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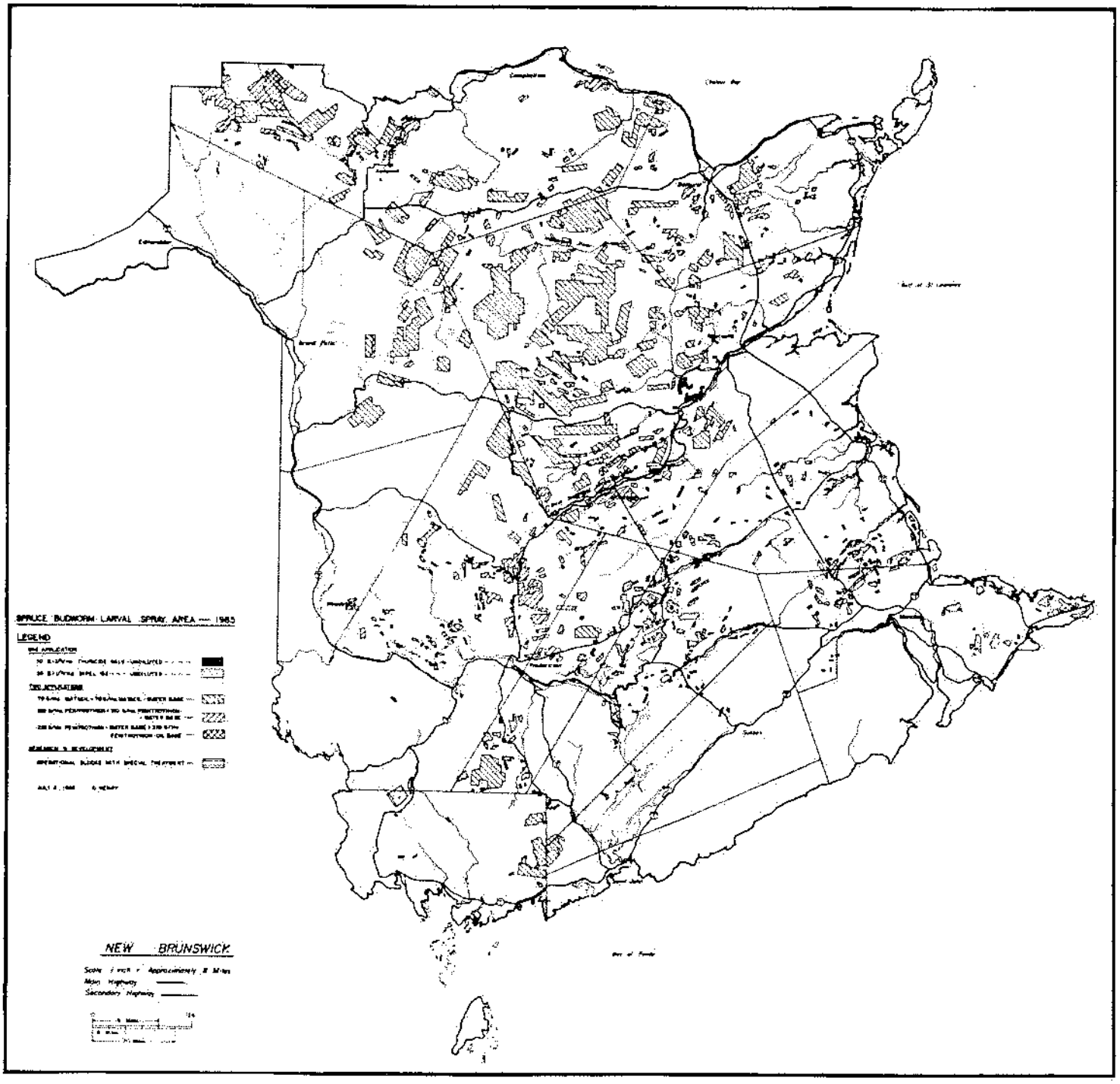
D.C. Eidt and C.A.A. Weaver

Information Report M-X-158
Canadian Forestry Service — Maritimes



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# FREQUENCY OF FOREST RESPRAYING AND USE OF *B.t.* IN NEW BRUNSWICK, 1975-1986

by

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Fredericton, New Brunswick

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## ABSTRACT

Calculations based on New Brunswick spray maps for the years 1975 to 1985 indicate that 22 to 62% of the area sprayed one year was first resprayed the next. The total area sprayed in each of these years was 12.2 to 63.9% of the forested area of the Province. The areas first resprayed the next year were 4.5 to 28.0% of the forested area of the Province, and the areas first resprayed two years later were 0.6 to 10.8%. The use of B.t. (Bacillus thuringiensis) has steadily increased since its first operational use in 1982 in terms of both area sprayed and proportion of the total area sprayed.



