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Recurrence of Spruce Budworm Outbreaks for Two Hundred Years in Western Quebec

by
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Abstract

The history of spruce budworm (*Choristoneura fumiferana* (Clem.)) outbreaks for the past two hundred years in the Ottawa River Valley in Quebec was retraced through radial-growth studies on old white spruce (*Picea glauca* (Moench)) and black spruce (*Picea mariana* (Mill.) B.S.P.) trees. The radial-growth profiles clearly indicate three suppression periods resulting from outbreaks that occurred in the twentieth century, each starting about 1910, 1940 and 1967. There is no evidence of an outbreak during the nineteenth century in this region. However, a reduction in radial-growth starting in 1783 observed on the only three specimens of white spruce over 200 years old, has the characteristics of that caused by a budworm outbreak. An interval of 127 years between this and the 1910 outbreak is similar to other long intervals between outbreaks recorded prior to the twentieth century for some other regions in eastern Canada.

Résumé

L'historique des épidémies de la tordeuse des bourgeons de l'épinette (*Choristoneura fumiferana* (Clem.)) a été retracé pour une période de 200 ans, à l'aide d'études des anneaux de croissance sur de vieilles épinettes blanches (*Picea glauca* (Moench)) et noires (*Picea mariana* (Mill.) B.S.P.) provenant de la région de l'Outaouais. Les profils de croissance indiquent clairement la réduction causée par les trois épidémies (commençant vers 1910, 1940 et 1967) qui sévirent au cours du vingtième siècle. Il n'y a aucune évidence d'une invasion par cet insecte au cours du dix-neuvième siècle. Cependant, une réduction de croissance radiale débutant en 1783, observée sur les seuls trois échantillons d'épinette blanche ayant 200 ans, présente les caractéristiques de celles occasionnées par une épidémie de la tordeuse. Un intervalle de 127 ans entre cette invasion probable et celle de 1910 se rapproche de certains longs intervalles entre les épidémies avant le vingtième siècle pour d'autres régions de l'est du Canada.

Introduction

The history of spruce budworm (*Choristoneura fumiferana* (Clem.)) outbreaks from various regions can provide valuable information on the epidemiology of this insect (Blais 1968). Previous studies based on analyses of growth rings mostly from old white spruce (*Picea glauca* (Moench) Voss) trees, permitted the reconstruction of the history of past outbreaks for periods varying between 150 and 300

years for several regions from northwestern Ontario to New Brunswick (Blais 1954, 1961, 1964, 1965, Turner 1952). However, information was lacking on past outbreaks for a large sector from the eastern limits of the Algoma region in Ontario to the western limits of the Laurentian Park in Quebec. During impact studies of the current outbreak on spruce and fir in the Ottawa River watershed in western Quebec (Blais 1981), basal discs from old spruce trees were acquired to obtain information on past budworm outbreaks, especially on those that might have occurred prior to the twentieth century.

Methods

Between 1976 and 1979 visits were made once a year to the study area. At each visit, the butt-end of full-length tree trunks of white spruce and black spruce (*Picea mariana* (Mill.) B.S.P.) yarded at E.B. Eddy's Pomponne Depot were examined. They came from several localities scattered on the company's limits on the Dumoine River and Coulonge River watersheds. Several thousands of stems of these tree species were present in the yard at the time of each visit. Discs were obtained from the butt-end of the few very old specimens that could be found in the wood piles. The discs were brought to a laboratory for examination and were analysed according to the technique described by Blais (1962).

Results

At the time of the first visit to the yard in 1976, it soon became apparent that very old specimens were extremely rare. During the following years the same situation prevailed, and relatively few old specimens were found. Some old specimens could not be retained for analysis because radial growth had been severely suppressed for prolonged periods obscuring any suppression pattern caused by budworm defoliation. Eighteen white spruce and 8 black spruce trees, old enough to provide information on outbreaks that might have occurred prior to the twentieth century, were retained. The trees varied in age from 100 to 220 years (Table 1).

Average yearly radial growth for these trees is shown in Figure 1. Average growth for the first 100 years was based on all trees sampled since all were at least that old. Average growth for the next 100 years was based on a decreasing number of trees (Table 1). The radial growth profiles for both tree species are in good accord, indicating the dating of the growth rings was accurate.

