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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. Such information should increase our understanding of the role of fire in the natural ecosystems involved.

The fire was lightning-caused and occurred during the summer of 1988, on Stanley Ridge on the northeast end of Isle Royale. Before 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, 1994, 1995, 1998, and 1999. This report will discuss the results of the 1998/1999 sampling and will compare these with the results of sampling in 1991, 1992, 1993, 1994, and 1995.

Sampling during the summers of 1998/1999 was done by the investigators Robert Janke and Patrick Valencia, with the assistance of Steven Niemela, Jon Kazmierski, Lynn Repola, Trevor Peterson, and Andrea Rapinski.

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 southeast-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 or tall shrub species with height 1 meter or greater and d.b.h. less than 5 cm. (saplings) in addition to those with d.b.h. 5 cm. or greater (post-saplings) were sampled in circular plots of 6 meters radius centered about each plot reference point. Stem counts were made for each species. 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, within these plots we estimated the % cover of bare rock on the surface. To facilitate our sampling in the 2x2 meter plots, a 1x1 meter wooden quadrat frame was used and laid down on the ground 4 times to cover the 2x2 meter quadrat.

Our most recent monitoring of the Stanley Ridge Burn was performed in the summer of 1998 except for the saplings of tree/tall shrubs, which were sampled in the summer of 1999.

RESULTS and DISCUSSION

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 1992 or 1993, but have generally decreased since. The density of all species combined has behaved similarly, having decreased to 43% of its peak value. Of the tree species, quaking aspen and jack pine have declined the most.

On the open south slope, the density of sugar plum seedlings still far exceeds that of all other species, although it has declined since 1993. As on the ridge top, the density of all species combined, after increasing during the first five years after the burn, has declined since. 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 followed a similar time trend (Janke, 1991). This decline after the fifth year is undoubtedly partly due to seedlings becoming saplings (stems greater than 5 cm. d.b.h.) but probably also due to a reduced availability of seeds.

Our sampling of post-saplings indicated that no stems are in this stage of development (diameter at breast height > 5 cm.) Our first year of sampling this burn indicates that no post-saplings had 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.

On the ridge top, the density of jack pine saplings has increased phenomenally from 0 to 10,943.9 stems per hectare between 1992 and 1999. (Table 2). To a much lesser extent, aspen and birch have steadily increased up until 1995 and since then, birch has continued to increase while aspen has abruptly declined. On the south slope, jack pine has steadily increased up to 1999 but aspen has declined since 1994. Among the tall shrub species, sugar plum is now the dominant species in the sapling stage for both the ridge top and the south slope.

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 1999, they were 43 times more abundant. This is not surprising, since prior to the fire, the ridge top was almost a pure stand of jack pine. The initial dominance of aspen among the tree species may have occurred because of its faster rate of growth since a large percentage of its reproduction is usually by sucker shoots. The present dominance of jack pine among the ridge top tree species is probably related to soil conditions. One of our past research projects has shown that among the 3 most common post-fire tree species invaders in Isle Royale's boreal forests, namely white birch, quaking aspen, and jack pine, the latter is most likely to be found on the poorest soil conditions. (Janke, 1983). Aspen, on the other hand, was most likely to be found on the best soil conditions. Pure stands of jack pine had an average percent cover of exposed rock on the soil surface of 17.4%; while for pure stands of birch, the % cover was 5.7% and for aspen, only 1.4%. On the ridge top of the Stanley Ridge Burn, the exposed rock has 19.6% cover. This probably is the reason why on the ridge top, jack pine is the most abundant of the 3

species mentioned above and aspen is the least abundant. Moose browsing may also be a factor affecting the relative densities of these 3 species, since jack pine is the least palatable and aspen the most palatable to moose.

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

	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1999</u>
forested ridge top	8.8	247.6	601.1	760.2	1025.4	1573.5
open south slope	26.5	44.2	353.7	486.2	406.7	238.6

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 on the ridge top greatly exceeded that of the 100 year old stands and up to 1999 it was still increasing. Fire, then, appears to decrease the woody food supply for moose in jack pine stands 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 the south slope up to 1994, but has declined since.

