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Reports III 1980-1981

ANNUAL PROGRESS REPORT

OF THE

RESEARCH PROJECT

ENTITLED

THE FLORA AND VEGETATIONAL ECOLOGY

OF ISLE ROYALE NATIONAL PARK

BY

ROBERT *A.* JANKE

CHIEF INVESTIGATOR

MAY, 1980

OBJECTIVES

This report describes research activities during the second year of a five-year study entitled "The Flora and Vegetational Ecology of Isle Royale National Park," funded by the National Park Service. This years objectives were: (1) to continue with the annual sampling of the vegetation invading two recent burns; (2) to begin a study of plant communities on the outer rocky exposed shores of Lake Superior; (3) to study the effect of seed source on the reproduction of the balsam fir (Abies balsamea) and white spruce (Picea glauca) by investigating how the quantity of reproduction changes with distance from the boundary of large burns; (4) to continue with the Isle Royale flora project including inventorying all vascular plants and determining their relative abundance in various habitats and (5) to continue making observations on the effects of beaver and moose on the park vegetation.

METHODS AND LOGISTICS

I arrived on Isle Royale on May 30, 1979 and spent about 2½ weeks looking for study sites for the ensuing field season and working on the flora project. A graduate and an undergraduate student hired under project funds, as well as a third undergraduate student hired under the Work-Study Program arrived on June 19 via motor vessel Ranger III to assist with the summer's field work. Our usual base camp was set up near Rock Harbor. Field work ended on August 25 when all returned to the mainland via motor vessel Ranger III.

One of the recent burns studied was at Card Point which burned in the summer of 1976. The other, near McGinty's Cove, burned in the

summer of 1975. Both were natural fires which were permitted to burn under the new "let-burn policy" for Isle Royale. Sampling methods used were the same as those used in 1977 in the same plots that were established at that time. These methods are described in detail in our annual report dated June, 1978.

Most of the work done on this first year of the rock shore plant communities study was exploratory. Much of our effort was spent in visiting rocky outer shorelines throughout the park in order to determine where these communities are best developed and how much variation exists from one part of the park to another. Also the amount of variation in rock shore communities from one microhabitat to another was explored. Also much time was spent in collecting and identifying vascular plants, lichens, and mosses in preparation for quantitative sampling. Some quantitative sampling was done near the end of the field season.

For the seed source study for balsam fir and white spruce, study areas were set up at the margins of the large 1936 burn as well as a somewhat older large burn near Todd Harbor. Sites on the burn boundaries were selected in which it was evident that, at the time of the burn, a seed source for these two species existed on the unburned side of the boundary but not on the burned side (where the fire left no survivors). Sampling lines were established perpendicular to the boundaries from a point a short distance outside the burn to a point well within the burn. Sampling for fir and spruce seedlings was done in strips straddling the sampling line, two meters wide, five meters long and with their centers spaced ten meters apart. From the center of every other of these seedling plots, ten meter radius circular plots were established for sampling of fir and spruce trees (DBH greater than five centimeters).

The Isle Royale vascular flora project, begun in the summer of 1978, was continued on a somewhat limited basis as we traveled throughout the park in connection with the other projects. Any unknown plants were collected and identified and notes were taken on habitat preferences and relative abundance of plants encountered. In particular, we were continually on the lookout for new species not previously recorded for the park. Also in our travels, observations were made on effects of moose and beaver on the vegetation of the park.

RESULTS AND CONCLUSIONS

Recent Burns

The most noticeable change in the Card Point burn this year was the completeness with which the soil was covered with plant life. Most of the area not covered with vascular plants was carpeted with mosses and liverworts.

On the other hand there was little change in the tree strata (Table 1) at Card Point. Standing living trees had the same density as in 1978, namely four stems/hectare. This is an extremely low density. It is about 3% of the density in 1977, the summer following the fire. With the opening of the tree canopy, the wind has evidently taken its toll. The only change indicated by our tree sampling between 1978 and 1979 is that the density of standing dead trees has been reduced by about 50% by wind.

For McGinty's Cove the situation is quite similar. Here no significant change in living tree density has occurred since our first sampling in 1977. Since the fire occurred in 1975, however, it is quite possible that post-fire wind casualties could have occurred during the first two years, as was the case at Card Point.

Table 1. Densities of standing trees (trees/hectare) in various conditions for 1977, 1978, and 1979 at Card Point and McGinty's Cove.

	<u>1977</u>	<u>1978</u>	<u>1979</u>
Card Point			
living			
healthy	20	4	0
unhealthy	100	0	4
burned	100	0	0
unburned	20	4	4
Total	120	4	4
dead			
burned	105	117	64
unburned	92	0	0
Total	197	117	64
McGinty's Cove			
living			
healthy	0	18	18
unhealthy	88	53	53
burned	35	35	35
unburned	53	35	35
Total	88	71	71
dead			
burned	301	159	35
unburned	35	0	0
Total	336	159	35

Dramatic changes in tree seedling densities have occurred in the past year. This is especially true of white birch in both Card Point and McGinty's Cove. White birch is now the most abundant tree seedling species in both burns while quaking aspen is second in abundance. It is interesting to note that at Card Point aspen was more abundant than birch in 1977. Although this was not the case for McGinty's Cove, aspen has nevertheless been losing ground to birch in the latter location.

