

Whitney Wallett

Barrens Habitat Restoration Plan

Abstract The purpose of this project was to develop a well-defined and formally documented restoration plan to reorganize, rejuvenate, and promote the future success of the HBS barrens restoration effort.

Introduction

Prior to European settlement, prairie-like grasslands extended over more than 162 million hectares of the North American continent (Samson and Knopf 1994). However, major agricultural conversion, the elimination of large herbivores, and fire suppression that accompanied settlement led to the decline of as much as 85-99% of these systems (Samson and Knopf 1994, Barnes 2002). Much interest exists in conserving or restoring the remaining fragments of these grasslands to mitigate the consequences of their degradation or loss.

Hancock Biological Station, and thereby Murray State University, possesses a potential site for barrens grassland restoration. Dr. Dick Marzolf, formerly associated with the Hancock Biological Station, identified several indicator species on the site in the late 1980s. A restoration attempt

was initiated in 1989, and consisted of mechanical removal of woody vegetation followed by prescribed burning. Since this initial work, prescribed fire has been applied to the site in March or early April on an approximate 2-3 year rotation. No formal documentation or monitoring of the results of this restoration attempt has occurred, and efforts have achieved only limited success to date.

Ecological Restoration & Planning

Ecological restoration is defined as “the process of assisting the recovery and management of ecological integrity” (SER 2004) with the aim to “fully restore the components and processes of a damaged site or ecosystem to a previous historical state, to a contemporary standard, or to a desired future condition” (Gayton 2001). Restoration begins as goals, objectives, and management strategies are developed from prior knowledge of the site and research of similar projects (Douglas 2002). Management strategies are then implemented and their outcomes monitored to allow for comparison to prior/desired future conditions and evaluation of overall efficacy. Upon evaluation, recurring management strategies are modified, adapted, and reevaluated as necessary to achieve restoration goals and objectives and promote future success (Douglas 2002).

Methods

Restoration Plan Development

Historical accounts and contemporary scientific literature concerning barrens and grassland restoration were reviewed to identify the nature, origin, and previous extent of barrens vegetation, as well as the management strategies or techniques used to maintain or restore similar habitats today (e.g. tallgrass prairie). A similar



Figure 1: Map (top) and aerial photographs (middle), and on-site photograph (bottom) detailing the location of the HBS restoration site.

review of literature concerning the settlement of the Jackson Purchase region was used to propose a land use history specific to the HBS site. Lastly, research was conducted to identify the organizations responsible for conducting similar restoration projects throughout the state of Kentucky. Once identified, these organizations (e.g., The Nature Conservancy (TNC) and University of Kentucky) were contacted to gain further insight into barrens ecosystems and the management strategies employed for their restoration.

Results

HBS-TNC Site Comparison

To assess the success of prior restoration efforts and describe the site's current vegetative condition, the HBS site was compared to three similar KY restorations – Mantle Rock Preserve, the Reynold's tract, and the Perkin's tract - managed by The Nature Conservancy (TNC) (Fig. 2). All three sites are located in Livingston County, KY, but vary in terms of total acreage, previous land use history, and duration of restoration efforts.

The average percent cover of total vegetation and each of five plant functional groups – gramminoids, forbs, cryptogams, shrubs/vines, and trees – were estimated within

5-10 1 m² sampling quadrats at each site in late March and early April 2014 (Fig. 2). Statistical analysis was conducted to identify significant differences in the average percent cover values between sites.

The average total percent cover of sampling quadrats ranged from 60-86.25% across the HBS site. Gramminoid species were most abundant, followed by cryptogams, forbs, shrubs/vines, and trees respectively (Table 1).

