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ANNUAL PROGRESS REPORT

RESEARCH PROJECT

THE FLORA AND VEGETATIONAL ECOLOGY

OF ISLE ROYALE NATIONAL PARK

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OBJECTIVES

This report will describe our research activities during the past year; the third year of a five (5) year project funded by the National Park Service. The objectives this year were: (1) to complete the study of plant communities of the exposed rocky shores of Lake Superior, (2) to continue the annual sampling of vegetation invading two recent burns, (3) to continue with the Isle Royale Flora project involving the complete listing of all vascular flora of Isle Royale with information on the relative abundance and habitat preference of all species, and (4) to continue making observations on the effect of moose and beaver on the park vegetation.

METHODS

The recent burns studied were at Card Point (burned in 1976) and at McGinty's Cove (burned in 1975). Sampling methods used were the same as those used in 1977 (see Annual Report to National Park Service, June 1978).

Our surveys of rock shore areas during the previous summer suggested that rock shore plant communities were best developed in four (4) sites: (1) the outer shore of Raspberry Island, (2) Scoville Point, (3) Blake Point, and (4) the southeast shore of Passage Island. Accordingly, we set up sampling plots on these four (4) sites. Sampling was done along lines of equal elevation above the lake at six (6) different levels. Plots were established by laying a 50 x 20 cm. metal sampling frame on the rock with the long dimension parallel to and straddling the sampling line. The percent (%) cover of each vascular plant species was estimated within the frame. Also, an estimate was made of the portion of the plot covered with soil and the average depth of this soil. A total of approximately 1500 plots were

sampled in all the areas combined.

The area of rock close to the water (to an elevation of about $1\frac{1}{2}$ meters) is splashed with water by waves most of the time. This, which we designated as the splash zone, was treated as a separate habitat. Vegetation here was so scant that plot sampling was not feasible. Instead we walked the entire shoreline in each sampling area and estimated the area occupied by each species in each patch of vegetation encountered. Though we could not determine percent cover of each species from these data, we could determine relative cover.

Many of the larger depressions in the rock are filled with water forming "rock pools". Since the vegetation along their margin seemed quite different from that of the rock slopes, we set up a separate set of plots along the rock pool margins.

Lichens were sampled along transects upslope from the shore in 10 x 10 plots at $1\frac{1}{2}$ meter intervals. The percent cover of each lichens species was estimated in each plot.

The Isle Royale vascular flora project was continued this year with the emphasis on rock shore plants. Collections were made of unknown species and notes taken on relative abundance and habitat preference. Wherever we traveled, we continued to make observations on any effects of moose or beaver on the vegetation.

RESULTS AND CONCLUSIONS

Recent Burns

The tree seedling data (Table 1) show that white birch (Betula papyrifera) continued to be the dominant tree species invader on burned soil.

Table 1. Tree seedling densitites (stems/ha) for Card Point on burned and unburned soil

<u>Species</u>	<u>Burned</u>				<u>Unburned</u>			
	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
White birch	1,450	12,417	85,275	108,200	0	255	2,688	1,547
Quaking aspen	11,000	17,892	20,111	20,300	0	766	1,101	836
White spruce	0	68	88	150	0	85	88	84
Balsam fir	0	160	0	90	0	2,648	1,278	1,212
Mountain ash	0	275	527	1,176	0	0	1,807	2,760
Pin cherry	0	0	0	0	0	0	0	293
Mountain maple	0	0	0	30	0	426	0	125
Big tooth aspen	0	0	585	1,206	0	0	0	0
White cedar	0	0	0	0	0	0	0	0

It increased considerably since 1979 but the rate of increase is less than in previous years. On unburned soil, birch is losing ground while mountain ash is leading in tree reproduction. Quaking aspen seedlings (Populus tremuloides) are still second in abundance on burned soil although its numbers have not increased from 1979 to 1980. On unburned soil the numbers have decreased. Mountain ash has gained significantly on both soil types. The coniferous species are still scarce on burned soil but, except for White spruce, are becoming relatively abundant on unburned soil.

At McGinty's Cove (Table 2), birch is still, by far, the leading species even though its numbers have shrunk. Conifers are relatively abundant here as compared to Card Point.

Among the ground cover species (Table 3), Epilobium angustifolium (fireweed) continues to dominate burned soil despite a recent decline in its numbers. Next in order of abundance are Poa palustris (fowl meadow grass), which has increased dramatically, Rubus parviflorus (thimbleberry), Rubus idaeus (raspberry), and the grass Calamagrostis canadensis (blue-joint grass). Unburned soils (Table 4) on the other hand, are dominated by Rubus idaeus, Rubus parviflorus, Cornus canadensis (Canada dogwood), and the grass Milium effusum (millet grass). None of these have increased significantly from 1979 to 1980. In McGinty's Cove, Rubus idaeus and Aralia nudicaulis (wild sarsaparilla) are the dominant ground cover species (table 5). Total cover of ground cover plants at Card Point (Table 6) have increased but at a slower rate. At McGinty's Cove total cover has increased dramatically. Number of species has increased considerably on all site types (Table 6) on both burns.

