

2018 Update on the White-clawed Crayfish Population within Wyre Forest

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Introduction

Annual monitoring of native White-clawed Crayfish *Austropotamobius pallipes* in streams of the Wyre Forest commenced in 2010, the ninth survey being undertaken during 2018. In a departure from previous years, where four streams were surveyed, during the 2018 surveys only Bell Brook and Forest Lodge Streams were surveyed by torching. Kingswood and Longdon streams appear to have lost their White-clawed Crayfish populations in recent years; consequently efforts were concentrated on Forest Lodge Stream and Bell Brook. Environmental DNA (eDNA) surveys of all four streams were undertaken in February and Bell Brook in August.

White-clawed Crayfish are listed as 'endangered' in the IUCN Red List of Endangered Species (Füreder et al., 2017) with populations declining and it is likely that the species will be extinct throughout much of their range within the next few decades. White-clawed Crayfish are under threat from Crayfish Plague *Aphanomyces astaci*; competition from introduced alien species of crayfish; and degradation of habitats. White-clawed Crayfish are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). As an Annex II species under the European Union Habitats Directive, member states are required to maintain favourable conservation status through the selection of a series of European Sites. The White-clawed Crayfish is listed as a Species of Principal Importance in England under Section 41 of the Natural Environment and Rural Communities Act 2006 and is a Priority Species in the UK Biodiversity Action Plan (BAP). The UK BAP seeks to maintain the current distribution of the species through a combination of restricting the spread of non-native crayfish and Crayfish Plague, as well as providing suitable habitat features.

Methods

A detailed description of methods is provided in the annual Wyre Forest Study Group Reviews from 2010, 2011 and 2012 (Hill and Hill 2011; Hill and Hill 2012 and Hill 2013). Following the confirmation of Crayfish Plague in Bell Brook in 2016 (Hill, 2017), to reduce the possibility of cross contamination, only bankside torching surveys and environmental DNA (eDNA) sampling were undertaken in 2018. The torch survey followed published guidelines (Peay 2000) and best practice. Torching has been shown to provide an accurate reflection of population abundance.

The 2018 torch survey replicated as closely as possible surveys of previous years using the same surveyors and stream reaches, in addition to a previously inaccessible

reach of Forest Lodge Stream in the Helen Mackaness Nature Reserve. Torch survey work of Forest Lodge Stream and Bell Brook was undertaken between 13 August and 17 August 2018 by two licenced surveyors (Graham Hill and Ann Hill) and two assistants Mike Averill and Jane Scott. In all cases the personnel have been involved in surveys of these watercourses for several years. The eDNA survey of Bell Brook was undertaken on 1 February and 23 August by one licenced surveyor (Graham Hill) and an experienced eDNA surveyor (Chris Troth).

Comparison of observations across the years is interpreted using Catch per Unit Effort (CPUE) data as an index for long term monitoring of crayfish populations. The CPUE was calculated using only live animal data and duration of search (minutes) and is derived by dividing the number of crayfish seen by the survey period in minutes.

Results

The watercourses monitored in 2018 are presented in Figure 1 and the details described in the following text.

Habitat

Water levels in 2018 were very low, following a dry summer. Water clarity was good: in Forest Lodge Stream 95% of the bed was visible by torch and in Bell Brook between 95% and 100%. There appeared to be no substantial change to the stream channels of either stream, each providing suitable habitat for crayfish – coarse stony substrate, overhanging banks and tree roots.

Torching	FL Upper	FL Lower	FL HMR
Date	13/08/2018	15/08/2018	15/08/2018
Surveyors	AH GH JS MA	AH GH JS MA	AH GH JS MA
Start time	20:53	20:45	22:15
Finish time	21:45	21:56	22:34
Water temp		16.7	16.6
Water level	Very low	Very low	Very low
Visibility %	95	95	95
Survey Mins	00:52	01:11	00:19
Native Adult	10	78	3
Native Juvenile	9	77	5
Signal Adult	0	0	0
Signal Juvenile	0	0	0

Table 1. 2018 Crayfish survey results from Forest Lodge (FL) and Helen Mackaness reserve (HMR)