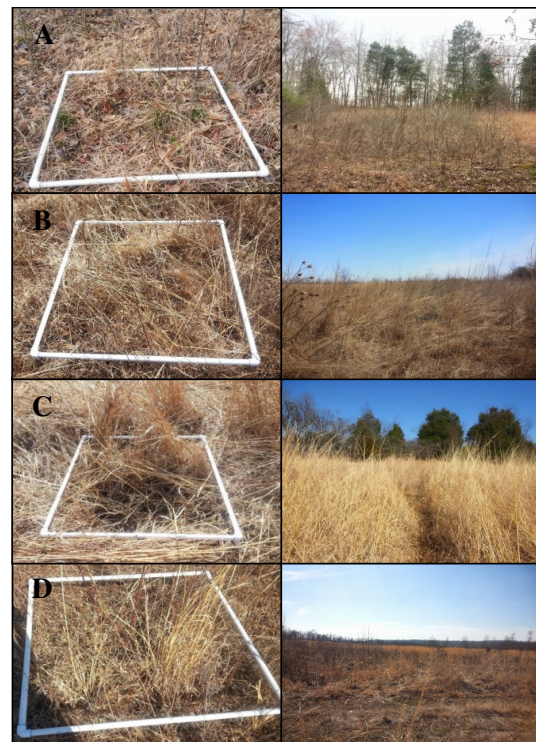


Figure 2: The vegetation typical within sampling quadrats and across each restoration site (A – HBS site; B- Mantle Rock Preserve; C – Reynold's tract; D – Perkin's Tract South)

Table 1: The mean average percent cover of total vegetation and each of five functional groups for the HBS restoration site and the three Livingston County sites used for comparison.

Restoration Site	Mean Average Percent Cover Values					
	Total	Gramminoids	Forbs	Cryptogams	Shrubs/vines	Trees
HBS	74.29	32.93	12.21	15.57	7.32	5.43
Mantle Rock	74.63	49.25	12.08	3.05	5.15	1.50
Reynold's Tract	61.88	48.25	6.25	5.65	1.25	0.38
Perkin's Tract S.	88.75	52.50	14.95	2.75	15.75	1.85

No significant differences occurred in the average percent cover of forbs or gramminoids between sites. The HBS site's average total percent cover was significantly lower than that of the Perkin's tract, significantly higher than that of the Reynold's site, and comparable to that of the MRP. This trend was mirrored by the average percent cover of shrubs/vines between the four sites (Fig. 3).

The HBS site had significantly higher cryptogam and tree cover than the MRP (Fig. 3), reflecting the relatively lower herbaceous density and substantial woody encroachment that is apparent on the site. As both sites have undergone 20+ years of similar management, this suggests that the HBS restoration effort has been less effective than the MRP project to date.

The HBS site did not differ significantly

from the Perkin's or Reynold's tract in terms of any functional group (Fig. 3). The Perkin's tract previously supported a loblolly pine plantation, and as a result, has required greater transition to native barrens vegetation. As restoration on the site began relatively recently (~ 8 years ago), the site remains subject to substantial woody encroachment and largely in flux between forest and grassland habitat types. Likewise, the Reynold's tract has undergone only recent restoration (~7 years), and its conditions are similar but not yet equivalent to those of the MRP. As the percent cover of functional groups did not differ significantly between the HBS and Perkin's or Reynold's tracts, HBS seemingly remains in similar flux between the two vegetative types. The HBS site exists in a state of restoration intermediate of the still-degraded Perkin's tract and more successful MRP.