Our 1998 sampling of low ground cover species on the ridge top (Table 3) revealed that the total % cover has continued to decline since it reached its peak value in 1992. Its present value is considerably less than what was present in the Card Point and McGinty's Cove burns 10 years after these burns occurred. The blueberry species, *Vaccinium angustifolium* is still the most dominant species. Although its % cover has generally declined since 1992 (4 years after the fire) it is still greater than that in 100 year old jack pine stands (4.7%). Other dominant ground cover species in order of abundance are: *Diervilla lonicera*, *Arctostaphylos uva-ursi*, and *Deschampsia flexuosa*.

The total number of vascular plant species (including trees, tall shrubs, and low ground cover) that have been found on the ridge top at one time or another since the burn is 77. This greatly exceeds the 50 species found in the 100-year-old jack pine stand that we have studied in the past. Of these 77 species seen in the burned-over ridge top forest, 44 were not found in the 100-year-old forests. Hence, one result of forest fires in this ecosystem type is an increase in the diversity of vascular plant species.

For the south slope, the % cover of all ground cover species combined had also increased up until 1993 and then declined since (Table 4). The value for 1998 on the south slope is less than half of that found on the ridge top. *Vaccinium angustifolium* is also the dominant species there although it is much less abundant than on the ridge top. 60 species of vascular plants have been seen there at one time or another since the burn.

SUMMARY

Saplings of tree and tall shrub species have generally continued to increase, while seedlings have continued to decrease. The increase in jack pine saplings has been phenomenal between 1993 and 1999. The aspen population has recently declined and, although originally it was the dominant species after the burn, it is now greatly exceeded by jack pine. 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 declined since. The % cover of *Vaccinium angustifolium* still greatly exceeds that of all other ground cover species on the forested ridge top. 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 species.

BIBLIOGRAPHY

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Table 1

Seedling densities (stems/hectare) of tree and tall shrub species

FORESTED RIDGE TOP

Number of Years Since Burn
(year)

Species	3 (1991)	4 (1992)	5 (1993)	6 (1994)	7 (1995)	10 (1998)
quaking aspen*	26,500	51,750	47,250	37,250	30,250	9,000
jack pine*	23,000	25,000	30,250	27,000	21,000	8,500
white birch*	9,750	20,750	24,000	22,500	18,000	13,500
sugar plum (serviceberry)	18,250	18,250	27,000	18,250	19,250	20,250
white spruce*	500	1,000	750	750	750	2,750
pin cherry	750	750	1,750	4,750	3,750	2,000
staghorn sumac	250	500	750	1,000	500	250
red elderberry	250	250	0	750	250	0
choke-cherry	500	0	0	0	0	0
balsam fir*	0	0	500	250	250	250
mountain ash*	0	0	0	0	750	750
white cedar*	0	0	0	0	0	250
total all species	79,750	118,250	132,250	112,500	94,750	57,500

OPEN SOUTH SLOPE

Species	3 (1991)	4 (1992)	5 (1993)	6 (1994)	7 (1995)	10 (1998)
sugar plum (serviceberry)	22,000	27,250	32,750	29,500	26,750	22,500
choke-cherry	1,750	9,750	12,500	8,500	6,750	7,750
staghorn sumac	500	1,500	2,250	5,500	7,750	11,750
jack pine*	1,000	0	250	250	250	250
pin cherry	1,000	0	0	0	0	0
willow	0	0	0	0	0	250
total of all species	26,250	38,500	47,750	43,750	41,500	42,500

*Species capable of occupying the forest canopy

Table 2

Sapling densities (stems/hectare) of tree and tall shrub species

FORESTED RIDGE TOP

Number of Years Since Burn
(year)

Species	3 (1991)	4 (1992)	5 (1993)	6 (1994)	7 (1995)	11 (1999)
quaking aspen*	8.8	141.5	353.6	371.3	468.6	256.4
white birch*	0.0	61.9	141.5	318.2	512.6	724.9
sugar plum (serviceberry)	0.0	26.5	61.8	53.0	17.7	450.8
pin cherry	0.0	17.7	8.8	17.7	8.8	123.8
jack pine*	0.0	0.0	433.8	3,783.5	7,276.9	10,943.9
willow	0.0	0.0	35.4	0.0	17.7	8.8
mountain alder*	0.0	0.0	8.8	0.0	0.0	0.0
mountain ash*	0.0	0.0	0.0	0.0	0.0	8.8
total all species	8.8	247.6	1,034.9	4,543.7	8,302.4	12,517.4

