Bell Brook Cray sh Survey with Panpipe Refugia (2016)

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Figure 1. Photograph of a Panpipe showing the range of sizes of plastic pipe set in an aluminium frame Graham Hill

Introduction

Bell Brook provides a home to a nationally important population of White-clawed Crayfish *(Austropotamobius pallipes)*, the population has been monitored by members of the Wyre Forest Study Group (WFSG) since 2010. Annual reports of the surveys have been published in the WFSG Review. Hill and Hill (2015) provide a summary of the findings of the investigations to 2015.

Two survey methods have been employed in Bell Brook – manual hand searching (Peay, 2003) and torching. The former method provides a method of describing population dynamics because crayfish are captured, sexed and measured. The torching survey provides a good estimate of the numbers of active individuals present.

A new method of monitoring has recently been developed which provide artificial refugia, in the form of plastic pipes (Green, 2009), here referred to as Panpipes. The Panpipes can be left in the stream for lengthy periods as they allow crayfish to come and go, and they are only trapped when the Panpipe is lifted for examination. They also have the advantage of allowing examination of smaller crayfish which often escape during the hand-searching method or are overlooked in the torching method.

The aim of the study was to investigate the distribution of crayfish along the watercourse.

Method

The panpipes are constructed from c.300mm lengths of plastic tubing riveted to an aluminium plate (figure 1). A short length of cord was attached to the front of the Panpipe to enable it to be retrieved with its contents. Two Panpipes were purchased from Green Ecology Ltd., the remainder were constructed locally.

The survey method guidelines (Green, 2009) suggest that the Panpipes are fixed on the streambed near to other crayfish refugia, tree roots, overhanging banks or large substrate, and they should be horizontal and at 90° to water flow. Sunny areas and silty sites should be avoided. The Panpipes were tied to the bank and weighted down by stones. Permission to use these devices was obtained from the Environment Agency and the appropriate tags were attached.

Approximately 1.15km of Bell Brook, upstream of the disused railway line, has been surveyed annually since 2010. On 1st July 2016 eighteen Panpipes were set in Bell Brook starting at the downstream end near the culvert under the disused railway track. Panpipes were placed within the length of Bell Brook where native crayfish had been recorded previously. The Panpipes were set approximately 75m apart, although one site which coincided with a pool was moved upstream to more suitable habitat. The location of each one was determined by GPS survey and mapped (Figure 2). It was intended that the Panpipes would be left in place until the end of October 2016 and inspected at two-weekly intervals through the summer.

