National Park Service

Devils Tower National Monument, Wyoming

Fire Effects Monitoring Plan

INTRODUCTION

Prescribed fire will be used to maintain and restore the fire adapted ecosystems at Devils Tower. 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.

MONITORING DESIGN

SAMPLING DESIGN

All plots established at Devils Tower follow standard Fire Monitoring Handbook (FMH) (2003) protocols. The sampling design for the FMH plots are contained in the individual monitoring unit description sheets found in Appendix 1. Long-term photo monitoring points have also been established.

FIELD MEASUREMENT

The individual variables to be measured are defined in the monitoring unit descriptions found in 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 Fire Management Office (NGP) at Wind Cave National Park. A digital text file with UTM coordinates and ArcView 'shape' file are also on file at the NGP. The Northern Great Plains Fire Monitoring Crew will retain copies and backups and will be responsible for providing updated versions to Devils Tower as needed.

MONITORING LOCATION

Currently there are seventeen monitoring plots and four photo points at Devils Tower (Fig. 1).

PRESCRIBED FIRE MONITORING PARAMETERS

Devils Tower has adopted the NPS FMH (2003) 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 prescribed fire
Level 4 – Long-term Change	Continued monitoring of Level 3 variables to measure trends and change over time

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

Wildland fires that are suppressed 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 NGP Fire Monitoring Crew, according to the schedule of plot rereads following a prescribed fire 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 FMH plots in a unit, information on Level 3 and 4 Variables will be collected.

Level 1 variables

Reconnaissance monitoring 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 (2003) or the RX-91 – 'Monitoring Prescribed and Wildland Fire' text.

Level 2 variables

Fire conditions monitoring 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
- 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 units. The Northern Great Plains Fire Ecologist will be responsible for checking the minimum plot numbers in all units that have more than five plots installed. Each monitoring unit 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

Timing of monitoring

All plots are currently monitored at peak diversity for the native vegetation approximately halfway between the peak in cool and warm season grasses. This will need to be examined after

pilot sampling. All plots are currently being read pre-burn, immediately post-burn, and 1, 2, 5, 10, and 20 years post-burn.

Pre-burn Sampling

Pre-burn sampling will be done during peak phenology. Plots should be installed the growing season before prescribed fires. 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 prescribed fire planning.

Post-burn sampling

Post-burn sampling will be done immediately post-burn and 1, 2, 5, 10, and 20 years after the prescribed fire. Plots that burn in the spring will be read at peak phenology that summer, and then at the regular schedule (1, 2, 5, 10, and 20 year). The 1-Year reads for grassland plots burned in the spring are during the growing season the same year as the prescribed fire, and the 2-year read occurs in the following year. The 1-year reads for forest plots burned in the spring are during the growing season one year after the prescribed fire. Fall prescribed fires will be read the following summer as 1 year post-burn reads. If a unit is scheduled to be burned for a second or third time between reads, an additional pre-burn read will be added. For example, a unit burned in the spring of 2000 would be sampled within a week following the fire, 1 year read summer 2000, 2 year read summer 2001, and 5 year read summer 2004. The unit is then scheduled to burn again in 2008. A second pre-burn read should be added 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 Devils Tower 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 Devils Tower 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 Devils Tower in the Resource Management files. The Lead Monitor will provide monitoring data to the Devils Tower Resource Management staff 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 Devils Tower 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 should happen every 3-5 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 insure 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 insure that all unknowns are consistently observed. Devils Tower 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 the grass types. 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

Administrative duties will be assigned as follows:

- *Northern Great Plains Fire Ecologist*: Plan revision, crew supervision, data management and data analysis
- *Superintendent, Devils Tower National Monument*: Park liaison
- *Northern Great Plains Lead Monitor*: Data collection, data entry, data management and field crew supervision
- *Midwest Regional Fire Ecologist*: Coordinate 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 NGP 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 Devils Tower Resource Management in an additional meeting as requested.

