National Park Service
Agate Fossil Beds National Monument, Nebraska
Fire Effects Monitoring Plan

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INTRODUCTION

Agate Fossil Beds National Monument (AGFO) encompasses 3055 acres of which 2270 are federally fee-owned in western Nebraska. The park was established to protect the concentrations of animal fossils found in beds of sedimentary rock in the area. Vegetation of the park is largely mixed-grass prairie with the exception of the riparian areas adjacent to the Niobrara River, which bisects the park. Dominant species of the mixed-grass prairie include needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), threadleaf sedge (*Carex filifolia*), western wheatgrass (*Pascopyrum smithii*), prairie sandreed (*Calamovilfa longifolia*), and sand bluestem (*Andropogon hallii*). Mixed-grass prairie dominated by western wheatgrass (*Pascopyrum smithii*), needle-and-thread, and grama grasses (*Bouteloua* spp.) is believed to be the major pre-settlement vegetation type for the area, although the exact composition of the communities before settlement is unknown. Kuchler (1964) described the potential vegetation for the AGFO area as wheatgrass-needlegrass prairie and Nebraska sandhills prairie.

Large and small-scale disturbances shaped the landscape of AGFO and surrounding areas. Disturbances included seasonal bison grazing, extended wet and dry periods, soil disturbance (bison wallows and prairie dog towns) and fire. Some of these disturbances continue in AGFO today. Fires started both by lightning and Native Americans maintained the prairies and kept shrubs and trees limited to wetter areas or areas of broken topography until the area was settled by Europeans in the 1880s. Fire suppression, overgrazing and plowing for farming broke up the areas of continuous fuels and significantly reduced the number of fires and acres burned. The lack of trees with fire scars make interpreting fire history for the area difficult. Wendtland (1993) considered historical accounts and fire scar data from the edges of the Black Hills. They estimated fire return intervals from as short as 5 years in level to gently rolling topography to 15-30 years in more broken topography at Scotts Bluff, Nebraska.

Collins and Gibson (1990) documented the need for an interaction of four different disturbance types to maintain diverse community structure in mixed grass prairie. The interaction of cyclical weather patterns, grazing, fire and soil disturbance--both bison wallows and prairie dog towns--alters community structure. In the absence of any one of these disturbances, species richness (the number of species per unit area), evenness (the distribution between dominance among species), and patch structure (the association of species at various spatial scales) will change. The absence of fire tends to increase woody species and reduce species richness and patch structure. The absence of grazing by large ungulates and/or soil disturbance reduces species diversity and decreases community heterogeneity. Management actions that include all disturbance types should be considered to maintain diverse community structure.

Prescribed fire will be used to maintain and restore the fire-adapted ecosystems at AGFO. National Park Service (NPS) Reference Manual 18 states, “Monitoring is a critical component of fire management and the Fire Monitoring Plan is important to identify why monitoring will be done, what will be monitored, how it will be monitored, where it will be done, and how often it will be completed.” Monitoring of these fires is mandated in Director’s Order #18: Wildland Fire Management issued in 1998. Section 5.2, *Fire Management Plans* (no. 10) states, “Include procedure for short and long term monitoring to document that overall program objectives are

being met and undesired effects are not occurring". Section 5.8 directly addresses *Prescribed Fire Monitoring*:

a) Fire effects monitoring must be done to evaluate the degree to which objectives are accomplished.
b) Long-term monitoring is required to document that overall programmatic objectives are being met and undesired effects are not occurring.
c) Evaluation of fire effects data is the joint responsibility of fire management and natural resource management personnel.

There are two communities at AGFO that will be monitored: (1) native mixed-grass prairie, and (2) non-native prairie. There is no record of significant fire within the current park boundary for nearly a century and grazing by domestic livestock ended in 1974. Fire will be used to restore non-native communities to more native conditions and to maintain native systems by burning within the predicted range of fire return intervals. A more complete discussion of fire effects and management follows.

DESCRIPTION OF THE ECOLOGICAL MODEL

NORTHERN GREAT PLAINS MIXED-GRASS PRAIRIE

The vegetation of AGFO is mixed-grass prairie. Mixed-grass prairie is characterized as having a mixture of mid-height and shortgrasses as well as a mixture of cool- and warm-season grasses (Singh et al. 1983). This diversity of species found on the Northern Great Plains is a result of great and repeated migrations of species that responded to changes in climate during periods of glaciation (Weaver and Albertson 1956, Wells 1970). One of the unique traits of the Northern Great Plains mixed-grass prairie is the dominance of cool-season grasses (Singh et al. 1983). A complex disturbance regime of biotic and abiotic disturbances (including periodic drought, grazing, fire, and soil disturbances) have interacted to form and continue to maintain grasslands of the Northern Great Plains (Anderson 1990, Collins and Gibson 1990). These disturbances also interact with climate, topography, soils, and competition among plant species to influence grassland composition (Fig. 1) (Wells 1970, Wright and Bailey 1980, Collins and Gibson 1990).

Although cool-season species tend to dominate northern mixed-grass prairies, warm-season species co-dominate on more xeric sites since these species are generally better adapted to warm, dry conditions (Singh et al. 1983). Light to moderate grazing also favors warm-season species while heavy grazing can shift composition toward warm-season shortgrasses like buffalograss (*Buchloe dactyloides*) and blue grama (Weaver and Albertson 1956, Ode et al. 1980, Singh et al. 1983). Native ungulates generally favor graminoids over forbs which may lead to increases in occurrence of forb species (Krueger 1986). Annual forbs colonize small-scale soil disturbances such as prairie dog mounds or buffalo wallows (Collins and Gibson 1990).

Historically, fire was a frequent and large-scale disturbance on northern mixed-grass prairies and continues to be a tool that managers use. Historic fire frequencies are very difficult to determine largely due to a lack of trees on the plains to record fire scars (Wright and Bailey 1980). Most fire frequency estimates have been based on accounts of early settlers or known fire frequencies needed to prevent woody plant encroachment into grasslands. Mean fire return intervals have been estimated at 4 to 9 years for the sandhills of north-central Nebraska (Steinauer and Bragg

1987), 10 to 12 years for the forest-prairie ecotone of the Black Hills of South Dakota (Brown and Sieg 1999), and 15 to 30 years for the broken topography of Scotts Bluff National Monument, Nebraska (Wendtland and Dodd 1990, Wendtland 1993).

Ignition sources for fires in presettlement times are believed to be mainly lightning and ignition by American Indians, both intentional and unintentional. A study of lightning-ignited fires in the Northern Great Plains over the past five decades indicates that nearly 75% of lightning-ignited fires occurred during July and August and lightning-ignited fires were recorded every month from April to September (Higgins 1984). It is presumed that this pattern has not changed significantly for at least a few centuries. Historical documents and accounts of early settlers suggest that there were two seasonal periods for fires ignited by American Indians, one during the spring with a peak in April and one during the fall with a peak in October (Higgins 1986).

Effects of fire can vary depending on the season the burn occurred, frequency of fire, grazing history, precipitation before and after burn, vegetation composition, fire intensity and severity, and topography (Anderson 1990, Collins and Gibson 1990). Fire can influence both productivity and structure of plant communities. Productivity may be increased following fire as a result of reduction in the litter layer and grazing may have similar effects (Anderson 1990). In mixed-grass prairie, with both warm- and cool-season species, season of burn can strongly affect species composition. Generally, spring and fall burns favor warm-season grasses while summer burns tend to favor cool-season grasses (Steuter 1987, Howe 1994).

VEGETATION OF AGATE FOSSIL BEDS NATIONAL MONUMENT

The vegetation of AGFO is comprised of three general types: 1) native mixed-grass prairie, 2) non-native prairie, and 3) Niobrara River floodplain (Fig. 2). Before AGFO was authorized, the area was grazed by domestic livestock and parts of the current park were used for other agricultural purposes (i.e., cultivation, livestock corral). Nevertheless, the overall condition of vegetation is good and is considered similar to historic vegetation communities (Stubbendieck and Willson 1986).

Native mixed-grass prairie

Mid- and upper-slopes are generally covered by needle-and-thread, threadleaf sedge, and blue grama. Lower slopes contain needle-and-thread, prairie sandreed, western wheatgrass, and sand bluestem. Shrubs and subshrubs include yucca (*Yucca glauca*), skunkbush sumac (*Rhus aromatica*), and fringed sagewort (*Artemisia frigida*). Forbs such as annual sunflower (*Helianthus annuus*), slimflower scurfpea (*Psoralea tenuiflora*), milkvetches (*Astragalus* spp.), milkweeds (*Asclepias* spp.), and rush skeletonplant (*Lygodesmia juncea*) are found in these areas. Non-native species present include cheatgrass (*Bromus tectorum*), prickly lettuce (*Lactuca serriola*), lambsquarters (*Chenopodium album*), goatsbeard (*Tragopogon dubius*), field pennycress (*Thlaspi arvense*), and Kentucky bluegrass (*Poa pratensis*).

