Re-introduction of the Mayfly Ephemera Danica to the River Wey

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Introduction

A pollution incident, which occurred in May 2002 on the South Wey in the vicinity of Bordon sewage treatment works in Surrey, resulted in a drastic reduction in the invertebrate community together with a total loss of the mayfly *Ephemera danica* population. Whilst a good emergence of adults was recorded at Headley Wood Farm (a mile below Bordon sewage treatment works) on the evening before the incident, none were recorded after. Recruitment of the next generation should have started with small nymphs appearing in August/September from the eggs laid in May/June but none had been recorded by November and invertebrate data recorded by the Environment Agency and by myself during the summer and autumn of 2002 showed that this species was no longer present.

Although a normal community of invertebrates remained above the sewage treatment works at Bordon, the *E. danica* population was not large and whilst downstream invertebrate drift did result in a certain amount of recovery of some species, this was unlikely to be the case with *E. danica* which, due to its burrowing habit, does not normally enter the drift. Frequently when this mayfly is lost from a site it does not return unless given a helping hand (i.e. Hills 1934).

In collaboration with the Environment Agency, English Nature, The John Spedan Lewis Trust for the Advancement of the Natural Sciences, The Wey Valley Fisheries Consultative Association, The Frensham Fly Fishers and Headley Wood Farm, a species recovery programme was carried out to re-introduce *E. danica* back into the South Wey. This was carried out at two sites during May and June of 2003 using nymphs and eggs taken from Leckford on the River Test in Hampshire. Site 1 was at Headley Wood Farm, a mile downstream of Bordon sewage treatment works, and Site 2 was at Frensham, 8 miles further downstream. Re-introduction was in two stages; first 1500 mature nymphs were introduced at both sites in early May, this was followed in June with the introduction of over a million eggs at each site.

Feasibility and problems of a re-introduction programme

The small population of *E. danica* on the South Wey above Bordon sewage treatment works could not provide the numbers required for a re-introduction programme, whereas the River Test at Leckford has an extremely large (and increasing) population of *Ephemera danica* (Bennett 2002). Whilst the removal of a relatively few of this common species would have no impact on the population at Leckford, it could provide the impetus necessary to replace the River Wey population.

Females produce between 3000 and 6000 eggs, depending on body length (Bennett 1996) and fewer than 0.5 % of these will normally develop through

***Ephemera danica* eggs, 'milking' eggs from fertilised female**

to the adult stage, with 95 % of losses occurring during the egg and early larval stages (Elliott, Humpesch & Macan.1988). However, previous work on the River Wey (Bennett 2002) has shown that well over 90 % of *Ephemera danica* eggs reared artificially in an experimental stream will hatch successfully. Therefore, the eggs from about 500 adult females should produce several million nymphs to re-establish this species to the River Wey.

Introduction of pathogens:

As nymphs and eggs were being moved from another river system, it was essential to ensure that no unwanted pathogens were imported during the re-introduction programme. Considerable work on *E. danica*, both at Leckford (Bennett 2002) and on the River Wey (Bennett 1996), had revealed the following parasites at **both** sites:
Gordius aquaticus (Gordiace)
Cystidicoloides tenuissima (Nematoda)
Telomyxa glugeiformis (Microsporida)
Crepidostomum farionis (Trematoda)
Gamocystis ephemerae (Gregarinida)
Epoicocladius flavens (Chironomidae)
All of these are part of the normal parasite community found in this species.

However, *Spiriopsis adipophila* (= *Spirinella adipophila* Arvy & Delage 1966) is a new species to the UK and very much evident on the River Wey, particularly the North Wey. This parasite, which is specific to the Ephemera species of Mayfly, has so far only been recorded in the Thames catchment area (Bennett 1994, 1996). Contamination is usually 100% in a population and although up to 6000 parasites can be found in some nymphs it appears to have little detrimental effect on them. Recent work has also shown that there is considerable doubt about the original classification of Spiriopsis and the definitive host still remains to be identified. However, as *E. danica* was being moved into a site with this parasite rather than out, this should not cause a problem.

Genetic differences at each site:

Iso enzyme analysis and DNA sequencing carried out at The Natural History Museum (Stothard 1999 - unpublished) found no evidence of any inherent genetic differences between the *E. danica* populations on the river Test at Leckford and those on the River Wey at Tilford and suggested that there may even be migration of individuals between the two sites. This may well have occurred with the transference of *E. danica* nymphs/eggs carried in the water with stocked trout from Leckford which has taken place over many years.

Re-introduction programme

Stage 1 - Introduction of mature nymphs:

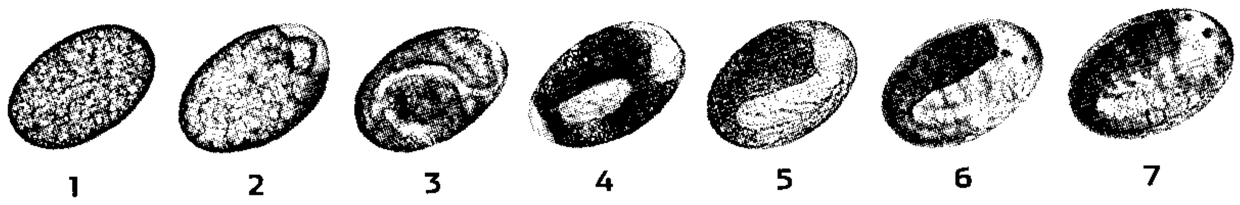
Around 3000 mature male and female nymphs were collected from Leckford in early May and immediately introduced at each of the two sites; some were placed into isolation tanks containing water & sediments from the South Wey in order to check if re-introduction was successful. As these nymphs were released just before the main adult emergence period for this species, a high proportion should emerge and be able to reproduce within a matter of days thus reducing losses due to predation.