Seedlings of species characteristic of mature forests, such as balsam fir (Abies balsamea), white spruce (Picea glauca), northern white cedar (Thuja occidentalis), are sparse in both burns but more so at Card Point. The greater reproduction of these species at McGinty's Cove may be due to the small size of this burn which places most parts of the burn nearer to a source of seeds. Also since these are shade tolerant species they might be expected to fare better at McGinty's Cove where the density of surviving trees is greater (Table 2).

At the time plots were set up at Card Point (1977) it was possible to clearly delineate patches of soil within the outer burn periphery in which the organic top layer had been burned to mineral soil from patches which were unburned (and in most cases the ground flora unharmed). We took advantage of this by setting up some plots on completely burned soil and others on completely unburned soil. Table 2 shows average seedling densities for the two types of plots. It is evident that white birch and quaking aspen reproduction is more prolific on the burned soil. For both species, mineral soil is known to be a preferred site for seedling establishment. White spruce, balsam fir and mountain ash, on the other hand, have greater seedling densities on the unburned soil. At McGinty's

Table 2. Tree seedling densities (stems/hectare) for Card Point and McGinty's Cove for 1977, 1979, and 1979.

[illegible]

Cove the plots could not be separated into burned and unburned categories since, by the time the plots were established (two years after the fire) the differences were not clear cut.

The total percent cover of non-arboreal ground cover species also increased dramatically between 1977 and 1979 (Table 3) at Card Point, but there was no significant increase at McGinty's Cove. The total number of species increased for 18 to 35 at Card Point and from 14 to 23 at McGinty's Cove.

The increase in total percent cover as well as number of species for burned soil was considerably greater than on unburned soil at Card Point. This is to be expected since the burned plots were essentially bare in 1977 while the unburned plots had already contained a substantial cover of pre-burn vegetation on them at that time.

Table 4 gives the percent cover of ground cover species for burned and unburned plots combined for Card Point. Almost all species show an increasing trend in percent cover between 1977 and 1979. Rubus parviflorus (thimbleberry) maintains the highest cover value for all three years although in relation to other species (relative cover) it is losing ground. Among other major species, Calamagrostis canadensis (blue-joint grass) is also losing ground in relation to other species while Epilobium angustifolium (fireweed) and Impatiens biflora (jewel weed) are gaining. At McGinty's Cove many (Table 5) species are increasing in percent cover which others are decreasing. Among major species, Rubus idaeus (wild raspberry) maintains the highest cover value for all three years. Aralia nudicaulis (wild sarsaparilla), Rubus parviflorus and Epilobium angustifolium have increased considerably while Sambucus pubens (red elderberry) and Millium effusum (millet grass) have declined.

Table 3. Total % cover of ground cover species and total number of species for Card Point and McGinty's Cove for 1977, 1978, and 1979.

	<u>Total % Cover</u>			<u>Number of Species</u>		
	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
Card Point						
burn	2.6	21.3	48.1	10	23	29
unburned	92.2	98.9	173.9	20	18	31
combined	27.1	41.7	78.6	18	25	35
McGinty's Cove						
combined	75.1	60.5	69.2	14	24	23

Table 4. Percent cover of vascular ground cover species on burned and unburned plots combined for Card Point for 1977, 1978, and 1979.

	<u>1977</u>	<u>1978</u>	<u>1979</u>
Rubus parviflorus	11.5	12.6	11.7
Rubus idaeus	4.0	6.3	9.9
Epilobium angustifolium	0.9	4.1	9.3
Cornus canadensis	2.7	1.9	7.6
Calamagrostis canadensis	4.4	4.4	5.7
Impatiens biflora	0.4	0.2	4.8
Sambucus pubens	1.2	5.0	3.8
Clintonia borealis	0	0	3.3
Millium effusum	0.3	0.3	3.2
Epilobium adenocaulon	0.1	2.5	3.0
Poa palustris	0.4	1.0	2.7
Diervilla lonicera	0.1	0	2.5
Aralia nudicaulis	0.3	0.3	1.7
Linnaea borealis	0	0	1.3
Stellaria calycantha	0	0	1.1
Anaphalis margaritacea	0	0	1.0
Achillea millifolium	0.2	0.8	0.8
Ranunculus abortivus	0	0.5	0.6
Maianthemum canadense	0	0	0.5
Glyceria striata	0	0.4	0.4
Lactuca biennis	0	0	0.4
Carex aenea	0.2	0.5	0.4
Rosa acicularis	0	0.1	0.3
Osmorhiza claytoni	0	0	0.3
Rubus pubescens	0	0	0.3
Taraxacum officinale	0.1	0.2	0.3
Salix CPL	0	0	0.3
Carex brunnescens	0	0	0.2
Agropyron trachycaulon	0	0	0.2
Solidago rugosa	0	0	0.2
Polygonum cilinode	0.2	0	0.2
Veronica americana	0	0	0.2
Galium triflorum	0	0.4	0.1
Cirsium vulgare	0	0	0.1
Viola CPL	<u>0</u>	<u>0</u>	<u>0.1</u>
TOTAL	27.1	41.1	78.6

