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¹¹Boyd, W. L. and J. W. Boyd 1964. The presence of bacteria in permafrost of the Alaskan arctic. *Canadian Journal of Microbiology* 10(2): 917-19.

¹²Hansen, Kjeld. 1969. Edaphic conditions of Danish heath vegetation and the response to burning-off. *Botanisk Tidsskrift*, 64: 121-40.

Changes in the Northern Limit of Spruce at Dubawnt Lake, Northwest Territories

Larsen¹ described the treeline west of Hudson Bay and particularly at Ennadai, Yathkyed and Dubawnt Lakes, as clumps of spruce, relict from a former more northerly distribution. He considered the distribution to be climate-controlled and suggested that the clumps were not re-establishing themselves. In contrast, Marr² reported that the treeline east of Hudson Bay is not climate-limited, but that the forest is migrating as soil develops and a measurable successional progression has occurred in less than half a century. Evidence collected by us in 1966 on the Dubawnt River system on the Mackenzie-Keewatin border, indicates that the spruce trees are re-establishing themselves and have moved northward and closer to Dubawnt Lake during the past one hundred years.

The Tyrrell brothers^{3,4} on the first geological survey of the central barrens in 1893 recorded the last spruce grove at a point 5 miles upstream (southwest) from Dubawnt Lake (Fig. 1). J. Burr Tyrrell³ describes the location: "On the north bank of the river, half way between the above lake and Doo-bawnt Lake, is the last grove of black spruce on the river, where the trees are so stunted that they are not as high as one's head . . . For five miles below this last spruce grove, the banks are rather low . . ." J. W. Tyrrell⁴ describes these plants as "a little patch of stunted black spruce trees . . . not more than 4 or 5 feet high . . . We broke camp early, and bidding good-bye to the last vestige of growing timber to be seen, continued down the river . . ." In 1966, the last spruce tree (4 inch diameter at breast height) was within 2 miles of the shore of Dubawnt Lake, 1 mile north and 3 miles east of the last spruce plants visible to the Tyrrells. In addition, sight records of spruce of less than tree size were made north of Dubawnt Lake: at points

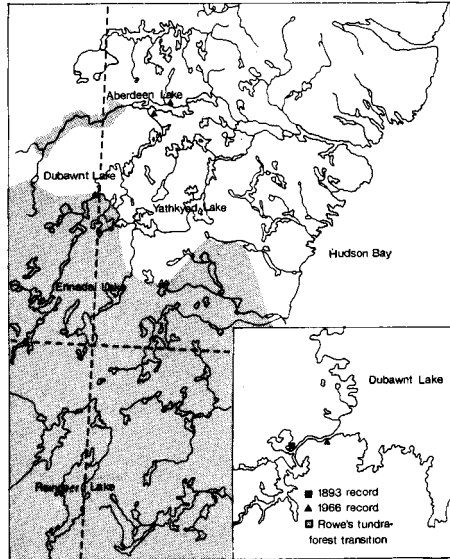


FIG. 1. Map showing locations of spruce plants on the Dubawnt River system, Northwest Territories. Inset shows locations of last spruce groves south of Dubawnt Lake.

2 miles south of Loudon Rapids near the junction of the Dubawnt and Thelon Rivers, and on the northwest shore of Aberdeen Lake. These latter individuals are probably outliers from the large island of spruce further west on the Thelon River⁵.

The spruce trees at Dubawnt Lake appeared to be intermediate in form between white spruce (*Picea glauca*) and black spruce (*Picea mariana*). In needle shape and number of rows of stomata they resemble black spruce, but in cone and twig characteristics they resemble white spruce. The absence of resin ducts in the needles indicates white spruce⁶.

Examination of the annual growth rings of the largest spruce (14 feet high and a 5 inch basal diameter) shows clear increments for 79 years (back to 1888); prior to that time, there are perhaps 18 rings, 9 of which are extremely narrow. The existent trunk diameter of this tree in 1893 was approximately $\frac{1}{4}$ inch at a point 1 foot above the root. A plant of this size could not have been seen by the Tyrrells passing on the river as it was set between rocks and tussocks of a low swampy area.