## RÉSUMÉ

Des calculs fondés sur les cartes de pulvérisations aériennes effectuées au Nouveau-Brunswick pour les années 1975 à 1985 indiquent que 22 à 62% de la superficie traitée dans une année donnée fut traitée de nouveau pour la première fois l'année suivante. La superficie totale traitée dans chacune de ces années représente de 12,2 à 63,9% de la superficie boisée de la province. Les superficies traitées de nouveau pour la première fois l'année suivante représentent de 4,5 à 28,0% de la superficie boisée de la province, et celles qui furent traitées de nouveau pour la première fois deux ans plus tard représentent de 0,6 à 10,8%. L'emploi du B.t. (Bacillus thuringiensis) s'est accru constamment depuis son premier usage opérationel en 1982 en termes de superficie traitée et de la proportion de la superficie traitée.

## INTRODUCTION

The decision to protect New Brunswick Forests from the spruce budworm, Choristoneura fumiferana (Clem.), by spraying, has made it possible to maintain a wood supply and a level of industrial activity and employment that otherwise would have been lost. Forest spraying with insecticides was not undertaken without apprehension about environmental effects, and those effects that have materialized have been overcome or tolerated. Concern about widespread use of insecticides has led to the misconception that use is 'massive', that vast amounts of insecticide are used, and that the forest is 'drenched' with insecticide every year. The total amount of insecticide does sound massive, especially if it is stated as the amount of mix, rather than the insecticide itself. In fact, the actual amount of insecticide used per unit area is among the lowest used, when compared with other purposes, because the strategy is to protect trees, not eliminate insects. Furthermore, the same areas are not necessarily sprayed each year. This is important to the recovery of any organisms that are affected, including target insects carrying the genes for greatest susceptibility. Between 1952 and 1978 an average of only 19.7% of the forested area of the province was sprayed (Eidt and Fisher 1982).

As the budworm hazard increases in some places and diminishes in others, the areas sprayed change such that in 1982 the chances of a particular area being sprayed two years in succession were estimated at 10 to 20% and three years in succession, 5 to 10%. Because susceptible forest distribution is about the same from year to year, the chances of a particular area being sprayed again the next year were higher, about 25 to 60%, and three years in succession about 5 to 40% (Eidt and Fisher 1982). The data used by Eidt and Fisher were based on the spray records of egg-mass sampling stations. The stations constituted point samples with the disadvantages that some of the stations changed from year to year and the total number was not always the same. Egg-mass sampling has been superceded by sampling of hibernating second-instar larvae.

Seven years have passed since the last year for which Eidt and Fisher had data. It is our intention to update the record to 1985, and to base the calculations on the areas sprayed, for a greater degree of accuracy. A forecast for 1986 will be based on the proposed spray area. The use of B.t. (Bacillus thuringiensis) relative to the standard budworm insecticides, fenitrothion and aminocarb (Matacil), will be determined.

## METHODS

The area of New Brunswick forest sprayed each year was based on the records of the New Brunswick Department of Municipal Affairs and Environment (Fig. 1). Included was all sprayed forested area that could be accounted for, regardless of the insect target or the agency applying the spray. Total annual spray areas were rounded to the nearest 1000 ha. Total forested area is based on the forest inventory of the New Brunswick Department of Forests, Mines and Energy (formerly Natural Resources). Spray maps at 1:250,000 for each year are maintained by the province based on the areas sprayed by Forest Protection Ltd. and by Forest Patrol of the J.D. Irving Company.