Table 2. Tree seedling densities (stems/ha) at Card Point and McGinty's cove for 1977, 1978, 1979 and 1980

<u>Card Point - burned and unburned combined</u>					<u>McGinty's Cove - burned and unburned combined</u>			
<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
White birch	1,015	8,768	60,499	76,230	33,500	58,750	80,095	56,900
Quaking aspen	7,700	12,754	14,408	14,460	9,000	9,821	6,792	7,790
White spruce	0	73	88	130	1,000	2,143	1,410	1,765
Balsam fir	0	852	383	427	2,500	5,357	5,129	4,120
Mountain ash	0	193	911	1,650	0	893	2,051	882
Pin cherry	0	0	0	88	0	0	0	0
Mountain maple	0	128	0	59	500	1,429	1,283	1,180
Big tooth aspen	0	0	410	844	0	0	0	0
White cedar	0	0	0	0	0	893	602	1,765

Table 3. Percent cover of vascular ground species on burned soil for Card Point for 1977, 1978, 1979, and 1980

<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
<i>Epilobium angustifolium</i>	1.2	4.7	12.3	10.1
<i>Impatiens biflora</i>	0	2.5	6.8	2.8
<i>Rubus parviflorus</i>	0.3	2.6	4.8	4.6
<i>Epilobium adenocaulon</i>	0.2	3.5	4.3	1.6
<i>Poa palustris</i>	0.1	0.2	3.3	7.8
<i>Rubus idaeus</i>	0	0.8	2.4	4.6
<i>Calamagrostis canadensis</i>	0.2	0.8	2.3	4.5
<i>Cornus canadensis</i>	0.1	1.0	1.5	2.4
<i>Anaphalis margaritacea</i>	0	0	1.4	1.8
<i>Diervilla lonicera</i>	0.2	1.0	1.2	1.4
<i>Achillea millifolium</i>	0.2	1.1	0.1	1.7
<i>Stellaria calycantha</i>	0.1	0.8	0.8	0.5
<i>Glyceria striata</i>	0	0.6	0.6	0.7
<i>Milium effusum</i>	0	0.2	0.6	1.1
<i>Rosa acicularis</i>	0	0.2	0.5	1.3
<i>Sambucus pubens</i>	0	1.0	0.5	0.1
<i>Carex aenea</i>	0	0.3	0.5	0.1
<i>Taraxacum officinale</i>	0	0.2	0.4	1.6
Willow spp.	0	0	0.4	0.6
<i>Agropyron trachycaulum</i>	0	0	0.3	0.1
<i>Carex brunnescens</i>	0	0.1	0.3	1.0
<i>Solidago rugosa</i>	0	0	0.2	0.8

Table 3. (con't)

<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Veronica americana	0	0	0.2	0
Ranunculus abortivus	0	0.1	0.2	0.2
Polygonum cilinode	0	0	0.2	0.3
Cirsium vulgare	0	0	0.2	0.1
Galium triflorum	0	0.2	0.2	0.2
Lactuca biennis	0	0.1	0.2	0.4
Aralis nudicaulis	0	0.1	0.1	0.2
Galeopsis tetrahit	0.1	0.9	0	0.1
Lonicera canadensis	0	0	0	0.1
Maianthemum canadensis	0	0	0	0.1
Osmorhiza clatoni	0	0	0	0.1
Clintonia borealis	0	0	0	0.2
Carex Deweyana	0	0	0	0.2
Physocarpus opulifolius	0	0	0	0.1
Aster macrophyllus	0	0	0	0.1
Linnaea borealis	0	0	0	0.2
Melampyron lineare	0	0	0	0.2
Poa nemoralis	0	0	0	0.4
Ranunculus acris	0	0	0	0.1
Aster puniceus	0	0	0	0.1
Carex houghtoniana	<u>0</u>	<u>0</u>	<u>0</u>	<u>1.0</u>
TOTALS	2.6	21.3	48.1	55.5

Table 4. Percent cover of vascular ground cover species on unburned soil for Card Point for 1977, 1978, 1979 and 1980