Non-native prairie

This vegetation type occurs mainly in disturbed areas or areas that were under cultivation before the park was established. Cheatgrass is the most common non-native grass, but Kentucky bluegrass, Japanese brome (*Bromus japonicus*), and crested wheatgrass (*Agropyron cristatum*) are also present. Non-native forbs include kochia (*Kochia scoparia*), Russian thistle (*Salsola*

tragus), and tumble mustard (*Sisymbrium altissimum*), yellow sweetclover (*Melilotus officinalis*), Canada thistle (*Cirsium arvense*), and curly dock (*Rumex crispus*). Native species such as prairie sandreed, needle-and-thread, blue grama, western wheatgrass, sedges (*Carex* spp.) and annual sunflower also occur in this vegetation type.

Niobrara floodplain

The floodplain can be separated into the lower, middle, and upper terraces. The lower terrace is adjacent to the river and tends to be the wettest part of the floodplain. Graminoids that occur on the lower and middle terraces include sedges, rice cutgrass (*Leersia oryzoides*), foxtail barley (*Hordeum jubatum*), Baltic rush (*Juncus balticus*), scratchgrass (*Muhlenbergia asperifolia*), switchgrass (*Panicum virgatum*), and softstem bulrush (*Schoenoplectus tabernaemontani*). Native forbs such as broadleaf cattail (*Typha latifolia*) and American licorice (*Glycyrrhiza lepidota*), and non-native forbs like field sowthistle (*Sonchus arvensis*) and Canada thistle (*Cirsium arvense*) are present in these areas. The non-native paleyellow iris (*Iris pseudacorus*) occurs in very saturated areas along the river. Narrowleaf willow (*Salix exigua*) and western snowberry (*Symphoricarpos occidentalis*) occur in small patches along the floodplain.

The upper terrace is the area of the floodplain that is most likely to be impacted by fire. This area contains mainly western wheatgrass, Kentucky bluegrass, and smooth horsetail (*Equisetum laevigatum*). Forbs include giant sumpweed (*Iva xanthifolia*), twoscale saltbush (*Atriplex micrantha*), and Flodman's thistle (*Cirsium flodmanii*).

FIRE EFFECTS

Cheatgrass and Japanese brome

Cheatgrass and Japanese brome are both members of the genus *Bromus*. They are very similar in growth, reproduction, and habitat. Both are cool season annuals that germinate primarily during the fall from the previous year's seed crop (Baskin and Baskin 1981). They reproduce entirely from seeds and are prolific seed producers. Little research has been carried out regarding the effects of fire on cheatgrass in the Northern Great Plains. Response of Japanese brome to burning appears to be highly correlated with litter reduction by fire and the amount of precipitation the autumn after the fire.

At Wind Cave National Park, Japanese brome density was reduced the first growing season after both spring (Apr. 10) and fall (Sept. 18) burns, with slightly better reduction following the fall burn (Gartner 1975). Yield of Japanese brome was reduced following both spring (May 15) and fall (Nov. 7) burns in a study near Rapid City, SD (Gartner et al. 1978). A fall burn (2nd week of October) near Miles City, Montana resulted in a reduction in cheatgrass and Japanese brome cover of nearly 70%; while reduction was only 50% following a spring (Apr. 9) burn (White and Currie 1983). Significant reduction in Japanese brome density and yield was reported following a spring (April 20) burn at Badlands National Park, but this reduction appeared to persist for only one season unless burning is followed by dry weather (Whisenant and Uresk 1990).

MANAGEMENT OBJECTIVES

Management objectives are established based on the best available information and data. They are intended to be flexible and dynamic as the prescribed fire program develops and fire effects data are collected. Objectives and success in meeting those objectives should be assess periodically and modified as appropriate. This process should include resource management staff, fire ecologist, fire effects monitors, and others with knowledge of the vegetation of AGFO.

NATIVE MIXED-GRASS PRAIRIE

This monitoring type is dominated by native species, so desired future conditions are primarily to maintain native species in these areas. As prescribed fire is applied, it is desired to maintain or increase native grass species to at least 80% relative cover, increase native forb species to more than 10% relative cover, reduce non-native grass and forb species to less than 10% relative cover, and maintain or increase species diversity.

Immediate post-burn

- Burn at least 75% of the burnable project area
- Achieve burn severity of at least 'lightly burned' (3) as defined in the Fire Monitoring Handbook

Two years post-burn

- Increase or maintain relative cover of native perennial grass species at or above 80%
- Increase or maintain relative cover of native forb species at or above 10%
- Reduce relative cover of non-native grasses and forbs to less than 10%

Five years post-burn

- Maintain cover of native perennial grass species
- Maintain cover of native forb species
- Maintain reduction in non-native species

NON-NATIVE PRAIRIE

Because this monitoring type generally occurs in areas that experienced high levels of disturbance, non-native species dominate and native species are somewhat scarce. These areas may require intense management practices including prescribed fire, seeding, mowing, and herbicide application to reduce dominance of non-native species. Desired future conditions for this monitoring type are to reduce cover of non-native grass and forb species while increasing cover of native grass and forb species and species diversity. Within 5 years after initiation of prescribed fire program, it is desired that relative cover of native species is greater than 50%, and within 10 years relative cover of native species is greater than 75%.

Immediate post-burn

- Burn at least 75% of the burnable project area
- Achieve burn severity of at least 'lightly burned' (3) as defined in the Fire Monitoring Handbook

Two years post-burn

- Reduce relative cover of non-native grasses and forbs by at least 20%
- Increase relative cover of native perennial grass and forb species by at least 20%
- Evaluate need for additional treatment (fire or other)

MONITORING DESIGN

Two monitoring types have been defined for AGFO based on vegetation associations that will be treated with particular burn prescriptions. Riparian areas are not included in these monitoring types because these areas generally will not burn in a prescribed fire. See Appendix 1 for detailed descriptions of these monitoring types.

MONITORING OBJECTIVES

Native mixed-grass prairie

- Install enough plots to be 80% confident that relative cover of native perennial grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that relative cover of non-native grass and forb species is within 25% of the true population mean.

Non-native prairie

- Install enough plots to be 80% confident that relative cover of non-native grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that relative cover of native perennial grass and forb species is within 25% of the true population mean.

SAMPLING DESIGN

Three types of plots have been established at AGFO: 1) native mixed-grass prairie plots (LTEM), 2) pilot sampling plots in areas dominated by non-native species, and 3) long-term photo monitoring plots.

Eleven vegetation monitoring plots were established in 1998 by the Prairie Cluster Long-Term Ecological Monitoring (LTEM) Program to detect and describe long-term changes in grassland plant communities (Willson et al. 2002). These plots cover five vegetation types, four of which are dominated by native species. Sampling protocols and plot locations can be found in Appendix 4. The fire effects monitoring program will coordinate with and potentially assist the LTEM program to ensure that sampling is synchronized with prescribed fire activities. Plots installed in the future will follow LTEM protocols.

Protocols were developed to monitor vegetation change in areas dominated by non-native species. These plots were designed to require less sampling time than standard FMH plots so a larger number of plots can be established. This should allow us to detect changes in vegetation over short time periods (1 to 3 years) with high confidence levels. Appendix 2 includes sampling protocols and a sample data sheet.

Long-term photo monitoring plots are intended to document vegetation change over time at stand to landscape levels. Examples of data sheets and photos are located in Appendix 3. Additional photo points will be established as other burn units are scheduled for treatment.

FIELD MEASUREMENT

The individual variables to be measured are defined in the monitoring type description sheets (Appendix 1). All plots are marked with steel rebar approximately half a meter in height. Each piece of rebar has a brass tag indicating its location within the plot. The rebar at the zero end of each plot has a tag with complete plot data as specified by the handbook. All locations have been georeferenced with a GPS unit. A hard copy of each plot location is retained in the Northern Great Plains Area Fire Management Office (NGPA) at Wind Cave National Park. A digital text file with UTM coordinates and ArcView 'shape' file are also on file at the NGPA. The Northern Great Plains Fire Monitoring Crew will retain copies and backups and will be responsible for providing updated versions to AGFO as needed.

MONITORING LOCATION

Currently there are 21 monitoring plots in 3 burn units. See attached maps (Fig. 3 & Appendix 4).

PRESCRIBED FIRE MONITORING PARAMETERS

AGFO has adopted the NPS Fire Monitoring Handbook (2001) as a guide for fire effects monitoring. The handbook identifies four monitoring levels:

Level 1 – Reconnaissance	Fire cause, location, size, fuel and vegetation types, relative fire activity, potential for spread, current and forecasted weather, resource or safety threats and constraints, and smoke volume and movement
Level 2 – Fire Conditions	Fire monitoring period, ambient conditions – topographic and fire weather, fuel model, fire characteristic, and smoke characteristic
Level 3 – Immediate Post fire Effects	Fuel reduction, vegetative change or other objective dependent variables with in 1 to 5 years after a burn
Level 4 – Long-term Change	Continued monitoring of Level 3 variables to measure trends and change over time

The plots that have been described in this document thus far are being used to examine levels 3 and 4.

