

Crayfish of Wyre Forest - an update

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1. Introduction

Hills Ecology Ltd was commissioned by the Forestry Commission to map the distribution of White-clawed Crayfish *Austropotamobius pallipes* in Dowles Brook and associated tributaries, Wyre Forest. The White-clawed Crayfish is the only native species of crayfish in the British Isles. It is under threat and decreasing in range. Research suggests that the White-clawed Crayfish has declined by 60% in the UK (Holdich, Reynolds, Souty-Grosset and Sibley 2009).

2. Method

Survey work was undertaken by two licensed surveyors and several assistants between 3 August and 4 October 2011 following published guidelines and best practice (Peay 2002). All licence conditions were complied with. Information on the known distribution of crayfish in the Dowles Brook catchment was obtained from existing records held by the Wyre Forest Study Group and Worcestershire Biological Records Centre.

A qualitative appraisal of likely White-clawed Crayfish habitat (and preliminary daytime safety check) was undertaken of all forty-three waterbodies within the stream network of the Grow with Wyre area. Parts of the River Rea and Gladder Brook, which are not watercourses situated within the Dowles Brook catchment but do flow within the Grow with Wyre project area, were also included in the survey. A small number of the smaller tributaries were not surveyed because of access permissions. The detailed results of the habitat appraisal were recorded on standard crayfish habitat survey cards. Habitat features were marked on to the survey map, annotated with notes on features which are favourable and unfavourable as crayfish habitat.

Night-time torching (using a 15-minute timed search) was undertaken of twenty waterbodies that the habitat appraisal found to have the suitable combination of habitat and flow conditions to, potentially, support crayfish. Crayfish were identified to species. Where there was uncertainty over identification, individuals were caught to confirm species identity. All active adult and juvenile crayfish were recorded. For bio-security reasons no further survey effort was made of those watercourses where non-native crayfish species was recorded. Where terrain and access issues allowed, all surveys were undertaken starting at the downstream end of a reach.

A standard daytime manual search was made of all those waterbodies where evidence of White-clawed Crayfish had been found during the night-time torching

survey: Bell Brook, Forest Lodge Stream, Kingswood Stream and Longdon Stream. In addition a standard daytime manual search was also undertaken of five waterbodies where doubt remained as to the presence of White-clawed Crayfish: Lem Brook, Withybed Stream, an upstream reach of Baveney Brook, Doghanging Tributary 1 and the lower reach of Doghanging Stream. One 100 m sampling site was surveyed in a 500 m stretch of each tributary. Five areas of habitat considered being the most favourable for crayfish were selected within each 100 m sampling site and 10 potential refuges were manually searched in each habitat patch. In some tributaries it was possible to survey more than one 500 m stretch of a tributary, but this was dependent on access permissions and tributary characteristics. All crayfish caught were recorded for species, sex and size. Carapace length (CL) of all live and dead crayfish was recorded to nearest mm, measured from tip of rostrum to junction of carapace and tail. In addition, signs of disease etc. were noted. No non-native crayfish were returned to the stream (a legal requirement). No standard daytime manual search was made of Gladder Brook and the River Rea because these had been additional waterbodies to the commissioned work and the study was at the end of the recommended survey season. Baited traps replaced a daytime manual search in those waterbodies where the water was >0.5 m deep: Dowles Brook, Forest Lodge Stream Pool, Lem Brook, River Rea, a small pool below St. Georges Farm and Unclys Pool. Environment Agency approval to use traps was obtained.

In addition, the 2010 baseline survey of Bell Brook and Forest Lodge Stream was repeated in 2011 using the same team of surveyors, the same number and location of sample stretches and the same amount of survey effort. The aim was to detect any change in the White-clawed Crayfish population since the 2010 study.

According to Environment Agency data (2009) Dowles Brook has water quality of Chemistry A (very good) and of Biology B (good) which is within the parameters suitable for White-clawed Crayfish (Environment Agency General Quality Assessment biological class A or B, Peay 2002). Water pH measurements were similar across all watercourses (Kruskal-Wallis test, sig. = 0.075, p = n.s, n = 78) and ranged between 7.0 pH and 8.50 pH with an average 8.04 water pH. The measurements were within the water pH levels (6.5–9.0) suitable to support White-clawed Crayfish (Holdich 2003). Water temperature ranged between 11°C and 19.9°C with an average water temperature of 15.04°C. The distribution of water temperature across all the waterbodies was significantly different

(Kruskal-Wallis test, sig. = 0.011, $p = 0.05$, $n = 79$). However, differences would be expected given the range of waterbodies tested i.e. from standing water to running water, from smaller tributaries to the larger brooks such as Dowles Brook and Baveney Brook. Nevertheless, all water temperatures were above the recommended 8°C, which was important as surveys have poorer results when the water temperature is less than 8°C, as crayfish are less active and deeper in their refuges (Peay 2002).