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

	<u>1977</u>	<u>1978</u>	<u>1979</u>
<i>Rubus idaeus</i>	23.0	21.3	23.4
<i>Aralia nudicaulis</i>	8.4	12.3	15.9
<i>Sambucus pubens</i>	14.8	7.2	5.6
<i>Milium effusum</i>	10.1	4.8	1.7
<i>Epilobium angustifolium</i>	1.7	3.9	4.8
<i>Rubus parviflorus</i>	1.0	2.5	6.2
<i>Carex B</i>	0	1.2	0
<i>Galium triflorum</i>	4.6	1.0	1.5
<i>Epilobium adenocaulon</i>	7.9	0.9	0.4
<i>Clintonia borealis</i>	0.3	0.8	0
<i>Poa alsodes</i>	0	0.7	0
<i>Carex C</i>	0	0.6	0
<i>Taraxicum officinalis</i>	0.2	0.6	0.4
<i>Impatiens biflora</i>	0.2	0.4	1.1
<i>Lactuca biennis</i>	0.3	0.4	1.6
<i>Trientalis borealis</i>	0	0.4	1.1
<i>Calamagrostis canadensis</i>	0	0.3	0
<i>Maianthemum canadensis</i>	0	0.2	0.6
<i>Osmorhiza clatoni</i>	0	0.2	0.3
<i>Poa palustris</i>	2.4	0.2	0
<i>Salix B</i>	0	0.2	0
<i>Salix C</i>	0	0.2	0
<i>Ranunculus abortivus</i>	0	0.1	0.6
<i>Anaphalis margaritaceae</i>	0	0.1	0.3
<i>Carex houghtoniana</i>	0	0	0.7
<i>Lonicera canadensis</i>	0	0	0.6
<i>Salix MG1</i>	0.4	0	0.5
<i>Taxus canadensis</i>	0	0	0.3
<i>Carex scoparia</i>	0	0	0.1
<i>Stellaria calycantha</i>	0	0	0.1
<i>Viola spp.</i>	<u>0</u>	<u>0</u>	<u>0.1</u>
TOTAL	75.1	60.5	69.2

On burned soil at Card Point (Table 6) Epilobium angustifolium is the leading species in all three years and its percent cover has increased remarkably. Impatiens biflora, Rubus parviflora, and Epilobium adenocaulon (willow herb) are the next important species in that order and all are increasing with time.

On unburned plots (Table 7), Rubus parviflorus is the most abundant in all three years but it is decreasing in abundance. Among other important species, Rubus idaeus and Cornus canadensis (Canada dogwood) are increasing while, Calamagrostis canadensis is remaining relatively unchanged.

Comparison of species abundance on burned and unburned plots (Tables 6 and 7) reveals that several of the major species normally associated with post-fire invasion show a distinct preference for one or the other of these sites. Epilobium angustifolium, Impatiens biflora, Anaphalis margaritacea (pearly everlasting), and Achillea millefolium (yarrow) show preference for burned soil, while Rubus parviflorus, R. idaeus, Calamagrostis canadensis, Sambucus racemosa, Diervilla lonicera and Milium effusum show preference for unburned soil. Another group of plants, Cornus canadensis, Galium triflorum (bedstraw), Aralis nudicaulis, Clintonia borealis, and Linnaea borealis also are more abundant on unburned soil. These species are normally associated with mature boreal-type forests. These species probably survived the fire on the unburned soil and were able to tolerate the open conditions created by the fire. Their presence in smaller quantities on burned soil suggests that they are spreading out from their original confinement to unburned soil.

Table 6. Percent cover of vascular ground species on burned soil for Card Point for 1977, 1978, and 1979.

	<u>1977</u>	<u>1978</u>	<u>1979</u>
<i>Epilobium angustifolium</i>	1.2	4.7	12.3
<i>Impatiens biflora</i>	0	2.5	6.8
<i>Rubus parviflorus</i>	0.3	2.6	4.8
<i>Epilobium adenocaulon</i>	0.2	3.5	4.3
<i>Poa palustris</i>	0.1	0.2	3.3
<i>Rubus idaeus</i>	0	0.8	2.4
<i>Calamagrostis canadensis</i>	0.2	0.8	2.3
<i>Cornus canadensis</i>	0.1	1.0	1.5
<i>Anaphalis margaritacea</i>	0	0	1.4
<i>Diervilla lonicera</i>	0.2	1.0	1.2
<i>Achillea millifolium</i>	0.2	1.1	1.1
<i>Stellaria calycantha</i>	0.1	0.8	0.8
<i>Glyceria striata</i>	0	0.6	0.6
<i>Milium effusum</i>	0	0.2	0.6
<i>Rosa acicularis</i>	0	0.2	0.5
<i>Sambucus pubens</i>	0	1.0	0.5
<i>Carex aenea</i>	0	0.3	0.5
<i>Taraxacum officinale</i>	0	0.2	0.4
Willow CP1	0	0	0.4
<i>Agropyron trachycaulum</i>	0	0	0.3
<i>Carex brunnescens</i>	0	0.1	0.3
<i>Solidago rugosa</i>	0	0	0.2
<i>Veronica americana</i>	0	0	0.2
<i>Ranunculus abortivus</i>	0	0.1	0.2
<i>Polygonum cilinode</i>	0	0	0.2
<i>Cirsium vulgare</i>	0	0	0.2
<i>Galium triflorum</i>	0	0.2	0.2
<i>Lactuca biennis</i>	0	0.1	0.2
<i>Aralis nudicaulis</i>	0	0.1	0.1
<i>Galeopsis tetrahit</i>	<u>0.1</u>	<u>0.9</u>	<u>0</u>
TOTAL	2.6	21.3	48.1

Table 7. Percent cover of vascular ground cover species on unburned soil for Card Point for 1977, 1978, and 1979.