Wildland fires will be monitored at levels 1 and 2 with observations entered into the park's monitoring database. In the event that long-term fire effects plots are burned in a wildland fire, they will be read by the NGPA Fire Monitoring Crew, according to the schedule of plot sampling following a burn treatment. Level 1 and 2 monitoring observations will be filed with the final fire package and a copy placed with the records for the Fire Management Unit that was burned.

Prescribed fires will meet at least the Level 1 and 2 recommended standards. If there are monitoring plots in a unit, information on Level 3 and 4 Variables will be collected.

Level 1 variables

Reconnaissance monitoring (Level 1) provides a basic overview of the fire event. The following variables will be collected on all fires.

- Fire cause (origin), location and size
- Fuels and vegetation type
- Relative fire activity
- Potential for further spread
- Current and forecasted weather
- Resource or safety threats and constraints
- Smoke volume and movement

Specific information on the collection of these variables can be found in the NPS Fire Monitoring Handbook (2001) or the RX-91 – 'Monitoring Prescribed and Wildland Fire' text.

Level 2 variables

Fire conditions monitoring (Level 2) provides information on fire weather, fire behavior and resource values at risk. The following variables will be collected and summarized in a monitoring report on all prescribed fires.

- Fire monitoring period
  - fire number and name
  - observations data and time
  - monitor's name
- Ambient conditions
  - topographic variables
  - slope (%)
  - aspect
- Fire weather variables
  - dry bulb temperature
  - relative humidity
  - wind speed
  - wind direction
  - fuel shading and/or cloud cover
  - time-lag fuel moisture
  - live fuel moisture
  - drought index
- Soil moisture
- Fuel model
- Fire characteristics
  - linear rate of spread
  - perimeter or area growth
  - flame length
  - fire spread directions
- Smoke characteristics (based on state and local requirements)

INTENDED DATA ANALYSIS

Plot installations will be based on prescribed fire priorities and with the intention of achieving a statistically valid sample size within five years for the priority monitoring types. The Northern Great Plains Fire Ecologist will be responsible for checking the minimum plot numbers in all types that have more than five plots installed. Each monitoring type description delineates the variables that will be analyzed. When minimum plot numbers have been reached, objectives will be evaluated after the data have been checked to meet the assumptions of the statistical test. If the data meet the assumptions, including normality, then confidence intervals will be used for change over time comparisons. If data do not meet the assumptions, a statistician will be consulted. Correlation of Level 2 data with vegetation data can be done with either regression or multivariate analysis.

The Northern Great Plains Fire Ecologist will compare data with fire effects research that has been completed in the park and area. Inconsistencies should lead the ecologist to examine different methodologies, data interpretation, and potential research questions.

MONITORING IMPLEMENTATION SCHEDULE

Prescribed fire unit schedule

Appendix F of the Fire Management Plan identifies the planned prescribed fire schedule for the next several years. The unit rotation is based on a 5 to 15 year fire return interval. Units dominated by non-native species may require shorter burn intervals to meet desired objectives. A map of the burn units is also included (Fig. 4).

Timing of monitoring

We attempt to sample plots near peak biomass, which occurs between the peak in cool and warm season grasses, usually mid-June to mid-July. Plots are sampled at approximately the same time of the growing season from year to year. All plots are currently sampled pre-burn, immediately post-burn, and 1, 2, 5, 10, and 20 years post-burn. This schedule is reset when each time a plot is burned.

Pre-burn sampling

Pre-burn sampling will be done during peak biomass. Plots should be installed the growing season before prescribed burns. All plots that have not burned within 2 years of installation will not be reread until that unit is again scheduled to burn. These plots can also be considered for control plots depending on long-term burn planning.

Post-burn sampling

Post-burn sampling will be done immediately post-burn and 1, 2, 5, 10, and 20 years after the burn. Plots that burn in the spring will be read at peak biomass that summer, and then at the regular 1, 2, 5, 10, and 20 year schedule. On grassland plots, sampling during the first growing season after the prescribed fire is year 1, the second growing season is year 2, and so on. If a unit is scheduled to be burned between regularly scheduled sampling events, an additional pre-burn sample will be added. For example, a unit burned in the spring of 2000 would be sampled immediate post-burn within two weeks of the fire, year 1 sampled summer 2000, year 2 sampled

summer 2001, and year 5 sampled summer 2004. The unit is then scheduled to burn again in 2008. A second pre-burn sample should be added for summer 2007.

DATA MANAGEMENT

Other monitoring programs have shown that between 25-40% of the time associated with monitoring should be on data management. The data for AGFO is collected and managed by the Northern Great Plains Fire Monitoring Crew located at Wind Cave National Park, Hot Springs, South Dakota. All data collected at AGFO will be entered and checked by this crew at their office. Generally the seasonal field staff enters and checks data. This process is supervised the NGP Lead Monitor and Fire Ecologist. Original copies of all data will be kept at the crew's office. Hard copies of the Plot Location Data Sheets will be archived at AGFO in the Resource Management files. The Lead Monitor will provide monitoring data to the AGFO Resource Management Specialist annually on CD for archiving. Data are currently entered and analyzed in the FMH software. It is backed up to the server at Wind Cave. It will be sent annually to AGFO and the Midwest Regional Ecologist in conjunction with the annual report. Global positioning data of plot locations are stored on CD at the Fire Monitoring Office at Wind Cave.

QUALITY CONTROL

Data quality will be ensured through proper training of the crew in data collection and a system of checks in the data entry process. All data sheets will be checked by the lead crewmember before leaving a plot for data accuracy and completeness. Data will be summarized annually and results reported to the park and regional fire ecologist. A program review by the Northern Great Plains Fire Ecologist should happen every 4-5 years to maintain consistency of data collection and analysis and re-assessment of program requirements. More frequent review may be necessary if there are significant staffing changes, additional ecological concerns, or by request of the park or monitoring crew.

SOURCES OF DATA ERRORS

Errors in recording can be reduced by checking all data sheets for completeness and accuracy before leaving the plot. Standardized crew training at the beginning of the season will ensure all data are being collected in the same manner by all crewmembers. Transcription errors will be corrected by checking all data once entered in the computer. Collecting voucher specimens and using the study collection to verify plant identifications can minimize incorrect identification of plant species. All unknown plant species will be photographed and added to the unknown plant database. These photos can be used as a field reference to ensure that all unknowns are consistently observed. AGFO Resource Management personnel will be notified of unknowns of particular concern so special attention can be given to identify it. Undersampling of less-frequently occurring species is a large problem in grassland vegetation. An additional sampling technique, nested frequency, will be added after consulting with the regional fire ecologist to better sample the species richness found in these types.

The impacts of monitoring include compacting of fuels and vegetation and the collection of voucher plant specimens. Compaction can be minimized by crew awareness as to where data are collected. Voucher specimens are not collected in the plot – if no other specimen is found, the unknown plant will be photographed and added to the unknown plant photo database. Accurate

plot locations including GPS data will aid in plot location and minimize vegetative compaction. Test all directions by having new crewmembers use previously written directions to ensure accuracy. Incomplete or missing data will be corrected as soon as possible. Plot protocols need to be reviewed annually with the seasonal crew prior to beginning work to insure that data are accurately collected. Problems encountered by the field crew must be brought to the attention of the lead monitor and fire ecologist.

RESPONSIBLE PARTIES

This **Fire Monitoring Plan** was written by Cody Wienk, Northern Great Plains Fire Ecologist

Administrative duties will be assigned as follows:

- *Northern Great Plains Fire Ecologist*: Plan revision, crew supervision, and data analysis
- *Northern Great Plains Lead Monitor*: Data collection, data entry, data management and field crew supervision
- *Northern Great Plains Fire Effects Monitoring Crew*: Data collection, data entry, and data management
- *Superintendent, AGFO*: Park liaison
- *Midwest Regional Fire Ecologist*: Program reviews

MANAGEMENT IMPLICATIONS OF MONITORING RESULTS

Monitoring results will be summarized and presented to the park in the fall meeting of the Fire Committee with the NGPA Fire management Officer, Prescribed Fire Specialist and Fire Ecologist. This meeting helps coordinate fire activities including prescribed fire for the park in the coming year. The annual report information can be conveyed to the AGFO staff in an additional meeting as requested.

Review of the data summary and analysis by the NGPA Fire Ecologist, Prescribed Fire Specialist, and AGFO staff should determine if the current program is moving the vegetation towards the desired conditions or having unwanted results. Objectives should be reviewed and refined, and burn prescriptions and/or other vegetation management techniques could be adjusted to compensate. This review could also generate questions that may lead to fire effects research being conducted in the park. Data from the AGFO program could be analyzed with other parks from the NGPA group as appropriate and should be presented to other parks and at scientific meetings and publications.

