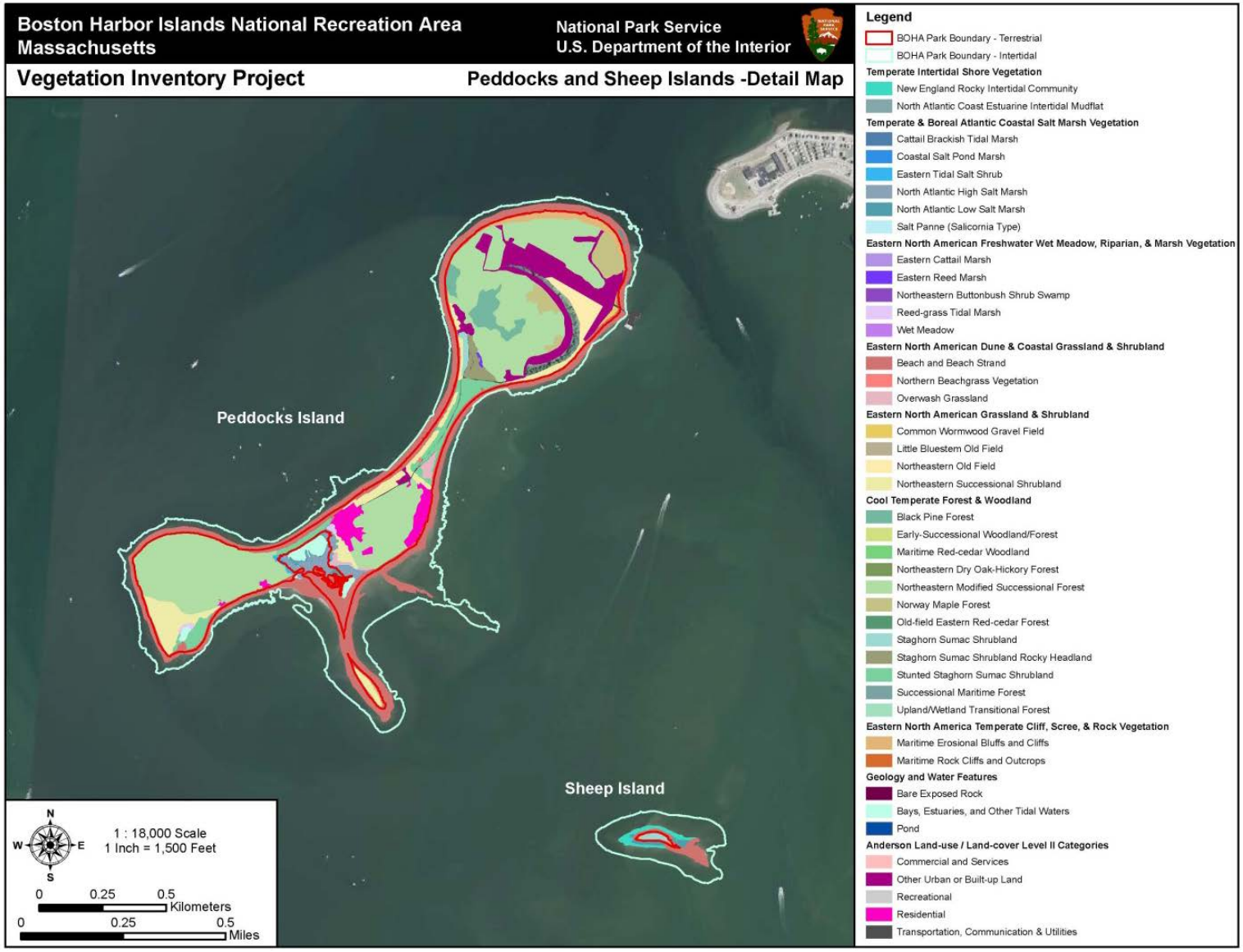


Figure J-7. Vegetation associations and land use - land cover categories of Peddocks and Sheep Islands of Boston Harbor Islands National Recreation Area.

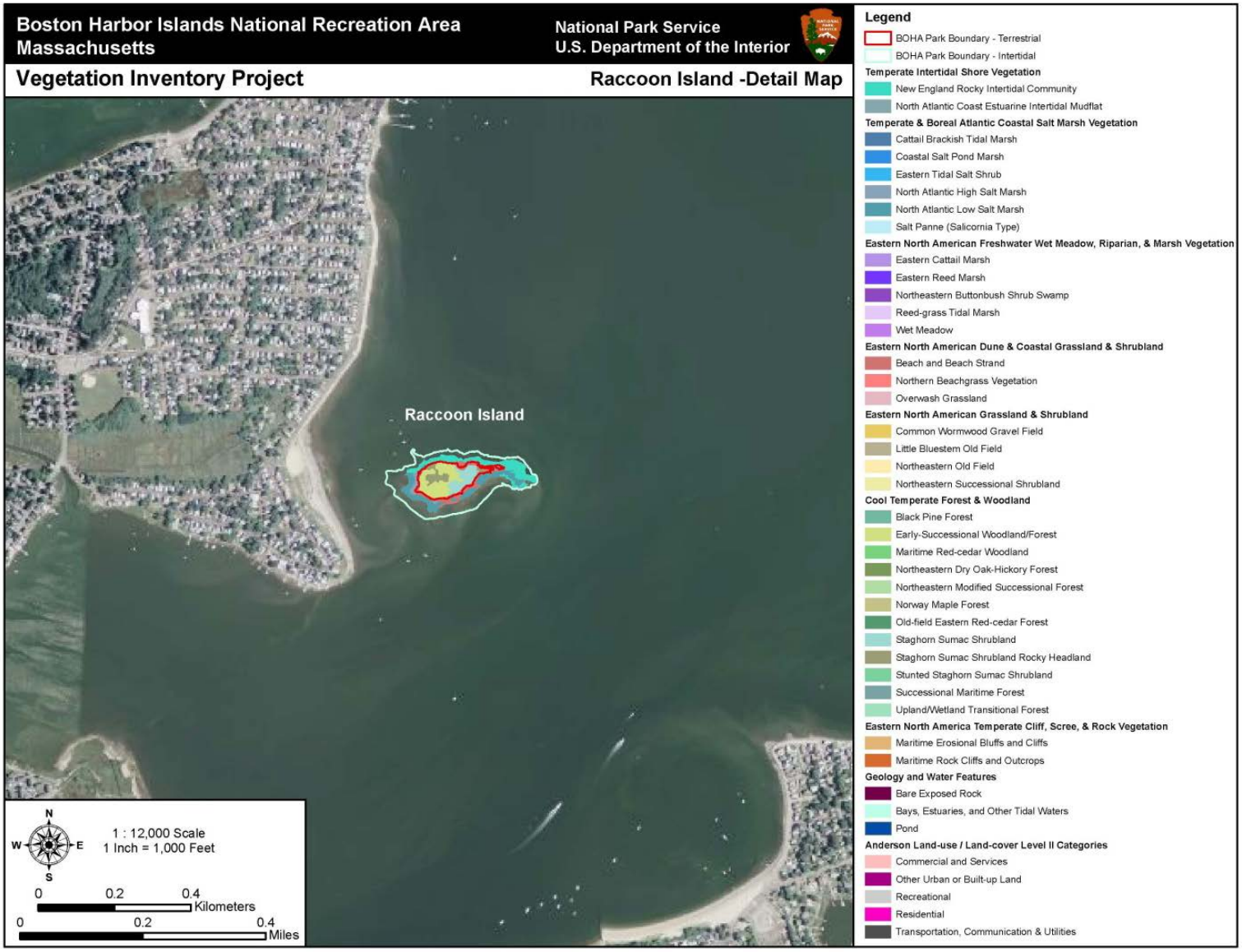


Figure J-8. Vegetation associations and land use - land cover categories of Raccoon Island of Boston Harbor Islands National Recreation Area.