	<u>1977</u>	<u>1978</u>	<u>1979</u>
Rubus parviflorus	37.8	36.0	27.9
Rubus idaeus	13.3	19.3	27.4
Cornus canadensis	8.7	4.1	21.9
Calamagrostis canadensis	14.3	12.9	13.5
Sambucus pubens	4.0	14.3	11.4
Clintonia borealis	0.1	0	10.7
Milium effusum	1.1	0.6	9.4
Galium triflorum	0.1	1.1	8.2
Heracleum maximum	0	0	6.4
Diervilla lonicera	0	0	5.5
Aralia nudicaulis	1.1	0.9	5.2
Linnaea borealis	0	0	4.0
Equisetum arvense	0	0	2.7
Lycopodium annotinum	0	0	2.3
Oxalis montana	0	0	2.2
Epilobium angustifolium	0.1	2.6	2.2
Stellaria calycantha	0	0	2.0
Maianthemum canadensis	0.6	0.9	1.5
Poa palustris	1.0	2.9	1.4
Ranunculus abortivus	0	0.1	1.4
Osmorhiza claytoni	0.6	0.3	1.1
Dryopteris spinulosa	0	0	1.1
Rubus pubescens	0	0	1.1
Lactuca biennis	0	0	0.9
Streptopus roseus	0	0	0.7
Lycopodium obscurum	0	0	0.6
Impatiens biflora	1.4	0.5	0.3
Geocaulon livida	0	0	0.3
Viola CP1	0	0	0.2
Carex aenea	0.6	0.7	0.1
Viola CP2	0	0	0.1
Taraxacum officinale	0.4	0.1	0
Polygonum cilinode	0.7	0.3	0
Galeopsis tetrahit	<u>5.0</u>	<u>1.0</u>	<u>0</u>
TOTAL	92.2	98.8	173.9

Rock Shore Communities

Since this phase of the project is only about half finished, we have very few results to present at this time. In our survey of various rock shore areas on the outer shores of the park we found approximately 100 species of vascular plants. Many of these seem to be unique to this particular habitat. Others are also found in open rocky fields or under forest canopies. Succession in rock pools often leads to the development of miniature bogs in which typical bog plants such as sundews, labrador tea, and bog laurel can be found.

The best development of these rock shore communities seems to be along the south shore of the main island and some of the outer islands, especially on the northeast end of the park. In particular, Scoville Point, Blake Point and Passage Island have outstanding examples of these types of communities with regard to size of the area, and diversity of habitat, community types, and species.

From the limited sampling that we have done so far we were able to determine the relative abundance of the more important vascular plant species throughout all microhabitat types. Abundance values are presented in the form of frequencies:

Campanula rotundifolia	67.2
Achillea millefolium	50.8
Potentilla tridentata	47.5
Deschampsia caespitosa	44.3
Solidago hispida	44.3
Trisetum spicata	32.8
Solidago graminifolia	21.3
Scirpus caespitosus	18.0
Potentilla fruiticosa	16.4
Primula mistassinica	16.4

Tree Seed Source

The results of the seed source study for balsam fir and white spruce are summarized in Fig. 1-4. Fig. 1 shows the average distribution of balsam fir tree densities along all transects layed out perpendicular to burn boundaries. To the left of the vertical axis is outside the burn and to the right is within the burn. The vertical height of each plotted point represents the realtive density of trees at that location in relation to the total trees sampled. Balsam fir trees, though ample outside the burn, are nonexistent within the burn even next to the boundary. Seedlings of balsam fir, on the other hand, have recently become established within the burn (Fig. 2) but there is a distinct decline in relative density with distance from the burn boundary. At about 150 meters it drops to zero. Since the seed source is on the unburned side of the boundary, this strongly suggests that balsam fir reproduction attentuates rapidly with distance from the seed source.

For white spruce trees, unlike fir, trees are present within the burn but relative densities attenuate with distance from the boundary (Fig. 3). Evidently spruce seedlings were established here much earlier in the history of the burn than was the case for fir, but as with the present fir reproduction, it decreased with increasing distance from its seed source outside the burn. White spruce seedlings show no attentuation with distance from the boundary. This may be because spruce trees which are now well out into the burn are now mature enough to produce seed.

These results agree well with the results obtained from our previous studies of post-fire tree seedling reproduction (Table 8). In these studies tree seedling densities were sampled in about 250 plots throughout Isle Royale.

Figure 1. Relative density of balsam fir trees versus distance from the burn boundary.

