RETURN OF THE NATIVE CRAYFISH TO A WELSH RIVER

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ABSTRACT

The upland rivers of rural mid-Wales supported thriving populations of *Austropotamobius pallipes*, the native white-clawed crayfish, until a dramatic decline began to occur around a decade ago. Crayfish plague, caused by the fungus *Aphanomyces astaci,* although at times a common problem in England, was not the main cause of decline in Wales. So what was the cause?

Excess sediment deposition and sheep dip pollution are thought to be two of the main factors causing deterioration in the aquatic life of upland Welsh rivers. The decline and apparent recovery of *A. pallipes* populations in the Afon Edw, a tributary of the River Wye coincide with changes in sheep dip use as specified by the Environment Agency.

In an effort to measure the amount of sediment being deposited into the Edw, specialised traps were positioned along the length of the river. Results collected so far suggest that excess sediment deposition remains a threat to *A. pallipes* and other organisms in the Afon Edw despite measures taken to reduce it.

Keywords: crayfish, Wales, sheep dip, sediment, decline, recovery

INTRODUCTION

The current nationwide decline in *A. pallipes,* the native white-clawed crayfish, is commonly attributed to the well-publicised encroachment of the North American signal crayfish, *Pacifastacus leniusculus*, which can eliminate the native crayfish by means of crayfish plague and increased competition (Holdich & Rogers, 2000; Hiley, a, this volume; Sibley, this volume). The upland rivers of rural mid-Wales supported thriving populations of *Austropotamobius pallipes* (Holdich, 1993) until a dramatic decline began to occur around a decade ago. Although surveys carried out by the Environment Agency have shown that crayfish plague was present in a few locations within the Welsh region of the Wye Catchment, cases appeared to be isolated and did not spread (Coley, 2000; Holdich, a, this volume). Other factors may therefore be responsible for the decline of *A. pallipes* in upland rivers of mid Wales. The upland rivers of rural mid-Wales supported thriving populations of *Austropotamobius pallipes*, the native white-clawed crayfish, until a dramatic decline began to occur around a decade ago.

Frequent heavy rain is common in the uplands of mid-Wales, and most of the catchment areas are heavily stocked with cattle and sheep (Environment Agency, 1999). These factors result in excess silt deposition and sheep dip pollution, both of which may be detrimental to *A. pallipes* populations (Slater & House, 2001).

Livestock on farms adjacent to rivers have always been allowed free access to the waterways, and cause poaching and bank erosion as well as silt deposition and organic pollution. As a result, fish populations and the general health of the rivers are thought to be suffering. Excess silt entering the river may eventually get permanently deposited on and within the riverbed. Gaps between and underneath stones are filled and in extreme cases the entire riverbed becomes coated in silt. *A. pallipes* use gaps under stones as vital refuges (Rogers & Holdich, 1995; Slater & House, 2001). Where there are no gaps, *A. pallipes* is rarely found (Foster, 1990). Concern was raised that a similar fate was befalling fish, which have also dramatically declined in numbers over the last decade. Fish, particularly salmonids, lay their eggs in hollows they make in the bed gravel (Jones, 1959). When no gaps are present due to silt deposition, oxygen levels (from water flowing through the stones) are reduced, and fish eggs are killed. In 1999, the Wye Foundation, in association with a number of other organisations, set up the Wye Habitat Improvement Project (WHIP) to rectify this problem. Selective coppicing and fencing was carried out along stretches of the River Edw, a 16 km tributary of the Wye near Builth Wells, mid-Wales.

Fencing was intended to prevent livestock from eroding the banks. At specific points along the river, livestock were allowed controlled access to the water to drink. Although fencing of banks is thought to benefit fish, crayfish and other invertebrates, also rely on clear riverbeds (Environment Agency, 1997). Coppicing, particularly of alder (*Alnus glutinosa*), may reduce the overall biodiversity of the habitat. For example, a detrimental impact may be felt by birds and other organisms that rely on bank side trees for shelter, food or shade and particularly crayfish that, as omnivores, will consume tree leaves (Parkyn *et al*., 1997). Further research will be required to investigate whether the project has been successful overall.

In order to measure the amount of silt entering and moving along the river, the authors installed a series of silt traps along the River Edw as described by Naden *et al*. (2002). Captured silt was measured in September and November 2002, and will be further monitored every two months throughout 2003.

Sheep dip pollution is another possible cause of the dramatic decline of *A. pallipes* in rural Wales. In the past, after sheep had been dipped, they were often released into fields adjacent or near to waterways to drip dry. The insecticide could then enter the ground or pass directly into the watercourse. The frequent heavy rain that occurs in the uplands would wash excess insecticide off the animals and from the ground, eventually ending up in the rivers (Environment Agency, 1999).