OPEN SOUTH SLOPE

Species	3 (1991)	4 (1992)	5 (1993)	6 (1994)	7 (1995)	11 (1999)
sugar plum (serviceberry)	0.0	35.4	168.0	70.7	203.3	159.1
jack pine*	0.0	26.5	114.9	327.1	663.1	751.4
willow	8.8	8.8	53.1	97.2	44.2	53.0
quaking aspen*	17.7	0.0	123.8	150.3	141.5	17.7
choke-cherry	0.0	0.0	8.8	0.0	0.0	0.0
pin cherry	0.0	0.0	0.0	168.0	17.7	8.8
total all species	26.5	70.7	468.6	813.3	1,069.8	990.1

*Species capable of occupying the forest canopy

Table 3

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

Species	Number of Years Since Burn (year)					
	3	4	5	6	7	10
	1991	1992	1993	1994	1995	1998
<i>Vaccinium angustifolium</i>	14.3	14.5	10.9	10.1	11.1	6.9
<i>Epilobium angustifolium</i>	.7	3.6	3.4	1.7	0.6	0.2
<i>Deschampsia flexuosa</i>	0.1	2.0	2.3	2.0	2.4	2.0
<i>Maianthemum canadense</i>	0.5	1.9	1.8	1.7	1.9	1.5
<i>Potentilla tridentata</i>	1.3	1.3	3.1	2.6	1.7	1.0
<i>Potentilla arguta</i>	P	1.0	0.2	0.1	0.1	P
<i>Carex aenea</i>	2.9	1.0	0.5	0.5	0.1	P
<i>Hieracium florentinum</i>	0.1	1.0	0.8	0.6	0.5	0.9
<i>Diervilla lonicera</i>	1.0	0.9	1.4	1.1	1.5	2.8
<i>Rubus strigosus</i>	0.5	0.9	1.9	1.8	2.1	0.8
<i>Vaccinium myrtilloides</i>	0.6	0.8	1.0	0.8	1.1	0.8
<i>Solidago nemoralis</i>	P	0.8	0.8	0.9	0.4	0.2
<i>Arctostaphylos uva-ursi</i>	0.4	0.7	0.9	0.6	0.6	2.3
<i>Lonicera dioica</i>	0.4	0.5	0.6	0.0	0.0	0.2
<i>Danthonia spicata</i>	0.0	0.5	0.4	0.2	0.3	0.4
<i>Linnaea borealis</i>	0.2	0.4	0.5	0.4	0.5	0.6
<i>Carex houghtoniana</i>	0.2	0.4	0.2	P	P	0.0
<i>Symphoricarpos alba</i>	0.1	0.2	0.1	P	0.1	P
<i>Argrostis hyemalis</i>	0.3	0.2	0.9	0.3	0.1	P
<i>Calamagrostis canadensis</i>	0.3	0.2	0.4	0.2	0.4	0.1
<i>Aster macrophyllus</i>	0.0	0.2	0.4	0.2	0.6	0.6
<i>Oryzopsis pungens</i>	P	0.1	0.2	0.3	0.3	0.2
<i>Fragaria virginiana</i>	0.1	0.1	0.2	0.2	0.2	0.2
<i>Arabis divaricarpa</i>	P	0.1	0.2	0.1	P	P
<i>Anaphalis margaritacea</i>	P	0.1	0.1	0.3	0.2	0.2
<i>Erigeron canadensis</i>	0.0	0.1	P	0.0	0.1	0.0
<i>Poa glauca</i>	0.0	P	0.1	0.1	P	P
<i>Geranium bicknellii</i>	P	P	P	0.0	0.0	0.0
<i>Corydalis sempervirens</i>	0.1	P	0.0	0.0	0.0	P
<i>Polygonum douglasii</i>	P	P	P	0.0	0.0	0.0
<i>Convolvulus spithameus</i>	P	P	P	P	P	P
<i>Rubus parviflorus</i>	P	P	P	P	0.0	0.0
<i>Campanula rotundifolia</i>	P	P	P	0.1	0.1	P
<i>Agropyron trachycaulon</i>	0.3	P	0.0	0.2	0.0	P

continued

Table 3 (continued)