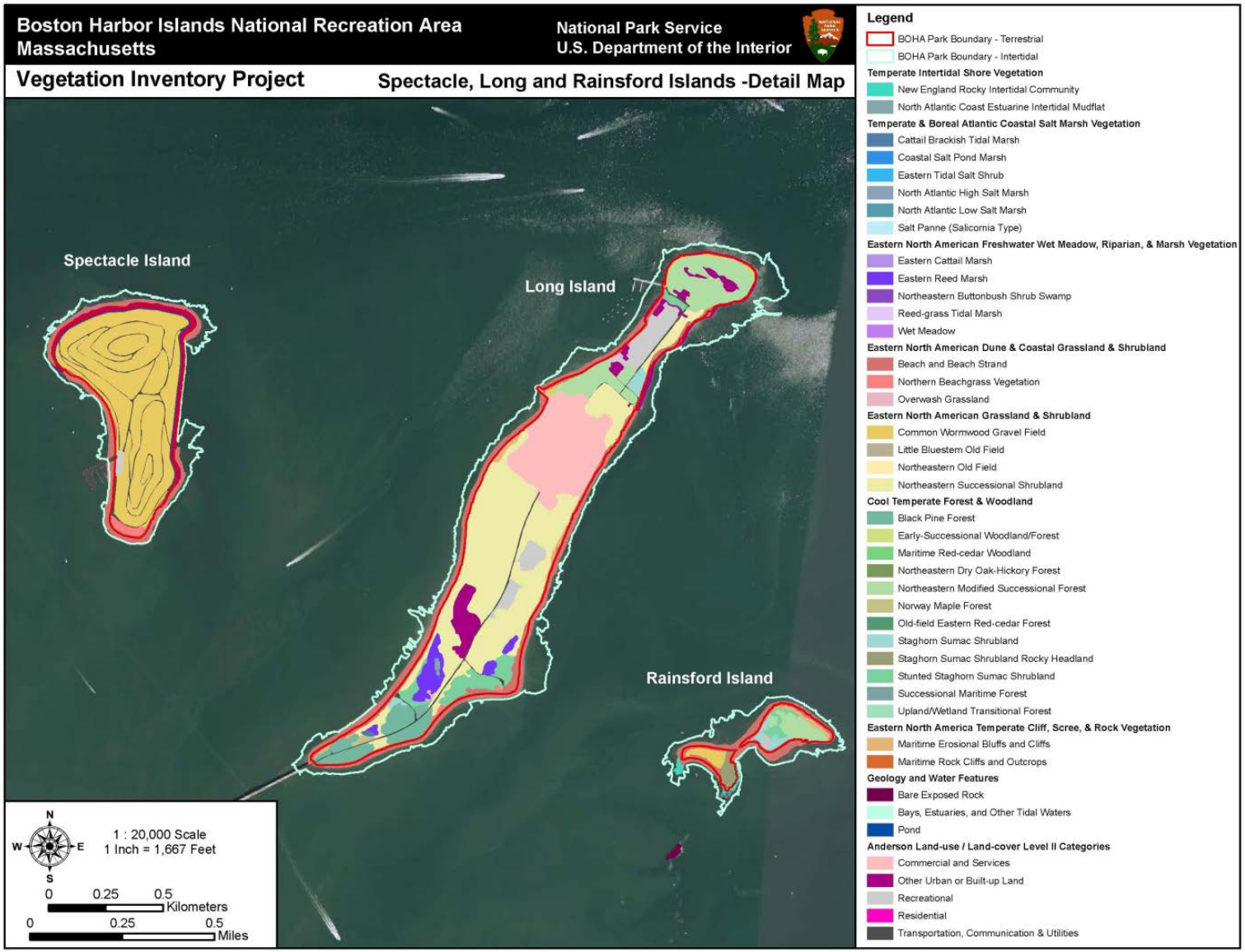


Figure J-9. Vegetation associations and land use - land cover categories of Spectacle, Long, and Rainsford Islands of Boston Harbor Islands National Recreation Area.

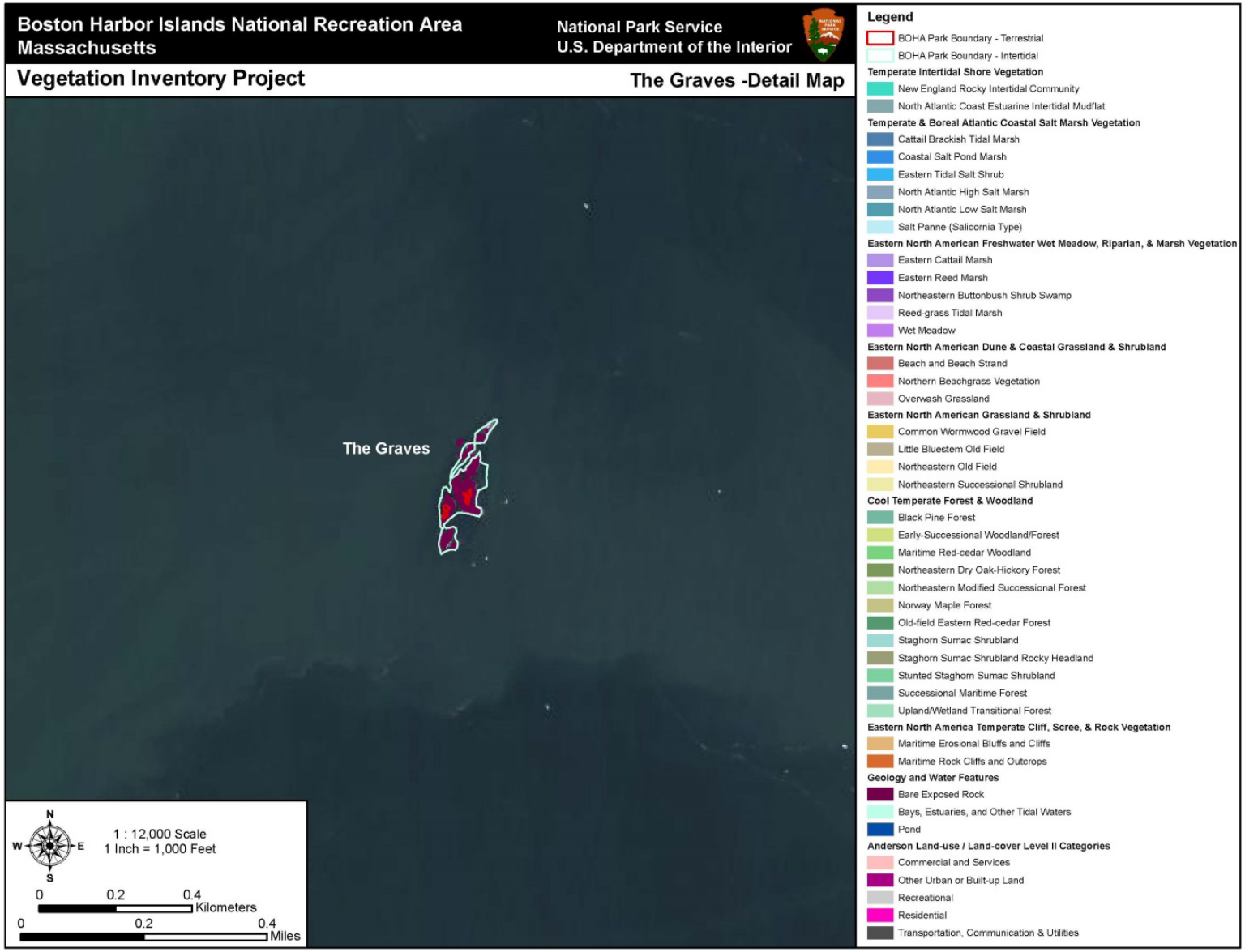


Figure J-10. Vegetation associations and land use - land cover categories of The Graves of Boston Harbor Islands National Recreation Area.

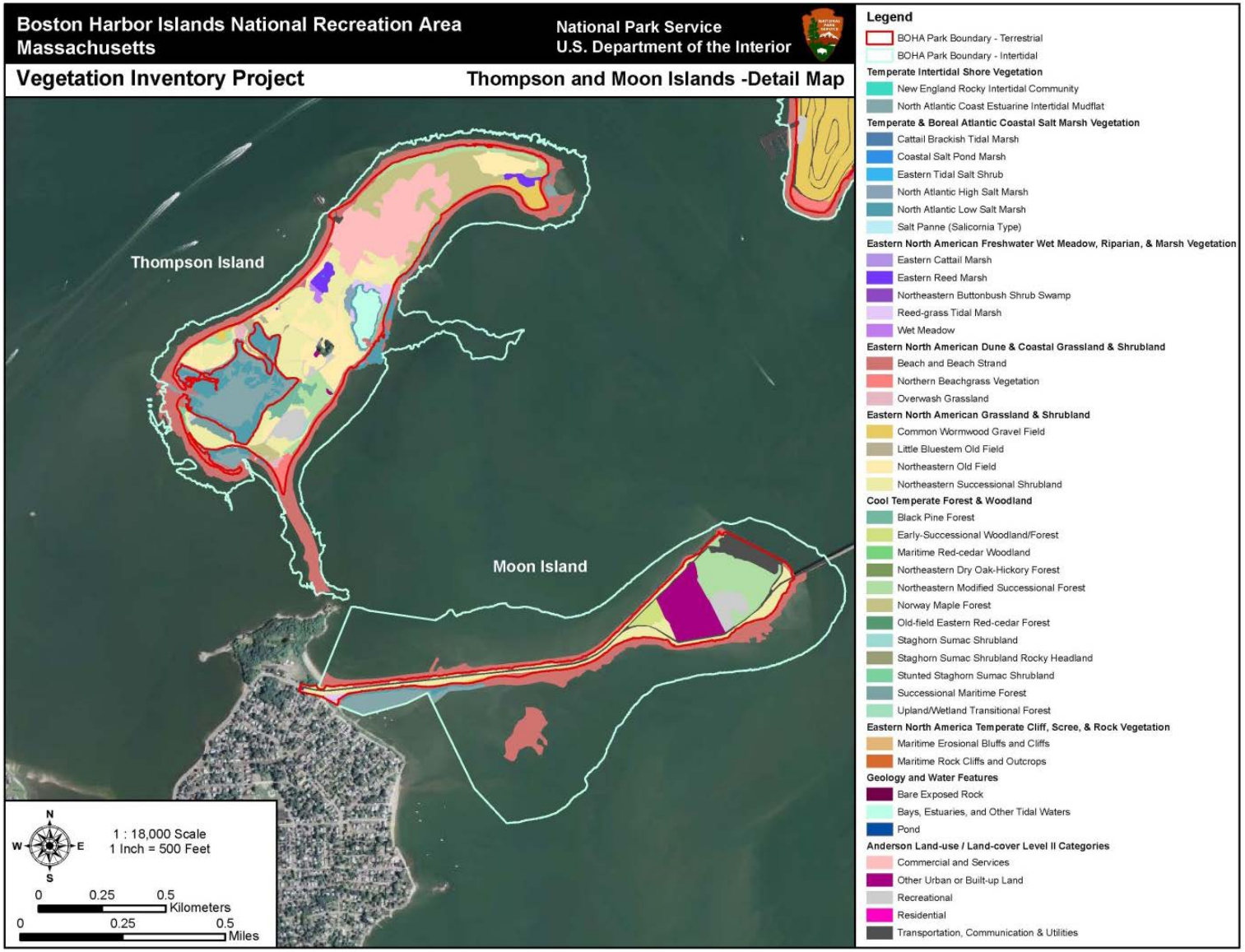


Figure J-11. Vegetation associations and land use - land cover categories of Thompson and Moon Islands of Boston Harbor Islands National Recreation Area.