Treatments were sometimes carried out so close to waterways that when leakages occurred, pollution of these waterways was inevitable. In 1999, the Environment Agency introduced Groundwater Regulations in order to ensure that dipping treatments were carried out at safe distances from any watercourses and that freshly dipped sheep were not allowed to roam freely but were restricted to a safe area. The regulations also allowed for the safe disposal of unused dip. They hoped that this would help to eliminate any further pollution incidents (Environment Agency, 1999).

In recent times, organophosphate (OP) sheep dips were widely used. Over a number of years, concern raised about the harmful symptoms displayed by farmers from continued, long term handling of OPs led to a, temporary ban in late 1999. Another group of insecticides, synthetic pyrethroids (SPs) were introduced for sheep dipping in the early 1990s. SP usage increased dramatically after OPs were banned in 1999. Although SPs appear to be much less harmful to

humans than OPs, they are, unfortunately, 100 times more toxic to many invertebrate species, including *A. pallipes* (Coley, 2000). One teaspoon of SP can destroy the crayfish population of a small lake (D. Jerry, pers. com., 2002). SPs break down quickly, which makes chemical detection difficult when not measured immediately after an incident. If a period of more than a few days has elapsed since an incident, biological indicators must be used to try to identify the cause and severity of the pollution. *A. pallipes* is very sensitive and is therefore a good indicator of pollution. Unfortunately they take a number of years to grow and mature and so are particularly vulnerable within the first few years of life (Foster, 1990). This makes their recovery a slow, uncertain process.

With this information in mind, in Summer 2002, we conducted a detailed search of the River Edw and its fine tributaries. These results together with those of past surveys were collated to look for any trends in the *A. pallipes* population size. Possible reasons for such trends are discussed.

METHODS

The main part of this study focuses on the Edw catchment, a tributary of the Wye in mid-Wales. The River Edw joins the River Wye at the grid reference SO 075 470.

Crayfish survey

Austropotamobius pallipes is protected under Schedule 5 of the Wildlife and Countryside Act 1981. All individuals working on this survey were therefore licensed by the Countryside Council for Wales and access permission was always sought.

Crayfish searches were carried out by stone turning with kick sampling (standard procedure, following methodology used by Foster (1990) and Slater & House (2001)). In each stream, searches were carried out in a downstream direction. If a hand or fingers could fit underneath the edge of a stone it was considered suitable for crayfish presence, and a search was conducted. A kick sampling net was placed immediately downstream of the stone, which was lifted to allow any crayfish underneath to escape and swim into the net. If none emerged, kick sampling was carried out. For any crayfish caught, the following data were recorded: date of capture, location, sex, carapace length, weight, number of missing appendages and disease status, e.g. plague or porcelain disease

Stone turning at each site was carried out for one man hour. This enabled the calculation of CPUE (catch per unit effort), which equals the number of crayfish caught per man hour. The entire length of the Edw and its fine tributary streams were searched in this way.

Silt deposition experiment

Seven sampling stations were established along the length of the River Edw. Each station comprised of four silt traps and either a cattle drinking area, a sheep crossing or a tributary stream entry point. At each station, two silt traps were positioned upstream and two downstream of the feature (dinking area etc). Of each pair, one trap a flowerpot trap and one was a basket trap.

Silt samples were collected, sealed and labelled in the field. Once in the laboratory, bags were transferred to 1-litre wide neck plastic sample bottles. Silt was filtered and sorted using stacked sieves. Oven dried sample weights were measured and recorded.

RESULTS

Crayfish survey

A search for *A. pallipes* throughout the Edw catchment carried out in Summer 2002 revealed 60 individuals, with a highest CPUE of 15. This compares with only seven individuals (two of which were dead) and a maximum CPUE of 2 in 2000 (Slater & House, 2001) but was still much lower than a CPUE of 46.5 found during a crayfish survey on the River Edw in 1988 (Foster, 1990).

