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MARITIMES FOREST RESEARCH CENTRE

TECHNICAL NOTE NO. 103

OPERATIONAL USE OF *B.t.k.* IN NEW BRUNSWICK IN FOREST PROTECTION PROGRAMS AGAINST THE SPRUCE BUDWORM

In New Brunswick operational spraying with preparations of *Bacillus thuringensis kurstaki* took place 1980, 1982, and 1983 to provide protection of balsam fir and spruce foliage on private woodlots. In 1980, all woodlots were sprayed with *B.t.*, but in 1982 and 1983 only a small proportion of the woodlots were sprayed with *B.t.* Regulating agencies permitted the use of chemicals for woodlot protection in 1981, 1982, and 1983, but the stringent rules imposed on the chemical application applied equally as well to areas treated with *B.t.*

Historically, in New Brunswick there has been a continuing interest in the development and use of *B.t.* by the Canadian Forestry Service and Forest Protection Ltd. from 1960 to present. These agencies have worked cooperatively in testing *B.t.* preparations as they became available and seemed to offer some promise for forest protection (Table 1).

The results of these tests added to the bank of knowledge on *B.t.*, sometimes positively, sometimes negatively. It must be understood that through the 1970s and continuing into the 1980s, there were many advances in the development of more stable and concentrated formulations of *B.t.* Consequently the *B.t.* formulations used in 1982 and 1983 are not the same as those used in 1980 or tested previously. One of the nagging problems that has been identified by investigators in Canada and the USA with currently available *B.t.* preparations is apparent inconsistent product potency and viscosity.

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Efficacy:

Efficacy of *B.t.* and chemical sprays are determined by comparing prespray budworm population density, and posttreatment defoliation and pupal survival in treated and nontreated areas. Figure 1 shows the relationship between prespray populations and resultant defoliation in nontreated control areas for 1980 and 1983.

1980. In 1980 (Table 1, Figure 2) about 10 521 ha were treated with either Thuricide 16B or Novabac-3 using three spray delivery systems - 1) fixed wing aircraft with boom and nozzle spray gear, 2) fixed wing aircraft with Micronair AU 3000 rotary atomizers, and 3) helicopter with boom and nozzle. Most spray blocks were rectangular woodlots and most could be easily identified from the air. The results of the operations are detailed by Kettela (1984).

The results in terms of foliage protection were extremely variable depending on timing, aircraft type, forest composition and condition, and budworm population density. Of the 148 woodlots assessed, only 50% had a detectable level of protection.

1982. In 1982 about 4 000 ha of forest were treated with *B.t.*, 3 200 ha operationally with Dipel 88 and 800 ha in a test program with Novabac-3 and Bactospeine (Figure 3).

The area treated with Dipel 88 was located in north-western New Brunswick. One-half of the area was treated at a rate of 20 BIU/ha and the other at 30 BIU/ha. The Dipel was sprayed "neat" (straight from the drum). Results were good in terms of larval mortality, but poor in terms of foliage protection. This is an unresolved mystery.

The results of the trials with Novabac-3 and Bactospeine were encouraging; adequate foliage protection was provided at 30 BIU/ha. This information was used to complete the registration package for Novabac-3.

1983. Comments on this year's results are preliminary but show a trend similar to those of 1980. However, unlike 1980 results, in 1983 it was possible to compare chemical and *B.t.* spraying at approximately the same timing and in the same geographical area (Tables 2, 3). Prespray populations of budworm were quite variable, but most of the *B.t.* blocks had substantially lower infestations than the chemical-treatment areas.

About 10 117 ha (Figure 4) were treated with Novabac-3 and the data (Table 2) show that 9 of the 17 areas sampled had a detectable level of foliage protection. Similarly, of the 17 chemical-treatment blocks (Table 3), 9 had a detectable level of foliage protection.

This result, in which only 53% of the treatment blocks sampled have a detectable level of foliage protection, is probably due to factors other than efficacy of either *B.t.* or fenitrothion.

FACTORS AFFECTING *B.t.* PERFORMANCE

The major factors probably affecting performance of *B.t.* and chemical sprays applied to woodlots and similar forest areas are:

1. Irregular-shaped spray areas

   - Difficult to navigate and spray (Figure 5)
   - Increased boundary zone compared with rectangular spray blocks, hence a dilution of actual spray deposition treatment area.

