Monitoring Fire Management of Oak Savanna and Tall Grass Prairie in Rondeau Provincial Park

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Abstract

Rondeau Provincial Park has recently begun a fire management program aimed at restoring significant oak savanna and oak woodland communities. The purpose of this paper is to provide an outline of the monitoring protocols developed as part of an adaptive management framework for the prescribed fire program. These protocols are based on review and recommendations outlined in a background report prepared by North-South Environmental Inc. (2002a) and they have provided to Rondeau Provincial Park in a report that provides detailed field data collection methods and data analysis techniques (North-South Environmental Inc. 2002b).

This paper includes an introduction detailing the following: an outline of site conditions; fire management in oak savanna and oak woodlands; the goal of the fire management program at Rondeau Provincial Park;the indicators selected to assess the management objectives; determination of the required sampling intensity for statistical certainty; the expertise required by staff conducting monitoring; and the monitoring logistics and schedule.

Following the introduction, the monitoring program is summarized to provide an outline of the following:site establishment; establishing sampling transects; and a summary of the objective, rationale, and a brief outline of the methods for each monitoring protocol (please refer to North-South Environmental Inc. 2002b for a detailed description monitoring protocol methods, data collection sheets and analysis methods).

Site Description

Rondeau Provincial Park is located on a cuspate sand spit on the north shore of Lake Erie. Fluctuating water levels have created a series of sand dunes parallel to the north-south orientation of the peninsula. The resulting ridge and trough topography, combined with sandy substrates has resulted in the formation of oak savanna and oak woodland vegetation communities considered uncommon in the

province.

The oak savanna communities are located primarily along the eastern and northern edge of the peninsula. The savanna grades into a transitional woodland habitat towards the interior of the peninsula (Ontario Parks, 2001a). Large openings are present in the tree canopy in some areas and prairie species proliferate in many places in the understory.

The oak savanna and oak woodland habitats have in the past been impacted by mowing, planting of aggressive, exotic plant species, fire suppression and grazing by white-tailed deer. Mowing was discontinued in these habitats in 1994 and grazing by white-tailed deer has declined in the 1990s as a result of a culling program. Despite the large degree of disturbance to plant communities in the Park, many features and species indicative of the original savanna environment are still present.

Fire Management

The role of fire in the maintenance of oak savanna and woodlands is well established. The exclusion of fire from the savanna and oak woodland has resulted in an increase in woody vines, shrubs and trees creating a dense, shaded understory which excludes sun-loving prairie forbs and grasses. A century of fire suppression, combined with other impacts such as a large deer population and invasive plants, will mean that a substantial management effort will be required to restore the original character of the savanna and woodland habitats in Rondeau. A long-term management program that includes the application of regular prescribed burns will be a key component of this restoration program. Monitoring changes in savanna resulting from the application of prescribed fire will provide an indication of the response of vegetation to fire management and the degree to which the structural/functional features are being restored/maintained.

Goals, Objectives and Monitoring Indicators for Fire Management

The establishment of clear goals and objectives provides a framework that guides and directs resource management. Goals and objectives that relate back to the mandate and obligations of resource managers provide benchmarks against which the results of management prescriptions can be evaluated, thus providing an adaptive management framework that refines resource management prescriptions. This is particularly important where there is an imprecise knowledge of the effects of management intervention, such as is the case with prescribed fire, and where there are confounding factors, such as invasive exotic species and seasonal variation in

climate. In adaptive resource management, monitoring is the tool that demonstrates when management actions are correlated with movement towards or away from goals and objectives. For example, if an objective of fire management is to achieve a particular degree of canopy opening, monitoring will reveal if this is being achieved and this information can be used to guide future burn prescriptions and/or indicate the need for mechanical removal of woody vegetation.

Six indicators have been selected to monitor fire management in Rondeau Provincial Park based on the goal and objectives that have been established in the background report to this document (see Table 1 and North-South Environmental Inc. 2002a). The indicators have been selected based on their ability to provide reliable, quantitative data that can be easily and rapidly collected by summer park staff with limited field experience who are under the direction of a Park Ecologist. The indicator data collected should clearly show whether the objectives of the fire management program are being met by the current prescribed burning or whether a refinement of management is required to meet the objectives.

Table 1. Fire management goal, objectives and corresponding indicators for Rondeau Provincial Park.