Species	Number of Years Since Burn (year)					
	3 1991	4 1992	5 1993	6 1994	7 1995	10 1998
Polygonum cilinode	P	P	0.0	0.0	0.0	0.0
Antennaria plataginifolia	0.0	P	P	P	P	0.0
Silene antirrhina	P	P	0.0	0.0	0.0	P
Viola conspersa	P	P	P	0.0	P	0.0
Ribes glandulosum	P	0.0	P	0.0	P	0.0
Oryzopsis asperifolia	0.0	0.0	0.1	0.3	0.1	P
Melampyron lineare	0.0	0.0	P	0.0	P	P
Actea rubra	0.0	0.0	P	P	0.0	0.0
Aralia hispida	0.0	0.0	P	P	0.0	0.0
Shepherdia canadensis	0.0	0.0	P	0.0	P	P
Lonicera involucrata	0.0	0.0	0.0	0.4	0.0	0.0
Festuca rubra	0.0	0.0	0.0	P	0.0	0.0
Carex umbellata	0.0	0.0	0.0	0.2	0.1	P
Clintonia borealis	0.0	0.0	0.0	P	P	0.0
Aquilegia canadensis	0.0	0.0	0.0	P	P	P
Geocaulon lividum	0.0	0.0	0.0	P	0.1	0.2
Poa compressa	0.0	0.0	0.0	P	P	P
Solidago graminifolia	0.0	0.0	0.0	P	0.0	0.0
Solidago hispida	0.0	0.0	0.0	0.0	P	0.0
Carex spp.	0.0	0.0	0.0	0.0	0.0	P
Lonicera canadensis	0.0	0.0	0.0	0.0	0.0	P
Unknown grass	0.0	0.0	0.0	0.0	0.0	P
Saxifraga virginiana	0.0	0.0	0.0	0.0	0.0	P
Cornus canadensis	0.0	0.0	0.0	0.0	0.0	P
Polypodium virginiana	0.0	0.0	0.0	0.0	0.0	P
Arabis divaricarpa	0.0	0.0	0.0	0.0	0.0	P
Pyrola asarifolia	0.0	0.0	0.0	0.0	0.0	P
Total all species	26.2	34.4	33.8	28.4	28.0	23.5

