Effects of Fenitrothion from 1974 Forest Spraying on Benthos of the Nashwaak Project Study Streams

by

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ABSTRACT

Concentrations of the insecticide fenitrothion in waters of three streams were too low and declined too fast to produce any effect on drift of benthos.

RÉSUMÉ

Des concentrations de l'insecticide fenitrothion dans les eaux de trois ruisseaux furent trop bases et diminuèrent trop vite pour avoir des effets sur la faune du fond.

Corrigendum. The name of Middle Brook has been changed as of March 1975 to Narrows Mountain Brook.

INTRODUCTION

Fenitrothion as an operational larvicide against the spruce budworm inevitably enters streams (Eidt and Sundaram in press) and lakes (Kingsbury 1973). It often causes kills of stream benthos (Banks 1973, Peterson and Zitko 1974, Eidt in press), may reduce fish growth through its effect on food supply (Symons and Harding 1974), and under certain circumstances may directly cause fish mortality (Kingsbury 1973). A serious spruce budworm situation is anticipated in 1975 and extensive use of fenitrothion is planned (E.G. Kettela, Maritimes Forest Research Centre, Fredericton, New Brunswick, private communication). Constant vigilance is needed to ensure that the side-effects do not nullify the benefits of the insecticide. Perspective on the effects on stream fauna can be improved by documenting the results for various streams in different years under different spray programs. This report documents the consequences of the 1974 aerial spray program for three streams and their invertebrate fauna, a temporal extension of the results reported by Eidt and Sundaram (in press) and Eidt (in press) for the same streams in 1973.

The three streams, Middle Brook, Hayden Brook and a small branch of Lake Brook, are headwaters streams of the St. John River, located in the west central New Brunswick uplands about 48 km northwest of Fredericton. All three basins are heavily forested, the dominant species being maples, beech, balsam fir, and red spruce. Hardwoods and softwoods occur in about equal numbers, the softwoods predominating at the lower elevations and along the streams. The streams are sheltered

by the overstorey except for a road crossing Lake Brook basin, and several beaver dams or old dam sites on each stream.

This work is a part of the Nashwaak Experimental Watershed Project, a cooperative study of environmental impacts of forestry practices, involving Environment Canada, the University of New Brunswick, the Province of New Brunswick and the St. Anne-Nackawic Pulp and Paper Co. Ltd.

METHODS

The spruce budworm control program was not modified to accommodate this study. One irregular-shaped spray block (ca 4800 ha), number 538, was involved; the probable area is indicated by stippling in Fig. 1. The unsprayed areas in the interior of the block contain mostly hardwoods. The insecticide was applied with TBM aeroplanes at the rate of 210 g/ha (3 oz/ac) actual fenitrothion using the same aqueous emulsion formulation as in 1973. The spray was applied between 0705 and 0754 hours on 4 June when the wind was from the northwest at 3.2-6.4 kph (2-4 mph), the weather was clear at 14°C, and the spray settled well.

The fenitrothion sampling and analysis methods were the same as those described by Eidt and Sundaram (in press). Two water samples were checked by the Water Quality Laboratory, Environment Canada, Moncton, N.B.; the differences were not significant.

The methods for insect drift collection and analysis were the same as those described by Eidt (in press) with one exception. In 1973 some samples were lost when a sudden spate flushed the insects from the

