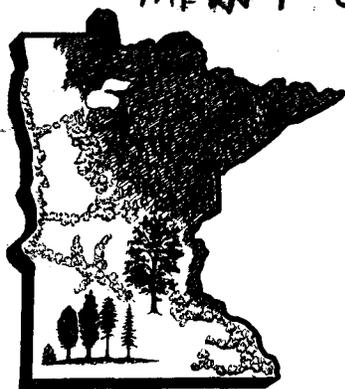
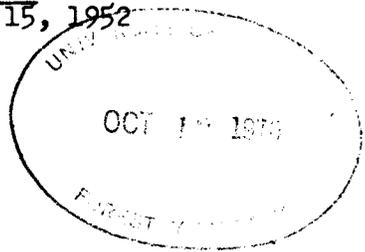


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GROWTH OF UNTHINNED JACK PINE STANDS AT CLOQUET

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Permanent inventory plots ($\frac{1}{4}$ -acre) in the Cloquet Experimental Forest measured both in 1939 and 1949 provide growth data on unthinned jack pine for the forest management plan.

As of 1939, these jack pine stands were in the 21-30, 41-50, 51-60, and 61-70 year age classes. They occupy gently rolling outwash plain soils which are classified as Omega loamy medium sand. In 1939, the site quality was classified as "average". Using the jack pine yield table in the 1934 revision of Univ. Minn. Agr. Exp. Sta. Tech. Bull. 39 (p.194), the periodic annual growth for the decade 1939-1949 was predicted. These predictions may now be compared with actual growth.

Table 1. Per acre volumes of representative stands in each age class.

| 1939 age class | Plot Sample Acres | 1939 Volume | | | 1949 Volume | | | Percent normal stocking | |
|----------------------|-------------------------|-------------|------|----------------------|-------------|------|----------------------|----------------------------|------|
| | | All Species | | Percent jack pine | All Species | | Percent jack pine | 1939 | 1949 |
| | | Cu. Ft. | Cds. | | Cu. Ft. | Cds. | | | |
| 21-30 | 1.75 | 869 | 10.0 | 90 | 2284 | 26.2 | 86 | 105 | 166 |
| 41-50 | 3.35 | 1761 | 20.2 | 98 | 2453 | 28.2 | 96 | 66 | 77 |
| 51-60 | 1.35 | 2734 | 31.4 | 63 | 2866 | 32.9 | 60 | 86 | 82 |
| 61-70 | 1.25 | 2405 | 27.6 | 81 | 2330 | 26.8 | 74 | 69 | 63 |

The above table is based upon a single representative stand of good density for each age class. Averages of all stands would have less value as they would be based on stands the density of which varied widely. The proportion of jack pine is higher in the younger stands due in considerable degree to the establishment and development of red pine, aspen, and paper birch as the jack pine becomes older. As measured by the normal yield table for jack pine, average site, the 21-30 year-old stand is overstocked on a volume basis. Over-stocking increases as the stand passes into the 31-40 year age class. Also, an increase in stocking occurs as the 41-50 year age class passes into the 51-60 year class.

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The relative stocking of both the 51-60 and 61-70 year age stands, however, decreases as each of them moves into the next older age class. In both of these age classes, mortality is taking out volume, mostly from among the smaller trees, faster than growth on the living trees is replacing it. These stands either should be heavily thinned or should be harvested and regenerated. The 21-30 year-old stand also might well be thinned. Although understocked, the 41-50 year stand should not be thinned unless enough volume in the expected mortality is available to justify cutting.

Table 2. Predicted periodic annual growth versus actual periodic annual growth of selected jack pine stands for the 1939-1949 decade.

| 1939 age class | Net periodic annual growth, 1939-1949 | | | | | | | |
|----------------------|---------------------------------------|------|---------|-------|----------------|------|---------|-------|
| | All species | | | | Jack pine only | | | |
| | Predicted | | Actual | | Predicted | | Actual | |
| | Qu. Ft. | Cds. | Qu. Ft. | Cds. | Qu. Ft. | Cds. | Qu. Ft. | Cds. |
| 21-30 | 98.1 | 1.13 | 141.5 | 1.63 | 89.4 | 1.03 | 118.2 | 1.36 |
| 41-50 | 39.6 | 0.45 | 69.2 | 0.79 | 38.1 | 0.44 | 63.1 | 0.72 |
| 51-60 | 23.0 | 0.26 | 13.2 | 0.15 | 15.0 | 0.17 | -2.0 | -0.02 |
| 61-70 | 16.1 | 0.19 | -7.6 | -0.09 | 12.5 | 0.14 | -22.9 | -0.26 |

In these stands, the yield table method of predicting net periodic annual growth was not satisfactory. For the 21-30 and the 41-50 year age classes the predicted growth was considerably greater than the actual growth, which became negative for the jack pine in the 51-60 year age class and negative for all species in the 61-70 year class.

Conclusions: Where the production of pulpwood is the chief objective, unthinned jack pine stands growing on medium or average sites should be cut when they reach an age of 50-60 years (or an average breast height diameter of between 6 and 7 inches). Where the production of box bolts or sawlogs is an important objective, jack pine stands growing on medium sites should be thinned when the stands are approximately 40 years old. The operation should be repeated as often as the volume to be obtained justifies the operating costs of making them. Remeasurement of the plots at Cloquet indicates that the larger trees will maintain a satisfactory individual rate of growth up to an age of 70 or 80 years, even though the volume of the stand as a whole is slipping backward (i.e. the net growth is negative) because of mortality among the smaller trees.