2. Shut-offs inside treatment areas

   - As dictated by instructions, these areas included 1) cuts, 2) presence of people, 3) visible water, 4) nonsusceptible forest type, and 5) roads. This results in dilute spray application to the area, increase in boundary zone, and probable reduction in expected efficacy.

3. Forest composition and condition

   - Many of the areas selected for treatment have had a long history of budworm damage and a complex harvesting history. As a result, much of the forest is very heterogeneous in both species composition and age class distribution.

   - Budworm damage has been severe in many of the areas. As a result, surviving susceptible trees are in poor condition.

   - Because of these factors and highly variable spruce budworm larval populations between trees, assessment of efficacy is difficult.

4. Weather

   - Regulatory constraints i.e., low wind speed almost guarantees off-target drift hence reduction in deposit in target zone.

   - Rain within four hours after spraying can reduce efficacy of *B.t.*

   - Relative humidity should be high for water-based *B.t.* sprays for improved effect.

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Kettela, E.G. 1982. Review of the results of experimental spray trials in New Brunswick in 1982. Marit. For. Res. Cent. Tech. Note 69, 1982.

Kettela, E.G. and Victor Steel. 1984. Results of the 1980 Woodlot Protection Project with *Bacillus thuringensis kurstaki* in New Brunswick. Marit. For. Res. Cent. Information Report M-X-150.

Table 1. Synopsis of *B.t.k.* use in New Brunswick 1960 to 1983

Year		Area (ha)	Agencies	BIU /ha	Vol L/ha	Aircraft	Spray system	Results: Larval mortality	Results: Foliage protection
1960	Thuricide SO 75	35	CFS/FPL	-	14	Stearman	B&N	Poor	Poor
1962	Thuricide SO 75	20	CFS/FPL	-	14	Stearman	B&N	Poor	Poor
1969	Thuricide 90TS	120	CFS/FPL	-	14	Stearman	B&N	Marginal	Not measured
1975	Thuricide 16B	320	CFS/FPL	20	7	Cessna AgTruck	Micronair	Excellent	Fair
	Dipel	400	CFS/FPL	20	7	AgTruck	Micronair	Excellent	Fair
1979	Thuricide 16B	200	CFS/FPL	20	7	AgCat	B&N	Variable	Poor
	Dipel	40	CFS/FPL	20	4	AgTruck	Micronair	Excellent	Good
1980	Thuricide 16B Novabac 3	10 521	FPL	20	7	Small Ag aircraft	B&N & Micronair	Variable	Variable
1982	Dipel 88	1 600	FPL	20	1	AgCat	Micronair	Excellent	Poor
		1 600	FPL	30	1.5	AgCat	Micronair	Excellent	Poor
	Novabac 3	400	CFS/FPL	30	7	AgCat	Micronair	Good	Fair
	Bactospeine	200	CFS/FPL	30	7	AgCat	Micronair	Good	Fair
		100	CFS/FPL	30	4.7	AgCat	Micronair	Good	Fair
		100	CFS/FPL	15	2.4	AgCat	Micronair	Fair	Poor
1983	Novabac-310	10 117	FPL/DNR	30	4.7	Ag-aircraft	Micronair	Variable	Variable
	Futura 11	40	CFS/FPL	30	1.1	AgTruck	Micronair	Excellent	Excellent
	Dipel 176	40	CFS/FPL	30	0.7	AgTruck	Micronair	Good	Fair

CFS - Canadian Forestry Service, FPL - Forest Protection Ltd, B&N - boom and nozzle,
BIU - Billion International Units.

Table 2. Summary of the results of spraying *B.t.k.* on woodlots (balsam fir) for 17 spray areas in 1983.

Development Index		Prespray	% Defoliation		% foliage
Shoots	Larvae	larvae/branch	Observed	Expected	saved
3.1	3.4	1.5	60	5	0
		5.0	70	30	0
		5.0	80	30	0
3.4	3.4	13.0	100	70	0
		7.0	100	50	0
		5.0	10	30	20
		10.0	20	60	40
3.9	3.5	3.0	60	15	0
		5.0	60	30	0
		22.0	10	90	80
3.9	3.6	8.0	60	55	0
4.0	3.5	12.0	30	70	40
		18.0	30	85	55
4.4	3.8	5.0	10	30	20
		11.0	50	65	15
4.6	3.0	6.8	30	45	15
4.9	3.3	6.8	25	45	20

Table 3. Summary of the results of spraying Fenitrothion on woodlots (balsam fir) for 17 spray areas in 1983.

