

## I. Introduction

### Overview

Sandplain grasslands of the northeastern U.S. are iconic hotspots for biodiversity and important conservation priorities because of their relative rarity, limited geographical range, and the diversity of uncommon plant and animal species that they support. Sandplain grasslands reach their greatest extent on dry, sandy soils on coastal outwash deposits, which formed following the retreat of the southernmost extension of the Wisconsin ice sheets from Long Island to Cape Cod, including the Massachusetts islands of Martha's Vineyard and Nantucket (Fig. 1). Additional but generally smaller areas of grasslands that have vegetation similar to that on the coastal outwash plain occur in pockets of level, sandy soils farther inland in Rhode Island, southern New Hampshire, Albany, New York, the Connecticut River Valley and on some hillier and rocker soils near the coast in southeastern Massachusetts.

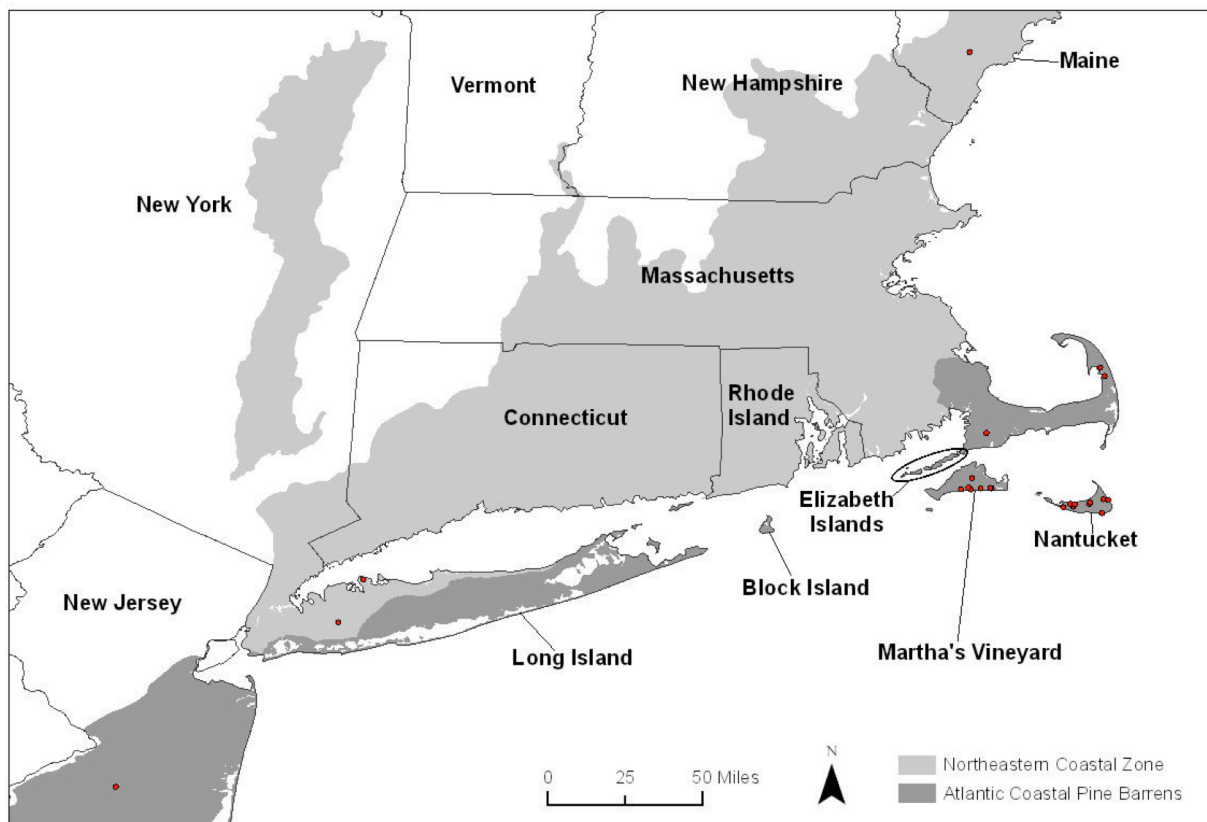


Figure 1. Map of the Atlantic Coastal Pine Barrens Region in which most sandplain grasslands occur, and the Northeastern Coastal Zone within which isolated pockets of sandplain grasslands also occur. Red dots indicate sites from which management experiences and case histories were drawn in this document.

