Coarse-level monitoring protocol for assessing baseline condition and restoration progress in southern sedge meadows and wet-mesic prairies

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Introduction

Wisconsin has lost an estimated 50% of its original wetland acreage since the mid-1800s (WDNR 1990). Remaining wetlands are often highly degraded by hydrologic impairments and invasive species such as reed canary grass especially in southern Wisconsin. Wetland enhancements (i.e., re-establishing and/or rehabilitating wetland vegetation and hydrology on previously drained wetlands) have become a priority over the last several decades for the Wisconsin DNR, other state agencies, non-governmental organizations, and private contractors, who restore them for compensatory mitigation, fish and wildlife habitat, and flood mitigation, among other reasons. However, wetland restoration, both for mitigation and for wildlife habitat, often results in low floristic quality with a composition that does not closely resemble original native plant communities (Gibson et al. 2020). Protection and management of relatively undisturbed wetland remnants have also become a priority for Wisconsin DNR and partners, who put particular focus on reducing impacts of fire suppression and non-native invasive species.

There is a need for objective quality assessments for both wetland enhancements and remnant, high-quality wetlands. Monitoring can be used to identify sites with the highest restoration potential, as well as to assess management progress over time. Existing monitoring protocols (e.g., quadrats, timed meander surveys) focus on a thorough plant inventory with species-level identification in order to evaluate quality using floristic quality metrics (e.g., species richness, FQI, mean C, etc.). While this type of rigorous, quantitative monitoring is valuable and necessary in certain cases, it is problematic for managers with limited time or those with limited botanical expertise and may be unnecessarily detailed for general habitat quality assessments.

We designed monitoring protocols specifically for field staff that are based on ecological integrity. Ecological integrity 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).

Here, we introduce new protocols for two wetland communities that are a priority for monitoring in southern Wisconsin: southern sedge meadow and wet-mesic prairie. Both communities are among the most common targets for wetland restoration and mitigation, particularly in the southern half of Wisconsin (S. Jarosz, pers. com.). In addition, less disturbed examples of these communities are threatened by fire suppression and shrub encroachment, invasive species and conversion to cattail marsh. Both are management priorities for the Wisconsin DNR as well as programs within the DNR, such as the State Natural Areas program.

A key principle of ecological integrity assessment (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). Several Level 1 tools exist (e.g., Potentially Restorable Wetlands GIS layer, Wetlands By Design tool) and Level 3 tools were recently developed (e.g. floristic quality benchmarks based on timed meander surveys (Marti and Bernthal 2019; Wisconsin DNR 2017; Hlina et al. 2015)). Level 2 tools exist, but to date have been limited to a function-based Rapid Assessment Method (RAM), rather than ecological integrity (WDNR 2014).

We designed Level 2 monitoring, hereafter called coarse-level metrics, based on EIA principles to fill a gap for rapid assessment of ecological integrity that requires limited botanical expertise and accommodates time-constrained practitioners. Coarse-level metrics are grounded in a conceptual ecological model for a given plant community that describes the typical physiographic setting, climate, hydrology, soils, ecological processes, vegetation, focal species, and stressors that impact the community (Figure 1).

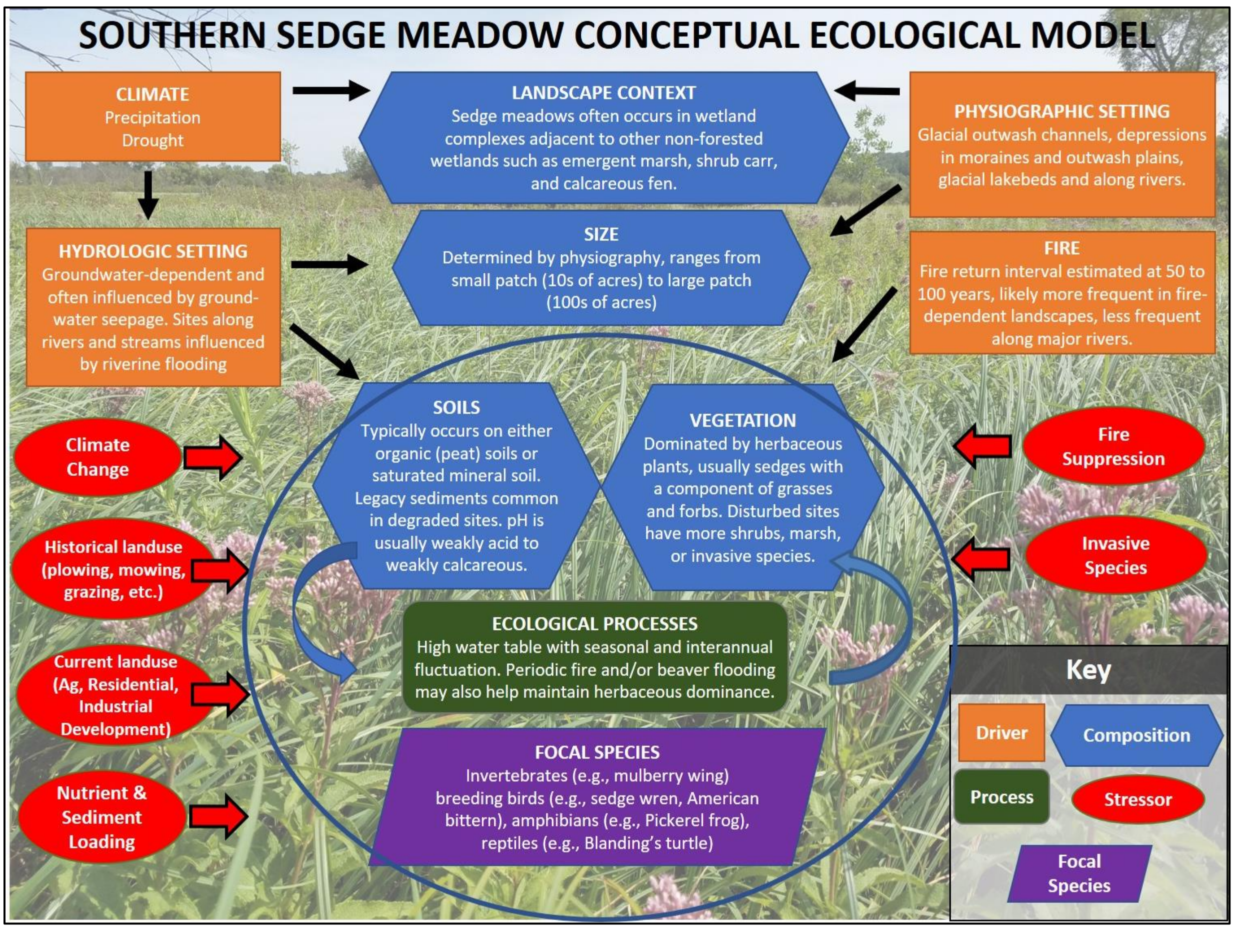


Figure 1. Southern sedge meadow conceptual ecological model.

Coarse-level metrics focus on key ecological attributes in the conceptual ecological model 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) and Huron-Manistee National Forest in Michigan for use in oak and pine barrens, coarse-level metrics have shown to provide a relatively quick and inexpensive means to track the progress of restoration and maintenance (Keogh et al. 2011). Evaluation of these metrics requires basic understanding of ecosystems but does not require extensive botanical expertise. The metrics are designed so that field managers can evaluate restoration success and determine the next restoration or management step(s) needed, without relying on external botanists or ecological consultants (Keogh 2011).

Metrics for southern sedge meadows and wet-mesic prairies were based on conceptual ecological models. Metrics were developed for three broad parameters: vegetative composition, vegetation structure (i.e., shrub cover), and hydrology. Parameters for composition and structure parameters have multiple metrics to measure different aspects of ecological stress.

Methods

Development of coarse-level metrics was supported by previously collected data from the Wisconsin wetlands floristic quality benchmarks project (Marti and Bernthal 2019, O'Connor and Doyle 2017). Floristic quality is based on the concept that plant species have different tolerance levels of anthropogenic disturbance, and each species in a state or region can be assigned a numerical score, termed the coefficient of conservatism (C-value), ranging from 0 (very tolerant of disturbance) to 10 (very intolerant of disturbance) (Bernthal et al. 2003). Floristic quality metrics for a site can be calculated based on plant species lists, including a mean C score, and where percent cover of plant species is known, the cover-weighted mean C value. Cover-weighted mean C has been shown to be more responsive to disturbance and a better overall measure of floristic quality (Marti and Bernthal 2019, Hlina et al. 2015, Bourdaghs 2012).