Fire Management Goal: ***To restore the ecological functions and attributes of the oak savanna, pine-oak savanna and oak woodland habitats in Rondeau Provincial Park through the reduction of woody plants and exotic species, while at the smae time stimulating the production of native forbs, grasses, sedges and tress.***	
Fire Management Objectives	**Fire Management Indicators**
Increase the abundance of native graminoids (grasses and sedges) and forbs typical of oak savanna and oak woodland	indicator species, grasses and sedges
Decrease the abundance of non-native cool season grasses	grasses and sedges
Decrease the abundance of woody species (especially exotic species)	tree sapplings, shrubs, stand composition
Increase the plant and animal diversity of the oak savanna and woodland habitats	species diversity

Determining Sampling Intensity

Monitoring data available from 2000 and 2001 (Hart, 2002) permitted an analysis of the statistical power of quadrat sampling of plant populations at Rondeau using the software package MONITOR, version 6.2 (Gibbs, 1995). This analysis provided an understanding of the ability of the current monitoring program to detect trends in plant abundance over a ten-year monitoring period. The software allows the user to vary the number of monitoring sites and frequency of monitoring (in addition to other parameters), to determine the potential statistical power of the sampling design. A general rule used was to look for power estimates that exceed 0.80 (Gibbs, 1995), meaning that trends would likely be detected greater than 80% of the time.

Gibbs (1995) notes that it is generally easier to detect positive change then negative change over time in populations.

Using the power analysis software with data collected at Rondeau Provincial Park in 2000 and 2001, it was determined that 40 quadrats would detect a 6% negative trend 81% of the time and a 10% negative trend 98% of the time; 30 quadrats would detect a 6% negative trend 70% of the time and a 10% negative trend 93% of the time; and 20 quadrats would detect a 6% negative trend only 27% of the time and a 10% negative trend only 49% of the time. It was concluded from these analyses that 40 quadrats should provide good statistical power at Rondeau to show negative trends in the monitoring data and would provide excellent statistical power to show positive trends.

Expertise

The majority of the fire monitoring program for Rondeau Provincial Park has been designed for implementation by a team of three people. It is expected that the team will be composed of seasonal summer staff with little or no previous experience in vegetation sampling or plant identification. It is anticipated, therefore, that a one or two day training workshop would be held at the beginning of each field season to familiarize the team with monitoring protocols and that pressed plant specimens would be available for training in plant identification. The diversity monitoring protocol outlined below differs from the other protocols in that it is based on data collection by field personnel or researchers that are experts in sampling and identifying select groups of plants and animals.

The monitoring protocols have been selected to minimize errors in data collection. For example, the monitoring of prairie indicator species is based on species that they are highly visible and easy to identify for staff with limited field experience. Also the identification and monitoring of shrubs and trees should not pose serious problems to inexperienced field personnel due to the limited number of species that will be encountered. Where it is recognized that some extra attention and expertise will be required, such as in the identification of willow shrub species, protocols have been outlined for the collection and later confirmation of species encountered in sampling.

The more difficult monitoring protocol from a data collection and more importantly data quality stand point is the determination of grass and sedge abundance. This monitoring protocol is based on percent cover, a measure that has long been documented as having problems due to observer bias. To minimize observer bias, smaller quadrats ($0.25m^2$), visible in their entirety by the human eye, and a modified Braun-Blanquet cover abundance rank method have been used to achieve the highest possible level of consistency in data collection (Masters, 1997).

Monitoring Logistics and Schedule

The monitoring protocols have been developed to permit the completion of all data collection along a single transect before continuing on to the next one. Those indicators sensitive to trampling effects are sampled first. Indicator species and tree sapling abundance are conducted at the same time with one member of the monitoring team walking down one side of the transect line and the two other members of the team walking at the edge of the belt transect. Grass and sedge abundance is conducted on the opposite side of the transect to the previous sampling. Shrub abundance is sampled next as it is unlikely that the trampling effects of the latter sampling will affect shrubs. Stand composition could then be measured last from the centre of each transect.

After a few years of monitoring the field methods will no doubt be refined to make the best possible use of staff and time. It is expected that after five years, the frequency for some monitoring, such as stand composition, should be reviewed. If for example the changes in the stand composition data are not occurring on an annual or bi-annual basis, the time period between conducting sampling for stand composition could be lengthened to once every two years or more.