A lone spruce, separated by 30 yards from the low-lying clump, was situated about 20 feet higher on the slope. It was 12 feet high with a basal diameter of 3 inches. The earliest ring dates from 1931 and all subsequent rings show good annual increments until 1960 —

the last 6 years having greatly decreased growth.

Larsen's¹ view that spruce has not re-established itself during the last half century does not apply at Dubawnt Lake, but may be true at the Ennadai and Yathkyed Lake regions. The treeline at Dubawnt forms a northeasterly bulge suggesting a response to a lake-modified climate. Dubawnt Lake is 60 miles long by 45 miles wide. In those years when the ice does not go out, only a narrow sheet of water is open around the shore³; but when it is clear of ice, as in 1966, there exists the usual pattern of off-shore and on-shore breezes and a characteristic cloud formation around the lake. Small changes in climate affecting break-up may produce a large change in the weather of the growing season. During warm years, the area around Dubawnt Lake may be more favourable for seed germination and tree growth than the Yathkyed and north Ennadai Lake regions.

The known changes in the treeline in the Dubawnt Lake area can be summarized as follows: the south arm of the Keewatin Glacier left the lake area possibly from 7.5 to 7.9 thousands of years before the present⁷ or as late as 5.5 thousand years ago⁸. By 4 thousand years ago, a closed canopy forest extended half way up the east shore of Lake Dubawnt, leaving fossil podzols¹. Individual clumps and trees probably extended further north. A southern retraction of treeline followed, but a re-extension took place c. A.D. 1100 at the "little climatic optimum"¹. A southern retraction again occurred and by 1770 Hearne⁹ recorded dead stumps 20 miles north of the treeline. Around 1870, satisfactory growth conditions existed within 2 miles of the south end of Dubawnt Lake and a minor northward extension took place. Re-establishment of spruce by means other than layering occurred by 1931. Less favourable growth conditions may have begun again in 1960.

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REFERENCES

- ¹Larsen, J. A. 1965. The vegetation of the Ennadai Lake area, N.W.T.: Studies in subarctic and arctic bioclimatology. *Ecological Monographs*, 35(1): 37-59.
- ²Marr, J. W. 1948. Ecology of the forest-tundra ecotone on the east coast of Hudson Bay. *Ecological Monographs*, 18(4): 117-44.
- ³Tyrrell, J. B. 1898. Report on the Doobaunt, Kazan and Ferguson Rivers and the north-west coast of Hudson Bay. *Geological Survey of Canada Annual Report*, 1896, Vol. 9: Report F. 1-218.
- ⁴Tyrrell, J. W. 1908. *Across the subarctics of Canada*. Toronto: William Briggs. 280 pp.
- ⁵Clarke, C. H. D. 1940. A biological investigation of the Thelon Game Sanctuary. *National Museum of Canada Bulletin*, No. 96, 135 pp.
- ⁶Durrell, L. W. 1916. Notes on some North American conifers based on leaf characters. *Iowa Academy of Sciences Proceedings*, 23: 519-82.
- ⁷Prest, V. K. 1969. Retreat of Wisconsin and recent ice in North America. Map 1267A. *Geological Survey of Canada*. Department of Mines, Energy and Resources.
- ⁸Bryson, R.A., W. M. Wendland, J. D. Ives, and J. T. Andrews. 1969. Radiocarbon isochrones on the disintegration of the Laurentide Ice Sheet. *Arctic and Alpine Research*, 1(1): 1-14.
- ⁹Hearne, S. 1795. *A journey from Prince of Wales Fort in Hudson's Bay, to the northern ocean . . . in the years 1769, 1770, 1771, 1772*. London: A. Strahn and T. Cadell. 458 pp.