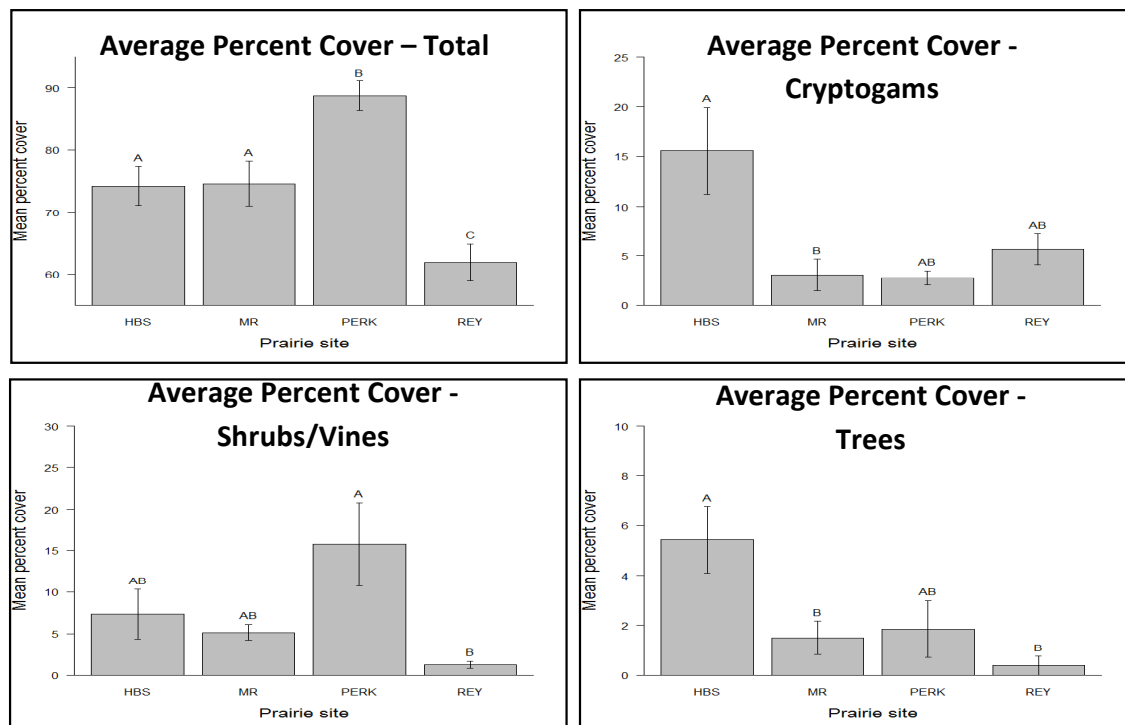


Figure 3: The mean average percent cover values of the functional groups that differed significantly between the four restoration sites (HBS – Hancock Biological Station; MR – Mantle Rock Preserve; PERK – Perkin's Tract South; REY – Reynold's Tract). The HBS site exhibited average percent covers of cryptogams and trees that were significantly higher than those of the Mantle Rock Preserve.

Restoration Goals & Objectives

The results of historical research, literature review, and the vegetative comparison of restoration sites were used to define the following goals and objectives for the HBS restoration project:

Goals: To restore a native barrens-like community to the HBS site. To manage the site so as to: promote the dominance of native warm-season grasses; suppress woody encroachment; maintain populations of as many herbaceous prairie/barrens-indicator species as possible; prevent or reduce the occurrence of non-native or invasive species

Objectives: To complete preliminary vegetative surveys to identify: the species composition of the site; the relative abundances of species present; the presence or absence of native warm-season grasses; the presence or absence of non-native or potentially invasive species. To increase the relative abundance of native warm-season grasses and prairie forb species. To decrease the relative abundance of cryptogam, shrub/vine, tree, and non-native species (particularly cool-season grasses)