<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Rubus parviflorus	37.8	36.0	27.9	27.3
Rubus idaeus	13.3	19.3	27.4	30.5
Cornus canadensis	8.7	4.1	21.9	23.8
Calamagrostis canadensis	14.3	12.9	13.5	13.9
Sambucus pubens	4.0	14.3	11.4	9.6
Clintonia borealis	0.1	0	10.7	7.6
Milium effusum	1.1	0.6	5.4	16.8
Galium triflorum	0.1	1.1	8.2	5.1
Heracleum maximum	0	0	6.4	7.0
Diervilla lonicera	0	0	5.5	8.0
Aralia nudicaulis	1.1	0.9	5.2	2.3
Linnaea borealis	0	0	4.0	3.7
Equisetum arvense	0	0	2.7	0.5
Lycopodium annotinum	0	0	2.3	1.0
Oxalis montana	0	0	2.2	1.8
Epilobium angustifolium	0.1	2.6	2.2	3.1
Stellaria calycantha	0	0	2.0	0.2
Maianthemum canadensis	0.6	0.9	1.5	2.0
Poa palustris	1.6	2.9	1.4	5.1
Ranunculus abortivus	0	0.1	1.4	2.4

Table 4. (con't)

<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Osmorhiza claytoni	0.6	0.3	1.1	1.4
Dryopteris spinulosa	0	0	1.1	0.5
Rubus pubescens	0	0	1.1	0.8
Lactuca biennis	0	0	0.9	0.6
Streptopus roseus	0	0	0.7	0.7
Lycopodium obscurum	0	0	0.6	0.3
Impatiens biflora	1.4	0.5	0.3	0.3
Geocaulon livida	0	0	0.3	0.3
Viola spp.	0	0	0.3	0.2
Carex aenea	0.6	0.7	0.1	0.2
Taraxacum officinale	0.4	0.1	0	0.3
Polygonum cilinode	0.7	0.3	0	0.1
Galeopsis tetrahit	5.0	1.0	0	0.2
Carex arctata	0	0	0	5.9
Carex armostachya	0	0	0	1.2
Carex houghtoniana	0	0	0	0.1
Dryopteris disjuncta	0	0	0	0.1
Epilobium adenocaulon	0	0	0	0.2
Anaphalis margaritacea	0	0	0	0.3
Trientalis borealis	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.2</u>
TOTALS	92.2	98.8	173.9	194.9

Table 5. Percent cover of vascular ground cover species for McGinty's Cove for 1977, 1978, 1979, and 1980

<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Rubus ideaeus	23.0	21.3	23.4	28.1
Aralia nudicaulis	8.4	12.3	15.9	16.2
Sambucus pubens	14.8	7.2	5.6	3.9
Milium effusum	10.1	4.8	1.7	2.4
Epilobium angustifolium	1.7	3.9	4.8	4.6
Rubus parviflorus	1.0	2.5	6.2	5.7
Carex B	0	1.2	0	0
Galium triflorum	4.6	1.0	1.5	3.0
Epilobium adenocaulon	7.9	0.9	0.4	0.3
Clintonia borealis	0.3	0.8	0	1.6
Poa alsodes	0	0.7	0	0
Carex C	0	0.6	0	0
Taraxicum officinalis	0.2	0.6	0.4	1.2
Impatiens biflora	0.2	0.4	1.1	1.0
Lactuca biennis	0.3	0.4	1.6	1.0
Trientalis borealis	0	0.4	1.1	0.3
Calamagrostis canadensis	0	0.3	0	0
Maianthemum canadensis	0	0.2	0.6	0.8
Osmorhiza clatoni	0	0.2	0.3	1.0
Poa palustris	2.4	0.2	0	2.0

Table 5. (con't)

<u>Species</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Salix SPP.	0.4	0.4	0.5	0.4
Ranunculus abortivus	0	0.1	0.6	1.2
Anaphalis margaritaceae	0	0.1	0.3	0
Carex houghtoniana	0	0	0.7	2.1
Lonicera canadensis	0	0	0.6	0.1
Taxus canadensis	0	0	0.3	0.6
Carex scoparia	0	0	0.1	0
Stellaria calycantha	0	0	0.1	0.1
Viola spp.	0	0	0.1	0.4
Streptopus roseus	0	0	0	0.3
Dryopteris disjuncta	0	0	0	1.1
Dryopteris spinulosa	0	0	0	0.6
Actea rubra	0	0	0	0.1
Aster macrophylla	0	0	0	0.1
Linnaea borealis	0	0	0	0.1
Mitella nuda	0	0	0	0.1
Pyrola secunda	0	0	0	0.1
Circaea alpina	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.1</u>
TOTALS	75.1	60.5	69.2	94.6

Table 6. Total percent cover of ground cover species and total number of species for Card Point and McGinty's Cove for 1977, 1978, 1979 and 1980

	<u>Total Percent Cover</u>				<u>Number of Species</u>			
	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Card Point								
Burn	2.6	21.3	48.1	55.5	10	23	29	42
Unburned	92.2	98.9	173.9	194.9	17	18	30	40
Combined	27.1	41.7	78.6	97.3	18	25	35	57
McGinty's Cove								
Combined	75.1	60.5	69.2	94.6	14	24	23	32

Table 7. Relative cover and relative frequency of all vascular plants sampled in plots on typical rock shore sites (excluding splash zone and rock pool margins). * preceeding a species indicates an arctic species. In "other I. R. sites" column, R = inland rock openings, F = forest ground cover, B = bog, and O = other sites. Under relative cover, p = present with cover less than 0.05%.