Development Index		Prespray	% Defoliation		% foliage
Shoots	Larvae	larvae/branch	Observed	Expected	saved
1.0	3.0	19	70	85	15
2.4	3.1	11	70	65	0
		19	70	85	15
2.6	2.8	25	80	100	20
2.7	3.3	6	40	40	0
2.8	2.8	15	90	75	0
2.9	3.3	7	90	50	0
		8	40	55	15
		16	40	80	40
		22	40	90	50
		24	100	100	0
		32	100	100	0
3.0	2.9	3	80	15	0
		14	20	75	55
3.1	3.4	25	100	100	0
4.6	3.0	12	40	70	30
4.9	3.3	9	40	60	20

Table 4. Comparison of 1983 spraying with Novabac-3 and Fenitrothion emulsion, pooled data, 17 sets of data per treatment.

Treatment	Prespray larvae/branch	% Defoliation		Average development	
		Observed	Expected	Shoots	Larvae
Novabac-3	8.7	50	50	3.4	3.3
Fenitrothion	16.4	60	75	2.7	3.1

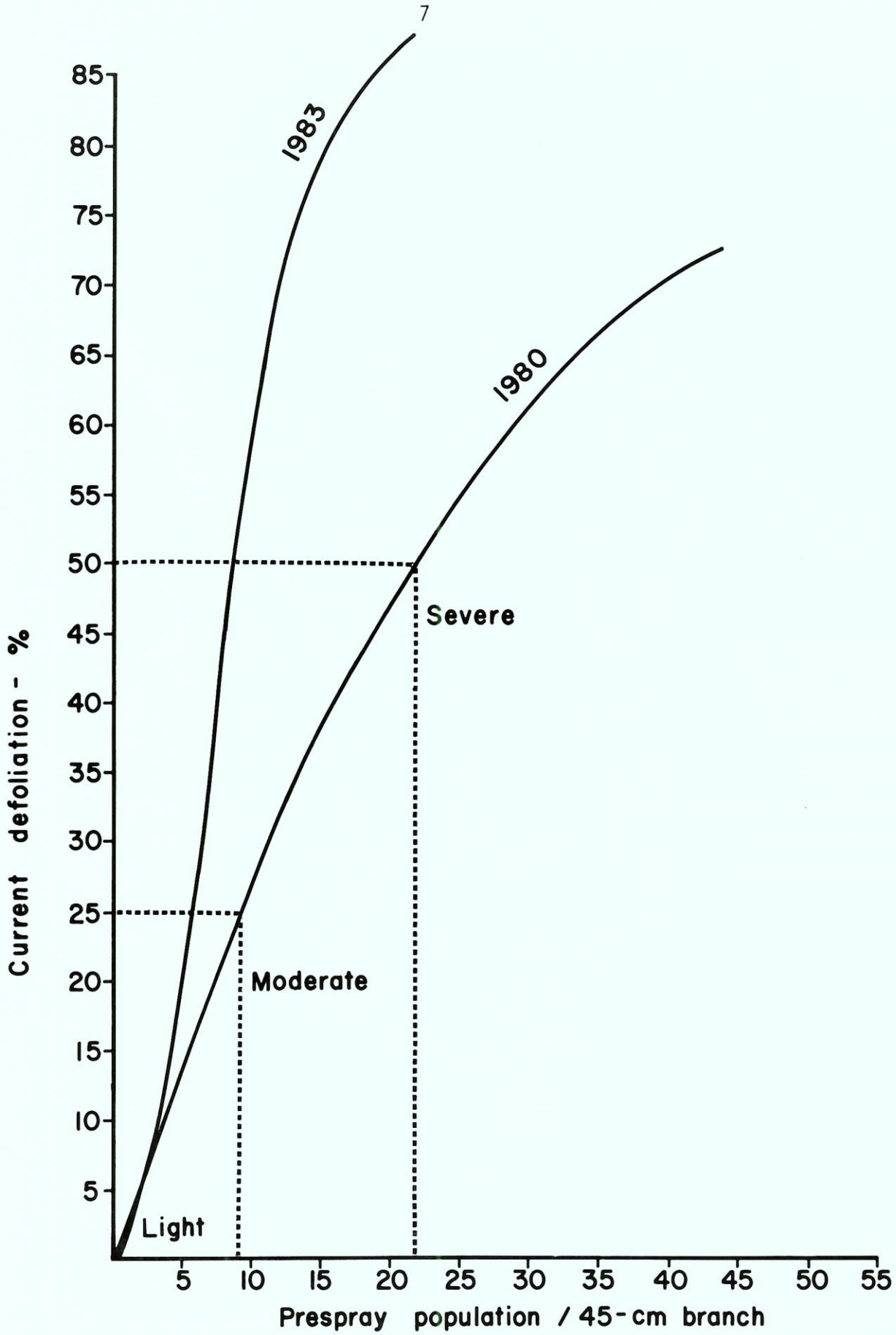

Figure 1: Relationship between prespray budworm population and current defoliation for balsam fir control data.

