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YEAR END REPORT
of the
STUDY OF THE ECOLOGY
of the
SPRUCE - FIR - BIRCH FOREST TYPE
of
ISLE ROYALE NATIONAL PARK

SUBMITTED MAY 19, 1975

by

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This report will summarize the progress and new findings of this research project during the period from May 1974 - May 1975. The field work undertaken in the summer of 1974 has already been described in the December 4, 1974 progress report submitted to the National Park Service.

Comparison of Present with Pre-settlement Forests

In the original land survey, the procedure normally called for the description of the trees nearest to the corner post in two of four quadrants at each section corner. The species, diameter, and distance to the corner post were written into the survey notes. Two blazes were made on the bole on which the location of the section corner post was described. The same was done for quarter section posts except that only the letters QS were marked on a single blaze. In addition, at least two other trees located directly on each mile segment of section line were blazed but not otherwise marked. Whenever the line intersected the boundary of a swamp, lakeshore, stream or other type of topographic feature, posts called meander posts were established and marked by blazing the two nearest trees in two quadrants. Furthermore for each mile segment of section line a general qualitative description of the vegetation was made including dominant tree species and prevalent shrubs. Recent burns were also noted.

From the tree descriptions given we attempted to reconstruct a general picture of what the boreal type forests of Isle Royale were like in 1847. The accuracy of this description, however, depends upon the extent of the surveyors bias in selecting suitable trees. This bias would be small in the above procedures were

rigorously followed. Trees thus selected however were sometimes unsuitable for blazing or marking or their life expectancy might be too short. In such cases it was common practice to pass them up for other trees which were more suitable. Considering the amount of blazing and information required, the section corner tree sample would be expected to have the greatest surveyor bias and the line and meander post trees, the least. Meander post trees might give a distorted sample, however, because they are often located near the boundaries of wetlands.

An analysis of surveyors was made using methods similar to those of Bourdo (1956). Our analysis is based upon the assumption that the line tree sample is relatively unbiased. In Table I the percent composition of the tree species are given for the section corner, quarter section, line, and meander post tree samples. The meander post sample, as expected, is biased toward wetland species. This was therefore excluded from the total sample. Homogeneity of the section corner, quarter section, and line tree samples were tested using a chi square test for difference in proportions. The hypothesis that the three samples are homogeneous could not be rejected even at $P = 0.30$. Hence, the probability of species bias is not highly likely.

A similar test was made using numbers of trees in various diameter classes instead of species. This test showed that significant differences exist between the samples at $P = 0.01$. It was concluded, therefore, that the survey notes would be useful for estimating the species composition of the 1847 forest but that conclusions about tree sizes should be avoided.

all negative

Table I

TREE SPECIES COMPOSITION (%) OF MAIN ISLAND IN 1847 COMPARED
TO 1974. SC = SECTION CORNERS; QS = QUARTER SECTION POSTS;
L = LINE TREES; AND MP = MEANDER POSTS.

	1847					1974
	SC	QS	L	MP	SC + QS + L	
b. fir	40	53	40	24	45	10
w. birch	16	13	11	16	13	44
spruce	26	14	24	31	21	25
~~x~~ aspen	5	3	9	0	6	15
~~x~~ cedar	10	11	12	15	11	2
other	3	6	4	15	4	4

The last two columns of Table I show that the tree composition of the boreal type forests of 1974 differ remarkably from those of 1847. Balsam fir (Abies balsamea) dominates the 1847 forest while white birch (Betula papyrifera) dominates the 1974 forest. This, together with the reduction in cedar (Thuja occidentalis) and increase in quaking aspen (Populus tremuloides) between these two dates indicates that the forests of today are much less mature than those of pre-settlement times and that fire has been extensive in recent times. It is well known that miners indulged in wide - spread burning of forests during the middle and late 1800's. A large fire burned about one fourth of the island's forests in 1936. If the forest of 1847 can be considered relatively pristine, our data suggest that the fires of recent times are more extensive than what would normally occur under natural conditions.

The spruce listed in Table I includes both white and black spruce (Picea glauca and P. mariana) since the survey notes do not distinguish between these two species. In our 1974 survey over 95% of these were white spruce. The same is likely true of the 1847 samples since swamp forests were not included in samples from either date. One might expect that spruce would be less in 1974 since it is a relatively shade tolerant species. Our previous studies (Janke, 1973) indicate, however, that spruce can be a pioneer tree following fire. Also the establishment of a moose population on Isle Royale in the early 1900's undoubtedly favored spruce over the other tree species which are palatable to moose. Moose may also be a factor in the reduction of fir between 1847

and 1974 (Snyder, 1972). Other interesting changes became apparent by comparison of the 1847 and 1974 forests. Tamarack (Larix laricina) made up most of the sampled trees listed under the "other" row in Table I; yet, in our recent survey not a single tamarack was sampled. This is probably due to a larch sawfly invasion in the early 1900's. American yew (Taxus canadensis) occurred abundantly in the mile line segment descriptions of the survey notes with a frequency of 67%. None was encountered in the 1974 survey. This drastic reduction is another result of moose browsing. Finally, no mention, whatsoever, is made of thimbleberry in the 1843 survey notes whereas today it is one of the most ubiquitous ground cover species. This species is also related to fire (de Waal Malefytte, 1974) but the removal of competition from the American yew may also be a factor.