SPECIES	% REL. COVER	% REL. FREQ.	OTHER I. R. SITES	SPECIES	% REL. COVER	% REL. FREQ.	OTHER I. R. SITES
<i>Deschampsia caespitosa</i>	10.4	8.5	R	<i>Sisyrinchium angustifolium</i>	0.2	0.4	R, O
<i>Potentilla tridentata</i>	9.1	1.5	R	<i>Lonicera dioica</i>	0.1	0.1	R, O
<i>Juniperus communis</i>	8.4	1.5		<i>Lilium philadelphicum</i>	0.1	0.1	R, F
<i>Aster ptarmicoides</i>	7.1	6.6		<i>Saxifraga virginiana</i>	0.1	0.4	R
<i>Danthonia spicata</i>	6.0	4.7	R	<i>Lobelia Kalmii</i>	0.1	0.5	O
<i>Potentilla fruticosa</i>	5.4	3.4		<i>Sambucus racemosa</i>	0.1	0.1	R, F
<i>Arctostaphylos uva-ursi</i>	5.4	8.7	R, F	* <i>Saxifraga aizoon</i>	0.1	0.2	
<i>Solidago hispida</i>	5.4	8.7	R	<i>Myrica gale</i>	p	p	B
<i>Oryzopsis pungens</i>	4.8	3.4	R	<i>Castilleja septentrionalis</i>	p	p	F, O
<i>Campanula rotundifolia</i>	4.3	12.7	R	<i>Rosa acicularis</i>	p	p	F
<i>Achillea millefolium</i>	3.3	6.4	R, O	<i>Viola adunca</i>	p	0.1	F, O
<i>Physocarpus opulifolius</i>	2.9	0.9	O	<i>Linnaea borealis</i>	p	0.1	F
* <i>Trisetum spicatum</i>	2.3	6.0		<i>Geocaulon livida</i>	p	0.1	R, F
* <i>Scirpus caespitosus</i>	2.3	1.0	B	* <i>Pinguicula vulgaris</i>	p	0.1	
<i>Thuja occidentalis</i>	1.2	0.1	F	<i>Euphrasia hudsoniana</i>	p	0.1	
<i>Arabis lyrata</i>	1.1	4.2		<i>Melampyrum lineare</i>	p	0.2	F
<i>Vaccinium angustifolium</i>	1.1	0.7	R	<i>Polypodium virginiana</i>	p	0.1	R
<i>Poa compressa</i>	0.9	0.4	R, O	<i>Prenanthes racemosa</i>	p	0.1	
<i>Woodsia ilvensis</i>	0.8	0.7	R	<i>Populus balsamifera</i>	p	0.1	F
<i>Amelanchier</i> spp.	0.8	0.2	R, F, O	<i>Solidago graminifolia</i>	p	0.1	O
<i>Festuca saximontana</i>	0.8	2.0		<i>Ledum groenlandicum</i>	p	0.1	B
<i>Selaginella rupestris</i>	0.8	0.3	R	<i>Vaccinium macrocarpum</i>	p	0.1	B
* <i>Poa alpina</i>	0.7	0.6		<i>Salix</i> spp.	p	0.1	
<i>Betula papyrifera</i>	0.7	0.8	F	<i>Fragaria virginiana</i>	p	0.1	R, O
<i>Viola</i> spp.	0.6	1.7	F				
* <i>Vaccinium uliginosum</i>	0.5	0.3					
<i>Abies balsamea</i>	0.4	0.4	F				
<i>Vaccinium myrtilloides</i>	0.4	0.4	R				
<i>Deschampsia flexuosa</i>	0.4	0.3	R, O				
<i>Picea glauca</i>	0.3	0.4	F				
<i>Cornus canadensis</i>	0.3	0.1	F				
* <i>Sagina nodosa</i>	0.3	1.6					
* <i>Saxifraga tricuspidata</i>	0.3	0.2					
<i>Allium schoenoprasum</i>	0.2	0.2	O				
<i>Calamagrostis canadensis</i>	0.2	0.2	O				
<i>Primula mistassinica</i>	0.2	0.6					