Forest Lodge Stream

Two surveys were undertaken of Forest Lodge Stream in 2018 by Ann Hill, Graham Hill, Mike Averill and Jane Scott. The upper part of the stream, above the driveway to Forest Lodge, was surveyed on 13 August 2018 between 20:53 and 21:45 (52 minutes) during which ten adult and nine juvenile White-clawed Crayfish were seen. The lower part of the stream

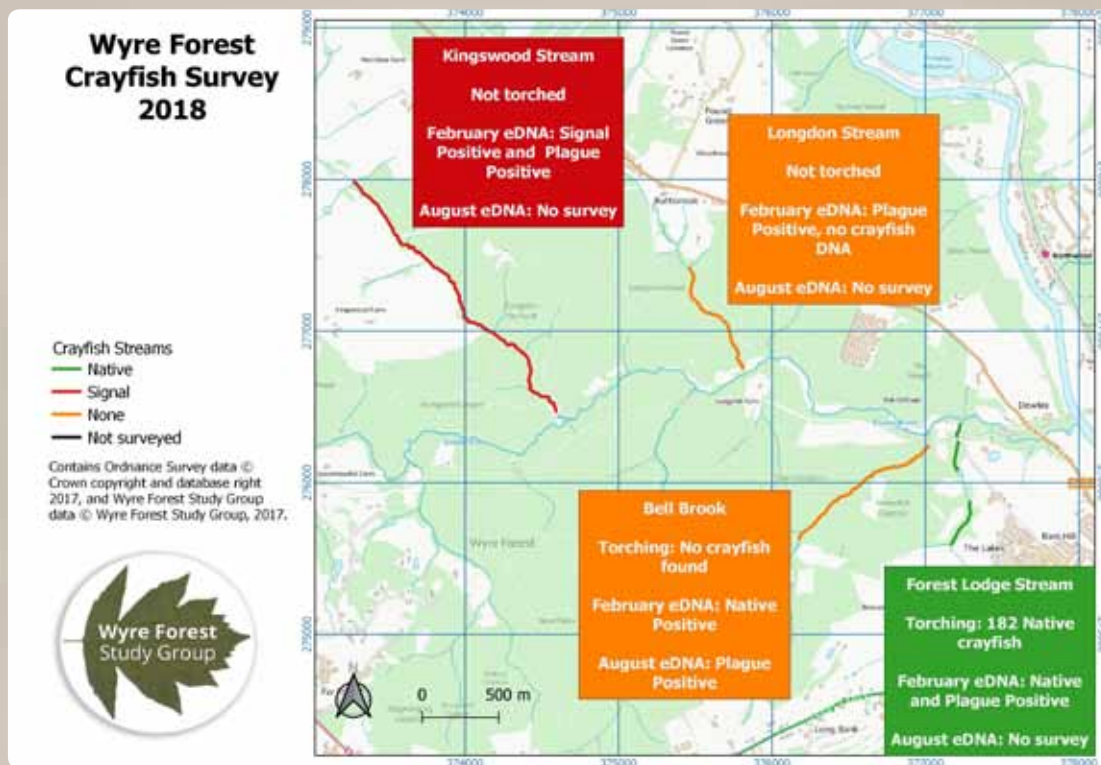


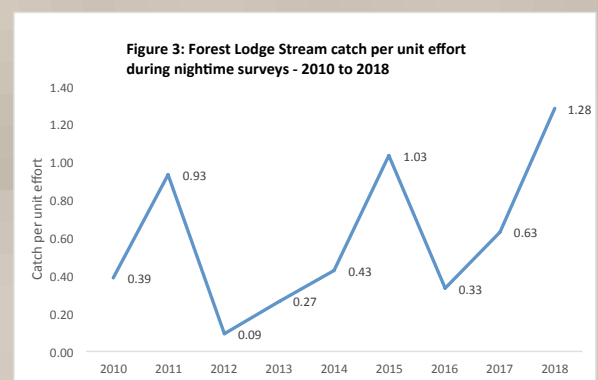
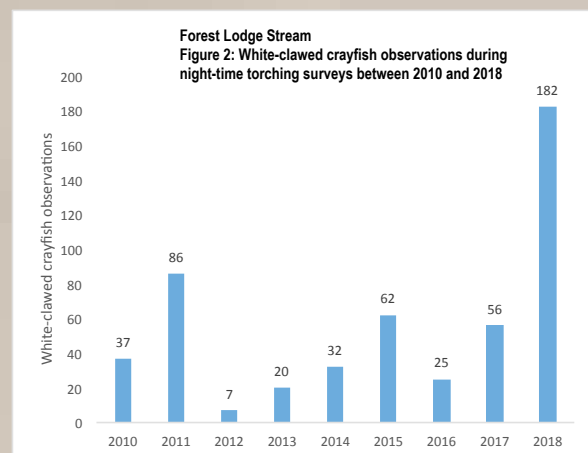
Figure 1: Location of watercourses surveyed in the Wyre Forest in 2018 showing results from each stream

