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PROGRESS REPORT

on the research project entitled

LONG TERM POST-FIRE VEGETATION MONITORING OF THE RECENT STANLEY RIDGE BURN IN ISLE ROYALE NATIONAL PARK

by

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INTRODUCTION

This report describes the progress made on a research project dealing with the monitoring of vegetation within a recently burned area in Isle Royale National Park. The primary objective is to determine what vegetation invades the area following a fire and how this vegetation changes with time after the fire.

The fire was lightning-caused and occurred during the summer of 1988 on Stanley Ridge on the northeast end of Isle Royale. Before it was extinguished by natural causes, the area burned spread over approximately 75 acres. It was the largest fire on Isle Royale since 1948. Part of this was on the ridge top which had been occupied by a forest of jack pine (*Pinus banksiana*). The remainder was on the rocky open south slope of the ridge.

The initial vegetation sampling of this burn occurred during the summer of 1991. The area was again sampled during the summers of 1992, 1993 and 1994. This report will discuss the results of the 1994 sampling and will compare these with the results of sampling in 1991, 1992 and 1993.

Sampling during the summer of 1994 was performed by myself with the assistance of three National Park Service employees Pat Valencia, Joel Flory and David Soleim. Funding ($800) was provided by the National Park Service.

METHODS

Following the ridge top, 10 plot reference points separated by random distances had been established with the assistance of National Park Service personnel during the summer of 1990 in the jack pine forested portion of the burn. These had been marked by permanent metal reference stakes. During the summer of 1991 we established 10 more plot reference points within the open rocky meadow on the south-east facing slope of the ridge. Each of these points were established at a random distance down-slope of the ridge (in a direction of 160 °) from one of the original 10 reference points and marked with a permanent metal stake. Thus 10 vegetation plots were established in each of 2 distinctly different ecosystems.

Stems of tree and tall shrub species greater than 1 meter in height (saplings) were counted in circular plots of 6 meters radius centered about each reference point. All stems were checked for moose browsing. Low ground cover plants and seedlings (stems less than 1 meter in height) of tree and tall shrub species were sampled in 2x2 meter square plots oriented so that one side of the square aligned with the line connecting one of the upper plot reference points with the corresponding lower one and so that the reference point was at the center of this side. For ground cover plants, % cover was estimated for each species. For seedlings, both % cover estimates and stem counts were made. Also browsing was noted. To facilitate this sampling, a 1x1 meter wooden quadrat frame was used and laid down on the ground 4 times to cover the 2x2 meter quadrat.

RESULTS

On the forested ridge top, the seedling densities of quaking aspen (*Populus tremuloides*), jack pine (*Pinus banksiana*), white birch (*Betula papyrifera*). and sugar plum (*Amelachier spp.*) still, by far, exceed that of all other tree/tall shrub species (Table 1). All four of these species had increased in densities up to 1993 but have decreased between 1993 and 1994, the sixth year following the burn. The seedling density of all species combined has followed the same pattern.

On the open south slope, the density of sugar plum seedlings still far exceeds that of all other species although it has declined between 1993 and 1994. As on the ridge top, the density of all species combined, after increasing during the first five years after the burn, has declined during the sixth year. Our monitoring of vegetation in the Card Point and McGinty's Cove burns has indicated that, for both burns, the seedlings densities of all species combined has also increased for five years after the burns and has decreased during the sixth year (Janke, 1991). This decline during the sixth year is undoubtedly partly due to seedlings becoming saplings (stems greater than 1 meter in height) but probably mostly due to increasing competition from other plant species.

Of the stems sampled in the 6 meter radius circular plots, none were in the tree stage of development (diameter at breast height >5 cm) (Table 2). Our first year of sampling this burn indicated that no stems in the tree stage survived the fire and this year's data indicates that there has been insufficient time since the fire for newly established woody plants to reach this stage of development. All stems sampled in these plots, then, were in the sapling stage of development.

On the ridge top the density of jack pine saplings has increased phenominally from 433.8 to 3783.5 stems per hectare. The density of white birch has more than doubled, while that of quaking aspen has only slightly increased. For the south slope, jack pine has more than doubled, while aspen, as on the ridge, has only slightly increased. The density of all species combined has increased considerably for both the ridge top and the south slope.

For the ridge top and south slope combined, the percentage of saplings that were browsed by moose was calculated for each species (Table 3). For aspen and birch close to 100% of the saplings sampled in 1994 were browsed. For jack pine, on the other hand, none of the saplings sampled were browsed. Because of this and because of the large increase in jack pine density, the percentage of saplings browsed for all species combined has decreased considerably.