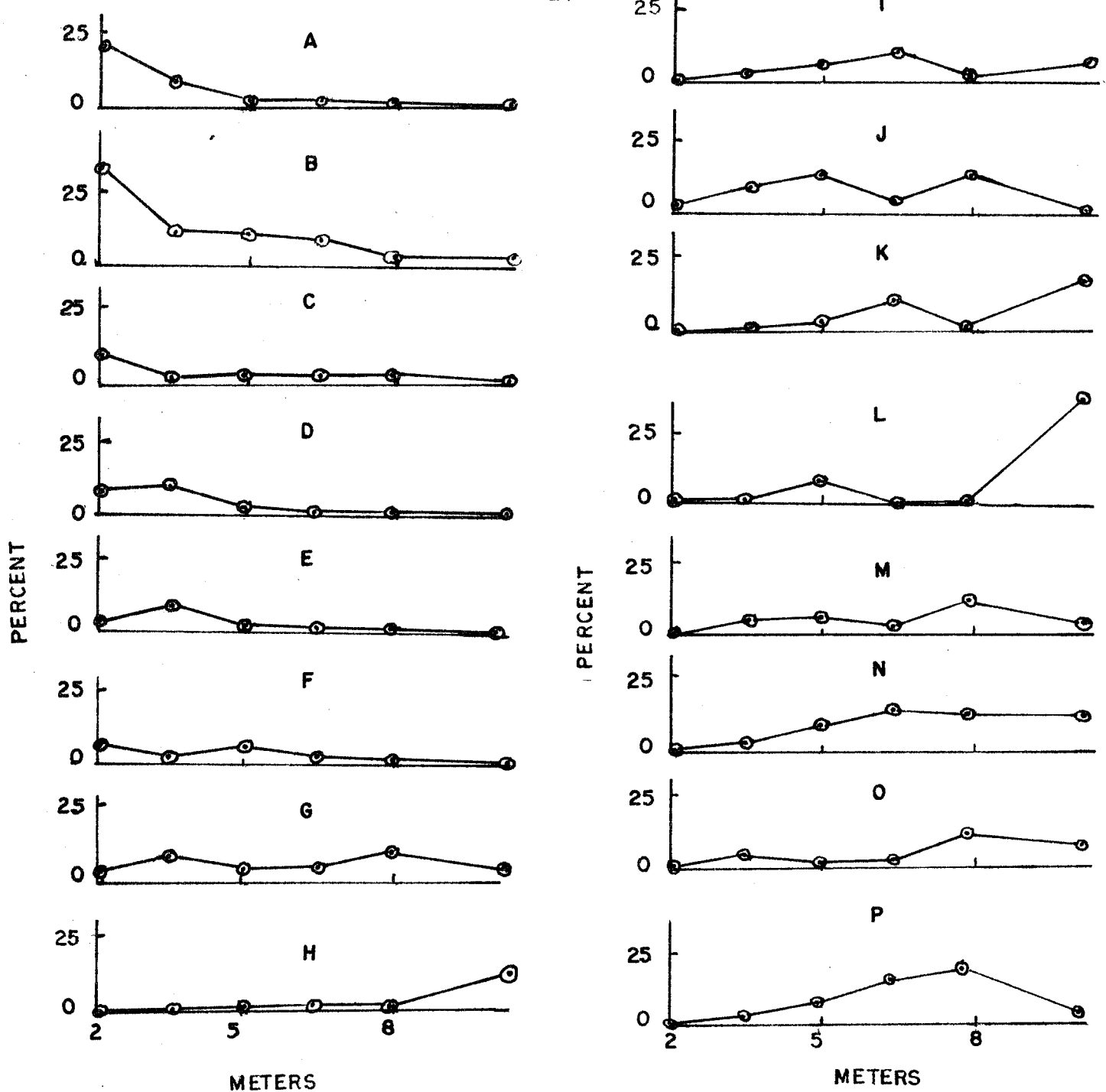


Figure 1. Relative cover for most abundant vascular plants of typical rock shore habitat. A = *Campanula rotundifolia*, B = *Deschampsia caespitosa*, C = *Trisetum spicatum*, D = *Achillea millefolium*, E = *Physocarpus opulifolius*, F = *Scirpus caespitosus*, G = *Solidago hispida*, H = *Poa alpina*, I = *Danthonia spicata*, J = *Aster plarnioides*, K = *Archostaphylos uva-ursi*, L = *Juniperus communis*, M = *Potentilla fruticosa*, N = *Potentilla tridentata*, O = *Oryzopsis pungens*, P = *Juniperus communis horizontalis*.

