

FIRE AND THE VEGETATIVE MOSAIC AT DEVIL'S
TOWER NATIONAL MONUMENT

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Objectives

The primary objective of the research underway is to determine the effects of past and present fire regimes on the vegetative mosaic at Devil's Tower. Secondary objectives are to develop a fire history, to assess the use of biogenic opal (phytoliths) as an indicator of vegetative boundaries, and to develop a burning plan to be used in vegetation management.

Methods

Using 1938 and 1978 aerial photographs, transects that cross major physiographic and vegetative boundaries were established in 1984. Along these transects 0.01 ha plots were established in each vegetation type and each soil type. Along these transects all fire scaped trees up to 20 m either side of the transect line were sampled by taking pie-shaped wedges. Within the sample plots trees in each diameter class and of each species were cored with an increment borer. These cores were field mounted.

Across any current or old (appearing on 1938 but not 1978 photos) meadow-forest boundary, soil samples were taken for phytolith analysis. Major grass and tree species were also sampled for phytolith analysis.

In the lab a temporary tree ring chronology was constructed. The fire scaped tree samples were aged and the dates of major fires determined using the chronology. The tree cores were also aged and fire scars or false rings were noted.

The plant samples were ashed in a muffle furnace at 450^o for eight hours and slats were taken up in hydrochloric acid. Soil samples had the organic matter removed by hydrogen peroxide treatment. The phytoliths were then extracted from the soil samples by the heavy liquid floatation method using tetrabromoethane and ethyl alcohol. Phytoliths from plants and soils were weighed and mounted on microscope slides. These slides were then observed at 450x to determine phytolith characteristics for the plants and to determine the type of phytoliths present in the soil.

Results

Preliminary results indicate that fire frequency at the monument has changed several times since 1770 (Table 1).

In addition, phytolith data indicate that there are three major forest community types on the monument (Table 2). These are stable forest with low phytolith content and mostly arborescent phytolith types, stable savanna with moderate phytolith content and both graminoid and arborescent phytoliths, and recently invaded meadow with high graminoid phytolith content and few if any arborescent phytoliths.

Our preliminary fuel data suggests that the fuel build-up is so large that a prescribed fire program to return the area to its original state will be difficult to implement. We are currently working on a feasible but likely very expensive plan for maintaining the forest-savannah-meadow system using physical intervention and prescribed fire.

Conclusions

Our preliminary conclusions are that intensified use by native Americans and early pioneers increased the fire frequency after 1770 and opened up the forest creating more savannahs and meadows. Fire suppression activity since 1900 has reduced fire frequency resulting in much more closed forest and savanna and much less meadow. The present forest is likely more dense than even the pre-1770 forest and much more dense than the 1770-1900 forest.

Table 1. Fire frequency at Devil's Tower.

Area wide fires before 1770	=	27.4 year return period
before 1900	=	19.3 year return period
from 1770-1900	=	14.25 year return period
since 1900	=	42.0 year return period
Tower area fires before 1700	=	14.9 year return period
before 1900	=	10.8 year return period
from 1770-1900	=	8.0 year return period
since 1900	=	28.0 year return period
East side fires before 1700	=	27.4 year return period
before 1900	=	14.3 year return period
from 1770-1900	=	9.5 year return period
since 1900	=	28.0 year return period
West side fires before 1700	=	17.1 year return period
before 1900	=	13.8 year return period
from 1700-1900	=	11.0 year return period
since 1900	=	42.0 year return period

Table 2. Selected opal phytolith transects from Devil's Tower

Plot	Phytolith % By Wt	Community Type & (Tree Ages in Years)
I .1	1.10	MEADOW
.2	0.94	SAVANNA (oldest tree 145 most 66-82)
.3	0.81	SAVANA (similar aged trees)
.4	0.97	MEADOW
.5	1.07	MEADOW
.6	0.57	FOREST (oldest trees 92-202)
.7	0.46	FOREST (oldest trees 106-213)
II .1	1.08	MEADOW
.2	0.77	FOREST (oldest trees 74-76)
.3	0.49	FOREST (oldest tree 229)
.4	0.99	MEADOW
.5	0.83	SAVANNA (oldest trees 44-47)
.6	0.55	FOREST (oldest tree 191)
IV .1	1.13	MEADOW
.2	0.89	SAVANNA (oldest trees 91-125)
.3	0.49	FOREST (oldest tree 194)
.4	1.03	MEADOW
.5	1.08	MEADOW
.6	0.94	SAVANNA (oldest trees 44-58)
.7	1.11	MEADOW
.8	0.54	FOREST (oldest tree 205)
V .5	0.39	FOREST (oldest tree 274)
.6	0.96	MEADOW
.7	0.53	FOREST (oldest tree 178)
.8	0.98	MEADOW