Review of the data summary and analysis by the NGP Fire Ecologist, Prescribed Fire Specialist, and Devils Tower Resource Management staff should determine if the current program is

moving the vegetation towards the desired conditions and/or having unwanted results. Targets should be reviewed and refined, and prescribed fire prescriptions and 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. Information from the Devils Tower program could be analyzed with other parks from the NGP 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. Devils Tower Resource Management staff will be responsible for coordination and consultation with the park and all other cooperators.

LITERATURE CITED

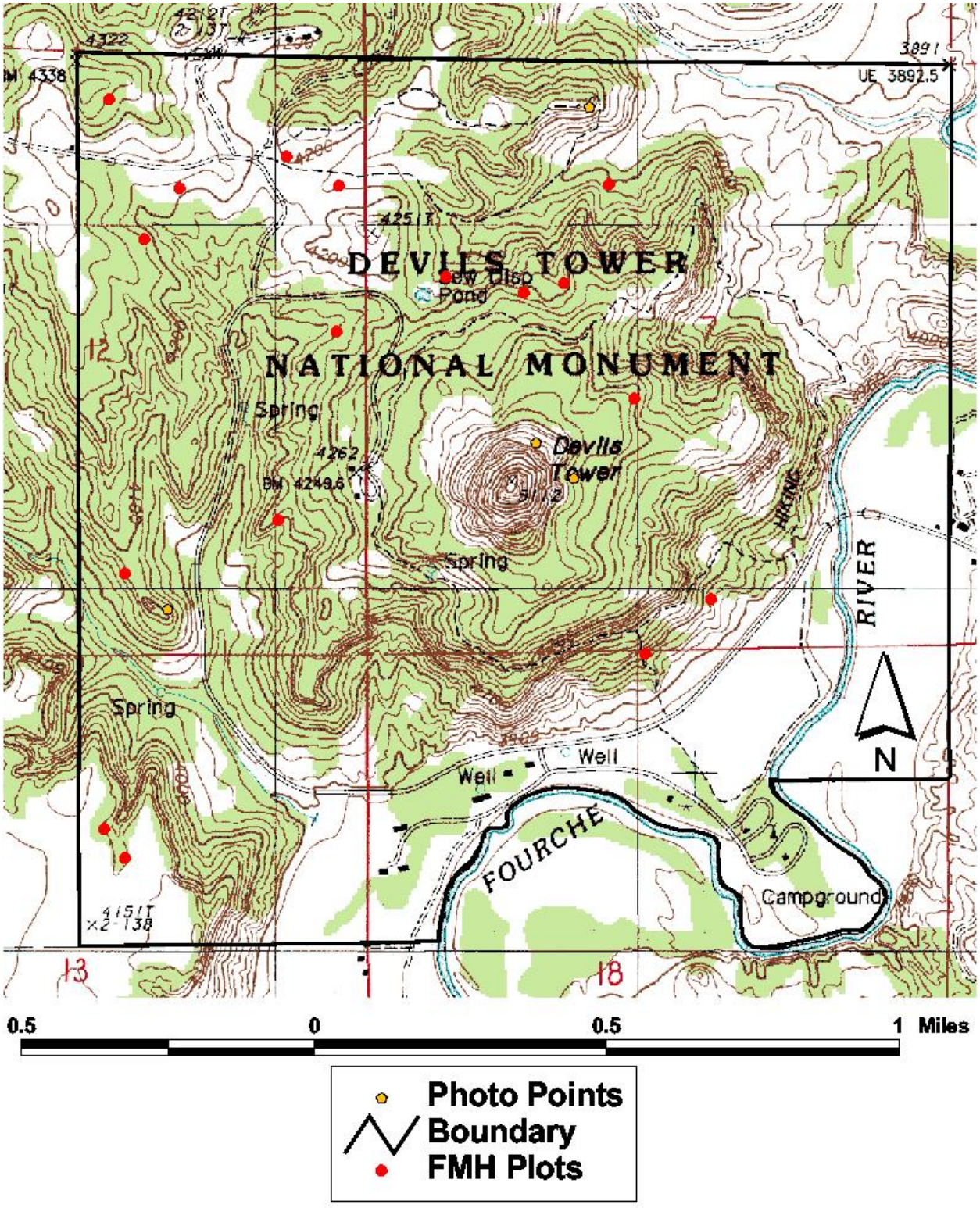
USDI National Park Service. 1998. Directors order #18: wildland fire management.