Many widely-distributed plant species adapted to droughty, nutrient-poor soils attain their greatest abundance on open lands of the coastal sandplain. Examples of these species include little bluestem (*Schizachyrium scoparium*), Pennsylvania sedge (*Carex pensylvanica*), red fescue

(*Festuca rubra*), poverty grass (*Danthonia spicata*), wild indigo (*Baptisa tinctorum*), stiff aster (*Ionactis linariifolia*), and bearberry (*Arctostaphylos uva-ursi*), intermixed with widespread shrubs such as black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*) and small bayberry (*Morella caroliniensis*). Sandplain grasslands contain more than 20 plant species that are listed as endangered, threatened, of special concern, or exist on state watch lists because they may become threatened. These include sandplain gerardia (*Agalinis acuta*), Nantucket shadbush (*Amalanchier nantucketensis*), sandplain blue-eyed grass (*Sisyrinchium fuscatum*), eastern silvery aster (*Symphotrichum concolor*), purple needlegrass (*Aristida purpurascens*), purple milkweed (*Asclepias purpurascens*), and butterfly weed (*Asclepias tuberosa*). Sandplain grasslands support regionally uncommon grassland birds such as grasshopper sparrows (*Ammodramus savannarum*), savanna sparrows (*Passerculus sandwichensis*), eastern meadowlarks (*Sturnella magna*), American kestrels (*Falco sparverius*), northern harriers (*Circus hudsonius*), short-eared owls (*Asio flammeus*) and barn owls (*Tyto alba*). All of these species are uncommon or declining in the northeast. Sandplain grasslands also support a variety of moth and butterfly species such as the chain dot geometer (*Cingilla catenaria*), tiger moths (*Grammia oithona*, *G. phyllira*) and the frosted elfin (*Callophrys irus*).

Most sandplain grasslands owe their origin to land clearing and grazing that occurred in the northeast U.S. following European colonization. Smaller areas of land very near the coast probably formed a mosaic of shrubby or grassy vegetation patches, maintained in different stages of succession by the disturbances of wind, salt spray, and fires set by indigenous people, whose populations reached their greatest numbers near the coast. Grasslands expanded greatly during the expansion of agriculture and particularly animal grazing that followed European post-settlement and reached their greatest extent in the mid-1800s (Foster 2017). Frequent wildfires occurred during a period of abandonment of agriculture and subsequent forest regrowth, lasting until roughly the time of World War II, when the residential development for vacation homes began to increase (Foster and Motzkin 1999b). These fires helped prolong the existence of grasslands and associated disturbance-dependent shrublands.

While never the dominant coastal vegetation before European colonization, sandplain grasslands and interspersed shrublands were important reservoirs of the region's biodiversity. Grasslands reached their greatest extent on Cape Cod, and on the islands of Martha's Vineyard, Nantucket, and Long Island. Today, the area covered by grasslands is declining sharply as a result of residential development, fire suppression, abandonment of agriculture and widespread regrowth of woody vegetation. More than 90% of the coastal grasslands and related heathlands that were widespread in the northeastern U.S during the mid-19th century have been lost and this ecosystem now ranks among the northeast U.S.'s most imperiled.

#### *Need for Active Management*

Sandplain grasslands require active vegetation management by periodic disturbance to arrest secondary succession to shrublands and woodlands and to maintain, promote, or restore particular species of conservation concern. Managers concerned with the persistence of grasslands and biodiversity have two main challenges. One is to preserve and enhance existing grasslands in key places where they can be actively managed. The other is to develop approaches to creating new sandplain grasslands, either from places that supported them in

the past, or from other types of ecosystems, such as woodlands or agricultural lands, in places where conditions are similar to those in extant grasslands. Such "new" sandplain grasslands could add to the total regional grassland area or replace previous grasslands lost to residential or other development, shoreline erosion, or succession to woodland in hard-to-manage locations. Both approaches are important, but different, and add to the complexity and challenge of regional sandplain grassland management.

