VEGETATIONAL HISTORY OF YELLOWSTONE PARK AS DETERMINED BY POLLEN ANALYSIS

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Objectives

The purpose of this project was to interpret the vegetational history of the Yellowstone Park area by the analysis of pollen contained in sediment cores from four locations in Yellowstone Lake. The cores, collected by Dr. Robert Smith of the University of Utah, were from the north central portion, the west thumb area, the south arm and the southeast arm of the lake. The cores were to be compared to determine pollen variations within the lake. Differences between a small pond and a large lake basin in reflecting climatic change were to be studied by comparing the results with pollen counts from Fifteen Foot Lagoon (Baker, 1976).

Procedures

As of December 8, 1978, seventy-eight samples from the four cores have been prepared, using standard procedures (Faegri and Iverson, 1950). Sixty-three samples have been counted and the pollen percentages determined. Chi square tests of homogenity were used to determine the similarity in pollen counts for samples of the same age from different cores. Sedimentation rates, available for three of the four cores (Shero, 1977), were used to determine sample age.

Results

Results for the most abundant pollen types (fig. 1 and table 1) show that pollen percentages have remained relatively stable for the past 1,500 years. Samples from the north central portion of the lake, dating to 3,700 years BP, also show similar pollen percentages. Sediment mixing is not a likely cause for the similarity in pollen percentages. Dredge samples collected near the Yellowstone Lake coring sites contain varves indicating very little or no mixing after the time of deposition (Shero, 1977).

The pollen profiles indicate a landscape dominated by pine, including Pinus albicaulis and Pinus contorta, with lesser amounts of spruce and fir. Pollen counts also indicate the presence of juniper, poplar, douglas-fir, and birch. Sagebrush pollen averages 11 percent of the total and pollen of the Goosefoot family (Chenopodiaceae) averages 2-3 percent. Table 1 includes an overall average for each category and an average excluding three samples from 1460-1484 BP. These three samples differ from the others in showing less pine and more sagebrush. This indicates that conditions were slightly warmer and drier during this span of time. The overall percentages of spruce and fir are

higher in the core from the southeastern arm of the lake. This part of the lake is the closest to the spruce-fir vegetation zone in the Absaroka mountains (Despain, 1973). Pollen percentages indicate that the spruce-fir vegetation type has existed in the southeastern portion of the park for at least 1,500 years.

These results closely correlate with the core from Fifteen Foot Lagoon, which has pollen percentages most similar to the core from southeastern arm of Yellowstone Lake. Pollen counts from the smaller body of water (Fifteen Foot Lagoon) have a higher frequency of rare pollen types than do those from larger Yellowstone Lake. This is consistent with Tauber's (1967) discussion of smaller lakes receiving a more local pollen rain and larger lakes receiving a more regional one.

Chi square homogenity tests (Mosimann, 1965) show seven out of thirteen pollen counts for samples of the same age from the southeast and south arms of the lake to differ significantly at the 0.05% level. Three out of twelve samples differ significantly (0.05% level) between the core from the south arm and the core from the north central portion of the lake, while five out of twelve samples differ significantly (0.05% level) between the core from the southeast arm and the core from the north central portion of the lake. Major differences were in the values for spruce, sagebrush and sedges. Higher spruce percentages in samples from the southeastern arm, fluctuations in the abundance of sedges growing near the lake shore, and changes in wind patterns may be contributing factors. Tests will conconducted later to determine if these differences could be ecologically significant. The high percentages of pine pollen (averaging 77%) in this area may accentuate the differences in less abundant types.

The final stages of this research project will include determination of the relative abundances of Pinus albicaulis and Pinus contorta in samples of the same age from different cores, and construction of a pollen profile for the west thumb area of Yellowstone Lake. Completed tables of pollen counts, percentages and chi square results will be included and discussed in more detail in the final report of this study to be submitted in January, 1979.

Conclusions

Despite some differences in pollen counts from one part of Yellowstone Lake to another, the pollen profile from each core reflects a picture of climatic stability for the past 4,000 years in the Yellowstone Park area. Minor fluctuations in percentages occur but no major change in vegetation or climate is indicated. The pollen profile from Fifteen Foot Lagoon shows a similar pattern. Thus the analysis of one sediment core from any of the Yellowstone Lake sampling sites or from Fifteen Foot Lagoon would provide a reasonably accurate record of climatic change in the southeastern portion of Yellowstone Park during the past 4,000 years.

