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THE SPRUCE BUDWORM IN NORTHERN ALBERTA: WITH EMPHASIS ON THE WABASCA OUTBREAK

by

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INTRODUCTION

The spruce budworm, Choristoneura fumiferana (Clem.) is the most damaging forest insect in Alberta. Elsewhere this insect has a long history as a troublesome native pest, particularly in eastern Canada and adjacent areas in the United States (Webb, Blais and Nash, 1961; Morris, 1963; and Craighead, 1923). Outbreaks of varying degrees of intensity exist throughout northern Canada (Brown and Stevenson, 1962; Tripp, Stevenson and Baranyay, 1966) but major attention has been focused on the Wabasca area because of its long history of budworm attack and its large volume of merchantable timber.

METHODS

The distribution and intensity of budworm infestations have been recorded by annual surveys carried out by the Federal Government since 1954. Data relevant to the extent and severity of infestations were plotted onto forest type maps. Infestations were categorized by

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aerial and ground surveys into negative, light, moderate and severe categories.

Information relative to impact of the budworm on the forest has been collected, commencing in 1962. In that year cruise lines and representative 1/10 acre plots were distributed throughout the infestation to encompass areas with varying amounts of defoliation. Studies were initiated to determine the incidence of tree mortality, top killing and growth loss at locations shown in Appendix Fig. 1. Cross-sectional discs from the upper 1/3 crown level were obtained from 25 trees; 10 at the confluence of the Muddy-Wabasca rivers, 5 near the mouth of Senex Creek and 10 east of Wadlin Tower along the Wabasca River to provide an estimate of radial growth loss. Radial growth in this level is more sensitive and thus reacts more quickly to defoliation and consequently reflects more exactly the degree and time of defoliation. A time lag of 2 or 3 years is used when interpreting calendar dates from growth profiles (Blais, 1962).

When interpreting growth loss profiles, years of severe budworm defoliation appear as "distinct dips". Years of poor increment were used to determine years and possible severity of budworm activity prior to 1954.

ASSESSMENT OF IMPACT

Tree Mortality and Related Damage

Damage symptoms such as dead tops, adventitious budding, clumped crowns, and dead trees were common to all areas with a history of

defoliation. The incidence of damage was generally proportional to the frequency continuity, and degree of severity of defoliation. For example, areas sustaining 4 or more consecutive years of severe defoliation showed more damage than areas only periodically attacked.

In 1962 when impact studies commenced, average figures for the incidence of tree mortality and top killing in two representative plots was 5% and 18%. The greatest amount of damage at that time occurred at the confluence of the Wabasca and Muddy rivers. Assessments carried out in 1965 revealed no important increase in mortality. However, assessments in 1967 revealed a sharp increase in tree mortality and incidence of dead tops, to 34% and 49% respectively. The same area was re-surveyed in 1968, at which time mortality and dead top figures were largely unchanged from 1967 (Table I). In the later years the plots became centered within heavily defoliated portions of the outbreak area. While no longer representative of the entire region, the mortality data and dead top data from these plots indicated important losses are occurring in all areas within the severe defoliation class.

In 1962 preliminary forest inventory volume estimates in the B_3 SwA and B_3 ASw forest types at the confluence of the Muddy-Wabasca rivers indicated a merchantable volume of 7280 FBM per acre. Because of severe spruce budworm attacks, volume loss in these areas in terms of number of dead stems per acre will be reduced to near 50 per cent and many of the remaining trees will exhibit top damage.

TABLE I. WABASCA SPRUCE BUDWORM INFESTATION, CONFLUENCE WABASCA-MUDDY RIVERS

Year	Total Trees	% Mortality Dom. & Codom.	% Live Trees With Dead Tops
1962	174	5.0 (2.9 trees)	18.0 (10 trees)
1965	190	6.3 (3.3 trees)	18.9 (10 trees)
1967	304	34.0 (111 trees)	49.0 (160 trees)
1968	383	39.0 (98 trees)	44.0 (113 trees)

The second area in the Wabasca outbreak seriously defoliated by the spruce budworm occurs near the mouth of Senex Creek (Fig.1). Although damage has not been as persistent here as in the Muddy River area, the incidence of tree mortality and top killing has also increased since 1962.