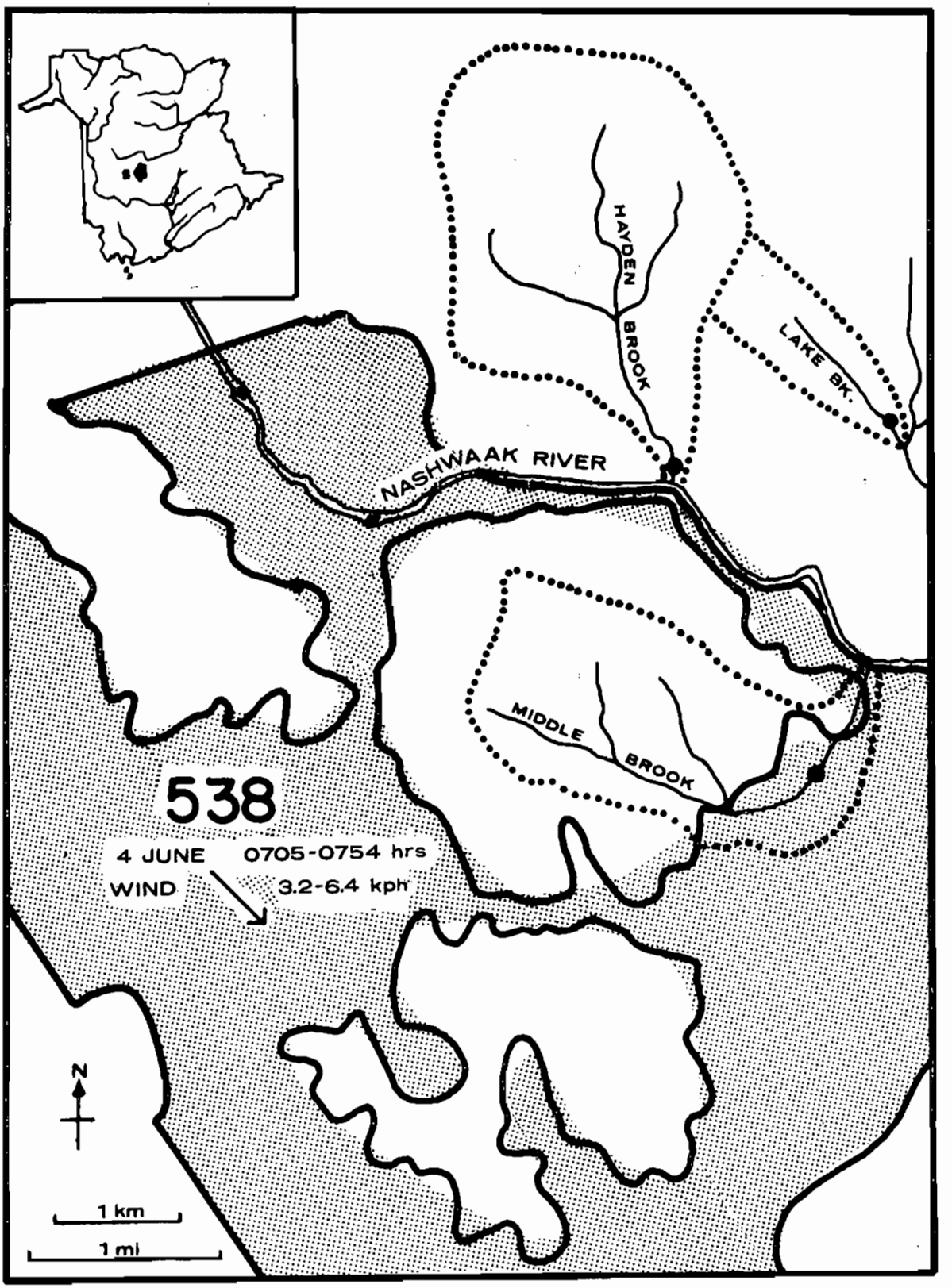

Fig. 1. Study area showing parts sprayed (stippled), spray block boundaries (solid lines), areas not susceptible to spruce budworm (irregular white areas within block), watersheds (dotted lines), sample stations (large dots).

holding cages which were weighted to the bottom of the stream in shallow places. In 1974, styrofoam floats were added so that the cages drifted at anchor in the streams, thereby giving a constant water level. A spate did not occur so the modification was not tested under extreme conditions.

RESULTS AND DISCUSSION

Following spraying, fenitrothion residues were found in all the streams. In none, however, was any increase in drift, living or dead, seen during the two days following spraying, so insect drift sampling was discontinued.

