

Introduction

The White-clawed Crayfish *Austropotamobius pallipes* is the only native species of freshwater crayfish in the UK. It has a decreasing population and the species faces an uncertain future in England and Wales, where it is vulnerable to pollution, habitat destruction and competition from introduced crayfish. A recent sighting (during a cave spider survey in July 2010) suggested that there might be a native crayfish population in one of the tributaries of Dowles Brook. As a result, a baseline survey of the watercourse was undertaken to establish the status of the native crayfish population in the Wyre Forest. The local native population of white-clawed crayfish was thought to be in decline (Linck 2000) although White-clawed Crayfish had once been "abundant throughout the Dowles and tributary streams" according to Norman Hickin in his book 'The Natural History of the Wyre Forest'.

The distribution of the White-clawed Crayfish is governed by geology and water quality. The species can be found in a variety of locations including canals, streams, rivers, lakes, reservoirs and water-filled quarries, where it occupies cryptic habitats. They are largely nocturnal, with breeding taking place from September to November when water temperatures drop below 10°C for an extended period. The White-clawed Crayfish is usually associated with stony habitats containing obvious refuges in the form of gaps between and under rocks, macrophytes and marginal tree roots, particularly in streams and lakes with clear water and little marginal mud (Holdich 2003). If the banks are composed of suitable material, then they may also construct and live in burrows. The bottom substrate and presence of morphological structures acting as hiding places, and the geographical isolation of the habitat seem to be of importance.

There has been a significant decline in the reported distribution of White-clawed Crayfish across England and Wales during the period 1997-2001 compared to the preceding period 1990-1996 (both inclusive) (Sibley,

Brickland and Bywater 2002). The most widespread threat is that of invasive alien species, in particular the Signal Crayfish (Holdich et al. 2009). The Signal Crayfish is a vector for crayfish plague, a fungal pathogen which can spread rapidly through populations of White-clawed Crayfish and has caused them to disappear from many parts of Britain (Holdich and Rogers, 1997; Holdich et al., 1999). Signal Crayfish are also aggressive predators for food and habitat, and often prey upon the White-clawed Crayfish. Localised declines in White-clawed Crayfish populations can also occur as a result of alteration to the hydrological regime of rivers, pollution from agriculture, domestic pollution, sedimentation, eutrophication, loss of in-stream cover such as tree roots and pebbles, droughts and changes in land-use activities.

The White-clawed Crayfish is protected from 'taking and sale' under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended 1992), listed under the EU Habitats Directive Annex II and V, included as a priority species under Appendix III of the Bern Convention and is listed as endangered on the IUCN Red Data List for endangered and threatened species. The species is also a priority species under the UK Biodiversity Action Plan (BAP), with a BAP steering group for White-clawed Crayfish overseeing the delivery of a national action plan (UK Biodiversity Group 1995). The key objective of this Action Plan is to "maintain the present distribution of ... (*A. pallipes*)", and fundamental to this aim is the requirement for an effective programme of distribution monitoring and reporting. The White-clawed Crayfish is also a Worcestershire BAP priority species. The Worcestershire BAP Vision Statement is that "all known White-clawed Crayfish populations being safe and secure and populations expanding to colonise all suitable rivers and streams".

White-clawed Crayfish is also indirectly affected by the EU Water Framework Directive which seeks to achieve good ecological status of aquatic systems.

A protected species licence is required for any surveys for White-clawed Crayfish. Licences are issued by Natural England and the Countryside Council for Wales.

Site

The surveyed watercourses were in woodland to the south-east of the Wyre Forest (SO 769 759), approximately 1.8 km north-west of Bewdley town centre.

Method

A baseline crayfish survey of the tributary where the July 2010 sighting was made (Tributary A) and an adjacent tributary (Tributary B) of Dowles Brook was undertaken



White-clawed Crayfish adult

Rosemary Winnall



on 10 August 2010 using the standard manual search method (Peay 2002, 2003). Only one 100m sampling site was surveyed in a 500m stretch of each tributary. Five areas of habitat (termed 'patches') considered being the most favourable for crayfish were selected within each 100m sampling site and 10 potential refuges were manually searched in each habitat patch. A total of 100 refuges were manually searched in Tributary A and 50 refuges were manually searched in Tributary B. In addition, an uncounted number of casual searches were made during the survey and the results recorded separately. The manual survey recorded information on the relative abundance and population structure of the crayfish caught including size distribution and sex ratio. All caught crayfish were checked for signs of disease,

incidence of claw loss and regeneration and other damage, and were returned to the watercourse.