Data for this project was collected between 2013 and 2019 from over 1,100 wetlands across of full spectrum of condition gradients, ranging from least disturbed (i.e., reference condition) to most disturbed, encompassing the full suite of major natural communities in Wisconsin. This included southern sedge meadow (n=101) and wet-mesic prairie (n=23). Data were collected by experienced botanists and ecologists using timed meander surveys (WDNR 2017) to generate a thorough plant species list and estimates of percent aerial cover. An independent disturbance checklist was also completed to evaluate and rank overall disturbance. Data were used by Marti and Bernthal (2019) to develop floristic quality benchmarks based on cover-weighted mean C scores.

We analyzed timed meander survey data from southern sedge meadows and wet-mesic prairies to identify potential coarse-level metrics. Potential metrics were developed by combining data on individual species into coarse ecological groups (e.g., total percent cover of native grasses and sedges, total percent cover of invasive grasses, total percent cover of disturbance forbs, etc.) that correlated with stress in the conceptual ecological model for the community. Potential coarse-level metrics were investigated and evaluated for their ability to distinguish between least disturbed and most disturbed sites. The correlation between each potential metric and the cover-weighted mean C score from the floristic quality benchmarks project was evaluated using regression analysis or a Spearman-rank correlation. Metrics with a low correlation with cover-weighted mean C were rejected.

Metrics requiring plant identification were also screened for their difficulty of application by non-experts. Metrics requiring a high degree of botanical expertise were excluded or modified. For example, all sedges were lumped into a single category of total sedge cover to eliminate the need to identify sedges to the species level.

For each metric, condition tiers were established ranging from A (best quality) through E (lowest quality). Each parameter is also summarized with a subtotal A-E score based on the composite metrics. Finally, the site is assigned an overall rating through a procedure that rolls up the subtotal parameters into an overall A-E score. Metrics and procedures for rolling up scores for individual parameters and for the overall scores for southern sedge meadow and wet-mesic prairie are described in detail following the General Methods.

Distinguishing between Southern Sedge Meadow and Wet-mesic Prairie

The coarse-level metrics for this protocol were designed for use in southern sedge meadow and wet-mesic prairie natural communities in Wisconsin. These communities are described in greater detail on the Wisconsin DNR website (dnr.wi.gov; keyword: natural communities) and in Chapter 7 of the Ecological

Landscapes of Wisconsin (Epstein 2017). In addition, a key to wetland natural communities, including how to differentiate between southern sedge meadow and wet-mesic prairie, is available on the DNR website (keyword: wetland communities).

Southern sedge meadows are typically dominated by tussock sedge (*Carex stricta*), lake sedge (*C. lacustris*), and sometimes by wiregrass sedge (*C. lasiocarpa*). Common forbs species include Joe-Pye-weed (*Eutrochium maculatum*), jewelweed (*Impatiens capensis*), sensitive fern (*Onoclea sensibilis*), giant goldenrod (*Solidago gigantea*), glossy-leaved aster (*Symphyotrichum firmum*), and tall meadowrue (*Thalictrum dasycarpum*). Soils are typically neutral to mildly alkaline peat, or mucky mineral, but occasionally can be saturated clay loam to sandy clay loam, especially in the Driftless Region. Sites disturbed by past agriculture or legacy sediments often have silt loam soils.

Wet-mesic prairies are dominated by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*), with prairie dropseed (*Sporobolus heterolepis*), bluejoint grass (*Calamagrostis canadensis*), cordgrass (*Spartina pectinata*). Tussock sedge can be locally common. Prairie forbs such as prairie blazing-star (*Liatris pycnostachya*), prairie phlox (*Phlox pilosa*), prairie coneflower (*Ratibida pinnata*), prairie dock (*Silphium terebinthinaceum*), and Culver's-root (*Veronicastrum virginicum*) are often common, especially in high-quality sites. Soils of wet-mesic prairies are usually loam, silty clay loam, or silty clay, sometimes overlain by a few inches of sand.

The original plant community may be difficult to discern in highly degraded, or ruderal sites dominated by non-native species. In these cases, use the metrics for the community that best matches the site based on any remnant vegetation that may be present. For sites that are highly degraded by reed canary grass, cattail, or Phragmites, we suggest using the metrics for southern sedge meadow due to how the overall composition metric is calculated. However, using coarse-level metrics for either community should result in a similar overall score for highly disturbed or ruderal sites, as the metrics are relatively robust with parallel evaluation of multiple stressors and sources of disturbance.

Wetland enhancements (including mitigations) present a special case. In these sites, it is suggested that the metrics be applied based on the stated restoration goal. For example, if the goal of the enhancement was to restore sedge meadow, the southern sedge meadow metrics should be applied. However, it should be noted that metrics were developed only from naturally occurring communities across of range of integrity, and data from wetland enhancements were not included in metric development. Thus, using coarse-level metrics for evaluation of wetland enhancement should be used with caution. In addition, since formal monitoring of wetland enhancements is usually dictated by established performance criteria approved by regulatory agencies, those tools should be the primary method for evaluating these sites.

General Methods

1. Divide the site into assessment areas (AAs) that are useful for both management and monitoring purposes (Figure 2). Assessment areas may be based on natural ecosystem boundaries, existing management units, or prescribed burn units. It is recommended that disturbed areas, such as previously plowed areas, dense clumps of invasive species, or areas with heavy shrub cover be split into separate AAs. Assessment Areas may range in size from 2-3 acres up to roughly 40 acres in size. However, the larger AAs are, the more challenging it will be to accurately assess metrics involving percent cover. In a document or on a map, sketch the boundaries of your AAs and document the rationale for why AAs were located where they were to facilitate long-term knowledge transfer.

   It is recommended that a goal (or desired future condition) for the AAs be clearly articulated. Examples of management goals include maintenance of a high-quality reference site or a mitigation site that meets minimum performance criteria.

2. To ensure AAs are adequately covered in surveys, meander through the AA, being careful to survey any microhabitats (e.g., brushy patches, wetter and drier spots, small patches of invasives, etc.) that may occur within the AA. For large areas of invasives, consider defining separate AAs as noted in step 1. 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 2). For larger AAs, observers may want to record interim observations in order to improve accuracy of the metric. Observers may track their survey path using the track function of a GPS, though this is optional.

   Note that survey methods differ from timed meander surveys, where the goal is to generate a thorough species list for a site (WDNR 2017). Here, the goal is to cover the entire AA in order to estimate the coarse-level metrics for the site, regardless of whether diversity is low or high. There are no set time parameters, though it is estimated that staff experienced with the protocol might spend between one and four hours per AA, depending on expertise and the size and complexity of the AA.