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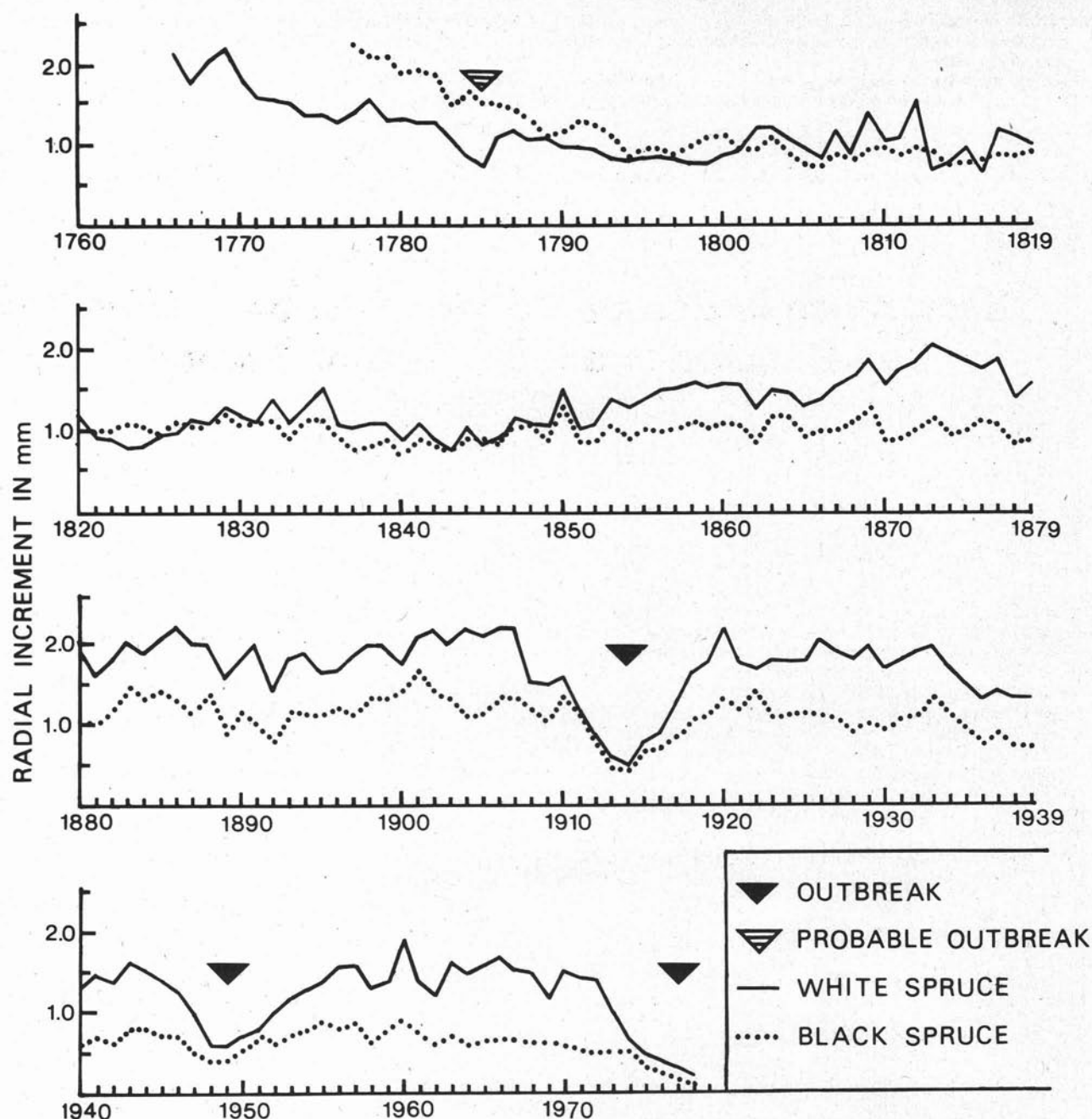


Figure 1. Average yearly radial growth from basal discs for white spruce and black spruce trees from 1766 to 1978 from the Dumoine River and Coulonge River watersheds in Quebec. Yearly growth for the first 100 years was based on data from 18 white spruce and 8 black spruce trees; for the next 100 years it was based on a decreasing number of trees (Table 1).