USDI National Park Service. 1999. Reference manual 18.

USDI National Park Service. 2003. Fire monitoring handbook. National Interagency Fire Center, Boise, ID. 274 pp.

FIGURES

FIGURE 1. LOCATION OF FIRE EFFECTS MONITORING PLOTS.



APPENDICES

APPENDIX 1 – MONITORING UNIT DESCRIPTION SHEETS

FMH-4 MONITORING TYPE DESCRIPTION SHEET Park: **DETO**

Monitoring Type Code: GPOPR1D01 **Date Described**: 6/28/00

Monitoring Type Name: Non-native Grass Prairie – Kentucky bluegrass

Prepared by: A. Thorstenson, K. Paintner

Physical Description
Open meadows within Ponderosa pine forests Soils include: Alice fine sandy loam, Alice Theda Lund complex, Lakoa-Butche complex, Nunn clay loam and Samsil-Gaynor complex. Characteristic soils consist of loamy soils, shallow to deep, well drained, alluvial fans, uplands and terraces, slopes >40%, elevation 3,500 to 5,000 feet, with lower to mid slopes and valleys.

Biological Description
Stands typically have moderate herbaceous cover, ranging from 40-90% and have dense ground litter. Areas tend to be dominated by non-native cool season grasses, primarily Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*). Native grasses occurring include green needle grass (*Stipa viridula*), side-oats grama (*Bouteloua curtipendula*), western wheatgrass (*Pascopyrum smithii*), needle-and-thread (*Stipa comata*), and sedges (*Carex* spp.). Shrubs include wild rose (*Rosa* spp.), and western snowberry (*Symphoricarpos occidentalis*). Native forbs such as showy milkweed (*Asclepias speciosa*), scurfpea (*Psoralea* spp.), goldenrod (*Solidago* spp.), and common yarrow (*Achillea millefolium*) are common. Non-native forbs found at the monument include yellow sweet clover (*Melilotus officinalis*) and leafy spurge (*Euphorbia esula*).

Selection Criteria
At least 60% grass cover within the plot.

Rejection Criteria
Large outcroppings or barren areas greater than 10% of the plot; slopes >25%; areas with anomalous vegetation; areas dominated by deciduous trees (>30% cover); areas within 30 meters of roads, man-made trails, or human created clearings.

Desired Future Condition
Areas currently dominated by non-native cool season grasses are thought to have been mixed grass prairie, though the exact pre-settlement vegetative composition is not known. The vision for this community is to reduce the cover of non-native grasses and forbs and increase the relative cover of native grasses and forbs.

Burn Prescription
Units will be burned between April and green-up.

Fire Prescription Elements	
RH: 25-55%	**Average Rate of Spread: 0-3 ch/hr**
Temp: 30-85°F	**Live Fuel Moisture:**
Average Mid-flame Winds: 0-20 mph	**1-hour TLFM: 6-14%**
Fuel Loading: 3-5 tons/acre	**10-hour TLFM: 8-15%**
Average Flame Length: 0.4-1.5 ft	**100-hour TLFM:10-30%**

Monitoring Variables (in order of importance)
- Relative cover of non-native grass
- Relative cover of native grass
- Relative cover of native forbs

Prescribed Fire Goals
- Reduce amount of herbaceous thatch.
- Increase the relative cover of native grasses while reducing relative cover of non-native perennial grasses.
- Decrease the encroachment of ponderosa pine into the open meadow areas.
- Return fire to the grassland ecosystem.

Prescribed Fire Objectives
Immediate Post-burn
- Burn at least 60% of the burnable project area.
- Reduce herbaceous fuel loading by at least 30%.