Spray maps for different years were laid over one another on a light table and the areas of overlap were traced on clear acrylic. The areas were then measured by tracing the perimeters with a digitizer which was calibrated to give direct readings of the areas in hectares. Using various combinations of maps, for each year, the proportions first sprayed the following year, two years later, and two, three, and four years in succession were calculated. Likewise, for each year, the proportions sprayed the previous year, last sprayed two years earlier, and sprayed the previous two and three years were calculated. These statistics were also expressed

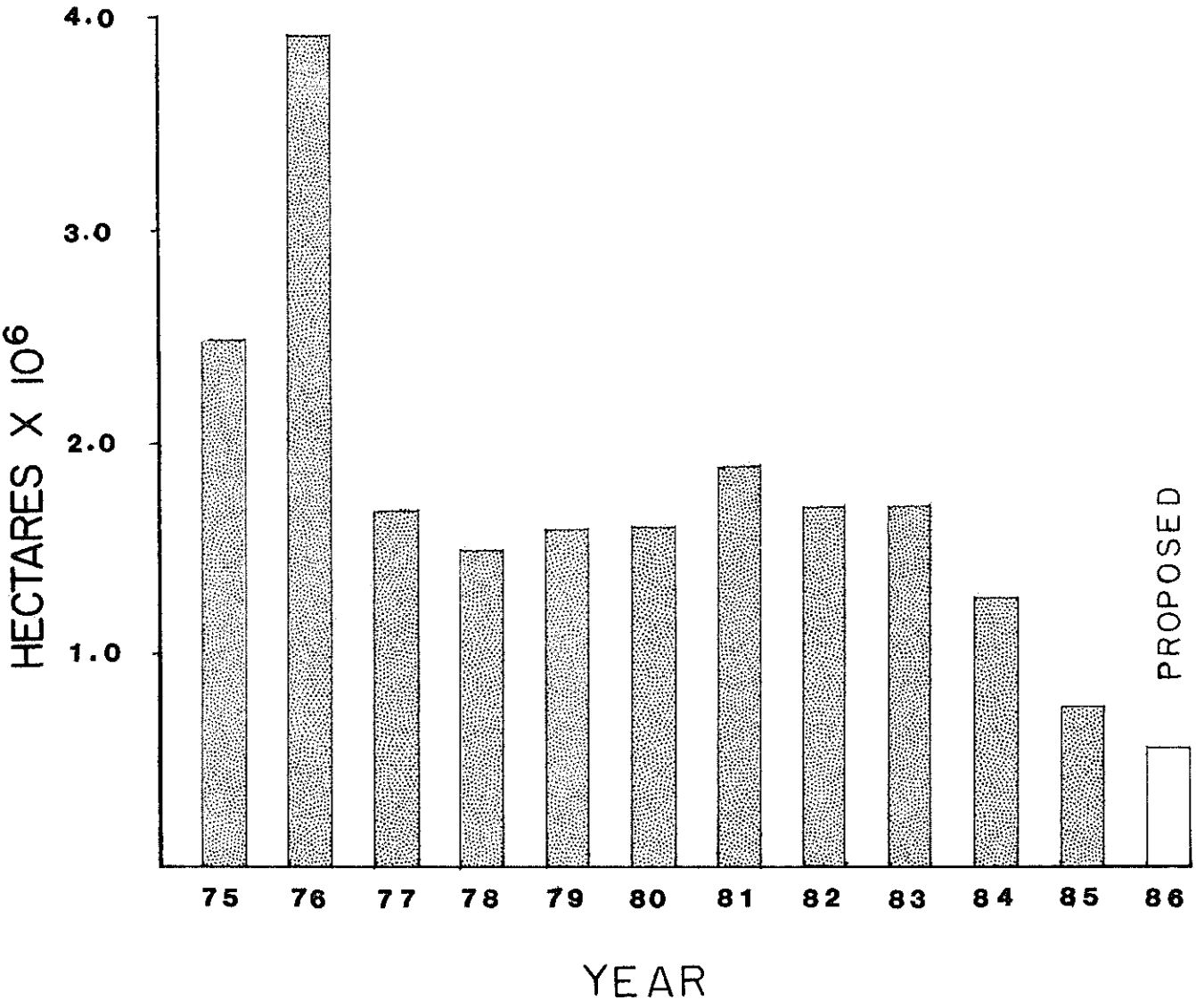


Fig. 1. Areas sprayed (millions of hectares) for forest insect control in New Brunswick.

as proportions of the forested area of New Brunswick.

## RESULTS

By considering respray in successive years, the most recent year for which complete respray information is available is 1982 (Table 1). In that year, 1 725 000 ha were sprayed, of which 50.8% was first resprayed in 1983, 17.0% was first resprayed in 1984, 14.3% was resprayed in both 1983 and 1984 (i.e., sprayed 3 or more consecutive years), and 3.4% was resprayed in 1983, 1984, and 1985 (i.e., sprayed 4 or more consecutive years). We calculated means for each of these respray histories based on the years available, but in scanning the columns in Table 1, it can be seen that incidence of respray has generally diminished as the area sprayed diminished (Fig. 2).