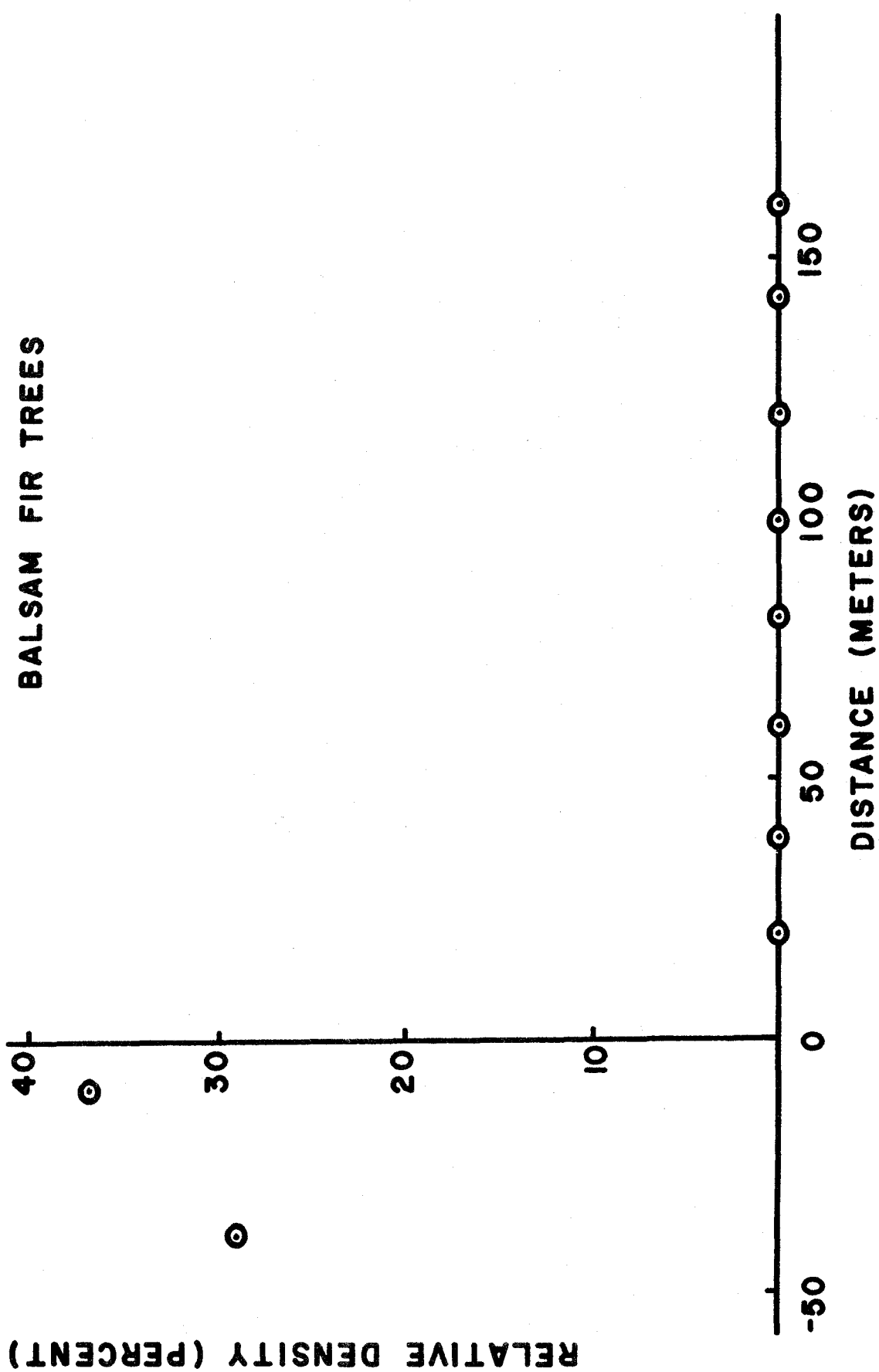


Figure 2. Relative density of balsam fir seedlings versus distance from the burn boundary.