CONSULTATION AND COORDINATION

The Northern Great Plains Fire Monitoring Crew is responsible for coordination and consultation with other parks in the group, fire management personnel, and the Midwest Regional Fire Ecologist. AGFO Resource Management staff will be responsible for coordination and consultation with the park and all other cooperators including:

Nebraska Game and Parks Commission, Alliance, Nebraska
Sioux County Commission, Harrison, Nebraska
Crescent Lake National Wildlife Refuge, Oshkosh, Nebraska
Apache Tribe, Oklahoma
Arapahoe Tribe of the Wind River Reservation, Wyoming
Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation, Montana
Cheyenne-Arapahoe Tribes, Oklahoma
Cheyenne River Sioux Tribe of the Cheyenne River Reservation, South Dakota
Comanche Indian Tribe of Oklahoma
Crow Creek Sioux Tribe of the Crow Creek Reservation, South Dakota
Crow Tribe of Montana
Flandreau Santee Sioux Tribe, South Dakota
Fort Sill Apache Tribe, Oklahoma
Jicarilla Apache Tribe of the Jicarilla Apache Indian Reservation, New Mexico
Kiowa Tribe, Oklahoma
Lower Brule Sioux Tribe of the Lower Brule Reservation, South Dakota
Mescalero Apache Tribe of the Mescalero Reservation, New Mexico
Northern Cheyenne Tribe of the Northern Cheyenne Indian Reservation, Montana
Northwestern Band of Shoshoni Nation, Idaho
Oglala Sioux Tribe of the Pine Ridge Reservation, South Dakota
Omaha Tribe, Nebraska
Pawnee Indian Tribe, Oklahoma
Ponca Tribe of Indians, Oklahoma
Ponca Tribe, Nebraska
Rosebud Sioux Tribe of the Rosebud Indian Reservation, South Dakota
Santee Sioux Tribe of the Santee Reservation, Nebraska
Shoshone-Bannock Tribes of the Fort Hall Indian Reservation, Idaho
Shoshone Tribe of the Wind River Reservation, Wyoming
Shoshone-Paiute Tribes of the Duck Valley Reservation, Nevada and Idaho
Spirit Lake Sioux Tribe of the Devils Lake Sioux Reservation, North Dakota
Standing Rock Sioux Tribe of the Standing Rock Reservation, South Dakota & North Dakota
Three Affiliated Tribes of the Fort Berthold Reservation, North Dakota
Yankton Sioux Tribe, South Dakota

The AGFO Resource Management Division participated in shaping and preparing this plan. The following provided assistance with, or review of, this plan:

Ruthann Knudson, Superintendent, Agate Fossil Beds National Monument
Andy Thorstenson, Lead Monitor, NPS, NGPA Fire Monitoring Crew
Kevin Rehman, Asst. Lead Monitor, NPS, NGPA Fire Monitoring Crew
Bill Gabbert, former Fire Management Officer, NPS, NGPA Fire Management Office
Jim DeCoster, Regional Fire Ecologist, NPS, Midwest Region, Omaha
Cody Wienk, Fire Ecologist, NPS, NGPA Fire Management Office

PEER REVIEW

Peer/technical review for this plan was provided by:

Mike DeBacker, Botanist, Prairie Cluster LTEM Program

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FIGURES

Figure 1. The Northern Great Plains mixed-grass prairie is characterized as having a mixture of mid-height and shortgrasses with different photosynthetic pathway types (cool- and warm-season). Cool-season grasses are dominant. A complex disturbance regime of biotic and abiotic disturbances (including periodic drought, grazing, fire, and soil disturbances) have interacted to form and continue to maintain grasslands of the Northern Great Plains. These disturbances also interact with climate, topography, soils, and competition among plant species to influence grassland composition.

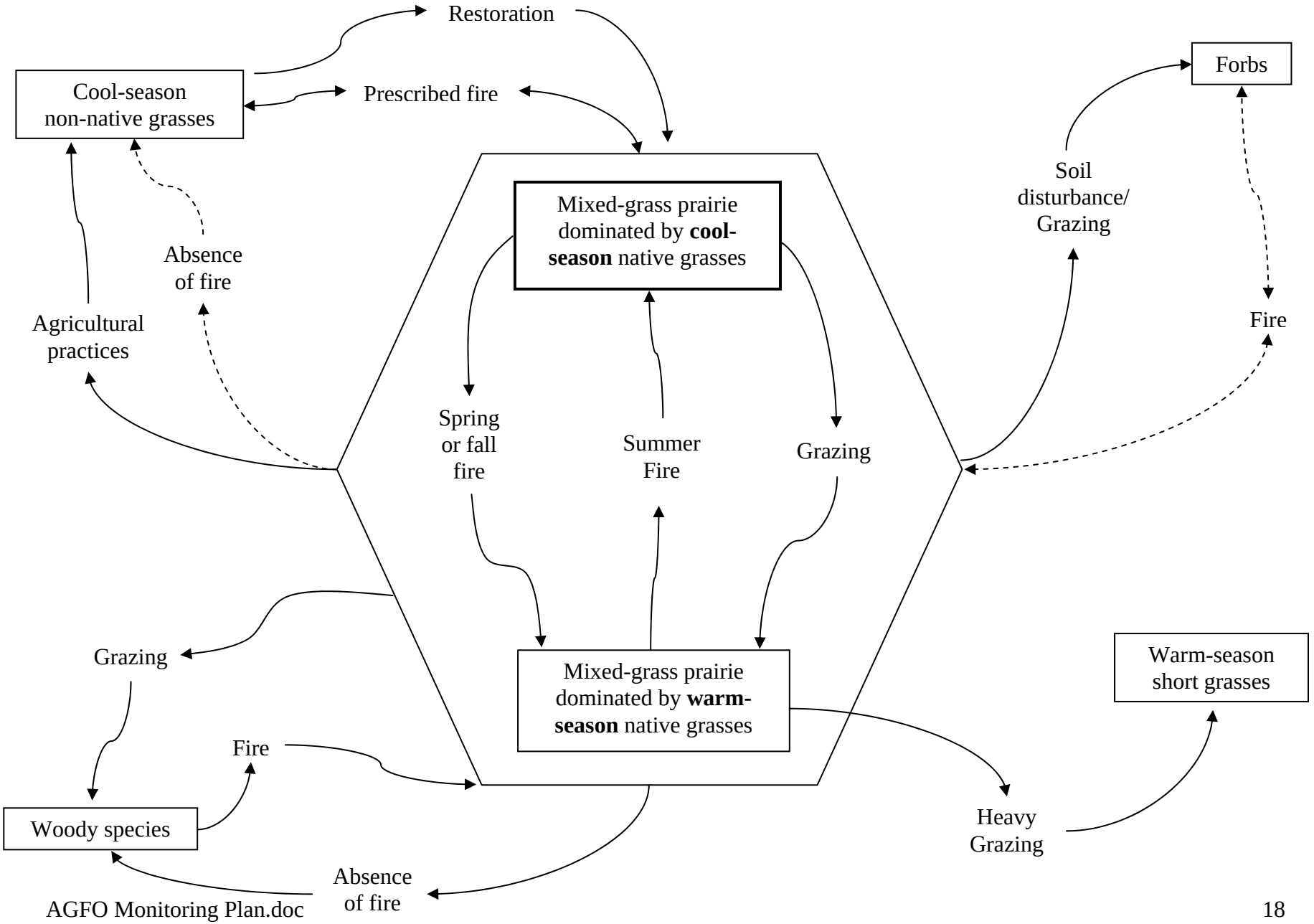


Figure 2. Vegetation map of Agate Fossil Beds National Monument. Product of the USGS-NPS Vegetation Mapping Program (USGS 1998). PODE = *Populus deltoides*, plains cottonwood; Salix = *Salix exigua*, sandbar willow; SYOC = *Symphoricarpos occidentalis*, western snowberry; STCO = *Stipa comata*, needle-and-thread; BOGR = *Bouteloua gracilis*, blue grama; CALO = *Calamovilfa longifolia*, prairie sandreed; ANHA = *Andropogon hallii*, sand bluestem; PASM = *Pascopyrum smithii*, western wheatgrass; Juncus = *Juncus balticus*, Baltic rush; Typha = *Typha latifolia*, broadleaf cattail; SCSC = *Schizachyrium scoparium*, little bluestem.

