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A FOUR YEAR STUDY OF THE EFFECT OF FIRE ON THE VEGETATION IN TWO FIELDS, SARATOGA NATIONAL HISTORICAL PARK (SNHP), NEW YORK

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ABSTRACT

An experiment was designed to evaluate species composition on burned (experimental) and unburned portions of 2 fields, Freeman's Farm Overlook and The Great Redoubt, Saratoga National Historical Park, New York (SNHP). During the growing season of 1988, permanent line transects were established on both fields. Permanent quadrats (20 x 100 cm) were established on the transects, and vegetation within these quadrats was sampled in July and August 1988. Frequency data for each species occurring in the quadrats were calculated. The burned fields were sampled in August, 1992, and the vegetation on burned sites was compared with that on the preburned (1988) data. Fire apparently had little influence on the total numbers of species in both fields. The total number of woody species on the Freeman Farm Field decreased from 9 to 4 and from 12 to 7 on the Great Redoubt Field. Thirty nine percent of the species in these fields are not native to the United States.

INTRODUCTION

Saratoga National Historical Park (SNHP), comprising 1088 ha, is located in Saratoga County New York (latitude 43 00'; longitude 73 38')². The Park is the site of the Battles of Saratoga, 1777, which resulted a major defeat of the British army⁶. The Park is mandated to restore and maintain the historic landscape of the battle field as it looked in 1777. Exotic vegetation in the fields of SNHP have been designated for control management action to help restore the Park's historic quality. The objective of the present study is to compare species composition on burned and preburned portions of 2 fields, Freeman's Farm Overlook, a field comprising 3.2 ha and the Great Redoubt, a field comprising 7.3 ha, over a four year period, 1988 to 1992. Geology soils and climate of SNHP have been discussed in detail in earlier papers^{5,6}.

METHODS

During the growing season of 1988, permanent line transects were established in the above two fields at SNHP. Transects originate at mile markers on the edge of the park road and extend into the fields following a predetermined compass line so that the transects are perpendicular to their point of origin. Permanent quadrats (20 x 100 cm) have been established on the transects at 5 m intervals beginning at a point 10 m from the edge of the road following the procedure of Stalter and Lynch (1991)⁷.

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Vegetation in the aforementioned fields was sampled by the quadrat method in July and August, 1988. Frequency data, percent quadrats occupied for each species occurring in the quadrats in each field, was calculated. The vegetation data obtained in July-August 1988 serves as base line data for the present study, a comparison of pre-burned and burned fields 1988-1992. Woody vegetation on Freeman's Farm Overlook site was burned in 1989 and 1991 during late March and early April. Woody vegetation on The Great Redoubt site was cut by hand in 1986 and 1990. The Great Redoubt site was burned in 1988, 1990 and 1992 during late March-early April. The two study sites are burned following the techniques of Niering and Goodwin (1974)³. Fields were sampled in August 1992. We compare the effects of burning on species composition of two fields over a four year period, 1988-1992 (Table 1). Nomenclature follows that of Gleason and Cronquist (1991)¹.

RESULTS AND DISCUSSION

Freeman's Farm Overlook

Twenty five species were observed on the Freeman's Farm Overlook Field, in 1988, while 28 were observed in 1992, an increase of three species. Fifteen similar species were observed in both 1988 and 1992 (similarity coefficient of 0.57). Nine woody species were present in 1988, 36% of the total, while only 4 woody species were observed in 1992, a significant decrease. Five new herbaceous plants were observed in 1992. Eight new non native species were observed within the quadrats in 1992. The percentage of non native species increased from 20 percent in 1988 to 52 percent of the total in 1992. The total number of non native plants increased from 5 to 13, a significant increase. Centaurea spp. increased from 53% to 67% over the four year period. Galium verum, Fragaria virginiana, Carex spp. Lotus corniculatus and Toxicodendron radicans increased by 20 percent or more over the 4 year period. Rumex acetosella and Parthenocissus quinquefolia decreased from 27 and 20 percent, respectfully, to 0%.

The Great Redoubt

Thirty two species were observed within the quadrats on the Great Redoubt Field in 1988. Twenty-nine species were observed in 1992. Twelve woody species were observed in 1988; seven were observed in 1992 (Table 1). Non-native species declined from seven in 1988 to five in 1992. The similarity coefficient comparing in 1988 and 1992 data is high ($S = 75$ percent). Species apparently favored by burning are Daucus carota which increased from 0 to 47%, Solidago spp. (13 to 73%), Aster spp. (53 to 73%) and Plantago rugelii (0-27%). Cornus racemosa decreased (60 to 47%) as did Rubus flagellaris (73 to 53%) and Fragaria virginiana (67 to 47%).