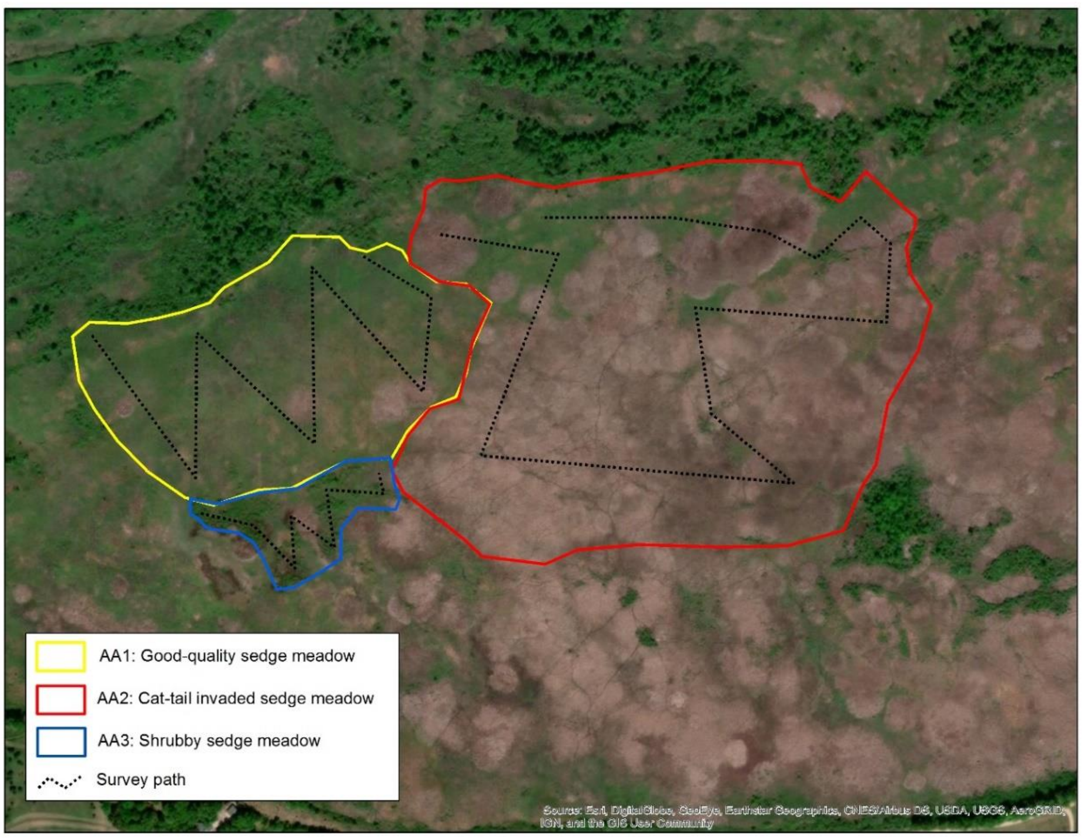


Figure 2. Hypothetical assessment areas (yellow: good-quality sedge meadow; red: cattail invaded sedge meadow; blue: shrubby sedge meadow); and potential survey path (black zig-zag) at Blue Mounds Creek Bottom, Iowa Co.

3. It is recommended that the assessments be performed by at least two people familiar with wetland ecology. Having two surveyors is particularly helpful for metrics that require estimates of percent cover. 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, discuss their estimates, and average their respective values for a more accurate overall estimate.

4. Evaluate composition metrics. For each metric in the AA, write the corresponding estimate to the nearest whole percent in the column "Your Obs", then assign the letter rank (A, B, C, D, E) that

corresponds to the observation. Note that condition tiers for each metric differ. For wet-mesic prairie, convert the letter rank into a numerical score using a grade-point style conversion (i.e., A=4, B=3, C=2, D=1, E=0), which will be used to calculate parameter subtotals. Numerical scores are not needed for southern sedge meadow metrics due to differences in how parameter subtotals are calculated.

5. *For wet-mesic prairie only:* Evaluate forb species indicative of high-quality habitat. For the number of indicator species, use the indicator species checklist form and check off each species observed during the survey. When looking for indicator species, move slowly and check habitat microsites thoroughly, such as seepy areas, on and between sedge tussocks, and in open and shrubby areas. Keep a running tally of species for the entire AA and enter the total number in the "your obs" column.

6. Evaluate structural metrics for non-native invasive shrubs and trees. Consider the total percent cover of all invasive shrubs present regardless of size. For example, if large Eurasian bush honeysuckle comprises 10% cover and numerous glossy buckthorn seedlings comprise 5% cover, the total percent cover of invasive shrubs would be 15%. Keep in mind that some species of tree willows are non-native, such as crack willow (*Salix* X *fragilis*) and white crack or hybrid willow (*S.* X *rubens*) and should be included here.

   If an unknown species of shrub is encountered, collect a specimen for later identification. If the shrub appears to be invasive, such as having aggressive growth or dense spreading clumps that have little to no native species beneath, it may be counted provisionally in the invasive metric. Use the notes field to document the unknown species, its estimated cover, and whether or not it was included in the total percent cover estimate.

7. Evaluate structural metrics for native shrubs over three (3) feet tall. Native shrubs less than three feet tall can be ignored.

8. Evaluate Hydrology parameters. Hydrologic disturbance is best evaluated using a combination of aerial photos and field observations. Note whether current or historic stressors are:
   - currently affecting areas within the AA
   - currently affecting areas within a buffer of the AA (suggested distances provided)
   - historically affected areas within the AA (e.g., former plowing or grazing)

   Disturbances like the presence of drain tiles can sometimes be determined by looking for sub-surface drainage patterns such as:
   - Unsaturated, oxidizing muck soils even in a year of normal precipitation.
   - Light-colored bands on plowed soil in historic imagery. Good sources of historical imagery including the Wisconsin Historical Aerial Image Finder for the 1937-38 aerial photos, and photos available from USGS Earth Explorer from 1950's to present.
   - Regularly spaced linear growth patterns in fallow vegetation.
   - Small point-like depressions indicating tile blow-outs.

   For each stressor, rate the overall <u>level of impact</u> (low, medium, or high) you think the stressor is having on the AA currently. Document specific observations and any related rationale for level of impact in the notes column.
   - Examples of low impact include past grazing evident in historical aerial photos or a very old hand-dug ditch less than one foot deep and one or two feet wide, or a road/railroad 75 meters away with appropriate-size culverts and no impounding water upstream or dense shrubs downstream, and overall minimal evident changes in vegetation structure and composition.

- Examples of medium impact include past plowing evident in historical photos, minor evidence of historical sedimentation (e.g., legacy sediment), or a medium-sized ditch somewhat close to the AA, but the AA is still dominated by native herbaceous wetland vegetation.
- Examples of high impact include streams incised into many feet of legacy sediments, active drain tile fields and oxidizing muck from dewatering, medium-sized ditches that pass through the AA, and roads, railroads, or berms that are causing ponding of deep water upstream or dense growth or shrubs downstream within or immediately adjacent to the AA. Sites highly impacted by hydrologic alterations usually (but not always) also show signs of impacts to vegetation (e.g. dense stands of reed canary grass or cattail, many weedy forbs, etc.).

Finally, calculate the overall hydrology metric subtotal using the guidance provided on the form.

9. Calculate a composite rank for the entire AA using the Composite Rank Guide provided below and on the form:

	Summary rank: Metric Subtotals are:
A	All As
A-	2 As, 1 B
B	1 A, 2 Bs OR 3 Bs
B-	2 Bs, 1 C
C	1 B, 2 Cs
C-	3 Cs OR 1 C-
D	1 or more Ds
E	1 or more Es

10. Document any management recommendations based on the field monitoring. Illustrate locations of specific management concerns on a map.

11. To calculate an overall score for a site that is comprised of multiple AAs, calculate a weighted average for each assessment area:
    a. First, calculate the area of each AA and determine the proportional area of each AA 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.

General Guidelines and Timing of Coarse-level Estimates

1. Conduct field monitoring during July and August when herbaceous species are easiest to identify, especially native grasses, indicator species and invasive species. If conducting repeated monitoring to document changes over time, strive for a similar timeframe (e.g., within 2-3 weeks) as the initial monitoring event to avoid potential sources of error from inherent changes in percent cover over the growing season. However, the metrics are designed to be robust and with large condition bins such that changes in phenology should have a minimal impact on the overall ranks.
2. Conduct field monitoring when high priority invasive species are most visible (e.g., if concerned about purple loosestrife, mid-late July may be best for observing flowering individuals; if concerned about Canada goldenrod, late August may be a more optimal time frame).
3. 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., areas split by rivers or streams that cannot easily be crossed, etc.).

4. The vegetation patterns of wetlands are intrinsically uneven due to natural variations in hydrology, woody cover, and patchy distribution of species. Thus, it is important to evaluate each metric thoroughly across the entire assessment area. For example, percent cover of sedges or grasses in open areas should be averaged with the coverage (or lack thereof) beneath dense shrubs.
5. It is recommended that monitoring be repeated approximately every 3-5 years, though repeat sampling should be based on management needs rather than strict rules. In general, it will be beneficial to conduct baseline monitoring, and then repeat the monitoring following management activity to evaluate the effectiveness of management and determine next steps.

6. Suggest adding some brief statement of how to know when to use the SSM metric vs the WMP. Or how to know if you're in either of these communities to begin with (and not in a wet meadow for example). Can this be used on a ruderal wet meadow?