Stage 2 - Collection and incubation of eggs:

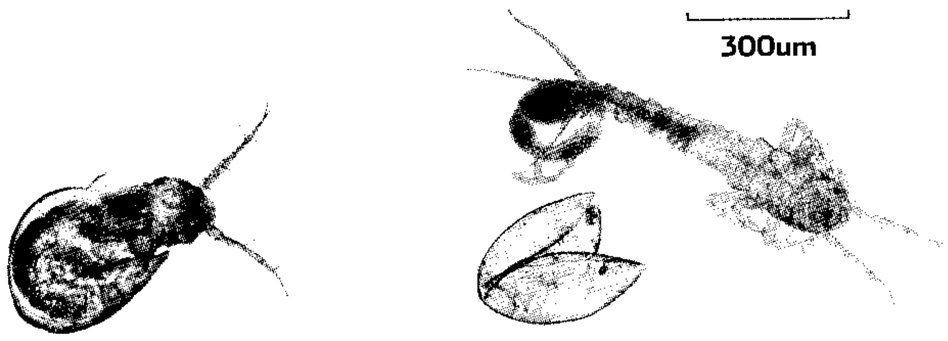
In late May and early June, fertilised females returning to the water to lay their eggs were collected at Leckford. The eggs were then "milked", placed onto microscope slides and left in shallow trays overnight to attach to the glass; development of the eggs could then be monitored using a high power microscope. Each slide contained about 30,000 eggs and a total of over two million eggs were incubated in glass jars

(normally used for staining microscope slides); these were constantly aerated and checked daily. Fertilised eggs slowly darken as they mature whereas unfertilised eggs remain white.

The adjacent figure shows the developing stages for *E. danica* and by incubating the eggs at 20 ºC, development in most of the eggs had reached the final stage in 10 days. At this point the eggs were placed into the river at the two sites where the eggs would hatch within a day or two.



Developing stages



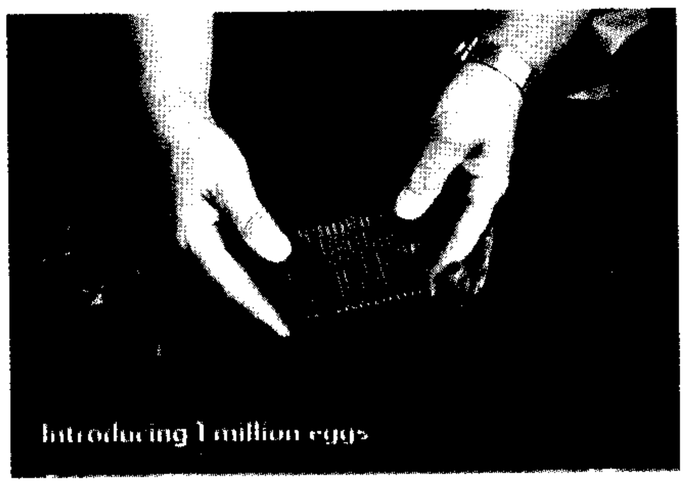
Hatching Nymph

Newly Hatched Nymph

Introduction of the eggs:

The microscope slides containing the eggs were placed back to back in small bottomless (staining) trays and suspended from a stake driven into the river bed. This kept the eggs up out of the reach of bottom feeding predators and allowed the newly hatched nymphs to drop out of the bottom and quickly reach cover in the sediments. The trays were regularly checked and only removed when all of the eggs had hatched.

Whilst all of the eggs hatched at both sites, most of the newly hatched nymphs at Site 1 were almost certainly killed by a further pollution incident at Bordon sewage treatment works in late June 2003. However, monitoring carried out at site 2, (about 8 miles below the sewage treatment works) in October 2003 showed that significant numbers of small nymphs were present. Further monitoring in early April 2004 showed that these were approaching maturity and adults were seen emerging in the middle of May confirming that a population of *E. danica* had been re-established at this site.



Conclusions

With the ever increasing reports of reductions in fly life on our rivers, this project has provided an ideal opportunity to evaluate the re-introduction of a species and has shown that in some cases this could become a useful tool to recover species of aquatic flies that have been lost after a pollution incident. The re-introduction of *Ephemera danica* is by no means unique; after a number of failures, the world renowned river keeper William Lunn was able to re-introduce *E. danica* back into the River Test at Houghton using large numbers of eggs taken from fertilised females (Hills 1934). This project has generally followed Lunn's basic procedures but with the added benefit of modern techniques such that the development stages of the eggs could be monitored and the eggs placed into the river when they were just about to hatch, considerably reducing the heavy losses that would normally occur during this period.
The fact that *E. danica* females produce large numbers of eggs that hatch relatively quickly, together with the short emergence period during which time large numbers of fertilised females can be collected, makes this an ideal species for re-introduction. Anglers particularly welcome the re-introduction of this species as it provides excellent fly fishing during the emergence period, but caution is needed to ensure that unwanted parasites are not introduced to a new site. Ideally nymphs should be taken from the same river but in this case the small size of the population above the sewage treatment works prevented this.

Acknowledgements

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