Night viewing of Tributary A and Tributary B, and the linking reach of Dowles Brook, was undertaken on four nights in August and September as a supplementary method to the above standard manual search. The torching method gives an abundance estimate of the White-clawed Crayfish population. Timed 15-minute searches were made of the same two standard manual search sampling sites on 17 and 23 August. In addition, the down stream sections of Tributaries A and B and the linking stretch of Dowles Brook between Tributary A and B were night viewed, using timed 15-minute searches, on 31 August. Additional night viewing on the upstream stretches of the same two tributaries was undertaken on 13 September to try to establish the upstream extent of the White-clawed Crayfish population. The stop watch was stopped and re-started during the survey, where necessary.

All surveys were undertaken from the downstream end of each reach. Difficult terrain, fallen timber and dense vegetation with associated health and safety issues prevented survey in places but it is considered that a representative sample was taken. All surveys were carried out by, or under, the supervision of experienced license holders and all license conditions were complied with. Precautions were taken to prevent the spread of crayfish plague.

The water temperature was between 15 and 16°C for the day-time surveys and between 11 and 15°C for the night-time surveys. Flow conditions fluctuated between low, normal and reducing water levels after periods of rain.

Results

Abundance

There were 382 White-clawed Crayfish recorded in Tributary A and 39 White-clawed Crayfish recorded in Tributary B. No White-clawed Crayfish were recorded during a short survey of Dowles Brook. No evidence of non-native crayfish was found during any of the surveys.

Table 1: Summary of White-clawed Crayfish recorded during day-time manual surveys in Tributary A, Wyre Forest.

Tributary A					
Sample	Method	Refuges	Adults		Juveniles
			Male	Female	
A1	Standard Search	50	0	0	0
A2	Standard Search	50	0	6	2
	Casual Search		2	2	4
Total white-clawed crayfish			2	8	6
Average number of white-clawed crayfish per 10 refuges searched			0.08		

Table 2: Summary of White-clawed Crayfish recorded during night viewing surveys in Tributary A, Wyre Forest.

Tributary A						
Sample	Method	Time	Sample Site Extent	Adult	Juveniles	Bullhead
A1			Not torched			
A2/1	Torching	15 minutes	200m	48	10	Nil
A2/2	Torching	15 minutes		51	27	Nil
A2/3	Torching	15 minutes		15	12	Nil
A2/4	Torching	15 minutes		26	61	Nil
A2/5	Torching	15 minutes		4	9	Nil
A2/6	Torching	15 minutes		14	13	Nil
A3/1	Torching	15 minutes	140m	19	36	Nil
A3/2	Torching	15 minutes		7	11	Nil
A4/1	Torching	10 minutes	105m	3	Nil	Nil
Total white-clawed crayfish				187	179	
Average number of white-clawed crayfish per 15-				41		

Table 3: Summary of White-clawed Crayfish recorded during night viewing surveys in Tributary B, Wyre Forest

Tributary B					
Sample	Method	Refuges	Adults		Juveniles
			Male	Female	
B5	Standard Search	50	1	0	1
Total white-clawed crayfish			1	0	1
Average number of white-clawed crayfish per 10 refuges searched			0.04		

Table 4: Summary of White-clawed Crayfish recorded during night viewing surveys in Tributary B, Wyre Forest

Tributary B						
Sample	Method	Time	Sample Site Extent	Adult	Juveniles	Bullhead
B1/1	Torching	Approx 9 minutes	50m	Nil	Nil	Nil
B2/1	Torching	Approx. 20 minutes	135m	9	Nil	Nil
B3/1	Torching	15 minutes	113m	7	12	Nil
B4/1	Torching	15 minutes	136m	5	2	Nil
B5/1	Torching	15 minutes	150m	Nil	Nil	Nil
B5/2	Torching	15 minutes		Nil	Nil	Nil
B5/3	Torching	15 minutes		Nil	2	Nil
B5/4	Torching	15 minutes		Nil	Nil	Nil
B6/1	Torching	11 minutes	19m	Nil	Nil	2
Total white-clawed crayfish				21	16	
Average number of white-clawed crayfish per 15-				4		

