

Do demon shrimp carry demon parasites?

A fascinating insight into the the excess baggage invasive species may be carting with them on their travels to and within our waterways from Amaia Green Etxabe and Alex Ford based at the University of Portsmouth.

Killer vs Demon Shrimp

Invasive non-native species (INNS) are a significant threat to biodiversity and ecosystem services, and their ecological impacts are difficult to reverse (Mace *et al.* 2005). The total annual cost of INNS to the British economy is estimated at approximately £1.7 billion (Williams *et al.*, 2010). In September 2010, an amphipod (*Dikerogammarus villosus*) from the Ponto-Caspian region and now more commonly known as “Killer Shrimp” was found in UK waters. It established rapidly and caused considerable ecological damage (e.g. preying upon/competing with native *Gammarus pulex*). This amphipod has been categorised as the number one most threatening invasive species by the Environment Agency in England. The most recently discovered amphipod invader (*D. haemobaphes*) is a close relative, already even further widespread than *D. villosus* (EA Briefing Note, 2013) and continuing to spread throughout river and canal networks (Figure 1). Given the name “Demon Shrimp” it has the potential overtake its cousin (the killer shrimp) top position as the EA’s most threatening invasive species to British waterways.

Amphipods and their parasites

One of the main reasons why invasive species are successful is the escape from predators, parasites and disease in their native habitats enabling competitive release. Amphipods are known to harbour a variety of parasites which have the ability to drastically alter population numbers through changes in the host’s health, growth, behaviour, reproduction and sex. These parasites vary considerably in their life cycles with some requiring several hosts (e.g. Acanthocephala & Trematoda) whereas others have direct life-cycles (e.g. Microsporidia & Paramyxea) moving between the same species of hosts. The direct harm they cause their hosts depends largely on their life history strategies and whether they require their hosts to be “eaten”, require their host’s tissues, or alternatively require their host to be fit and reproduce successfully. We currently know that some invasive species of amphipods

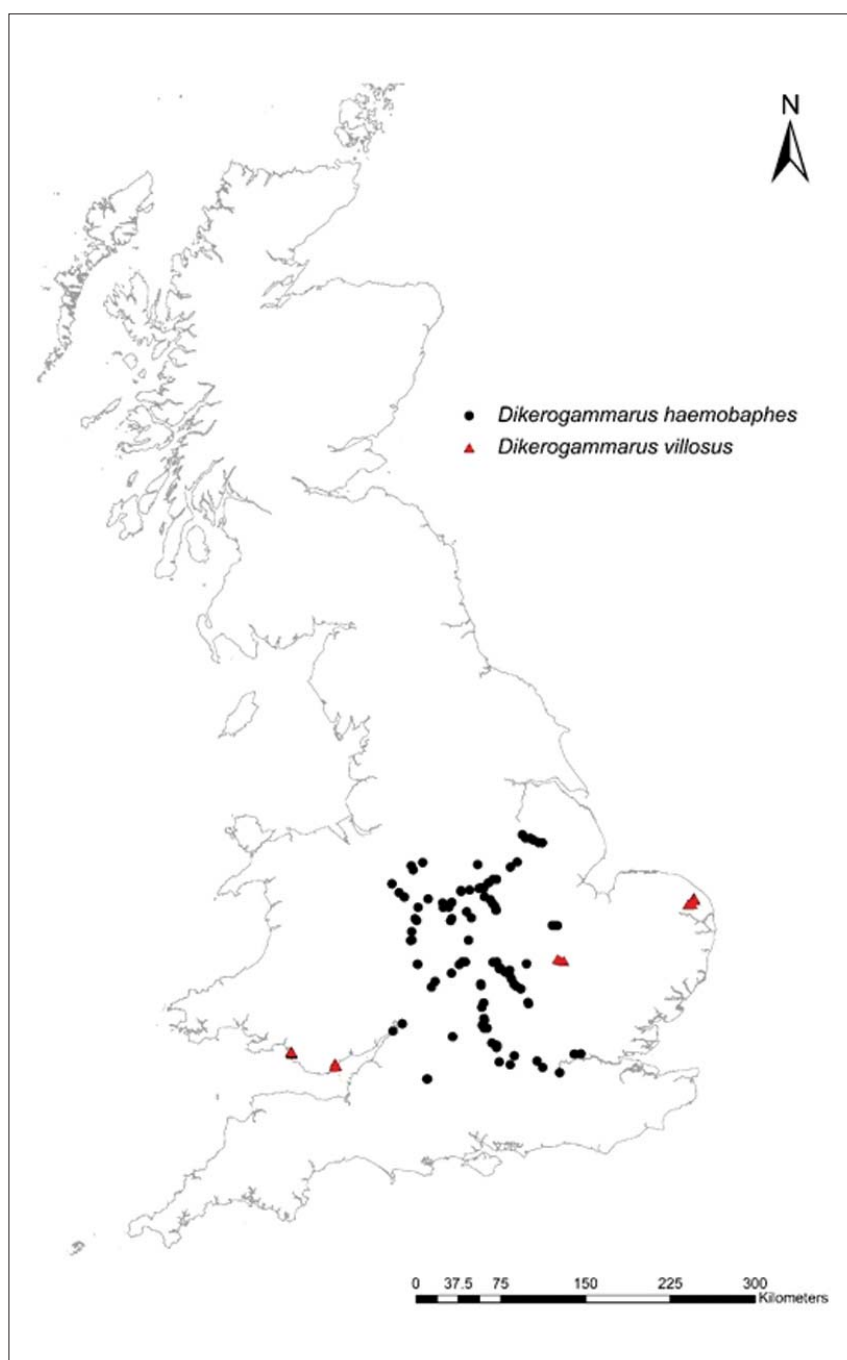


Figure 1: Recent confirmed reports of *D. haemobaphes* (Blue) and *D. villosus* (Red) in the UK (EA – unpublished data January 2014; photo courtesy of SE Environment Agency).

have the ability to carry non-native microsporidian parasites, and very recently studies from France have shown that microsporidian parasites in *D. villosus* can cross infect other gammarid amphipods.

