Coarse-level monitoring protocol for assessing baseline condition and restoration progress in oak and pine barrens

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Introduction

Midwest oak and pine barrens are globally rare and have long been a focus of conservation efforts, with increased restoration focus beginning in the 1990s and expanding through the present. Most barrens have been degraded through past grazing, severely altered fire regimes, invasive species, and fragmentation. Oak and pine barrens support a disproportionate number of rare species relative to other natural communities, including federally endangered species such as the Karner blue butterfly (*Lycaeides melissa samuelis*) and the Kirtland's warbler (*Setophaga kirtlandii*). Significant resources have been invested in restoring and maintaining barrens by public agencies and private organizations, and was identified as a high priority for restoration and management by the Wisconsin DNR in 2017.

As interest in managing barrens has increased, so has the need to identify sites with the highest restoration potential, as well as the need to assess restoration progress over time. Monitoring is often problematic for managers with limited time or those with limited botanical expertise, and is often limited to photo points or cursory, qualitative visual inspections that are inconsistent and non-repeatable. On a subset of sites, such as those managed for rare species like the Karner blue butterfly, species-specific monitoring is conducted. While population surveys and habitat suitability monitoring of indicator species is crucial, more comprehensive community-level monitoring of ecological integrity encompassing the full range of barrens sites is needed, especially for sites that are ecologically significant but are not know to support federally listed species. In addition, using consistent measures of community structure and composition in multiple barrens sites across multiple ownerships and ecological landscapes would provide a valuable index of their conservation status.

We designed a monitoring approach for oak barrens based on ecological integrity. Ecological integrity is a concept used extensively by NatureServe and is grounded in the best scientific understanding of high-functioning ecosystems, taking into account ecological processes, vegetation composition and structure, and anthropogenic disturbance (Parrish et al. 2003, Faber-Langendoen et al. 2016).

A key principle of ecological integrity assessments (EIA) is the ability to implement monitoring at multiple scales depending on level of detail desired, expertise, and available resources. Typically, these are designated as Level 1 (remote sensing), Level 2 (moderate detail), and Level 3 (most detailed). We designed barrens EIA protocols and forms for Level 2 (accommodates time-constrained practitioners and/or those with limited botanical expertise) and Level 3 (requires greater time investment and high level of botanical expertise). While the Level 2 protocol is presented here; draft Level 3 forms and protocol are available upon request from the authors.

Coarse-level monitoring (also called coarse-level metrics) focuses on key ecological attributes, or metrics, that are biologically important for plant and animal species and that can be

influenced by management. First developed and used by The Nature Conservancy (TNC) along with the Huron-Manistee National Forests (HMNF) in Michigan, coarse-level metrics have shown to provide a relatively quick and inexpensive means to track the progress of restoration and maintenance in oak and pine barrens (Keogh et al. 2011). Evaluation of these metrics requires basic understanding of barrens ecosystems but does not require extensive botanical expertise. The metrics are designed so that land managers and stewards can evaluate restoration success and determine the next restoration or management step(s) needed, without relying on external botanists or ecological consultants (Keogh 2011).

Ten metrics have been selected for coarse-level monitoring based on key ecological attributes. Each metric is evaluated independently, with observers recording their observation, a corresponding letter grade (A, B, C, D), and a numerical score. Metrics include:

- Relative percent cover of all native plants
- Percent cover of invasive species [e.g., knapweed (*Centaurea* spp.), orange hawkweed (*Hieracium aurantiacum*), bluegrass (*Poa pratensis*), sweet-clover (*Melilotus* spp.), etc.]
- Percent cover of native disturbance indicators [e.g., Pennsylvania sedge (*Carex pensylvanica*), bracken fern (*Pteridium aquilinum*), blackberry/raspberry/bristleberry species (*Rubus* spp.), and other weedy natives]
- Number of native indicator species (see checklist with photographs)
- Percent cover of native grasses and sedges not including Pennsylvania sedge
- Tree composition appropriate for region: relative percent cover of oaks and pines in tree layer
- Percent cover of medium-statured shrubs (2 – 6 feet tall)
- Percent cover of saplings and tall shrubs (6 – 20 feet tall)
- Percent cover of overstory (trees over 20 feet tall)
- Spatial heterogeneity of canopy and openings

General Methods

1. Divide the site into assessment areas (AAs) that are useful for both management and monitoring purposes (Figure 1). Assessment areas may be based on natural ecosystem boundaries, existing management units, or prescribed burn units. Disturbed areas, such as a ditched or plowed area, or dense clumps of invasive species, may be split into separate AAs. It is recommended that AAs be at least 2-3 acres in size and may be up to 40 acres in size or more, recognizing, however, that it may be challenging to accurately complete the coarse-level protocol in very large areas. In a document or on a map, record the boundaries of your AAs and document the rationale for the layout to facilitate knowledge transfer.