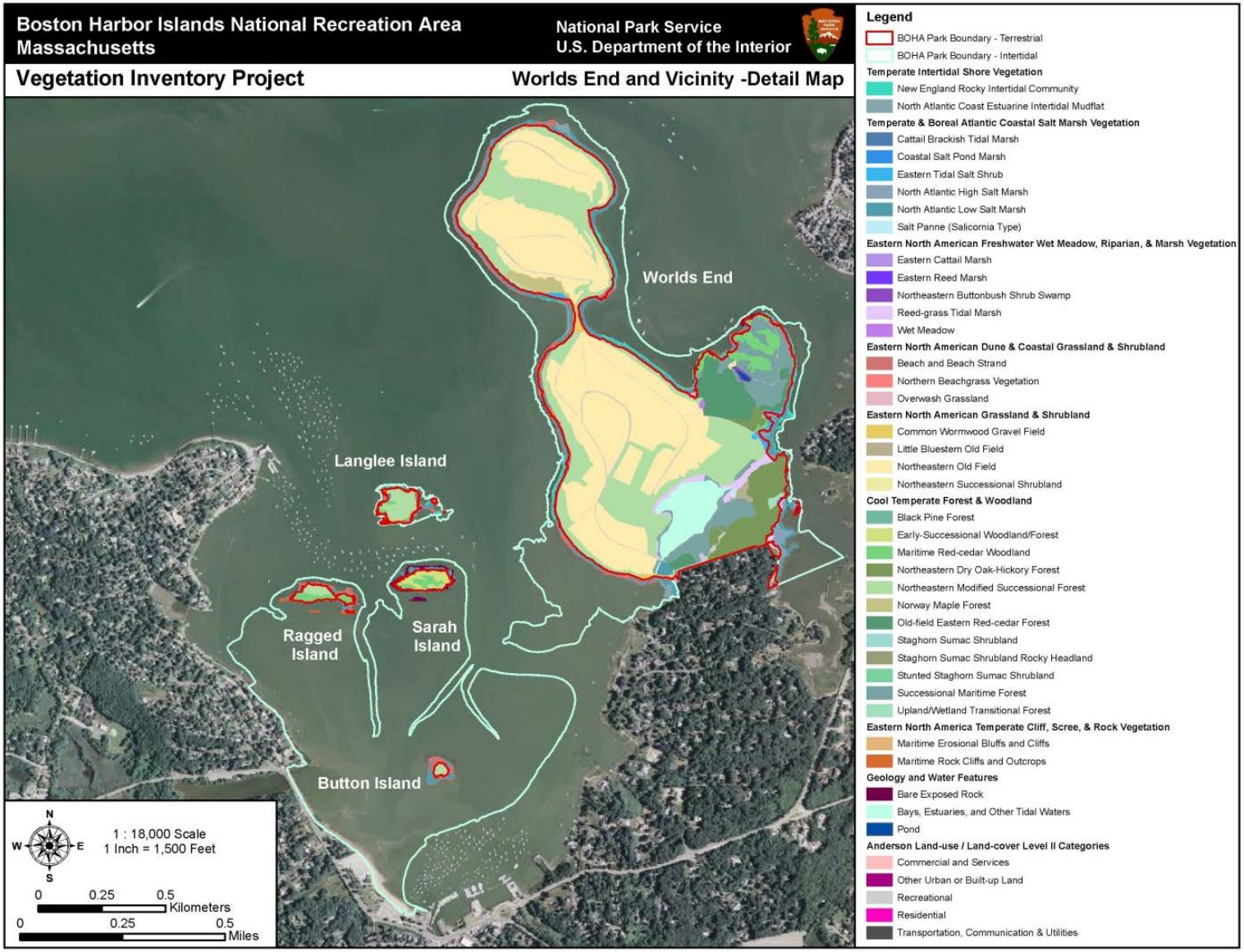


Figure J-12. Vegetation associations and land use - land cover categories of World's End peninsula and Langlee, Ragged, Sarah, and Button Islands of Boston Harbor Islands National Recreation Area.

Appendix K. NatureServe global and state conservation status rank definitions.

Listed below are definitions for interpreting NatureServe's global, (range-wide) conservation status ranks for species (plants and animals) and vegetation associations (natural communities). Global conservation status ranks are assigned by NatureServe scientists or by a designated lead office in the Natural Heritage Network.

Table K-1. NatureServe global conservation status definitions

Rank	Definition
GX	Presumed Extinct (for species) — Not located despite intensive searches and virtually no likelihood of rediscovery. Eliminated (for vegetation associations) — Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
GH	Possibly Extinct (for species) — Missing; known from only historical occurrences but still some hope of rediscovery. Presumed Eliminated (Historic, for vegetation associations) — Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut (Forest).
G1	Critically Imperiled — At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled — At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable — At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	Apparently Secure — Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure — Common; widespread and abundant.
G?	Species/vegetation association has not yet been ranked.
GNR	Species/vegetation association has not yet been ranked.
GNA	Rank not applicable

Note: To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).

Table K-2. NatureServe state conservation status definitions.

Rank	Definition
S1	Critically imperiled because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.
S2	Imperiled because of rarity (6 to 20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.
S3	Rare in state with 21 to 100 occurrences (plant species and vegetation associations in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.
S4	Apparently secure in state, with many occurrences.
S5	Demonstrably secure in state and essentially ineradicable under present conditions.
G4	Apparently Secure — Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure — Common; widespread and abundant.
S?	Species/vegetation association has not yet been ranked.
SNR	Species/vegetation association has not yet been ranked.
SNA	Rank not applicable

Appendix L. Bibliography for U. S. National Vegetation Classification global vegetation descriptions for associations of Boston Harbor Islands National Recreation Area.

Adams, D. A. 1963. Factors influencing vascular plant zonation in North Carolina salt marshes. Ecology 44:445-456.

Allard, D. J. 1990. Southeastern United States ecological community classification. Interim report, Version 1.2. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC. 96 pp.

Ambrose, J. 1990. Georgia's natural communities--A preliminary list. Unpublished document. Georgia Natural Heritage Inventory. 5 pp.

Anderson, D. M. 1982. Plant communities of Ohio: A preliminary classification and description. Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Columbus, OH. 182 pp.

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. USDI, Geological Survey Professional Paper No. 964. Washington, DC. 26 pp.

Anderson, R. 1999. Disturbance as a factor in the distribution of sugar maple and the invasion of Norway maple into a modified woodland. Rhodora 101:264-273.

Andreu, M. G., and M. L. Tukman. 1995. Forest communities of the Tellico Lake Area, East Tennessee. M.F. project report, Duke University, School of the Environment. Durham, NC. 66 pp. plus appendices.

Apfelbaum, S. I. 1985. Cattail (Typha spp.) management. Natural Areas Journal 5(3):9-17.

Art, H. W. 1987. Patterns of community dynamics in the Sunken Forest: 1967 to 1985 and 1985 to 1986. National Park Service, North Atlantic Regional Office. 66 pp.

Au, S. 1974. Vegetation and ecological processes on Shackleford Bank, North Carolina. USDI National Park Service, Scientific Monograph No. 6.

Baalman, R. J. 1965. Vegetation of the Salt Plains National Wildlife Refuge, Jet, Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman, OK.

Bailey, R. 1997. Map: Ecoregions of North America (rev.). Washington, DC: USDA Forest Service in cooperation with The Nature Conservancy and the U.S. Geological Survey. 1:15,000,000.

Bailey, R. G. 1998. Ecoregion map of North America: Explanatory note. Miscellaneous Publication Number 1548, USDA Forest Service. 10 pp.

Barry, J. F. 1980. Natural vegetation of South Carolina. University of South Carolina Press, Columbia, SC. 214 pp.

Bartgis, R. 1986. Natural community descriptions. Unpublished draft. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis, MD.

Baumann, C. 1978. The effects of overwash on the vegetation of a Virginia barrier island. M.A. thesis. College of William and Mary, Williamsburg, VA. 104 pp.

Bell, R., M. Chandler, R. Buchsbaum, and C. Roman. 2002. Inventory of intertidal habitats: Boston Harbor Islands, a National Park area. Technical Report NPS/NERBOST/NRTR-2004/1. USDI National Park Service, Northeast Region, Boston, MA. 13 pp.

Bellis, V. J. 1992. Floristic continuity among the maritime forests of the Atlantic Coast of the United States. Pages 21-29 *in*: C. A. Cole and F. K. Turner, editors. Barrier island ecology of the mid-Atlantic Coast: A symposium. Technical Report NPS/SERCAHA/NRTR-93/04.

Berdine, M. A. 1998. Maryland vegetation classification. Maryland Department of Natural Resources, Annapolis, MD.

Berrill, M., and D. Berrill. 1981. A Sierra Club naturalists' guide, the North Atlantic Coast: Cape Cod to Newfoundland. Sierra Club Books, San Francisco, CA.

Bertness, M. D. 1988. Peat accumulation and the success of marsh plants. Ecology 69:703-713.

Bertness, M. D., L. Gough, and S. W. Shumway. 1992. Salt tolerances and the distribution of fugitive salt marsh plants. Ecology 73(5):1842-1851.

Boule, M. E. 1979. The vegetation of Fisherman Island, Virginia. Castanea 44:98-108.

Bowman, P. 2000. Draft classification for Delaware. Unpublished draft. Delaware Natural Heritage Program.

Breden, T. F. 1989. A preliminary natural community classification for New Jersey. Pages 157-191 in: E. F. Karlin, editor. New Jersey's rare and endangered plants and animals. Institute for Environmental Studies, Ramapo College, Mahwah, NJ. 280 pp.

Breden, T. F., Y. R. Alger, K. S. Walz, and A. G. Windisch. 2001. Classification of vegetation communities of New Jersey: Second iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, New Jersey Department of Environmental Protection, Trenton, NJ.

Breeding, C. H. J., F. D. Richardson, and S. A. L. Pilgrim. 1974. Soil survey of the New Hampshire tidal marshes. New Hampshire Agricultural Experiment Station. Research Report No. 40. Durham, NH. 94 pp.