Land managers have a number of potential options for managing for disturbances in existing sandplain grasslands. The main tools in sandplain grassland managers' collective toolbox are: prescribed fire, mowing, grazing, and vegetation removal (by either mechanical or chemical treatments). Each method has ecological benefits and potential drawbacks. Each also has different challenges for implementation, especially for the frequency at which disturbances are desired. Additionally, each method has a large number of potential associated influential variations that include seasonal timing, frequency, weather and climate conditions, composition and structure of existing vegetation, type of animals, and other factors. For example, prescribed burning can effectively prevent encroachment of woody plants and increase the density of some target, rare sandplain forbs. However, this method can be much less effective in restoring grassland and heathland vegetation to areas where second-growth oak and pine forests are well established, because many woody plants regrow vigorously from rootstocks. Mowing or chemical treatments can be alternatives to prescribed fire and can more predictably be used in cases where adjacent land use or local/regional concerns about fire risk and air pollution make use of fire less feasible. A return to a historic method, the use of grazing animals, could potentially play a greater role in grassland maintenance and management.

Options for creating new sandplain grasslands vary depending on whether existing land is shrubland or woodland, or open and agricultural. Creating sandplain grasslands from shrublands and woodlands involves tree clearing, establishment of grassland vegetation, and managing aggressive woody regrowth. Creating grasslands from former agricultural land often requires eliminating or greatly reducing the existing predominantly non-native invasive weeds and cool season grasses, and potentially undoing soil conditions such as high pH, created by previous agricultural use that can favor non-native over native species.

### *Pathways to Better Management*

While conservation ownership now protects a majority of the region's remaining large grasslands, many critical management challenges remain. One common challenge is that woody vegetation is expanding into grasslands across the region. A second is that many rare grassland-dependent plant and animal species continue to decline on many properties. A third challenge is the spread of non-native plant species into sandplain grasslands from surrounding lands. Lastly, all sandplain grasslands must now be managed in ways that consider the effects of rapid changes in and disruptions to climate. Most of these challenges occur widely and have common threads across the northeast region.

Although some sandplain grassland managers have experience from sandplain grasslands across a wide geographical region, there are also many that do not. Many managers have experience with some management tools, like fire, but have not attempted others, such as

grazing. Although some of the information on the outcomes of sandplain grassland management actions or experiments is published in the scientific literature, much is either in other reports and "gray" literature. Some of this information is largely unwritten in any form, but resides in the experience of individual land managers and management practitioners. There could be great of value to managers and practitioners by the distribution of information on both the successes and failures of sandplain grassland management experiences.

These challenges and the desire to share lessons learned from management experiences motivated managers to meet in April 2016 and form a Sandplain Grassland Network. This meeting took place at the Marine Biological Laboratory in Woods Hole, MA. At that meeting, the Network committed to an activity designed to: (1) capture management experiences across the region, and (2) to disseminate this information. The group wanted the activity to review what we now know about different approaches to management and make available out-of-print and hard-to-get reports and other sources of detailed information. The activity would also point to management actions that might not have been previously tested—but should be. It would recommend approaches to improving monitoring of sites and management actions or experiments that are separated geographically and temporally. Lastly, it would recommend approaches to management that collective experience suggests will foster grasslands and the biodiversity they support in the face of continued pressures of expanding human land use and a changing climate.

This web-based document is the result of that activity. It was produced by assembling and evaluating dozens of publications and reports provided by managers and practitioners. It is based on that literature, but also on more than 40 in-person and phone interviews with managers.

### *Organization of this Document*

This document is organized into five main sections, designed to help managers find and use information that helps them to sustain sandplain grasslands and their associated biodiversity (Fig. 2).

Section 1 addresses experiences with management that was designed to maintain or enhance current sandplain grassland areas. Chapter 1.1 in this section describes experiences with the use of prescribed fire in existing grasslands. Chapter 1.2 describes experiences with the use of mowing in existing grasslands. Chapter 1.3 covers experiences with vegetation removal of woody and non-native, invasive, or undesired vegetation in existing grasslands. Chapter 1.4 addresses experiences with the use of grazing animals to either maintain existing sandplain grasslands or reduce shrub cover in areas in which more grass- and forb-dominated vegetation is desired.