Supplies and Equipment

- Compass
- GPS unit or smartphone app
- Physical or digital map depicting assessment area boundaries on a current aerial photo
- Data sheets, clipboard, and pencils with erasers
- Field guide to Wisconsin wildflowers (e.g., Wildflowers of Wisconsin, 2nd ed., by Black and Judziewicz).

Detailed description of Southern Sedge Meadow Metrics

Eight metrics were selected for coarse-level monitoring of southern sedge meadow based on key ecological attributes. Each metric is evaluated independently, with observers recording their observation, and a corresponding letter grade (A, B, C, D, E) based on established condition tiers. Each metric is described below. For a conceptual ecological model of southern sedge meadows, please see Figure 1 (page 2).

Composition Metrics for Southern Sedge Meadow

1) Relative % cover of native wetland sedges and grasses (i.e., ratio of % cover native graminoids to % cover of other vegetation).

A (Excellent)	**B** (Good)	**C** (Fair)	**D** (Poor)	**E** (Very Poor)	Your obs (e.g., 45%)	Letter rank (A, B, C, D, E)
>60% (>60:40)	40-60% (40:60 to 60:40)	20-40% (20:80 to 60:40)	5-20% (20:80 to 5:95)	<5% (<5:95)		

Rationale and notes: Coverage of native wetland grasses and sedges is strongly correlated with more detailed floristic quality benchmarks based on cover-weighted mean C. Cover can be expressed in two ways: 1) the total or absolute cover a species occupies or 2) the relative cover, or ratio of a given species or group of species to all other vegetation. With total cover, the sum of cover for all species will often be over 100% (and often as high as 150% or 200%) due to multiple overlapping strata including scattered trees, shrubs, tall robust wildflowers, graminoids, and abundant but small-statured species such as clearweed (*Pilea* sp.) and seedlings of touch-me-not (*Impatiens* sp.). With relative cover, coverage of all species will always total 100%, because it is effectively expressed as a ratio relative to other species or groups.

For sedge meadows, data analysis showed that relative cover was a much better measure than total cover, likely due to the fine-leaved nature of graminoids and multiple layers of vegetation. To estimate relative cover, determine the approximate ratio of native wetland sedges and grasses to all other vegetation. When considering other vegetation, be sure to include all other strata as described above, including scattered trees, shrubs, tall robust wildflowers, and dense but small-statured species.

2) Total % cover of non-native invasive grasses: reed canary grass (*Phalaris arundinacea*), non-native Phragmites (*Phragmites australis* var. *australis*), tall manna grass (*Glyceria maxima*), etc.

A	**B**	**C**	**D**	**E**	Your obs	Letter rank
<1%	1-3%	C: 4-10% C-: 11-30%	31-70%	>70% (see 2b below)		

2b) If non-native grasses metric is E, adjust score up to D- (D minus) if total % cover of tall forbs are at least 10% cover, including asters (*Symphyotrichum lanceolatum*, *S. puniceum*, etc.), Joe-pye-weed (*Eutrochium maculatum*), boneset (*Eupatorium perfoliatum*), touch-me-not (*Impatiens capensis*), and giant goldenrod (*Solidago gigantea*). Do not include Canada goldenrod in your estimate.

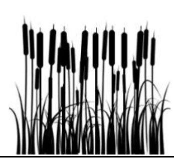
Rationale and notes: Non-native grasses also have a very high correlation with more detailed metrics of floristic quality. While reed canary grass is the most common non-native grass, other grasses are also lumped in this category such as non-native Phragmites and the emerging invasive tall manna grass. Other grasses such as redtop (*Agrostis gigantea*) could also be included in this category if abundant. A moderate cover of tall forbs may indicate greater restoration potential in an AA, even in sites heavily dominated by non-native grasses, and is therefore included to distinguish between sites in the lowest condition tier versus sites that may be better restoration targets.

3) Total % cover of <u>native</u> Phragmites. If unsure if Phragmites in your AA is native or invasive, assume invasive and include in 2) above.

A	B	C	D	E	Your obs	Letter rank
0-5% AND abundant native plants beneath	6-15% OR, if >15%, abundant native plants beneath	16-30% AND <u>some</u> native species missing or reduced in cover	31-70% AND <u>many</u> native species missing or reduced in cover	>70%, many species missing		

Rationale and notes: Some managers are concerned about perceived increases in density and patch size of native Phragmites, and thus, this metric is included as a component of monitoring. Note that the metric includes both an estimate of the cover of native Phragmites as well as an estimate of native plant diversity and cover beneath the Phragmites. While native Phragmites is natural, and may even form locally dense clones, it is usually accompanied by a healthy diversity of cover of other native plants. Observers may want to split out large patches of native Phragmites into their own AA for more accurate monitoring purposes. Where patch size is a concern, field staff could also consider mapping the outer margin of the patch and compare patch size over successive years.

4) Total % cover of native and non-native cattail (*Typha latifolia*, *T. angustifolia*, *T.* X *glauca*).

A	B	C	D	E	Your obs	Letter rank
0-5% AND sparse, single stems 	6-15% AND sparse, single stems 	16-30% OR moderately dense patches 	31-70%, very dense patches 	>70%, extensive monocultures 	Images modified from Vecteezy.com	

Rationale and notes: Cattail is a major concern in southern sedge meadows, and is one of the leading causes of composition degradation of previously high-quality sites. All cattail species are lumped together in this metric, eliminating the need to attempt to distinguish between species and hybrids that intergrade morphologically and are difficult to tell apart. While cattails are a natural part of sedge meadows on the wet end of the moisture spectrum, they should occur as sparse, single stems in high-quality sites. Where cattails begin forming dense patches (often visible as circular clones on aerial photos), sites are at risk of conversion to cattails monocultures. Thus, this metric incorporates both percent cover of cattails as well as the density of patches. Cattail invasion is also associated with nutrient enrichment (especially nitrogen and phosphorus) from upstream landuse, including agricultural practices and occasionally leaking septic fields.

5) Total % cover of disturbance forbs: Canada goldenrod (*Solidago canadensis*), Canada thistle (*Cirsium arvense*), stinging nettle (*Urtica dioica*), purple loosestrife (*Lythrum salicaria*), giant ragweed (*Ambrosia trifida*), etc.

A	B	C	D	E	Your obs	Letter rank
0-1%	2-5%	6-20%	21-35%	>35%		

Rationale and notes: Disturbance forbs (especially Canada goldenrod, Canada thistle, stinging nettle, and giant ragweed) are strongly correlated with floristic quality benchmarks, and tend to be indicative of previous soil disturbance, including plowing, sedimentation (e.g., legacy sediments), and a lowered water table from tiling or ditching. Purple loosestrife is also included here as a disturbance forb. While loosestrife beetles have reduced purple loosestrife in many sites, it occasionally reaches high abundances locally, and will be picked up by this metric.

Southern Sedge Meadow Composition subtotal: Take the LOWEST score of metrics 1-5.

Rationale and notes: The various metrics of composition for southern sedge meadows evaluate different types of stressors from the conceptual ecological model (Figure 1, page 2). For example, reed canary grass is often an indicator of past soil disturbance, ditching, and legacy sediments on drier sites, while large stands of cattail are an indicator of hydrologic disturbance and nutrient enrichment on wetter sites. However, reed canary grass and cattail are unlikely to both be abundant in the same AA, and where one metric ranks a D or E, the other metric will likely rank an A. Sites or AAs that are highly degraded in any category are degraded. Thus, the best measure of overall composition is the lowest score of the five composition metrics.

STRUCTURE METRICS

6) Total % cover of non-native invasive shrubs and trees (honeysuckle, common buckthorn, glossy buckthorn, crack willow, etc.)

A	B	C	D	E	Your obs	Letter rank
<1%	1-3%	C: 4-10% C-: 11-30%	31-50%	>50%		

Rationale and notes: Non-native invasive shrubs and trees are very problematic and difficult to control once well-established on a site. In addition to altering vegetation structure by increasing woody cover, they also tend to aggressively shade out other native vegetation and alter soil chemistry with nitrogen-rich leaves, making reestablishment of native species following removal more difficult compared to native shrubs. Note that the metric addresses non-native invasive shrubs regardless of their size, and that even small individuals (i.e., less than 3 feet tall) should be included in the total estimate.