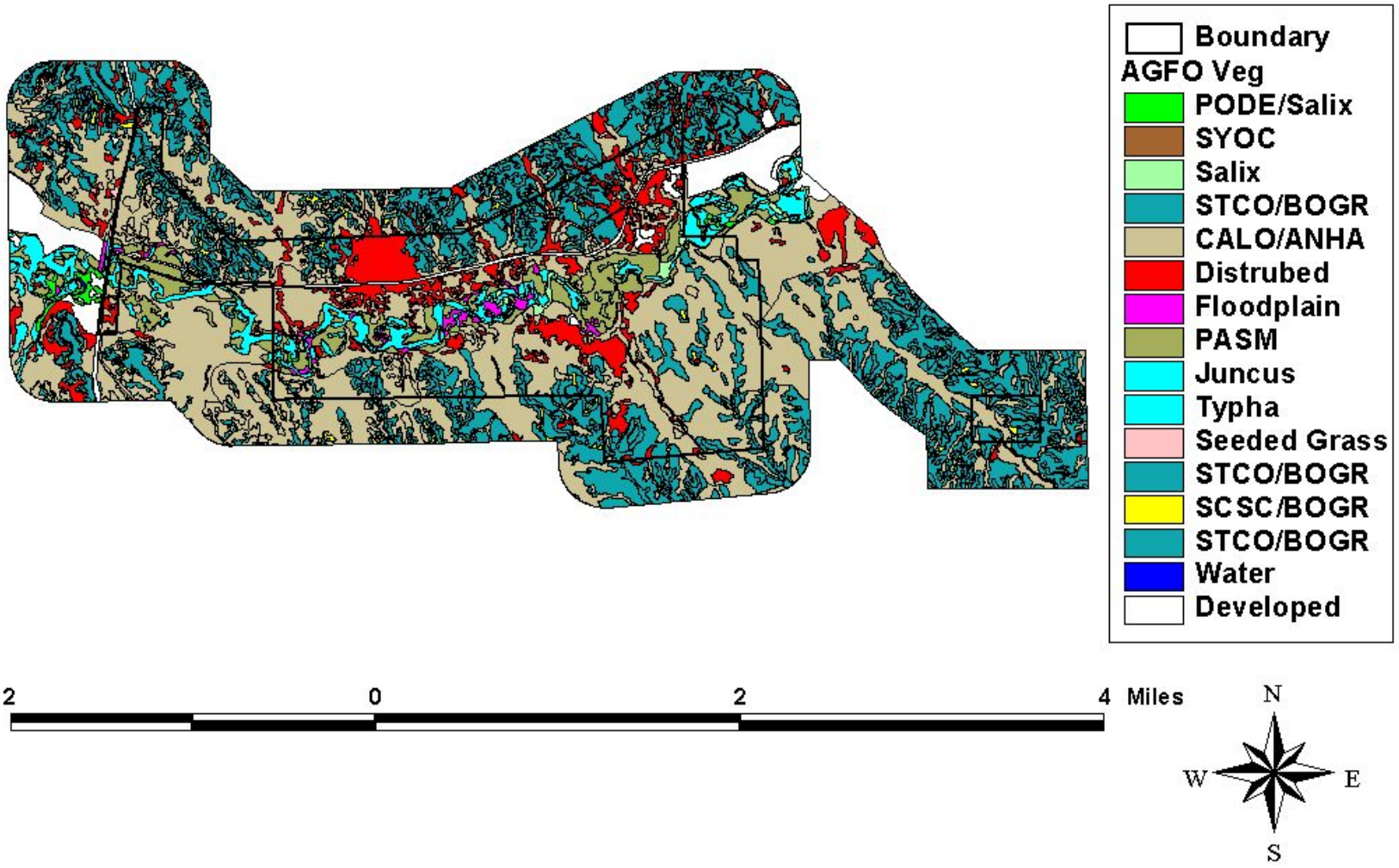


Figure 3. Location of fire effects monitoring plots.

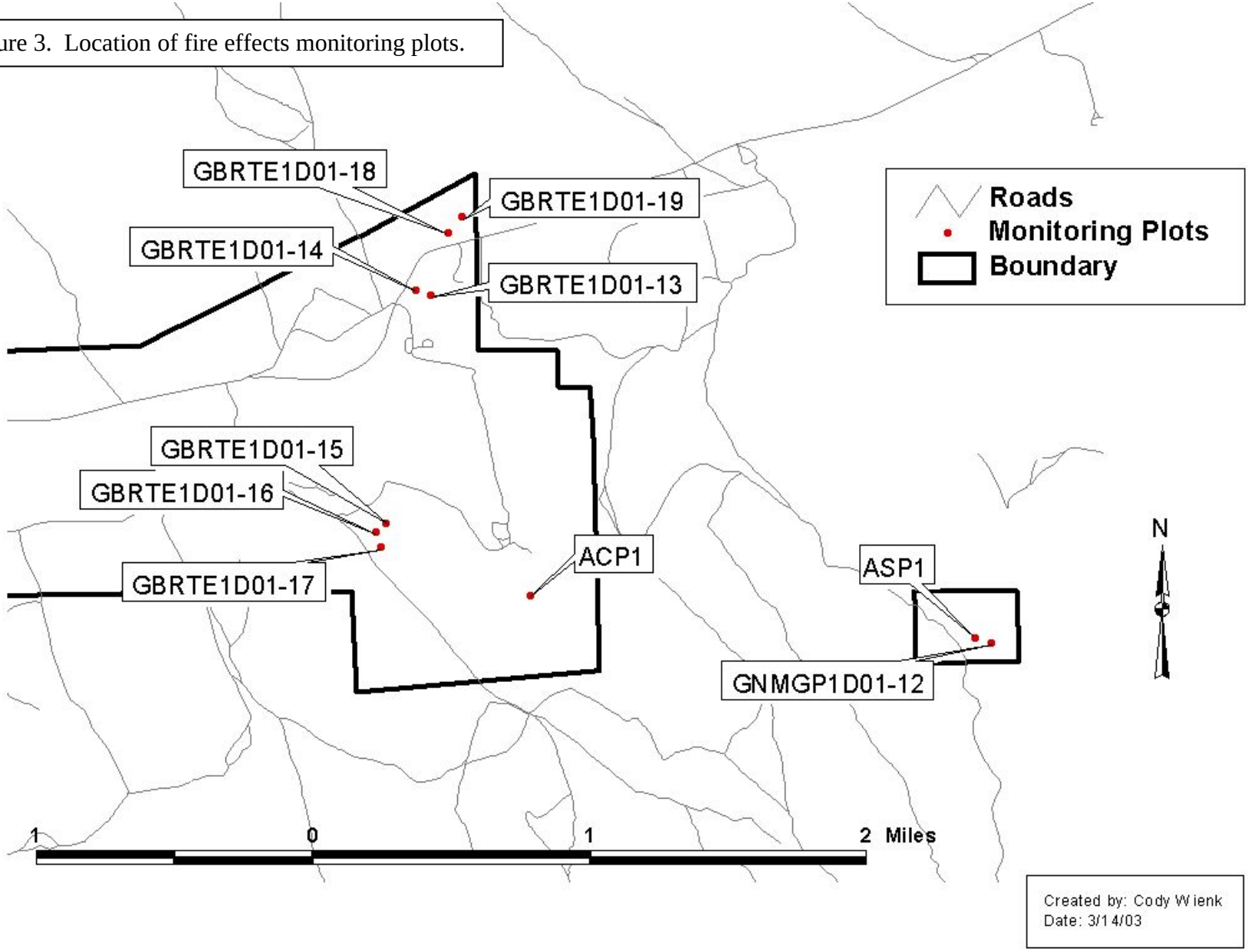
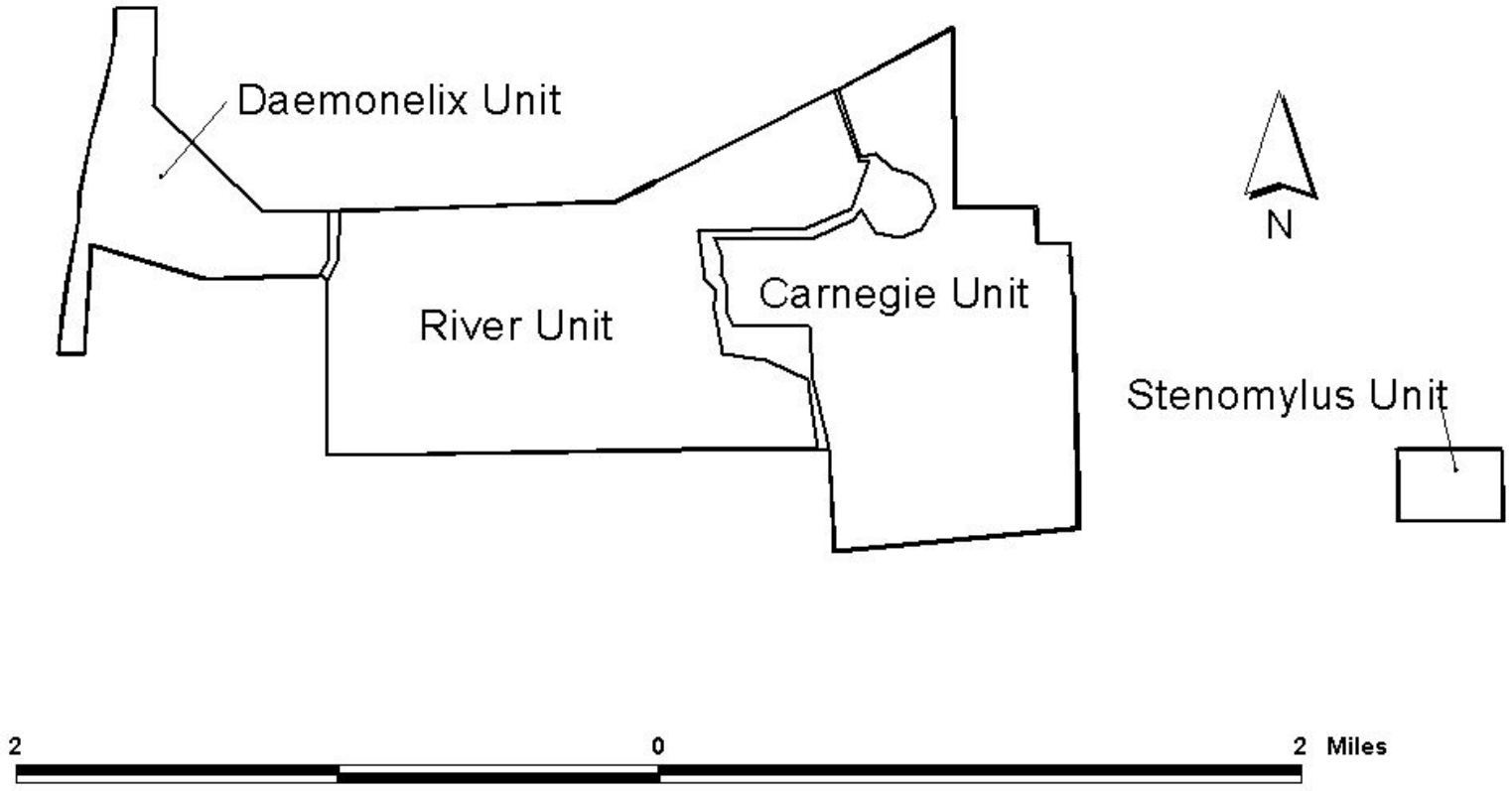