The study sampled twenty-three percent of the available channel length (17.2 km from a total channel length of 74.6 km). It was not possible to sample the entire length of every watercourse (difficult terrain, fallen timber and dense vegetation with associated health and safety issues prevented survey in places) but by using the recognised survey protocol (Peay 2002) it was ensured that a representative sample was undertaken. No constraints regarding climatic conditions were identified during the survey and there were no periods of increasing or high river flow.

3. Pre-existing information

There have been three detailed crayfish surveys within the study area since 1987.

3.1. 1987 - J Bingham (Natural England) Crayfish Survey of Dowles Brook and Associated Tributaries

John Bingham from Natural England undertook a survey of Dowles Brook and associated tributaries for White-clawed Crayfish in 1987, Figure 1. The 1987 survey found White-clawed Crayfish present along

Dowles Brook and within many of the tributaries. Alien crayfish are not noted as being present. In the year following John Bingham's survey, an unpublished PhD thesis (Reevel 1990) identifies crayfish plague as being responsible for the mortalities of White-clawed Crayfish in the Dowles Brook catchment of the Wyre Forest in 1988.

3.2. 2000 – K Linck (Worcestershire Wildlife Trust) Crayfish Survey of Worcestershire

In 2000 a county-wide study of White-clawed Crayfish across Worcestershire surveyed seven watercourses within Dowles Brook catchment and found one population of White-clawed Crayfish (Linck 2000). The 2000 survey made the following records: i) Bell Brook – 8 White-clawed Crayfish (4 female adults; 1 male adult, 2 dead adults and 1 escapee) from 45 minutes stone turning. Searched 20 m below pools for 30 minutes and no crayfish found; ii) Dowles Brook – 6 traps set near confluence with River Severn – no crayfish; iii) Doghanging Stream (between confluence and footbridge) - searched 35 m for 50 minutes and no crayfish found; iv) Lem Brook - searched 40 m for 30 minutes plus 6 traps and no crayfish found; v) Lem Brook Betts Reserve - trapped and searched whole length of brook through reserve and no crayfish found; vi) Doghanging Stream - searched 40 m for 60 minutes and no crayfish found; and vii) Park Brook - no crayfish found.

3.3. 2010 – Hills Ecology Baseline Crayfish Survey of Bell Brook and Forest Lodge Stream

More recently, a baseline crayfish survey of two tributaries of Dowles Brook in August 2010 (Hill 2010)

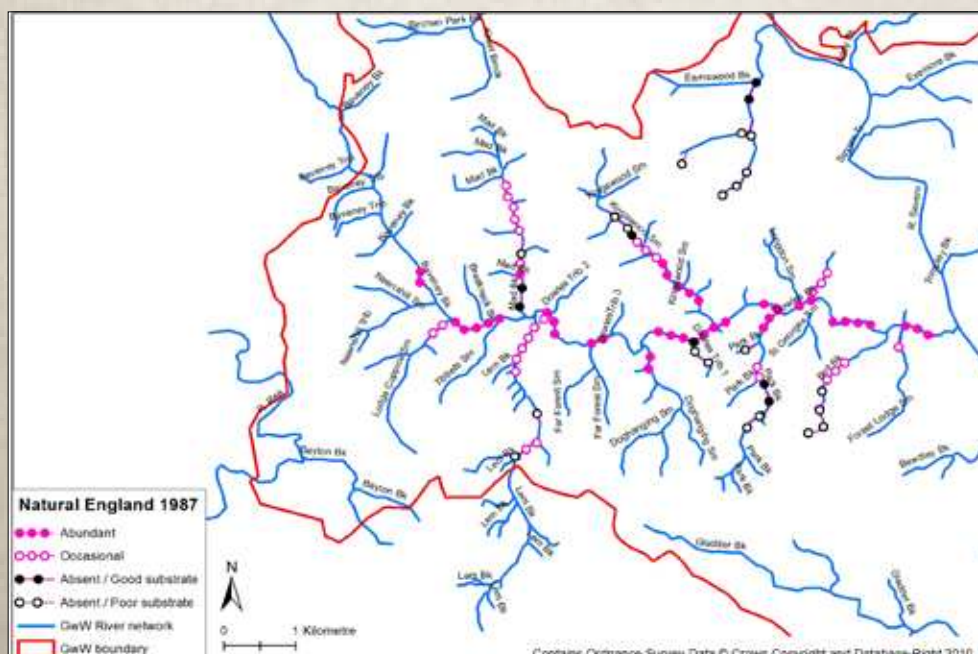


Figure 1: John Bingham, Natural England crayfish survey of Dowles Brook, dated 1987.

recorded crayfish as follows: a) Bell Brook - 2 male + 8 female White-clawed Crayfish daytime manual survey and 187 adults + 179 juvenile White-clawed Crayfish from a night-torching survey; and b) Forest Lodge Stream - 1 male White-clawed Crayfish daytime manual survey and 21 adults + 16 juvenile White-clawed Crayfish from night-torching survey.

