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Rate of growth of tamarack (Larix tarcina) in Cedarburg Bog

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This study was undertaken to determine the influence of bog conditions on growth rate of tamarack *(Larix larcina)*. The Cedarburg Bog in Ozaukee County, Wisconsin presents a unique opportunity for such study since it includes the southernmost string bog in the United States (Grittinger, 1970).

METHODS

I conducted this study during the summer of 1971. Tamaracks were sampled in Cedarburg Bog. Eight sampling points were chosen along an east-west transect extending eastward halfway across the bog. Three points were in the cedar-tamarack swamp bordering the string bog, three were on strings, and two points were on low islands within the string bog (Table 1). Five trees were selected at each point and cores were taken using a Swedish increment borer. To obtain trees of maximum age, the largest trees at each point were chosen. However, heart rot in the largest trees at many of the points forced me to use alternate trees that were smaller. Incipient heart rot made other trees difficult to sample. Diameter (DBH) was measured with a tree tape and height was estimated to the nearest foot.

The cores were dried very slowly to prevent cracking. When dry, the cores were glued into slotted boards and sanded flat to provide a smooth readable surface. Most cores had rings sufficiently dark to enable counting, but in a few the most recent rings were very light. A penetrating oil stain was applied to enhance the light rings to make them countable. Rings were counted, using a binocular dissecting microscope (Foote 1945).

RESULTS

Height growth rates and diameter growth rates were calculated from the age, diameter and height data as was done by Rigg (1917) for trees in sphagnum bogs (Table 2). Both height and diameter growth rates decrease as one moves from the edge of the cedar-tamarack swamp into the string bog (Fig. 1). Buell et al. (1968) found a similar decrease in growth rate from the edge of a bog to the center. Within the string bog, growth rates for trees on the strings were nearly equal, while trees on the small cedar-tamarack islands showed substantially greater growth than on the strings, but still far slower growth than shown by trees at the edge of the cedar-tamarack swamp near the large raised island. Ages of individual trees are shown in Table 3.

Presumably differences in growth rate between the strings and the small cedar-tamarack islands are due in part to the difference in root elevations above water level. The islands are a few inches higher than the strings so that the tree roots are better aerated. Likewise, island soil is firmer than the peat making up the strings. The physical differences between the cedar-tamarack swamp and the string bog are harder to determine. One of the outstanding differences is the amount of raised peat. The cedar-tamarack swamp is a large continuous area whereas in the string bog, the raised portions are broken by large areas of open water and floating mat.

DISCUSSION

Bogs are a specialized type of habitat, characterized by several unique physical features. Bogs form peat and grow on top of deep layers of partially decayed sphanmum moss, wood and other material. This peat absorbs bases and releases acid. Bog water is usually of low pH, low in dissolved electrolytes and low in lime (Ruttner, 1969). Peat is generally saturated with water, hence, deficient in oxygen, as well as lacking in mineral nutrients. These factors create a harsh environment for plants, and several authors have noted that trees of bogs are stunted and gnarled (e.g., Rigg, 1917).

My results demonstrate very slow growth of tamarack in Cedarburg Bog both in diameter and height. Differences in growth rates depend on the particular area of the bog, aeration, and mineral availability. As indicated by other studies, much more work is needed to determine how various factors affect growth of trees as well as other plants in string bogs.

I thank my husband, John Meyer, for helping me sample the tamaracks, Paul Matthiae for helping me set up the project, Al Becher for construction of some of the equipment, Dr. Douglas Dunlop for assisting in counting tree rings, and Dr. Peter Salamun and Dr. Forest Stearns for critically reviewing the manuscript.