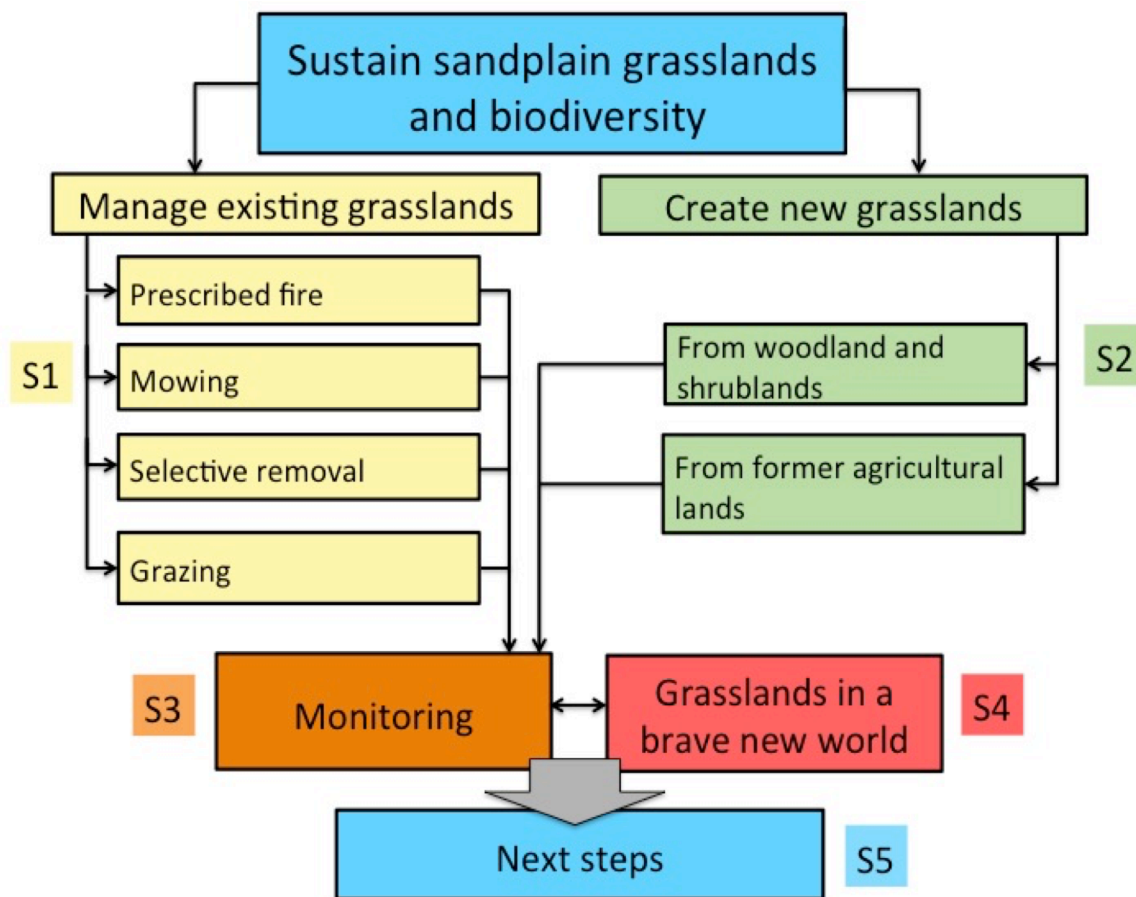


Figure 2. Organization of this document into sections (S1 to S5) that address management of existing grasslands, creation of new grasslands, monitoring, effects of future climate and land use, and next management steps.

Section 2 addresses experiences with actions designed to create or expand sandplain grasslands into areas that are currently not grasslands. Chapter 2.1 in this section covers experiences with forest or shrubland clearing to expand sandplain grasslands. Chapter 2.2 describes experiences with the creation of sandplain grasslands on former agricultural lands.

Section 3 outlines a regional approach to vegetation monitoring and improving the rigor with which grassland management actions are evaluated.

Section 4 describes the new issues that sandplain grassland managers now must contend with in the "brave new world," created by the combination of climate change, increased human population, and use of the landscapes in which sandplain grasslands are now embedded in the northeast U.S.

Section 5 describes new management approaches and experiments that this review suggests would allow more effective management of sandplain grasslands and their biodiversity in the future.

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Sections 1 and 2 contain detailed case histories. These are descriptions, from specific places, where lessons can be learned from particularly well-documented outcomes of past management.

## References

Foster, D.R. 2017. A meeting of land and sea: Nature and the future of Martha's Vineyard. Yale University Press.

Foster, D.R., & Motzkin, G. 1999. Historical influences on the landscape of Martha's Vineyard: perspectives on the management of the Manuel F. Correllus State Forest. Harvard University, Harvard Forest.