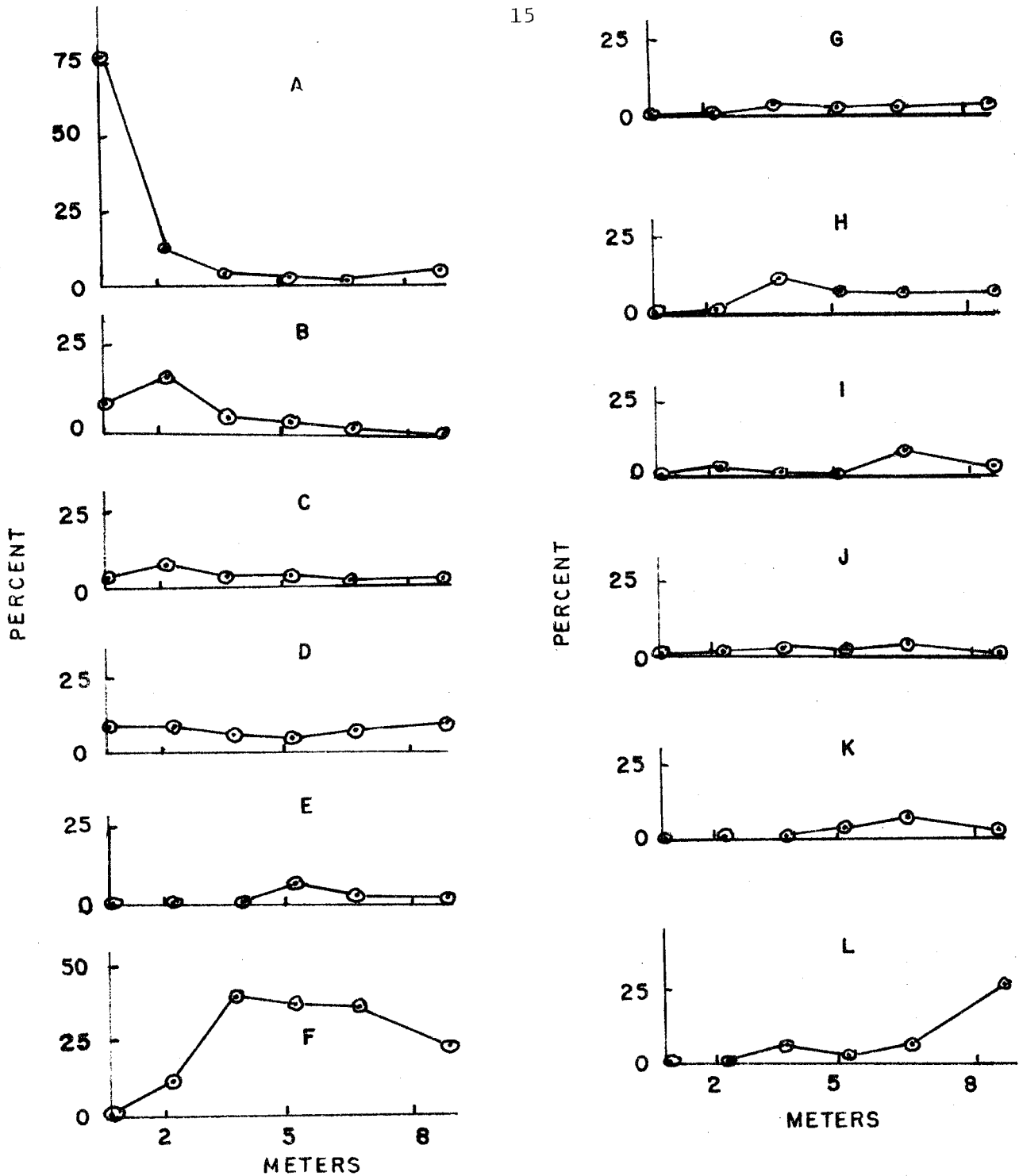


Figure 2. Relative cover of most abundant lichens of typical rock shore habitat. A = *Staurothele clopina*, B = *Caloplaca elegans*, C = *Phycia phaea*, D = *Candelariella vitellina*, E = *Rhizocarpon geographicum*, F = *Rhizocarpon disparum*, G = *Acarospora badiofusca*, H = *Lepraria neglecta*, I = *Lecanora atra*, J = *Phycia substiga*, K = *Lecanora chryssoleuca*, L = *Parmelia (conspersa group)*.

Table 8. Various environmental and vegetation parameters versus elevation above Lake Superior.