This article is an extract from the Wyre Forest Study Group annual Review 2016

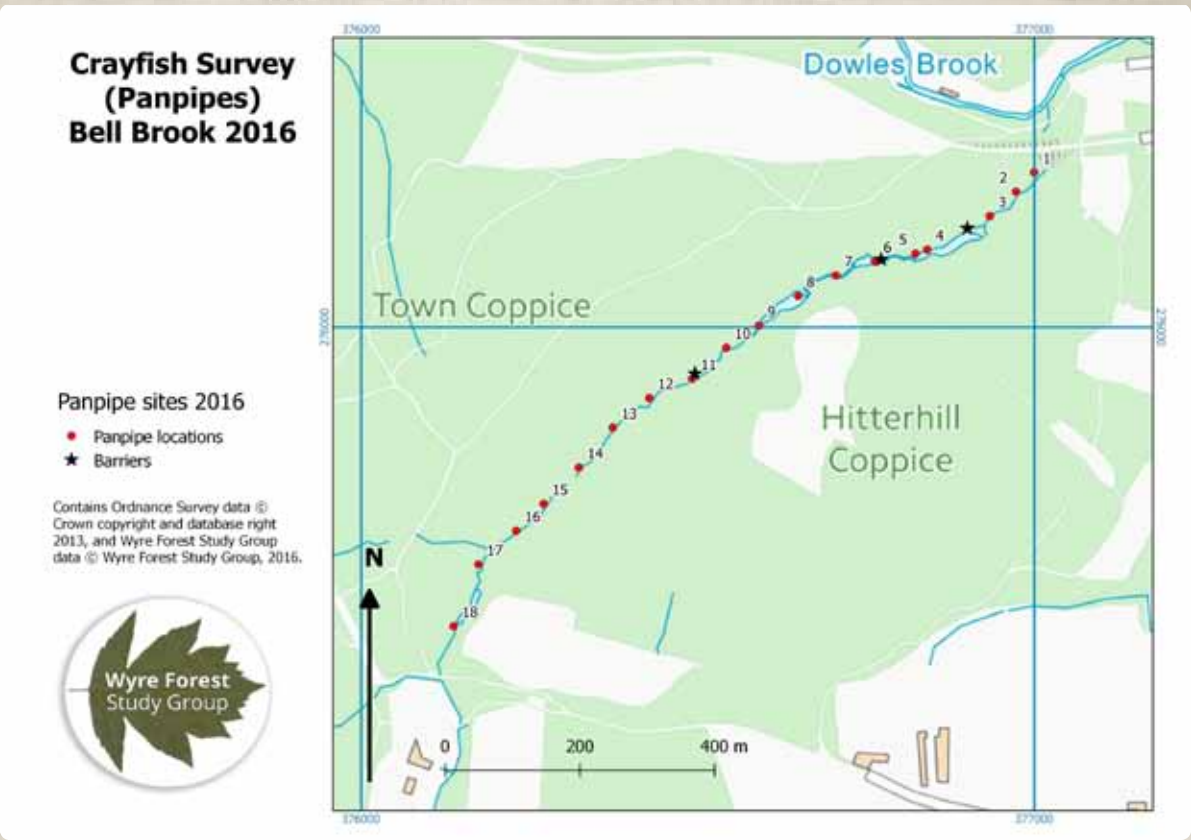

Figure 2. Location of Panpipe refugia and significant barriers along Bell Brook, 2016.

Each Panpipe was set on the streambed at 90° to the streamflow, it was weighted down with suitable rocky material and tethered to the bank. They were located in places where they would be hidden from public gaze, to prevent possible disturbance. Installation of the Panpipes started from the downstream end of Bell Brook. At each site details of water depth, substrate type and habitat availability were recorded along with water temperature, flow magnitude, pH and conductivity.

Inspection of the Panpipes also commenced at the downstream end, working upstream. At each site the securing tether was undone, the rocks were removed from the top of the device and the Panpipes were carefully lifted from their resting position with the open end uppermost. The contents of the tubes were briefly examined as the Panpipes were lifted from the water, the contents were then placed carefully into a plastic box containing stream water. A record was made of the contents of the Panpipes, and crayfish were identified to species, sexed and measured in accordance with standard recording procedure. All material was returned to the stream after being processed. The Panpipes were swilled off in the stream to remove accumulated silt and replaced. Water temperature, flow magnitude, pH and conductivity were recorded at the lower end and upper end of the survey reach on each survey.

Results

The first inspection of the Panpipes took place one week after placement on 8th July 2016, thereafter surveys were at two-weekly intervals.

Table 1 shows the total numbers of male, female or unidentified native crayfish recorded in all 18 Panpipe devices on each survey date. On 8th July and 5th August seven crayfish were found in the Panpipes, on 22nd July there were five, on the 19th August and 2nd September two were found and on the 30th September none were found.

Table 1 Total numbers of crayfish found using Panpipes during six surveys in 2016.

Date	M	F	?	Total
08-Jul	2	5	0	7
22-Jul	1	4	0	5
05-Aug	2	5	0	7
19-Aug	1	1	0	2
02-Sep	1	1	0	2
30-Sep	0	0	0	0

Table 2 shows the numbers of crayfish found using the individual Panpipes during six surveys. It is clear that the crayfishes readily took to using the Panpipes, during the

Pan Pipe	Date	M	F	?
1	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
2	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
3	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
4	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
5	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
6	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
7	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
8	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
9	08-Jul	0	**1**	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
10	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
11	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
12	08-Jul	**1**	**2**	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
13	08-Jul	0	**2**	0
	22-Jul	**1**	**1**	0
	05-Aug	**1**	**1**	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
14	08-Jul	**1**	0	0
	22-Jul	0	**1**	0
	05-Aug	0	**1**	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
15	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	0	0	0
	19-Aug	0	**1**	0
	02-Sep	0	0	0
	26-Sep	0	0	0
16	08-Jul	0	0	0
	22-Jul	0	**1**	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
17	08-Jul	0	0	0
	22-Jul	0	0	0
	05-Aug	**1**	**3**	0
	19-Aug	**1**	0	0
	02-Sep	0	0	0
	26-Sep	0	0	0
18	08-Jul	0	0	0
	22-Jul	0	**1**	0
	05-Aug	0	0	0
	19-Aug	0	0	0
	02-Sep	**1**	**1**	0
	26-Sep	0	0	0

Table 2. Native crayfish found in Panpipe devices during six surveys of Bell Brook in 2016

first survey. One week after placement seven crayfish were found in the tubes and this was encouraging. On 8th July the moulted exoskeleton (Figure 3) of a native crayfish was found in Panpipe 8 and a female carrying hatched young (Figure 4) was found in Panpipe 14. Both of these events suggest that White-clawed Crayfish found the Panpipes to be a safe refuge. Crayfish are vulnerable to predation immediately after moulting and require a safe place where they can harden off the new skin.

It was noted that none of the eight lower Panpipes had been used by crayfish in the first survey (8th July) and that by the time of the second (22nd July) and third (5th August) none below Panpipe 13 had been used. In the fourth survey (19th August) no crayfish were found below Panpipe 15 and in survey five (2nd September) crayfish were found only in Panpipe 18. During the final survey (26th September) no crayfish were found using the Panpipes and during this survey the Panpipes were taken from the stream and thoroughly disinfected and dried before being stored for the winter.