Two Years Post-burn
- Reduce relative cover of non-native grasses by at least 20%.
- Increase relative cover of native grasses by at least 10%.
- Increase relative cover of native forbs by at least 20%.

Fire Monitoring Objectives
- Install enough plots to be 80% confident that relative cover of native and non-native grasses will be within 25% of the population mean.

Relevant Literature

Fisher, R. F., M. J. Jenkins, and W. F. Fisher. 1987. Fire and the prairie-forest mosaic of Devil's Tower National Monument. American Midland Naturalist **117**:250-257.

Parrish, J. B., D. J. Herman, and D. J. Reyher. 1996. A century of change in Black Hills forest and riparian ecosystems. U.S. Forest Service and South Dakota Agriculture Experiment Station B 722, South Dakota State University, Brookings, SD.

Progulske, D. R. 1974. Yellow ore, yellow hair, yellow pine: a photographic study of a century of forest ecology. Agriculture Experiment Station Bulletin 616, South Dakota State University, Brookings, SD.

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, D. C., USA.

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.

Plot Protocols

General Protocols		**YES**	**NO**		**YES**	**NO**
Preburn	Control Plots/Opt		•	Herb Height/Rec	•	
	Herbaceous Density/Opt		•	Belt Transect Width: 5 meters		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: All		
	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: FMH – 17			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

FMH-4 MONITORING TYPE DESCRIPTION SHEET Park: **DETO**

Monitoring Type Code: FPIPO1D09 **Date Described:** 6 /20/96

Monitoring Type Name: Ponderosa Pine Forest

Prepared by: G. San Miguel, B. Adams, G. Kemp, P. Reeberg

Updated: A. Thorstenson, K. Rehamn, J. Decoster – April, 2001

Physical Description
Includes upland sites on all aspects and slopes with an elevation from 4,000 to 6,000', which includes upper, mid to lower slopes. Talus slopes and steep slopes (>40% slope) are excluded. Characteristic soils consists of deep, well drained clay or sandy loam of the Larkson-Lakota Series. There are also some areas of exposed sandstone.

Biological Description
Overstory dominated by ponderosa pine (*Pinus ponderosa*). Understory trees include bur oak (*Quercus macrocarpa*), chokecherry (*Prunus virginiana*), and American plum (*Prunus americana*). Shrubs include Oregon grape (*Mahonia repens*), common juniper (*Juniperus communis*), western red current (*Ribes cereum*). Dominant grasses are poverty oat grass (*Danthonia spicata*), needle-and-thread (*Stipa comata*), western wheatgrass (*Agropyron smithii*), big bluestem (*Andropogon gerardii*), and non-native Kentucky bluegrass (*Poa pratensis*). Native forbs such as common yarrow (*Achillea millefolium*), milkvetch (*Astragalus* spp.), arrowleaf balsamroot (*Balsamorhiza sagittata*), bedstraw (*Galium* spp.), scurfpea (*Psoralea* spp.), and goldenpea (*Thermopsis rhombifolia*) are common. Non-native forbs found in this monitoring type include yellow sweetclover (*Melilotus officinalis*), Canada thistle (*Cirsium arvense*), hound's tongue (*Cynoglossum officinale*), and leafy spurge (*Euphorbia esula*).

Rejection Criteria
Large outcroppings or barren areas >20% of the plot; areas with anomalous vegetation; monitoring type boundaries; riparian areas or areas dominated by deciduous trees (> 30% cover); areas within 30 meters of roads, man-made trails, or human created clearings; and areas within 20 meters of Woodlands Research exclosures are to be rejected.

Desired Future Conditions
- Decrease non-native species.
- Maintain open-canopy ponderosa pine stands with overstory tree density in a range of 200-350 stems/ha (80-140 stems/acre).
- Meadow and forest areas in various diverse stages of development
- Decrease density of pole-sized trees.
- Fuel load levels that are consistent with frequent, low intensity fires

Burn Prescription:
Units will be burned from April to green-up, or Labor Day to the end of November.