Rainfall was negligible and stream discharges diminished slowly during the sample period (Fig. 2). There were therefore no complications due to the effect of changing water volume on fenitrothion concentration or of stream flow on drift numbers.

Middle Brook

It took 50 minutes to spray the block; the eastern half including Middle basin was done first. Three minutes after spraying was completed, the concentration of fenitrothion was 3.10 ppb and 3 hrs 26 min after spraying the concentration was 3.80 ppb, the highest recorded (Fig. 3). The concentration then dropped very rapidly. Peak fenitrothion concentration was lower and dropped faster than in 1973. The water was 1-4°C cooler in 1974 according to four temperature checks. During the three days following the spray, the pH averaged 6.6 in 1973 and 6.8 in 1974. The rates of decline of fenitrothion concentration did

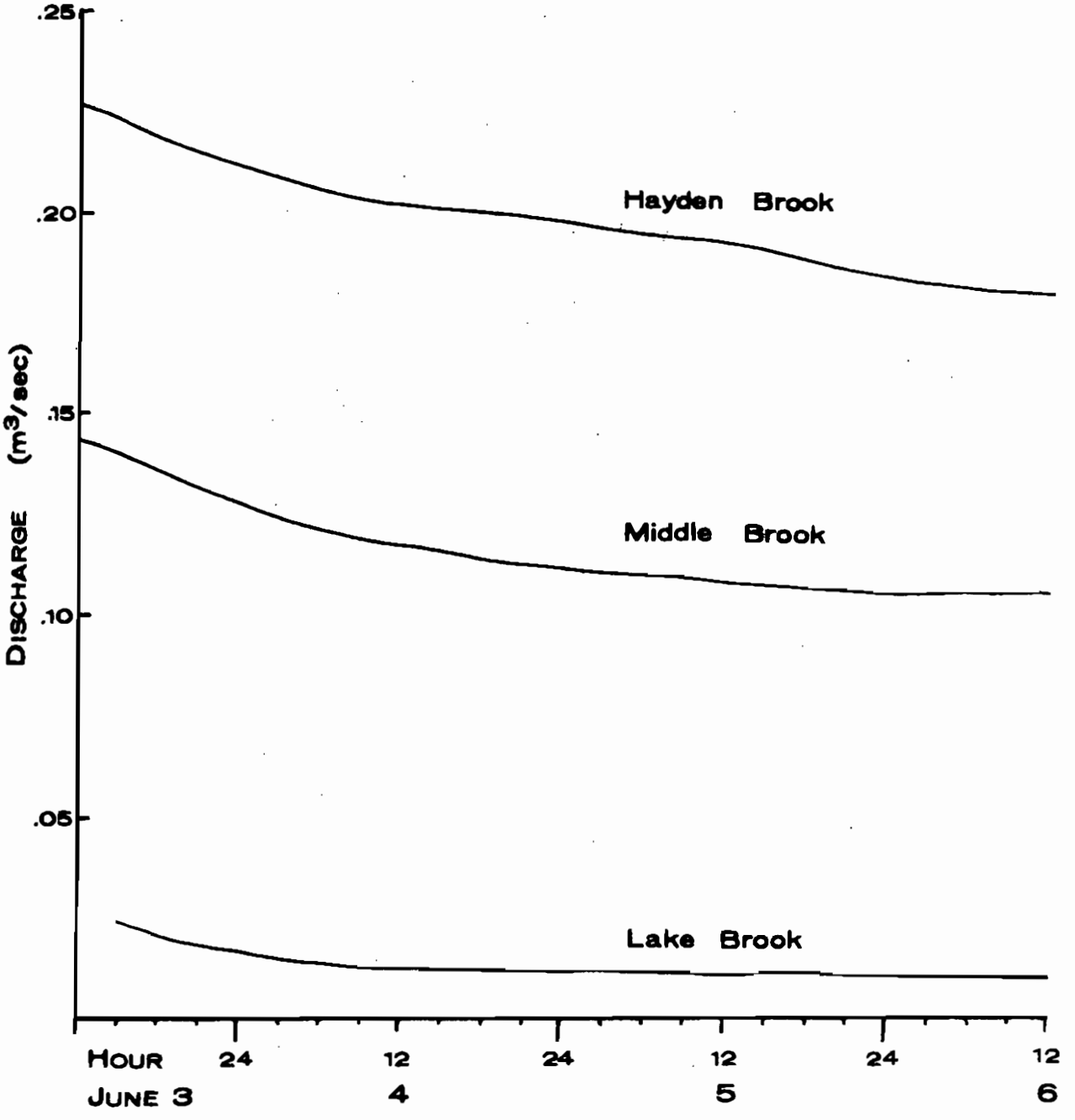

Fig. 2. Stream discharge of Hayden, Middle and Lake Brooks.

