Frontline

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Technical Note No. 27

BLACK SPRUCE CONE CROP PERIODICITY IN NORTHERN ONTARIO

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CATEGORY: Cone and seed
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INTRODUCTION

For natural regeneration from seed, cones in the crowns of standing trees are crucial to the establishment of young seedlings on adjacent cutovers. For artificial regeneration programs, cones must be collected in sufficient quantity to fulfil seed requirements for seedling production and direct seeding. It is imperative that forest managers understand the natural reproductive rhythm of the tree species in the area being managed.

Because black spruce (*Picea mariana* [Mill.] B.S.P.) has semiserotinous cones, a store of seeds is present in the crown at all times (Haavisto 1982). Even though good to bumper cone crops occur on an average of once every 4 years, some cone production occurs almost every year (Fig. 1). It has generally been recommended that black spruce cones be collected immediately following good cone years. To judiciously plan and budget for seed procurement, the forest manager must be familiar with this cyclical reproductive pattern. This technical note outlines the pattern of periodicity in black spruce cone crops across northern Ontario.

INFORMATION SOURCE

A series of studies was conducted throughout northern Ontario by research personnel from the Canadian Forest Service–Sault Ste. Marie and the Ontario Forest Research Institute over a period of 25 years (Fig. 2). Cone crop production information from the following studies was used for this report.

Cone Production and Retention

A study to determine the quantity and quality of seeds in black spruce cones retained on trees was conducted from 1964 to 1967 in Kennedy Township, Cochrane District (Haavisto 1975). All cones were harvested and the date of their origin was identified. Some cones were found to be 25 years old. The number of cones originating in any given year provided an indication of the relative cone crop size.

Figure 1. A heavy (bumper) black spruce cone crop.

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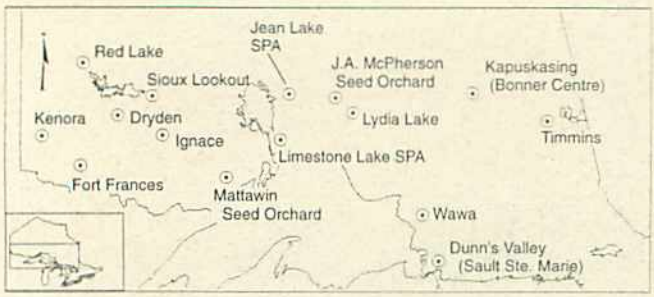

Figure 2. Locations of black spruce cone crop sampling in northern Ontario.

Cone Crop Monitoring and Collecting

Cone crop assessments and collections, if warranted, were made annually from 1979 to 1989 in several areas (Skeates and Haavisto 1987). Two young black spruce seed production areas (SPAs) were monitored in the Nipigon District (Limestone Lake and Jean Lake). Binocular estimates were made in semimature SPAs in the Geraldton and Kapuskasing districts. Tree by tree collections were made in the James Angus McPherson Black Spruce Seed Orchard near Longlac, Ontario. At this site, the staff of Kimberly-Clark Forest Products Inc. continuously monitored cone production over a 15-year period.

Observational Monitoring

Binocular estimates of black spruce cone crops were made in natural stands along roads in northeastern Ontario.

Black Spruce Cone Crop Evaluation

In 1980, permanent sample plots were established in Site Class 1 black spruce stands in the Sioux Lookout, Geraldton, Hearst, and Cochrane districts. All cones on candidate trees were collected in 3 consecutive years and identified by age class: namely, current year, 1 year, 2 years, or 3–5 years old.

RESULTS

Although some cones are produced by black spruce on a regular basis, fluctuations from the norm occur in time and space. For example, in 1979 heavy crops were observed throughout most of northwestern Ontario (Fig. 3a). Stands at Ignace, however, produced low yields per tree. Good cone crops also occurred in the Geraldton District at Lydia Lake (north central Ontario), but low yields or crop failures were observed elsewhere in the province.