   It is recommended that a goal (or desired future condition) for the AAs be clearly articulated. Examples of desired future condition include dry sand prairie, oak barrens, jack pine barrens. The metrics described here may be applied differently, or not at all, in units having a goal other than oak or pine barrens.

2. To ensure AAs are adequately covered in surveys, meander through the AA being careful to equally cover all available habitat, including areas that are open, brushy, and canopied. To facilitate adequate coverage in the field and avoid observer bias, survey routes may be established *a priori* that zig-zag across the entire AA (Figure 1). Along each zig-zag segment, observers should record interim metrics (see Step 4 below) at least once (twice or more for large sites over 40 acres) .

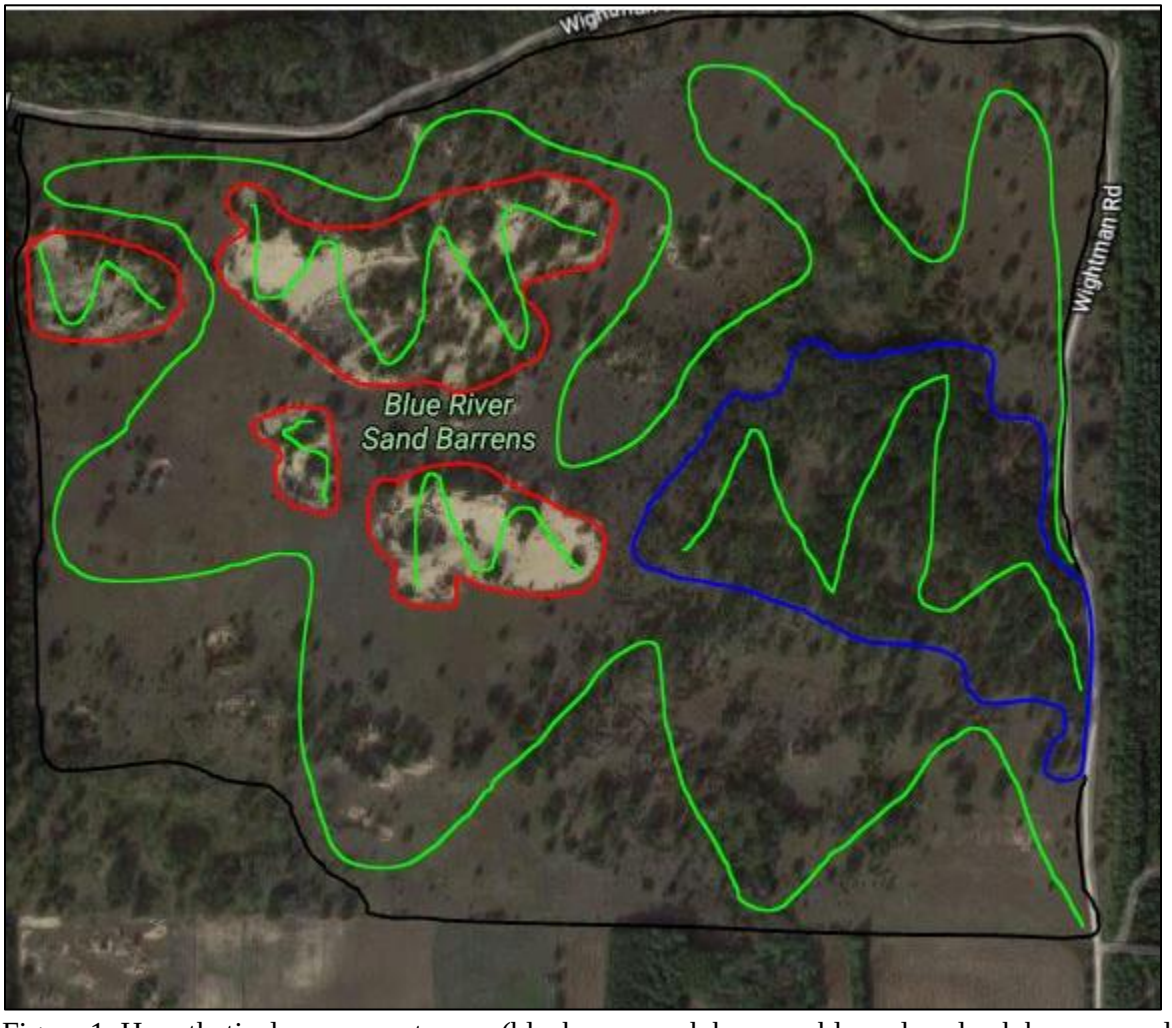

Figure 1. Hypothetical assessment areas (black: open oak barrens, blue: closed oak barrens, red: sand barrens) and survey routes (green zig-zag) at Blue River Sand Barrens SNA.

