Prescribed Fire Science Research and Management at Head of the Plains, Nantucket Island, MA

Department of Science and Stewardship; Nantucket Conservation Foundation
P.O. Box 13, Nantucket, MA 02554-0013; Phone 508-228-2884
Contact: Karen Beattie, Science and Stewardship Department Manager
kbeattie@nantucketconservation.org

Background

Property Description: The NCF's Head of the Plains properties are located in the southwestern portion of Nantucket Island, Massachusetts. The site consists of a relatively flat, outwash plain bordered by the Atlantic Ocean to the south. The two dominant soils types are Riverhead Sandy Loam and Evesboro Sand, which occur in approximately equal amounts. NCF has managed the Head of the Plains property primarily as protected, undeveloped open space that is open to the public for passive recreation activities.

Past Land Use: The south shore of Nantucket, including Head of the Plains, was held in common ownership following European settlement and subjected to intense sheep grazing for several hundred years. The extensive patches of early successional sandplain grassland, heathland and scrub oak barren habitats currently present in this area of the island are likely indicative of historical prolonged grazing and other disturbances such as wind and salt spray. Between 1943 and 1946, Head of the Plains and the surrounding area was acquired by the Department of Defense and used as a practice range for aerial bombing.

Current Vegetation Communities: the dominant upland vegetation communities present are as follows: sandplain grassland (~26 acres), sandplain heathland (~246 acres), open scrub oak shrubland (~60 acres), closed scrub oak shrubland (~36 acres), pitch-pine mixed shrub woodland (~17 acres), and coastal shrubland (~13 acres). Acreage estimates are based on interpretation of 1991 aerial photography (the most recent available); woody shrub cover is known to have increased since then, with a corresponding decrease in open grassland habitat.

Management: Various vegetation management techniques have been utilized at Head of the Plains since 1994, including prescribed fire, annual mowing, brushcutting, and selective pine removal. This work has been undertaken to maintain existing grassland and heathland and reduce wildfire risk.

Rare species: The following state-listed plant species have been documented in upland habitats at Head of the Plains within the last five years:

Species	Common Name	State Status
Scleria pauciflora var. caroliniana	Papillose nut-sedge	E
Liatris scariosa var. novae-anglia	New England blazing star	SC
Linum intercursum	Sandplain flax	SC
Sisyrinchium fuscatum	Sand-plain blue-eyed grass	SC

The following state-listed wildlife species have been documented in upland habitats at Head of the Plains within the last ten years:

Species	Species Type	Common Name	State Status
Acronicta albarufa	Moth	Barrens daggermoth	T
Abagrotis nefascia	Moth	Coastal heathlands cutworm	SC
Anisota stigma	Moth	Spiny oakworm	SC
Cingilia catenaria	Moth	Chain-dotted geometer	SC
Circus cyaneus	Bird of prey	Northern harrier	T

Non-native, Invasive Plant Species: Overall, known populations of non-native, invasive species at Head of the Plains are relatively small and manageable. Populations of Japanese black pine (*Pinus thunbergiana*), common reed (*Phragmites australis*), Chinese silvergrass (*Miscanthus sinensis*), bush honeysuckle (*Lonicera* sp.) and spotted knapweed (*Centaurea stoebe* (= *maculosa*)) have been inventoried and are currently under management.

Projects Conducted and Completed (2007-2015)

Research on the Impacts of Prescribed Fire on Rare Vegetation Communities

Overview:
In 2005, Science and Stewardship Department staff initiated a comprehensive research project aimed at documenting the effectiveness of prescribed fire in maintaining globally rare sandplain grasslands and heathlands at Head of the Plains. Prescribed fire is a key management tool for these early successional habitats, although the effectiveness of prescribed fire at maintaining ecological function by reducing encroachment by woody species had not been effectively examined. Efforts to restore or create sandplain grassland and coastal heathland communities from shrub dominated areas have seen limited success, placing high conservation priority on preventing existing grasslands and heathlands from succeeding to woody-dominated habitats. This research project compared the effectiveness of dormant season (spring and fall) and growing season (late summer) prescribed fire as a tool for maintaining existing sandplain grassland communities and reducing the cover of woody species in coastal heathland habitat adjacent to existing grasslands.

Methods Summary:
In areas not recently burned, 9 15-acre prescribed burn management units were designated for this research project. Randomly established and permanently marked vegetation community monitoring plots were sampled both prior to prescribed fire and 5 growing seasons post-fire. Attempts were made to burn one research unit during the growing season prior to September 30th, one during the fall dormant season after October 15th (provided there had been a hard frost), and one during the spring dormant season prior to March 15th. A total of five units were treated with prescribed fire between September 2005 and November 2006: one during the growing season, two during the spring, and two during the fall. The remaining units were unable to be treated due to a number of prescribed fire implementation limitations and issues. In addition to vegetation community response to fire, environmental conditions and fire dynamics and severity were also monitored.