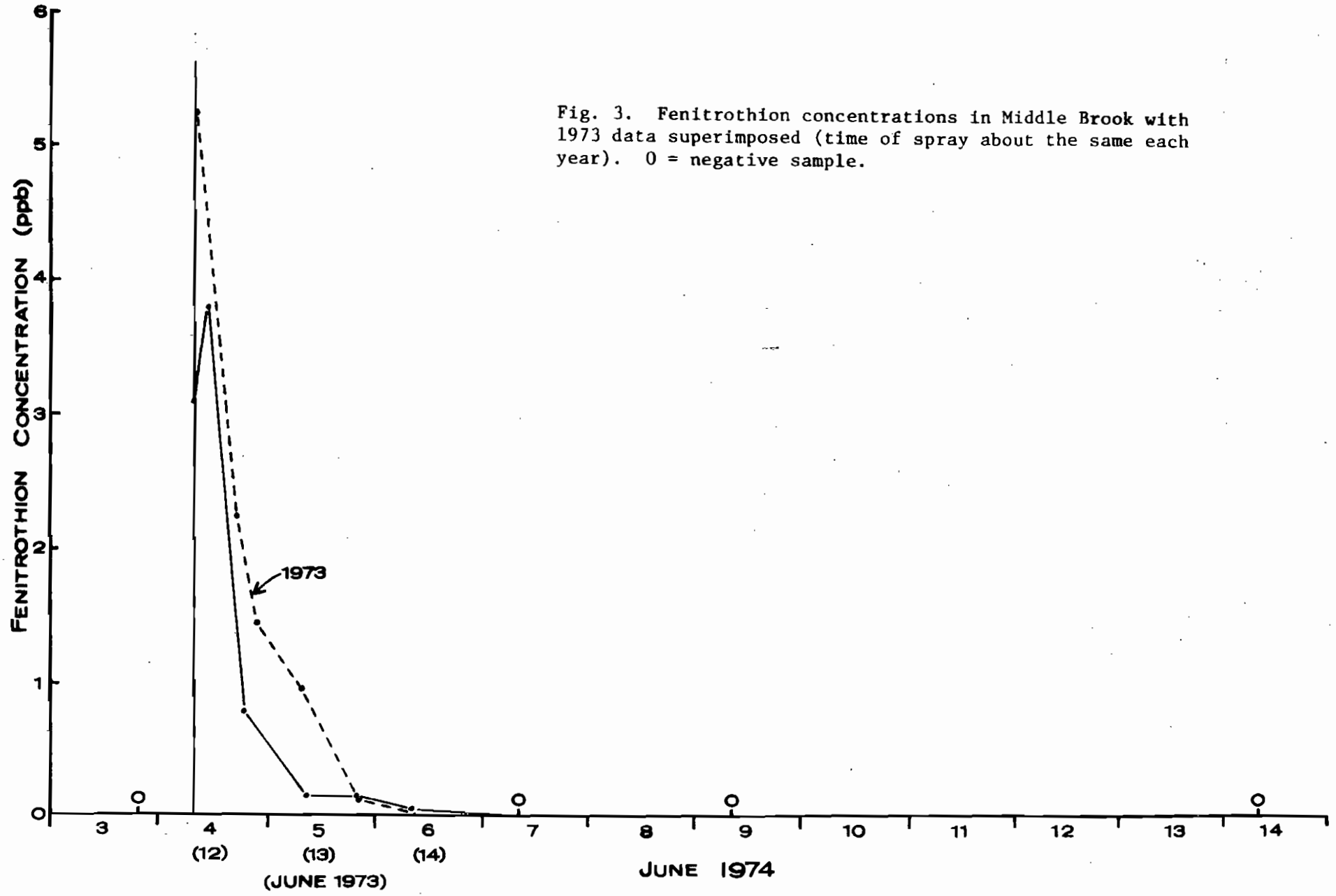

Fig. 3. Fenitrothion concentrations in Middle Brook with 1973 data superimposed (time of spray about the same each year). 0 = negative sample.

not differ markedly between years. The small difference on the second day after spray does not relate to temperature or pH; both favor more rapid hydrolysis when high (Sundaram 1973).

Benthos drift on Middle Brook showed the usual daily fluctuations with peaks at night (Fig. 5). The dead component (Fig. 6) contained up to 5 insects except at 2400 hrs 4 June when 12 dead insects were collected. This is too few to infer an effect of the insecticide. Results in 1973 (Eidt in press), demonstrated that with increasing dose, an increase in living drift occurs before there is mortality.

Hayden Brook

A peak of 0.55 ppb fenitrothion was found in Hayden Brook 4 June, 7 min before spraying ceased on the west side of the block (Fig. 4). Hayden basin was completely outside the designated sprayed block and not downwind of any part of the block. In spraying the narrow band of softwoods along the Nashwaak River, some spray obviously settled on the lower main stem near the sample site. The insecticide concentration rapidly fell below detectable levels.

The drift increased abruptly at 0900 on 4 June, immediately following the spray, at a time when drift should have been minimal (Fig. 5). This was probably due to the fenitrothion in the water. No one species dominated the catch which was a mixture of the mayflies, *Baetis*, *Ephemerella*, and *Leptophlebia*, and the stoneflies, *Leuctra* and *Amphinemoura*, and more than one species of some of these genera. There was no mortality (Fig. 6).