From our sampling results for 1991 and 1992, it appeared that quaking aspen would become the dominant tree species on the ridge top. By 1993, however, jack pine saplings exceeded those of aspen and by 1994 they were 10 times more abundant. This is not surprising since prior to the fire the ridge top was almot a pure stand of jack pine. On Isle Royale, it is common for jack pine to grow in dry rocky environments such as this. The decline in jack pine seedlings between 1993 and 1994 about equals the increase in saplings. This suggests that the seedlings decline is due almost entirely to their development into saplings. For aspen, on the other hand, the seedling decline far exceeds the sapling increase, indicating that many are not surviving. Aspen generally requires better soil conditions to survive than does jack pine. Also it is highly subject to browsing by moose.

In determining the effects of fire on any Isle Royale ecosystem, one of the most important things to investigate is the effect of a fire on the food supply of moose. We have estimated this by totaling the densities of all sapling species considered to be palatable to moose. The results of this are given below in stems/hectare for both the ridge top and the south slope for each year sampled:

	1991	1992	1993	1994
forested ridge top	8.8	247.6	601.1	760.2
open south slope	26.5	44.2	353.7	486.2

In one of our previous studies dealing with 100 year old jack pine stands, the density of palatable saplings averaged 289 stems/hectare (Janke, 1983). By 1993 (5 years after the burn) the density of these species greatly exceeded that of the 100 year old stands and by 1994 this value increased even more. Fire, then, appears to decrease the woody food supply for moose immediately after the fire occurs but, after a few years, the supply increases considerably above its value prior to the fire. Future years of sampling will reveal how long the food supply will remain above its pre-fire value. The density of palatable species has steadily increased for both

the ridge top and the south slope since our first year of sampling. That of the ridge top is considerably greater than that of the south slope.

Among the low ground cover plants on the ridge top, the blueberry species (*Vaccinium angustifolium*) is still by far the most dominant (Table 4). Its % cover, however, has decreased since 1992. The % cover in 100 year old stands had been found to be only 4.7%. Another effect of fire, on jack pine stands, then, is an increase in the blueberry crop. For all ground cover species combined, the % cover had increased to a value of 46.5% by 1993 and then declined to 40% in 1994 (Table 4). For 100 year old stands, the % cover averages only 22.1%.

The total number of ground cover species on the ridge top for various years of sampling are as follows:

1991 - 42
1992 - 50
1993 - 50
1994 - 49

After increasing up to 1992, the number remained relatively constant. The number of species for 100 year old jack pine stands averages only 39. Fire on the ridge top has thus resulted in a greater amount of ground cover vegetation and a greater diversity of ground cover species.

For the south slope, the % cover of all ground cover species combined had also increased up until 1993 and then declined slightly in 1994 (Table 5). The value for 1994 on the south slope is about half of that found on the ridge top in 1994. The blueberry species *Vaccinium angustifolium* is not a dominant species here as it is on the ridge top. The total number of ground cover species for the various sampling years for the south slope are as follows:

1991 - 37
1992 - 41
1993 - 46
1994 - 46

The number of species has increased up to 1993 but did not change in 1994.

SUMMARY

Saplings of tree and tall shrub species have generally continued to increase, while seedlings have begun to decrease. The increase in jack pine saplings has been phenomenal between 1993 and 1994. The aspen population has only moderately increased and, although originally it was the dominant species after the burn, it is now greatly exceeded by jack pine. Almost all of aspen and birch saplings have experienced some browsing by moose while jack pine saplings have experienced none. The sapling density of species palatable to moose has continued to increase. The total % cover of all low ground cover species, after having increased up to 1993, has begun to decline. The % cover of *Vaccinium angustifolium* still greatly exceeds that of all other ground cover species on the forested ridge top but is only a minor element on the open south slope. Some significant effects that fire has had on the ridge top are (1) an increase in the density of woody plants palatable to moose, (2) an increase in the % cover of the dominant ground cover species, *Vaccinium angustifolium*, (3) an increase in the total ground cover vegetation, and (4) an increase in the diversity of ground cover species.

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TABLE 1. Seedling densities (stems/hectare) of tree and tall shrub species for 1991, 1992, 1993 and 1994.