PARAMETER	ELEVATION ABOVE LAKE (METERS)					
	2.0	3.5	5.0	6.5	8.0	9.2
Soil availability (cm. ²)	1.5	2.5	7.5	12.7	6.4	19.5
Average soil depth (cm. ²)	0.41	0.53	0.96	1.21	0.95	1.87
Matt area (cm. ²)	0.0	1.5	19.0	43.5	17.4	70.9
Total vascular plant cover (%)	36.9	80.0	115.9	205.7	165.7	315.5
Percent shrub and tree species	8.0	22.4	27.9	32.1	30.7	51.1
Number of vascular plant species	1.5	39.0	52.0	42.0	25.0	27.0
Lichen cover (%)	3.1	57.1	53.8	103.6	96.9	93.5

Rock Shore Communities

Table 7 is a complete list of all vascular plant species sampled in plots of typical rock shore habitat. Deschampsia caespitosa (tufted hair-grass) is the most dominant species (greatest cover value) whereas Campanula rotundifolia (harebells) is the most widely distributed (highest frequency). Of the species sampled, 14 are more or less unique to the rock shore habitats, 8 are arctic tundra species, 16 are also found in the ground cover of Isle Royale forests, and 4 are also typical of bogs.

The change in vascular plant species composition with elevation above Lake Superior is shown in Figure 1. The relative cover for the more prevalent species is plotted against elevation. Progressing from the first of these species diagrams to the last there is shown an increasing affinity for the higher elevations. Campanula rotundifolia and Deschampsia caespitosa are important at the lower elevations while Juniperus horizontalis is very important at the upper elevations. Figure 2 indicates that there is a similar progression of species composition change of lichen species with elevation.

Table 8 shows the change in other parameters with elevation. Both soil availability (cover) and soil depth show upward trends with increased elevations. Matt area refers to a continuous patch of soil and vegetation, not in crevices or depressions in the rock, but on the flat surface. A Matt represents an advanced stage of primary succession in this rocky habitat. The table also shows that matt area per plot increases with elevation. There is also shown an increasing trend in total vascular plant cover, and the percent of the vascular plants comprised of shrub and tree species. Lichen cover increases rapidly up to 6.5 meters and subsequently remains relatively constant. The number of species sampled is greatest at intermediate heights.

It should be noted that Juniperus horizontalis and Arctostaphylos uva-ursi (bearberry) are more abundant at higher sites. These species are important in matt formations. They establish roots in rock crevices and spread out horizontally over the rock surface where they can hold soil in the rock and provide sites for other plants to become established.

All of the above trends suggest that primary succession is taking place and that the succession is increasingly advanced with increases in elevation above the lake. Near the lake vascular plants are found only in crevices and small depressions and only crustose lichens occupy the flat rock surfaces. As the creeping shrubs like juniper and bearberry become more established at higher elevations vascular plants have an increasing tendency to form continuous matts on the rock surface. Although crustose and foliose lichens change in species composition with elevation, there is no evidence that they prepare a seed bed for the invasion of vascular plants. This may be so because they are not substantial enough to hold soil in place against the strong winds and wave action on these exposed sites.

The relative cover and relative frequency values for plants sampled in the rock pool margins are presented in Table 9 in the order of cover abundance. Scirpus caespitosum is by far the most abundant species in this habitat. Of the species listed, 29 (prefixed by a + symbol) are much more abundant in the rock pool margins than in the typical xeric rock shore habitat. Of these, 11 species are also typical of Isle Royale bogs. Of the entire list, 10 species are also found as ground cover in Isle Royale boreal-type forests. Also 8 species are known to be arctic tundra species.

Species and their relative cover values found in the splash zone are listed below:



<u>Species</u>	<u>Relative cover</u>
Deschampsia caespitosa	43.6
Campanula rotundifolia	14.7
Achillea millefolium	12.9
Sagina nodosa	10.0
Physocarpus opulifolius	7.2
Primula mistassinica	1.7
Arabis lyrata	1.5
Solidago hispida	1.5
Danthonia spicata	1.4
Lobelia Kalmii	0.9
Trisetum spicatum	0.7
Aster ptarmicoides	0.5
Scirpus caespitosus	0.2
Potentilla tridentata	0.2

Species richness and the total cover of vascular plants in this zone are both very low compared to other rock shore habitats. We had expected that many of the species in this zone would be wetland species because of the continual splashing with waves, but the results indicated to the contrary. Comparison of this list with the species composition of rock pool margins shows very little similarity. The splash zone species composition most resembles that of the plants sampled on the lower elevation of the typical rock shore habitat just above the splash zone (Figure 1).

Four other rare species were found along the rock shores which did not occur in the sample plots. There are:

Lycopodium selago
Polygonum viviparum
Empetrum nigra
Carex garberi

Table 9. Relative cover and relative frequency of vascular plants on rock pool margins. + preceeding a plant name means plant significantly more abundant on rock pool margins than on typical rock shore sites. * indicates an arctic tundra species. In the "other I.R. sites column", R = inland rock openings, F = forest ground cover, B = bog, and O = other sites. Under relative cover, P = present with cover less than 0.05%.