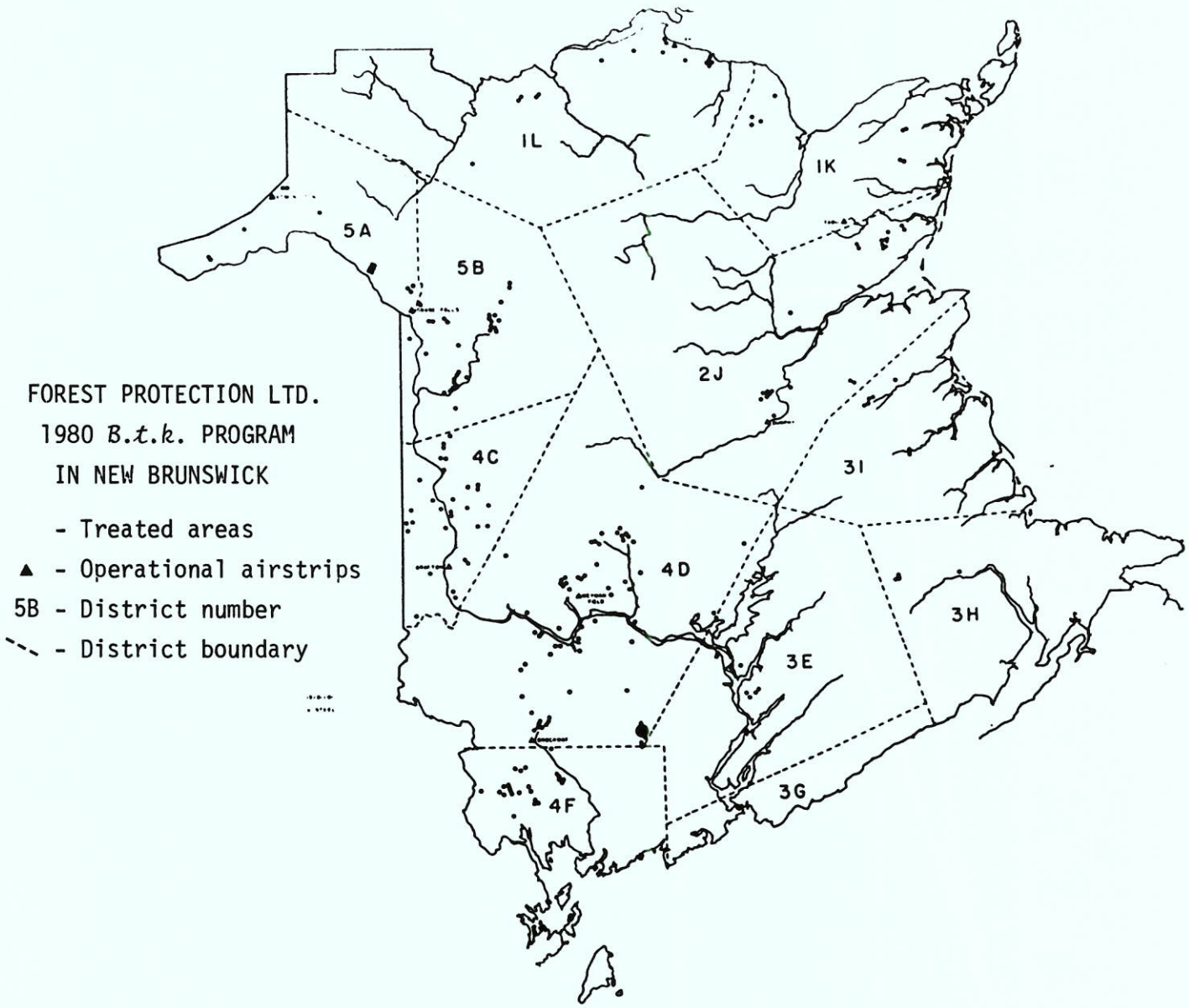

Figure 2: Districts, location of treated woodlots and airstrips used for the *B.t.k.