Results:
Due to the inherent pre-burn vegetation variability in each of the research units and environmental variability between multiple treatment years combined with the smaller than expected number of units treated (as described above), the influence of seasonality on woody species could not be examined. However, all research units experienced a large decrease in the cover of woody species immediately post-burn and an increase in grassland associated species in the first one to two years post-burn. In units dominated by woody heathland-associated species, prescribed fire did not dramatically increase the cover of grassland associated species. Units with more mixed vegetation composition showed an initial decrease in woody species, but this quickly turned to a trajectory of increased heathland species five years post-burn.

Future Recommendations:
Results indicate that a five year burn interval window appears appropriate to maintain current levels of woody species. However, management implemented at this burn interval will not likely decrease the cover of woody species. Further research on either more frequent prescribed fire treatments or a combination of management tools may provide a mechanism for woody species reduction. There is some evidence that a single burn may increase the reproduction of some grass species but decrease their abundance over a short time period. The influence of repeated burning on grassland species over time is unclear and should also be explored through further research.

Reports and Publications:
2014. Karberg, J.M. *Prescribed Fire Management in Sandplain grasslands and heathlands: Impacts of Burn Seasonality and Intensity on Vegetation Composition, Head of the Plains, Nantucket MA.* Final Project Report.
A paper for professional journal publication is currently in production.

Research on the Impacts of Prescribed Fire on Key Rare Species

Overview:
In conjunction with the vegetation community research project described above, the impacts of prescribed fire on key rare plant species were monitored either within established monitoring plots (for more locally-abundant species) or across the property (for less locally-abundant species). Analysis of the data from this long term project will provide a better understanding of the direct effects of prescribed fire on each species as well as the long term effects on overall population dynamics.

Methods Summary:
In 2005, intensive surveys within the prescribed fire management area were conducted to document known or suspected rare species. Populations of six rare species were documented: sandplain flax, New England blazing star, bushy rockrose, sandplain blue-eyed grass, papillose nut-sedge, and Nantucket shadbush. Sandplain flax and papillose nut-sedge populations were found in isolated populations across Head of the Plains, so property-wide annual surveys were conducted for these species. Bushy rockrose, sandplain blue-eyed grass and New England blazing star were locally-abundant, so surveys were restricted to permanent monitoring plots. Nantucket shadbush is addressed in a separate research project described below. Populations were monitored annually to examine both changes in population dynamics as well as responses to prescribed fire as applied in the previously-described research project. Since the initiation of this project, the Massachusetts Natural Heritage and Endangered Species Program has de-listed Nantucket shadbush and begun the process of de-listing bushy rockrose and sandplain flax.

Results:
The results of this project are still being analyzed. In general, populations of these rare plants increased immediately post-burn. While prescribed fire increased the density of individuals within already colonized areas, it did not appear to increase the area covered by the populations.

Future Recommendations:
Species that are still state-listed should be re-surveyed using comparable methodology once every 5-7 years in order to document long-term population trends and responses to any management undertaken.

Reports and Publications:
Under production.

Research on the Response of Nantucket Shadbush to Prescribed Fire

Overview:
Nantucket shadbush is a regionally-rare low-growing, deciduous, clonal shrub. This species was generally known to respond well to periodic disturbances such as brush-cutting or prescribed fire, which reduces the height of competing vegetation. NCF's Science and Stewardship Department examined the long-term effects of fire management on this species at Head of the Plains. Similar research was also conducted on the effects of brushcutting on this species at a different site (the Foundation's Trots Hills property, approximately one mile northeast of Head of the Plains). In 2011, the Massachusetts Natural Heritage and Endangered Species Program de-listed Nantucket shadbush. However, it was still listed a "Species of Special Concern" when this prescribed fire research and management project was initiated.

Methods Summary:

Permanently-marked plots were established within clonal Nantucket shadbush patches and monitored over time pre and post-prescribed fire treatment at Head of the Plains, with identical data collected in untreated control patches.
Results: Vigorous re-sprouting of Nantucket shadbush stems appeared to be the primary, immediate benefit of fire. The plant survived the application of fire, tolerated both spring and fall burns and appears to require a relatively long time frame for recovery to pre-burn conditions (~4-5 years).
Future Recommendations: This species is currently local abundant on Nantucket, but relatively uncommon elsewhere. It relies on periodic management for population health. Therefore, lack of management or a change in the management regime could lead to rapid declines in this species. Management in areas containing Nantucket shadbush should occur on a 4-5 year return interval. This species is also linked to particular guilds of native bees, making it an important component to retain within coastal sandplain grassland and heathland habitats.
Reports and Publications: 2014. Omand, K.A. Head of the Plains Nantucket Shadbush (*Amelanchier nantucketensis)* Response to Prescribed Fire Management, Final Report 2014. ***This is a currently unpublished report that may be revised and submitted for future publication.***