Fire Prescription Elements	
RH: 25-55%	**Average Rate of Spread: 0-3 ch/hr**
Temp: 30-85°F	**Live Fuel Moisture:**
Average Mid-flame Winds: 0-20 mph	**1-hour TLFM: 6-14%**
Fuel Loading: 3-5 tons/acre	**10-hour TLFM: 8-15%**
Average Flame Length: 0.4-1.5 ft	**100-hour TLFM:10-30%**

Monitoring Variables (in order of importance)
- Total dead and down fuel load
- Density of overstory ponderosa pine
- Relative cover of herbaceous species
- Density of pole size ponderosa pine

Prescribed Fire Project Objectives
Immediate Post Burn
- Reduce dead and down fuel loading by 30-70% immediate postburn
- Burn 80-100% of the project area

One Year Post Burn:
- Reduce density of pole-size ponderosa pine by 30 to70%
- Reduce relative cover of non-native grasses by 30 to 50%
- Increase relative cover of native grasses cover by 10 to 25%
- Increase relative cover of native forb cover by 10 to 25%

Five Year Post Burn
- Maintain 30% reduction of non-native grass relative cover.
- Maintain overstory density of ponderosa pine within 30% of preburn condition.
- Maintain increase of relative cover of native grass and forbs.

Fire Monitoring Objectives:
- Install enough plots to be 80% confident that the relative cover for non-native grasses are within 20% of the true population mean.
- Install enough plots to be 80% confident that the density of pole-size and overstory trees is with 20% of the population mean.
- Install enough plots to be 80 % confident that the fuel load is within 20% of the true population mean.

Data Analysis
- Track relative cover of native and non-native grass in year 1, 2, 5 and 10.
- Track density of pole-size and overstory trees in year 1, 2, 5, and 10.
- Track fuel load in immediate postburn and in year 1, 2, 5, and 10.

Relevant Literature

Arno, S. F. 1988. Fire ecology and its management implications in ponderosa pine forests. Pages 133-139 *in* D. M. Baumgartner and J. E. Lotan, editors. Ponderosa pine: the species and its management. Symposium Proceedings, Washington State University, Spokane.

Covington, W. W., and M. M. Moore. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. Journal of Forestry **92**(1):39-47.

Fisher, R. F., M. J. Jenkins, and W. F. Fisher. 1987. Fire and the prairie-forest mosaic of Devil's Tower National Monument. American Midland Naturalist **117**:250-257.

Kuchler, A.W. 1964. Potential natural vegetation of the coterminous Untied States. Am. Geogr. Soc. Spec. Publ. 36 (Manual), New York.

Parrish, J. B., D. J. Herman, and D. J. Reyher. 1996. A century of change in Black Hills forest and riparian ecosystems. U.S. Forest Service and South Dakota Agriculture Experiment Station B 722, South Dakota State University, Brookings, SD.

Progulske, D. R. 1974. Yellow ore, yellow hair, yellow pine: a photographic study of a century of forest ecology. Agriculture Experiment Station Bulletin 616, South Dakota State University, Brookings, SD.

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.

Plot Protocols

GENERAL PROTOCOLS		YES	NO		YES	NO
Preburn	Control Plots/Opt		•	Herb Height/Rec	•	
	Herbaceous Density/Opt		•	Belt Transect Width: 5 meters *		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: All		
	Stereo Photography/Opt		•	Crown Intercept/Opt		•
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt		•
	Herbaceous Data Collected at: **Q4-Q1**					
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec	•	
Postburn	Herbaceous Data/Opt: FMH - 17			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

FOREST PLOT PROTOCOLS		YES	NO		YES	NO
Overstory	Area sampled: 50 x 20m			Quarters Sampled: Q1-Q4		
	Tree Damage/Rec	•		Crown Position/Rec	•	
	Dead Tree Damage/Opt		•	Dead Crown Position/Opt		•
Pole-size	Area Sampled: 25 x 10m			Quarters Sampled: Q1		
	Height/Rec	•		Poles Tagged/Rec		•
Seedling	Area Sampled: 5 x 10m			Quarters Sampled: Subset of Q1		
	Height/Rec	•		Seedlings Mapped/Opt		•
Fuel Load	Sampling Plane Length: 6, 6, 12, 50, 50			Fuel Continuity/Opt		•
	Aerial Fuel Load/Opt		•			
Postburn	Char Height/Rec	•		Mortality/Rec	•	