3. It is recommended that the assessments be performed by at least two people familiar with barrens ecology. This is particularly helpful for metrics that require estimates of percent cover, which are subjective and may thus vary among surveyors. While illustrations of various degrees of percent cover are provided on the field form as a guide, the effect of individual bias may be reduced by having surveyors make independent assessments of percent cover and average the values at the end of the survey.

4. For each metric in the AA, write the corresponding estimate to the nearest whole percent in the column "Your Obs", then assign a letter rank (A, B, C, D) for that metric using guidelines provided on the form (Attachment A - Oak Barrens Monitoring Form). Note that there are unique descriptions of A- through D-ranks for each individual metric. Convert the letter rank into a numerical score using a grade-point style conversion (A=4, B=3, C=2, D=1). For larger AAs or when a survey route has been pre-established and metrics are evaluated at multiple points along the survey route, record interim estimates for each metric on the back of the form and calculate the average value for each metric in the AA. Use the average estimate for each metric to estimate the overall metric ranking for the AA.

5. For the metric for number of indicator species, use the indicator species checklist form and check off each species observed during the survey. The species were selected among those that typically bloom in July and August in Wisconsin, though they do not need to be flowering to be checked on the checklist. When looking for indicator species, move slowly and check habitat microsites thoroughly, such as sand blows, dry depressions, ridges, slopes, shady areas, and large and small openings. Keep a running tally of species for the entire AA; do not track zig-zag segments separately. Upon completion of the survey, count the total number of indicator species observed in the management unit and enter it on the main form, and follow the procedure in Step 4 to translate that into a letter grade and numerical score.

6. Calculate a composite rank for the entire management unit by adding all scores, dividing by 10, and translating to a letter rank using the Composite Rank Guide (provided below and on the form).

A	3.8-4.0
A-	3.5-3.79
B	3.0-3.49
B-	2.5-2.99
C	2.0-2.49
C-	1.5-1.99
D	<1.49

7. In some cases, a site may be composed of more than one assessment area, or an assessment area may not be uniform and may be subdivided for estimates (e.g., multiple sand barrens AAs in Figure 1). To determine values for each metric for the entire community, or for multiple communities across the entire site, calculate a weighted estimate for each assessment area:
    a. First, calculate the area of each assessment area and determine the proportional area of each assessment area over the whole site.
    b. Second, calculate the weighted value for each metric in each assessment area by multiplying the estimated values by the proportional area.
    c. Lastly, determine the sum of all weighted values for each metric across all assessment areas.

8. Illustrate locations of specific management concerns on a map. Reference concerns in the notes section of the form and include recommendations for those areas of management concern.

Guidelines for Field Estimates

1. Conduct field monitoring during July and August when herbaceous species are easiest to identify, especially native grasses, indicator species and invasive species.
2. Ensure all areas within an AA are visible and accessible to observers on the ground. Exclude features that may be inaccessible or separate inaccessible features into different AAs (e.g., blufftops surrounded by cliffs, areas split by rivers or streams that cannot easily be crossed, etc.).
3. Conduct field monitoring when high priority invasive species are most visible (e.g., July is best for spotted knapweed when it's flowering).

4. The vegetation patterns of savannas are intrinsically uneven due to variable degrees of shade and woody cover, and patchy distribution of various species, thus it is important to evaluate each metric thoroughly across the entire assessment area. For example, percent cover of herbaceous species in open areas should be averaged with those that occur underneath shrubs or trees.

Supplies and Equipment

- Compass
- GPS unit or digital map depicting assessment area boundaries
- Aerial photographs depicting assessment area boundaries
- Data sheets
- Clipboard
- Pencils with erasers
- Field guide to Wisconsin wildflowers (can be a simple, introductory guide if all indicator species are included)

Literature Cited

Faber-Langendoen, D., W. Nichols, J. Rocchio, K. Walz, J. Lemly, R. Smyth and K. Snow. 2016. Rating the condition of reference wetlands across states: NatureServe's Ecological Integrity Assessment method. National Wetlands Newsletter 38 (3):12-16

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Parrish, J.D., D. P. Braun, and R.S. Unnasch. 2003. Are we conserving what we say we are? Measuring ecological integrity within protected areas. BioScience 53: 851-860.