Monitoring Methods

The first step in establishing a monitoring program is to select a monitoring site such that it is composed of a single vegetation community. The second step is to determine the location and placement of transects for monitoring. The number and length of transects will vary for each monitoring site, however, there are specific requirements for locating transects that will dictate their location in the site and the total length required.

1. Transects must not be within 50 m of a vegetation community edge. This requirement is due to the 'prism sweep' requiring a radius of 50 m as well as a desire to minimize vegetation "edge effects" as much as possible.
2. To conduct the stand composition monitoring protocol there must be a minimum of four transects within each vegetation community. In addition, each transect must be a minimum of 100 m in length and located at least 50 m from any other transect.
3. The monitoring protocol for grass and sedge abundance requires quadrats to be located every 10 m along each transect. Power analysis (see above) allows a determination of the number of quadrats required for monitoring and this will determine a minimum total transect length. For Rondeau Provincial Park, a minimum of 40 quadrats is required to provide statistical power for data analyses and this translates into a minimum total transect length of 400 m.

If the vegetation community being monitored is sufficiently large, then transects could be located randomly within it. Random transects are not practical in Rondeau Provincial Park due to the ridge and trough topography as well as the location of the savanna and woodland communities in a narrow band (400 m wide) along the eastern shoreline of the peninsula. It has been determined that the placement of transects should be perpendicular to the shoreline and thus perpendicular to the ridge and trough topography; in this way sampling will capture the natural variability inherent in this community.

Monitoring Site Establishment

- Select and clearly define the monitoring site (e.g., burn blocks for 2003), noting that a site must be composed of a single vegetation community type.
- Within the monitoring site transects will be established for data collection (see below).
- An accurate map should be prepared to show the location of a monitoring site, including access to the site, the location of sampling transects and other general information that may be useful.
- Complete the site establishment data sheet with information such as observer names, date, site condition, etc.
- Using the Ecological Land Classification manual (Lee *et al.*, 1998) determine and record Habitat Information and Stand Description on a site establishment data sheet.
- Using the ELC manual (Lee *et al.*, 1998) or the field manual for describing soils in Ontario (Denholm and Schut 1993) complete the soil analysis information on the site establishment data sheet. Be sure to locate a soil auger sample within a permanent transect location.
- File paper and/or electronic copies of the site establishment data sheet where it can be located in the future.
- Every five years, briefly review and update where necessary, the site establishment data sheet.

Transect and Plot Establishment

- Define the number and length of transects required for monitoring. In Rondeau this must be achieved through a transect configuration with a minimum of 400 m of transect length, using four transects, each 100m in length.
- Define the number, location and size of quadrats. In Rondeau a minimum of 40 quadrats, 50 cm x 50 cm are recommended; this translated into a quadrat located every 10 m on each of the 100m transects.
- Establish transects by permanently marking the start and end locations with steel rods inserted into the ground with approximately 10 cm of

rod exposed above the soil.

- Paint the top of the steel rods with bright coloured spray paint to assist in re-location in future years.
- Determine the exact position (UTM grid coordinates) of the start and end locations using a Global Position System (GPS) unit. Differential correction of GPS readings should be considered to obtain sub-one metre accuracy.
- Take a compass bearing of the direction the transect follows from start to the end.
- Take a photograph from the start location along the length of the transect directly towards the end location. This photograph should be taken from a tripod with the lens 1.6m from the ground using a standard 50mm or 55mm lens.
- File paper and/or electronic copies of the transect establishment data sheet where they can be located in the future.
- Every five years, briefly review and update where necessary, the transect establishment data sheet.

Monitoring Protocol 1 - Plant Indicator Species

Objective

To monitor the change in the presence and abundance of native forbs typical of oak savanna and oak woodland communities.

Rationale

Sampling a few relatively easy to identify forb indicator species will provide information on how savanna forbs are responding to fire management. The indicator plants selected are species typical of oak savannas and woodlands. These species may not currently be present within all the transects, as the current vegetation communities being sampled have dense tree canopies due to past fire exclusion. However, by monitoring species that are expected to increase in frequency when the tree canopy opens, the restoration of the woodland and savanna communities can be tracked. Frequency sampling is considered highly objective, repeatable, rapid and simple, involving a minimum number of decisions limited to identifying a few easily recognizable indicator species and determining whether or not a particular individual is rooted within the belt transects.