* program in New Brunswick.

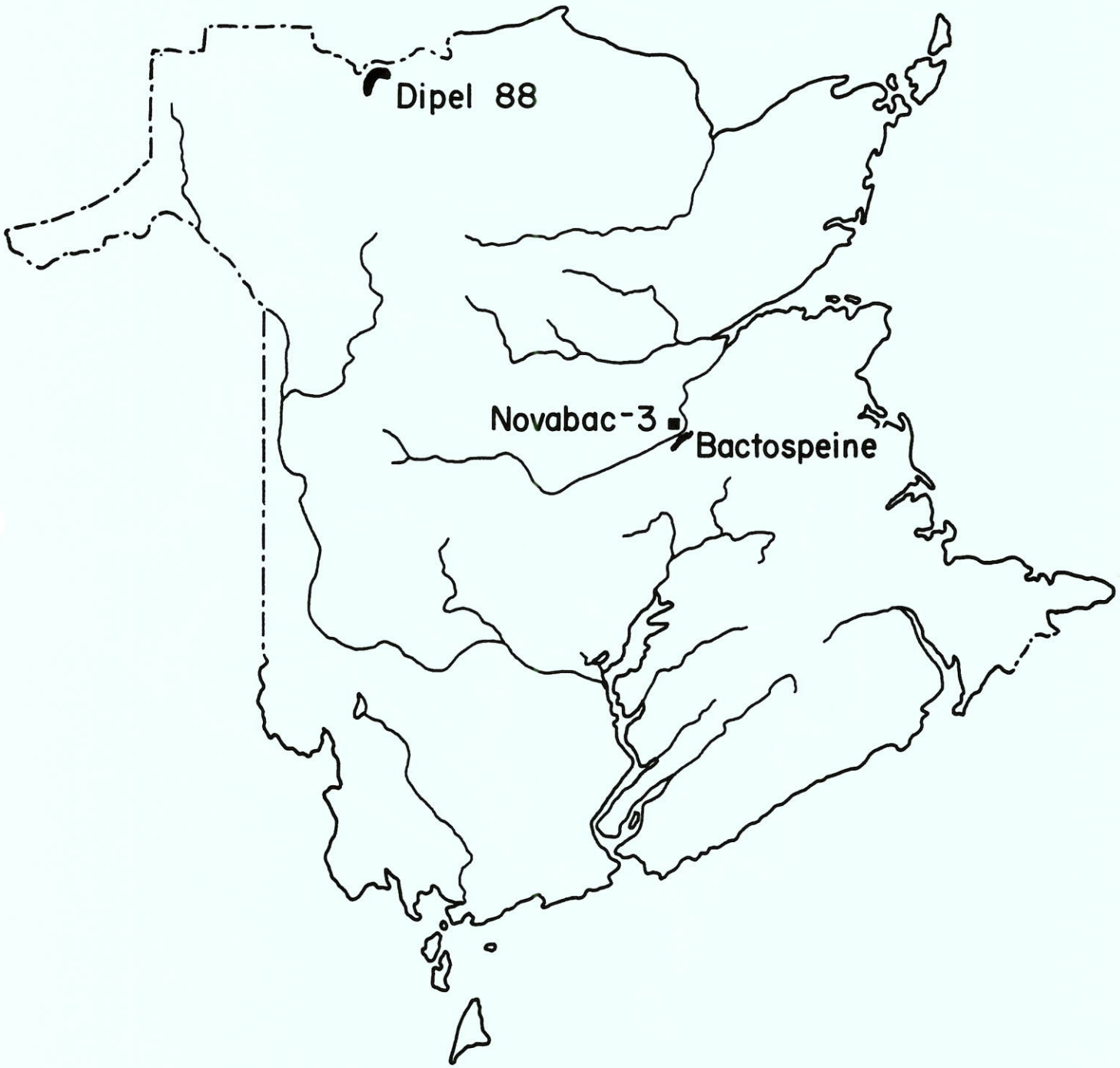

Figure 3: Areas sprayed with *B.t.k.* in 1982 in New Brunswick.