Figure 4. Burn units at Agate Fossil Beds National Monument.



APPENDICES

APPENDIX 1 – MONITORING TYPE DESCRIPTION SHEETS

MONITORING TYPE DESCRIPTION SHEET Park: **AGFO**

Monitoring Type Code: GNMGP1D01 **Date Described:** 10/20/02

Monitoring Type Name: Native Mixed-grass Prairie

Prepared by: C. Wienk, A. Thorstenson, K. Rehman

Physical Description

Soils are generally loamy very fine sands of the Oglala-Canyon Association, Tassel-Ashollow-Rock outcrop Association, and Otero-Las Animas-Lisco Association. Soils of the Oglala-Canyon Association are well drained, loamy soils found on 1 to 30% hillslopes and are derived from sandstone parent materials. Tassel-Ashollow-Rock outcrop soils are well drained, sandy soils derived from sandstone parent materials and are found on hillslopes ranging from 3 to 60%. Soils of the Otero-Las Animas-Lisco Association are very deep, loamy and sandy soils on flood plains and stream terraces. Topography of the park is gently rolling and elevations range from 4400 feet along the flood plain to 4600 feet at the tops of the surrounding hills.

Biological Description

Mid- and upper-slopes are generally covered by needle-and-thread (*Stipa comata*), threadleaf sedge (*Carex filifolia*), and blue grama (*Bouteloua gracilis*). Lower slopes contain needle-and-thread, prairie sandreed (*Calamovilfa longifolia*), western wheatgrass (*Pascopyrum smithii*), and sand bluestem (*Andropogon hallii*). Shrubs and subshrubs include yucca (*Yucca glauca*), skunkbush sumac (*Rhus aromatica*), and fringed sagewort (*Artemisia frigida*). Forbs such as annual sunflower (*Helianthus annuus*), slimflower scurfpea (*Psoralea tenuiflora*), milkvetches (*Astragalus* spp.), milkweeds (*Asclepias* spp.), and rush skeletonplant (*Lygodesmia juncea*) are found in this monitoring type. Non-native species present include cheatgrass (*Bromus tectorum*), prickly lettuce (*Lactuca serriola*), lambsquarters (*Chenopodium album*), goatsbeard (*Tragopogon dubius*), field pennycress (*Thlaspi arvense*), and Kentucky bluegrass (*Poa pratensis*).

Rejection Criteria

- Large outcrops or barren areas >20% of the plot
- Areas with anomalous vegetation
- Monitoring type boundaries
- Riparian areas
- Bio-control areas
- Areas within 20 meters of roads, man-made trails, or human created disturbance areas

Desired Future Condition

Mixed-grass prairie dominated by western wheatgrass, needle-and-thread, and grama grasses (*Bouteloua* spp.) is believed to be the major pre-settlement vegetation type for the area, although the exact composition of the communities before settlement is unknown. Kuchler (1964) described the potential vegetation for the AGFO area as wheatgrass-needlegrass prairie and

Nebraska sandhills prairie. The fire return intervals reported for this type of prairie vary from as short as five years in level to gently rolling topography to 15-30 years in more broken topography (Wendtland and Dodd 1992). It is believed that the historic fire return interval in these areas would have been on the more frequent end of this range.

This monitoring type is dominated by native species, so desired future conditions are largely to maintain native composition in these areas. General desired future conditions include:

- Maintain or increase native grass cover to > 80% cover.
- Increase cover of native forb species to > 10% cover.
- Maintain or increase diversity (richness).
- Reduce non-native cool season annual grasses and non-native forbs to < 10% cover.

Burn Prescription
If prescribed burning is used to mimic historic fire regimes, this monitoring type will be burned between April and October, with most fires occurring in July, August and September.

Fire Prescription Elements	
RH: **25-55%**	Average Flame Length: **0.4-1.5 feet**
Temp: **50-90 °F**	Live Fuel Moisture: **NA**
Average Mid-flame winds: **2-12 mph**	1-hour TLFM: **4-12%**
Fuel loading: **2-5 tons/acre**	10-hour TLFM: **8-15%**
Average Rate of Spread: **1-100 chains/hr.**	100-hour TLFM: **NA**

Monitoring Variables (in order of importance)
- Cover of native perennial grass species
- Cover of native forb species
- Cover of non-native grass and forb species

Prescribed Fire Objectives*
Immediate post-burn
- Burn at least 80% of the burnable project area
- Achieve burn severity of at least 'lightly burned' (3) as defined in the Fire Monitoring Handbook

Two years post-burn
- Increase cover of native perennial grass species by at least 20%
- Increase cover of native forb species by at least 20%
- Reduce cover of non-native grasses and forbs by at least 20%

* Objectives intended for first prescribed fire treatment and are subject to change as information becomes available through fire monitoring activities.

Five years post-burn

- Maintain increase in native perennial grass species
- Maintain increase in native forb species
- Maintain reduction in non-native species

Fire Monitoring Objectives

- Install enough plots to be 80% confident that cover of native perennial grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that cover of non-native grass and forb species is within 25% of the true population mean.

Data Analysis

- Assess cover of native grass and forb species after sampling years 1, 2, and 5.
- Assess cover of non-native grass and forb species after sampling years 1, 2 & 5.

Relevant Literature

Kuchler, A.W. 1964. Potential natural vegetation of the coterminous United States. Special Publication 36 (Manual), American Geographical Society, New York, NY.

Stubbendieck, J., and G. Willson. 1986. An identification of prairie in National Park units in the Great Plains. USDI National Park Service Occasional Paper No. 7, Washington, DC.

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Wendtland, K.J., and J.L. Dodd. 1992. The fire history of Scotts Bluff National Monument. In: Smith, D. and C. Jacobs (eds) Twelfth North American Prairie Conference. Cedar Falls, Iowa.

Plot Protocols

GENERAL PROTOCOLS		YES	NO		YES	NO
Preburn	Control Plots/Opt		•	Herb Height/Rec		•
	Herbaceous Density/Opt		•	Belt Transect Width: 2 meters		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: 0P & 30P		
	Stereo Photography/Opt		•	Crown Intercept/Opt		•
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt		•
	Herbaceous Data Collected at: 0P-30P					
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec	•	
Postburn	Herbaceous Data/Opt: Not collected.			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

Rec = Recommended, Opt = Optional

MONITORING TYPE DESCRIPTION SHEET Park: **AGFO**

Monitoring Type Code: GBRTE1D01 **Date Described:** 10/22/02

Monitoring Type Name: Non-native Prairie – Cheatgrass

Prepared by: C. Wienk, A. Thorstenson, K. Rehman

Physical Description
Soils are generally loamy very fine sands of the Oglala-Canyon Association, Tassel-Ashollow-Rock outcrop Association, and Otero-Las Animas-Lisco Association. Soils of the Oglala-Canyon Association are well drained, loamy soils found on 1 to 30% hillslopes and are derived from sandstone parent materials. Tassel-Ashollow-Rock outcrop soils are well drained, sandy soils derived from sandstone parent materials and are found on hillslopes ranging from 3 to 60%. Soils of the Otero-Las Animas-Lisco Association are very deep, loamy and sandy soils on flood plains and stream terraces. Topography of the park is gently rolling and elevations range from 4400 feet along the flood plain to 4600 feet at the tops of the surrounding hills.