4. Field survey

4.1. Habitat Appraisal

Dowles Brook and associated tributaries was found to have potential for crayfish in 56% of the waterbodies appraised. Nineteen watercourses had no running or standing water on the day of survey and were considered unsuitable to support crayfish: these

Waterbody	Habitat Evaluation	Habitat Score ¹	Further Survey Required
Baveney Brook	Variable: Frequent to Abundant habitat, present but mostly unsuitable with marginal possibilities, poor habitat with abundant bedrock and low instream habitat	3	Yes
Baveney Tributary 4	Poor habitat: not suitable, watercourse dry or insufficient	0	No
Baveney Tributary 6	Poor: watercourse dry	0	No
Baveney Tributary 8	Poor: habitat with a bare trickle of water; refuges poor to absent	0	No
Bell Brook	Frequent - Abundant	3	Yes
Bell Brook Pool	Frequent	2	Yes
Doghanging Stream	Frequent - Abundant	3	Yes
Doghanging Tributary 1	Present - low - negligible habitat suitability	1	Yes
Doghanging Tributary 2	Poor - Present: no submerged banks and little in-stream refuges; watercourse and habitat potential reduced; water depth almost too shallow	1	Yes
Doghanging Tributary 3	Poor habitat - too shallow	0	No
Doghanging Tributary 4	Poor habitat - dry	0	No
Dowles Brook	Variable: Poor - frequent - abundant	3	Yes
Dowles Tributary 1	Variable: Frequent downstream but rapidly reduced upstream to Poor to non-existent with bankside refuges	2	Yes
Dowles Tributary 2	Poor: watercourse dry; in-stream habitat: low, vegetation in gaps in bedrock; silt in places; bankside habitat: moderate with tree roots and overhangs	0	No
Dowles Tributary 3	Poor: not favourable, channel full of leaf litter and dry	0	No
Dowles Tributary 4	Poor: instream refuges: few, bankside refuges: overhanging tree roots	0	No
Far Forest Stream	Poor - Present: tiny amounts of water/pools but no regular water with imperceptible flow	1	Yes
Far Forest Tributary	Poor: unsuitable	0	No
Forest Lodge Stream	Frequent - Abundant: gabions installed in places	3	Yes
Forest Lodge Stream Pool	Present	1	Yes
Gladder Brook	Present to Frequent but not abundant	2	Yes
Great Bog tributaries	Poor - none - negligible: not favourable; instream refuges were rare; bankside refuges: occasional overhanging banks and vegetation	0	No
Kingswood Stream	Varied: Poor (downstream) - Present - Frequent - Abundant	3	Yes
Lem Brook	Frequent - Abundant	3	Yes
Lodge Coppice Stream	Variable: low (upstream) to excellent (downstream)	3	Yes
Lodge Coppice Tributary 2	Poor: habitat dry	0	No
Longdon Stream	Varied: mainly Frequent to Abundant, upstream becomes less favourable; gabions installed upstream	3	Yes
Mad Brook	Present - Abundant	3	Yes
Mad Tributary 2	Poor: low in stream flow; not suitable habitat; too silty; moderate bank side habitat; high-energy flow	0	No
Mad Tributary 7	Poor: not favourable	0	No
Mad Tributary 8	Poor: unsuitable habitat, insufficient flow	0	No
Neenshill Stream	Poor: habitat more reflective of standing water; in-stream habitat low	1	Yes
Neenshill Tributary	Poor: not suitable, very low flow - damp substrate	0	No
Park Brook	Present - Frequent: white foam and oily scum on the water surface	2	Yes
Park Brook Tributary 1	Poor: only minimal potential for refuges; substrate was wet but had no flow; no submerged banks and little in-stream refuges	0	No
Park Brook Tributary 2	Poor: no flowing water only muddy substrate	0	No
Park Brook Tributary 3	Poor: very little flow, no crayfish habitat	0	No
River Rea	Present - Frequent - Abundant	3	Yes
Small pool below St Georges Farm	Poor	1	Yes
St George's Stream	Poor: no water; bed dry and covered in leaves; ephemeral water course	0	No
Tibbet's Stream	Present: not suitable; habitat sparse	1	Yes
Unclys Pool	Present - frequent	2	Yes
Withybed Stream	Variable: Present to Frequent upstream; downstream the habitat was poor with only minimum potential for refuges; a number of natural steps in the downstream reach were good barriers; channel has some capability but low flow and decreasing water levels decreases favourability of the habitat; between pool little flow	2	Yes

Table 1: A summary of crayfish habitat in individual watercourses within Dowles Brook and associated tributaries, Wyre Forest, Worcestershire/Shropshire. Key: ¹ Evaluation of crayfish habitat for whole watercourse (Habitat Score: 0 = none, 1 = present, 2 = frequent, 3 = abundant).

watercourses were not surveyed further. A summary of the habitat appraisal is given in Table 1.