BALSAM FIR SEEDLINGS

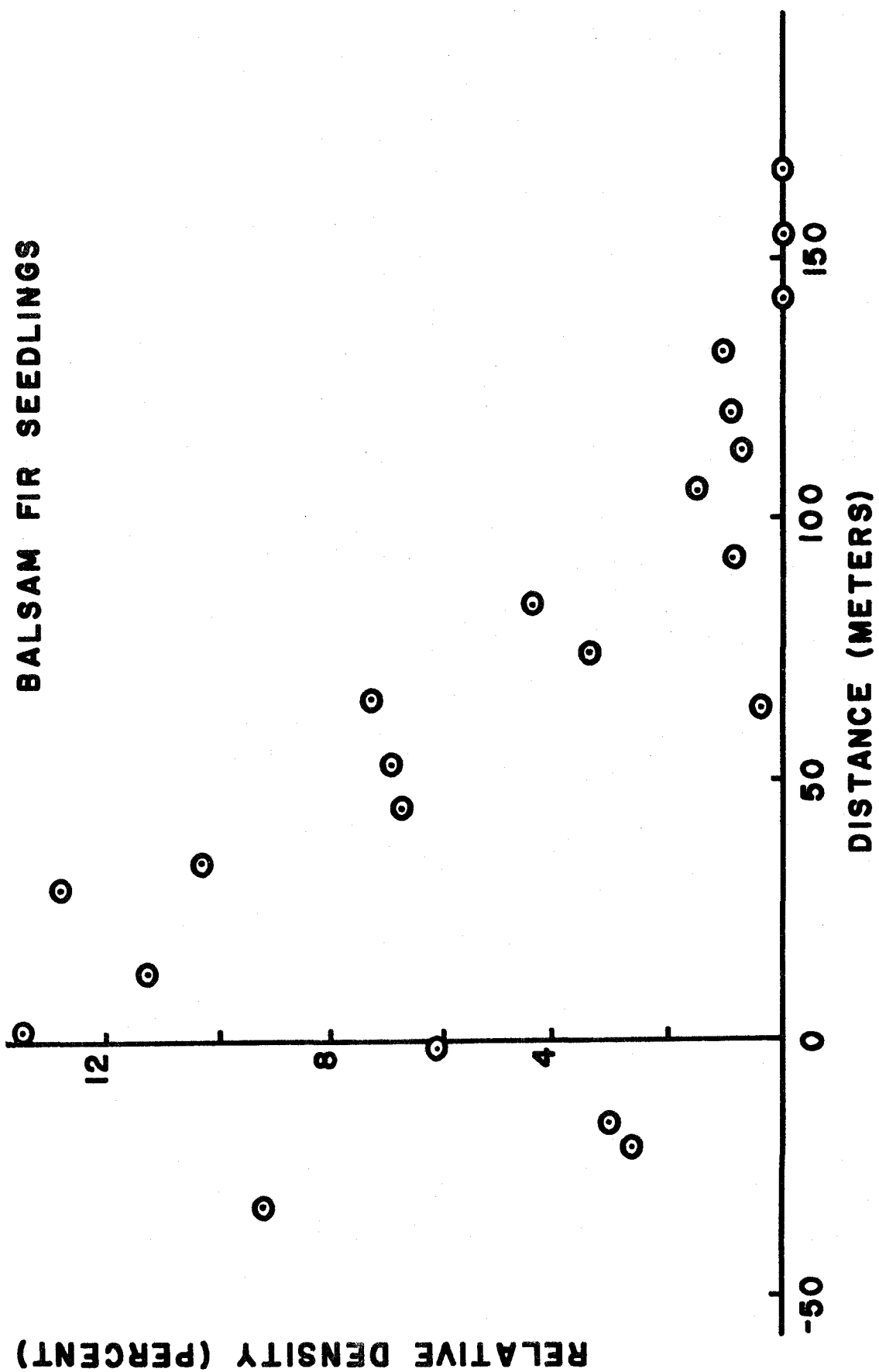


Figure 3. Relative density of white spruce trees versus distance from the burn boundary.