TABLE II. WABASCA SPRUCE BUDWORM INFESTATION CONFLUENCE WABASCA-SENEX CREEK AREA

Year	Total Trees	% Mortality Dom. & Codom.	% Live Trees With Dead Tops
1962	117	2.6 (2.2 trees)	18.8 (16 trees)
1965	128	3.1 (4.1 trees)	18.6 (14.5 trees)
1967	99	9.9 (10 trees)	34.0 (29.1 trees)

Volume estimates just north of Senex Creek in B_3 SwA forest type were 6960 BFM per acre. Reduction in volume in this particular stand is near 10 per cent due to budworm activity; a loss to the inventory of near 700 FBM per acre. The soundness of this dead material

is questionable although some may be salvageable.

Elsewhere in the Wabasca outbreak, defoliation has been less than the aforementioned areas. Only recently has defoliation been observed north of Senex Creek. East of Wadlin Tower, along the Wabasca River, tree mortality attributable to the spruce budworm has been nil but in 1968 the incidence of dead tops in dominant and intermediate trees was 17% and 49% respectively. No concern need be associated with these figures as yet, as this area represents the northern fringe of the Wabasca outbreak.

Influence on Regeneration

Although rarely observed from the air, damage to regeneration can be serious, particularly within or adjacent to severely defoliated older stands. In fact, during severe defoliation conditions many seedlings and saplings die or are badly deformed. The most severe damage to regeneration has occurred in the Wabasca outbreak.

Within many infested stands along the Wabasca River much of the spruce regeneration is in very poor condition. For example, on a 1/10 acre plot, the incidence of mortality and injury to spruce regeneration was 83% dead, 6.5% living (but possessing dead tops) and 6% uninjured trees.

Most spruce and fir regeneration were completely void of foliage when moderate-severe defoliation conditions prevailed in the older timber. In these stands, intermediate age classes trees were more severely defoliated than dominant age classes.

Growth Loss

Spruce budworm defoliation causes a reduction in annual increment. Persistent defoliation, particularly for a number of consecutive years, can have a profound detrimental effect on vigour and growth.

In Quebec, Blais (1962) states the number of suppressed rings and the degree of suppression is dependent on the duration and intensity of an outbreak. In Quebec, growth suppression attributable to spruce budworm defoliation was classified as being either light or severe. On this basis, the width of the ring of the greatest reduction was compared with the average radial growth for the decade preceding the outbreak. When the width of the ring of greatest suppression was not more than one-half the average for the decade, Blais (1962) considered the trees as having suffered severe suppression. When the ring growth was greater than one-half but less than the average for the decade, the trees were considered as showing light suppression. In addition, Blais (1958 & 1961) has shown that an average reduction in radial growth of 50 per cent was usually associated with mortality amongst the most vulnerable trees.

Examination of growth patterns in the Wabasca shows them normal until 1941 when a distinct and gradual narrowing of the annual rings occurs and continues to the present (Fig. 3). Graphically, the decline in annual growth is most noticeable between 1938 and 1948. No significant recovery occurs until 1951, followed by another decline in growth to 1956. A second recovery period in 1957 and 1958 was short lived and followed by a steady decline to the present time. The presence

of narrow rings during 1960-1962 coincides with ocular estimates of high budworm abundance in that region. A significant decline in annual increment was expected and did occur, particularly since 1962 in the area near the mouth of the Muddy River. It is believed this location has sustained the greatest amount of budworm defoliation.

FOREST MANAGEMENT AND THE SPRUCE BUDWORM

In Alberta the major spruce budworm outbreaks lie within the Footner Lake Forest. In this northern area the Wabasca outbreak has the longest history of extensive outbreaks and consequently the greatest amount of damage.