Rec = Recommended Opt = Optional

FMH-4 MONITORING TYPE DESCRIPTION SHEET Park: **DETO**

Monitoring Type Code: FPIPO1D02 **Date Described:** 6 /20/96

Monitoring Type Name: Ponderosa Pine – Mixed-grass Savannah

Preparer: G. San Miguel, B. Adams, G. Kemp, P. Reeberg

Physical Description:
Characteristic soils consist of loamy soils, shallow to deep, well drained, alluvial fans, uplands and terraces, slopes >40%, elevation 3,500 to 5,000 feet, with lower to mid slopes and valleys. Soils include Alice fine sandy loam, Alice Theda Lund complex, Lakoa-Butche complex, Nunn clay loam and Samsil-Gaynor complex.

Biological Description:
Open canopy ponderosa pine (*Pinus ponderosa*) with occasional Rocky Mountain juniper (*Juniperus scopulorum*). Understory trees include bur oak (*Quercus macrocarpa*), chokecherry (*Prunus virginiana*), and American plum (*Prunus americana*). Shrubs include Oregon grape (*Mahonia repens*), common juniper (*Juniperus communis*), western red current (*Ribes cereum*). Dominant grasses are poverty oat grass (*Danthonia spicata*), needle-and-thread (*Stipa comata*), western wheatgrass (*Agropyron smithii*), big bluestem (*Andropogon gerardii*), and non-native Kentucky bluegrass (*Poa pratensis*). Native forbs such as common yarrow (*Achillea millefolium*), milkvetch (*Astragalus* spp.), arrowleaf balsamroot (*Balsamorhiza sagittata*), bedstraw (*Galium* spp.), scurfpea (*Psoralea* spp.), and goldenpea (*Thermopsis rhombifolia*) are common. Non-native forbs found in this monitoring type include yellow sweetclover (*Melilotus officinalis*), Canada thistle (*Cirsium arvense*), hound's tongue (*Cynoglossum officinale*), and leafy spurge (*Euphorbia esula*).

Rejection Criteria
Large outcroppings or barren areas >20% of the plot; areas with anomalous vegetation; monitoring type boundaries; riparian areas or areas dominated by deciduous trees (> 30% cover); areas within 30 meters of roads, man-made trails, or human created clearings; and areas within 20 meters of Woodlands Research exclosures are to be rejected.

Desired Future Condition
- Decrease non-native species.
- Maintain open-canopy ponderosa pine stands with overstory tree density in a range of 150-250 stems/ha (60-100 stems/acre).
- Meadow and forest areas in various diverse stages of development.
- Decrease density of pole-sized trees.
- Fuel load levels that are consistent with frequent, low intensity fires.

Burn Prescription:
Units will be burned from April to green-up, or Labor Day to the end of November.

Fire Prescription Elements	
RH: **25-55%**	Average Rate of Spread**: 0-3 ch/hr**
Temp**: 30-85°F**	Live Fuel Moisture**:**
Average Mid-flame Winds**: 0-20 mph**	1-hour TLFM**: 6-14%**
Fuel Loading**: 3-5 tons/acre**	10-hour TLFM**: 8-15%**
Average Flame Length**: 0.4-1.5 ft**	100-hour TLFM**:10-30%**

Monitoring Variables (in order of importance)
- Total dead and down fuel load
- Density of pole-size and overstory ponderosa pine
- Relative cover of herbaceous species

Prescribed Fire Project Objectives
Immediate Post Burn
- Reduce dead and down fuel loading by 30-70% immediate postburn
- Burn 80-100% of the project area

One Year Post Burn:
- Reduce density of pole-size ponderosa pine by 30 to70%
- Reduce relative cover of non-native grasses by 30 to 50%
- Increase relative cover of native grasses cover by 10 to 25%
- Increase relative cover of native forb cover by 10 to 25%
- Maintain density of juniper, deciduous trees, and shrubs within 15% of preburn density.