In 1980, black spruce cone production was absent in northwestern Ontario and at Lydia Lake (Fig. 3b). Cone production in the Geraldton and Sioux Lookout districts was light; a moderate crop occurred in the Thunder Bay and Nipigon districts. Only sporadic cone production was reported in northeastern Ontario.

Very few cone crops were observed in most of northern Ontario in 1981. Light crops were noted in the Geraldton and Nipigon districts, while heavy cone crops were reported in the Sioux Lookout District.

The 1982 crop year was good throughout north central and northeastern Ontario (Fig. 3c). Moderate cone crops were collected in the Timmins, Chapleau, and Wawa areas. Even though crops in northwestern Ontario were either small or absent, a second consecutive heavy crop occurred in parts of the Sioux Lookout District.

The 1983 cone crops were rated as either light or absent throughout northern Ontario. In 1984 the crops proved to be very good; indeed, heavy crops were recorded in north central Ontario (Nipigon and Geraldton districts) and in northeastern Ontario at the Bonner Centre, near Kapuskasing (Fig. 3d). All of the observed trees were less than 30 years old. The older Lydia Lake stand produced only a light cone crop. Cone production in the James Angus McPherson Black Spruce Seed Orchard was light to moderate, and production varied among clones, and among ramets within clones.

Few areas in northern Ontario produced black spruce cones in 1985. In 1986, only moderate to light crops were recorded at some locations in north central Ontario.

Moderate cone crops were observed in the Mattawin and the James Angus McPherson seed orchards in 1986. It should be noted that a late spring frost that year destroyed emerging flowers in the Cochrane area in northeastern Ontario and caused a promising cone crop to fail. Very few black spruce cones were produced in northern Ontario in 1987.

A bumper black spruce cone crop occurred in 1988 throughout northern Ontario. However, with the advance of the eastern spruce budworm (*Choristoneura fumiferana* Clem.) into the Nipigon area, a potentially good cone crop was destroyed.

As expected, the 1989 cone crop proved to be light or absent in most locations. However, some anomalies did occur. For example, three clones in the James Angus McPherson Black Spruce Seed Orchard, all originating from one watershed, produced as well or better than they had during the 1988 crop year.

Cone production studies conducted in Kennedy Township, Cochrane District, provided relative data from 1945 to 1967. Counts of cones, whose year of origin had been determined on carefully felled trees, exhibited peaks and hollows in crop years. Because cones continue to fall over time, estimating the magnitude of crops is considered unreliable beyond a cone age of 5 years. Notwithstanding this caution, it appears that good cone crops occurred in 1950, 1956, 1960, 1964, and 1967. Minor peaks were evident in 1948, 1954, 1958, and 1962.