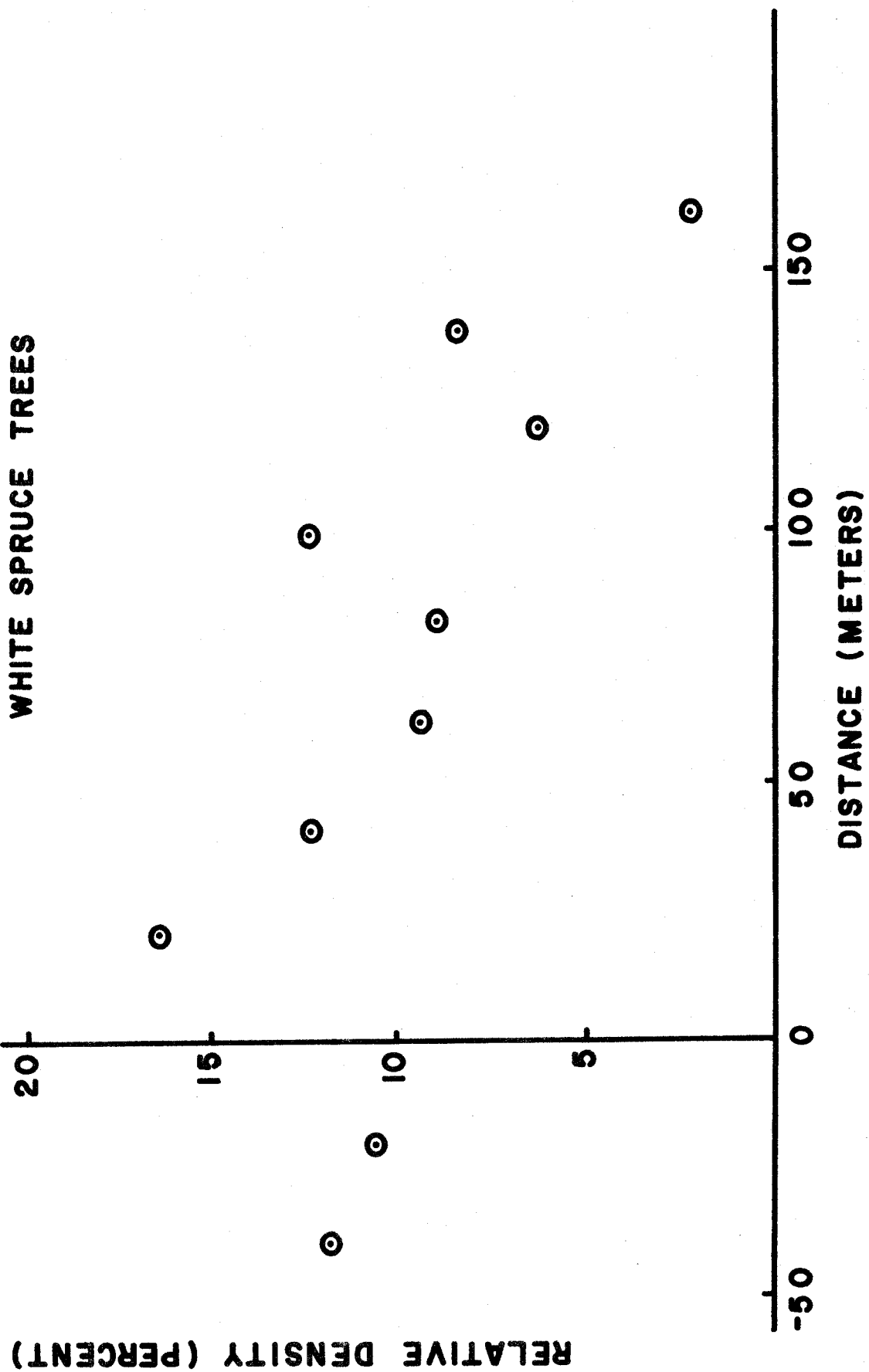


Figure 4. Relative density of white spruce seedlings versus distance from the burn boundary.

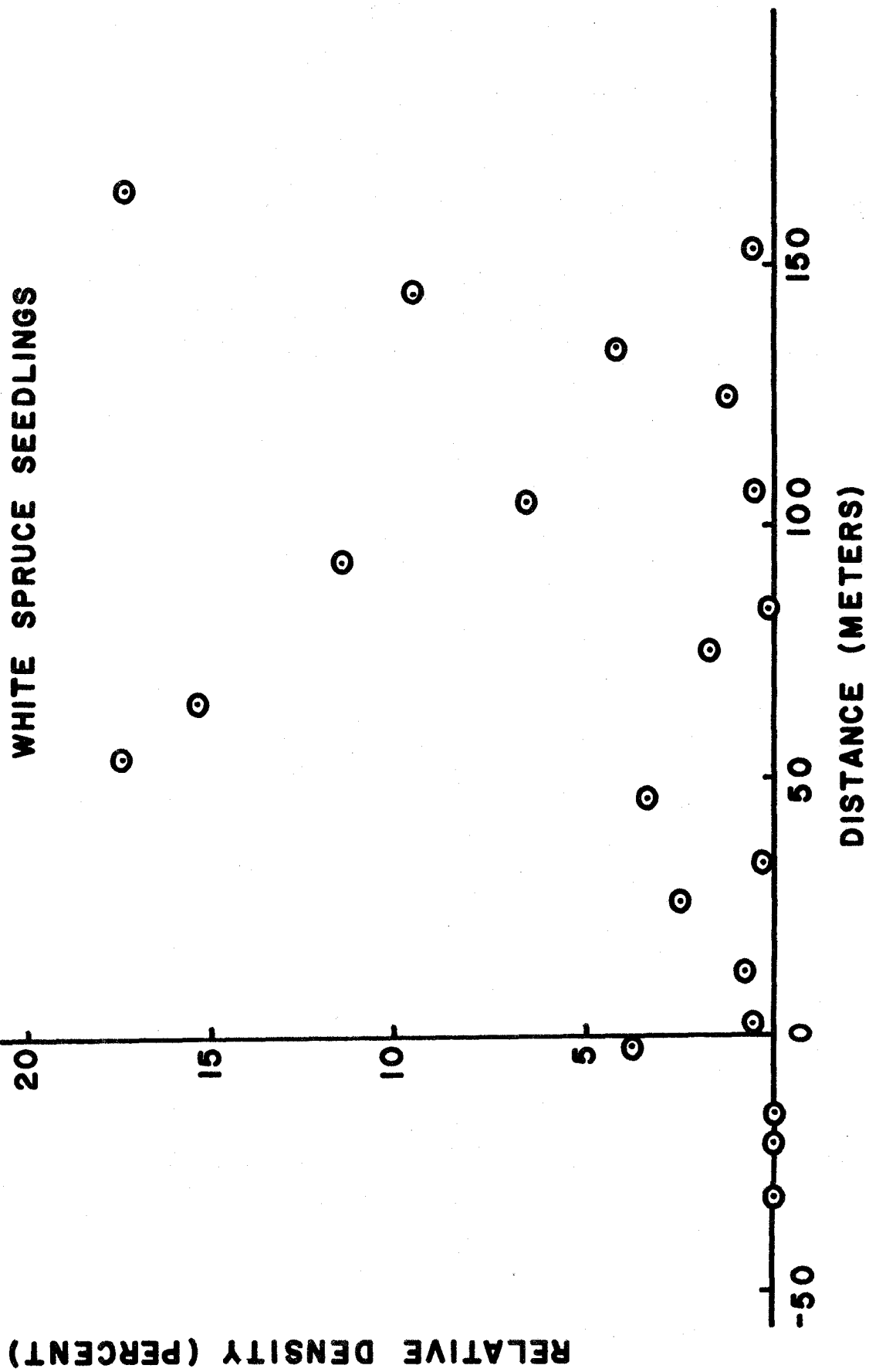


Table 8. Tree seedling density versus abundance of mature trees within 60 meters. Key to abundance index: 0 = no trees; 1 = 1-2 trees; 2 = 3-6 trees; 3 = 7 or more trees.