Demon parasites?

The invasion of non-native species into British waterways carries a biosecurity threat not only in the ability of non-natives to outcompete their native counterparts, but also the very real threat of spreading disease and parasites in populations without acquired resistance. Therefore, to fully assess the risk posed by invasive species an understanding of the potential threat posed by parasites and disease needs to be established. An important research question we are currently addressing at the Institute of Marine Sciences at the University of Portsmouth is whether these “demon shrimp” carry “demon parasites”. We are also trying to answer the question whether the demon shrimp are able to acquire native parasites (e.g. from *Gammarus pulex*). This second question is particularly important as over time it may result in suppressing population growth of an invader and help us understand whether an invader is getting integrated into a food-web.

Parasite Soup

The approaches one can use to try and identify parasites within amphipods range from simple dissection, histology through to advanced molecular techniques. Simple dissection can be a little tricky with small (<1cm) crustaceans and the parasites we are interested in are very often intracellular which leaves the options of electron microscopy and/or molecular techniques. In our study we have opted for the molecular route in that it offers the ability to extract DNA from each individual amphipod and in doing so extract the DNA of the parasites that reside within them creating a “parasite soup”. This enables us to screen an individual native or invasive shrimp for multiple species of parasites from one sample. Subsequently we use adapters that attach to specific parts of DNA enabling us to amplify up pieces of parasite DNA for sequencing. With support from the South East region of the Environment Agency we have analysed specimens of *D. haemobaphes* and *G. pulex* from regions within the Thames basin.

Sexually abnormal demons

Our preliminary results so far have revealed a variety of parasites both within the invasive and native species with a few overlaps. Particularly interesting is a finding that

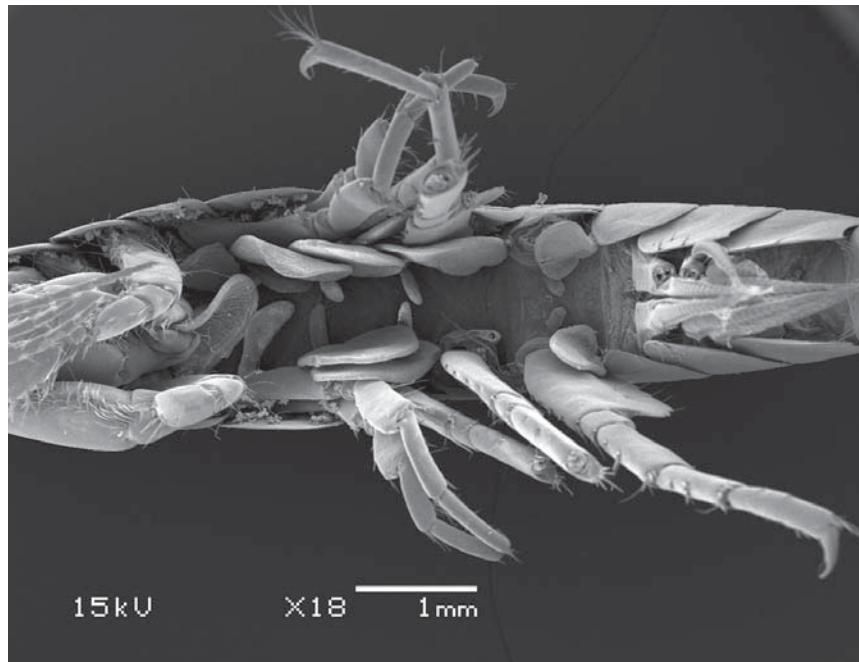


Figure 2: A male Demon Shrimp (*Dikerogammarus haemobaphes*) with female rudimentary brood plates and genital papilla. Photo: Amaia Green Etxabe; University of Portsmouth.

suggests a very large proportion of demon shrimp display intersexuality (Figure. 2), a condition whereby specimens display characteristics of being male and female. This is quite common in populations of amphipods with feminising parasites and offers up intriguing research question(s). Do demon parasites not cope well in British rivers leaving their hosts with incomplete feminisation? Have demon shrimp caught British feminising parasites that don't efficiently feminise in alien hosts?

National Survey

We hope, with assistance of the appropriate organisations, to widen our studies to cover the entire UK so that we can analyse and map the occurrence, co-existence, spread and interaction of parasites within native and alien amphipods in British waterways.

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References

- Mace G. et al. (2005) Millennium Ecosystem Assessment.
Williams F. et al. (2010) The economic cost of invasive non-native species on Great Britain. CABI report 198pp.

Eds: As mentioned in the Editorial, former FBA Director Mike Dobson produced an excellent guide to identifying invasive freshwater shrimps and isopods, which is available free to download at <http://www.fba.org.uk/downloads>.