Table 5: Summary of White-clawed Crayfish recorded during night viewing surveys in Tributary B, Wyre Forest

Dowles Brook						
Sample	Method	Time	Sample Site Extent	Adult	Juveniles	Bullhead
C1/1	Torching	15 minutes	125m	Nil	Nil	Nil
C1/2	Torching	15 minutes		Nil	Nil	Nil
C1/3	Torching	15 minutes		Nil	Nil	Nil
Total white-clawed crayfish				Nil	Nil	
Average number of white-clawed crayfish per 15-				0		

A summary of the results of the day-time and nocturnal surveys are shown in Tables 1, 2, 3, 4 and 5. The location of the records is shown in Figures 1 and 2. Please note that the torching records may include duplicate records from the day-time manual survey. Nevertheless this would still give a total of 366 records from Tributary A and 35 records from Tributary B.

White-clawed Crayfish were more abundant in Tributary A than in Tributary B. The White-clawed Crayfish abundance per site from the manual search (calculated as the number of crayfish per 10 refuges) was for Tributary A calculated to be 0.08 and for Tributary B calculated to be 0.04. The average abundance of White-clawed Crayfish recorded during the torching survey in each of

Figure 2: Results of day-time crayfish survey within two tributaries of Dowles Brook, Wyre Forest in 2010.