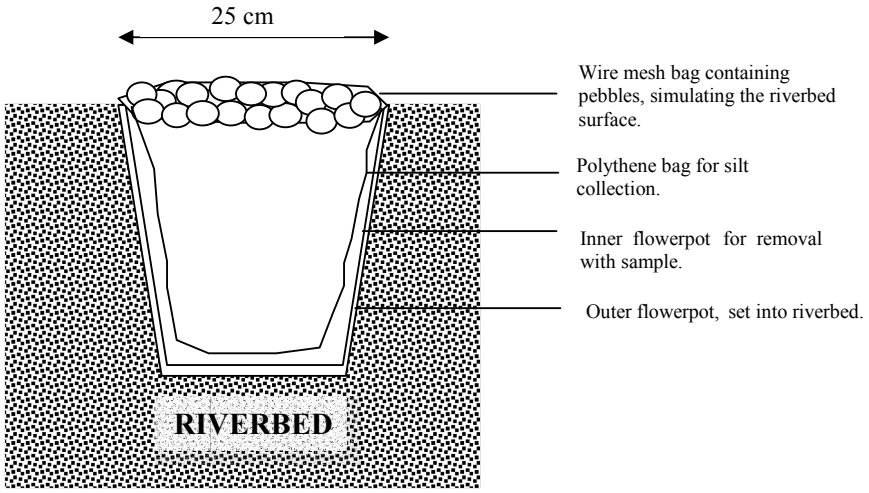

Figure 1. The flowerpot trap which captures riverbed surface silt.

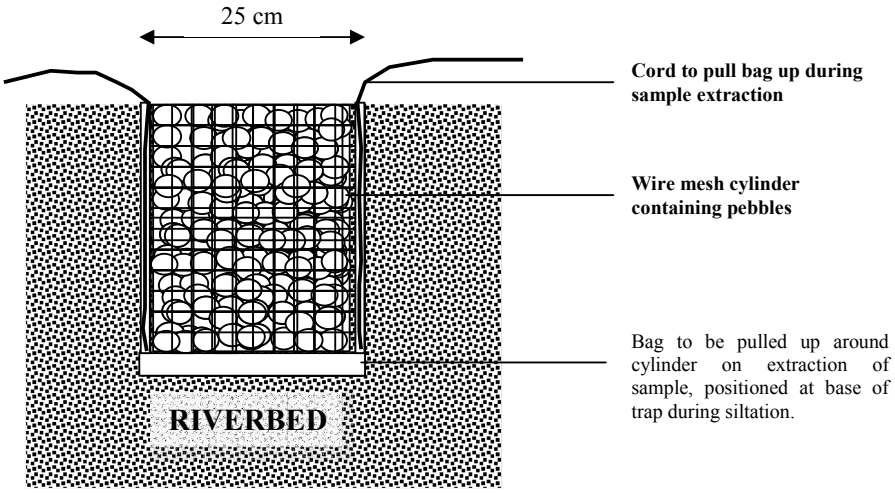

Figure 2. The basket trap which captures intra-bed plus surface silt.

In September 2002, more silt was collected in traps positioned downstream than upstream of livestock access points (Aberedw and Llanbadan-y-garreg). However, at Cregina, more surface silt was collected upstream than downstream of the tributary entry point (Table 1).

In November, some silt traps were lost due to flooding resulting in a loss of data. The use of a metal detector to locate the missing traps proved unsuccessful. A full set of results was collected only from Llanbadan-y-garreg, the site of the sheep crossing. Here, much more surface and intra- bed silt was found in November than in September (Fig. 4).

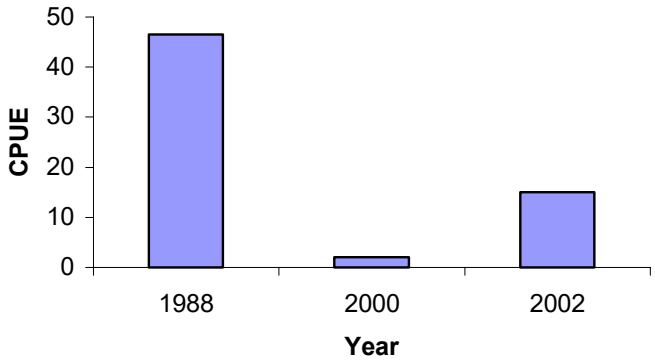

Figure 3. Maximum CPUE (catch per man hour) of *A. pallipes* on the River Edw during surveys of 1988, 2000 and 2002.

Silt deposition experiment

	SEPTEMBER				NOVEMBER			
	Surface		Surface & Intrabed		Surface		Surface & Intrabed	
SITE	U	D	U	D	U	D	U	D
A	11	292	54	205	*	*	928	780
B	1	14	2	34	2154	1439	1061	34
C	8	4	19	44	*	797	9115	840

Table 1. Dry weight and rate of deposition of silt collected from transects up and down stream of riparian features in September and November, where site A = Aberedw (cattle drinking area), site B = Llanbadan-y-garreg (sheep crossing), site C = Cregina (tributary stream), U = upstream and D = downstream.

Incidental finding

Another important observation was made while collecting the first set of silt samples in September 2002. A crayfish was discovered under riverbed stones situated close to one of the basket traps. The stones in the immediate vicinity of each trap were relatively free of silt in comparison with the rest of the river due to the disturbance caused when initially installing the traps. This discovery was significant as it indicated that where there were gaps under and between stones, i.e. where little silt was absent, crayfish were likely to be found.