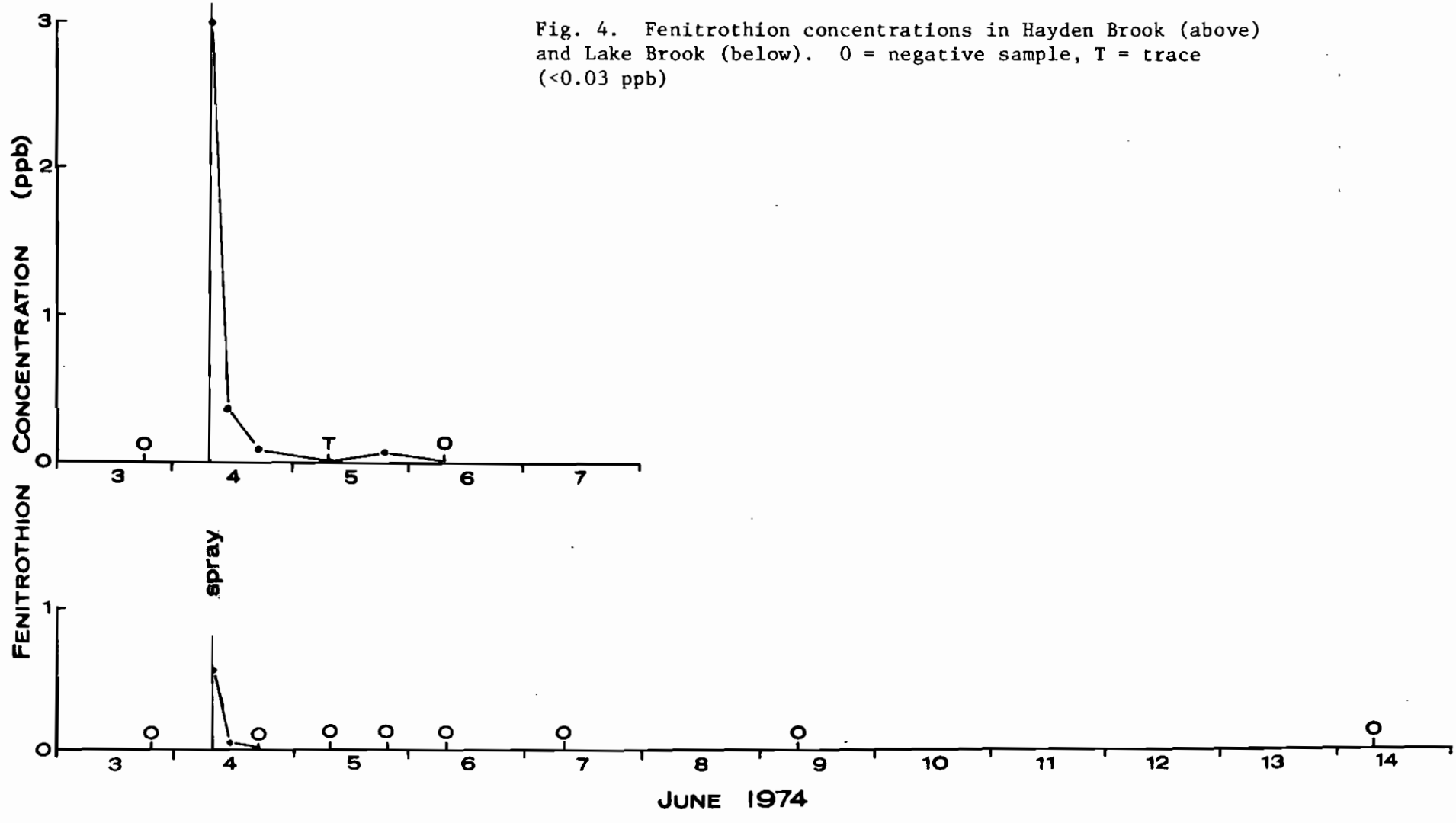

Fig. 4. Fenitrothion concentrations in Hayden Brook (above) and Lake Brook (below). 0 = negative sample, T = trace (<0.03 ppb)