Restoration Activities, Methods, & Timeline

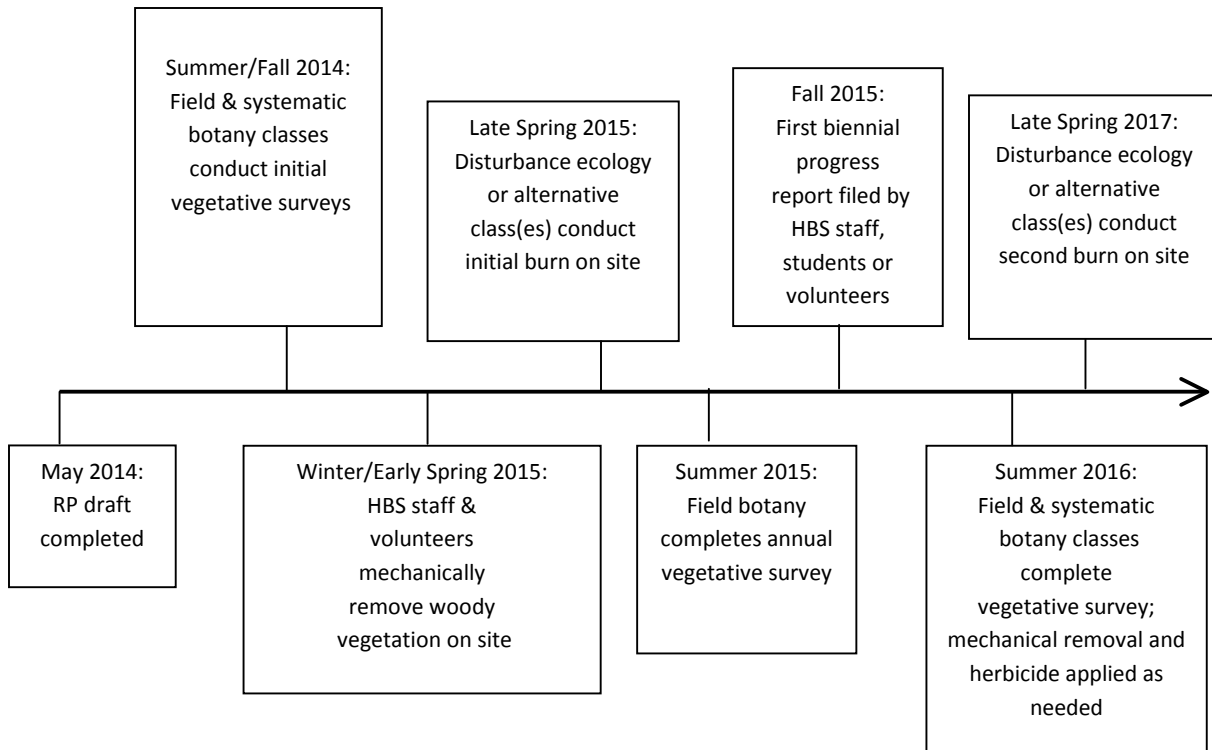
The restoration plan developed mimics restorations of similar barrens and prairie sites and consists of two phases of management activity. These phases are thoroughly outlined in the document, and each activity is described in terms of its purpose, methods, and the proposed frequency and/or timing of its completion. Additionally, suggestions are made as to the parties responsible for, and the outputs to be generated by, each activity.

The first phase includes a species-level vegetative survey of the site, pre-burn mechanical removal of the site's woody vegetation, and a late-spring prescribed burn. The vegetative survey, conducted by MSU's

Field or Systematic Botany classes, will describe the current vegetative condition of the HBS site, confirm the presence of required native species, and identify potential threats from any invasive species on-site. Next, pre-burn removal of woody vegetation will supplement fire in eliminating or suppressing woody vegetation on the site and may be completed by HBS staff, students, or volunteers. Lastly, an initial prescribed burn will be conducted to reduce the abundance of woody and non-native vegetation, to stimulate increased vigor and fitness of native barrens species, and to reinforce the dominance of warm-season grasses. This burn may be completed by one or more of several MSU classes; disturbance ecology, wildlife management, etc. A burn plan and documentation of the fire should be completed. Pre-burn requirements, an ignitions strategy, and a sample burn plan are provided in the document.

The second phase of management activities consists of vegetative monitoring, mechanical removal/herbicide application, prescribed burning, data maintenance, and the filing of biennial progress reports. Annual vegetative monitoring will be conducted in the same manner as the initial survey and will allow for comparative evaluation of restoration progress. Mechanical removal and the application of species-specific herbicides will supplement fire in the suppression of woody encroachment and control of non-native invaders. Bi- or triennial prescribed burns will suppress woody encroachment and non-native species, stimulate increased vigor and fitness of native species, and maintain the dominance of required warm-season grasses. Data maintenance and biennial progress reports by HBS staff, students, or volunteers will ensure a documented record of restoration activities and allow for the evaluation and adaptive management of restoration strategies.