Using the tree sampling data, a comparison was made between the species composition at the two ends of Isle Royale (Table II). For 1847 there was little difference between the two ends in the amounts of white birch, aspen, and cedar. For 1974, however, white birch and aspen are greater and cedar is less at the northeast end than at the southwest end. This suggests that the northeast end had more fire during the mining era than did the other end.

Those trees sampled in 1974 which were within the area burned in 1936, were also tabulated separately (Table II). As expected, fire related species birch, aspen and spruce dominated this area while the less - fire tolerant species such as fir and cedar occurred in negligible quantities.

Table II

TREE SPECIES COMPOSITION (%) FOR THE TWO ENDS OF THE MAIN ISLAND
AND FOR THE 1936 BURN AREA IN 1847 AND IN 1974

		NE Northeast- end	SW Southwest- end	1936 burn
b. fir				
	1847	36	46	43.6
	1974	19	13	1.7
w. birch				
	1847	18	14	5.1
	1974	47	31	64.2
spruce				
	1847	26	15	33.3
	1974	16	30	17.1
q. aspen				
	1847	3	2	13.3
	1974	13	6	12.7
w. cedar				
	1847	12	9	7.7
	1974	3	9	0
y. birch				
	1847	0	9	0
	1974	0	9	0
other				
	1847	5	5	5.0
	1974	2	2	8.0

Lake Sediments Analysis

This phase of the project was carried out by graduate student Randall Raymond. His efforts were mostly aimed at analyzing the amount of charcoal in half centimeter increments over the top 20 centimeters of sediment from four lakes. The results thus far obtained are summarized in Table III. It is possible that each of the peaks represents a single fire or perhaps several closely spaced fires. Estimates of the time spans between peaks were made using radiocarbon dates which we have recently obtained (fig. 2). These dates are all older than what we had expected from our survey of the literature. Furthermore, the top date for Anglemorm Lake is older than the lower dates, indicating some kind of anomaly in the sedimentation near the top. This anomaly has two possible explanations: (1) The material contained within the upper 7cm of sediment from Anglemorm Lake resulted from a slumping of sediments in the area of the lake sampled causing older sediments to fall upon younger sediments. (2) The fire frequency within the past 200-300 years around Anglemorm Lake has increased causing material from considerably older origin to erode into the Anglemorm Lake basin and be deposited along with recently accumulating material.

If we exclude the anomalous date, we can estimate the time intervals between peaks in the charcoal diagrams by using the other four dates. In Chickenbone Lake there are 12 distinct intervals of high charcoal influx over the past 2,200 years. The average time interval between any particular peak is then 180 years with a range of 100-400 years. Anglemorm Lake has 19 char-

Table III

Radiocarbon age determinations for surface **gyttja** from Chickenbone and Angleworm Lakes. The determinations were performed by H. Kruger, Kruger Enterprises, Geochron Laboratory Division, Cambridge, Mass.