Within this outbreak the gross volume of merchantable timber is 1,428,951 M.F.B.M. but with a deletion due to marginal and unoperative stands the net volume is 1,357,926 M.F.B.M.* Presently this volume is scheduled for harvest over a 45-year period. However, this program may be revised to obtain an equitable balance between the age of the timber, its condition, and the period over which operations can be projected. Presently the annual allowable cut is scheduled at 30 M.F.B.M. A further increase may be justified on the basis of high incidence of spruce budworm damage. The areas containing the greatest amounts of damage are known.

The largest volumes of timber are concentrated near the center of the "F-2" management unit, primarily along the Wabasca River and the eastern escarpment of the Buffalo Head Hills. Within this management

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* Hamilton, R. 1969. Forest management data, preliminary cruise (1962) "F-2" FMU Footner Lake Forest.

unit four quotas have been established. Presently the high hazard areas in this outbreak extend along both sides of the Wabasca River between the Muddy River and Senex Creek. Criteria determining these high hazard areas are based upon a high incidence of tree mortality along with a substantial number of the surviving trees having dead tops and excessive amounts of adventitious budding, and reduced radial growth due to defoliation. In addition, the damage to young trees at these sites has been severe, in some instances removing all traces of viable regeneration.

Characteristically, at each location varying amounts of sound, dead timber are still standing; much of this volume is considered reclaimable. To date, no evidence of excessive blowdown has occurred and the incidence of wood boring beetles has been minor.

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APPENDIX

- Wabasca spruce budworm infestation area and study plots locations.
- Growth profile of spruce budworm damaged trees confluence of Muddy and Wabasca rivers.
- Photo of cross-sectional disc from mid-crown of spruce budworm infested white spruce confluence of Muddy and Wabasca rivers.