was surveyed on 15 August 2018 between 20:45 and 21:56 (71 mins), 78 adult and 77 juvenile White-clawed Crayfish were seen, a total of 155 crayfish. The reach within the Helen Mackaness Reserve was surveyed on the same day between 22:15 and 22:34 (19 minutes), 3 adult White-clawed Crayfish were seen along with 5 juveniles. Bed visibility was generally good with 95% of the bed visible in each reach (Table 1).

A total of 182 White-clawed Crayfish were seen during the 2018 torch survey (Figure 2), the highest recorded in Forest Lodge Stream. The catch per unit effort value (1.28) is also the highest recorded (Figure 3), although the 2018 data includes the additional reach of Forest Lodge Stream in the Helen Mackaness Reserve, where eight crayfish were noted during 19 minutes of survey. The CPUE for the two upper reaches of Forest Lodge Stream alone was 1.41, this figure is directly comparable to previous surveys and shows a considerable increase in White-clawed Crayfish numbers.

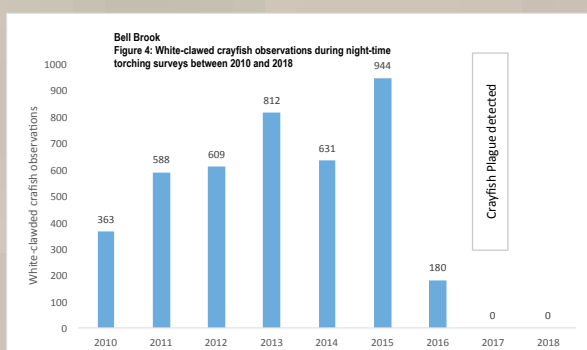
Bell Brook

A torch survey of Bell Brook was undertaken on 17 August 2018 by three surveyors (Ann Hill, Graham Hill and Jane Scott). Surveying started at 20:33 and concluded at 22:25. The brook was surveyed in six sections, all which had been used in previous years, but no crayfish were seen during the survey (Table 2, Figure 4).



Torching	BB 1	BB 2	BB 3	BB 4	BB 5	BB 6
Date	17/08/2018	17/08/2018	17/08/2018	17/08/2018	17/08/2018	17/08/2018
Surveyors	GH	AH JS	GH	AH JS	AH GH JS	AH GH JS
Start time	20:37	20:33	21:12	21:14	21:41	22:08
Finish time	20:50	20:54	21:35	21:27	22:00	22:25
Water temp °C	14.8					
Water level	Very low	Very low	Very low	Very low	Very low	Very low
Visibility %	100	95	100	100	90	100
Survey mins	00:13	00:21	00:23	00:13	00:19	00:17
Native Adult	0	0	0	0	0	0
Native Juvenile	0	0	0	0	0	0
Signal Adult	0	0	0	0	0	0
Signal Juvenile	0	0	0	0	0	0

Table 2. 2018 Crayfish survey results from Bell Brook (BB).



Environmental DNA (eDNA)

Environmental DNA is DNA which can be found within samples of water, soil, or air etc., in 2015 an eDNA survey identified White-clawed Crayfish DNA in Bell Brook (Troth 2016). On 1 February 2018 eDNA surveys were conducted on Bell Brook, Forest Lodge Stream, Longdon Stream and Kingswood Stream. On 26 August 2018, four locations on Bell Brook were also surveyed with eDNA sampling.