7) Total % cover of native trees and shrubs >3ft tall (dogwood, willow, elm, etc.).

A	B	C	D	E	Your obs	Letter rank
0-10%	10-20%	20-40%	40-70%	>70%		

Rationale and notes: Native trees and shrubs are a natural component of southern sedge meadows, but due to fire suppression, legacy sediments, and hydrologic disruption leading to a lower water table, tree and shrub encroachment is a major concern. Progressively higher cover of woody species leads to the loss of sedges and native forbs through shading. Because tall woody species (i.e., over three feet tall) are the concern from shading, the metric evaluates only cover from taller-statured individuals. When estimating this metric, include the entirety of trees and shrubs over three feet tall, rather than just the subset of the individual that is above three feet (Figure 3).

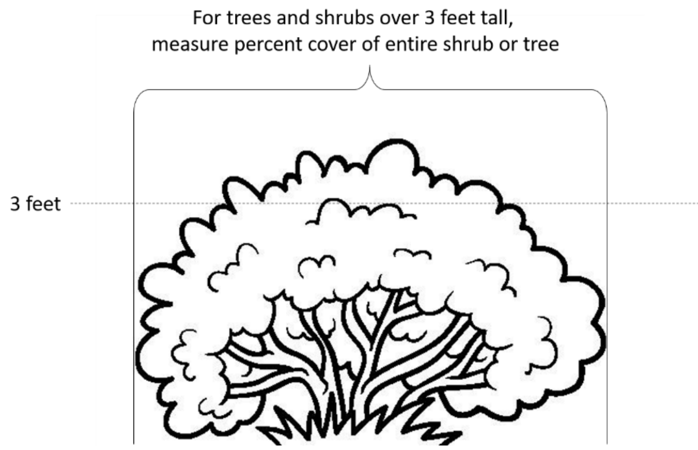


Figure 3. Diagram of how to measure cover of shrubs over three feet tall.

Structure subtotal: Take the LOWEST score of metrics 6-7.

Rationale and notes: While both native and non-native invasive shrubs and trees alter vegetation structure, the metrics measure different aspects of stress and disturbance. The best measure of overall vegetation structure is the lowest of the two metrics. If the structure of an AA is highly altered by either native or non-native invasive shrubs, the overall structure is considered altered.

HYDROLOGY METRICS

8) Are there hydrologic impairments affecting the site? Consider each stressor and check the box if current or historic stressors are *affecting* the assessment area. Rank the estimated level of impact as low, medium, or high.

Stressor	Currently within AA	Within a buffer of:	Historically within AA	Impact Level (L, M, H)
Ditch or excavated pond		100m		
Channelized stream		100m		
Effect of berm, dike, road, or RR grade		30-100m		
Mowing, haying, or grazing		-		
Plowing or drain tile		30m		
Sedimentation or legacy sediments		30m		
Nutrient enrichment		30m		
Stormwater/drain tile input		30m		

Rationale and notes: Hydrologic impairments are often the root cause of stressors to vegetation composition and structure. While this metric will likely be correlated with composition and structure metrics, it is helpful to evaluate hydrologic stressors independently. For a more thorough discussion of how to assess hydrologic impairments, please see section 8 in the general methods section on page 5.

SUMMARY RANK for Southern Sedge Meadow

Review composition, structure, and hydrology subtotal metrics. Convert to a final rank by using the guidance for summary rank.

Rationale and notes: It is useful to have an overall rank for the AA for prioritization and comparison from one survey period to the next. Similar to other parameter subtotals, the overall score is not an average but a reflection of the major impairments to the AA. Note the final rank is calculated based on the three subtotal ranks, and not an evaluation of all eight individual metrics.

Detailed description of Wet-mesic Prairie Metrics

Seven metrics were selected for coarse-level monitoring of wet-mesic prairie based on key ecological attributes. Each metric is evaluated independently, with observers recording their observation, and a corresponding letter grade (A, B, C, D, E) based on established condition tiers. Due to how the composition subtotal is calculated, the letter rank is also translated into a numerical score similar to a GPA scale (A=4, B=3, C=2, D=1, E=0). Metrics are based on a conceptual ecological model illustrating the typical physiographic setting, climate, hydrology, soils, ecological processes, vegetation, focal species, and stressors that impact the community (Figure 4). Each metric for wet-mesic prairies along with the rationale and note is described below.

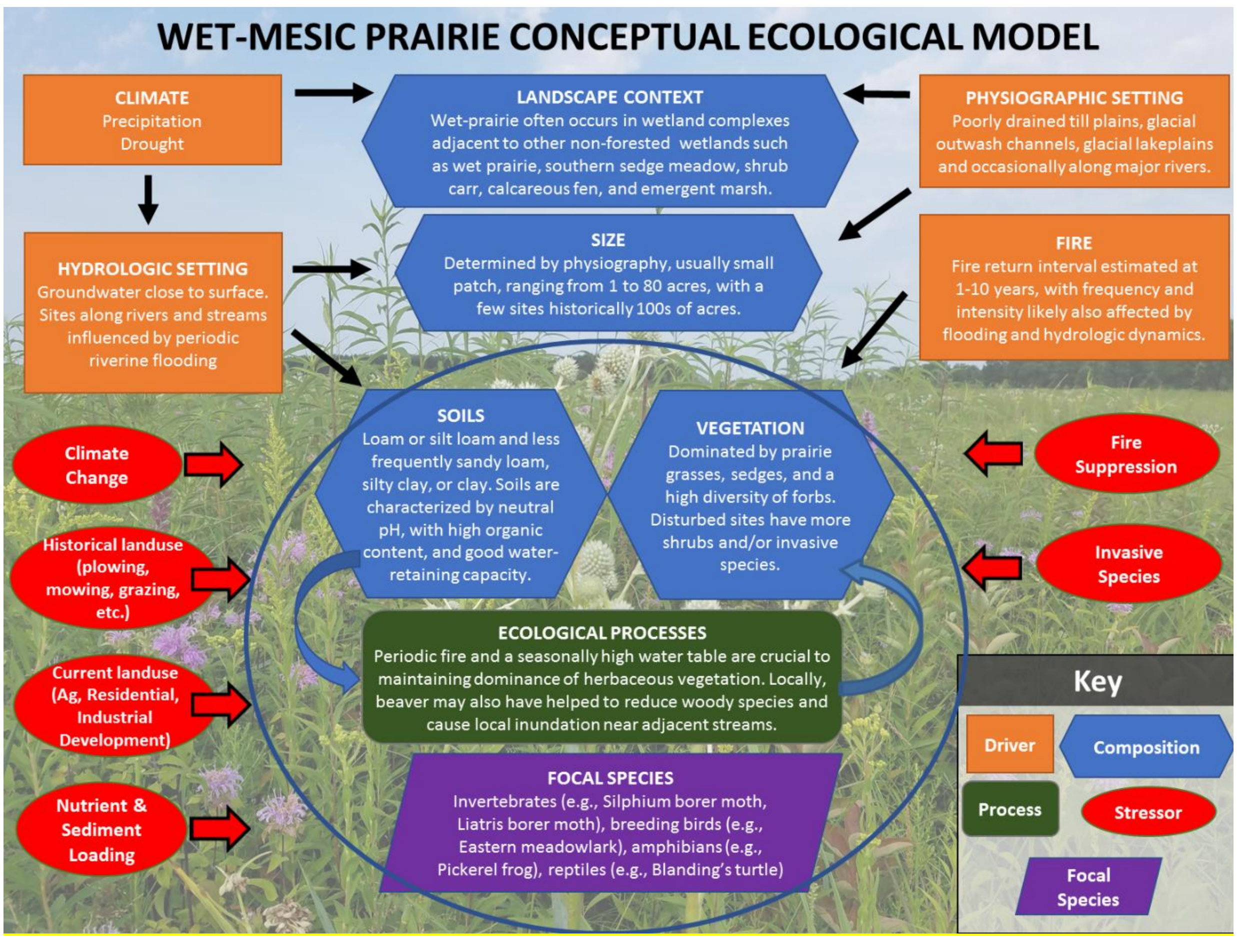


Figure 4. Conceptual ecological model for wet-mesic prairie.