Looking at the data in terms of incidence of respray in successive years

gives limited information for 1983 and 1984 and none for 1985. We therefore rephrased the question to ask what is the proportion of the area sprayed in any year that had been sprayed in preceding years. Thus 37% of the area sprayed in 1985 had been sprayed in 1984 (Table 2), 12.4% had been last sprayed in 1983, 13.5% was sprayed the previous 2 years (i.e., sprayed three or more successive years), and 8.0% was sprayed the previous 3 years (i.e., sprayed four or more successive years).

A trend towards less respray, especially in the last two years, is related to reduced infestation, relatively healthy trees, and a change in strategy toward targeted spraying. The proportions resprayed for the years 1975 to 1978 in Tables 1 and 2 are slightly higher than the proportions obtained by Eidt and Fisher for the same years. This is expected because of the different methods of estimation; we instinctively expect the method based on maps to be more accurate than the method based on egg-mass sampling stations.

The chances of any part of the forested area of New Brunswick being sprayed are represented by the proportions given in Table 3, in terms of subsequent respray, and in Table 4, in terms of immediate spray history. The percentages were generated by dividing the areas of respray in Tables 1 and 2 by 6 070 400 ha, the approximate forested area of New Brunswick times 100. The data are based on the assumption that

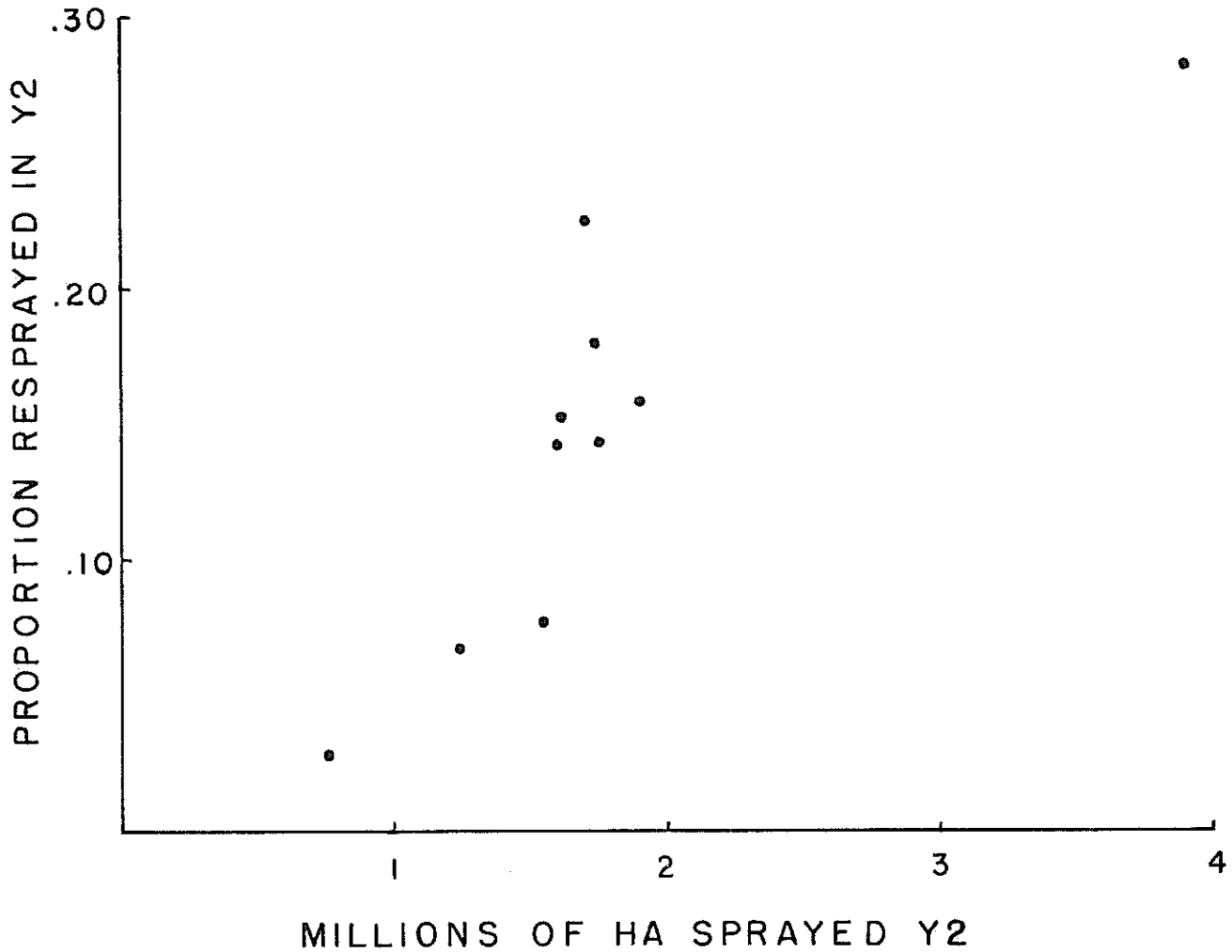


Fig. 2. Proportion of the area sprayed (in Y1) and resprayed the following year (Y2) as a function of the area sprayed in Y2.