Acknowledgments

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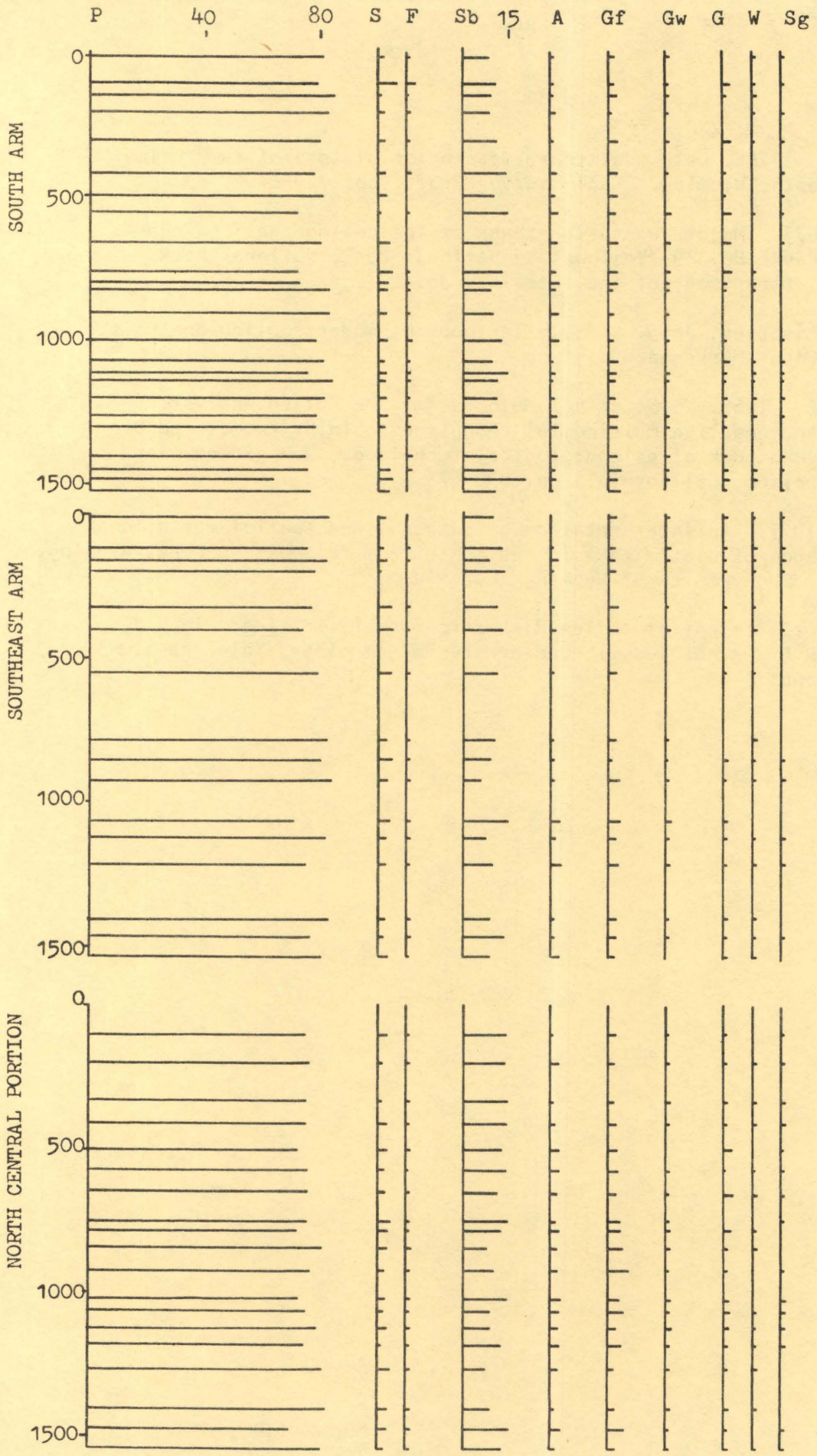

Figure 1.

Selected Pollen Percentages from three cores from Yellowstone Lake.

P = pine (Pinus)
S = spruce (Picea)
F = fir (Abies)
Sb = sagebrush (Artemisia)
A = Aster family (Compositae)
Gf = Goosefoot family (Chenopodiaceae)
Gw = greasewood (Sarcobatus)
G = grass (Gramineae)
W = willow (Salix)
Sg = sedge (Cyperaceae)

Table I. Percentages of the most common pollen types in sediment cores from three locations in Yellowstone Lake.

Years Before Present	South Arm				Southeast Arm				North Central Portion			
	pine	spruce-fir	sage-brush	Goose-foot family	pine	spruce-fir	sage-brush	Goose-foot family	pine	spruce-fir	sage-brush	Goose-foot family
0-30	81.7	2.3	8.4	1.4	82.2	2.4	10.2	1.2	sample not available			
100-133	79.2	1.8	10.9	2.0	74.7	2.5	12.6	2.2	74.8	3.2	15.0	2.5
191-233	83.5	2.2	7.6	1.6	78.1	1.4	14.2	3.6	76.2	2.1	12.0	2.4
300-340	79.8	1.9	11.6	2.6	76.6	4.7	10.4	3.7	76.4	1.2	15.0	2.1
397-442	75.5	3.4	14.2	2.0	72.5	6.0	13.8	3.2	75.0	2.7	14.5	2.2
543-580	72.4	3.1	15.7	2.4	78.9	4.2	10.8	2.4	76.0	1.8	14.2	2.4
747-795	71.4	5.5	12.6	3.1	80.1	3.5	10.2	3.3	72.0	3.9	12.7	3.9
838-865	77.0	3.3	10.1	1.6	79.7	4.9	9.5	1.0	80.1	3.0	7.7	4.6
904-924	82.7	2.2	9.1	1.6	84.2	2.8	4.9	4.4	76.0	1.9	10.1	6.0
1053-1079	81.3	2.5	10.1	1.5	70.1	3.0	14.8	3.8	75.5	3.2	9.4	5.4
1254-1275	77.9	3.5	10.2	2.8	75.2	3.1	10.0	3.4	80.8	4.2	7.5	1.7
1388-1408	77.2	2.4	10.9	2.5	77.9	3.0	10.3	2.5	82.0	2.0	8.5	2.2
1461-1484	63.7	2.5	20.6	3.0	75.9	1.9	13.8	2.5	68.9	2.7	15.7	4.4
average	77.2	2.8	11.7	2.2	77.4	3.3	11.2	2.9	76.2	2.7	11.6	3.4
average minus last value	78.3	2.7	11.0	2.3	77.7	3.6	11.0	2.9	76.9	2.7	11.2	3.3