It is impossible to separate the effect of cutting and fire on species composition at the Great Redoubt Field. No conclusions can be drawn as to which played a greater role on species composition here. Fragaria virginiana increased by thirty percent at Freeman's Farm, but decreased by 20 percent on The Great Redoubt. Centaurea spp. and Cornus racemosa had similar changes (Table 1).

Fire apparently has reduced the number of woody species in both fields, results similar to those observed by Niering and Goodwin (1974) and Niering (1983) on burned fields at the Connecticut Arboretum at Connecticut College, Connecticut. Thus the long term field management objectives at SNHP, to reduce the numbers and dominance of woody species, has been achieved.

A second objective, the reduction of exotic (i.e. non native) species from fields at SNHP appears to have been compromised. The number of exotic species has increased from five to thirteen on Freeman's Farm but decreased from seven to five on The Great Redoubt Field. These data may be somewhat misleading as at least 50 percent of the exotics on both fields were observed in but one quadrat (Table 1). Moreover, native species, i.e., asters, and goldenrods have increased in The Great Redoubt Field.

Results from the present study suggest that a four year interval may be too short a time period to measure the effectiveness of fire as a management tool i.e., an effective control of non native species such as Centaurea spp. and/or favoring native grasses such as Schizachyrium scoparium. Niering's (1983)⁴ data indicate that at least ten years of periodic burning is needed to stimulate native grasses at the expense of alien species e.g., Centaurea spp. Four years of burning appears to have increased the number of alien species, especially in the Freeman's Farm Overlook Field where the number of herbaceous alien plants has more than doubled. The number of woody species has decreased. Long-term fire management may be needed to stimulate the growth of native plants such as Schizachyrium scoparium at the expense of non native species.

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TABLE 1. Frequency data for species on permanent quadrats on two fields: Freeman's Farm Overlook; The Great Redoubt, SNHP, NY. 1988 data on unburned fields; 1992 data burned fields. An asterisk (*) proceeds weedy non-native species. A dash (-) indicates the species never was observed within the permanent quadrats at a particular field.

SPECIES	STUDY SITE			
	Freeman's Farm 1988	Freeman's Farm 1992	GreatRedoubt 1988	GreatRedoubt 1992
*Centaurea spp.	40	33	53	67
Potentilla simplex	20	13	33	33
Cornus racemosa	60	47	13	20
Schizachyrium scoparium	47	47	7	0
*Daucus carota	0	47	0	7
Solidago spp.	13	73	13	13
Aster spp.	53	73	7	7
*Hieracium spp.	7	0	-	-
Rhus glabra	27	20	-	-
Equisetum arvense	27	20	13	27
Rubus flagellaris	73	53	7	0
Galium verum	7	27	60	87
Fragaria virginiana	67	47	13	47
*Rumex acetosella	7	13	27	0
Vitis aestivalis	13	20	-	-
*Achillea millefolium	7	13	0	7
*Melilotus officinalis	7	0	-	-
Ulmus americana	7	0	7	0
Carex spp.	27	27	7	27
Rubus occidentalis	7	0	7	0
Oxalis stricta	20	27	7	0
Hamamelis virginiana	7	7	-	-
Ranunculus spp.	13	13	0	13
Rudbeckia hirta	7	13	0	7
Prunus serotina	7	13	-	-
Rubus hispidus	7	0	-	-
Rubus allegheniensis	20	0	20	27
Rhus typhina	7	0	-	-
Geranium maculatum	20	0	-	-
Galium aparine	7	7	-	-
*Celastrus orbiculatus	7	0	-	-
*Prunella vulgaris	7	7	0	13
Fraxinus americana	7	7	-	-
Toxicodendron radicans	-	-	33	53
Sambucus canadensis	-	-	7	0
Asclepias syriaca	-	-	7	7
Parthenocissus quinquefolia	-	-	20	0
*Glechoma hederacea	-	-	7	0
*Hypericum perforatum	-	-	7	0
*Linaria vulgaris	-	-	13	7
Robinia pseudoacacia	-	-	7	7
*Chrysanthemum leucanthemum	0	7	-	-
*Potentilla recta	0	7	-	-
*Thymus serpyllum	0	7	-	-
Plantago rugelii	0	7	0	7
*Vicia tetrasperma	-	-	0	7
*Calystegia sepium	-	-	0	7
*Veronica spp.	-	-	0	7
*Medicago sativa	-	-	0	7
*Lotus corniculatus	-	-	0	20
*Trifolium pratense	-	-	0	13
*Trifolium aureum	-	-	0	7
*Vicia dasycarpa	-	-	0	7