4.2. Crayfish Records

A total of twenty night-time torching surveys (fifty-six 15-minute timed searches); six trapping sessions (105 baited traps); and ten manual standard surveys (370 refuges) were undertaken. The survey effort produced a total of 850 White-clawed Crayfish records and 119 American Signal Crayfish records during 2011. It is important to remember that the aim of the study was to map the distribution of White-clawed Crayfish and therefore, less survey effort was spent on surveying watercourses found to have non-native crayfish populations and hence lower numbers of non-native crayfish are to be expected. A summary of the records from all the surveys is given in Table 2.

Watercourse	Date	Method	Records	
			Native Crayfish	Signal Crayfish
Baveney Brook	16/08/2011	Torching	0	6
	12/08/2011	Casual	17	0
	15/08/2011	Casual	37	0
Bell Brook	24/08/2011	Standard	27	0
	19/09/2011	Torching	4	0
	31/08/2011	Torching	588	0
Bell Brook Pool	31/08/2011	Torching	4	0
Doghanging Stream	15/09/2011	Standard	0	9
	03/08/2011	Torching	0	93
Dowles Brook	20/08/2011	Torching	0	2
	15/09/2011	Casual	0	1
	02-03/09/11	Trap	0	3
	03-04/09/11	Trap	0	1
Forest Lodge Stream	24/08/2011	Rescue	46	0
	25/08/2011	Torching	59	0
	01/09/2011	Torching	27	0
Kingswood Stream	27/08/2011	Standard	13	0
	23/08/2011	Torching	19	0
Lodge Coppice Stream	17/08/2011	Torching	0	2
Longdon Stream	30/08/2011	Standard	1	0
	30/08/2011	Torching	8	0
Mad Brook	22/08/2011	Torching	0	2

Table 2: Crayfish recorded within Dowles Brook and associated tributaries, Wyre Forest, Worcestershire/Shropshire during August to October 2011 using different survey methods.

4.3. Crayfish Distribution

The meta-population of White-clawed Crayfish was concentrated within the east of the Wyre Forest and in the downstream tributaries of Dowles Brook, Figure 2. American Signal Crayfish were detected in watercourses within the west of the Wyre Forest. Above Furnace Mill, the upstream limit of detection of American Signal Crayfish was at the confluence of Lodge Coppice Stream and Baveney Brook. The downstream limit of detection of American Signal Crayfish was where the forestry road crosses Dowles Brook, near to the Mercian Way signpost.

The overall crayfish distribution was as follows:

- White-clawed Crayfish in four watercourses: Bell

Brook (including Bell Brook Pool), Forest Lodge Stream, Kingswood Stream and Longdon Stream.

- American Signal Crayfish in five watercourses: Baveney Brook, Doghanging Stream, Dowles Brook, Lodge Coppice Stream and Mad Brook.
- Suitable crayfish habitat was present but crayfish were absent or undetected in ten waterbodies: Doghanging Tributary 2, Dowles Tributary 1, Far Forest Stream, Gladder Brook, Lem Brook, Neenshill Stream, Park Brook, River Rea, Tibbet's Stream and Withybed Stream.

4.4. Crayfish Abundance

Relative abundance of crayfish was calculated as the number of crayfish per ten refuges searched (Catch per Unit Effort, CPUE). During the daytime manual survey Bell Brook had the highest CPUE of White-clawed Crayfish and Doghanging Brook had the highest CPUE of American signal crayfish, Figure 3.

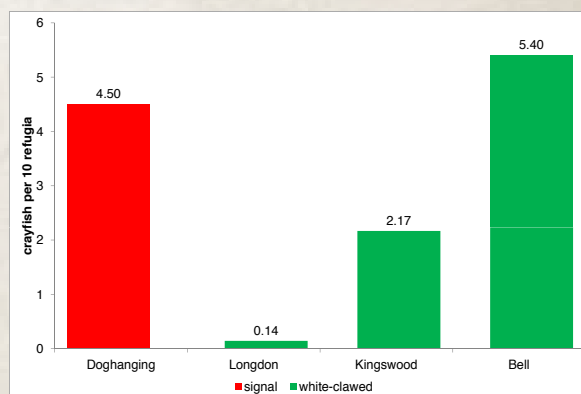


Figure 3: Relative abundance of crayfish per ten refuges (Catch per Unit Effort) (using standard manual daytime search method) recorded in Dowles Brook and associated tributaries, Wyre Forest, Worcestershire/Shropshire during August to October 2011.

