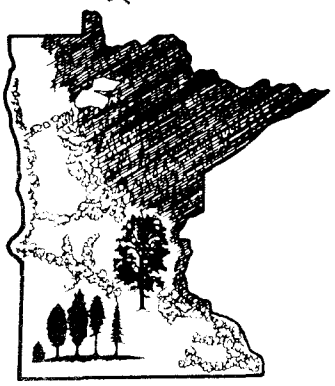

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REPRODUCTION CHARACTERISTICS OF UPLAND FOREST COMMUNITIES IN ITASCA STATE PARK, MINNESOTA

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Knowledge of reproduction characteristics is important in determining successional trends of forest types and predicting future composition of specific forest stands. Although the origin of the present forest of Itasca Park was largely associated with early forest fires, the management of this area has essentially eliminated fire as a factor affecting current regeneration processes. Because of this and a minimal amount of disturbance by man's activities, Itasca Park provides an ideal field laboratory for the study of "natural" forest regeneration in the absence of fire.

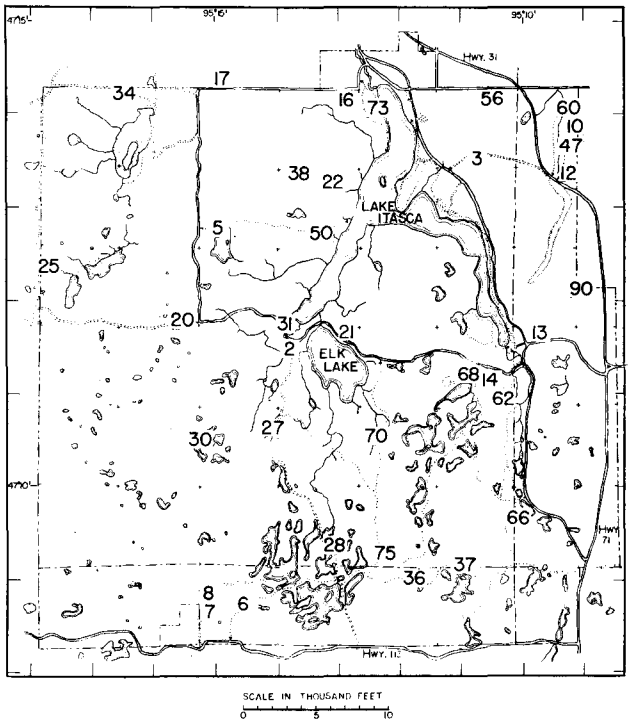

Figure 1. Locations of stands selected for intensive study in Itasca State Park, Minnesota.

A reconnaissance survey was made in 1963 and 1964 of 130 stands covering the full range of upland site conditions to study the regeneration and other ecological aspects of the forests of the park (Kurmis, 1969). For intensive study 36 stands were selected to represent variations in tree composition and age and soil moisture and nutrient conditions. Eight subplots in each stand were permanently established. Figure 1 shows the location of these stands.

The method of synecological coordinates (Bakuzis, 1959) was used to: (1) ordinate the forest stands in a moisture-nutrient coordinate system (edaphic field); (2) aid in identifying and classifying forest types; and (3) to analyze tree reproduction in relationship to stand and site characteristics. In Figure 2 each forest stand is located in a position relative to all other stands in terms of their moisture and nutrient adaptations.