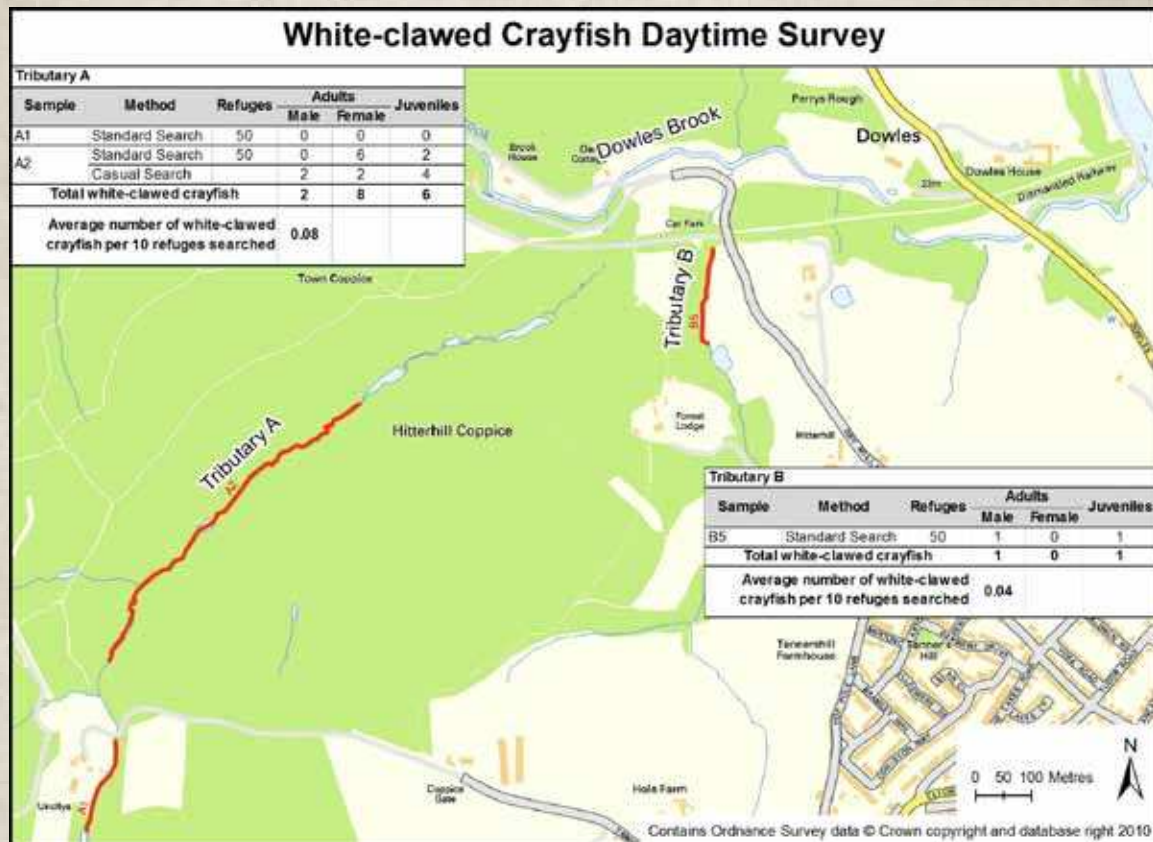
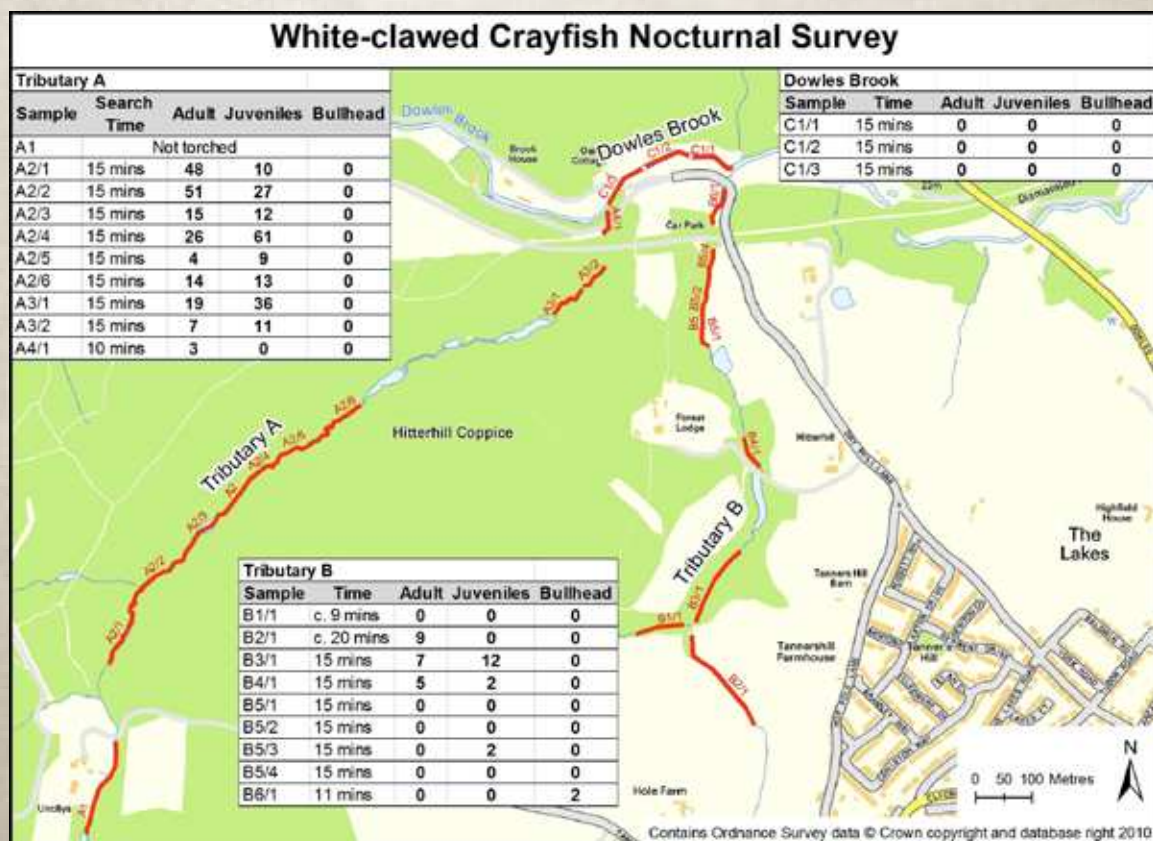


Figure 3: Results of night viewing crayfish survey within two tributaries of Dowles Brook, Wyre Forest in 2010.



the nine sampling sites along Tributary A was 41 crayfish per 15-minute search. The average abundance for each of the nine sampling sites along Tributary B during the torching survey was four crayfish per 15-minute search.