<u>Species</u>	<u>% rel. cov.</u>	<u>% rel. freq.</u>	<u>Other I.R. Sites</u>		<u>% rel. cov.</u>	<u>% rel. freq.</u>	<u>Other I.R. Sites</u>
* + Scirpus caespitosus	42.8	13.9	B	Festuca saximontana	0.3	0.2	
Deschampsia caespitosus	6.7	8.6		Amelanchier spp.	0.3	0.3	FO
Aster ptarmicoides	5.3	8.6		+ Rosa acicularis	0.3	0.3	F
Potentilla fruticosa	3.5	5.7		* Vaccinium uliginosum	0.2	0.3	
+ Allium shoenophrasum	3.5	1.4		Solidago hispida	0.2	1.4	R
+ Myrica gale	3.4	1.4	BO	+ Vaccinium macrocarpum	0.2	1.0	B
* + Andromeda glaucophylla	3.2	1.9	B	Poa nemoralis	0.2	0.3	
* + Pinquicula vulgare	3.0	8.6		* + Tofieldia glutinosa	0.3	2.3	O
+ Primula mistassinica	2.6	9.1		Viola spp.	0.3	1.3	F
+ Picea glauca	2.4	0.5	F	Calamagrostis canadensis	0.2	0.3	O
+ Drosera rotundifolia	2.3	3.3	B	+ Juncus brevicaudatus	0.2	1.4	B
+ Alnus crispa	1.9	1.4	BO	+ Linnaea borealis	0.2	0.3	F
+ Drosera linearis	1.5	0.5	B	+ Viola adunca	0.1	0.3	FO
Danthonia spicata	1.5	3.3	O	+ Lobelia kalmii	0.1	0.5	B
+ Scirpus atrovirens	1.5	1.0	O	+ Euphrasia hudsoniana	0.1	0.3	
+ Aster macrophyllus	1.5	0.3	F	* Trisetum spicatum	0.1	1.0	
Campanula rotundifolia	1.3	4.3	R	Sisyrinchium angustifolium	0.1	0.3	RO
Achillea millefolia	1.2	2.4	RO	* Sagina nodosa	P	0.5	
+ Selaginella selaginelloides	0.9	0.5	O	Physocarpus opulifolius	P	0.5	O
Potentilla tridentata	0.7	1.91	R	* + Tofieldia pusilla	0.1	1.0	O
+ Shepherdia canadensis	0.7	1.4	RO	+ Menyanthes trifoliata	P	0.3	B
+ Clintonia borealis	0.7	0.3	F	+ Coptis groenlandica	P	0.3	F
+ Prenanthes racemosa	0.6	1.4		+ Spiranthes romanzoffiana	P	0.3	RB
Cornus canadensis	0.5	0.5	F				
+ Carex media	0.3	0.3	O				

All four are mostly confined on Isle Royale to the rock shores. Empetrum nigrum and Polygonum viviparum are typical of arctic tundra.

Other projects:

We continued to make progress on the flora project and the project dealing with moose and beaver effects on vegetation but these projects are still incomplete. Report of the results shall await the completion of these projects in May 1973.

SUMMARY

The vegetation cover on the Card Point and McGinty's Cove burns is still increasing. The phenomenal rates of increase such as occurred at Card Point during the first 3 years after the fire are no longer in evidence. A striking difference still exists between the species composition on the burned soil and that on unburned soil within the periphery of the Card Point burn. This suggests that the post-fire succession will, in general, be strongly influenced by the percentage of the soil whose organic layer has been burned off.

The flora of the rock shore communities is relatively diverse, considering severity of the habitat. Although many of the species are unique to this habitat, a large percentage are bog or forest ground cover species. Some are ^a tundra plants. Many of the latter are a considerable distance south of ^{of} their normal geographic range of distribution.

The species composition of these rock shore areas changes considerably with elevation above the lake. It appears as if this is primarily due to differences in the stage of succession, which in turn is probably due to the higher elevation having been emerged from Lake Superior for a longer period of time. The species composition of the margins of rock pools differs considerably from that of the more typical rock shore habitat, a large percentage of

the plant cover (about 58%) being composed of typical bog species.

Recommendations

Since the vegetation in the Card Point and McGinty's Cove burns has become considerably more stable, we recommend that these sites be sampled on a biennial basis in the near future. Eventually a sample every 5 years should be adequate.

We believe that the rock shore plant communities are botanically a highly interesting and unique array of plants and that they are one of the outstanding natural features of Isle Royale National Park. However, because of the severity of the environment, it is a very fragile ecosystem. These areas are highly worthy of inclusion in the park interpretive program but, at the same time, should be protected from the devastating effects of heavy human impact.