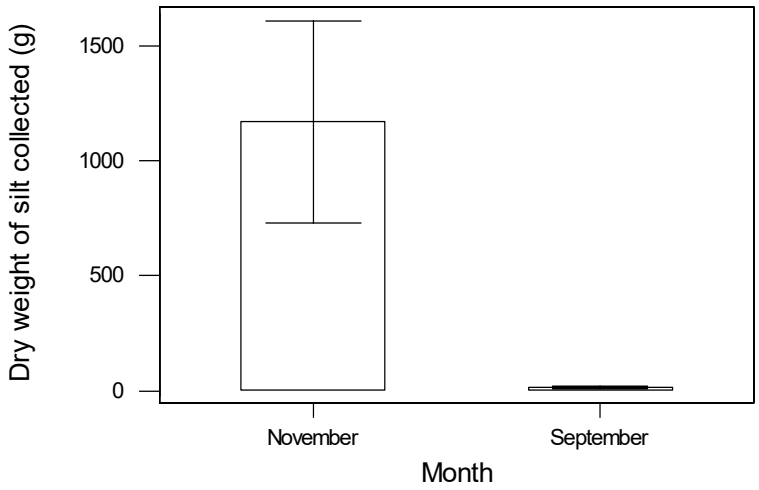

Figure 4. Comparison of dry weights of surface and surface plus intra-bed silt collected in November and September at Llanbadan – y-garreg (sheep crossing).

DISCUSSION

Crayfish survey

In 1988, crayfish were abundant in the River Edw (Foster, 1990). At around the same time, organophosphates (OPs) were the main insecticides being used as a sheep dip (Environment Agency, 1999). OPs are less toxic to freshwater invertebrates such as *A. pallipes* than other sheep dip insecticides and the Edw's crayfish population survived this situation even when minor pollution incidents did occur. The dramatic fall in *A. pallipes* numbers within the following 12 years indicated by the discovery of just seven individuals in 2000 despite an extensive survey (Slater & House, 2001), may be attributed, in part, to changes in the types of sheep dip being used. The OP ban in 1999, and a subsequent increase in synthetic pyrethroid (SP) use (Environment Agency, 1999) may have had a devastating impact on *A. pallipes* populations due to their much higher toxicity to invertebrates. However, as SPs break down relatively quickly (Coley, 2000) it is almost impossible to confirm that they were responsible for the observed dramatic decline in *A. pallipes* numbers. The Environment Agency's Groundwater Regulations introduced late in 1999, controlled how unused sheep dip was disposed of and restricted the movement of freshly treated sheep dip. This would undoubtedly have reduced or even prevented any further SP pollution incidents (Environment Agency, 1999). Three years later, in Summer 2002, the *A. pallipes* population of the Edw appeared to have partially recovered possibly indicating the beginnings of a slow recovery for *A. pallipes* in the Edw (Slater & Howells, 2003). However, the population has not yet recovered sufficiently to be classed as safe or stable.

Silt deposition experiment

Excess silt deposition, another factor thought to have had a detrimental impact on native crayfish populations, is thought to have been reduced in the Edw by fencing (Slater & House, 2001). The potential degree of improvement to the crayfish habitat has been experimentally tested by assessing the difference in silt deposition above and below livestock entry points.

September's results show that where livestock entered the river, more silt was collected in the down than upstream traps, indicating that the sheep and cattle increased levels of silt deposited within and on the surface of the riverbed. This was expected as it was observed while samples were being collected that cattle regularly entered the river at the drinking site. The bank was poached and large quantities of silt, faeces and urine began to flow downstream as soon as the cattle entered the river. A similar situation was observed at the sheep crossing. Therefore, although fencing was controlling bank damage, downstream flow from remaining entry points meant that silt deposition was still high.

In September, less surface silt was found in the trap down stream than upstream at Cregina, where a tributary stream enters the Edw. It is seems likely that the extra flow created by the stream was washing away some of the surface silt from the riverbed including the area where the trap was located, or that the tributary carried a lower silt load and so "diluted" the silt load of the main river. Tributary entry points may therefore be likely crayfish habitat, and might merit more intensive surveying.

More silt found in silt traps in November than September probably resulted from heavier rainfall in winter months, as compared to September when dry weather caused the water levels of the rivers to drop right down.

Seasonal and geographical variability in silt deposition is likely to have a marked influence on crayfish distribution. Further crayfish surveys in conjunction with habitat assessment, particularly including silt monitoring should enable a clearer understanding of crayfish distribution and causes of population change.

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