Bundy, R. M., J. V. Baumgartner, M. S. Reid, P. S. Bourgeron, H. C. Humphries, and B. L. Donohue. 1996. Ecological classification of wetland plant associations in the Lahontan Valley, Nevada. Prepared for Stillwater National Wildlife Refuge and USDI Fish and Wildlife Service. 53 pp. not including inventories, tables and graphs.

Bunin, J. E. 1985. Vegetation of the City of Boulder, Colorado open space lands. Report prepared for the City of Boulder, Real Estate/Open Space, Boulder, CO. 114 pp.

Burk, C. J. 1968. A floristic comparison of lower Cape Cod, Massachusetts and the North Carolina Outer Banks. Rhodora 70:215-227.

Byers, E. A., J. P. Vanderhorst, and B. P. Streets. 2007. Classification and conservation assessment of high elevation wetland communities in the Allegheny Mountains of West Virginia. West Virginia Natural Heritage Program, West Virginia Division of Natural Resources, Elkins, WV.

CAP [Central Appalachian Forest Working Group]. 1998. Central Appalachian Working group discussions. The Nature Conservancy, Boston, MA.

Cahoon, D. R., and J. C. Stevenson. 1986. Production, predation, and decomposition in a low-salinity Hibiscus marsh. Ecology 67:1341-1350.

Campbell, J. J. N. 1989. Historical evidence of forest composition in the Bluegrass Region of Kentucky. Pages 231-246 in: Proceedings of the Seventh Central Hardwood Forest Conference, Southern Illinois University, Carbondale, IL.

Campbell, J. J. N. Personal communication. Kentucky Field Office, The Nature Conservancy.

Chapman, K. A., D. A. Albert, and G. A. Reese. 1989. Draft descriptions of Michigan's natural community types. Michigan Department of Natural Resources, Lansing, MI. 35 pp.

Chapman, V. J. 1937. A note on the salt marshes of Nova Scotia. Rhodora 39:53-57.

Chappell, C., R. Crawford, J. Kagan, and P. J. Doran. 1997. A vegetation, land use, and habitat classification system for the terrestrial and aquatic ecosystems of Oregon and Washington. Unpublished report prepared for Wildlife habitat and species associations within Oregon and Washington landscapes: Building a common understanding for management. Prepared by Washington and Oregon Natural Heritage Programs, Olympia WA, and Portland, OR. 177 pp.

Christy, S. 1973. An analysis of the woody vegetation on the South Platte River flood plain in northeastern Colorado. Unpublished thesis, University of Northern Colorado, Greeley, CO. 82 pp.

Clampitt, C. A. 1991. The upland plant communities of Seashore State Park, Virginia Beach, Virginia. Virginia Journal of Science 42:419-435.

Clancy, K. 1993. A preliminary classification of the natural communities of Delaware. Unpublished draft, Delaware Natural Heritage Inventory, Division of Parks and Recreation, Dover, DE. 30 pp.

Clancy, K. 1996. Natural communities of Delaware. Unpublished review draft. Delaware Natural Heritage Program, Division of Fish and Wildlife, Delaware Division of Natural Resources and Environmental Control, Smyrna, DE. 52 pp.

Clark, J. S. 1986. Vegetation and land-use history of the William Floyd Estate, Fire Island National Seashore, Long Island, New York. USDI, National Park Service, North Atlantic Region, Office of Scientific Studies. 126 pp.

Clovis, J. F. 1968. The vegetation of Smith Island, Virginia. Castanea 33:115-121.

Coffman, M. S., and G. L. Willis. 1977. The use of indicator species to classify climax sugar maple and eastern hemlock forests in upper Michigan. Forestry and Ecology Management 1:149-168.

Coleman, D. C., and A. C. Mathieson. 1975. Investigations of New England marine algae. VII: Seasonal occurrence and reproduction of marine algae near Cape Cod, Massachusetts. Rhodora 77:76-104.

Conard, H. S. 1935. The plant associations of central Long Island. The American Midland Naturalist 16:433-516.

Conner, W. H., J. G. Gosselink, and R. T. Parrondo. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. American Journal of Botany 68:320-331.

Cooper, A. W., and E. D. Waits. 1973. Vegetation types in an irregularly flooded salt marsh on the North Carolina Outer Banks. Journal of the Elisha Mitchell Scientific Society 89:78-91.

Coulling, P. P. 2002. A preliminary classification of tidal marsh, shrub swamp, and hardwood swamp vegetation and assorted non-tidal, chiefly non-maritime, herbaceous wetland communities of the Virginia Coastal Plain. October 2002. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 02-18. 30 pp.

Coulling, Phil. Personal communication. Vegetation Ecologist. Department of Conservation & Recreation, 217 Governor St., Richmond, VA 23219.

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. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.

Coxe, R. 2009. Guide to Delaware vegetation communities. Spring 2009 edition. State of Delaware, Division of Fish and Wildlife, Delaware Natural Heritage Program, Smyrna, DE.

Crow, T. R. 1988. Reproductive mode and mechanisms for self-replacement of northern red oak (Quercus rubra)--a review. Forest Science 34:19-40.

Crowe, E. A., and R. R. Clausnitzer. 1997. Mid-montane wetland plant associations of the Malheur, Umatilla, and Wallowa-Whitman national forests. USDA Forest Service, Pacific Northwest Region. Technical Paper R6-NR-ECOL-TP-22-97.

Curtis, J. T. 1959. The vegetation of Wisconsin: An ordination of plant communities. University of Wisconsin Press, Madison. 657 pp. [reprinted in 1987]

Daiber, F. C., L. L. Thornton, K. A. Bolster, T. G. Campbell, O. W. Crichton, G. L. Esposito, D. R. Jones, and J. M. Tyrawski. 1976. An atlas of Delaware's wetlands and estuarine resources. College of Marine Studies, University of Delaware, Newark, DE. 528 pp.

Damman, A. W. H. 1977. Geographical changes in the vegetation patterns of raised bogs in the Bay of Fundy region of Maine and New Brunswick. Vegetatio 35:137-151.

Damman, A. W. H., and B. Kershner. 1977. Floristic composition and topographical distribution of the forest communities of the gneiss areas of western Connecticut. Naturaliste Canadien 104:23-45.

Decker, E. 1955. The Conneaut Marsh: Marsh and waterfowl investigations. M.S. thesis, Pennsylvania State University Graduate School, School of Forestry. 108 pp.

Diamond, D. D. 1993. Classification of the plant communities of Texas (series level). Unpublished document. Texas Natural Heritage Program, Austin. 25 pp.

Dove, L. E., and R. M. Nyman, editors. 1995. Living resources of the Delaware Estuary Program. 530 pp.

Dowhan, J. J., and R. Rozsa. 1989. Flora of Fire Island, Suffolk Country, New York. Bulletin of the Torrey Botanical Club 116:265-282.

Dunlop, D. A., and G. E. Crow. 1985. The vegetation and flora of the Seabrook Dunes with special reference to rare plants. Rhodora 87:471-486.

Eastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boston, MA.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero, editors. 2002. Ecological communities of New York state. Second edition. A revised and expanded edition of Carol Reschke's ecological communities of New York state. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

Eggers, S. D., and D. M. Reed. 1987. Wetland plants and plant communities of Minnesota and Wisconsin. U.S. Army Corps of Engineers, St. Paul District, St. Paul, MN. 201 pp.

Egler, F. E. 1962. Ferns and flowering plants of Seashore State Park, Cape Henry, Virginia. New York State College of Forestry, Syracuse, NY. 60 pp.

Ehrenfeld, J. G. 1977. Vegetation of Morristown National Historical Park: Ecological analysis and management alternatives. Final Report. USDI National Park Service Contract No. 1600-7-0004. 166 pp.

Eleuterius, L. N. 1972. The marshes of Mississippi. Castanea 37:153-168.

Elliman, T. 2004. A Vascular Plant Survey of the Boston Harbor Islands National Park Area: Final Report. A Report for the Island Alliance, Massachusetts Natural Heritage and Endangered Species Program, and National Park Service. 166 pp.

Enser, R. 1993. Natural community classification for Rhode Island (draft). Rhode Island Natural Heritage Program. Providence, RI.

Enser, R. 1999. Natural communities of Rhode Island. Unpublished draft, December 1999. 22 pp.

Enser, R., and J. A. Lundgren. 2005. Natural communities of Rhode Island. Review draft. Rhode Island Natural Heritage Program, Department of Environmental Management and The Nature Conservancy of Rhode Island. Providence, RI.

Evans, M. 1991. Kentucky ecological communities. Draft report to the Kentucky Nature Preserves Commission. 19 pp.

Ewing, A. L., J. F. Stritzke, and J. D. Kulbeth. 1984. Vegetation of the Cross Timbers experimental range, Payne County, Oklahoma. Research Report P-856, Oklahoma State University, Oklahoma Agricultural Experiment Station, Stillwater, OK.

Eyre, F. H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.

FNAI [Florida Natural Areas Inventory]. 1992a. Natural communities. Unpublished document. The Nature Conservancy, Florida Natural Areas Inventory, Tallahassee, FL. 6 pp.

FNAI [Florida Natural Areas Inventory]. 1992b. Natural community classification. Unpublished document. The Nature Conservancy, Florida Natural Areas Inventory, Tallahassee, FL. 16 pp.

Faber-Langendoen, D., and Midwest State Natural Heritage Program Ecologists. 1996. Terrestrial vegetation of the midwest United States. International classification of ecological communities: Terrestrial vegetation of the United States. The Nature Conservancy, Arlington, VA.

Faber-Langendoen, D., and P. F. Maycock. 1989. Community patterns and environmental gradients of buttonbush, *Cephalanthus occidentalis*, ponds in lowland forests of southern Ontario. The Canadian Field-Naturalist 103(4):479-485.

Fender, F. S. 1937. The flora of Seven Mile Beach, New Jersey. Bartonia 19:23-41.

Ferren, W. R., Jr., R. E. Good, R. Walker, and J. Arsenault. 1981. Vegetation and flora of Hog Island, a brackish wetland in the Mullica River, New Jersey. Bartonia 48:1-10.

Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Recreation. Bureau of Forestry. Harrisburg, PA. 86 pp.

Flaccus, E., and L. F. Ohmann. 1964. Old-growth northern hardwood forests in northeastern Minnesota. Ecology 45:448-459.

Fleming, G. P. 1998. Virginia natural community framework, version January 30, 1998. Unpublished document. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 6 pp.

Fleming, G. P. 2001. Community types of Coastal Plain calcareous ravines in Virginia. Preliminary analysis and classification. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 4 pp.

Fleming, G. P., P. P. Coulling, K. D. Patterson, and K. M. McCoy. 2004. The natural communities of Virginia: Classification of ecological community groups. Second approximation. Natural Heritage Technical Report 04-01. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. [http://www.dcr.virginia.gov/dnh/ncintro.htm]

Fleming, G. P., and W. H. Moorhead, III. 1998. Comparative wetlands ecology study of the Great Dismal Swamp, Northwest River, and North Landing River in Virginia. Natural Heritage Technical Report 98-9. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report submitted to the U.S. Environmental Protection Agency. 181 pp. plus appendices.

Fleming, Gary P. Personal communication. Ecologist, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Foti, T. 1994a. Natural communities of Arkansas (terrestrial and palustrine). Unpublished document. Arkansas Natural Heritage Commission, Little Rock, AR. 2 pp.

Foti, T., compiler. 1994b. Natural vegetation classification system of Arkansas, draft five. Unpublished document. Arkansas Natural Heritage Commission, Little Rock, AR. 8 pp.

Foti, T., M. Blaney, X. Li, and K. G. Smith. 1994. A classification system for the natural vegetation of Arkansas. Proceedings of the Arkansas Academy of Science 48:50-53.

Fountain, M. S., and J. M. Sweeney. 1985. Ecological assessment of the Roaring Branch Research Natural Area. Research Paper SO-213. USDA Forest Service, Southern Forest Experiment Station, New Orleans, LA. 15 pp.

Fralish, J. S. 1988b. Predicting potential stand composition from site characteristics in the Shawnee Hills Forest of Illinois. The American Midland Naturalist 120(1):79-101.

Fralish, J. S., F. B. Crooks, J. L. Chambers, and F. M. Harty. 1991. Comparison of presettlement, second-growth and old-growth forest on six site types in the Illinois Shawnee Hills. The American Midland Naturalist 125:294-309.

Funk, V. A. 1975. A floristic and geologic survey of selected seeps in Calloway County, Kentucky. M.S. thesis, Murray State University, Murray, KY. 84 pp.

Funk, V. A., and M. J. Fuller. 1978. A floristic survey of the seeps of Calloway County, Kentucky. Castanea 43:162-172.

Galloway, L. A. 1963. The vegetation of an actively eroding canyon in Canadian County, Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman, OK.

Galloway, L. A. 1964. The vegetation of an actively eroding canyon in Canadian County, Oklahoma. Proceedings of the Oklahoma Academy of Science 45:20-23.

Gawler, S. C. 1991. Natural landscapes of Maine: A classification of ecosystems and natural communities. Provisional edition, Maine Natural Heritage Program, Office of Comprehensive Planning, DECD, Augusta, ME.

Gawler, S. C. 2001. Natural landscapes of Maine: Natural community profiles. Open (non-forested) types. Final review draft, July 2001. Maine Natural Areas Program. Department of Conservation. Augusta, ME.

Gawler, S. C. 2002. Natural landscapes of Maine: A guide to vegetated natural communities and ecosystems. Maine Natural Areas Program, Department of Conservation, Augusta, ME.

Girard, M. M., H. Goetz, and A. J. Bjugstad. 1989. Native woodland habitat types of southwestern North Dakota. Research Paper RM-281. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 36 pp.

Godfrey, P. J., M. Benedict, and M. Soukup. 1978. A guide to the ecology of Cape Cod National Seashore (Mary 1978 draft). National Park Service Cooperative Research Unit, Institute for Man and Environment, University of Massachusetts, Amherst, MA.

Golden, M. S. 1979. Forest vegetation of the lower Alabama Piedmont. Ecology 60:770-782.

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. USDI Fish and Wildlife Service, Washington, DC. 151 pp.

Good, R. E. 1965. Salt marsh vegetation, Cape May, New Jersey. Bulletin of the New Jersey Academy of Science 10:1-11.

Good, R. E., and N. F. Good. 1975. Vegetation and production of the Woodbury Creek and Hessian Run freshwater tidal marshes. Bartonia 43:38-45.

Gosner, K. L. 1979. A field guide to the Atlantic seashore: Invertebrates and seaweeds of the Atlantic coast from the Bay of Fundy to Cape Hatteras. Houghton Mifflin, Boston, MA.

Grace, J. B., and R. G. Wetzel. 1981. Habitat partitioning and competitive displacement in cattail (Typha): Experimental field studies. The American Midland Naturalist 118:463-474.

Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence, KS. 1402 pp.

Greller, A. M. 1977. A classification of mature forests on Long Island, New York. Bulletin of the Torrey Botanical Club 104:376-382.

Hansen, H. L., L. W. Krefting, and V. Kurmis. 1973. The forest of Isle Royale in relation to fire history and wildlife. University of Minnesota, Agricultural Experiment Station, Technical Bulletin 294, Forestry Series 13.

Hansen, P. L., R. D. Pfister, K. Boggs, B. J. Cook, J. Joy, and D. K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Miscellaneous Publication No. 54. 646 pp. + posters.

Hansen, P., K. Boggs, and R. Pfister. 1991. Classification and management of riparian and wetland sites in Montana. Unpublished draft version prepared for Montana Riparian Association, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT. 478 pp.

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, Northwest Science and Technology, Thunder Bay, Ontario. Field guide FG-01. 74 pp. plus appendix.

Harrison, J. W. 2001. Herbaceous tidal wetland communities of Maryland's eastern shore: Identification, assessment and monitoring. Report submitted to the U.S. EPA (Clean Water Act 1998 State Wetlands Protection Development Grant Program). Biodiversity Program, Maryland Department of Natural Resources, Wildlife and Heritage Division. 30 June 2001. [U.S. EPA Reference Wetland Natural communities of Maryland's Herbaceous Tidal Wetlands Grant #CD993724].

Harrison, J. W., and P. Stango, III. 2003. Shrubland tidal wetland communities of Maryland's Eastern Shore: Identification, assessment and monitoring. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis, MD. 118 pp.

Harrison, J. W., compiler. 2004. Classification of vegetation communities of Maryland: First iteration. A subset of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States, NatureServe. Maryland Natural Heritage Program, Maryland Department of Natural Resources, Annapolis, MD. 243 pp.

Harrison, Jason W. Personal communication. State Community Ecologist, Maryland Wildlife and Heritage Division, Department of Natural Resources, Tawes State Office Building, E-1, Annapolis, MD 21401.

Harshberger, J. W. 1900. An ecological study of the New Jersey strand flora. Proceedings of the Academy of Natural Science Philadelphia 52:623-671.

Harvill, A. M., Jr. 1965. The vegetation of Parramore Island, Virginia. Castanea 30:226-228.

Harvill, A. M., Jr. 1967. The vegetation of Assateague Island, Virginia. Castanea 32:105-108.

Heckscher, S. 1994. The vegetation of the Glades Region, Cumberland County, New Jersey. Bartonia 58:101-113.

Higgins, E. A. T., R. D. Rappleye, and R. G. Brown. 1971. The flora and ecology of Assateague Island. University of Maryland Experiment Station Bulletin A-172. 70 pp.

Hill, A. F. 1923. The vegetation of the Penobscot Bay region, Maine. Proceedings of the Portland Society of Natural History 3:307-438.

Hill, S. R. 1986. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). Castanea 5:265-305.

Hillestad, H. O., J. R. Bozeman, A. S. Johnson, C. W. Berisford, and J. I. Richardson. 1975. The ecology of the Cumberland Island National Seashore, Camden County, Georgia. Technical Report Series No. 75-5. Georgia Marine Sciences Center, Skidway Island, GA.

Hoagland, B. 2000. The vegetation of Oklahoma: A classification for landscape mapping and conservation planning. The Southwestern Naturalist 45(4):385-420.

Hoagland, B. W. 1997. Preliminary plant community classification for Oklahoma. Unpublished draft document, version 35629. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman, OK. 47 pp.

Hoagland, B. W. 1998a. Classification of Oklahoma vegetation types. Working draft. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman, OK. 43 pp.

Hoagland, B. W. 1998c. Oklahoma riparian vegetation. In: A. Fallon and M. Smolen, editors. Riparian area management handbook. Publication number E-952. Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, OK.

Hopping, R. 2000. Property Profile (World's End). The Trustees of Reservations. Beverly, MA.

Hosier, P. E. 1975. Dunes and marsh vegetation. Pages D3-D45 in: W. M. Campbell and J. M. Dean, directors. Environmental inventory of Kiawah Island. Environmental Research Center, Inc. Columbia, SC.

House, H. D. 1917. The vegetation of the eastern end of Oneida Lake. New York State Museum Bulletin #197. Albany, NY. pp. 61-71.

Hunt, D. 1997. Long Island oak forest project: Classification justification. Unpublished materials. New York Natural Heritage Program, Latham, NY.

INAI [Iowa Natural Areas Inventory]. No date. Vegetation classification of Iowa. Iowa Natural Areas Inventory, Iowa Department of Natural Resources, Des Moines, IA.

Island Alliance. 2001. Boston Harbor Islands: Grape Island facts. Available online: www.bostonislands.org/grap_factsheet.asp.

Jenkins, D. 1974. Natural areas of the Chesapeake Bay region: Ecological priorities. Smithsonian Institute, Ecology Program, Center for Natural Areas Ecology.

Johnson, A. F. 1981. Plant communities of the Napeague Dunes. Bulletin of the Torrey Botanical Club 108:76-84.