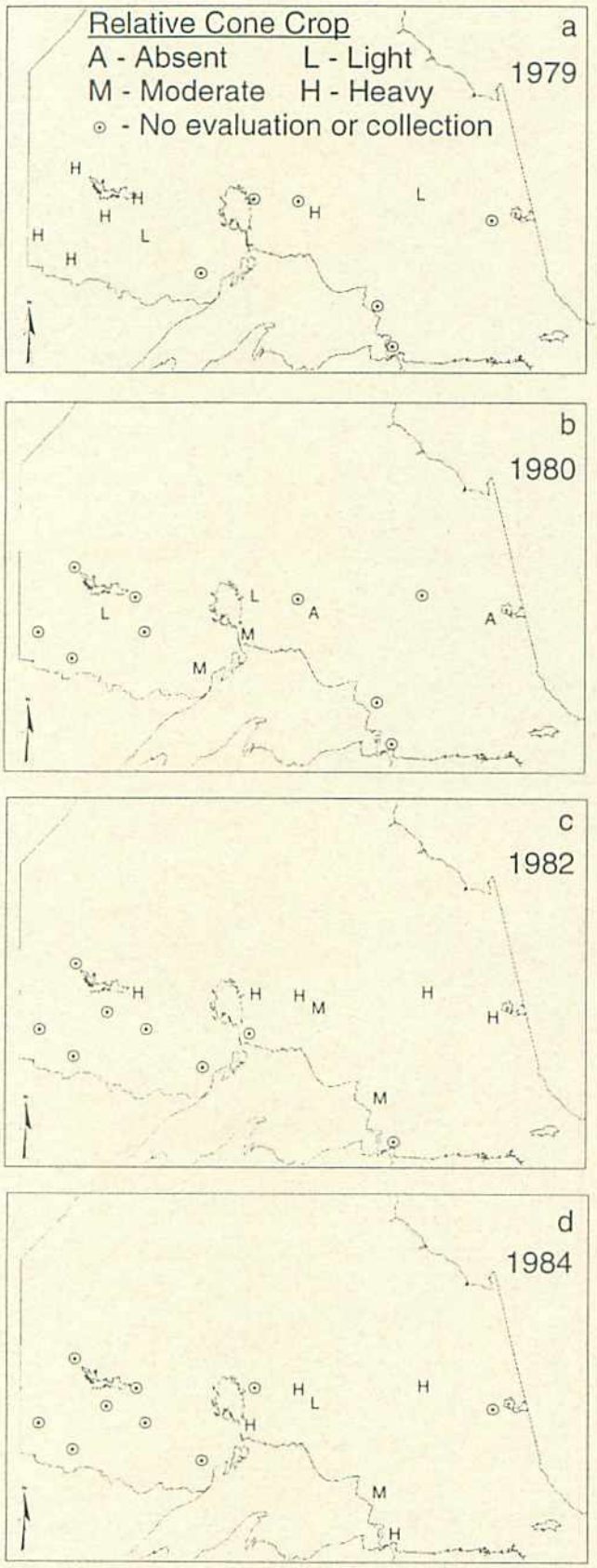

Figure 3. The distribution of the relative black spruce cone crop across northern Ontario in a) 1979, b) 1980, c) 1982, and d) 1984.

In the James Angus McPherson Black Spruce Seed Orchard, good cone crop years were evident in 1971, 1974, 1979, 1983, 1984, and 1988; light to moderate crops were produced in 1970, 1972, 1973, 1975, 1976, 1977, 1986, and 1989. Few years were observed when cone crops were absent.

The history of black spruce cone crops in northeastern Wisconsin was reported for a 25-year period (Godman and Mattson 1976). Good or bumper black spruce cone crops were reported for 52 percent of the years; moderate cone crops occurred 24 percent of the time. Heavy crops were reported in 5 consecutive years (1970–1974).

DISCUSSION

In Ontario, even though heavy cone crops occurred on an average of one in 4 years, they varied from one in 3 years to one in 6 years. Smaller crops occurred in some intervening years, thereby suggesting that potentially collectable crops are produced at least every 2 to 3 years. No direct correlation could be established between climatic parameters and the abundance of cones. These findings are similar to those of the Wisconsin study, in which crops were either poor or absent for 5 out of 25 years. There were no consecutive years when cone crops were absent.

Irregularities in the pattern of black spruce cone production are common. Extensive spruce budworm infestations throughout much of northeastern Ontario during the 1970s severely damaged or completely destroyed reproductive structures, thus precluding the formation of collectable cone crops. Complete cone crop failures have also been attributed to late-spring and early-summer frosts. In certain years and locations, cone crops were decimated by red squirrels (*Tamiasciurus hudsonicus* Erxleben). A selective process occurs whereby losses may be negligible or nonexistent in some trees, but complete destruction may occur in others within the same stand.

Cone crops vary among trees, among clones, and among ramets within clones. In a heavy cone year almost all trees in a stand bear a crop of cones, but the quantity varies. So also do cone and seed characteristics. During light to moderate crop years, most trees in a stand produce some cones. However, due to the semiserotiny of black spruce, a store of seed generally occurs within tree crowns regardless of the cone year cycle.

Knowledge of cone crop periodicity and the various factors that influence the production of cones is incomplete. Cone crop potential can be forecast for the ensuing year by forcing floral production of branches during the late fall or winter (Haavisto and Gordon 1982). A more reliable cone crop evaluation can be conducted in mid-June, after the risk of late-spring frosts has diminished.

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