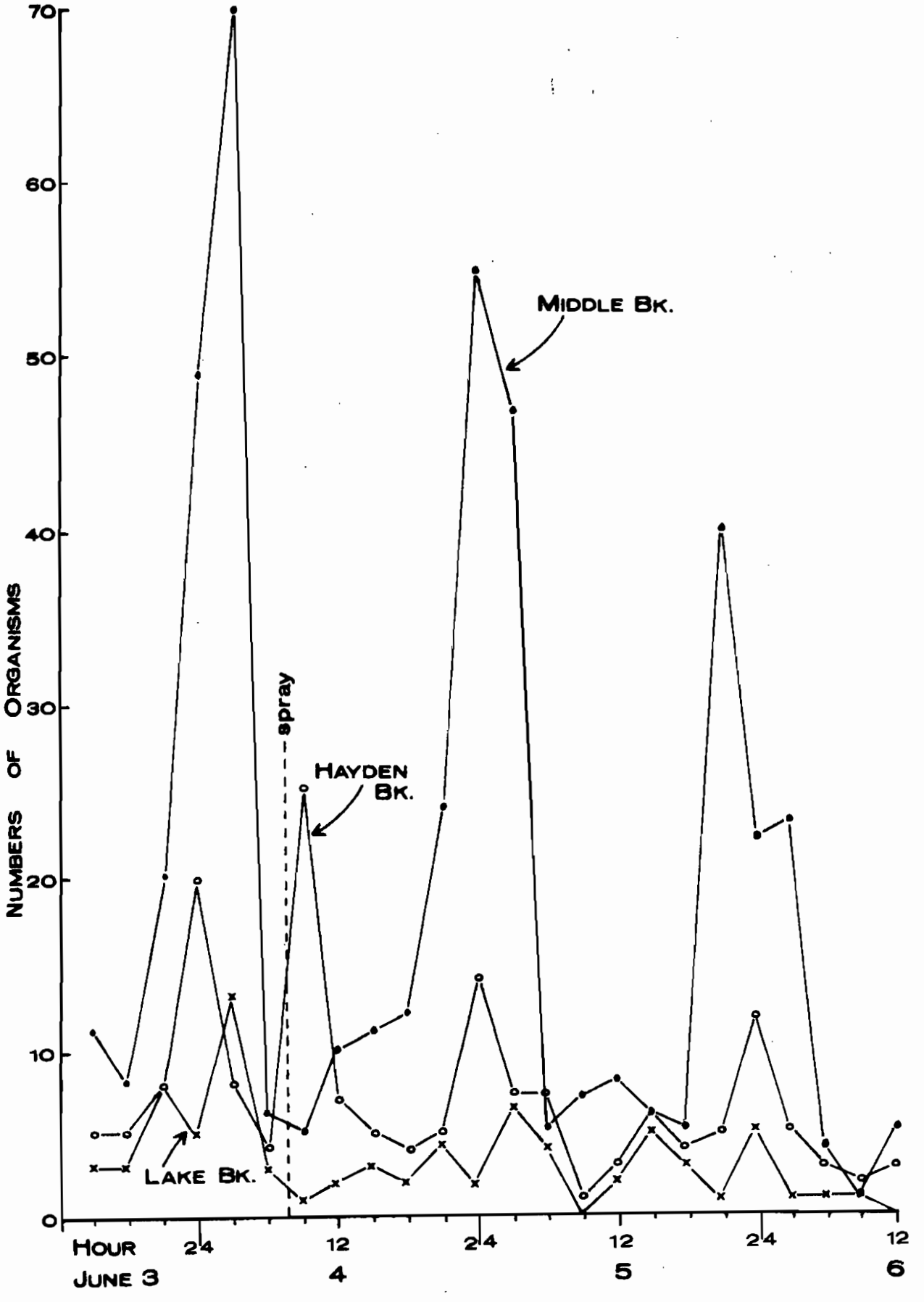

Fig. 5. Three-hourly total drift from 1500 hrs 3 June to 1200 hrs 6 June on Middle, Hayden and Lake Brooks.