In February 2018, following protocols used in previous years (Troth 2018) water samples were taken from Bell Brook, Forest Lodge Stream, Longdon Stream and Kingswood Streams. The samples were divided into 12 replicates and analysed in the laboratory using a process called real-time PCR (qPCR) to identify DNA of White-clawed crayfish, Signal Crayfish or Crayfish Plague (Table 3).

Location	Grid Reference	Native DNA	Signal DNA	Plague DNA
Longdon Stream	SO 75796 76788	0	0	1/12
Kingswood Stream	SO 74582 76485	0	1/12	1/12
Forest Lodge Stream	SO 77211 76251	1/12	0	1/12
Bell Brook	SO 77006 76228	1/12	0	0

Table 3. Results of DNA analysis of water samples from four streams in the Wyre Forest in February 2018. (The values show the number of qPCR replicates testing positive)

White-clawed crayfish DNA was identified from one sample in each of Forest Lodge Stream and Bell Brook; Signal Crayfish DNA from one sample from Kingswood Stream and Crayfish Plague from Longdon, Kingswood and Forest Lodge Streams. The samples were taken in

the winter period as part of testing the protocols for the eDNA sampling procedure. It was no surprise to find White-clawed Crayfish DNA in Forest Lodge Stream because a population had been noted in the previous summer, but it was a surprise to find White-clawed Crayfish DNA in Bell Brook though. Signal Crayfish have been seen in Kingswood Stream in recent years. Finding Crayfish Plague DNA in Longdon and Forest Lodge Streams was a surprise, especially the latter as there is a good population of native crayfish present.

On 23 August, Bell Brook was further investigated because in 2017 crayfish plague DNA was identified in the samples (Hill 2018, Troth 2018). This was a surprise because plague was thought to have killed all the native crayfish in Bell Brook in 2016, therefore, in theory if plague DNA was present, then crayfish should also be present – unless the result was a ‘false positive’. To determine if crayfish plague was still present within Bell Brook, water samples were taken from four locations – Table 4.

eDNA	Bell Brook 1	Bell Brook 2 St Georges Stream	Bell Brook 3	Bell Brook 4
Grid Ref.	SO 76113 75487	SO 76179 75675	SO 76487 75928	SO 76925 76156
Date	23/08/2018	23/08/2018	23/08/2018	23/08/2018
Surveyors	GH CT	GH CT	GH CT	GH CT
Time	10:04	10:27	10:44	11:08
Water level	Low	Low	Low	Low
Native DNA	Negative	Negative	Negative	Negative
Signal DNA	Negative	Negative	Negative	Negative
Plague DNA	Negative	Positive	Negative	Negative

Table 4: Location of eDNA sample points along Bell Brook, August 2018, with results of DNA analysis

Water sampling was undertaken using a newly developed single use filter system (Figure 5). A sterile ladle was used to collect 1L of water from each sampling location. Using a plastic syringe, a minimum of 150ml of this collated sample was then forced through a microporous filter unit (pore size 0.45µm, similar to those used in personal water purification systems). The filter collects fine waterborne particles which are preserved for later analysis. The samples were then divided into 6 replicates and then analysed in the laboratory using qPCR (Troth 2018) to detect the presence of target species DNA.

The August 2018 eDNA analysis suggests that, in Bell Brook, no Native or Signal Crayfish are present, however, Crayfish Plague was detected in one of the sites - St George's Stream (2/6 qPCR replicates) near to the footpath alongside Bell Brook.

Discussion

A round of eDNA sampling was undertaken in February 2018 as part of the testing procedures for the sampling method. Finding White-clawed Crayfish DNA in

samples from Forest Lodge Stream was not unexpected, however, finding it in Bell Brook was a surprise (Table 3). It is considered unlikely that White-clawed Crayfish have survived in Bell Brook, which is supported by eDNA sampling in August when negative results were obtained from all four samples. The possibilities are that the White-clawed Crayfish DNA has persisted for longer than expected or that this is a 'false positive'. Finding Signal Crayfish and Crayfish Plague DNA in Kingswood Stream is not unexpected, Signal Crayfish have been seen in the stream in recent years. Crayfish Plague was also found in Longdon Brook, although no crayfish DNA has been isolated for that location, and in Forest Lodge Stream – this is a real worry, if the finding is accurate. The round of summer surveys of Forest Lodge Stream found a good population of White-clawed Crayfish present in the stream, both upstream and downstream of the eDNA sampling point. This suggests that the February 2018 result was a 'false positive'.