The four watercourses were graded on the basis of CPUE categories determined from standard surveys undertaken nationally (Peay 2002). The grading for the study site as a whole was between low and very high abundance:

- Bell Brook: A CPUE of 5.4 which equates to a very high population of White-clawed Crayfish (i.e. very high >5 CPUE, Peay 2002).
- Kingswood Stream: A CPUE of 2.17 which equates to a moderate population of White-clawed Crayfish (i.e. moderate ≥ 1 , <3 CPUE, Peay 2002).
- Longdon Stream: A CPUE of 0.14 which equates to a low population of White-clawed Crayfish (i.e. low >0, <1 CPUE, Peay 2002).
- No comparison could be made with the numbers of White-clawed Crayfish in Forest Lodge Stream because the standard manual day-time survey became a rescue operation to move stranded White-clawed Crayfish (and fish) to pools within the same tributary. However,



Figure 2: Location of native and non-native crayfish populations in Dowles Brook and tributaries, Wyre Forest, Worcestershire/Shropshire recorded between August and October 2011.

it was likely from the numbers recued in the day-time survey (46 individuals) that the stream would be classed as having a high population (i.e. ≥ 3 , ≤ 5 CPUE, Peay 2002) of white-clawed crayfish.

Bell Brook had the highest CPUE of White-clawed Crayfish and Doghanging Brook had the highest CPUE of American Signal Crayfish recorded during night-time torching surveys, Figure 4. There is no nationally recognised measure to compare the relative abundance from night-torching surveys.

4.5. Crayfish Size Distribution

The White-clawed Crayfish carapace length (CL) of individuals caught and measured ranged between 8.0 mm and 39.1 mm in Bell Brook, 10.8 mm and 40.2 mm in Forest Lodge Stream and 12 mm and 35 mm in Kingswood Stream. Juvenile is taken as size < 25 mm CL. There was no significant difference between the White-clawed Crayfish CL of individuals caught and measured in Bell Brook, Forest Lodge Stream and Kingswood Stream (Kruskal-Wallis test, sig. = 0.685, $p = n.s.$, $n = 107$). The carapace size distribution of the population of White-clawed Crayfish indicates a) a stable population in Bell Brook (skewness -0.074); and b) a recruiting population in Forest Lodge Stream (skewness +0.212),

Figure 5. There were too few observations (< 30 observations) to comment on population status in Kingswood Stream and no White-clawed Crayfish were measured in Longdon Stream (all escapees).

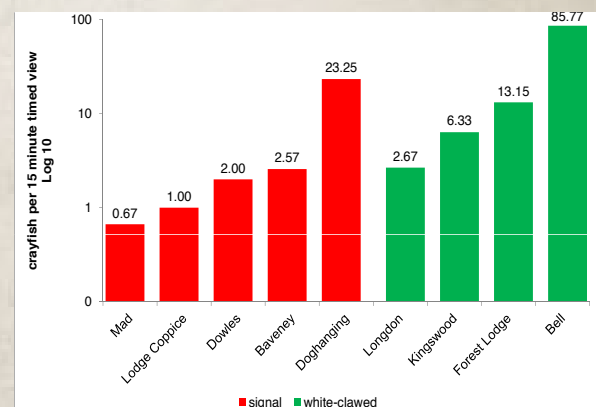


Figure 4: Relative abundance of crayfish per 15-minutes of night-torching (Catch per Unit Effort) recorded in Dowles Brook and associated tributaries, Wyre Forest, Worcestershire/Shropshire during August to October 2011.

4.6. Monitoring Study

4.6.1. Crayfish Observations

There was a non-significant increase in both the day-time and night time observations of White-clawed