Five Year Post Burn
- Maintain 30% reduction of non-native grass relative cover.
- Maintain overstory density of ponderosa pine within 30% of preburn condition.
- Maintain increase of relative cover of native grass and forbs.

Fire Monitoring Objectives:
- Install enough plots to be 80% confident that the relative cover for non-native grasses are within 20% of the true population mean.
- Install enough plots to be 80% confident that the density of pole-size and overstory trees is with 20% of the population mean.
- Install enough plots to be 80 % confident that the fuel load is within 20% of the true population mean.

Data Analysis
- Track relative cover of native and non-native grass in year 1, 2, 5 and 10.
- Track density of pole-size and overstory trees in year 1, 2, 5, and 10.
- Track fuel load in immediate postburn and in year 1, 2, 5, and 10.

Relevant Literature

Arno, S. F. 1988. Fire ecology and its management implications in ponderosa pine forests. Pages 133-139 *in* D. M. Baumgartner and J. E. Lotan, editors. Ponderosa pine: the species and its management. Symposium Proceedings, Washington State University, Spokane.

Covington, W. W., and M. M. Moore. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. Journal of Forestry **92**(1):39-47.

Fisher, R. F., M. J. Jenkins, and W. F. Fisher. 1987. Fire and the prairie-forest mosaic of Devil's Tower National Monument. American Midland Naturalist **117**:250-257.

Kuchler, A.W. 1964. Potential natural vegetation of the coterminous Untied States. Am. Geogr. Soc. Spec. Publ. 36 (Manual), New York.

Parrish, J. B., D. J. Herman, and D. J. Reyher. 1996. A century of change in Black Hills forest and riparian ecosystems. U.S. Forest Service and South Dakota Agriculture Experiment Station B 722, South Dakota State University, Brookings, SD.

Progulske, D. R. 1974. Yellow ore, yellow hair, yellow pine: a photographic study of a century of forest ecology. Agriculture Experiment Station Bulletin 616, South Dakota State University, Brookings, SD.

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.

Plot Protocols

GENERAL PROTOCOLS		YES	NO		YES	NO
Preburn	Control Plots/Opt		•	Herb Height/Rec	•	
	Herbaceous Density/Opt		•	Belt Transect Width: 5 meters *****		
	OP/Origin Buried		•	Abbreviated Tags	•	
	Voucher Specimens/Rec	•		Stakes Installed: All		
	Stereo Photography/Opt		•	Crown Intercept/Opt		•
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt		•
	Herbaceous Data Collected at: **Q4-Q1**					
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec	•	
Postburn	Herbaceous Data/Opt: FMH - 17			Herb. Fuel Load/Opt		•
	100 Pt. Burn Severity/Opt		•			

FOREST PLOT PROTOCOLS		YES	NO		YES	NO
Overstory	Area sampled: 50 x 20m			Quarters Sampled: Q1-Q4		
	Tree Damage/Rec	•		Crown Position/Rec	•	
	Dead Tree Damage/Opt		•	Dead Crown Position/Opt		•
Pole-size	Area Sampled: 25 x 10m			Quarters Sampled: Q1		
	Height/Rec	•		Poles Tagged/Rec		•
Seedling	Area Sampled: 5 x 10m			Quarters Sampled: Subset of Q1		
	Height/Rec	•		Seedlings Mapped/Opt		•
Fuel Load	Sampling Plane Length: 6, 6, 12, 50, 50			Fuel Continuity/Opt		•
	Aerial Fuel Load/Opt		•			
Postburn	Char Height/Rec	•		Mortality/Rec	•	

Rec = Recommended Opt = Optional

***** Shrub density will not be collected for Oregon grape

Appendix 2 – 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		