For the 2018 torching surveys it was decided not to include Longdon Stream and Kingswood Stream because White-clawed Crayfish had not been identified in either stream after a period of decline since the crayfish surveys started in 2011. Kingswood Stream had been invaded by Signal Crayfish in 2016 (Hill and Hill, 2017) and no Native Crayfish had been located in Longdon Stream since 2015 and in both cases eDNA analysis had been negative for native crayfish in 2017. Further, both streams were difficult to access at night and it was considered that it was unlikely that native crayfish remained in the streams and therefore surveying for them was unnecessary.



Figure 5. Syringe filter system used for DNA sampling in Bell Brook 2018
Chris Troth

Forest Lodge Stream contains a good population of Native Crayfish, both upstream and downstream of the track to Forest Lodge, there was an increased number to 182. In 2018 it was possible to survey the part of Forest Lodge Stream that flows through the Helen Mackaness Nature Reserve. It was good to find both adult and juvenile Native Crayfish in that reach of the stream. Worcestershire Wildlife Trust are now actively managing the reserve, partly for the benefit of native crayfish, which is good news, although the possibility of public access from Dowles Brook (Signal Crayfish and Crayfish Plague) remains a concern. There was a steady increase in numbers of White-clawed Crayfish between 2012 and 2015, it is good to see that native crayfish are thriving with increasing numbers.

Physical surveys of Bell Brook again failed to detect the presence of any crayfish, despite careful observations. This was supported by eDNA analysis from four places on the brook, this strongly suggests that the arrival of Crayfish Plague in the brook in 2016 has eradicated all White-clawed Crayfish. The results also suggest that Signal Crayfish are not present, although this is more difficult to be sure of, the apparent absence of Signal Crayfish is welcomed. Habitat for crayfish remains good throughout the length of the surveyed stream.

However, analysis of water samples from the lower end of St George's Stream showed that two of the six replicates tested positive for the presence of Crayfish Plague. This suggests that plague DNA is present there in small quantities, and raises some interesting issues. Crayfish Plague requires a crayfish host species as part of its lifecycle, surveys suggest that no crayfish are present in the stream, so why does plague persist? There is the possibility that the DNA has survived for up to two years before being collected; or that crayfish plague is hosted by another organism – although none are known. It is possible that plague is being transferred to this small stream by animals that have been into a plague infected waterbody and carrying the waterborne organism to St George's Stream. The sampling point is a few metres upstream of a footpath which is well used by walkers, cyclists and dogs, any one of them could have been in an infected stream and carried the plague on boots or clothing, tyres or fur. Although there is no proof, it is likely that the original plague outbreak in Bell Brook was instigated by similar means.

Without Signal Crayfish in Bell Brook there may be an opportunity to re-locate native crayfish into the brook to replace those lost in 2016. However, the presence of Crayfish Plague DNA in St George's Stream would introduce a potentially fatal risk to the re-introduced

crayfish, and suggests that the original cause of the Bell Brook infection is still present and would have to be removed before re-introduction of native crayfish. If human activity is responsible for the plague introduction then access to the stream would have to be carefully managed or eliminated first – and that could be a challenge.

Conclusion

Native crayfish are still present in Forest Lodge Stream, and whilst this is good news, the White-clawed Crayfish is still vulnerable to extinction locally. Crayfish Plague has been identified in a tributary to Bell Brook, which may have been introduced by visitor activity in the forest. The decline of the native crayfish, the expansion of Signal Crayfish populations and the spread of Crayfish Plague in the Wyre Forest seems to mirror the general national situation.

References

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Harvest Mouse breeding nest along hedge, Button Bridge, 26 November 2018

Rosemary Winnall