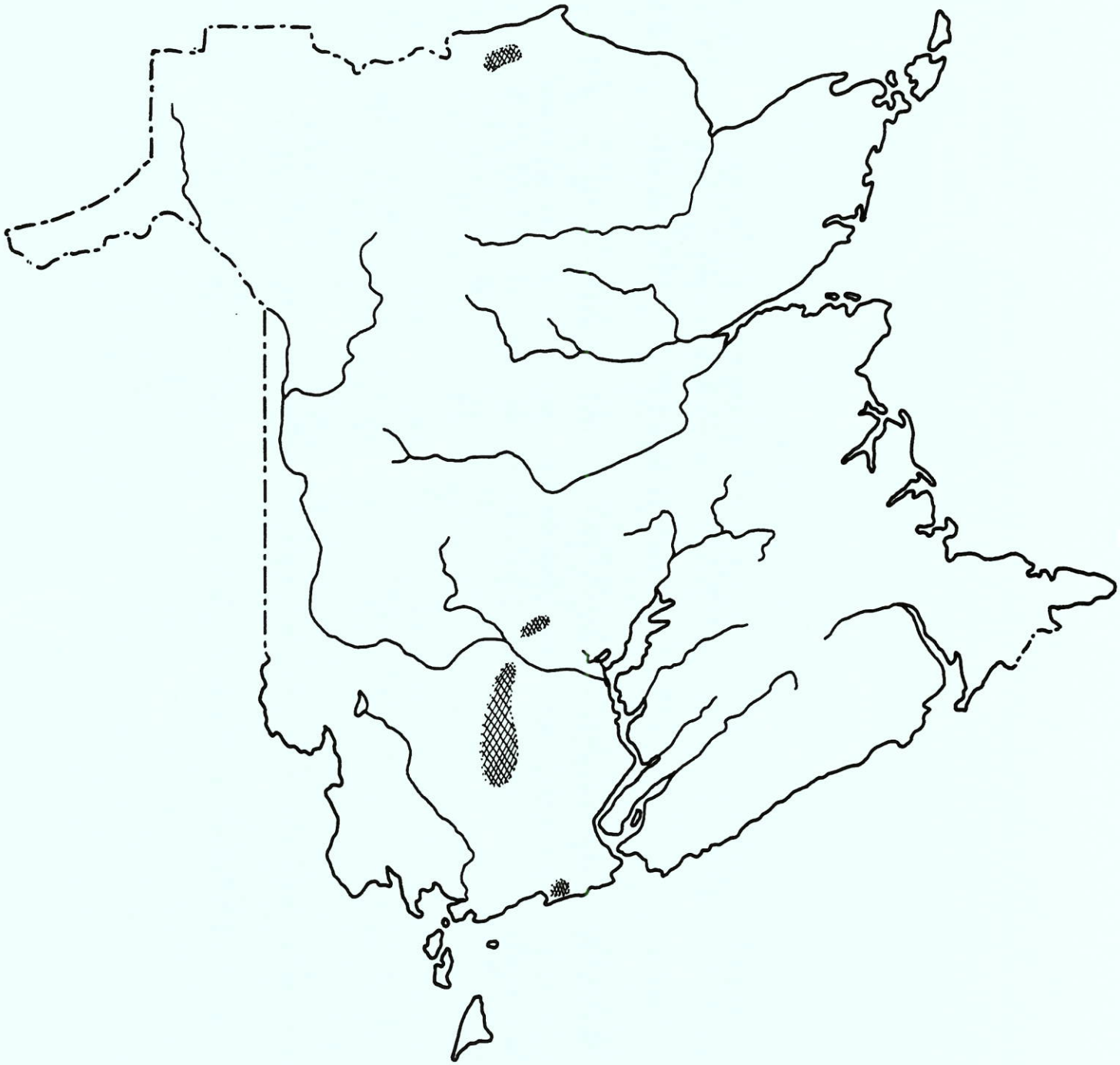

Figure 4: General areas in which Novabac-3 was sprayed in New Brunswick, 1983.