FORESTED RIDGE TOP

species	density 1991	1992	1993	1994
quaking aspen	26,500	51,750	47,250	37,250
jack pine	23,000	25,000	30,250	27,000
white birch	9,750	20,750	24,000	22,500
sugar plum (serviceberry)	18,250	18,250	27,000	18,250
white spruce	500	1,000	750	750
pin cherry	750	750	1,750	4,750
staghorn sumac	250	500	750	1,000
red elderberry	250	250	0	750
choke-cherry	500	0	0	0
balsam fir	0	0	500	250
total all species	79,750	118,250	132,250	106,250

OPEN SOUTH SLOPE

species	density 1991	1992	1993	1994
sugar plum (serviceberry)	22,000	27,250	32,750	29,500
choke-cherry	1,750	9,750	12,500	8,500
staghorn sumac	500	1,500	2,250	5,500
jack pine	1,000	0	250	250
pin cherry	1,000	0	0	0
total all species	26,250	38,500	47,750	43,750

TABLE 2. Sapling densities (stems/hectare) of tree and tall shrub species for 1991, 1992, 1993 and 1994.

FORESTED RIDGE TOP

species	density 1991	1992	1993	1994
quaking aspen	8.8	141.5	353.6	371.3
white birch	0.0	61.9	141.5	318.2
sugar plum (serviceberry)	0.0	26.5	61.8	53.0
pin cherry	0.0	17.7	8.8	17.7
jack pine	0.0	0.0	433.8	3783.5
willow	0.0	0.0	35.4	0.0
mountain alder	0.0	0.0	8.8	0.0
total all species	8.8	247.6	1034.9	4543.7

OPEN SOUTH SLOPE

species	density 1991	1992	1993	1994
sugar plum (serviceberry)	0.0	35.4	168.0	70.7
jack pine	0.0	26.5	114.9	327.1
willow	8.8	8.8	53.1	97.2
quaking aspen	17.7	0.0	123.8	150.3
choke-cherry	0.0	0.0	8.8	0.0
pin cherry	0.0	0.0	0.0	168.0
total all species	26.5	70.7	468.6	813.3

TABLE 3. Percent of stems browsed for saplings of tree and tall shrub species. The symbol * indicates that insufficient stems were sampled to yield an accurate value.

	1992	1993	1994
quaking aspen	56	74	93
white birch	*	63	94
jack pine	*	0	0
all species combined	42	49	21

TABLE 4. Percent cover of vascular ground cover species for forested ridge top. "P" indicates cover less than 0.1%.

Species	1991	1992	1993	1994
Vaccinium angustifolium	14.3	14.5	10.9	10.1
Epilobium angustifolium	1.7	3.6	3.4	1.7
Betula papyrifera	1.6	2.7	3.4	2.7
Amelanchier spp.	2.1	2.5	3.4	2.5
Populus tremuloides	1.9	2.5	2.7	2.3
Deschampsia flexuosa	0.1	2.0	2.3	2.0
Maianthemum canadense	0.5	1.9	1.8	1.7
Pinus banksiana	1.0	1.8	2.8	3.9
Potentilla tridentata	1.3	1.3	3.1	2.6
Potentilla arguta	P	1.0	0.2	0.1
Carex aenea	2.9	1.0	0.5	0.5
Hieracium florentinum	0.1	1.0	0.8	0.6
Diervilla lonicera	1.0	0.9	1.4	1.1
Rubus strigosus	0.5	0.9	1.9	1.8
Vaccinium myrtilloides	0.6	0.8	1.0	0.8
Solidago nemoralis	P	0.8	0.8	0.9
Arctostaphylos uva-ursi	0.4	0.7	0.9	0.6
Lonicera dioica	0.4	0.5	0.6	0.0
Danthonia spicata	0	0.5	0.4	0.2
Linnaea borealis	0.2	0.4	0.5	0.4
Carex houghtoniana	0.2	0.4	0.2	P
Symphoricarpos alba	0.1	0.2	0.1	P
Argrostis hyemales	0.3	0.2	0.9	0.3
Calamagrostis canadensis	0.3	0.2	0.4	0.2
Aster macrophyllus	0	0.2	0.4	0.2
Oryzopsis pungens	P	0.1	0.2	0.3
Fragaria virginiana	0.1	0.1	0.2	0.2
Arabis divaricarpa	P	0.1	0.2	0.1
Prunus pensylvanica	P	0.1	0.3	0.2
Anaphalis margaritacea	P	0.1	0.1	0.3
Erigeron canadensis	0	0.1	P	0
Poa glauca	0	P	0.1	0.1
Geranium bicknellii	P	P	P	0
Corydalis sempervirens	0.1	P	0	0
Polygonum douglasii	P	P	P	0
Convolvulus spithamaeus	P	P	P	P
Picea glauca	0	P	P	0
Rubus parviflorus	P	P	P	P
Campanula rotundifolia	P	P	P	0.1
Sambucus pubens	0.1	P	P	P
Agropyron trachycaulon	0.3	P	0	0.2
Prunus virginiana	P	P	0	0
Polygonum cilinode	P	P	0	0
Antennaria plataginifolia	0	P	P	P
Silene antirrhina	P	P	0	0
Dracocephalum parviflorum	0	P	0	0
Viburnum edula	0	P	0	0
Taraxacum officinale	0	P	P	P
Rhus typhina	0.1	P	P	P