Tentative Timeline of Restoration Activities:



MSU Class Involvement/Plan Continuation & Feasibility

Murray State University classes, such as disturbance ecology, systematic botany, and field botany, will play critical roles in the prolonged success of the HBS restoration effort. The subjects that these classes cover and the intervals at which these classes occur correspond well to restoration activities (e.g., disturbance ecology covering prescribed fire as a management technique occurs biennially to apply prescribed fire to the site). Involvement of these classes will ensure that management activities are adequately staffed, completed in a regular, timely manner, and performed at little to no additional cost to the university. Additionally, involvement provides students with an invaluable hands-on learning experience while increasing student awareness of HBS, native habitat types, and ecological restoration in general.

Results

The work described above resulted in a 47-page document containing a statement of purpose, background information, comprehensive HBS site description, and detailed explanation of restoration goals, objectives, activities, and future directions (Fig. 4). Additionally, contact lists, applicable legislation, sample documents, and blank document templates (e.g., prescribed burn plan, biennial report format, etc.) were attached as appendices to further simplify the plan's implementation.

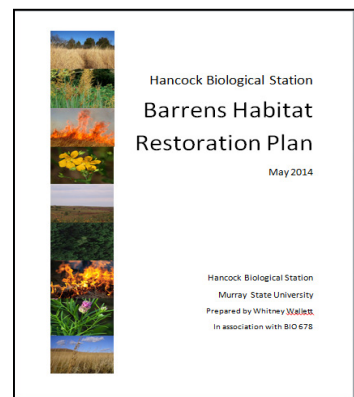


Figure 4: Title page of the HBS Barrens Habitat Restoration Plan drafted by this project.

This document will be distributed to the following individuals: Dr. David White, Murray State University, Professor of Biological Sciences, Director of Hancock Biological Station. Shelly Morris, The Nature Conservancy, Western KY Project Director, MSU Alumna. Dr. Howard Whiteman, Murray State University, Watershed Studies Institute, Professor of Biological Sciences (BIO 578/678), Director of the Watershed Studies Institute. Dr. Dayle Saar, Murray State University, Assistant Professor of Biological Sciences (BIO 350), MSU Herbarium Curator. Dr. Richard Abbott, Missouri Botanical Garden, Murray State University, Visiting Assistant Professor of Biological Sciences (BIO 553/653). Dr. Paul Gagnon, Murray State University, Watershed Studies Institute, Assistant Professor of Biological Sciences (BIO 590/690).

Distribution of this document is anticipated to spur coordination between these individuals, leading to implementation of the restructured restoration effort in the near future.

Discussion

The plan developed outlines clear, measureable goals and objectives for the HBS barrens restoration project, and also suggests several methods and procedures by which to attain them. Additionally, the plan indicates how restoration progress should be documented, the ways in which MSU can incorporate the project

into current student courses and curriculum, and a projected timeline for restoration activities. With proper implementation and future adaptation, this plan promises to result in successful restoration of barrens vegetation to the HBS site. Concurrently, the project will serve as a potential hands-on learning tool for MSU students and a means by which to enhance MSU's commitment to environmental conservation.

Literature Cited

- Barnes, T. (2002). *Kentucky's last great places*. Lexington, KY: University Press of Kentucky.
- Douglas, T. (2002). *Ecological restoration guidelines for British Columbia*. Terrestrial Ecosystem Restoration Program of British Columbia, Biodiversity Branch, Ministry of Water, Land, and Air Protection, Victoria, BC.
- Gayton, D. (2001). SIFERP. Ground work: Basic concepts of ecological restoration in British Columbia (Vol. 3). Southern Interior Forest Extension and Research Partnership. Society for Ecological Restoration International Science & Policy Working Group. 2004. *The SER International Primer on Ecological Restoration*. www.ser.org & Tucson: Society for Ecological Restoration International.
- Samson, F., & Knopf, F. (1994). Prairie conservation in North America. *BioScience*, 44(6), 418-421.