Johnson, A. F. 1985. A guide to the plant communities of the Napeague Dunes, Long Island, New York. Mad Printers, Mattituck, NY. 58 pp. plus plates.

Jones, G. P., and G. M. Walford. 1995. Major riparian vegetation types of eastern Wyoming. Submitted to Wyoming Department of Environmental Quality, Water Quality Division. Wyoming Natural Diversity Database, Laramie, WY. 245 pp.

Jones, S. M. 1988a. Old-growth forests within the Piedmont of South Carolina. Natural Areas Journal 8:31-37.

Jones, S. M. 1988b. Old-growth, steady state forests within the Piedmont of South Carolina. Ph.D. dissertation, Clemson University, Clemson, SC. 94 pp.

Karanaukas, M. 2001. A survey of the aquatic invertebrates of the Boston Harbor Islands. Report to the Island Alliance, National Park Service, and the Massachusetts Natural Heritage and Endangered Species Program.

Keever, C. 1979. Mechanisms of plant succession on old fields of Lancaster County, Pennsylvania. Bulletin of the Torrey Botanical Club 106(4):299-308.

Kittel, G., R. Rondeau, and A. McMullen. 1996. A classification of the riparian vegetation of the Lower South Platte and parts of the Upper Arkansas River basins, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Prepared by Colorado Natural Heritage Program, Fort Collins, CO. 243 pp.

Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, and J. Sanderson. 1999. A classification of the riparian plant associations of the Rio Grande and Closed Basin watersheds, Colorado. Unpublished report prepared by the Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Klemas, V., F. C. Daiber, D. S. Bartlett, O. W. Crichton, and A. O. Fornes. 1973. Coastal vegetation of Delaware. University of Delaware, College of Marine Studies. 27 pp.

Klotz, L. H. 1986. The vascular flora of Wallops Island and Wallops Mainland, Virginia. Castanea 51:306-326.

Knight, D. H. 1994. Mountains and plains: Ecology of Wyoming landscapes. Yale University Press, New Haven, MA. 338 pp.

Komarkova, V. 1976. Alpine vegetation of the Indian Peaks Area, Front Range, Colorado Rocky Mountains. Unpublished dissertation, University of Colorado, Boulder, CO. 655 pp.

Komarkova, V. 1986. Habitat types on selected parts of the Gunnison and Uncompahgre national forests. Unpublished final report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 270 pp. plus appendices.

Kotar, J., and T. L. Burger. 1989. Forest habitat type classification for the Menominee Indian Reservation. Department of Forestry, University of Wisconsin, Madison, WI. 90 pp.

Kovalchik, B. L. 1987. Riparian zone associations - Deschutes, Ochoco, Fremont, and Winema national forests. USDA Forest Service Technical Paper 279-87. Pacific Northwest Region, Portland, OR. 171 pp.

Kovalchik, B. L. 1993. Riparian plant associations on the national forests of eastern Washington - Draft version 1. USDA Forest Service, Colville National Forest, Colville, WA. 203 pp.

Kurz, H., and K. Wagner. 1957. Tidal marshes of the Gulf and Atlantic coasts of northern Florida and Charleston, South Carolina. Florida State University Studies, No. 24. Tallahassee, FL. 168 pp.

Lea, C. 2002. Vegetation classification of Assateague Island National Seashore, Addendum (version 2) - March 1, 2002. Unpublished draft. National Park Service. 31 pp.

Lea, C. 2004. Draft vegetation types in National Capital Region Parks. Edited by S.C. Gawler and J. Teague. Working draft for review by NatureServe, Virginia Natural Heritage, West Virginia Natural Heritage, Maryland Natural Heritage, and National Park Service. July 2004. 157 pp.

Lindauer, I. E. 1978. A comparison of the vegetative communities of the South Platte and Arkansas River drainages in eastern Colorado. Pages 56-72 in: W. D. Graul and S. J. Bissel, editors. Lowland River and Stream Habitat in Colorado: A Symposium, 4-5 October 1978. Colorado Chapter of Wildlife Society and Audubon Council.

Lindauer, I. E., and S. J. Christy. 1972. An analysis of the woody vegetation on the South Platte River floodplain in northeastern Colorado. Unpublished report to the U.S. Bureau of

Reclamation, Denver, CO, by the University of Northern Colorado, Biology Department, Greeley.

Lundgren, J. 2000. Lower New England - Northern Piedmont Ecoregion Forest Classification. The Nature Conservancy, Conservation Science, Boston, MA. 72 pp.

Lundgren, J. A. 1998. Natural communities of coastal Massachusetts: Inventory and assessment. Massachusetts Department of Fisheries and Wildlife Natural Heritage and Endangered Species Program, Boston, MA.

MANESP [Massachusetts Natural Heritage Endangered Species Program]. 2017. NHESP Plant Watch list. Available online: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/rare-plants/plants-watch-list.html (accessed 10 July 2017).

MENHP [Maine Natural Heritage Program]. 1991. Natural landscapes of Maine: A classification of ecosystems and natural communities. Unpublished document. Office of Comprehensive Planning, Maine Natural Heritage Program, Augusta, ME. 77 pp.

MNAP [Maine Natural Areas Program]. 1991. Natural landscapes of Maine: Classification of ecosystems and natural communities. Maine Natural Areas Program, Maine Department of Conservation, Natural Resources Information and Mapping Center. Augusta, ME.

MNNHP [Minnesota Natural Heritage Program]. 1993. Minnesota's native vegetation: A key to natural communities. Version 1.5. Minnesota Department of Natural Resources, Natural Heritage Program, St. Paul, MN. 110 pp.

Marks, M., B. Lapin, and J. Randall. 1994. *Phragmites australis* (*P. communis*): Threats, management, and monitoring. Natural Areas Journal 14(4):285-294.

Martin, W. E. 1959. The vegetation of Island Beach State Park, New Jersey. Ecological Monographs 29:1-46.

Masek, J. 1979. Vegetation community descriptions for the South Platte River in Colorado and Nebraska. Unpublished report prepared for the Water and Power Resources Service, Denver, CO. 23 pp.

McCormick, J., and T. Ashbaugh. 1972. Vegetation of a section of Oldmans Creek Tidal Marsh and related areas in Salem and Gloucester counties, New Jersey. Bulletin of the New Jersey Academy of Science 17:31-37.

McCoy, K. M., and G. P. Fleming. 2000. Ecological communities of U.S. Army Garrison, Fort Belvoir, Fort Belvoir, Virginia. Natural Heritage Technical Report 00-08, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report submitted to the U.S. Army. 156 pp. plus appendices.

McDonnell, M. J. 1979. The flora of Plum Island, Essex County, Massachusetts. University of New Hampshire, Agricultural Experiment Station. Station Bulletin No. 513. Durham, NH. 110 pp.

McEachern, K. 1979. Population biology of *Populus sargentii* in northeastern Colorado. Unpublished thesis, University of Northern Colorado, Greeley, CO. 41 pp.

McLeod, D. E. 1988. Vegetation patterns, floristics, and environmental relationships in the Black and Craggy mountains of North Carolina. Ph.D. dissertation, University of North Carolina, Chapel Hill, NC. 222 pp.

Mercer, J. L. 1978. Westmoreland County Tidal Marsh Inventory. Special Report No. 59 in Applied Marine Science and Ocean Engineering. Virginia Institute of Marine Science. Gloucester Point, VA. 108 pp.

Metzler, K. J., and J. Barrett. 1992. Connecticut community classification. Unpublished draft. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database, Hartford, CT.

Metzler, K. J., and J. P. Barrett. 2001. Vegetation classification for Connecticut. Draft 5/21/2001. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database, Hartford, CT.

Metzler, K. J., and J. P. Barrett. 2004. Vegetation classification for Connecticut. Draft. State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, Hartford, CT.

Metzler, K., and J. Barrett. 1996. Vegetation classification for Connecticut organized into the modified UNESCO hierarchy. Unpublished review draft. Connecticut Natural Diversity Database. Hartford, CT. 48 pp.

Metzler, K., and R. Rosza. 1982. Vegetation of fresh and brackish tidal marshes in Connecticut. Newsletter of the Connecticut Botanical Society 10(1):1-3.

Midwestern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Minneapolis, MN.

Miller, W. R., and F. E. Egler. 1950. Vegetation of the Wequetequock-Pawcatuck tidal-marshes, Connecticut. Ecological Monographs 20:143-172.

Mitsch, W. J., and J. G. Gosselink. 1993. Wetlands. Second edition. Van Nostrand Reinhold Company, New York, NY. 722 pp.

Mohlenbrock, R. H. 1959. A floristic study of a southern Illinois swampy area. Ohio Journal of Science 59:89-100.

Monk, C. D., D. W. Imm, and R. L. Potter. 1990. Oak forests of eastern North America. Castanea 55(2):77-96.

Montague, C. L., and R. G. Wiegert. 1990. Salt marshes. Pages 481-516 in: R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, FL.

Moul, E. T. 1969. Flora of Monomoy Island, Massachusetts. Rhodora 71:18-28.

Moul, E. T. 1973. Marine flora and fauna of the northeastern United States: Higher plants of the marine fringe. USDC National Oceanographic and Atmospheric Administration. Technical Report NMFS CIRC-384. Seattle, WA. 61 pp.

Muldavin, E., B. Sims, and L. Johnson. 1993. Pecos Wild and Scenic River in stream flow report. Final Report prepared for the USDA National Forest Service, Santa Fe National Forest, Santa Fe, NM.

Muldavin, E., P. Durkin, M. Bradley, M. Stuever, and P. Mehlhop. 2000. Handbook of wetland vegetation communities of New Mexico: Classification and community descriptions (volume 1). Final report to the New Mexico Environment Department and the Environmental Protection Agency prepared by the New Mexico Natural Heritage Program, University of New Mexico, Albuquerque, NM.

NatureServe and E. Russell. 2003. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Great Swamp National Wildlife Refuge. NatureServe Central Databases. Arlington, VA. Data current as June 2003.