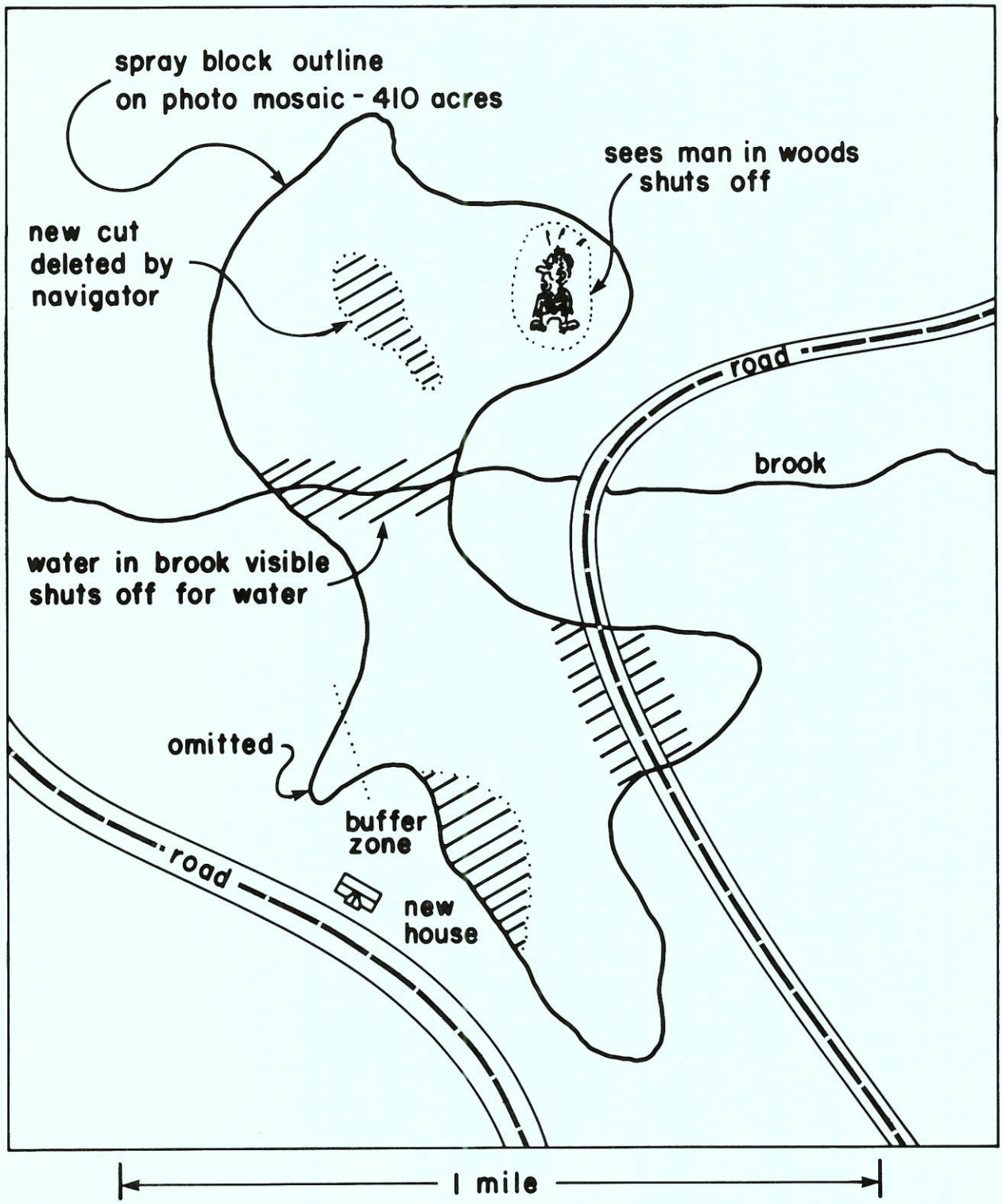

Figure 5: Schematic diagram of a woodlot spray block.

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