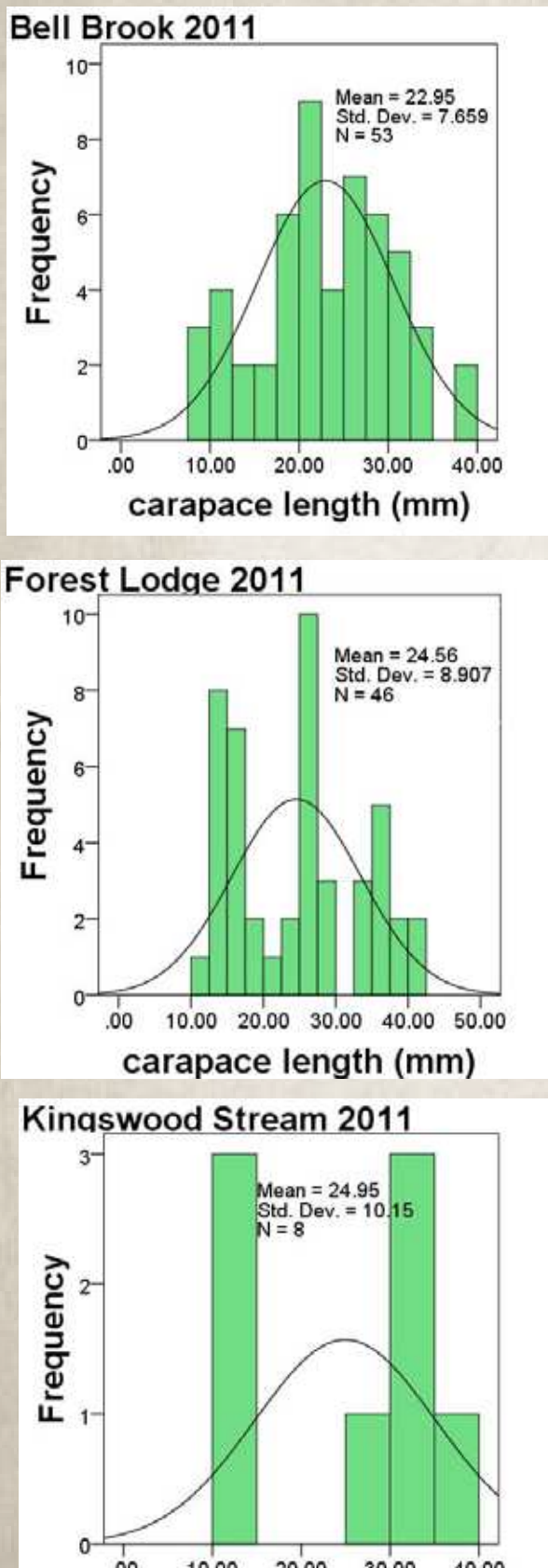


Figure 5: Histogram showing size distribution (carapace length) of White-clawed Crayfish population in three tributaries of Dowles Brook, Wyre Forest, Worcestershire/Shropshire.

Crayfish in Bell Brook (Kruskal-Wallis test, sig. = 0.609, $p = n.s.$, $n = 32$), Figure 6. There was a statistically significant increase in the numbers of individual White-clawed Crayfish recorded in Forest Lodge Stream in 2011 from the numbers recorded in 2010 (Kruskal-Wallis test, sig. = 0.034, $p = 0.05.$, $n = 16$). Absence of water and low flow conditions prevented replication of the 2010 survey in Forest Lodge Stream in 2011. Instead stranded dying crayfish (and fish) were rescued and transferred to small in-stream pools.

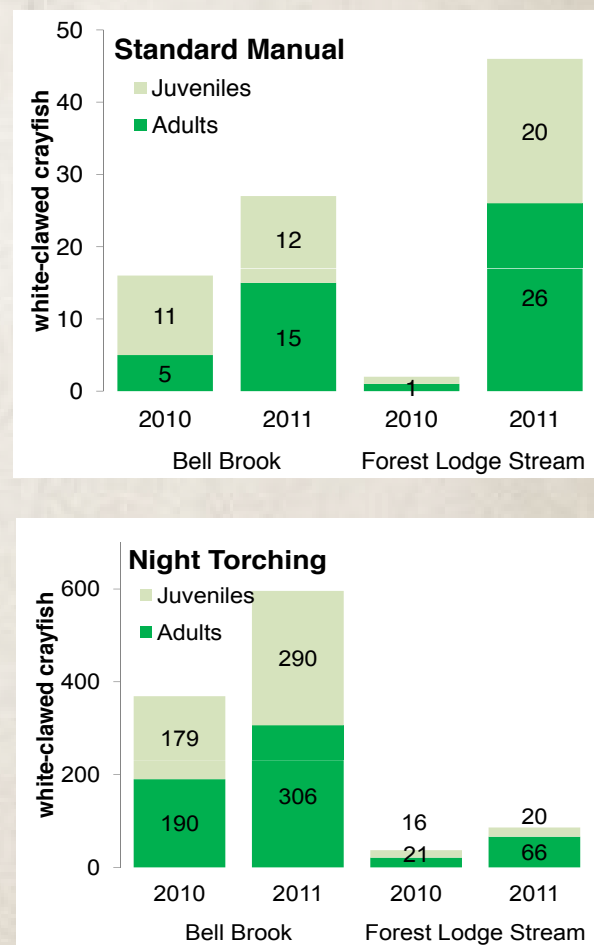


Figure 6: Comparison of White-clawed Crayfish records observed in Bell Brook and Forest Lodge Tributary, Wyre Forest in 2010 and 2011.