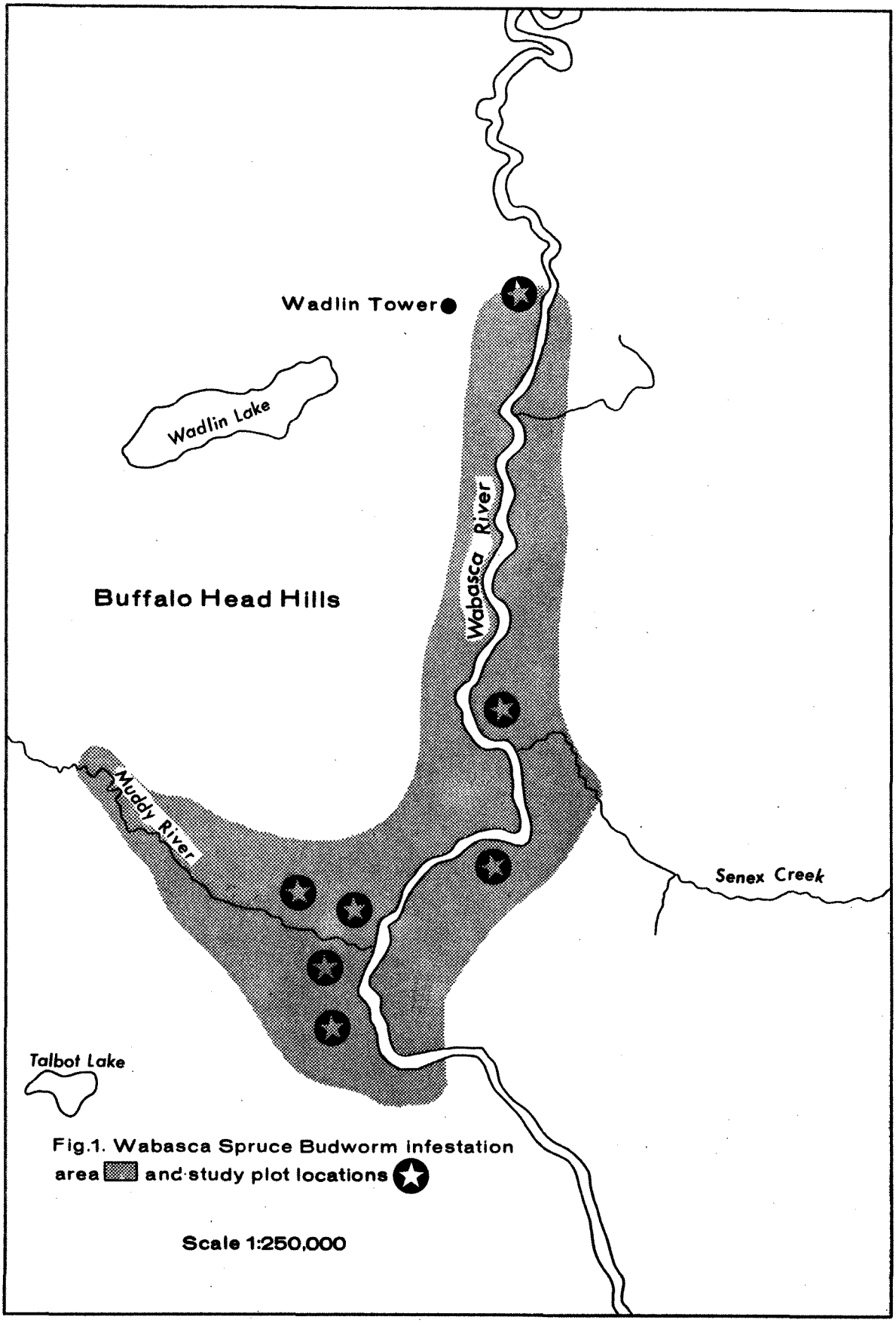


Fig.1. Wabasca Spruce Budworm infestation area and study plot locations

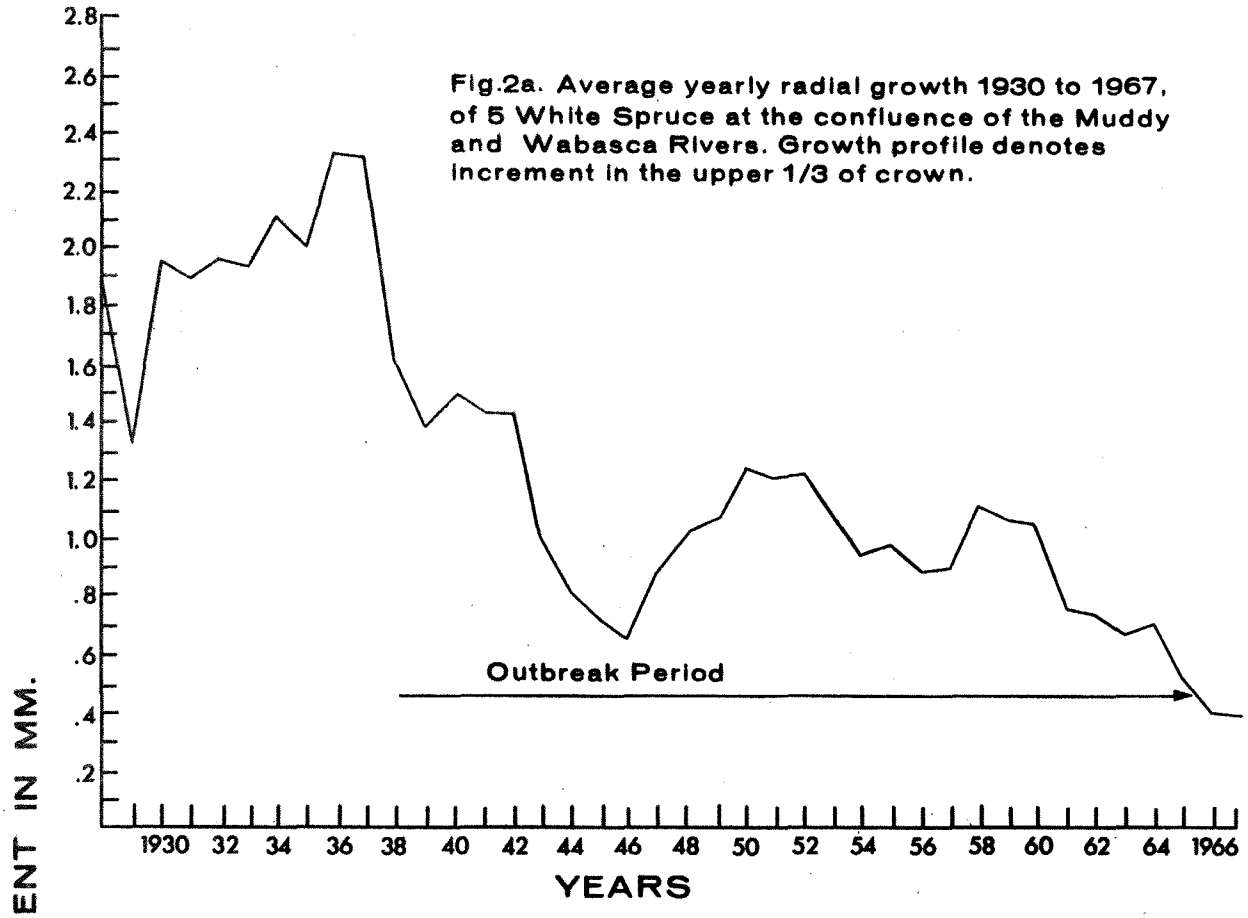


Fig.2a. Average yearly radial growth 1930 to 1967, of 5 White Spruce at the confluence of the Muddy and Wabasca Rivers. Growth profile denotes increment in the upper 1/3 of crown.