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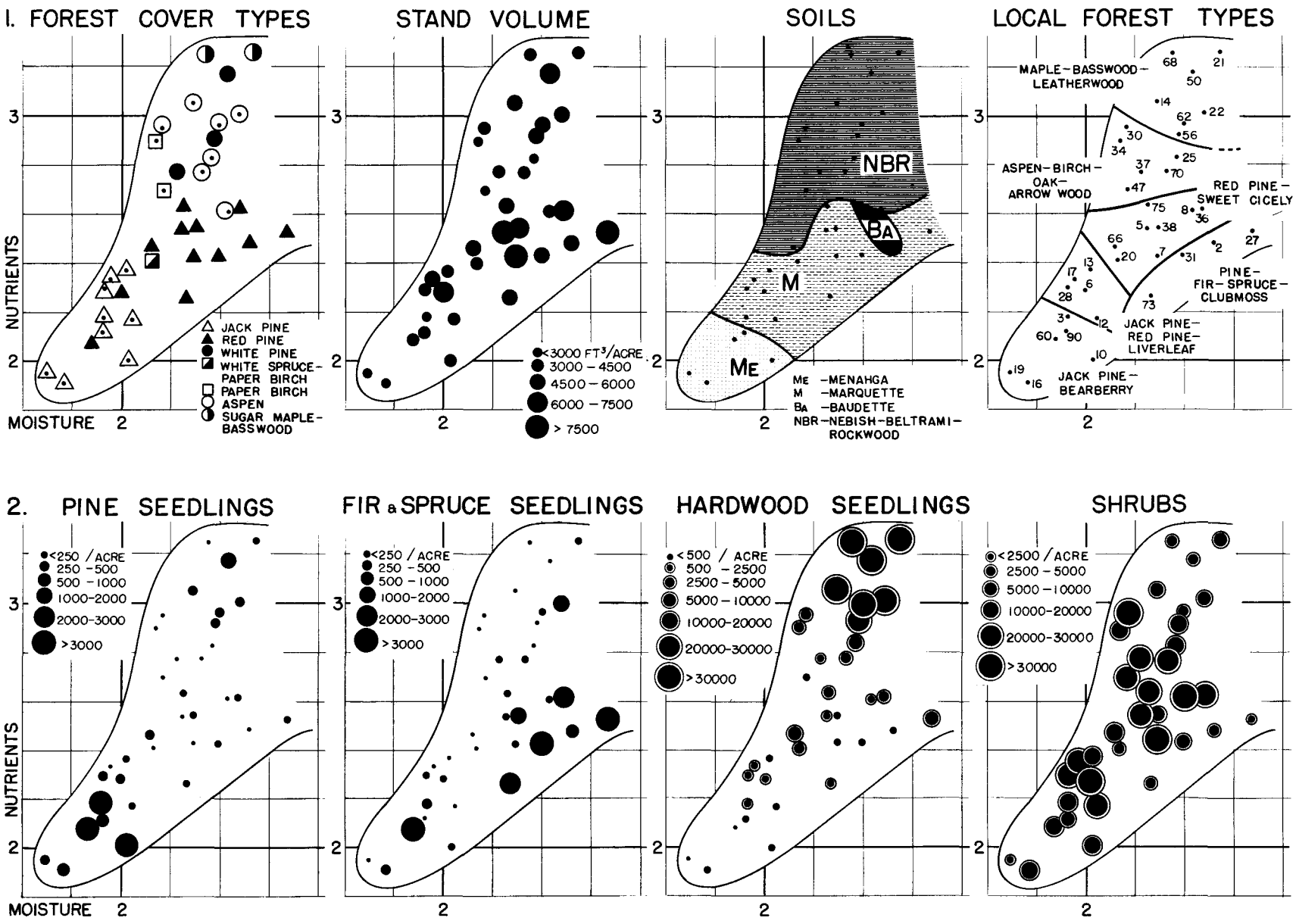

Figure 2. (1) Distribution of forest cover types, stand volumes, soils, local forest types, and (2) tree reproduction and shrubs in the moisture-nutrient coordinates (edaphic field) of upland forests in Itasca State Park, Minnesota.

Cover Types, Soils, and Stand Volumes. Forest cover types and stand volumes are shown in the first two diagrams of Figure 2-1. Aspen is the major cover type in the park occupying about 13,000 acres followed by red pine (5,700), jack pine (1,600), spruce-fir (1,500), and white pine (800) (Hansen, 1955). Stands of red pine have the largest average volumes and occupy mesic, intermediate nutrient sites characterized mainly by Marquette soils (third diagram in Figure 2-1). Jack pine stands on Menahga and Marquette soils, and aspen-birch stands mainly on Nebish-Rockwood soils, are relatively low in volumes. Stands on mesic, nutrient-rich sites characterized mainly by Nebish-Rockwood soils, with different stages of northern hardwood development and more or less open overstories of old aspen and scattered white pine, are intermediate in volumes.