All discs examined provided clear evidence for outbreaks starting about 1910, 1940 and 1967. The three outbreaks resulted in pronounced radial-growth suppression lasting for several years in white spruce (Fig. 1). Growth suppression on black spruce was less pronounced since this species is less severely defoliated by budworm than balsam fir (*Abies balsamea* (L.) Mill.) or white spruce (Blais 1957). Some trees sampled were dead when cut because of recent severe defoliation by budworm. Although this outbreak came to an end in 1975, radial growth in surviving trees had not recovered by 1978. (Fig. 1). Radial-growth suppression was more pronounced during the 1910 than during the 1940 outbreak for both tree species, indicating the earliest outbreak was more severe. In their account of the 1910 outbreak,

Swaine and Craighead (1924) write: "On a wide belt lying immediately south of the Height of Land, stretching from Lake Kipewa to the eastern limits of the Saguenay drainage basin, about 500 miles in length and varying from 50 to 150 miles in width, a very high percentage of the balsam fir was killed. On large sections of that area between 90 and 100 per cent of the original stand of balsam is now dead and fallen." These authors mention that very few white spruce trees were killed. McLintock (1955) noted an average of 53% mortality of balsam fir of merchantable size in 10 large sample plots in the Upper Gatineau in 1952, three years after the end of the 1940 outbreak. During the following two years it is possible that an additional 10 to 15% of the trees died as a result of the protracted mortality of severely weakened

Table 1. Number of white spruce and black spruce trees by age class from which radial-growth data were obtained in the Ottawa River watershed in Quebec.

Decade of first growth	No. of white spruce trees	No. of black spruce trees
1881-1890	18	8
1871-1880	17	8
1861-1870	16	8
1851-1860	12	8
1841-1850	11	8
1831-1840	9	8
1821-1830	6	7
1811-1820	6	5
1801-1810	4	3
1791-1800	4	2
1781-1790	3	1
1771-1780	2	—
1761-1770	1	—

trees, bringing final mortality of merchantable size fir to approximately 65%. This is somewhat less than was observed for the 1910 outbreak. As for the previous outbreak, few white spruce trees were killed at the time of the 1940 outbreak (McLintock 1955). Current studies on the impact of the 1967 outbreak indicate it was more severe than the two previous ones; an average of over 90% of fir of merchantable size was killed, but, of more importance, mortality of white spruce averaged 50% in this area (Blais 1981).

The radial-growth patterns for the sampled white and black spruce trees provide no clear evidence of any growth reduction resulting from budworm defoliation for 120 years prior to 1910. A typical growth-reduction pattern caused at the time of a budworm outbreak is well known and is characterized by several years of declining growth followed by years of recovering growth. Width of the growth ring of greatest suppression is usually narrower than that of any of the 20 or so preceding or following growth rings. No such pattern is discernable on the growth profile of the trees studied for the period from 1790 to 1910. Admittedly, the number of sample trees is small, especially for the earlier years (Table 1), however, in similar studies conducted elsewhere (Turner 1952) (Blais 1965, 1968), unmistakable evidence of old outbreaks was obtained from only three or four very old trees. In this present investigation, three white spruce trees provided evidence of a growth suppression prior to 1790. The radial growth pattern of these trees indicates that a suppression lasting four years started in 1783; the ring produced in 1785 is much narrower than those preceding or following for several years. Although this period of growth suppression is characteristic of that caused by budworm, the trees were young at the time, and so less apt to reflect the effects of budworm defoliation. One of the black spruce trees sampled was only 7 years old in 1783, too young to clearly reflect the effects of a budworm outbreak. Further evidence would be required to definitely establish that a budworm outbreak occurred in 1783 in the region. Chances of ever obtaining this evidence are slight.

The most significant finding of the present investigation is that apparently no budworm outbreak occurred in the Ottawa River watershed for some 120 years prior to 1910. There is some evidence that an outbreak starting about 1783 took place in this region; if so, the interval between this and the 1910 outbreak lasted 127 years. Similar long intervals between outbreaks were recorded for the Lake Nipigon region in Ontario and the Laurentian Park region in Quebec (Blais 1968). It is noteworthy that the 1940 and 1967 outbreaks encompassed most spruce-fir stands covering a territory from central Ontario to the Maritimes. Outbreaks prior to the twentieth century were not as extensive and did not occur simultaneously over such vast regions. For instance the outbreak that took place in the Laurentian Park region of Quebec in 1808 (Blais 1965) or the one that occurred in the

Algoma region of Ontario in 1832 (Turner 1952) did not affect spruce-fir stands in the Ottawa River Valley lying between these two regions. Also, if an outbreak did take place in the Ottawa River Valley in 1783, as suspected from the data at hand, it did not occur in adjoining regions east or west of this valley. These findings provide further evidence that budworm outbreaks occurred more frequently and covered more extensive areas during the twentieth century than in preceding times.

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