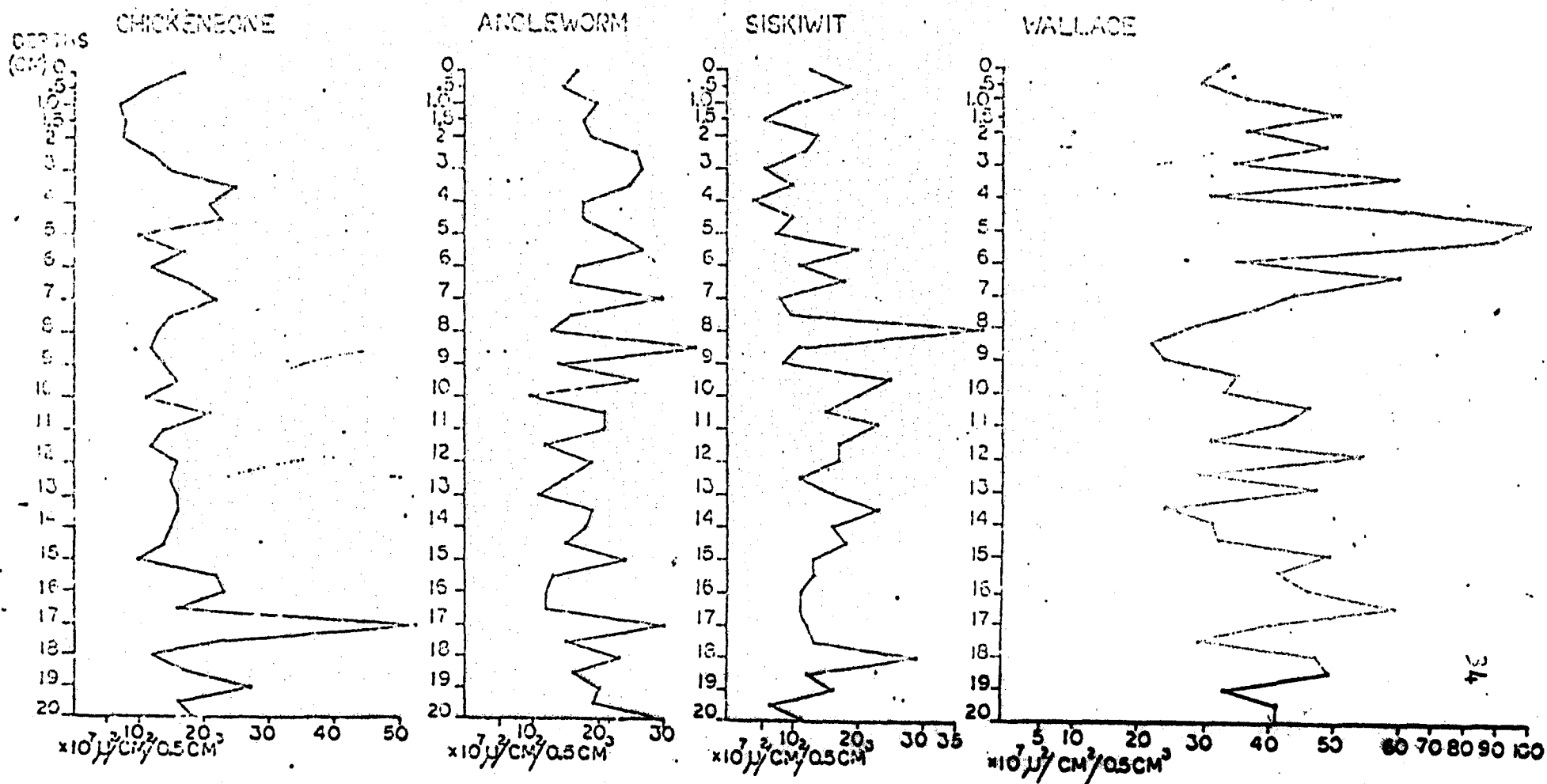
Lake	Lab. No.	Depth	Years Before Present (B.P.)*
Chickenbone Lake	GX3718	0- 7cm	1125 ± ^{**} 130 C ¹⁴ years B.P.
	GX3719	14-20cm	1940 ± ^{**} 140 C ¹⁴ years B.P.
Angleworm Lake	GX3716	0- 7cm	1210 ± ^{**} 110 C ¹⁴ years B.P.
	GX3717	14-20cm	940 ± ^{**} 140 C ¹⁴ years B.P.
	GX3608	18-22cm	1095 ± ^{**} 95 C ¹⁴ years B.P.

* The dates are based upon the Libby half life (5570 years) for C¹⁴.

** The error stated is ± 16 as judged by the analytical data alone. The age is referenced to the year A.D. 1950.

Figure 1.

Charcoal influx diagram for the four lakes,
(a) Chickenbone, (b) Angleworm, (c) Siskiwit,
(d) Wallace, over at least the past 1,000 years.



coal peaks within the last 1095 years, the average interval between peaks being 58 years. Here the range is from 30-120 years. Wallace and Siskiwit Lakes have 18 charcoal peaks each. Based upon a projected rate of sediment accumulation, calculated from the gyttja to postglacial lake clay interface, these diagrams cover approximately the last 1,000 years as in Angleworm Lake. From this assumed rate, the average interval between charcoal peaks in these lakes becomes 60 years, ranging from 30-90 years in Siskiwit Lake and 30-120 years in Wallace Lake.

One of our objectives in this study was to locate the 1936 fire and the 100 year old mining fires on these charcoal diagrams. If these dates are represented by charcoal peaks, then we know that we can locate other past fires within the last several hundred years. Having finally received the radiocarbon dates (often a 1½ year wait), it is now clear that we must analyze samples representing smaller increments of depth so that the time increment is small compared to the time between fires. This, Raymond will attempt during the summer of 1975. Only then will we know whether or not this method will work on Isle Royale lakes.

Literature Cited

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