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SOME RELATIONSHIPS BETWEEN VEGETATIONAL INDICATION AND BROAD SOIL GROUPS IN MINNESOTA FOREST COMMUNITIES

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Pioneer farmers made frequent use of vegetational indicators of soil productivity. It was commonly recognized, for example, that land in Minnesota supporting oak-maple-basswood stands was good corn land. Farmers also learned from experience about the suitability and productivity of clay, silt, loam, sand, rock, and peat soils for various crops. The broad soil groups are physiographic indicators. The objective of both vegetational and physiographic indicators is to provide for estimates of the biologically effective parts of the environment.

The purpose of this report is to present the consequences of introducing physiographic observations into a scheme solely built on a vegetational basis. Both vegetational and physiographic indicators were observed in 356 forest communities throughout Minnesota. Sixty-nine were found on silt soils, 46 on clay, 38 on loam, 92 on sand, 44 on rock, and 67 on peat soils. The results will show primarily whether the broad soil groups retain their well known moisture and nutrient properties. This would not only substantiate the validity of the vegetational indication method, but would open the way for new hypotheses, dealing with such problems as the characteristic configuration of regional site complexes (synecological fields), untested vegetation-environment relationships, particularly in heat-light coordinates, and others.

In a previous report (Minn. For. Notes No. 84) a procedure of vegetational indication was described. It starts with the determination of relative values for the requirements or adaptation of individual forest species to the essential environmental factor complexes: moisture, nutrients, heat and light. The factors are represented on a scale from 1 (lowest requirement) to 5 (maximum requirement). Community requirements are obtained as averages of the requirements of the species present. These values can be plotted using any combination of these factors as coordinate axes.

The four essential factor complexes provide for six bi-variate combinations. Only two of these, the edaphic complex (moisture-nutrient axes) and the climatic complex (heat-light axes) are shown in the figure. The community synecological requirements or values are distributed within characteristic "synecological fields" as shown by the outline of the ecotopes (the squares of the coordinate net) in the figure. The edaphic field is of approximate triangular shape resembling the triangle of the primary ecological succession schemes as demonstrated by many American ecologists (Clements, Cooper, Kittredge). The climatic field is approximately circular indicating that within such a heterogeneous forest area as Minnesota, community heat and light requirements are, in general, rather independent. This however, does not necessarily apply to more restricted areas or to individual species.

The number of communities belonging to individual ecotopes (squares) of both edaphic and climatic fields was determined. Within a particular ecotope the number of communities on a specific soil was expressed as a percentage of the total number of communities in that ecotope on all soils. Frequency lines are drawn at 20 percent intervals using ordinary contour mapping techniques. Within the climatic and edaphic fields, zones of frequency are shown for separate soil groups.

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The soil groups show moisture and nutrient capacities which agree with established knowledge. Silt, sand, rock and peat soils tend to support forest communities with more extreme requirements or adaptabilities. Clay and loam soils have communities with more intermediate requirements. Clay soils appear to be wetter and colder than loam soils. Rock soils are less droughty than sands on a community basis in agreement with several recent authors but contrary to older beliefs. The relationships of drainage and increased nutrient levels of peat soils is indicated. Predictions of light requirements of forest communities can be made from a knowledge of soil groups. The wide spread of sand and loam soils over the edaphic field emphasizes the need for more detailed knowledge to split these heterogeneous groups into smaller homogeneous units. Analysis of other factor combinations can provide additional hypotheses and suggest other factor relationships.

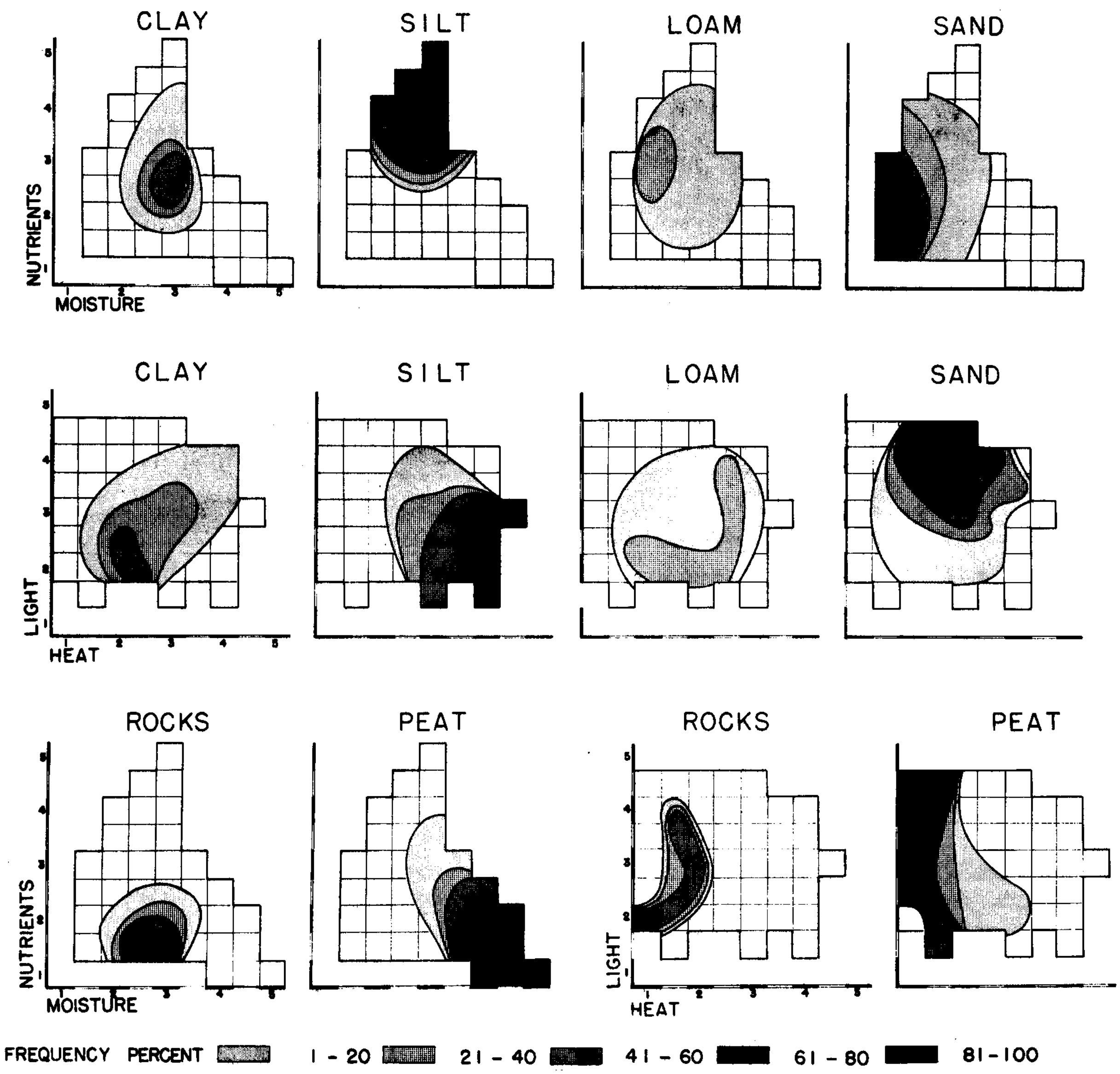

Figure. Frequency distribution of Minnesota forest communities growing on different soils in edaphic (moisture-nutrient) and climatic (heat-light) coordinate systems.

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