Population Structure

Fourteen White-clawed Crayfish were measured to the nearest mm from tip of the rostrum to the junction of the carapace and tail (day-time manual survey). The minimum carapace length was 5.05mm and the maximum carapace length was 36.8mm (see Figure 4). The median size was 22.05mm carapace length. The percentage of population classed as juveniles (juvenile = < 25mm carapace length) from the combined surveys in Tributary A was 48% and in Tributary B was 44% (see Figure 5).

No evidence of disease in any of the recorded White-clawed Crayfish was found. One female White-clawed Crayfish was missing a left cheliped and another female had a missing antennae. One White-clawed Crayfish was observed eating another crayfish.

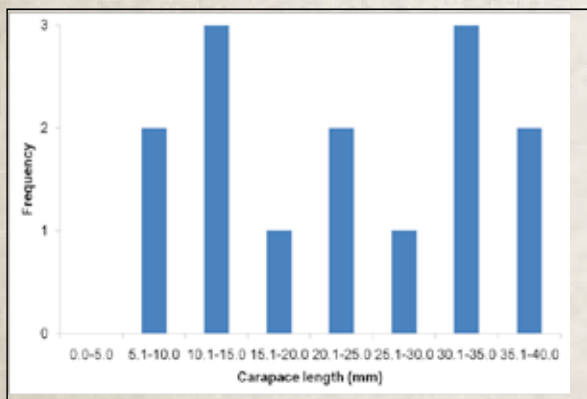


Figure 4: Histogram showing carapace length of fourteen White-clawed Crayfish measured during a day-time survey of two tributaries of Dowles Brook, Wyre Forest in 2010.

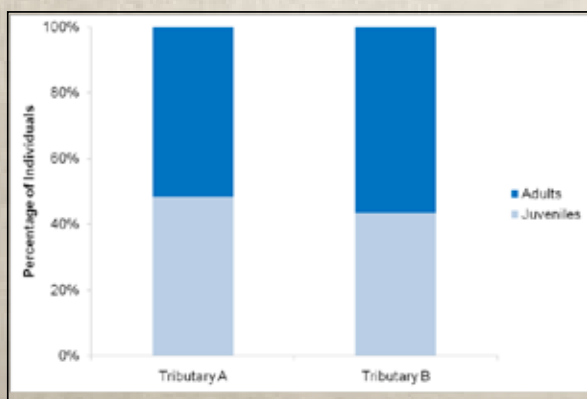


Figure 5: Percentage of population of adult and juvenile White-clawed Crayfish recorded in two tributaries of Dowles Brook, Wyre Forest in 2010. The day-time manual and night viewing survey results have been combined.

Crayfish Habitat

Woodland was the dominant land use on either bank of Tributary A and provided approximately 70-80% shade to the watercourse. At the upstream end of the reach there was an area of open grassland on the left bank which provided approximately 55-65% shade to the watercourse. *Rhododendrum* clearance was being undertaken along the banks. Tributary A water channel was semi-natural and deeply incised in places. The main substrate was cobble (6.5-15cm), pebble (<6.5cm) and gravel (<1.6cm) with some bedrock. Several natural and man-made dams and pools were present along the channel but these appeared to have become silted up and becoming naturalised. Other channel features included natural sandstone waterfalls, vertical and sometimes undercut banks, exposed tree roots and debris dams. There was a culvert and three silt traps towards the upper end of the reach. There were a further two culverts (one single culvert and one double culvert) with some associated bank and stream bed modification just before the confluence with Dowles Brook. A public right of way followed the left bank and other footpaths crossed the tributary in places.

Woodland was the dominant land use on either bank of Tributary B and provided approximately 80-99% shade to the watercourse. The channel was semi-natural and was deeply incised in places with occasional undercut banks, a large range of woody debris dams and exposed tree roots. The main substrate was gravel/pebble and some cobbles with sandstone plate bedrock. Other channel features included constructed pools, culverts (old and new) and stone revetments. There appeared to be less human impact on Tributary B with no nearby public rights of way and the steep terrain and dense vegetation potentially inhibits access.