Table 1. Proportion (%) of sprayed area resprayed in successive years

| Year | Y1 Area (ha x 1000) | First resprayed Y2 | First resprayed Y3 | Resprayed next 2 yr (Y2,Y3) | Resprayed next 3 yr (Y2,Y3,Y4) |
|---|---|---|---|---|---|
| 1975 | 2 745 | 61.8 | 1.4 | 19.3 | 5.4 |
| 1976 | 3 887 | 34.7 | 16.9 | 9.4 | 5.1 |
| 1977 | 1 683 | 27.5 | 28.3 | 18.0 | 9.1 |
| 1978 | 1 554 | 55.2 | 24.8 | 32.5 | 14.2 |
| 1979 | 1 601 | 56.6 | 21.3 | 21.0 | 13.6 |
| 1980 | 1 614 | 59.0 | 26.5 | 35.7 | 14.3 |
| 1981 | 1 900 | 56.6 | 12.1 | 26.5 | 6.9 |
| 1982 | 1 725 | 50.8 | 17.0 | 14.3 | 3.4 |
| 1983 | 1 743 | 23.5 | 5.3 | 5.8 | - |
| 1984 | 1 252 | 21.9 | - | - | - |
| 1985 | 786 | - | - | - | - |
| Mean | 1 858 | 45.0* (n=10) | 15.9* (n=9) | 18.8* (n=9) | 8.1* (n=8) |
| 1986 | 585 (proposed) | | | | |

* Calculated from mean areas.

Table 2. Proportion (%) of sprayed area previously sprayed

| Year | Y1 Area (ha x 1000) | Last previously sprayed Y-1 | Last previously sprayed Y-2 | Sprayed previous 2 yr (Y-1,Y-2) | Sprayed previous 3 yr (Y-1, Y-2, Y-3) |
|---|---|---|---|---|---|
| 1975 | 2 745 | - | - | - | - |
| 1976 | 3 882 | 43.7 | - | - | - |
| 1977 | 1 683 | 80.1 | 2.3 | 31.4 | - |
| 1978 | 1 554 | 29.8 | 42.2 | 23.4 | 9.5 |
| 1979 | 1 601 | 53.6 | 29.7 | 18.9 | 12.4 |
| 1980 | 1 614 | 56.1 | 23.9 | 31.3 | 9.5 |
| 1981 | 1 900 | 50.1 | 17.9 | 17.7 | 11.6 |
| 1982 | 1 725 | 62.3 | 24.8 | 33.4 | 12.7 |
| 1983 | 1 743 | 50.3 | 13.2 | 28.8 | 13.3 |
| 1984 | 1 252 | 32.7 | 23.4 | 19.7 | 10.5 |
| 1985 | 786 | 35.0 | 11.7 | 12.7 | 7.6 |
| Mean | 1 858 | 50.1* (n=10) | 25.1* (n=9) | 21.3* (n=9) | 11.2* (n=8) |

* Calculated from mean areas.