Table 4

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

Species	Number of Years Since Burn (year)					
	3 (1991)	4 (1992)	5 (1993)	6 (1994)	7 (1995)	10 (1998)
<i>Polygonum douglassii</i>	0.3	1.2	0.4	0.1	P	P
<i>Convolvulus spithameus</i>	1.6	1.2	1.9	1.6	1.4	0.6
<i>Geranium bicknellii</i>	0.1	1.0	1.4	0.1	P	P
<i>Saxifraga virginiana</i>	0.2	0.9	0.4	0.3	0.1	0.1
<i>Solidago nemoralis</i>	0.4	0.8	0.9	0.6	0.4	0.4
<i>Danthonia spicata</i>	1.3	0.8	0.8	0.4	1.0	1.0
<i>Argrostis hyemalis</i>	0.4	0.8	1.4	1.6	0.4	P
<i>Symphoricarpos albus</i>	0.3	0.8	0.8	0.5	0.6	0.3
<i>Potentilla arguta</i>	0.5	0.7	0.9	1.0	0.6	0.6
<i>Fragaria virginiana</i>	0.5	0.5	1.6	1.6	0.9	0.8
<i>Argopyron trachycaulum</i>	0.3	0.5	1.6	2.2	1.6	0.9
<i>Deschampsia flexuosa</i>	0.1	0.4	0.8	0.4	0.9	0.7
<i>Hieracium pilloselloides</i>	0.1	0.4	0.6	0.6	0.2	0.5
<i>Antennaria plantaginifolia</i>	0.1	0.4	0.1	0.2	0.1	P
<i>Diervilla lonicera</i>	0.5	0.4	0.4	0.4	0.2	P
<i>Arabis divaricarpa</i>	0.2	0.3	0.7	0.7	0.5	0.1
<i>Vaccinium angustifolium</i>	0.3	0.3	0.2	0.1	0.1	1.3
<i>Carex houghtoniana</i>	0.0	0.3	0.4	P	P	0.0
<i>Woodsia ilvensis</i>	0.2	0.2	0.2	0.2	0.2	P
<i>Satureja vulgaris</i>	P	0.2	0.5	0.5	0.1	0.2
<i>Artemisia campestris</i>	0.1	0.2	0.6	1.1	0.4	0.6
<i>Aquilegia canadensis</i>	0.0	0.1	0.2	0.2	0.1	0.2
<i>Arctostaphylos uva-ursi</i>	0.1	0.1	0.2	0.1	0.2	0.2
<i>Rubus strigosus</i>	0.1	0.1	0.2	0.2	0.1	P
<i>Viola conspersa</i>	P	0.1	0.1	0.3	0.1	P
<i>Mianthemum canadense</i>	P	P	0.0	P	P	0.0
<i>Carex aenea</i>	P	P	0.0	0.0	P	0.0
<i>Lilium philadelphicum</i>	0.0	P	P	P	P	0.0
<i>Dracocephalum parviflorum</i>	P	P	P	0.0	0.0	P
<i>Campanula rotundifolia</i>	P	P	0.1	P	P	P
<i>Oryzopsis pungens</i>	P	P	0.1	0.1	0.1	P
<i>Corydalis sempervirens</i>	0.1	P	0.0	0.0	0.0	0.0
<i>Polygonum cilinode</i>	P	P	0.0	0.0	0.0	0.0
<i>Erigeron canadensis</i>	0.0	P	0.4	0.0	P	0.0
<i>Taraxacum officinalis</i>	0.0	P	0.1	0.1	0.0	P
<i>Carex umbellata</i>	0.0	0.0	0.5	0.3	0.6	0.1

continued

Table 4 (continued)

<u>Species</u>	Numbers of Years Since Burn (year)					
	3 (1991)	4 (1992)	5 (1993)	6 (1994)	7 (1995)	10 (1998)
<i>Ranunculus rhomboideus</i>	0.0	0.0	0.3	0.1	P	P
<i>Poa compressa</i>	P	0.0	0.2	0.3	0.2	0.2
<i>Poa glauca</i>	0.0	0.0	P	P	P	P
<i>Epilobium angustifolium</i>	0.0	0.0	P	P	P	0.0
<i>Silene antirrhina</i>	0.0	0.0	P	P	P	P
<i>Melampyrum lineare</i>	0.0	0.0	P	P	P	P
<i>Collinsia parviflora</i>	0.0	0.0	P	0.0	0.0	0.0
<i>Lonicera canadensis</i>	0.0	0.0	P	0.0	0.0	0.0
<i>Anaphalis margaritacea</i>	0.0	0.0	0.0	P	0.0	0.0
<i>Vaccinium myrtilloides</i>	0.0	0.0	0.0	P	0.0	P
<i>Oryzopsis asperifolia</i>	0.0	0.0	0.0	P	0.0	P
Unknown grass	0.0	0.0	0.0	P	0.0	0.0
<i>Rosa acicularis</i>	0.0	0.0	0.0	0.2	0.1	P
<i>Potentilla tridentata</i>	0.0	0.0	0.0	0.0	P	0.0
<i>Lactuca</i> spp.	0.0	0.0	0.0	0.0	P	0.0
<i>Festuca brachphylla</i>	0.0	0.0	0.0	0.0	P	P
<i>Calamagrostis canadensis</i>	0.0	0.0	0.0	0.0	0.0	0.6
<i>Carex</i> spp.	0.0	0.0	0.0	0.0	0.0	0.2
<i>Arabis drummondii</i>	0.0	0.0	0.0	0.0	0.0	P
Total all species	8.3	13.3	19.2	16.5	12.1	10.7