Local Forest Types. Forest communities were grouped into six local forest types (fourth diagram in Figure 2-1): (1) jack pine-bearberry (Pinus banksiana-Arctostaphylos), (2) jack pine-red pine-liverleaf (Pinus banksiana-Pinus resinosa-Hepatica), (3) pine-fir-spruce-clubmoss (Pinus-Abies-Picea-Lycopodium), (4) red pine-sweet cicely (Pinus resinosa-Osmorhiza), (5) aspen-birch-oak-arrow wood (Populus-Betula-Quercus-Viburnum), and (6) maple-basswood-leatherwood (Acer Tilia-Dirca). These types reflect the moisture-nutrient intensity levels and follow the concept of forest site types. The type boundaries were adjusted to local ecological conditions such as individual species distribution in the edaphic field, developmental stage of reproduction and shrubs, and soil characteristics. Such an approach groups functionally similar ecosystems into forest types suitable for management purposes and for generalizing conclusions about reproduction.

Tree Reproduction and Shrubs. Figure 2-2 illustrates some aspects of tree reproduction and the occurrence of shrubs in these upland forests by species groups including pines, fir and spruce, hardwoods, and shrubs. The reproduction pattern and abundance are shown in relationship to the moisture-nutrient gradients. By visual inspection the reproduction can be seen in relationship to forest types, stand volumes, soils, and shrubs as presented in the individual diagrams in Figure 2. The number of reproduction and shrubs per acre includes all new stems older than two years and up to one inch at dbh.

The distribution patterns and abundance of pine, fir-spruce, and hardwood reproduction indicate that there are three main areas of reproduction concentration in the edaphic field (Figure 2-2). Pine reproduction, mainly white pine, appears on dry, nutrient-poor sites in the jack pine-bearberry type and to some extent on mesic, nutrient-rich sites in the maple-basswood-leatherwood type with low to medium shrub densities. Fir-spruce reproduction, mainly balsam fir, occupies the mesic, nutrient-poor to intermediate nutrient sites in the pine-fir-spruce-clubmoss type where low shrub densities prevail. Hardwood reproduction, mainly sugar maple, is concentrated on mesic, nutrient-rich sites in the maple-basswood-leatherwood type with low shrub densities. Shrubs have the greatest abundance in the central part of the edaphic field occupying a large portion of the dry to mesic, intermediate nutrient sites in the jack pine-red pine-liverleaf, red pine-sweet cicely, and aspen-birch-oak-arrow wood types (last diagram in Figure 2-2). These four forest undergrowth groups have their individual concentrations in separate parts of the edaphic field. This suggests strong competition between these groups, especially between the shrubs and tree reproduction.

Table 1 shows the composition of forest undergrowth by local forest types. Conifers, mainly balsam fir, are only predominant in the pine-fir-spruce-clubmoss type. Sugar maple reproduction is the main contributor to the high hardwood

percentage in the maple-basswood-leatherwood type. In jack pine-bearberry, jack pine-red pine-liverleaf, red pine-sweet cicely, and aspen-birch-oak-arrow wood types shrubs constitute over 80 percent of the total undergrowth. In the latter three types conifer reproduction is scattered and its height growth is restricted. About 85 percent of the total upland forest area in the park is in this condition.

Table 1. Composition of forest undergrowth in local forest types in Itasca Park, Minnesota

Local forest types	Number of stands*	Undergrowth in percent		
		conifers	hardwoods	shrubs
Jack pine-bearberry	6	17	2	81
Jack pine-red pine-liverleaf	5	1	2	97
Pine-fir-spruce-clubmoss	4	44	16	40
Red pine-sweet cicely	8	5	12	83
Aspen-birch-oak-arrow wood	6	0.1	13	87
Maple-basswood-leatherwood	7	1	88	11

* eight 2-milacre subplots per stand

Successional Implications

1. Except for a few stands on dry, nutrient-poor sites, pine reproduction is totally inadequate to regenerate existing pine stands.

2. The role of shrubs in deterring the regeneration of tree species is indicated by the fact that except in the pine-fir-spruce-clubmoss and maple-basswood-leatherwood types, over 80 percent of all the undergrowth is composed of various shrub species.

3. The adequacy of hardwood species reproduction and the low density of the shrub canopy in the maple-basswood-leatherwood type indicates that this type is perpetuating satisfactorily.

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