continued

TABLE 4. continued

Species	1991	1992	1993	1994
Viola conspersa	P	P	P	0
Ribes glandulosum	P	0	P	0
Oryzopsis asperifolia	0	0	0.1	0.3
Melampyron lineare	0	0	P	0
Abies balsamea	0	0	P	0
Actea rubra	0	0	P	P
Aralia hispida	0	0	P	P
Shepherdia canadensis	0	0	P	0
Lonicera involucrata	0	0	0	0.4
Festuca rubra	0	0	0	P
Carex umbellata	0	0	0	0.2
Clintonia borealis	0	0	0	P
Aquilegia canadensis	0	0	0	P
Geocaulon lividium	0	0	0	P
Poa compressa	0	0	0	P
Solidago graminifolia	0	0	0	P
total of all species	33.0	44.1	46.5	40.0

TABLE 5. Percent cover of vascular ground cover species for open south slope. "P" indicates cover less than 0.1%.

Species	1991	1992	1993	1994
Amelanchier spp.	1.9	2.5	2.1	1.9
Polygonum douglassii	0.3	1.2	0.4	0.1
Convolvulus spithemaeus	1.6	1.2	1.9	1.6
Geranium bicknellii	0.1	1.0	1.4	0.1
Saxifraga virginiana	0.2	0.9	0.4	0.3
Solidago nemoralis	0.4	0.8	0.9	0.6
Danthonia spicata	1.3	0.8	0.8	0.4
Argrostis hyemales	0.4	0.8	1.4	1.6
Symphoricarpos albus	0.3	0.8	0.8	0.5
Potentilla arguta	0.5	0.7	0.9	1.0
Prunus virginiana	0.3	0.6	0.7	0.4
Fragaria virginiana	0.5	0.5	1.6	1.6
Argopyron trachycaulum	0.3	0.5	1.6	2.2
Deschampsia flexuosa	0.1	0.4	0.8	0.4
Hieracium florentinum	0.1	0.4	0.6	0.6
Antennaria plantaginifolia	0.1	0.4	0.1	0.2
Diervilla lonicera	0.5	0.4	0.4	0.4
Arabis divaricarpa	0.2	0.3	0.7	0.7
Vaccinium angustifolium	0.3	0.3	0.2	0.1
Carex houghtoniana	0	0.3	0.4	P
Woodsia ilvensis	0.2	0.2	0.2	0.2
Satureja vulgaris	P	0.2	0.5	0.5
Artemisia canadensis	0.1	0.2	0.6	1.1
Rhus typhina	0.2	0.2	0.4	1.2
Sorbus decora	0.2	0.1	0.6	0
Aquilegia canadensis	0	0.1	0.2	0.2
Arctostaphylos uva-ursi	0.1	0.1	0.2	0.1
Rubus strigosus	0.1	0.1	0.2	0.2
Viola conspersa	P	0.1	0.1	0.3
Prunus pensylvanica	0.1	0.1	P	0
Mianthemum canadense	P	P	0	P
Pinus banksiana	P	P	0.1	0.1
Carex aenea	P	P	0	0
Lilium philadelphicum	0	P	P	P
Dracocephalum parviflorum	P	P	P	0
Campanula rotundifolia	P	P	0.1	P
Oryzopsis pungens	P	P	0.1	0.1
Corydalis sempervirens	0.1	P	0	0
Polygonum cilinode	P	P	0	0
Erigeron canadensis	0	P	0.4	0
Taraxacum officinalis	0	P	0.1	0.1
Carex umbellata	0	0	0.5	0.3
Ranunculus rhomoideus	0	0	0.3	0.1
Poa compressa	P	0	0.2	0.3
Poa glauca	0	0	P	P
Epilobium angustifolium	0	0	P	P
Silene antirrhina	0	0	P	P
Melampyrum lineare	0	0	P	P
Collinsia parviflora	0	0	P	0

TABLE 5. continued

Species	1991	1992	1993	1994
Lonicera canadensis	0	0	P	0
Anaphalis margaritacea	0	0	0	P
Vaccinium myrtilloides	0	0	0	P
Oryzopsis asperifolia	0	0	0	P
Unk grass D	0	0	0	P
Roas acicularis	0	0	0	0.2
total of all species	11.0	16.8	23.1	20.1