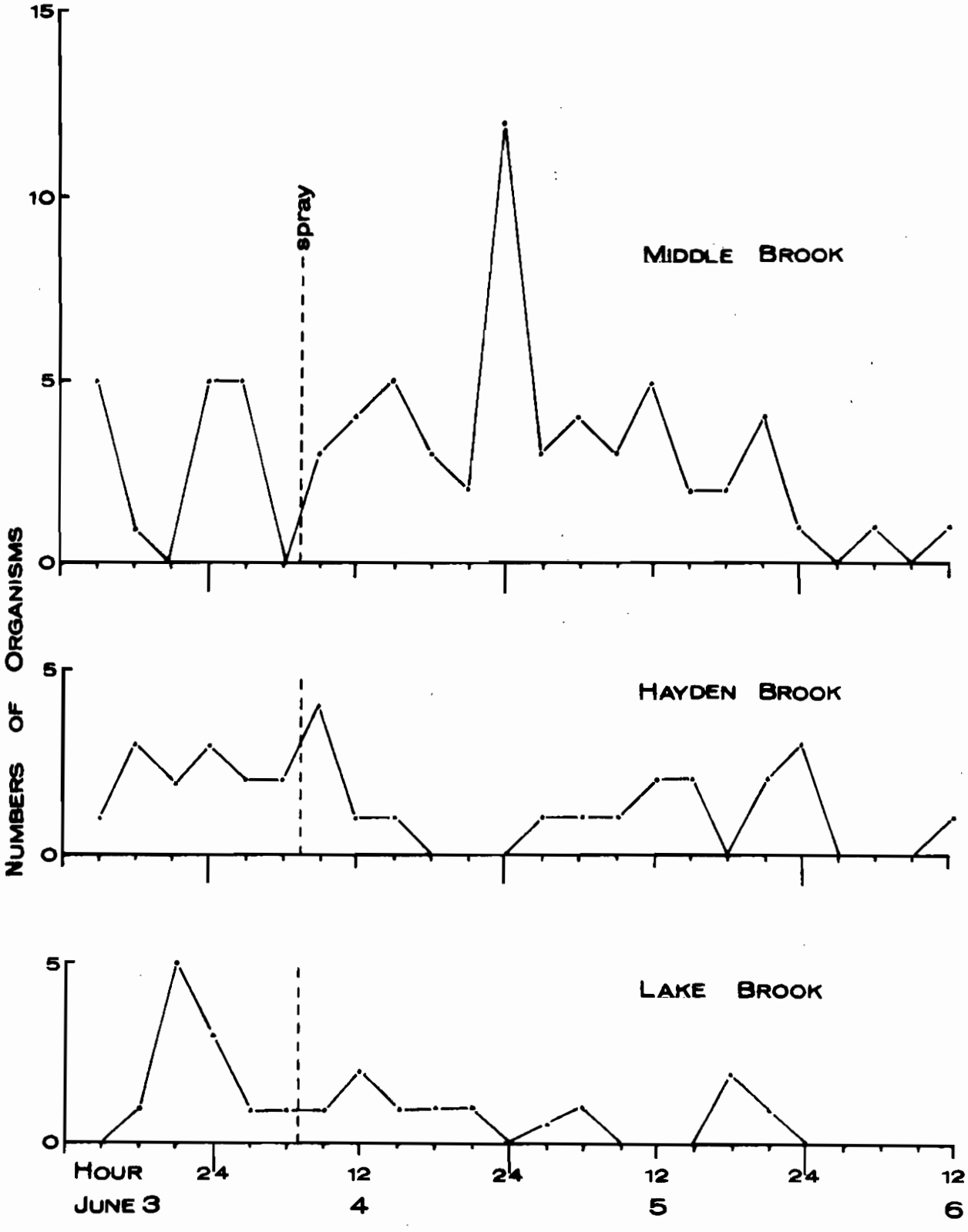

Fig. 6. Three-hourly dead drift from 1500 hours 3 June to 1200 hours 6 June on Middle, Hayden, and Lake Brooks.

Lake Brook

Sampling of fenitrothion was discontinued in Lake Brook the third day following spraying: it was believed that no spray would reach the basin because it was more than 1 km upwind of the spray block. However, 1 min after spraying ceased, 3.00 ppb of fenitrothion were found in the water (Fig. 4) (the nearest swath was sprayed first, 51 min before the sample). The concentration dropped rapidly, but a detectable concentration was present almost 36 hrs later. The peak concentration was lower than in 1973 (6.38 ppb) but the rate of decline in concentration was at least as fast. The water was 1-5°C cooler and the pH was about the same; neither can be related to observed change in fenitrothion concentrations.

Drift in Lake Brook was not affected (Fig. 5). The drift pattern was more erratic than in Middle or Hayden Brooks partly because of a large Trichoptera component that tends to drift in the late afternoon. There was no mortality due to fenitrothion (Fig. 6).

CONCLUSIONS

Fenitrothion entered Hayden Brook and Lake Brook waters even though no part of the basins was within the spray block. The more remote stream, Lake Brook, contained a higher concentration than Hayden Brook, which probably received some fenitrothion directly near its outflow. The observations serve to emphasize the vagarious nature of fenitrothion deposits in streams.

With the possible exception of a slight increase in drift in Hayden Brook following the appearance of fenitrothion in the water, there was no effect on drift organisms in any of the streams; the peak fenitrothion concentrations were too low and the rates of decline too fast.

ACKNOWLEDGMENTS

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