Table 3. Proportion (%) of forested area of New Brunswick (6 070 400 ha) sprayed and resprayed in successive years

| Y1 | | First resprayed | | Resprayed next | |
|---|---|---|---|---|---|
| Year | Y1 % | Y2 | Y3 | 2 yr (Y2,Y3) | 3 yr (Y2,Y3,Y4) |
| 1975 | 45.2 | 28.0 | 0.6 | 8.7 | 2.4 |
| 1976 | 63.9 | 22.2 | 10.8 | 6.0 | 3.3 |
| 1977 | 27.7 | 7.6 | 7.8 | 5.0 | 2.5 |
| 1978 | 25.6 | 14.1 | 6.3 | 8.3 | 3.6 |
| 1979 | 26.4 | 14.9 | 5.6 | 5.6 | 3.6 |
| 1980 | 26.6 | 15.7 | 7.0 | 9.5 | 3.8 |
| 1981 | 31.3 | 17.7 | 3.8 | 8.3 | 2.2 |
| 1982 | 28.4 | 14.4 | 4.8 | 4.1 | 1.0 |
| 1983 | 28.7 | 6.8 | 1.5 | 1.6 | - |
| 1984 | 20.6 | 4.5 | - | - | - |
| 1985 | 12.9 | - | - | - | - |
| 1986 | 9.6 (proposed) | - | - | - | - |

Table 4. Proportion (%) of forested area of New Brunswick (6 070 400 ha) sprayed and previously sprayed

| Y1 | | Last previously sprayed | | Sprayed previous | |
|---|---|---|---|---|---|
| Year | % | Y-1 | Y-2 | 2 yr (Y-1, Y-2) | 3 yr (Y-1, Y-2, Y-3) |
| 1975 | 45.2 | - | - | - | - |
| 1976 | 63.9 | 28.0 | - | - | - |
| 1977 | 27.7 | 22.2 | 0.6 | 8.7 | - |
| 1978 | 25.6 | 7.6 | 10.8 | 6.0 | 2.4 |
| 1979 | 26.4 | 14.1 | 7.8 | 5.0 | 3.3 |
| 1980 | 26.6 | 14.9 | 6.3 | 8.3 | 2.5 |
| 1981 | 31.3 | 15.7 | 5.6 | 5.6 | 3.6 |
| 1982 | 28.4 | 17.7 | 7.0 | 9.5 | 3.6 |
| 1983 | 28.7 | 14.4 | 3.8 | 8.3 | 3.8 |
| 1984 | 20.6 | 6.8 | 4.8 | 4.1 | 2.2 |
| 1985 | 12.9 | 4.5 | 1.5 | 1.6 | 1.0 |
| Mean | 30.6 | 14.6 | 5.4 | 6.3 | 2.8 |

all parts of the forest are equally liable to be sprayed for protection against spruce budworm, which accounts for all but a small part of the total area sprayed. This is not true because not all forest is susceptible to spruce budworm, and by the nature of infestation, areas of risk are more likely to be adjacent to recent areas of infestation than are remote areas. The data are useful because they place in perspective the extent of forest spraying and respraying. The values in Tables 3 and 4 are the same, but they apply to different years because of the different perspective. The mean values in Table 4 will be high for purposes of prediction if the current trend toward smaller spray areas and more precise targeting continues.

The proposed spray program for 1986 totals about 585 000 ha, or 9.6% of the forested area of New Brunswick. Based only on recent experience, because of changing strategy, the chance of respraying areas sprayed in 1985 is between 30 and 35%. The chances of a particular area being resprayed in 1986 is about 5%. However, in any year, a place sprayed the previous year is more likely to be sprayed than a place remote from these areas.

Persons who feel that insecticides based on B.t. are environmentally safer than those such as fenitrothion and aminocarb, described as chemical insecticides, will be reassured to note an increase in its use (Table 5). The data do not include experimental sprays which exceeded 1000 ha in some years. Operational use of B.t. before 1982 was negligible. The trend towards greater use, which is predicated by increasing cost effectiveness, is expected to continue.

Table 5. Areas sprayed operationally with B.t. (Bacillus thuringiensis)

| Year | Area (ha) | Proportion of sprayed area (%) |
|---|---|---|
| 1982 | 4 552 | 0.3 |
| 1983 | 10 446 | 0.5 |
| 1984 | 37 300 | 3.0 |
| 1985 | 81 228 | 4.4 |
| 1986 (proposed) | 111 000 | 19.0 |

## ACKNOWLEDGEMENTS

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## REFERENCE

Eidt, D.C., and R.A. Fisher. 1982. Frequency of forest spraying in New Brunswick. Canadian Forestry Service Research Notes 2(2): 13-16.