Nelson, B. W., and L. K. Fink. 1980. Geological and botanical features of sand beach in Maine. Bulletin No. 14. Maine Sea Grant Publications. 163 pp.

Nelson, J. B. 1986. The natural communities of South Carolina: Initial classification and description. South Carolina Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries, Columbia, SC. 55 pp.

Nelson, P. W. 1985. The terrestrial natural communities of Missouri. Missouri Natural Areas Committee, Jefferson City. 197 pp. Revised edition, 1987.

Newbold, A., J. Evert, and J. Holt. 1988. Rare plant and general flora survey of the White Clay Creek Park, Newcastle County, Delaware. 40 pp.

Nichols, G. E. 1920. The vegetation of Connecticut: III. The associations of depositing areas along the seacoast. Bulletin of the Torrey Botanical Club 47:511-548.

Nichols, W. F., J. M. Hoy, and D. D. Sperduto. 2001. Open riparian communities and riparian complexes in New Hampshire. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH. 82 pp. plus appendices.

Niering, W. A., R. H. Goodwin, and S. Taylor. 1970. Prescribed burning in southern New England. Introduction to long-range studies. Proceedings of the Tall Timbers Fire Ecology Conference 10:267-286.

Niering, W. A., and R. S. Warren. 1977. Our dynamic tidal marshes: Vegetation changes as revealed by peat analysis. The Connecticut Arboretum Bulletin 22.

Niering, W. A., and 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. USDI Fish and Wildlife Service. FWS/OBS-81/55. 70 pp.

Northern Appalachian Ecology Working Group. 2000. Northern Appalachian / Boreal Ecoregion community classification (Review Draft). The Nature Conservancy, Eastern Conservation Science Center, Boston, MA. 117 pp. plus appendices.

Nowacki, G. J., M. D. Abrams, and C. G. Lorimer. 1990. Composition, structure, and historical development of northern red oak stands along an edaphic gradient in north-central Wisconsin. Forest Science 36(2):276-292.

Oakley, S. C., H. E. LeGrand, Jr., and M. P. Schafale. 1995. An inventory of mafic natural areas in the North Carolina Piedmont. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh, NC. 252 pp.

Odum, W. E. 1988. Comparative ecology of tidal freshwater and salt marshes. Annual Review of Ecological Systems 19:147-176.

Odum, W. E., T. J. Smith, III, J. K. Hoover, and C. C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States east coast: A community profile. USDI Fish and Wildlife Service. FWS/OBS-83/17. 176 pp.

Odum, W. E., and T. J. Smith. 1981. Ecology of tidal, low salinity ecosystems. Pages 36-44 in: R. C. Carey, P. S. Markovits, and J. B. Kirkwood, editors. Proceedings of the workshop on coastal ecosystems of the southeastern United States. USDI Fish and Wildlife Service, Office of Biological Services. Report No. FWS/OBS-80/59. Washington, DC.

Oosting, H. J. 1942. An ecological analysis of the plant communities of Piedmont, North Carolina. The American Midland Naturalist 28:1-127.

Overlease, W. R. 1987. 150 years of vegetation change in Chester County, Pennsylvania. Bartonia 53:1-12.

Padgett, W. G. 1982. Ecology of riparian plant communities in southern Malheur National Forest. Unpublished thesis, Oregon State University, Corvallis, OR. 143 pp.

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service, Intermountain Region. Report R4-ECOL-89-01. Ogden, UT. 191 pp.

Patterson, Karen D. Personal communication. Ecologist, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Peet, R. K., T. R. Wentworth, M. P. Schafale, and A.S. Weakley. 2002. Unpublished data of the North Carolina Vegetation Survey. University of North Carolina, Chapel Hill, NC.

Penfound, W. T. 1952. Southern swamps and marshes. Botanical Review 7:413-446.

Perles, S. J., G. S. Podniesinski, E. A. Zimmerman, W. A. Millinor, L. A. Sneddon. 2006a. Vegetation classification and mapping at Fort Necessity National Battlefield. Technical Report NPS/NER/NRTR--2006/038. National Park Service, Philadelphia, PA.

Perles, S. J., G. S. Podniesinski, E. A. Zimmerman, W. A. Millinor, and L. A. Sneddon. 2006b. Vegetation classification and mapping at Friendship Hill National Historic Site. Technical Report NPS/NER/NRTR--2006/041. National Park Service, Philadelphia, PA.

Perles, S. J., G. S. Podniesinski, W. A. Millinor, and L. A. Sneddon. September 2006c. Vegetation classification and mapping at Gettysburg National Military Park and Eisenhower National Historic Park. Technical Report NPS/NER/NRTR--2006/058. National Park Service, Philadelphia, PA.

Perles, S. J., G. S. Podniesinski, E. Eastman, L. A. Sneddon, and S. C. Gawler. 2007. Classification and mapping of vegetation and fire fuel models at Delaware Water Gap National Recreation Area: Volume 2 of 2 -Appendix G. Technical Report NPS/NER/NRTR--2007/076. National Park Service, Philadelphia, PA.

Pregitzer, K. S., and B. V. Barnes. 1984. Classification and comparison of upland hardwood and conifer ecosystems of the Cyrus H. McCormick Experimental Forest, upper Michigan. Canadian Journal of Forest Research 14:362-375.

Rawinski, T. 1984. Natural community description abstract - southern New England calcareous seepage swamp. Unpublished report. The Nature Conservancy, Boston, MA. 6 pp.

Rawinski, T. J. 1992. A classification of Virginia's indigenous biotic communities: Vegetated terrestrial, palustrine, and estuarine community classes. Unpublished document. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report No. 92-21. Richmond, VA. 25 pp.

Redfield, A. C. 1972. Development of a New England salt marsh. Ecological Monographs 42(2):201-237.

Reschke, C. 1990. Ecological communities of New York State. New York Natural Heritage Program. New York State Department of Environmental Conservation. Latham, NY. 96 pp.

Robertson, P. A., M. D. MacKenzie, and L. F. Elliott. 1984. Gradient analysis and classification of the woody vegetation for four sites in southern Illinois and adjacent Missouri. Vegetatio 58:87-104.

Rosburg, T. R., and D. C. Glenn-Lewin. 1996. Species composition and environmental characteristics of grassland and ecotonal plant communities in the Loess Hills of western Iowa (USA). Natural Areas Journal 16:318-334.

Saltonstall, K. 2002. Cryptic invasion by a non-native genotype of the common reed, Phragmites australis, into North America. Proceedings of the National Academy of Science 99:2445-2449.

Sawyer, J. O., and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society, Sacramento, CA. 471 pp.

Schafale, M. 2000. Fourth approximation guide. Coastal Plain. January 2000 draft. North Carolina Natural Heritage Program, Raleigh, NC.

Schafale, M. 2003. Fourth approximation guide. Coastal Plain communities. March 2003 draft. North Carolina Natural Heritage Program, Raleigh, NC.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh, NC. 325 pp.

Schafale, Mike P. Personal communication. Ecologist, North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh, NC.

Schotz, Al. Personal communication. Community Ecologist. Alabama Natural Heritage Program. Huntingdon College, Massey Hall, 1500 East Fairview Avenue, Montgomery, AL 36106-2148.

Segadas-Vianna, F. 1951. A phytosociological and ecological study of cattail stands in Oakland County, Michigan. Journal of Ecology 39:316-329.

Servheen, C., and L. C. Lee. 1979. Mission Mountain grizzly bear studies, an interim report, 1976-1978. Border Grizzly Project, Montana Forest and Conservation Experiment Station, University of Montana, School of Forestry, Missoula, MT. 299 pp.

Shreve, F., M. A. Chrysler, F. H. Blodgett, and F. W. Besley. 1910. The plant life of Maryland. Maryland Weather Service. Special Publication, Volume III. Johns Hopkins Press. Baltimore, MD.

Simkins, E. C. 1931. The alpine flora of Mt. Niwot, Colorado. Unpublished thesis, University of Colorado, Boulder, CO. 68 pp.

Smith, L. M., compiler. 1996. Natural plant communities in Louisiana currently recognized by the Louisiana Natural Heritage Program. Unpublished document. Louisiana Department of Wildlife and Fisheries, Natural Heritage Program, Baton Rouge, LA. 2 pp.

Smith, T. L. 1991. Natural ecological communities of Pennsylvania. First revision. Unpublished report. Pennsylvania Science Office of The Nature Conservancy, Middletown, PA. 111 pp.

Sneddon, L. 1996. Report on the vegetation of Assateague Island National Park. Unpublished document. The Nature Conservancy, Boston, MA.

Sneddon, L. A., K. J. Metzler, and M. Anderson. 1995. A classification and description of natural community alliances and selected community elements of the Delaware Estuary. In: L. E. Dove and R. M. Nyman, editors. Living resources of the Delaware Estuary. The Delaware Estuary Program. 530 pp. plus appendices.

Sneddon, L., M. Anderson, and K. Metzler. 1994. A classification and description of terrestrial community alliances in The Nature Conservancy's Eastern Region: First approximation. Unpublished report to USDI Fish and Wildlife Service, Gap Analysis Program. The Nature Conservancy, Eastern Heritage Task Force, Boston, MA. 116 pp.

Sneddon, L., and J. Lundgren. 2001. Vegetation classification of Fire Island National Seashore and William Floyd Estate. Final Draft. TNC/ABI Vegetation Mapping Program. 87 pp.

Soil Conservation Service. 1987. Soil survey of Nassau County, New York. USDA Soil Conservation Service. 156 pp.

Southeastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Durham, NC.

Sperduto, D. 1994. A classification of the natural communities of New Hampshire. April 1994 approximation. Unpublished document. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development, Concord, NH. 45 pp. plus appendices.

Sperduto, D. D. 1997a. The natural communities of New Hampshire: A guide and classification. The New Hampshire Natural Heritage Inventory, Concord, NH. 126 pp.