COMPOSITION METRICS for Wet-mesic Prairie

1) Total % cover of major native grasses and sedges: big bluestem, little bluestem, Indian grass, switchgrass, prairie dropseed, prairie cordgrass, and sedges (*Carex* spp.).

A (Excellent)	B (Good)	C (Fair)	D (Poor)	E (Very Poor)	Your obs (e.g. 45%)	Letter rank (A-E)	Score (4, 3, 2, 1, 0)
>60%	40-60%	20-39%	5-20%	<5%			

Rationale and notes: Wet-mesic prairies are dominated by graminoids, and coverage of native grasses and sedges is strongly correlated with more detailed floristic quality benchmarks based on cover-weighted mean C. Unlike metrics for southern sedge meadow, data analysis showed similar correlations between total or absolute cover and relative cover (i.e., the ratio of graminoids to other vegetation). This may be due to slightly different growth patterns of dominant species and a lower tendency for grasses and sedges to occur within and beneath different vegetation structural layers. For example, native prairie grasses require full sun, and have little to no cover beneath shrubs, whereas some sedges of sedge meadows tend to coexist somewhat better in moderately shrubby situations. While sedges are included in this metric for wet-mesic prairie, they are usually a minor component, and a simplified version of the metric using total cover was selected for ease of use. For a more thorough discussion of the differences of total cover and relative cover, please see the rationale and notes for Composition Metric 1 of southern sedge meadow above.

2) Total % cover of non-native invasive grasses: reed canary grass (*Phalaris arundinacea*), Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), timothy (*Phleum pratense*), redtop (*Agrostis gigantea*), non-native Phragmites (*Phragmites australis* var. *australis*), etc. For the Score field, A minus = 3.5; C minus = 1.5.

A	B	C	D	E	Your obs	Letter rank	Score
A: >1% A- : 1-2%	3-5%	C: 6-15% C-: 16-30%	31-70%	>70%			

Rationale and notes: Non-native grasses also have a very high correlation with more detailed metrics of floristic quality. While reed canary grass is the most common non-native grass, other grasses are also lumped in this category including Kentucky bluegrass, smooth brome, timothy, redtop and non-native Phragmites. Other non-native invasive grasses could also be included in this category if abundant.

3) Total % cover of forb disturbance indicators: Canada goldenrod (*Solidago canadensis*), Queen Anne's lace (*Daucus carota*), wild parsnip (*Pastinaca sativa*), and sweet clover (*Melilotus* spp.). Include only bolting/ flowering/fruiting individuals, NOT basal rosettes.

A	B	C	D	E	Your obs	Letter rank	Score
0-1%	2-5%	6-15%	16-30%	>30%			

Rationale and notes: Disturbance forbs are strongly correlated with more detailed floristic quality benchmarks. While some species like Canada goldenrod tend to be indicative of previous soil disturbance, others like wild parsnip and sweet clover are highly invasive in both more disturbed and less disturbed prairies. While other non-native or weedy native forbs are also indicative of disturbance, the four species listed here accounted for the vast majority of disturbance forb cover in analysis of previously collected data. For ease of measurement, include only those individuals that are bolting, flowering, or fruiting. While basal rosettes of species like Queen Anne's lace, wild parsnip, and sweet clover are problematic and signal potential management challenges in the following year, coverage of rosettes was deemed difficult to accurately estimate by beta testers and potentially prone to significant measurement error. If rosettes are present and observers want to note them, use the management comments section at the end of the form.

4) Number of native forb species indicative of high-quality habitat (see checklist below). Optimal survey time is August.

A	B	C	D	E	Your obs	Letter rank	Score
15+	10-14	5-9	2-5	0-1			

Rationale and notes: Native forbs indicative of high-quality habitat are one of the best measures of not only existing good-quality habitat but also of moderately degraded sites that could be good candidates for restoration. This list of indicator forbs was selected from a candidate pool of nearly 150 species with a coefficient of conservatism (C value) of at least 4 that were found in a range of least disturbed to most disturbed conditions across 23 sites. All prospective species were screened using existing data, with final indicators selected based on their frequency of occurrence (had to occur in at least 25% of sites; rare or uncommon species were excluded), ability to discern between high quality and low quality sites (e.g., species that occurred on every site were excluded, even if traditionally thought of as a good indicator, such as mountain-mint (*Pycnanthemum virginianum*)), and ease of identification during the optimal survey window (e.g., species were excluded if they were difficult to identify by non-experts in late summer). In some cases where multiple species in the same genera could potentially be present and indicative of high-quality habitat, but species were deemed difficult to tell apart, species were lumped at the genus level. For example, prairie blazing star (*Liatris pycnostachya*) and marsh blazing-star (*L. spicata*) were lumped under a single checkbox for blazing star (*Liatris* sp.).

When evaluating this metric in the field, observers should take care to search all available habitat, and move slowly, taking care to find species that may be uncommon on the site. Unlike other metrics, this is based only on presence rather than cover. Species that are uncommon in the AA are just as important to the metric as those that are abundant and easy to observe. It is also important to note that species may not necessarily be flowering, even those that typically bloom in mid to late summer. While species have been selected for relative ease of identification during the optimal survey window, flowering may be limited due to shading of shrubs, recent disturbance, browsing, or other factors. For the species in the checklist, August is suggested as the optimal survey time for easiest identification, but July is also acceptable for observers familiar with vegetative or pre-flowering individuals of the indicator plants speices. Observers are encouraged to carry a wildflower identification book, and, if necessary, take a photo voucher (being sure to obtain clear images of diagnostic features such as flowers, fruits, stem and stem leaves, basal leaves, and overall habit). Physical voucher specimens can also be collected for later identification or confirmation. Voucher specimens can be preserved in a sealed plastic bag (1- or 2-gallon ziplock bags work great) stored in a cooler or refrigerator for up to 2 weeks or pressed flat between in a plant press (or a homemade version using newspaper, thick blotter paper, and stiff cardboard) for later identification.

Wet-mesic Prairie Composition subtotal: Take the AVERAGE score of metrics 1-4.

Rationale and notes: The various metrics of composition for wet-mesic prairie respond to stressors in the conceptual ecological model (Figure 4) in similar ways and are thus averaged for a composite score. For example, previous soil disturbance or heavy grazing tends to lead to a decrease in native grasses and sedges (1) as well as forbs indicative of higher quality habitat (4), while these disturbance result in an increase in non-native grasses (2) and disturbance forbs (3). This differs from the composition metrics for southern sedge meadow, which respond differently to different types of disturbance. For wet-mesic prairies, when calculating the composition subtotal, add the numerical scores of the four metrics together and divide by four. Use the Summary Ranking Guide on the bottom of page 2 of the field form to translate the composite numerical score back into a letter rank.

STRUCTURE METRICS

5) Total % cover of non-native invasive shrubs and trees (honeysuckle, common buckthorn, glossy buckthorn, crack willow, etc.)

A	B	C	D	E	Your obs	Letter rank
<1%	1-3%	C: 4-10% C-: 11-30%	31-50%	>50%		

Rationale and notes: Non-native invasive shrubs and trees are very problematic and difficult to control once well-established on a site. In addition to altering vegetation structure by increasing woody cover, they also tend to aggressively shade out other native vegetation and alter soil chemistry with nitrogen-rich leaves, making reestablishment of native species following removal more difficult compared to native shrubs. Note that the metric addresses non-native invasive shrubs and trees regardless of their size, and that even small individuals (i.e., less than 3 feet tall) should be included in the total estimate.

6) Total % cover of native trees and shrubs >3ft tall: dogwood, willow, hazelnut, viburnum, aspen, elm, oak, etc.

A	B	C	D	E	Your obs	Letter rank
0-5%	6-10%	C: 11-20% C-: 21-30%	31-70%	>70%		

Rationale and notes: Native shrubs should be sparse in wet-mesic prairies. Higher coverage of woody species is an indicator of degradation due to fire suppression, hydrologic disruption leading to a lower water table, and nitrogen deposition. Progressively higher cover of woody species leads to the loss of sedges and native forbs through shading. Because the primary concern is from shading, the metric evaluates only cover from taller-statured individuals (i.e., over three feet tall) of either trees or shrubs. When estimating this metric, include the entirety of woody species over three feet tall, rather than just the portion that is above three feet (Figure 3, page 10).