4.6.2. Crayfish Abundance

The Catch per Unit Effort (CPUE) increased in both Bell Brook and Forest Lodge Stream. The relative crayfish category increased from 'high' population abundance in 2010 to 'very high' population abundance of White-clawed Crayfish in Bell Brook in 2011, Table 3. The relative abundance of White-clawed Crayfish in Forest Lodge Stream was 'low' population in 2010 and as discussed previously in this report, the population abundance would now be classed as a 'high'.

Watercourse	Catch per Unit Effort			
	2010		2011	
	number per 15 mins	number per 10 refuges	number per 15 mins	number per 10 refuges
Bell Brook	42.73	3.2	85.77	5.4
Forest Lodge Stream	4.59	0.4	13.15	n/a

Table 3: Comparison of relative abundance of white-clawed crayfish recorded per unit effort searched between 2010 and 2011 in Bell Brook and Forest Lodge Stream, Wyre Forest.

Watercourse	Male: Female Ratio	
	2010	2011
Bell Brook	2M:8F (1:4)	19M:33F (1:1.7)
Forest Lodge Stream	1M:0F (n/a)	29M:14F (1:0.5)

Table 4: Ratio of male and female white-clawed crayfish records over two recording years (2010 and 2011) from two tributaries of Dowles Brook, Wyre Forest. Key: M = Male; F = Female.

4.6.3. Crayfish Population Structure

There is no significant change in carapace lengths of White-clawed Crayfish measured between 2010 and 2011 in either Bell Brook (Kruskal-Wallis test, sig. = 0.852, n.s., n=58) or Forest Lodge Stream (Kruskal-Wallis test, sig. = 0.536, n.s., n=48), Figure 7.

Interestingly, more males than females were recorded in Forest Lodge Stream in both 2010 and 2011 and more females than males were recorded in Bell Brook in 2010 and 2011, Table 4.

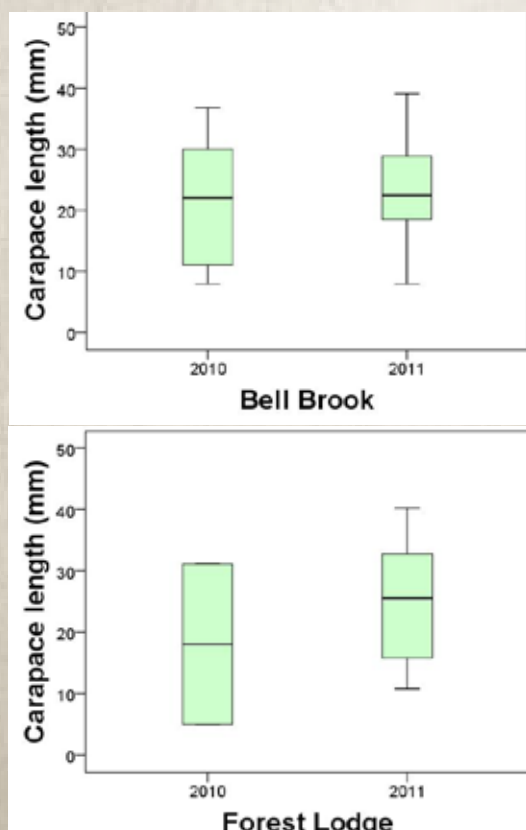


Figure 7: Comparison of White-clawed Crayfish carapace length between 2010 and 2011 in Bell Brook and Forest Lodge Stream, Wyre Forest.

5. Discussion

Historically, White-clawed Crayfish were widely distributed in the catchment of the Dowles Brook, in both the main river and the tributaries, until the population was thought to be lost following the outbreak of crayfish plague in 1988. This 2011 study has proved that Dowles Brook catchment supports at least four discrete populations of White-clawed Crayfish. Two populations were discovered and recorded in 2010 but the populations in Kingswood Stream and Longdon Stream are important results for the 2011 study. The population in Kingswood Stream is possibly a re-emergence of a relict population: the reasons for the re-emergence are unknown. However, there are no known historical records for Longdon Stream, so this is a significant new record of a White-clawed Crayfish population for the Dowles Brook catchment. Bell Brook has a very high and stable population of White-clawed Crayfish whilst Forest Lodge Stream (a more seasonal and ephemeral stream) has a high and recruiting population. Kingswood Stream and Longdon Stream have a moderate and low population of White-clawed Crayfish respectively. It is unknown whether the existing low population in Longdon Stream is a decreasing population, a colonising population or a population suffering from some environmental factor that is limiting population growth.

The main threats and pressures to the favourable conservation status of the White-clawed Crayfish in the catchment are the non-native American Signal Crayfish and the associated disease *Aphanomyces astaci* crayfish plague, water quality (especially in Kingswood Stream) and to a lesser extent climate change (particularly in Forest Lodge Stream).