Methods

- Monitoring is conducted along 2m wide belt transects with permanently marked start and end points (see site and transect establishment).
- A minimum 400m total transect length is recommended. For Rondeau,

four transects 100m in length are recommended.

- Sampling should be conducted once a year in August, at the peak of native forb flowering.
- Stretch a tape measure or rope marked in centimetre increments between the start and end points of the transect stakes as close to the ground as possible with the zero mark aligned with the start stake. Do not allow vegetation to deflect the alignment of the tape.
- Using a wooden dowel 2m in length (the centre point marked with a notch or permanent ink) or another suitable measuring stick two people walk along either edge of the wooden dowel, looking in towards the transect line searching for and recording any of the following indicator specimens:

  - butterfly weed (*Asclepias tuberosa*);
  - wild bergamot (*Monarda fistulosa*);
  - blazing star (*Liatris cylindracea*);
  - Canada tick-trefoil (*Desmodium canadense*);
  - pointed leaved tick-trefoil (*Desmodium glutinosum*);
  - round-headed bush-clover (*Lespedeza capitata*);
  - woodland sunflower (*Helianthus divaricatus*);and,
  - starry false Solomon's seal (*Maianthemum stellatum*).

Monitoring Protocol 2 – Tree Saplings

Objective

To monitor the change in the abundance of woody species (especially exotic species) within the oak savanna and oak woodland communities.

Rationale

Sampling the abundance of tree saplings within the savanna and woodland habitats will provide direct information on the change in abundance of woody species as well as indirect information on changes in community composition. Frequency sampling is considered highly objective, repeatable, rapid and simple, involving a minimum number of decisions limited to identifying a few easily recognizable species and determining whether or not a particular individual is rooted within the belt transect.

Methods

- Monitoring is conducted along 2 m wide belt transects with permanently marked start and end points (see site and transect establishment). A minimum 400 m total transect length is recommended. For

Rondeau, four transects, 100 m in length are recommended.

- Sampling should be conducted once a year in August. This monitoring protocol should be conducted in conjunction with Monitoring Protocol 1 - Indicator Species.
- Using a wooden dowel or other suitable measuring stick 2 m in length (the centre point marked with a notch or permanent ink) two people walk along either edge of the wooden dowel, looking in towards the transect line searching for any tree saplings (trees with DBH >2 cm and <10 cm).
- Record by dot (or dash) count tally on the data sheet, the number of saplings for each tree species that are rooted within the belt transect. Record the total number of counts made for each species per transect.
- Confirm the identification of the tree species. If the identification is not positive use a unique, tentative identification on the data sheet and collect a specimen for later identification. Attempt to determine the identification of as many dead tree saplings as possible to the species level.
- Continue until the end of the transect is reached.

Monitoring Protocol 3 - Abundance of Grasses and Sedges

Objective

To monitor the change in the abundance of native graminoids (grasses and sedges) and non-native cool season grasses in oak savanna and woodland communities.

Rationale

Monitoring the change in cover of graminoid species along a transect will provide an indication of changes in the understory of the savanna and woodland restoration sites. Changes in graminoids will provide information on whether the tree canopy is opening up as a result of prescribed fire as well as how subsequent fires will behave (understory composition or grasses and sedges is related to the fine fuels in prairies and savannas a factor that effects the rate of spread and heat attained during a fire). While monitoring plant cover and identifying graminoids to species is not simple, the use of small quadrats (0.25 m^2) and a cover abundance index instead of direct percent cover should reduce the amount of error associated with estimating cover, and capture only the most abundant graminoid species, reducing identification errors.

Methods

- Monitoring is conducted in minimum of forty, 50 cm x 50 cm quadrats located at 10 m intervals along each 100m transect.
- Sampling should be conducted once a year in August. After the first

year of monitoring if it is determined that identification of cool season grasses is not feasible, then consideration should be given to conducting sampling in July.

- Place a 50 cm by 50 cm quadrat frame open on one side at the designated monitoring interval beginning at the start of transect and every 10m along the transect. The quadrat frame should be placed perpendicular to the transect line, on the left-hand side of the transect, with the rear right-hand corner of the frame aligned with the designated interval on the transect line.
- Determine the identification of each grass and sedge rooted in the quadrat, to the species level. If an identification is not possible in the field use a unique, tentative identification on the data sheet and after the data is collected for the quadrat, collect a specimen for later identification.
- Assign each species rooted in the quadrat a cover abundance rank as described on the data sheet. Only one rank is given to each species per quadrat.

