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GROWTH AND MORTALITY IN AN OLD-AGE JACK PINE STAND

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ABSTRACT

Periodic measurements of a jack pine stand were taken between the ages of sixty and ninety years. Species composition, number of trees, diameter, height, basal area and total volume per acre were determined. Succession from jack pine to an open mixture of paper birch, red maple, and aspen with a dense brush understory is indicated.

In recent years, a movement to preserve mature and overmature forests for future generations has gained prominence. This raises the question of growth, decadence and regeneration of such stands. Although many generalized observations indicate that jack pine stands die and decay through time, little factual information is available regarding the rate of these processes. A series of 1/4 acre inventory plots established in 1939 at the Cloquet Forestry Center provide a measure of forest stand development of jack pine between age 60 and 90 years.

The study area originated as pure jack pine (*Pinus banksiana* Lamb.) in 1879 following a fire that killed a 57 year old jack pine stand. The absence of younger jack pine age classes within the stand indicates no severe fires have occurred since establishment. The soil type is Omega loamy sand which is a medium site for jack pine (site index 52). Data from eight 1/4 acre plots that were measured in 1939, 1949, 1962 and 1969 were selected for analysis. All trees in the 3 inch dbh class and over were used to compute number of trees per acre, average diameter, basal area per acre, and total cubic foot volume per acre.

Results

The total number of trees per acre in the stand declined over the 30 year period from 356 to 224 (table 1). The greatest loss was in jack pine which dropped from 298 to 139 trees per acre. Aspen (*Populus tremuloides* Michx. and *P. grandidentata* Michx.) dropped from 22 to 13 trees per acre. Baker (1949) lists these species as very intolerant in their respective groups, i.e. eastern conifers and eastern hardwoods. The number of more tolerant red pine (*Pinus resinosa* Ait.) and spruce (*Picea spp.*) remained the same. The more tolerant hardwoods, paper birch (*Betula papyrifera* Marsh.) and red maple (*Acer rubrum* L.), increased in number from 26 to 62.

The total basal area increased for all species except jack pine for the ten-year period between 1939-1949 (table 3). For jack pine the growth of the residual trees was equal to the mortality. During the next period, 1949-1962, the stand basal area remained constant, except jack pine which decreased 5 square feet or approximately 1 cord per acre. During this period mortality was greater than the growth on the residual trees. In the last period, 1962-1969, the stand basal area decreased over 5 square feet per acre. During this period loss of basal area due to mortality in the jack pine was greater than the growth on the remaining jack pine plus the increase on the other species.

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The growth in total volume (table 4) follows much the same pattern as that for basal area. The total stand volume increased at a diminishing rate during the first two periods. From 1962-1969 there was a loss. All the species but jack pine increased in volume with time. The jack pine increased the first period but loss from mortality was greater than increment on the remaining trees in the last two periods. During the last period the volume loss of 162 cubic feet in jack pine was 71 cubic feet greater than the increment of all other species combined. This resulted in a 2 percent loss for the stand. Volume lost in jack pine trees removed from the stand by mortality was 722 cubic feet during the 1939-1949 period, 754 cubic feet during the 1949-1962 period and 495 cubic feet during the period 1962-1969. Total loss over the three periods was 1,971 cubic feet or approximately 22 cords.

Conifer reproduction did not become established during the 30 year period. Alm (1971), in a study of coniferous reproduction in this jack pine stand, found no red pine seedlings and less than 1 percent stocking of jack pine seedlings on 150 milacre plots. He also found an evenly distributed shrub understory averaging 26,650 stems per acre. Average shrub height was 5.8 feet. The most common species was beaked hazel (*Corylus cornuta* Marsh.) with serviceberry (*Amelanchier* spp.), willow (*Salix* spp.), speckled alder (*Alnus rugosa* [DuRoi] Spreng.), pincherry (*Prunus pensylvanica* L.f.) and choke cherry (*Prunus virginiana* L.) present.

The data indicate a general succession from pure jack pine to an open, mixed stand of paper birch, red maple, and aspen with a dense understory of brush. If a jack pine type is to be maintained, adequate regeneration will be established only by the application of appropriate silvicultural practices. Because jack pine is an intolerant species requiring even-aged management for the establishment of seedlings, this would generally mean clearcutting by an acceptable harvesting system followed by site preparation and reforestation.

Literature Cited

Alm, A.A., 1971. Environmental conditions produced by mechanical logging and their impact on establishment of coniferous reproduction. Ph.D. Thesis, Univ. of Minnesota, Minneapolis, Mn. XII + 176 p.

Baker, F.S., 1949. A revised tolerance table. Jour. of Forestry 47:179-181.

Table 1. Number of trees per acre larger than 2.5 inches, 1939 to 1969.

	1939		1949		1962		1969	
Species	Trees/ Acre	Per- cent	Trees/ Acre	Per- cent	Trees/ Acre	Per- cent	Trees/ Acre	Per- cent
Jack pine	298	84	228	74	170	67	139	62
Red pine	6	2	6	2	6	2	6	2
Spruce	4	1	3	1	3	1	4	2
Birch	25	7	42	14	52	21	54	24
Aspen	22	6	23	8	14	6	13	6
Red maple	1	0.3	4	1	8	3	8	4
Total	356	100	306	100	253	100	224	101

Table 2. Average diameter at dbh and average height of all trees larger than 2.5 inches, 1939-1969.

	Average Diameter (inches)			
Species	1939	1949	1962	1969
Jack pine	8.1	9.3	10.5	11.1
Red pine	7.8	8.7	10.9	11.7
Spruce	6.7	8.1	9.0	9.7
Birch	4.8	5.3	5.9	6.3
Aspen	5.0	6.2	7.7	8.4
Red maple	3.5	3.7	4.7	4.6
	Average Height (feet)			
Jack pine	56	59	61	61

Table 3. Basal area in jack pine stand, 1939-1969.

	Basal Area per Acre (square feet)			
Species	1939	1949	1962	1969
Jack pine	107	107	102	94
Red pine	2	3	4	4
Spruce	1	1	1	2
Birch	3	6	10	12
Aspen	3	5	4	5
Red maple			1	1
Total	116	122	122	118

Table 4. Total volume by species in jack pine stand, 1939-1969.

	Total Volume per Acre (cubic feet)						
Species	1939		1949		1962		1969
Jack pine	2643	(722)*	2773	(754)*	2763	(495)*	2601
Red pine	63		81		123		145
Spruce	22		28		35		48
Birch	60		124		201		242
Aspen	52		86		98		108
Red maple	1		5		12		17
Total	2841		3097		3232		3161

* Numbers in parenthesis represent volume lost through mortality between measurements. Volume was computed from number of trees lost during the period and the average tree diameter at the beginning of the period.