The stronghold for American Signal Crayfish is Doghanging Stream and around its confluence with Dowles Brook. The extent and speed that American

Signal Crayfish will colonise upstream and downstream is unclear: American Signal Crayfish are likely to be at low abundance at the leading edge of invasion and the rate of invasion might be in the range 1-2 km per year depending on habitat suitability and time since introduction. The substantial waterfall at Furnace Mill does provide a major obstacle to migration but alien crayfish were both upstream and downstream of the waterfall. Any non-native crayfish above the barrier at Furnace Mill must have arrived via the headwaters of Baveney Brook suggesting either deliberate introduction or perhaps accidental translocation with fish movements. Expansion of the American Signal Crayfish populations in the Dowles Brook catchment is predicted and preventing the aliens from invading Bell Brook, Forest Lodge Stream, Kingswood Stream and Longdon Stream is imperative. Consequently, it is critical to the safeguarding of White-clawed Crayfish population in Wyre that measures are taken for the upkeep, maintenance and monitoring of the existing man-made barriers across the lower reaches of the individual watercourses.

The strength of the White-clawed Crayfish meta-population in Wyre Forest is that should any negative incidents i.e. pollution, disease etc, affect any one of the four discrete local populations the remaining populations are isolated from one another which should give a degree of protection. Conversely, the isolation, as well as giving protection also makes the individual local populations vulnerable to extinction and could lead to the decline of the species.

The monitoring study showed that whilst there was an increase in observations of White-clawed Crayfish in Bell Brook there was no significant change in the White-clawed Crayfish population structure. The increase in observations may be a result of underlying natural fluctuations in population size or may indicate that some outside factor is affecting the population i.e. favourable environmental conditions or an increase in recorder efficiency. The significant increase in observations of White-clawed Crayfish in Forest Lodge Stream is likely to be as a result of low water conditions concentrating the population into a smaller area. It may be that low water levels have provided a better representation of the whole population than conventional survey methods. Information on long-term variation will only gradually be obtained from the continued monitoring of both these crayfish populations.

All populations are vulnerable to issues regarding water quality and are particularly susceptible to acute pollution incidents caused by spills of organic material

with a high biochemical oxygen demand, such as cattle slurry or silage. Whilst a greater proportion of the surrounding land-use is forestry there are a number of agricultural holdings within the higher reaches of Dowles Brook catchment that present a risk of pollution from sheep dip or other operations. There have been verbal reports of pollution incidents involving sewage (Lem Brook), diesel (Park Brook) and farm waste effluents. Hay bales and silage clamps were present in Kingswood Stream. There were relatively high numbers of waterfowl on and adjacent to Kingswood Stream and the outflow from the adjacent duck ponds flows into the watercourse.

Water quantity is also a crucial criterion affecting the viability of the crayfish, with prolonged drought having the potential to decimate populations. In the dry summer of 2011 flow conditions in all the sampled watercourses were low, with parts of banks and bed exposed and a reduced width of wetted channel in many areas. During the survey, it is highly likely that the flow in Bell Brook was augmented sufficiently by water leaks from around the retaining walls of the upper pools which prevented the watercourse from drying out. Similarly water seepage around the retaining walls of the upper pools in Forest Lodge Stream assisted water flow. However, flow was insufficient to prevent Forest Lodge Stream drying out in places until only shallow pools were left. Low water levels can also increase crayfish vulnerability to predation and evidence of crayfish (both native and alien species) dismembered by Otters (or Mink) was found along Dowles Brook and Bell Brook. In healthy river systems, where crayfish exist at normal levels, predation will not have a significant impact upon populations. However where populations are already in decline predation may be enough to have a significant impact.

Finally, White-clawed Crayfish were absent or undetected upstream of the upstream limit of detection of the American Signal Crayfish population. The study did not have the resources and/or access permissions to survey all the smaller tributaries, especially in the headwaters of the catchment (Baveney Brook and Lem Brook in particular). The questions still remain whether a) there are any remaining isolated populations of White-clawed Crayfish in watercourses not yet surveyed; and b) are there any existing barriers good enough to protect them?

6. Acknowledgements

We are grateful to the Wyre Forest Study Group and Forestry Commission who provided local knowledge and access details, the landowners for access

permissions and the many volunteers who assisted with the survey work. Funding was generously provided through Grow with Wyre, the Heritage Lottery funded Landscape Partnership Scheme.

7. REFERENCES

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Graham and Ann Hill , 24 August 2011

Rosemary Winnall



White-clawed Crayfish & Brown Trout 24 Aug 2011

R. Winnall



Checking sex - female White-clawed Crayfish

Rosemary Winnall



White-clawed Crayfish in bank refuge

Rosemary Winnall



Night surveying for crayfish. Ann Hill (right) with Jane Scott

Rosemary Winnall