Structure subtotal: Take the LOWEST score of metrics 5-6.

Rationale and notes: While both native and non-native invasive shrubs and trees alter vegetation structure, the metrics measure different aspects of stress and disturbance. The best measure of overall vegetation structure is the lowest of the two metrics. If the structure of an AA is highly altered by either native or non-native invasive shrubs, the overall structure is considered altered.

HYDROLOGY METRICS

7) Are there hydrologic impairments affecting the site? Consider each stressor and check the box if current or historic stressors are *affecting* the assessment area. Rank the estimated level of impact as low, medium, or high.

Stressor	Currently within AA	Within a buffer of:	Historically within AA	Impact Level (L, M, H)
Ditch or excavated pond		100m		
Channelized stream		100m		
Effect of berm, dike, road, or RR grade		30-100m		
Mowing, haying, or grazing		-		
Plowing or drain tile		30m		
Sedimentation or legacy sediments		30m		
Nutrient enrichment		30m		
Stormwater/drain tile input		30m		

Rationale and notes: Hydrologic impairments are often the root cause of stressors to vegetation composition and structure. While this metric will likely be correlated with composition and structure metrics, it is helpful to evaluate hydrologic stressors independently. For a more thorough discussion of how to assess hydrologic impairments, please see section 8 in the general methods section on page 5.

SUMMARY RANK for Wet-mesic Prairie

Review composition, structure, and hydrology subtotal metrics. Convert to a final rank by using the guidance for summary rank.

Rationale and notes: An overall quality rank for the AA is useful for prioritization as well as for comparison from one survey period to the next. Similar to other parameter subtotals, the overall score is not an average but a reflection of the major impairments to the AA. Note that the final rank is calculated based on the three subtotal ranks, and not an evaluation of all seven individual metrics.

Literature Cited

Bourdaghs, M. 2012. Development of a Rapid Floristic Quality Assessment. Document number: wq-bwm2-02a. Minnesota Pollution Control Agency. St. Paul, MN.

Epstein, E.E. 2017. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management. Wisconsin Department of Natural Resources, PUBSS-1131H 2017, Madison, WI.

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

Gibson, M.C., A.P. Willman, P.T. Trochlell, and T.W. Bernthal. 2020. Condition Outcomes in Wetlands Restored Using a Variety of Hydrologic Restoration Techniques: An Application of Wisconsin DNR's FQA Methodology. Final Report to US EPA Region V. Grant #CD00E01576. Wisconsin Department of Natural Resources.

Hlina, P., N.P. Danz, K. Beaster, D. Anderson S. Hagedorn. 2015. Northern Lakes and Forests Inland Wetland Surveys: Relationship between Floristic Quality Assessment and Anthropogenic Stressors. Technical Report 2015-2, Lake Superior Research Institute, University of Wisconsin-Superior, Superior, WI.

Keough, H.; M. Kleitch; and J. McGowan-Stinski. 2011. Coarse-Level Metrics Methods and Guidelines for Assessing Restoration Progress in Oak Barrens, Pine Barrens, Dry Sand Prairie and Dry Prairie. USDA Forest Service Huron-Manistee National Forest and The Nature Conservancy. Lansing, Michigan.

Marti, A.M. and T.W. Bernthal. 2019. Provisional wetland Floristic Quality Benchmarks for wetland monitoring and assessment in Wisconsin. Final Report to US EPA Region V, Grants # CD00E01576 and #CD00E02075. Wisconsin Department of Natural Resources. EGAD # 3200-2020-01.

O'Connor, R. and K. Doyle. 2017. Setting Floristic Quality Assessment Benchmarks for Inland Wetland Plant Community Condition Across Wisconsin: Establishing a Reference Wetland Network. Report submitted to WDNR Bureau of Water Quality in fulfillment of U.S. Environmental Protection Agency Wetland Program Development Grant CD 00E78202. Wisconsin DNR. Madison, WI.

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.

Wisconsin Department of Natural Resources. 1990. Wetland Change Permit Tracking, Water Regulation and Zoning (WRZ), Wisconsin DNR. Madison, WI.

Wisconsin Department of Natural Resources. 2014. Wetland Rapid Assessment Methodology – User Guidance Document Version 2.0 Wisconsin DNR. Madison, WI. https://dnr.wi.gov/topic/wetlands/documents/wramuserguide.pdf

Wisconsin Department of Natural Resources. 2017. Timed-Meander Sampling Protocol for Wetland Floristic Quality Assessment. Wisconsin DNR. Madison, WI. https://dnr.wi.gov/topic/Wetlands/documents/TimedMeanderSamplingProtocol.pdf

WDNR Southern Sedge Meadow Coarse-level metrics

Version 2.2

Site name: _________________________________ Surveyors: __________________________________ Date: _________

Property/Management Unit Name: ___________________ Assessment Area (AA) name: _____________ AA acres: _____

GPS start: ___________________________ GPS end: __________________________ Attach digital or hand-drawn map of AA.

For each metric, write the corresponding measurement for your assessment area in "Your Obs" column, then enter a letter rank for that metric in the "Letter Rank" column following the ranking guidance.

COMPOSITION METRICS

1) Relative % cover of native wetland sedges and grasses (i.e., ratio of % cover native graminoids to % cover of other vegetation).

A (Excellent)	B (Good)	C (Fair)	D (Poor)	E (Very Poor)	Your obs (e.g., 45%)	Letter rank (A, B, C, D, E)	Notes
>60% (>60:40)	40-60% (40:60 to 60:40)	20-40% (20:80 to 60:40)	5-20% (20:80 to 5:95)	<5% (<5:95)			

2) Total % cover of non-native invasive grasses: reed canary grass (*Phalaris arundinacea*), non-native Phragmites (*Phragmites australis* var. *australis*), tall manna grass (*Glyceria maxima*), etc.

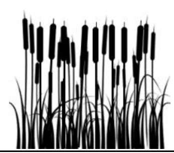
A	B	C	D	E	Your obs	Letter rank	Notes
<1%	1-3%	C: 4-10% C-: 11-30%	31-70%	>70% (see 2b below)			

2b) If non-native grasses metric is E, adjust score up to D if total % cover of tall forbs are at least 10% cover, including asters (*Symphyotrichum lanceolatum*, *S. puniceum*, etc.), Joe-pye-weed (*Eutrochium maculatum*), boneset (*Eupatorium perfoliatum*), touch-me-not (*Impatiens capensis*), and giant goldenrod (*Solidago gigantea*). Do not include Canada goldenrod in your estimate.

3) Total % cover of native Phragmites. If unsure if Phragmites in your AA is native or invasive, assume invasive & include in #2 above.

A	B	C	D	E	Your obs	Letter rank	Notes
0-5% AND abundant native plants beneath	6-15% OR, if >15%, abundant native plants beneath	16-30% AND some native species missing or reduced in cover	31-70% AND many native species missing or reduced in cover	>70%, many species missing			

4) Total % cover of native and non-native cattail (*Typha latifolia*, *T. angustifolia*, *T.* X *glauca*).

A	B	C	D	E	Your obs	Letter rank	Notes
0-5% AND sparse, single stems 	6-15% AND sparse, single stems 	16-30% OR moderately dense patches 	31-70%, very dense patches 	>70%, extensive monocultures 			Images modified from Vecteezy.com

5) Total % cover of disturbance forbs: Canada goldenrod (*Solidago canadensis*), Canada thistle (*Cirsium arvense*), stinging nettle (*Urtica dioica*), purple loosestrife (*Lythrum salicaria*), giant ragweed (*Ambrosia trifida*), etc.

A	B	C	D	E	Your obs	Letter rank	Notes
0-1%	2-5%	6-20%	21-35%	>35%			

Composition subtotal: Take the LOWEST score of metrics 1-5:

Metric #	**Letter rank**	**Notes**

Guide to percent cover:

5% 15% 25% 35% 45% 55% 65% 75% 85% 95%

STRUCTURE METRICS

6) Total % cover of non-native invasive shrubs (honeysuckle, common buckthorn, glossy buckthorn, etc.)