Biological Description
This monitoring type occurs mainly in disturbed areas or areas that were under cultivation before the park was established. Cheatgrass (*Bromus tectorum*) is the most common non-native grass, but Kentucky bluegrass (*Poa pratensis*), Japanese brome (*Bromus japonicus*), and crested wheatgrass (*Agropyron cristatum*) are also present. Non-native forbs include kochia (*Kochia scoparia*), Russian thistle (*Salsola tragus*), and tumble mustard (*Sisymbrium altissimum*), yellow sweetclover (*Melilotus officinalis*), Canada thistle (*Cirsium arvense*), and curly dock (*Rumex crispus*). Native species such as prairie sandreed (*Calamovilfa longifolia*), needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), western wheatgrass (*Pascopyrum smithii*), sedges (*Carex* spp.) and annual sunflower (*Helianthus annuus*) also occur in this monitoring type.

Rejection Criteria
- Large outcrops or barren areas >20% of the plot
- Areas with anomalous vegetation
- Monitoring type boundaries
- Riparian areas
- Bio-control areas
- Areas within 20 meters of roads, man-made trails, or human created disturbance areas

Desired Future Condition
Mixed-grass prairie dominated by western wheatgrass, needle-and-thread, and grama grasses (*Bouteloua* spp.) is believed to be the major pre-settlement vegetation type for the area, although the exact composition of the communities before settlement is unknown. Kuchler (1964) described the potential vegetation for the AGFO area as wheatgrass-needlegrass prairie and Nebraska sandhills prairie. The fire return intervals reported for this type of prairie vary from as short as five years in level to gently rolling topography to 15-30 years in more broken topography (Wendtland and Dodd 1992). It is believed that the historic fire return interval in

these areas would have been on the more frequent end of this range (5-15 years).

Because this monitoring type generally occurs in areas that experienced high levels of disturbance, non-native species dominate and native species are somewhat scarce. These areas may require intense management practices including prescribed fire, seeding, mowing, and herbicide application to reduce dominance of non-native species. Desired future conditions for this monitoring type:

- Reduce non-native cool season annual grasses and non-native forbs
- Increase native grass cover
- Increase cover of native forb species
- Increase diversity (richness) of native species
- 5-year goal: 50% cover native species
- 10-year goal: 75% cover native species

Burn Prescription
This monitoring type should be burned in the fall or spring, shortly after germination of cool-season annual grasses. Prescribed fire may be applied more frequently than historic fire in order to achieve resource management objectives.

Fire Prescription Elements	
RH: **25-55%**	Average Flame Length: **0.4-1.5 feet**
Temp: **50-90 °F**	Live Fuel Moisture: **NA**
Average Mid-flame winds: **2-12 mph**	1-hour TLFM: **4-12%**
Fuel loading: **1-5 tons/acre**	10-hour TLFM: **8-15%**
Average Rate of Spread: **1-100 chains/hr.**	100-hour TLFM: **NA**

Monitoring Variables (in order of importance)
- Cover of non-native grass
- Cover of non-native forb species
- Cover of native perennial grass and native forb species

Prescribed Fire Objectives[*]
Immediate post-burn
- Burn at least 80% of the burnable project area
- Achieve burn severity of at least 'lightly burned' (3) as defined in the Fire Monitoring Handbook

Two years post-burn
- Reduce cover of non-native grasses and forbs by at least 20%
- Increase cover of native perennial grass and forb species by at least 20%

[*] Objectives intended for first prescribed fire treatment and are subject to change as information becomes available through fire monitoring activities.

Five years post-burn
- Maintain reduction in non-native species
- Maintain increase in native species

Fire Monitoring Objectives
- Install enough plots to be 80% confident that cover of non-native grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that cover of native perennial grass and forb species is within 25% of the true population mean.

Data Analysis
- Assess cover of native grass and forb species after sampling years 1, 2, and 5.
- Assess cover of non-native grass and forb species after sampling years 1, 2 & 5.

Relevant Literature

Kuchler, A.W. 1964. Potential natural vegetation of the coterminous United States. Special Publication 36 (Manual), American Geographical Society, New York, NY.

Stubbendieck, J., and G. Willson. 1986. An identification of prairie in National Park units in the Great Plains. USDI National Park Service Occasional Paper No. 7, Washington, DC.

USDA, NRCS. 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA.

USDI National Park Service. 2001. Fire monitoring handbook. National Interagency Fire Center, Boise, ID. 288 pp.

USGS. 1998. Agate Fossil Beds National Monument, USGS-NPS Vegetation Mapping Program Products (http://biology.usgs.gov/npsveg/agfo/index.html). USGS-NPS Vegetation Mapping Program, USGS Center for Biological Informatics, Denver, CO.

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Wendtland, K.J., and J.L. Dodd. 1992. The fire history of Scotts Bluff National Monument. In: Smith, D. and C. Jacobs (eds) Twelfth North American Prairie Conference. Cedar Falls, Iowa.

Plot Protocols

GENERAL PROTOCOLS		YES	NO		YES	NO
Preburn	Control Plots/Opt		•	Herb Height/Rec	•	
	Herbaceous Density/Opt		•	Belt Transect Width: 2 meters		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: 0P & 30P		
	Stereo Photography/Opt		•	Crown Intercept/Opt		•
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt		•
	Herbaceous Data Collected at: 0P-30P					
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec	•	
Postburn	Herbaceous Data/Opt: Not collected.			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

Rec = Recommended, Opt = Optional

APPENDIX 2 – NON-NATIVE PRAIRIE SAMPLING PROTOCOLS

Abstract
These alternative sampling plots are intended to provide information on vegetative conditions in grassland areas. Data collected will provide occurrence, density, and frequency by species, lifeform, or native versus non-native.

Methods

- Plots are randomly located using a G.I.S. application within a specific ecological community.
- Plots consist of 20 Daubenmire frames, 3 nested frequency frames, and a complete list of observed species.
- 2 rebar are located at 0 meters and 25 (or 24) meters with a centerline run between them.
- Plot azimuth is randomly determined.
- Plot location is described with written directions from roads or trails, and global positioning coordinates are listed in UTM format datum NAD 83.
- Complete list of species is created for the 25-m x 10-m area (within 5 meters either side of the centerline).

Daubenmire frames are read beginning at 1-1.2 m, 2-2.2 m, 3-3.2 m…20-20.2 m

Daubenmire frames are placed on the left side of the centerline
Frames measure 20 cm x 50 cm
Each species is recorded and given a cover class 1 through 6 (1 = 0-5%, 2 = 6-25%, 3 = 25=50%, 4 = 51-75%, 5 = 76-95%, 6 = 96-100%)

Nested frames are placed beginning at 1-4.16 m, 10-13.16 m, and 20-23.16 m

Nested frames are placed on the right side of the centerline
Frame sizes are 0.01 m^2 (10 cm x 10 cm), 0.1 m^2 (31.6 cm x 31.6 cm), 1 m^2 (100 cm x 100 cm), 10 m^2 (3.16 m x 3.16 m)
Presence of each species is recorded for each size interval

Data sheets created for a plot include:

FMH-5 Plot Location Data Sheet
FMH-6 Species Code List
Nested Frequency Data sheet
Daubenmire Data Sheet

Equipment

2 30-meter tapes
Daubenmire frame(s)
Set of 3 increments of Nested frequency frames
4 Chaining pins for 10 m^2 nested frame
Set of 4 Data sheets
Plant identification guides

Plot ID: _____

Burn Unit: _____

Recorders: _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TOCO																				
LITT																				
BARE																				
TOGR																				
TOFO																				
TOSH																				

APPENDIX 3 – LONG-TERM PHOTO MONITORING

LONG TERM PHOTO MONITORING SHEET

Plot # _____ **Park: _____** **Date: _____**

Burn Unit: _____ **Recorders: _____**

UTM Zone:_____	**Camera height: _____ft.**	**Elevation: _____ft**
UTMN:_____	**Lens size: _____mm**	**Slope along transect: _____%**
UTME:_____	**Distance from pole: _____ft.**	**Slope of terrain: _____%**
Datum:_____	**Azimuth from camera to pole: ____**	**No. of Photos Taken: _____**
EPE:_____	**Height on pole used for shot: _____ft**	**Compass Bearing(s):**

Describe the route to the plot, include or attach a hand drawn map illustrating these directions, including the plot layout, and significant features:

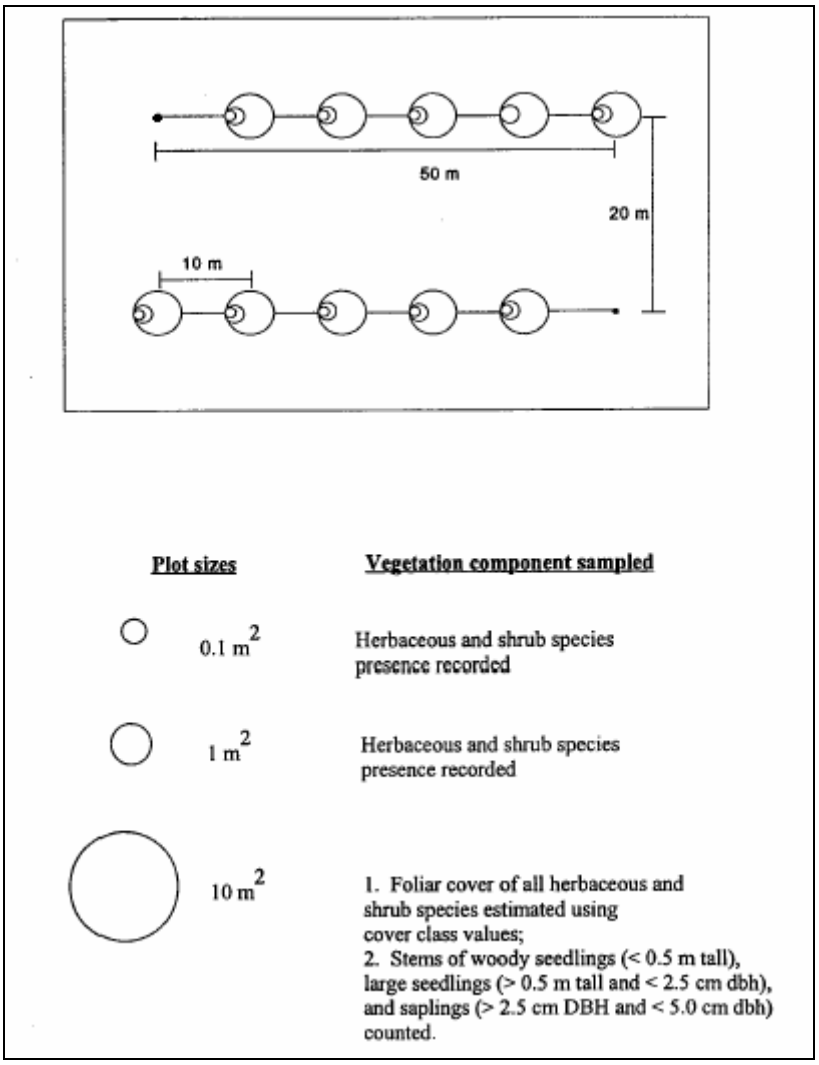
Visit	Initial/ Date	Comments
Install/Pre		
Immediate Post		
1 Year Post		
2 Year Post		
5 Year Post		
10 Year Post		

Long-term Photo Point – Carnegie Unit

APPENDIX 4 – LTEM SAMPLING PROTOCOLS AND PLOT LOCATIONS

Buck, C. E., L. P. Thomas, G. D. Willson, M. D. DeBacker. 2000. Background information and methods testing for the development of a plant community monitoring protocol for six prairie parks. DOI, USGS, Northern Prairie Wildlife Center, Missouri Field Station.

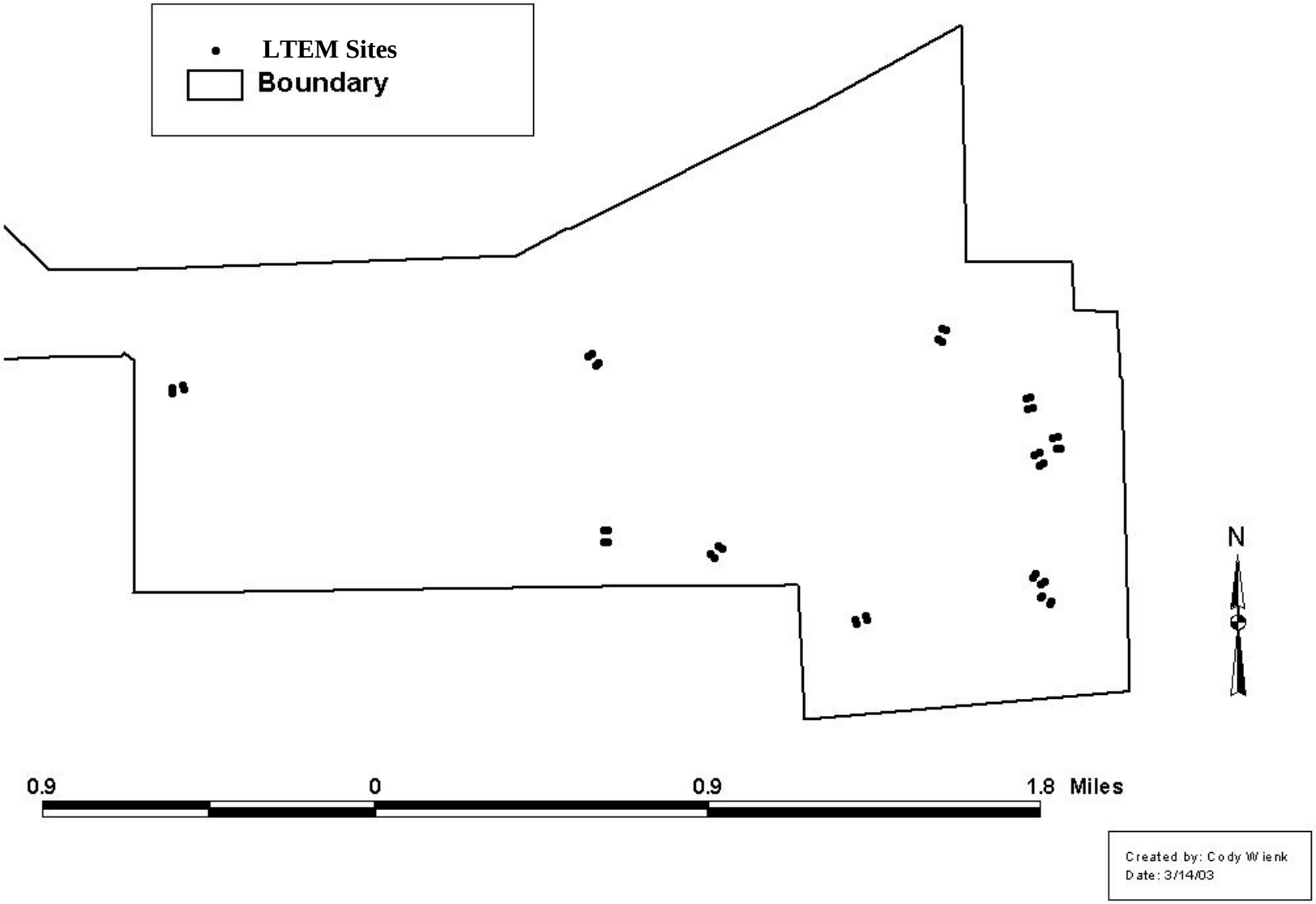
The LTEM group identified sampling localities within a designated plant community using a random numbers table. If the random number placed the paired transects on a vegetation boundary (e.g. a transition zone between a disturbed prairie remnant and a high-quality prairie remnant), they moved the paired transects into the habitat type to be sampled. Within each plant community identified for sampling, they randomly located two or more 50-m paired transects. The paired transects are 20-m apart and run parallel to each other and to the elevation contours. Along each transect they established five 10 m^2 circular plots at 10-m intervals (see figure below). Within each 10-m^2 circular plot, they nested a 0.1 m^2 circular plot and a 1.0-m^2 circular plot. In small communities where the sample site encompasses a large proportion of the total area (e.g., bluff top communities), they placed a single transect pair. They marked each transect at both ends with rebar. Using a global positioning system (GPS) unit, they recorded the coordinates for the end points of each transect. During sampling, they took photos of each transect from the permanent transect endpoints to have visual documentation of vegetation change. Within these plots, foliar cover, species frequency, species diversity, and species composition are measured.



See also:

DeBacker, M. D., J. R. Boetsch, and L. P. Thomas. 2003. Frequency measures for grasslands – examining scale, sample size and precision. DOI, USGS, Northern Prairie Wildlife Center, Missouri Field Station.

Willson, G. D., L. P. Thomas, M. D. DeBacker, W. M. Rizzo and C. Buck. 2002. Plant Community Monitoring Protocol for Six Prairie Parks. DOI, USGS, Northern Prairie Wildlife Center, Missouri Field Station.


LTEM Sites
Boundary
N
0.9
0
0.9
1.8 Miles
Created by: Cody Wienk
Date: 3/14/03