Culverts on both tributaries have received engineering/re-instatement works following serious high flows in 2007.

Within the 300m stretch of Dowles Brook that was surveyed for crayfish, the adjacent land-use was of broad-leaved woodland and managed garden/lawn. The channel features were diverse with fast flowing sections, debris dams, a weir, slow flowing side channels, exposed bars, riffles, runs, glides and pools.

During the survey period, the watercourses were generally very shallow (<0.5m) and slow flowing. Tributary A was between less than 0.01m to 0.3m (or more) deep. Tributary B was generally between 0.01m - 0.1m deep, with an occasional depth of more than 0.4m in pools. Dowles Brook varied greatly between exposed bars in places and in other places water considerably deeper possibly 0.5m deep.

Much of the surveyed watercourses had favourable habitat for White-clawed Crayfish on both the banks and within the channel. Favourable features included overhanging banks, heterogeneous flow patterns (riffles and slow-flowing glides and pools) with suitable refuges in the form of cobbles on pebble and gravel, crevices in bedrock, woody debris dams and logs. There were also occasional frequent exposed tree roots below the water level. The White-clawed Crayfish were found under cobbles and rocks, were seen crossing riffles, shallow stream margins and foraging in pools with a fine substrate. Numerous adult and juvenile White-clawed Crayfish were found foraging in accumulated detritus, leaf litter and macrophytes around and under woody debris dams. Adult White-clawed Crayfish were observed on stream pebbly margins.

Fish

Bullhead and numerous small fish (some possibly Stone Loach) were recorded in Tributary A.

Discussion

The remarkable and unexpected positive results suggest that the native White-clawed Crayfish is still present in the Wyre Forest. The 2000 survey of Worcestershire watercourses found only one small population of White-clawed Crayfish (4 female adults; 1 male adult, 2 dead adults and 1 escapee) in one of the tributaries of Dowles Brook, Wyre Forest (Linck 2000). The 2010 results indicate that there is a relatively large population of native White-clawed Crayfish in Tributary A and a small population in Tributary B. The nocturnal torching is likely to give a much better indication of population abundance of this nocturnal species than the day-time manual survey method. When moving from one sample point to the next it was observed that the White-clawed Crayfish appeared to be similarly abundant in those reaches not surveyed during the nocturnal torching. Possibly with the flow being so low the population was squeezed into a smaller area of channel which gave higher densities. Very low flow conditions may also tempt crayfish out of their refuges and hence easier to record. The warm water temperature and very low flow conditions gave optimum foraging conditions for crayfish.

Both male and females were caught and measured in Tributary A and male only in Tributary B although the presence of juveniles implies the presence or recent presence of breeding females in Tributary B. As expected, the torching results show that adults slightly outnumber juveniles in both Tributaries; night viewing is biased towards active adult crayfish (Peay 2003). The proportion of juveniles was between 44% and 48% of the population which implies a strong population

with effective recruitment. However, it is important to note, that during the nocturnal torching survey it was considered highly subjective in many cases as to whether to record an individual as a juvenile or adult native crayfish. The proportion of juveniles from a healthy population is likely to be about 40% (Peay 2003). Overall, the results suggest a healthy population and also indicate that the population is recovering or colonising. However, it is unknown whether the increase in population abundance is due to natural factors or because of an external reason.

Sampling of the population of White-clawed Crayfish has shown no evidence of disease. More importantly no evidence of the non-native crayfish was found in the watercourses searched.

Further research and survey work is planned to be undertaken in Worcestershire for this UK BAP priority species. The aim would be to improve knowledge of White-clawed Crayfish distribution and abundance to allow effective conservation action. At the moment, there is limited up-to-date knowledge of the distribution of all species of crayfish, including introduced species within Worcestershire. I would welcome any details that anyone has on native and non-native crayfish populations within Worcestershire or any other relevant information on the species. I can be contacted at ann@hillsecology.co.uk or via the Worcestershire Biological Records Centre.

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White-clawed Crayfish small juvenile

Rosemary Winnall

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White-clawed Crayfish male

Rosemary Winnall



Crayfish survey team from left: Graham Hill, Brett Westwood, Jane Scott, Ann Hill, Mike Averill

Rosemary Winnall