	0	1	2	3
balsam fir seedl. dens.	193	1,725	6,370	14,420
white birch seedl. dens.	11,900	1,060	4,890	2,550
white spruce seedl. dens.	32	328	598	1,600
quaking aspen seedl. dens.	0	0	400	1,980

The abundance of seed source trees was also measured for each species within 60 meters of the plot, using an abundance index as explained in the table caption. Quaking aspen reproduction is strongly related to the abundance of nearby trees. Aspen on Isle Royale reproduces primarily by sucker shoots, however, so that seed dispersal is not involved here. For white birch seedlings the data exhibits very little relationship to seed source proximity. Birch seeds are very small, light weight, and winged so that they should disperse long distances in the wind. For balsam fir and white spruce, however, seedling densities were strongly correlated with quantities of nearby seed trees. Both tree species have heavier seeds than birch, fir being the heaviest of the two. These results suggested that among the four species, spruce and fir strongly dependent upon nearby seed sources for successful reproduction. The study that we carried out this year was instigated primarily to test this hypothesis.

Flora Project: Moose and Beaver Effects

These projects are still in progress and we have few new results to report. The data and plant collection from the burn sites and rock shore habitats will contribute to the complete annotated list of Isle Royale vascular flora which we will publish at the conclusion of our project. Three new species were found which had not been previously recorded for Isle Royale. These were Dactylis glomerata (orchard grass), Lepidium campestra, and Salix planifolia. Moose and beaver observations are too incomplete to draw conclusions from.

SUMMARY AND CONCLUSIONS

Recent Burns

(1) Standing living tree density remains unchanged from last year. It is very sparse at Card Point and somewhat less so at McGinty's Cove.

(2) Tree seedlings have increased phenomenally at both burns - especially white birch. Reproduction of the latter species is by far the most abundant at both burns. Quaking aspen is second.

(3) White spruce, balsam fir, and white cedar seedlings (species characteristic of the mature boreal-type forest) are still extremely sparse at Card Point but less so at McGinty's Cove where the greater amount of tree canopy cover and the shorter distances to nearby seed source may favor reproduction of these species.

(4) Birch and aspen seedlings are more abundant on burned than on unburned soil; for spruce, fir, and mountain ash, however, densities are greater on unburned soil.

(5) The total percent cover of ground cover vascular plants and mosses increased dramatically at Card Point since last year, especially on burned soil. The total number of species increased considerably at both burns - especially on burned soil.

(6) Rubus parviflorus (thimbleberry) is the most abundant species at Card Point. It is the dominant plant on unburned soil; while Epilobium angustifolium (fireweed) dominates on burned soil. At McGinty's Cove, Rubus idaeus (wild raspberry) is the most abundant species.

(7) Epilobium angustifolium, Impatiens biflora (jewel weed), Anaphalis margaritaceae (pearly everlasting) and Achillea millefolium (yarrow) show preference for burned soil; while Rubus parviflorus, Rubus idaeus, Calamagrostis canadensis (blue joint grass), Sambucus racemosa (red elderberry), Diervilla lonicera (bush honeysuckle) and Millium effusum

(millet grass) prefer unburned soil. Several species characteristic of mature forests were more abundant on unburned soil, probably because they survived the fire.

(8) The species composition and the rate of invasion of species after a fire are affected by the size of the burn and the percentage of soil that is burned.

Rock Shore Communities

(1) Rock shore communities are best developed on the south shore of Isle Royale, especially toward the northeast where Scoville Point, Blake Point, and Passage Island offer the greatest area of such habitat, and the richest diversity of community types and species.

(2) The most abundant species on the rocky shore are Campanula rotundifolia (bluebells), Achillea millefolium, Potentilla tridentata (3-toothed cinquefoil), Deschampsia caespitosa (tufted hairgrass), Solidago hispida (goldenrod), and Trisetum spicatum.

Tree Seed Source

(1) Balsam fir and white spruce reproduction are strongly affected by the distance from the nearest seed source. The effect is greater for fir than for spruce. As a result of this, these species, especially fir, may fail to reproduce in large burns for a long time after the fire. Such indeed seems to be the case in the 1936 burn and in the 75 year old burn near Todd Harbor. This phenomena did not affect the small burn at McGinty's Cove, however.

RECOMMENDATIONS

Our study of recent burns indicates that a considerable amount of variation exists between various burns depending upon the size of the

burn, the amount of soil burned, the percentage of the tree canopy destroyed, and the nature of the pre-burn vegetation. Because of this we feel that it would be highly desirable if several more recent burns could be monitored as we have the Card Point and McGinty's Cove burns. We recommend, therefore, that, in the event that natural burns occur again in the future, similar studies be set up soon after these fires occur.

Our survey of rock shore communities indicates that the best development of these communities is at Scoville Point. The flora here includes several plants on the proposed threatened species list for Michigan. Many of these plants, like *Empetrum nigra* (creeping crowberry) are arctic species, as much as 200 miles south of their normal range. These rock shore communities, characteristic of Lake Superior shores, have often been described as "rock tundra." Like true tundra, it is very sensitive to disturbance. Unfortunately Scoville Point is the terminus of an interpretive trail. When visitors arrive there they tend to wander all over the "rock tundra" trampling over lichens and fragile vascular plants as they go. We recommend that the park administration consider ways of eliminating or reducing the impact of human visitation on this highly sensitive area.