Monitoring Protocol 4 - Abundance of Shrubs

Objective

To monitor the change in the abundance of woody species (especially exotic species) within the oak savanna and woodland communities.

Rationale

The exclusion of fire from fire regenerated ecosystems will often lead to the proliferation of woody plants, particularly shrubs, creating shade that excludes the growth of sun-loving prairie grasses, sedges and forbs. Sampling the cover of shrub species within the savanna and woodland habitats will provide direct information on the change in abundance of woody species as well as indirect information on changes in community composition. The line intercept method is considered well suited for estimating cover of shrubs (Smith, 1980; U.S. Forest Service, 2002).

Methods

- Monitoring is conducted directly along the length of each transect.
- Sampling should be conducted once a year in August.
- Re-locate the transect start and end locations in the field. If the stakes have become difficult to locate re-apply spray paint to the tops.
- Beginning at the zero mark, and walking down the left hand side of the transect line, proceed down the length of the transect until a shrub is encountered that is touched by the transect line or lying under or over it. If a shrub thicket is encountered each shrub species should be

considered separately. Do not consider woody vines (riverbank grape, Virginia creeper) or tree saplings or seedlings.

- Determine the shadow, or distance covered by the downward projection of foliage, onto the transect line in centimetres. Be sure not to inadvertently move the tape or exclude any shrubs.
- Determine the identification of each shrub to species. If identification is not possible in the field use a unique, tentative identification on the data sheet and after the data is collected for the shrub collect a specimen for later identification.
- For each shrub encountered, record on the data sheet the shrub species, the point on the transect line (in centimetres) where the shadow or foliage projection starts and where it ends.
- Continue until the end of the transect is reached.

Monitoring Protocol 5 – Stand Composition

Objective

To monitor change in the abundance of woody species (especially exotic species) within the oak savanna and oak woodland communities.

Rationale

Stand composition, both tree species abundance as well as the basal area of the site, can provide information on changes in the tree canopy of the savanna and woodland communities. This protocol is based on the prism sweep method, which is relatively straightforward with limited decision making to introduce error in the data.

Methods

- Monitoring is conducted at the centre point of each transect (minimum 100 m in length).
- Sampling should be conducted once a year in August.
- A 'prism sweep' is conducted at the central point on each transect (50m mark) using a wedge or cruising prism with a 2x prism factor. The wedge prism is calibrated such that a prism sweep will include trees in the tally based on a combination of their distance from the sampling point and the diameter of trees in the field of view. The ELC manual (Lee *et al.*, 1998) outlines detailed methods for the use of a wedge prism.
- Record by dot (or dash) count tally-the number of individuals for each tree species encountered in each prism sweep. A single tally count is made for each species per sweep.
- Determine the identification of each tree to species. If identification is

not possible in the field use a unique, tentative identification on the data sheet and collect a specimen for later identification. Dead trees are counted and should be identified if possible.

Monitoring Protocol 6 - Plant and Animal Species Diversity

Objective

To monitor changes in the diversity of plants and animals inhabiting the oak savanna and oak woodland communities.

Rationale

Biodiversity, the different kinds of plants and animal populations present in a community, will provide information on the overall health of the prairie and oak savanna communities. With conscientious long-term tracking of the presence/absence of all species within a site (vegetation community), changes in the overall plant and animal species composition of the community will become apparent.

Methods

- Monitoring is conducted throughout each site (vegetation community).
- Observations are made throughout the year, whenever feasible and is when best suited for certain species observations.
- Create a database (checklist) of the plant and animal species present in each site (vegetation community).
- This database could be produced using plant and/or animal observations collected as part of other research and monitoring studies (e.g., Forest Bird Monitoring, small mammal trapping, *etc.*) or as part of normal park operations.
- If plant and animal observations for the site (vegetation community) are not available, a comprehensive survey will be required to produce one.
- Individual(s) with detailed knowledge of the park should compile all of the observations from research and monitoring studies as well as casual observations on an annual basis. Any questionable observations should be confirmed before they are entered into the database. Observations of any species that are not already in the database for the site need to be confirmed with a specimen (in the case of a plant) or by a recognized expert for animal species.
- Every five years, individuals with detailed knowledge of the site should review information gathered over the five year period and summarize changes in the animal and plant species composition of the site (vegetation community).

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