A	B	C	D	E	Your obs	Letter rank	Notes
<1%	1-3%	C: 4-10% C-: 11-30%	31-50%	>50%			

7) Total % cover of native shrubs and trees >3ft tall (dogwood, willow, elm, etc.)

A	B	C	D	E	Your obs	Letter rank	Notes
0-10%	10-20%	20-40%	40-70%	>70%			

Structure subtotal: Take the LOWEST score of metrics 6-7:

Metric #	Letter rank	Notes

HYDROLOGY METRICS

8) Are there hydrologic impairments affecting the site? Consider each stressor and check the box if current or historic stressors are *affecting* the assessment area. Rank the estimated level of impact as low, medium, or high.

Stressor	Currently within AA	Within a buffer of:	Historically within AA	Impact Level (L, M, H)	Notes
Ditch or excavated pond		100m			
Channelized stream		100m			
Effect of berm, dike, road, or RR grade		30-100m			
Mowing, haying, or grazing		-			
Plowing or drain tile		30m			
Sedimentation or legacy sediments		30m			
Nutrient enrichment		30m			
Stormwater/drain tile input		30m			

Hydrology metric subtotal:

A: None evident

B: Minimal: 1-2 alterations, all low impact

C: Moderate: 3-5 of low impact OR 1-2 of moderate impact

D: Major: 3-5 of moderate impact OR 1 of high impact

E: Severe: 2+ of high impact OR 1 high impact and 3+ moderate impact

Letter rank	Notes

SUMMARY

Review composition, structure, and hydrology subtotal metrics. Convert to a final score by using the guidance for summary rank:

Metric name	Letter rank	Notes
Composition subtotal		
Structure subtotal		
Hydrology subtotal		
FINAL RANK		

	Summary rank: Subtotals are:
A	All As
A-	2 As, 1 B
B	1 A, 2 Bs OR 3 Bs
B-	2 Bs, 1 C
C	1 B, 2 Cs
C-	3 Cs OR 1 C-
D	1 or more Ds
E	1 or more Es

Management recommendations: ____

____

____

____

Guide to percent cover:

5% 15% 25% 35% 45% 55% 65% 75% 85% 95%

WDNR Wet-mesic Prairie Coarse-level metrics

Version 2.1

Site name: ______________________________ Surveyors: ______________________________ Date: _________

Property/Management Unit Name: ________________ Assessment Area (AA) name: _____________ AA acres: _____

GPS start: __________________________ GPS end:__________________________ Attach digital or hand-drawn map of AA.

COMPOSITION METRICS

1) Total % cover of major native grasses and sedges: big bluestem, little bluestem, Indian grass, switchgrass, prairie dropseed, prairie cordgrass, and sedges (*Carex* spp.).

A (Excellent)	B (Good)	C (Fair)	D (Poor)	E (Very Poor)	Your obs (e.g. 45%)	Letter rank (A-E)	Score (4, 3, 2, 1, 0)	Notes
>60%	40-60%	20-39%	5-20%	<5%				

2) Total % cover of non-native invasive grasses: reed canary grass (*Phalaris arundinacea*), Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), wild timothy (*Phleum pratense*), redtop (*Agrostis gigantea*), non-native Phragmites (*Phragmites australis* var. *australis*), etc. For the Score field, A minus = 3.5; C minus = 1.5.

A	B	C	D	E	Your obs	Letter rank	Score	Notes
A: >1% A- : 1-2%	3-5%	C: 6-15% C-: 16-30%	31-70%	>70%				

3) Total % cover of forb disturbance indicators: Canada goldenrod (*Solidago canadensis*), Queen Anne's lace (*Daucus carota*), wild parsnip (*Pastinaca sativa*), and sweet clover (*Melilotus* spp.). Include only bolting/ flowering/fruiting individuals, NOT basal rosettes.

A	B	C	D	E	Your obs	Letter rank	Score	Notes
0-1%	2-5%	6-15%	16-30%	>30%				

4) Number of native forb species indicative of high-quality habitat (see checklist below). Optimal survey time is August.

A	B	C	D	E	Your obs	Letter rank	Score	Notes
15+	10-14	5-9	2-5	0-1				


☐ swamp thistle* (*Cirsium muticum*)


☐ false toadflax (*Comandra umbellata*)


☐ purple prairie clover (*Dalea purpurea*)


☐ showy tick-trefoil (*Desmodium candense*)


☐ northern bedstraw* (*Galium boreale*)


☐ blazing-star (*Liatris* sp.)


☐ Michigan lily (*Lilium michiganense*)


☐ puccoon spp. (*Lithospermum* spp.)


☐ prairie loosestrife* (*Lysimachia quadriflora*)


☐ winged loosestrife* (*Lythrum alatum*)


☐ stiff cowbane* (*Oxypolis rigidior*)


☐ wood betony (*Pedicularis canadensis*)


☐ yellow coneflower (*Ratibida pinnata*)


☐ compass-plant (*Silphium laciniatum*)


☐ prairie dock (*S. terebinthinaceum*)


☐ Riddell's goldenrod* (*Solidago riddellii*)


☐ stiff goldenrod* (*Solidago rigida*)


☐ sky-blue aster* (*Aster oolentangiensis*)


☐ Culver's-root (*Veronicastrum virginicum*)


☐ golden Alexanders (*Zizia aurea*)

*Similar species may occur in your sample area. A field guide may be useful to ensure accurate ID.

Guide to percent cover:

5% 15% 25% 35% 45% 55% 65% 75% 85% 95%

Avg score	Letter rank	Notes

Composition Subrank: Enter the AVERAGE score of metrics 1-4, then convert to letter rank using 'Comp subrank score range' in table at lower right.

STRUCTURE METRICS

5) Total % cover of non-native invasive shrubs: honeysuckle, common buckthorn, glossy buckthorn, etc.

A	B	C	D	E	Your obs	Letter rank	Notes
<1%	1-3%	C: 4-10% C-: 11-30%	31%-50	>50%			

6) Total % cover of native shrubs and trees >3ft tall: dogwood, willow, hazelnut, viburnum, aspen, elm, oak, etc.

A	B	C	D	E	Your obs	Letter rank	Notes
0-5%	6-10%	C: 11-20% C-: 21-30%	31-70%	>70%			

Structure subrank: Take the LOWEST score of metrics 5-6:

Metric #	Letter rank	Notes

HYDROLOGY METRICS

7) Are there hydrologic impairments affecting the site? Consider each stressor and check the box if current or historic stressors are affecting the assessment area. Rank the estimated level of impact as low, medium, or high. See SOP manual for examples.

Stressor	Currently within AA	Within a buffer of:	Historically within AA	Impact Level (L, M, H)	Notes
Ditch or excavated pond		100m			
Channelized stream		100m			
Effect of berm, dike, road, or RR grade		30-100m			
Mowing, haying, or grazing		-			
Plowing or drain tile		30m			
Sedimentation/legacy sediments		30m			
Nutrient enrichment		30m			
Stormwater/drain tile input		30m			

Hydrology metric subrank:

A: None evident

B: Minimal: 1-2 alterations, all low impact

C: Moderate: 3-5 alterations of low impact OR 1-2 of moderate impact

D: Major: 3-5 alterations of moderate impact OR 1 of high impact

E: Severe: 2+ alterations of high impact OR 1 high impact & 3+ moderate impact

Letter rank	Notes

SUMMARY: Enter composition, structure, and hydrology subranks, then use summary rank column in table below for final rank.

Metric name	Letter rank	Notes
Composition subrank		
Structure subrank		
Hydrology subrank		
FINAL RANK		

	Comp subrank score range	**Summary rank:** Subranks are:
A	3.80 – 4.0	All As
A-	3.79 – 3.5	2 A, 1 A- or B
B	3.49 – 3.0	1 A, 2 Bs OR 3 Bs
B-	2.99 – 2.5	2 Bs, 1 C
C	2.49 – 2.0	1 B, 2 Cs
C-	1.99 – 1.5	3 Cs OR 1 C-
D	1.49 – 1.0	1 or more Ds
E	<1.0	1 or more Es

Management recommendations: ____

____

____

Guide to percent cover:

5% 15% 25% 35% 45% 55% 65% 75% 85% 95%