During the survey period several Panpipes had been disturbed by third parties, generally by being moved from their original location and replaced nearby in sub-optimal settings. Disturbance occurred at six locations, four were disturbed twice and two once each. No crayfish were found in any of these disturbed Panpipes.

Many dead and moribund crayfish were noted in Bell Brook during the annual manual hand searching (12th August) and torch survey (17th August). At that point it became clear that the population of native crayfish in Bell Brook was being affected by an unknown agent, that could be either a pollution incident or crayfish plague – for a fuller account of that aspect of these surveys see Hill and Hill, 2016 (page 18 of this Review). The incident was reported to the Environment Agency (EA) whose investigations concluded that Crayfish Plague *Aphanomyces astaci* was present in Bell Brook and was causing the mortality of native crayfish.

Following the intervention of the Environment Agency planned surveys after 2nd September were cancelled. The traps were collected on 26th September whilst EA staff were collecting samples of moribund crayfish for analysis.

Figure 3. Moulted exoskeleton of a White-clawed Crayfish, found in one Panpipe tube, Bell Brook 2016 Graham Hill

Figure 4. Female White-clawed Crayfish carrying young under her tail, Bell Brook, 2016 Graham Hill

Discussion

Although it was hoped that the Panpipe survey would give an insight into the population distribution of native crayfish in Bell Brook, it actually provided an insight into the spread of crayfish plague. It was pleasing to see that the refugia were quickly adopted by crayfish as within a week of deployment four Panpipes had been occupied, two by more than one individual.

Crayfish plague *Aphanomyces astaci* is an oomycete (a fungal type of organism) which requires a crayfish host within which to propagate spores. It can survive up to 22 days in damp places but beyond this period if it fails to infect a crayfish then it will die off (Kozubíková-Balcarová and Horká, 2015). Native crayfish do not survive infection by crayfish plague although Signal Crayfish *Pacifastacus leniusculus* are immune and have probably been responsible for the spread of crayfish plague in the United Kingdom.

When the first Panpipe survey was undertaken on 8th July all Panpipes downstream of Panpipe 9 were empty, and during manual searching and torching surveys on 12th and 17th August, respectively, no crayfish were found in this reach either, in 2015 the torching survey of these areas revealed healthy populations of native crayfish. This suggests that crayfish plague was introduced into Bell Brook above the bridleway below the lower pond and below the site of Panpipe 9 sometime prior to the 8th July. Once in Bell Brook crayfish plague would be carried downstream by the current and upstream by aquatic animals as they move upstream. There is a small waterfall at the downstream end of the lower pond (SO76890 76150) which would probably be a barrier to upstream movement of aquatic life, which suggests that the inoculation of plague occurred upstream of this point.

Whilst crayfish plague has been introduced to the UK by Signal Crayfish (Kozubíková-Balcarová and Horká, 2015), none have been found in Bell Brook. However, plague can also be carried on contaminated equipment, clothing or animals. The Wyre Forest is popular with many recreational users – cyclists, horse riders and walkers for example, and it is very popular with dog walkers. Disturbance of the Panpipes in Bell Brook suggests that some people go into the stream – stones had been replaced on top of Panpipes that had been moved. Clearly the forest teems with wildlife too - deer, otters and birds are also potential vectors of plague if they entered Bell Brook whilst carrying infected water from elsewhere in their fur or feathers. Although the means of inoculation is unlikely to be determined, the location is more certain.

Once the plague had entered Bell Brook it seems to have moved rapidly upstream, as evidenced by the lowest occupied Panpipe, or sightings of moribund or dead crayfish. By 26th September there were no crayfish below the confluence with the tributary coming from St George's Farm and only moribund individuals above there.

It is unfortunate that, although we took stringent precautions against bringing crayfish plague into Bell Brook, it is likely that our surveying effort progressed the plague upstream, although any of the other vectors previously mentioned could equally have been responsible. Manual surveying for crayfish requires the surveyor to enter the water, it is common for surveyors to work upstream to avoid the consequences of disturbed silt making visual observations difficult. Thus, it is likely that we inadvertently carried plague upstream as we surveyed.

Because the standard survey method requires the surveyor to enter the water in most cases, there is potential to transport plague upstream. Torching

surveys can be done from the bankside and pose a much lower risk of transmitting infection. The standard method is useful as it provides a measure of population diversity but the loss of a population is a risk and this should be avoided. It is suggested that non-invasive methods of survey (torching and eDNA) could provide useful information with less risk.

During the summer of 2016 three other streams in Shropshire, Herefordshire, Gloucestershire and Worcestershire suffered outbreaks of crayfish plague (email; D Throup [Environment Agency] 11/10/2016).

In conclusion, the use of Panpipes certainly showed promise as a survey method, but crayfish plague prevented the survey continuing as planned.

References

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Rhyacophila fasciata, Park Brook 4 May 2016 Roger Plant

Ecdyonurus sp., Park Brook 4 May 2016 Roger Plant