Institute of Freshwater Ecology

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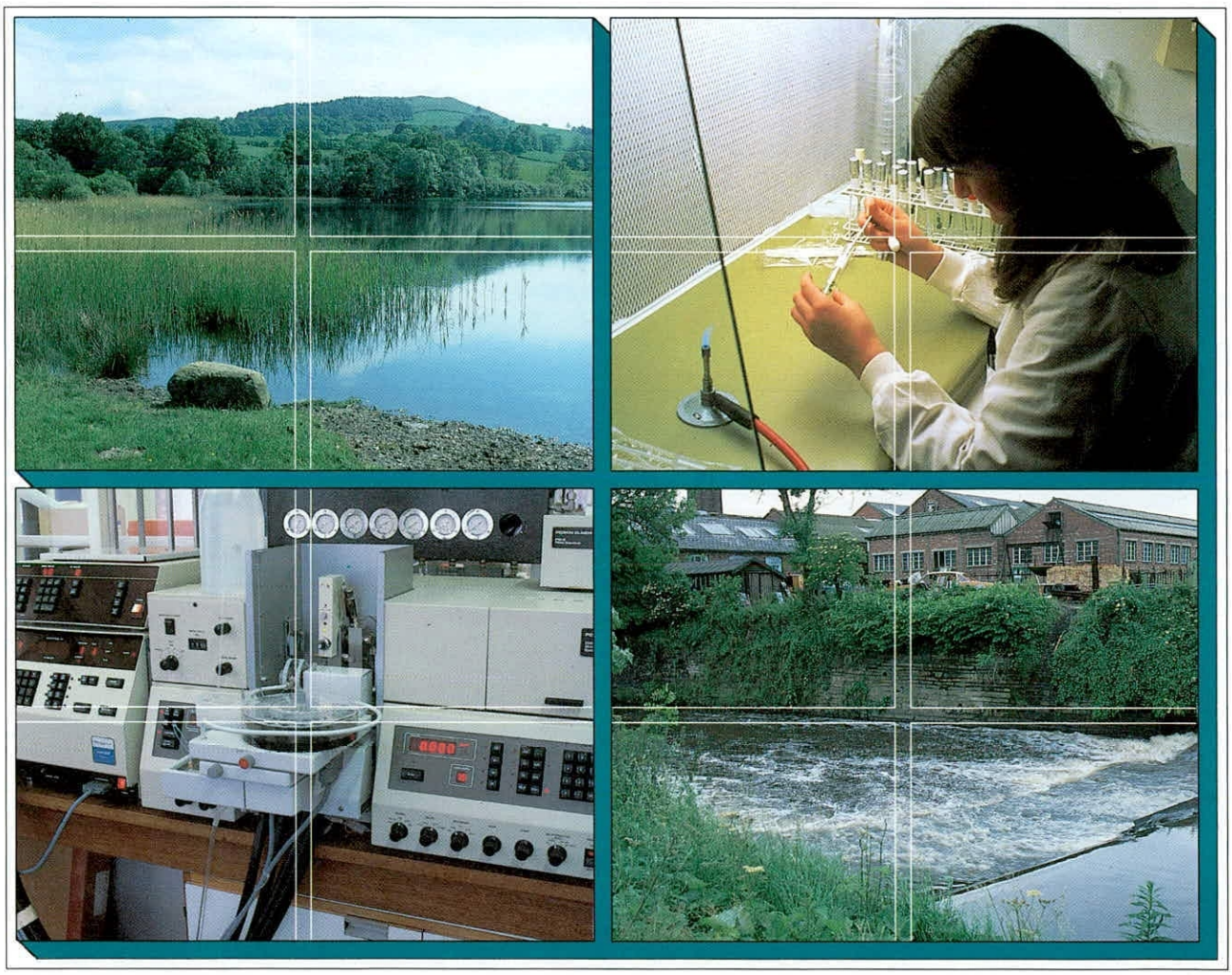

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An experimental treatment of *Simulium posticatum* with *Bti* at selected sites on the River Stour, Dorset, 1992

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CONCLUSIONS

1. In 1992 (as in 1989 and 1991) TEKNAR HP-D (*Bti*) was found to be an effective simuliicide when used against the larvae of *Simulium posticatum* under the conditions prevailing in the River Stour.

2. Laboratory tests using larvae of *Simulium posticatum* showed that the approved concentration (0.8 ppm for ten minutes) of *Bti* (used in the preceding year's trials) was still effective but that a lesser concentration (0.4 ppm for ten minutes) substantially reduced mortality (77%) showing that the permitted dose is approaching the lowest effective concentration.

3. Following preliminary surveys, six sites on the main river were selected for treatment and the furthest upstream (Blandford) and the penultimate downstream (Wimborne) of these were used for monitoring the effects of treatment.

4. Current meter measurements were used to calculate discharges and to permit suitable dilutions of *Bti* to be achieved. NRA discharge records for Hammoon and Throop confirmed that measurements were in the correct range.

5. The first *Bti* application coincided with a flood which resulted in increased discharge and turbidity. This reduced the efficacy of the treatment. Mortality was 33% at Blandford and 59% at Wimborne.

6. A second application several weeks later when conditions were less adverse produced mortalities of 94.9% and 77.1% at Blandford and Wimborne respectively.

7. The overall mortalities produced by two applications of *Bti* were 96% and 93% at Blandford and Wimborne respectively.

1. INTRODUCTION

In 1992, following the successful trials in 1989 and 1991, HSE gave the North Dorset District Council permission to experimentally treat the same region of the River Stour as in 1991 with a *Bti* preparation (TEKNAR HP-D). This was the latest phase in the attempted control of the biting pest *Simulium posticatum*. The treatment was to be restricted to the area of the main river downstream of Blandford but no less than 7 km upstream of the Longham intake of Bournemouth Water Co. (Fig. 1). It should be noted that large populations of *Simulium posticatum* occur in the river downstream of this obligatory cut off point.

The conduct of the present treatment took into account the "Guidelines for Biological Monitoring" put forward by the Pesticides Registration Section, 28 February 1990.

2. TESTS OF *Bti* (TEKNAR HP-D) TOXICITY

It was required by the HSE that the Teknar HP-D (the identical batch used in 1991 and stored at 5°C in the intervening period) be tested to establish that it was still effective against the larvae of *S. posticatum*.

2.1 Methods

Two experiments were carried out, in vitro, in which larvae of *Simulium* spp. were subjected to TEKNAR HP-D. Twenty 3-5mm larvae of *S. posticatum* collected from Blandford on the River Stour were placed in each of ten 100 ml plastic beakers containing River Stour water filtered through a 0.064 mm sieve. Water currents were induced and the water aerated by the introduction of air, under pressure, through a hypodermic needle. Larvae were allowed to settle and attain feeding positions for 18 hr 40 min in the first experiment and for 21 hr in the second experiment prior to treatment commencing.

TEKNAR HP-D was diluted to give final concentrations of 0.8 ppm and 0.4 ppm. The appropriate concentration was added to five of the ten replicates, the remaining five replicates being used as controls. After a ten minute exposure period both treatment and control samples were washed thoroughly in filtered river water over a period of fifteen minutes before being returned to containers of clean, filtered river water prior to counting. Beakers were examined twenty four hours after treatment and the numbers of dead (unresponsive to mechanical stimulation) and living larvae in each beaker counted.

2.2 Results

All larvae in control samples were alive after twenty four hours but of the one hundred larvae treated with 0.8 ppm of *Bti* for ten minutes only, only two were alive after twenty four hours (Table 1).

Table 1 Number of dead larvae in each control and treatment replicate following the addition of 0.8 ppm of *Bti* for 10 min to the treatment replicates.

Replicate	No. in each experiment	Treatment Number dead	Control Number dead
1	20	20	0
2	20	19	0
3	20	20	0
4	20	20	0
5	20	19	0
Total	100	98	0

The second experiment was less conclusive in its outcome than the first in the fact that a relatively high proportion of control group larvae (32%) were dead at the conclusion of the twenty four hour period. In treatment samples there was, however, 77% mortality (Table 2).

Table 2 Number of dead larvae in each control and treatment replicate following the addition of 0.4 ppm of *Bti* for 10 min to the treatment replicates.

Replicate	No. in each experiment	Treatment Number dead	Control Number dead
1	20	12	6
2	20	14	7
3	20	14	9
4	20	18	1
5	20	19	9
Total	100	77	32

3. PRELIMINARY SURVEYS

3.1 Methods

Walkover surveys were conducted in March 1992 to determine larval presence and the state of the simuliid populations. Samples of weed were taken from various sites on the main river in March 1992. The relative abundance of larvae on the weed, which gives an indication of the population density, was determined. These surveys identified the main areas of infestation and were ultimately used to locate precisely the treatment points.

3.2 Results

On the 6 March 1992 there were many large larvae of species other than *Simulium posticatum* at all sites examined between Blandford and Wimborne. On the same date samples from Blandford carrier stream, Charlton Marshall and Spetisbury contained very few, small larvae of *Simulium posticatum*, while those from Blandford (below the weir) and from Wimborne (Julians bridge) contained many small (first, second and third instar) *S. posticatum*.

A second inspection on 26 March 1992 revealed very few simuliid larvae other than those of *S. posticatum*. Those other species which were present were in the final instar and about to pupate. By this date the larvae of the target species (*S. posticatum*) covered a wide range of sizes, but no first instars were recorded. Larvae were abundant at Blandford (carrier stream and below the weir) and at Wimborne (Julians bridge) but were less numerous at Charlton Marshall and Spetisbury.

A pre-treatment examination at Blandford and Wimborne on 31 March gave the following results (Table 3).

Table 3 Density of *S. posticatum* (mean numbers g^{-1} weed ± 95% CL) present at Blandford and Wimborne on 31 March 1992 immediately preceding treatment.

Site	Number of samples	Number of larvae	Confidence limits
Blandford	30	44.4	±8.1
Wimborne	30	237.6	±60.4

Almost all the larvae on this occasion were instars 2-4 of *S. posticatum*. The results of this survey were used as pre-treatment samples in relation to the treatment of the river with TEKNAR HP-D.

3.3 Treatment Sites

As in 1991 sites T1, T2, T3 and T4 (Fig. 2) were selected for treatment as these were the main areas of infestation determined by an inspection of the entire river between Blandford and Wimborne. Other sites treated were at Corfe Mullen (T3A) and at Canford School (T5) as significant populations of *S. posticatum* were found in the preliminary surveys. Only sites T1 (Blandford) and T4 (Wimborne) were selected for monitoring, these being the most easily accessible and comparable with the studies in 1991.

4. DISCHARGE AND VELOCITIES

Discharge values were necessary for calculation of *Bti* dilution factors.

4.1 Methods

The Wessex region of the National Rivers Authority were unable to provided discharge values at the prescribed sampling/application points as there are only two continuous gauging stations on the Stour, one at Hammoon a considerable distance upstream of Blandford and a second at Throop many kilometres downstream of Wimborne. The NRA were, however, extremely helpful and supplied maps and graphs which established that **approximate** interpolation between gauging stations is reasonable despite the three to four fold difference in discharge at any given time (see 1991 report).

It was felt that more precise information was required and flow measurements were therefore undertaken. For precise flow estimation, measurements of width and depth were made at level cross sections clear of weed and major obstructions. These were combined with velocity determinations at a number of points on each cross section to give discharge values.

4.2 Results

The measured discharge at Blandford and Wimborne on 31 March 1992 was as follows

Blandford carrier	1.5 $m^3 s^{-1}$
Blandford main river	4.6 $m^3 s^{-1}$
Wimborne	6.3 $m^3 s^{-1}$

Table 4. NRA gauged flows (cumecs) prior to treatment on 1 April 1992

Date	Hammoon	Throop
29.3.92	1.79	6.97
31.3.92	7.07	8.15

5. *Bti* APPLICATION

5.1 Methods and quantities

The quantities of TEKNAR HP-D required in litres to achieve concentrations of 0.8 ppm over ten minutes was calculated from the manufacturer's formula:

Volume (litres) = 0.48*Flow (cumec) and was as follows -

- Blandford carrier 0.72 l, Blandford main river 2.2 l
- Charlton Marshall 3.0 l, Spetisbury 3.0 l,
- Corfe Mullen 3.0 l, Wimborne 3.0 l, Canford 3.0 l.