Sperduto, D. D. 1997b. A preliminary classification of natural communities in the New Hampshire Coastal Lowlands Ecoregion. NH Natural Heritage Inventory / The Nature Conservancy, Division of Forests and Lands, Department of Resources and Economic Development, Concord, NH.

Sperduto, D. D. 2000a. Natural communities of New Hampshire: A guide and classification. Near final unformatted draft without pictures and illustrations; includes upland classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH. 127 pp.

Sperduto, D. D. 2000b. A classification of wetland natural communities in New Hampshire. New Hampshire Natural Heritage Inventory, Department of Resources and Economic Development, Division of Forests and Lands. Concord, NH. 156 pp.

Sperduto, D. D., and W. F. Nichols. 2004. Natural communities of New Hampshire: A guide and classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH. 242 pp.

Stalter, R. 1979. The major plant communities of the Fire Island National Seashore. Pages 177-181 in: R. M. Linn, editor. Proceedings of the first conference on Scientific Research in the National Parks. USDI National Park Service, Washington, DC.

Stalter, R. 1990. The vascular flora of Assateague Island, Virginia. Bulletin of the Torrey Botanical Club 117:48-56.

Steinauer, G., and S. Rolfsmeier. 2000. Terrestrial natural communities of Nebraska. Unpublished report of the Nebraska Game and Parks Commission. Lincoln, NE. 143 pp.

Steury, B. W. 1999. Annotated list of vascular plants from a nontidal barrier wetland along the Chesapeake Bay in Calvert County, Maryland. Castanea 64(2):187-200.

Steyermark, J. A. 1940. Studies of the vegetation of Missouri. I. Natural plant associations and succession in the Ozarks of Missouri. Field Museum of Natural History Botany Series 9:349-475.

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.

Swain, P. C., and J. B. Kearsley. 2000. Classification of natural communities of Massachusetts. July 2000 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

Swain, P. C., and J. B. Kearsley. 2001. Classification of natural communities of Massachusetts. September 2001 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

TDNH [Tennessee Division of Natural Heritage]. No date. Unpublished data. Tennessee Division of Natural Heritage, 14th Floor, L&C Tower, 401 Church Street, Nashville, TN 37243-0447. 615-532-0431

TNC [The Nature Conservancy]. 1995a. Element Stewardship Abstract for North American cattails. The Nature Conservancy, Arlington, VA. 16 pp.

TNC [The Nature Conservancy]. 1995b. NBS/NPS Vegetation Mapping Program: Vegetation classification of Assateague Island National Seashore. Unpublished report. The Nature Conservancy, Eastern Regional Office, Boston, MA.

TNC [The Nature Conservancy]. 1995c. Unpublished data collected from Block Island, Rhode Island. The Nature Conservancy, Eastern Heritage Task Force, Boston, MA.

Teal, J. M. 1986. The ecology of regularly flooded salt marshes of New England: A community profile. Department of Interior, U.S. Fish and Wildlife Service, Washington, DC. Biological Report 85(7.4). 61 pp.

Thompson, E. 1996. Natural communities of Vermont uplands and wetland. Nongame and Natural Heritage Program, Department of Fish and Wildlife in cooperation with The Nature Conservancy, Vermont chapter. 34 pp.

Thompson, E. H., and E. R. Sorenson. 2000. Wetland, woodland, wildland: A guide to the natural communities of Vermont. The Nature Conservancy and the Vermont Department of Fish and Wildlife. University Press of New England, Hanover, NH. 456 pp.

Thompson, E., and J. Jenkins. 1992. Summary of field data from Minuteman National Park plant communities study. A report prepared under a contract with the Massachusetts Natural Heritage and Endangered Species Program for the National Park Service. 39 pp.

Thorne-Miller, B., M. M. Harlin, G. B. Thursby, M. M. Brady-Campbell, and B. A. Dworetsky. 1983. Variations in the distribution and biomass of submerged macrophytes in five coastal lagoons in Rhode Island, USA. Botanica Marina 26:231-242.

Tiner, R. W., Jr. 1977. An inventory of South Carolina's coastal marshes. South Carolina Marine Resources Center. Technical Report 23. Columbia, SC. 33 pp.

Tiner, R. W., Jr. 1984. Wetlands of the United States: Current status and recent trends. USDI Fish and Wildlife Service, National Wetlands Inventory 59 pp.

Tiner, R. W., Jr. 1985a. Wetlands of Delaware. Cooperative publication of USDI Fish and Wildlife Service, National Wetlands Inventory, Newton Corner, MA, and Delaware Department of Natural Resources and Environmental Control, Dover, DE. 77 pp.

Tiner, R. W., Jr. 1985b. Wetlands of New Jersey. USDI Fish and Wildlife Service, National Wetlands Inventory, Newton Corner, MA. 117 pp.

Tolstead, W. L. 1942. Vegetation of the northern part of Cherry County, Nebraska. Ecological Monographs 12(3):257-292.

Travis, R. W., and P. J. Godfrey. 1976. Interactions of plant communities and oceanic overwash on the manipulated barrier islands of Cape Hatteras National Seashore, North Carolina. Pages 777-780 in: Proceedings of the First Conference on Scientific Research in the National Parks, Volume II.

Tyrrell, L. E. 1987. A floristic survey of buttonbrush swamps in Gahanna Woods State Nature Preserve, Franklin County, Ohio. The Michigan Botanist 26(1):29-36.

USDA-USFS [U.S. Department of Agriculture, U.S. Forest Service]. 1994. Field guide to the ecological classification and inventory system of the Huron-Manistee national forests. USDA Forest Service.

USDA-NRCS [U.S. Department of Agriculture, Natural Resources Conservation Service]. 2001. Soil survey of Gateway National Recreation Area, New York and New Jersey. USDA Natural Resources Conservation Service and USDI National Park Service, Gateway National Recreation Area in partnership with Cornell University Agricultural Experiment Station and New York City Soil and Water Conservation District.

USDA-NRCS [U.S. Department of Agriculture, Natural Resources Conservation Service]. 2004. Soil survey of Saratoga County, New York. USDA Natural Resources Conservation Service. 590 pp.

Vanderhorst, J. P., B. P. Streets, J. Jeuck, and S. C. Gawler. 2008. Vegetation classification and mapping of Bluestone National Scenic River, West Virginia. Technical Report NPS/NER/NRTR-2008/106. National Park Service. Philadelphia, PA.

Voigt, J. W., and R. H. Mohlenbrock. 1964. Plant communities of southern Illinois. Southern Illinois University Press, Carbondale, IL. 202 pp.

Walz, K. S., K. H. Anderson, L. C. Kelly, A. G. Windisch, and M. C. Wong. 2008. New Jersey ecological community crosswalk: A tool for the identification of habitats across jurisdictional boundaries. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ.

Webber, E. E. 1967. Bluegreen algae from a Massachusetts salt marsh. Bulletin of the Torrey Botanical Club 94:99-106.

Welsh, B. L. 1980. Comparative nutrient dynamics of a marsh-mudflat ecosystem. Estuarine Coastal and Marine Science 10:143-164.

Western Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boulder, CO.

Wharton, C. H. 1978. The natural environments of Georgia. Georgia Department of Natural Resources, Atlanta, GA. 227 pp.

Whitlatch, R. B. 1982. The ecology of New England tidal flats: A community profile. USDI, U.S. Fish and Wildlife Service, Biological Services Program, Washington, DC. FWS/OBS-81/01. 125 pp.

Wieland, R. G. 1994a. Marine and estuarine habitat types and associated ecological communities of the Mississippi Coast. Mississippi Department of Wildlife, Fisheries, and Parks. Museum of Natural Science. Museum Technical Report 25. Jackson, MS. 270 pp.

Wieland, R. G. 1994b. Mississippi Natural Heritage Program: Ecological communities. Unpublished document. Mississippi Department of Wildlife, Fisheries, and Parks, Museum of Natural Science, Natural Heritage Program, Jackson, MS. 7 pp.

Williams, C. K., and B. G. Smith. 1990. Forested plant associations of the Wenatchee National Forest. Unpublished draft prepared by the USDA Forest Service, Pacific Northwest Region, Portland, OR. 217 pp.

Williams, C. K., and T. R. Lillybridge. 1983. Forested plant associations of the Okanogan National Forest. USDA Forest Service, Pacific Northwest Region. R6-Ecol-132b-1983. 140 pp.

Wolfe, S. H., editor. 1990. An ecological characterization of the Florida Springs Coast: Pithlachascotee to Waccasassa rivers. USDI Fish and Wildlife Service, Biological Report 90(21). Slidell, LA. 323 pp.

Wyckoff, P. H., and S. L. Webb. 1996. Understory influence of the invasive Norway maple (Acer platanoides). Bulletin of the Torrey Botanical Club 123:197-205.

Young, J., G. Fleming, P. Townsend, and J. Foster. 2006. Vegetation of Shenandoah National Park in relation to environmental gradients. Final Report v.1.1. Research technical report prepared for USDI, National Park Service. USGS/NPS Vegetation Mapping Program. 92 pp. plus appendices.

Youngblood, A. P., W. G. Padgett, and A. H. Winward. 1985. Riparian community type classification of eastern Idaho-western Wyoming. USDA Forest Service, Intermountain Region. R4-Ecol-85-01. Ogden, UT. 78 pp.

Zaremba, R. E. 1999. Memorandum: Basic notes on coastal salt ponds. Written summer 1999 for M. Jordan, Long Island Chapter, The Nature Conservancy.

Zaremba, R. E., and S. P. Leatherman. 1984. Overwash processes and foredune ecology, Nauset Spit, Massachusetts. Miscellaneous Paper EL-84-8. Prepared by Massachusetts Audubon Society and University of Massachusetts under cooperative agreement between USDI National Park Service, North Atlantic Region, Boston, MA, and the U.S. Army Corps of Engineering Research Center. Published by U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 232 pp.

Zollner, Douglas. Personal communication. Ecologist, The Nature Conservancy, Arkansas Field Office, Little Rock, AR.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 035/140366, October 2017

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov