THE CURRENT DISTRIBUTION OF SIGNAL AND NATIVE CRAYFISH IN BROADMEAD BROOK, WILTSHIRE

JOANNA SPINK AND JOANNA ROWE

(J. M. Spink, Environment Agency, Rivers House, East Quay, Bridgwater, Somerset TA6 4YS, England.
J. Rowe, School of Geography & Environmental Science, University of Birmingham, Birmingham, England.)

Introduction

Signal crayfish (*Pacifastacus leniusculus*) have existed in the upper reaches of Broadmead Brook in Wiltshire (Fig. 1) since 200 individuals were introduced at West Kington in 1981 (Holdich & Reeve 1987, 1989; Reeve, 1990). The population has expanded upstream and downstream since this introduction, however, giving rise to concerns that it may potentially threaten the native crayfish population further downstream.

Signal crayfish can act as a vector of crayfish plague – a disease caused by the fungus *Aphanomyces astaci* Schikora which results in almost complete mortality to the native, white-clawed crayfish *Austropotamobius pallipes* (Alderman & Polglase 1988; Alderman et al. 1990). The native crayfish in Broadmead Brook have not yet succumbed to crayfish plague and are currently free of the disease. However, as signal crayfish appear to out-compete the native species (Holdich & Domaniewski 1995), the native population could still be under threat.

In this article, we highlight the findings of previous crayfish surveys on Broadmead Brook and describe work undertaken in summer 2001 to map the current distribution of native and signal crayfish. Finally, options for controlling the spread of signal crayfish are discussed.

Previous crayfish surveys

A thriving population of signal crayfish developed at West Kington from 1981 to 1987. During this period, no native crayfish were present in this part of the Brook. By 1987 there was strong evidence that the population had begun to expand upstream and downstream, and by 1989 the total distance covered by the signal population was 1,900 m: 700 m downstream and 1,200 m upstream from the centre of the original introduction (Holdich, Reeve & Rogers 1995).

In 1998, a survey along Broadmead Brook showed that the downstream expansion of signal crayfish and the upstream expansion of native crayfish was resulting in an area in-between where the distribution of the two populations was merging (Lang & Wylde 2000). This interface was located near to the Fosse Way (Fig. 1). From the Fosse Way downstream and into By Brook only native crayfish were recorded.

Since 1998 signal crayfish have been trapped at Nettleton, 1 km downstream of the Fosse Way, suggesting that the population is continuing to advance downstream (M. Frayling personal communication). To confirm such reports the Environment Agency, in consultation with English Nature and Wiltshire Wildlife Trust, decided to carry out a survey to map the current distribution of the two species and establish the extent of this advance.

Mapping the distribution of native and signal crayfish

Mapping surveys were carried out in July and August 2001. The principal aim of mapping was to locate the "leading edge" of the advancing signal crayfish population. Once the leading edge was located, it was envisaged that a programme of trapping and removal of signal crayfish could then take place, targeted at a stretch of the Brook just beyond the leading edge of the population, to create a barrier to downstream movement (Harris & Young 1996). However, the necessity of a removal programme would depend on the extent to which the signal crayfish had migrated and whether they had extended beyond critical river points such as the confluence of Broadmead Brook and By Brook.

Two survey methods were used to map the distribution of crayfish: stone-turning and trapping.

Stone-turning

Stone-turning took place at sites between Fosse Way and the confluence with By Brook (Fig. 1), after the methods of Spink & Frayling (2000). The sampling sites were located approximately every 200 m, where the river was shallow enough to wade, and the survey was completed before undertaking the trapping survey. Native crayfish were recorded between Site 2, upstream of Fosse Way, and Site 20, downstream of the confluence with By Brook (Fig. 2). Signal crayfish were recorded between Site 1 and Site 6. Between Sites 7 and 20, no signal crayfish were found using this method.

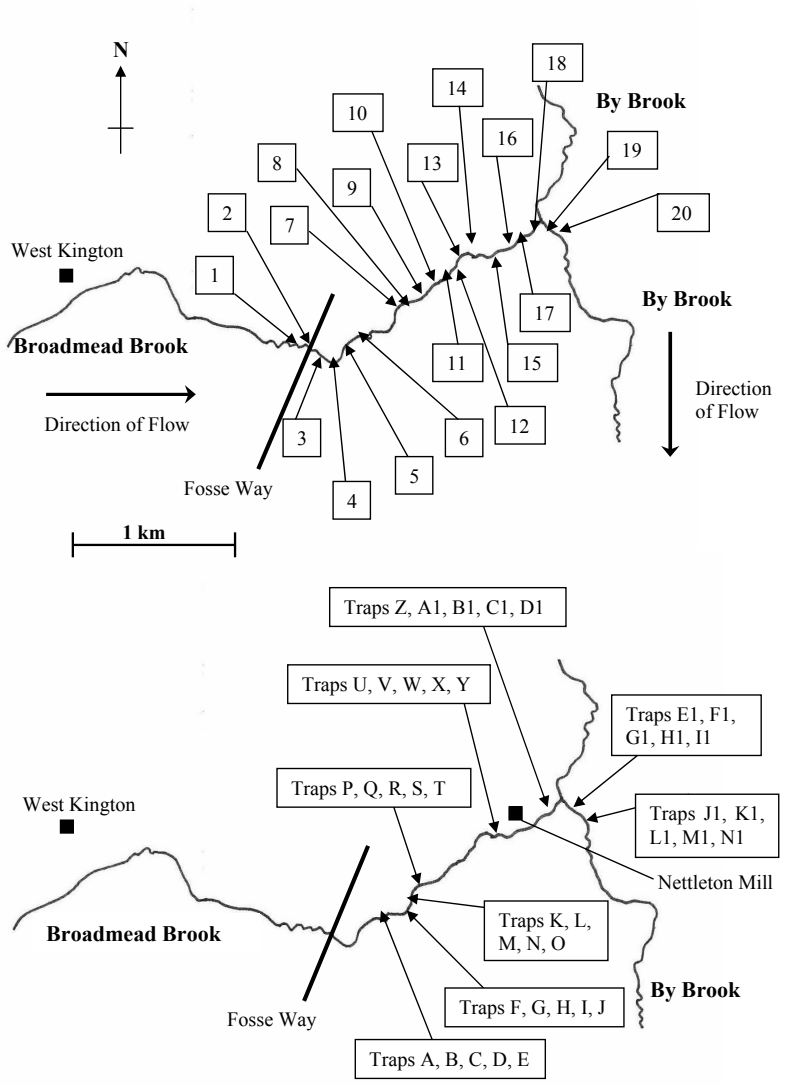

FIG. 1. Schematic map of crayfish survey sites on Broadmead Brook and By Brook, Wiltshire. *Above:* stone-turning survey. *Below:* trapping survey.

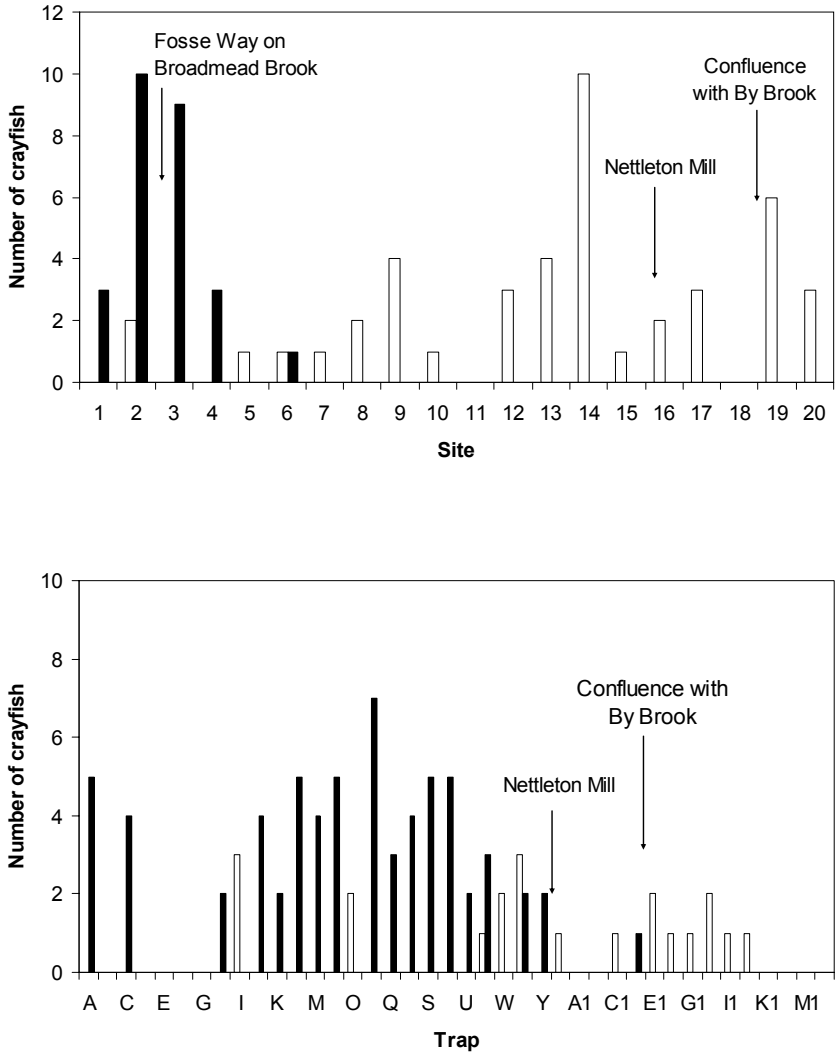

FIG. 2. Crayfish recorded at sites on Broadmead Brook and By Brook in 2001, for native white-clawed crayfish *Austropotamobius pallipes* (open bars) and signal crayfish *Pacifastacus leniusculus* (closed bars). *Above*: stone-turning survey. *Below*: trapping survey (*x*-axis labelled for alternate traps only).

Trapping

Following the stone-turning survey, traps were set at sites that failed to reveal crayfish by stone-turning or where the water depth was too deep to wade (Fig. 1). Swedish "Trappy" traps were used, each measuring 20 cm in diameter and 50 cm long with a mesh size of 2 cm × 2 cm. The trapping methodology was as described by Spink & Frayling (2000).

Twenty traps were laid from 150 m to 350 m downstream from the Fosse Way (Traps A–T, Fig. 1): a stretch of the river that was too deep for stone-turning. A very large number of signal crayfish were recorded (Fig. 2), indicating that the population had migrated further downstream than in 1998. Native crayfish were recorded in two of these 20 traps.

Traps were also laid to sample the river further downstream at Nettleton Mill and at the By Brook confluence, to pinpoint the advancing population front. Five traps were set at Nettleton Mill (Traps U–Y) and both signal and native crayfish were found. Five traps were then laid upstream of the By Brook confluence (alongside the golf course; Traps Z–D1), these also revealing the presence of signal and native crayfish.

Finally, 10 traps were placed downstream of the By Brook confluence (Traps E1–N1). Only native crayfish were found in these traps.

Survey conclusions: current distribution of signal and native crayfish

Populations of signal and native crayfish in Broadmead Brook were reported by Holdich (1990) to be separated by approximately 1 km of river. By 1998, the distributions of the two species overlapped (Lang & Wylde 2000) and our 2001 survey shows that the two populations are continuing to co-exist. However, the low numbers of native crayfish recorded suggests that they are increasingly under threat. Furthermore, the 2001 survey reveals that signal crayfish now inhabit the whole length of Broadmead Brook, representing a downstream colonisation of 1.7 km from the Fosse Way since 1998. This rate of downstream colonisation of approximately 1 km per year is comparable with rates observed by other authors (Harris & Young 1996; Peay & Rogers 1999; Sibley 2000).

Although stone-turning failed to reveal the presence of signal crayfish between sites 7 and 18, trapping revealed signal crayfish downstream of the Fosse Way, at Nettleton Mill and upstream of the confluence with By Brook. Firm conclusions cannot be drawn due to the limited number of sites where both sampling methods were carried out, but this apparent disparity between methods may reflect differences in the distribution of the two species within different habitats in the river. Spink & Frayling (2000) found that, in general, traps caught larger native crayfish than when

sampling by turning stones, and suggested that this may occur because the older, trappable crayfish tend to shelter either in deep pools and/or in burrows and in tree-root systems where the traps were laid, whereas the juveniles may prefer the shallower areas of the river sampled by stone-turning. Similarly, in the 2001 survey on Broadmead Brook, traps were set up against the river bank rather than in the open riverbed. It is possible that signal crayfish have out-competed the native species between sites 7 and 18 and driven them out of riverbank shelters.

In conclusion, the 2001 survey demonstrates the speed at which signal crayfish have colonised Broadmead Brook in the three years since the 1998 survey and indicates that they continue to threaten the native species. In other cases of mixed populations of native crayfish and plague-free signal crayfish, *A. pallipes* has substantially declined in numbers or has been eliminated over a number of years (Holdich & Domaiewski 1995). With this in mind, options to control further spread of signal crayfish in Broadmead Brook are currently being explored.

Controlling the spread of signal crayfish

Options to control the spread of signal crayfish have been researched nationally by the Environment Agency (Peay 1999), with one of the options considered being the complete removal of signal crayfish from a watercourse. However, a number of difficulties have been demonstrated in field trials of trapping to remove signal crayfish, these including:

- very young crayfish escaping through the trap mesh due to their small size;
- female crayfish have been shown to be "trap shy" when carrying eggs (Woodland 1967);
- removal of large adult male crayfish can actually encourage the growth of the population, as habitat niches become available for younger crayfish to occupy (Ibbotson et al. 1996).

In the context of Broadmead Brook, removal of signal crayfish from the leading edge only is an option that may slow the advance of the population and prevent colonisation of By Brook. However, even though no signal crayfish were recorded in By Brook during the 2001 survey, it is likely that given their close proximity upstream of the confluence, populations may have already settled in By Brook due to downstream migration of hatchlings under spate conditions. Given the time and cost implications of confirming presence or absence of signal crayfish in By Brook, neither a survey of this nor subsequent removal have been attempted.

A second option is therefore being considered: relocation of native crayfish from Broadmead Brook to another waterbody where signal crayfish are absent, to mitigate for the reduction in population on Broadmead Brook. Although most rivers in Wiltshire are at risk from colonisation by signal crayfish, there are streams within neighbouring Somerset that are currently free from signal crayfish and which might be suitable for introducing the native species. Experience in relocating native crayfish to still waters such as disused quarries in Somerset (M. Frayling personal communication) indicates that this might be a viable option. Careful studies of the receiving watercourses would be required to confirm their suitability and relevant organisations would need to be consulted, but we recommend that the feasibility of such relocation is explored further.

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