A total of 17.92 litres of suspension.

The TEKNAR HP-D was carried to the sites as measured doses in closed containers and mixed in 20 l knapsack sprayers with sieved river water. The material was sprayed, by a qualified operative, who traversed the river approximately ten times during the application period. The jet of the spraying equipment was totally submerged beneath the water surface to avoid spray drift or loss. The sites were treated sequentially starting at Blandford, the furthest upstream at 0930 hr and ultimately treating the Canford site at 1200 hr.

6. MONITORING THE EFFECTS OF *Bti* ON *SIMULIUM POSTICATUM*

6.1 Methods

On pre-treatment day (31 March 1992), samples of larvae were taken at Blandford and Wimborne. Thirty weed samples were taken at each site 50 m downstream of the proposed application point. The number of larvae on each piece of weed was recorded along with the weight of the weed.

Sampling was repeated on 3 April 1992, two days after treatment at which time it was expected that all dead larvae would have been washed off the weed. Numbers of larvae and weights of weed were again recorded.

6.2 Results

There was a 6-fold difference in density of *S. posticatum* (numbers per gram of weed) on pre-treatment day between Blandford and Wimborne (Table 5).

Table 5 Density of *S. posticatum* larvae (mean number g^{-1} weed ± 95% CL) at Blandford and Wimborne before and after treatment with *Bti*

Date	31.3.92	3.4.92	% mortality
Blandford	44.4±8.4	29.8±6.5	33
Wimborne	237.6±60.4	98.3±20.8	59

Conditions were not good for the application of *Bti*. The water was turbid and the discharge had increased following heavy rain. This can be seen in the change in discharge recorded by the NRA (Table 4) where the value at Hammoon in the upper catchment of the river changed from 1.79 to 7.07 $m^3 s^{-1}$ just prior to application. The discharge at Throop was only slightly higher indicating that the flood was at this time in the upper catchment.

A decision was taken not to delay the treatment as it was not known how long conditions would remain unfavourable. This proved to be the correct decision as the water remained turbid for three weeks.

As the mortalities both at Blandford and Wimborne were low in comparison to the known efficacy of *Bti*, a second treatment was planned to take place once conditions became favourable. Samples were taken on 21 April to determine pre-treatment densities of larvae at the two sites. Examination of the larvae showed that many were in their final instar (pupal gill filaments evident) and indeed, some had pupated. However, this second application proceeded on 23 April so as to reduce the number of larvae as much as possible.

The NRA gauged discharges for Hammoon and Throop on 20 April were 2.5 and 8.3 $m^3 s^{-1}$ respectively. There was no perceptible change in discharge between this date and the day of treatment. These discharges were interpolated to determine the quantity of *Bti* to be added. Two litres were added at Blandford (main river +carrier) and Charlton marshall and 3 l were added at Spetisbury, Corfe Mullen and Wimborne. No treatment was possible at Canford due to water sports at the school.

The densities found at Blandford and Wimborne immediately before the second treatment were very similar to the densities remaining after the first treatment indicating a stable population level in the weeks between the treatments (Table 6).

Table 6 Density of *S. posticatum* larvae (mean numbers g^{-1} weed ± 95% CL) at Blandford and Wimborne before and after the second treatment with *Bti*.

Date	21.4.92	27.4.92	% mortality
Blandford	39.2±8.9	2.0±1.0	94.9
Wimborne	71.96±22.2	16.5±5.6	77.1

The mortality was high at both Blandford and Wimborne (Table 6). The densities on 21 April (pre-2nd treatment) at Blandford and Wimborne were 88% and 30% of the initial densities respectively giving overall mortalities from the two treatments of 96% and 93% at Blandford and Wimborne respectively.

Fig. 1 Map of the River Stour showing treatment area

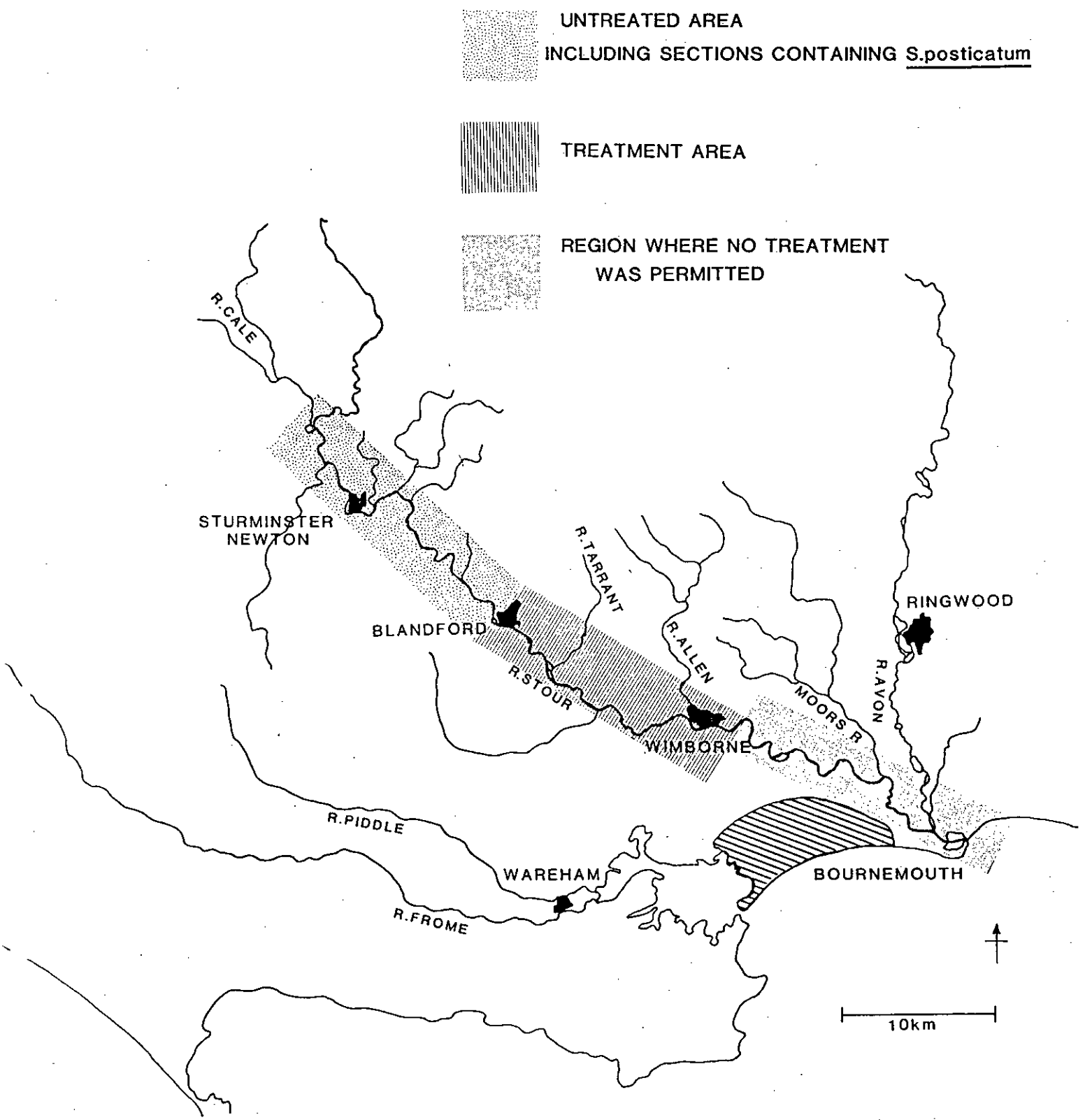

Fig. 2 Position of treatment sites on the River Stour