Table 1. Location of Sampling Points

Point	Location
A	Cedar-tamarack swamp near large raised upland forest island
B	Near center of cedar-tamarack swamp
C	Edge of cedar-tamarack swamp
D	Small cedar-tamarack island in string bog
E	A string within the string bog
F	A string within the string bog
G	A string within the string bog
H	Small cedar-tamarack island in string bog

Table 2. Growth Rates

Point	Average Diameter	Average Height	Average Age	Growth Rate of Diameter	Growth Rate of Height
A	16.6 cm	1171 cm	40 yrs.	.412 cm	28.96 cm
B	9.4 cm	354 cm	105 yrs.	.089 cm	3.36 cm
C	8.3 cm	470 cm	111 yrs.	.074 cm	4.21 cm
D	18.0 cm	1049 cm	164 yrs.	.110 cm	6.37 cm
E	8.4 cm	510 cm	110 yrs.	.076 cm	3.57 cm
F	9.4 cm	329 cm	132 yrs.	.071 cm	2.49 cm
G	12.0 cm	464 cm	178 yrs.	.068 cm	2.62 cm
H	16.7 cm	976 cm	189 yrs.	.088 cm	5.15 cm

* To calculate growth rates, total height (five trees), total diameter and total age were used. Growth rate of diameter = total diameter ÷ total age. Growth rate of height = total height ÷ total age. The table averages are total ÷ 5.

Table 3. Tamarack Ages

Point	Tree Number				
	1	2	3	4	5
A	42 yrs.	39 yrs.	39 yrs.	42 yrs.	40 yrs.
B	143 yrs.	144 yrs.	54 yrs.	90 yrs.	95 yrs.
C	106 yrs.	150 yrs.	115 yrs.	78 yrs.	108 yrs.
D	160 yrs.	151 yrs.	125 yrs.	174 yrs.	211 yrs.
E	70 yrs.	147 yrs.	77 yrs.	109 yrs.	146 yrs.
F	170 yrs.	102 yrs.	127 yrs.	150 yrs.	110 yrs.
G	139 yrs.	192 yrs.	195 yrs.	208 yrs.	154 yrs.
H	204 yrs.	208 yrs.	122 yrs.	184 yrs.	227 yrs.

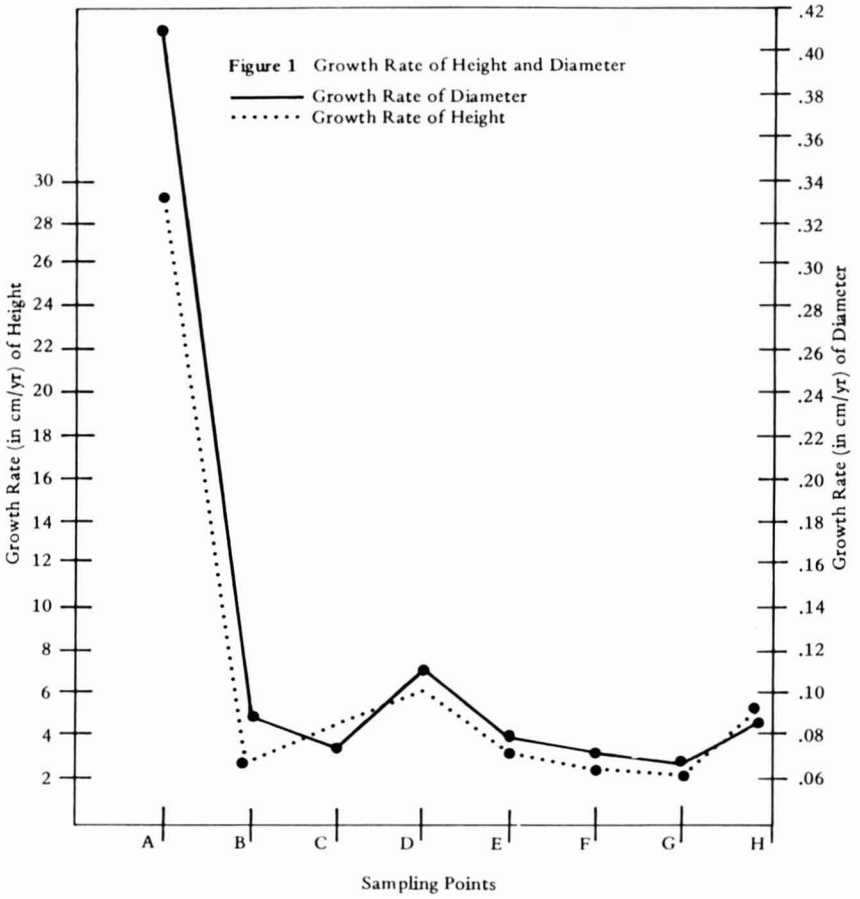

Figure 1 Growth Rate of Height and Diameter

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