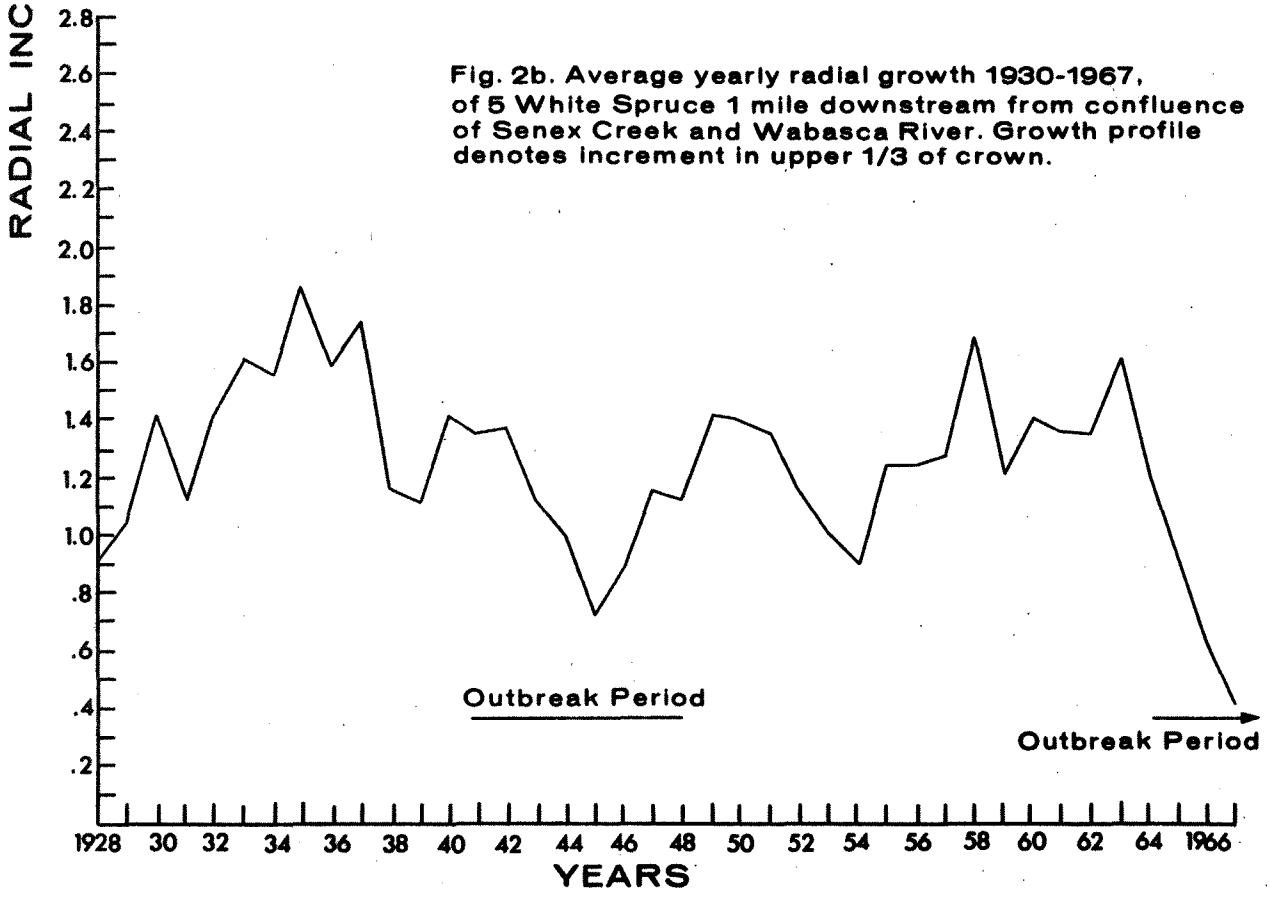
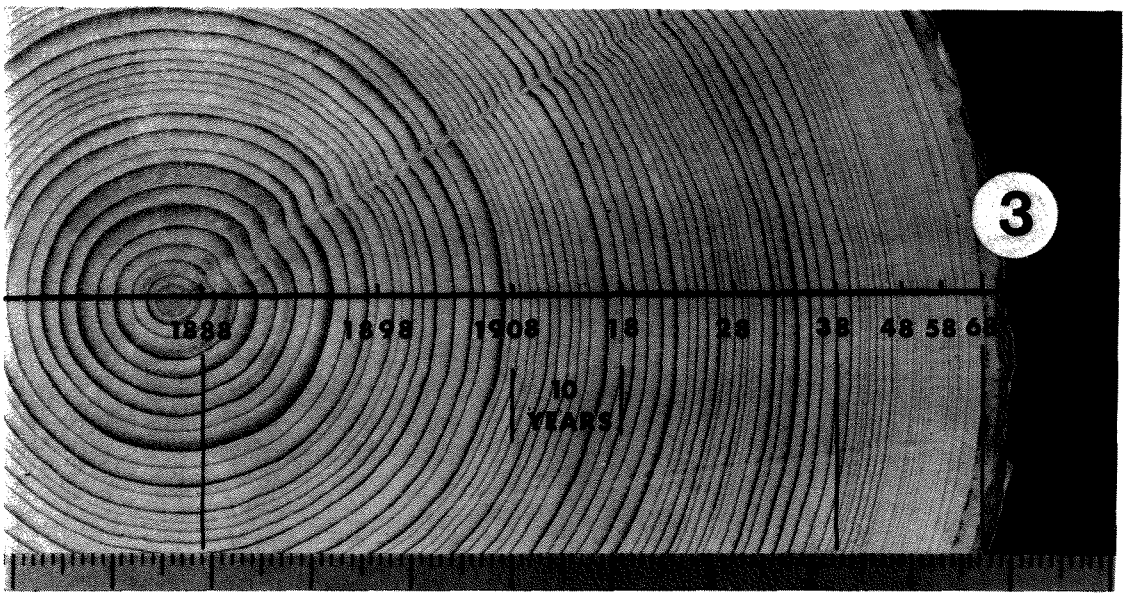


Fig. 2b. Average yearly radial growth 1930-1967, of 5 White Spruce 1 mile downstream from confluence of Senex Creek and Wabasca River. Growth profile denotes increment in upper 1/3 of crown.



Pre-outbreak Period

Outbreak Period

Fig. 3 Cross-sectional disc, mid crown white spruce, showing reduction in radial increment due to defoliation by spruce budworm, confluence of Wabasca and Muddy rivers, Northern Alberta.

Time scale between dots denoted in ten year periods.