Discovery of a ponto-caspian mysid shrimp (Hemimysis anomala) in South East England: Potential for bird mediated dispersal?

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Discovery of a ponto-caspian mysid shrimp (*Hemimysis anomala*) in South East England: Potential for bird mediated dispersal?

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Abstract

The Ponto-Caspian Bloody-red mysid shrimp (*Hemimysis anomala*) was discovered in a large freshwater reservoir in the south-east of England in 2020 (Abberton reservoir, Essex, UK). The shrimp was discovered while carrying out aquatic invertebrate surveys across a range of permanent, semi-permanent and seasonal habitats between October and December 2020. The shrimp were found in semi-permanent lagoons adjacent to and connected to the main reservoir and in shallow water bays in the main reservoir. Surveys conducted in January 2021 along a reservoir wall also found the shrimp but no accurate abundance estimates were made. Surveys conducted across the same sites with increased effort in July 2021 did not find any individuals in lagoons, bays or off the reservoir wall in either shallow or deep shelves. The identity of the species was confirmed with high magnification inverted light microscopy due to the shape and setae distribution of the antennal scale and telson in addition to the characteristic bloody red colour of the shrimp pre-preservation. Previous introductions of this species to the UK have been identified before, but whether these propagules arrived from natural or anthropogenic introductions was not clear. Abberton reservoir has no public access for boating or recreational activities other than a small, restricted local angling group at the furthermost point from where the mysid shrimp were discovered, but is an internationally important site for migratory and overwintering waterfowl and waders. The migration routes of several waterfowl species for which Abberton is noted would mean that this new shrimp species is likely to have been introduced from either its native range or from its expanded non-native range in the UK or Netherlands by birds. It is not yet confirmed that this discovery represents a successful invasion of this species at Abberton and if it is, when it arrived or what effects it may be having on the food web of this site.

Keywords: INNS; invasive non-native species; invertebrates; predators; waterbirds; wildfowl; reservoir; food webs

Introduction

Non-native and also non-native and invasive species (INNS) remain identified as one of the top causes of biodiversity loss (IPBES 2019). Successful non-native species invasion to aquatic habitats appears to be particularly common (IPBES 2019), and associated with large effects sizes on the ecology of such systems (Flecker & Townsend 1992). This latter point being attributed to the generalist nature, or size structuring, of predation in aquatic systems (Persson et al., 2007). It is also well recognised that invertebrate predators can have surprisingly larger effects on ecosystems, with population level effects as or greater than fishes for example (Brooks & Dodson, 1965).

Here we report the discovery of the Bloody red shrimp (*Hemimysis anomala*) in the south East of the UK in a large but relatively isolated freshwater reservoir system on the Essex coast. This is not the first report of this species from the UK, with several studies in the English midlands since 2004 (Holdich *et al*., 2006). Since then there have been sightings throughout the midlands and the London area within a relatively compact area (NBN Atlas, 2022). This includes the two closest recordings to Colchester, Essex that are approximately equal distance based near Downham Market (Norfolk) and Roydon (Harlow, London), both reported in 2012.

Distribution

In November 2020, using a 25*20cm standard square invertebrate sampling net, five shrimp were discovered in two of three invertebrate kick samples in a shallow semi-permanent lagoon that had recently been connected to the main Abberton reservoir when water levels were higher. This lagoon was located on the south side of the reservoir (51°49'18.05"N, 0°52'22.90"E). These shrimp were found in very shallow water, less than 10cm depth. No other samples of lagoons found shrimp that same day. A further single shrimp that looked similar to the first five was found in a single sample in a bay of the north bank of the main reservoir (51°49'59.02"N, 0°51'42.98"E). A photo of this shrimp was taken using a smart phone (Figure 1). No materials were taken to the site to safely fix the shrimp and given suspicions at that time that it may be an unknown non-native species – the shrimp were despatched and left on site.

A return visit to the site in January 2021 found three of what appeared to be the same shrimp in deeper water off the North east bank of the reservoir off an engineered dam wall (51°50'26.64"N, 0°52'47.26"E), where a plankton net was thrown out into the water and allowed to sink a little before being hauled (30cm diameter, 100um mesh; KC Denmark). Despite significant effort no further samples were found, so large densities were not likely to be at this site at that time. The three shrimp were fixed in 70% ethanol inside a secure screw top Nalgene bottle for transport off site. A return visit using the thrown plankton net method all around the North, North East and East banks of the reservoir in July 2021 found no shrimp in any samples (n= >100 attempts).

Identification

While the shrimp was already thought to be *Hemimysis anomala* based on its colour, shape and behaviour – this required confirmation. To confirm the identity of the shrimp the fixed individuals were manipulated into position for inverted light microscopy to examine the shape of the antennal

scale and telson (Dobson, 2012). The anterior region of the antennal scale of all three specimens was identical and showed a rounded antennal scale, with no spine on the outer edge, and setae on the inner edge but absent for much of the outer edge (Figure 2). A close up view of the dorsal view of the telson showed a flatted truncated end with uniform small serrations along its edge enclosed between two longer outer spines (Figure 3). These are clear and robust identification features of *Hemimysis anomala* – the bloody red shrimp.

Discussion

The discovery of *Hemimysis anomala* at low density following peak bird winter migration where this site is internationally recognised to host peak counts of 39,000 wintering waterbirds, the absence of any shrimp found in samples in summer in habitats that would be ideal for it to form large and high density swarms and the restricted public access all suggest that this is likely a recent zoochorous propagule event that has not been successful in forming a permanent population at Abberton reservoir (Coughlan et al., 2017; Reynolds et al., 2015). This conclusion would not exclude the likelihood that previous arrivals of this species at Abberton, brought in by migratory waterfowl, have occurred and either were not discovered or remained at such low densities that they were undetectable. The species was not detected in extensive zooplankton surveys occurring at this site between 2006 and 2019 before, during and after an enlargement project to increase the water storage capacity of the main reservoir by 58% that finished in 2013 (Wallis et al., 2019). Furthermore, the species was not discovered in an aquatic macro-invertebrate survey of the site in 2017, so it is unlikely that any previous arrival of this species before the currently reported event has occurred. While there is a small local angling group that will fish off dam walls in the western section, there is no access for fishing into the main reservoir where our sampling too place.

The risks from invasion of Ponto-Caspian species non-native to the UK and western Europe are well recognised (Gallardo & Aldridge 2015). Whether this invasion to a large wetland site that is relatively isolate from other recorded UK sites is occurring regularly due to the role of large annual movements of waterbirds is unclear. If *Hemimysis anomala* were to become established in Abberton, the likelihood of large effects on the ecology of the site will be dependent on how well the existing fish and invertebrate predator community could limit its abundance, but the evidence suggests its effects would be detrimental to all trophic levels (Ricciardi et al., 2012). Given the likely role of plankton-based food webs on the food resources for visiting and breeding birds at the site, monitoring of this risk should be undertaken.

Figure 1: Photograph of a shrimp like organism with features including a transparent abdomen, a pinkish colour in nature with two large black eyes. Credit of image: Tom Cameron and Christopher Andrews 2020; taken on phone camera.

Figure 2: High resolution images under inverted light microscope to capture shape and setae distribution on antennal scale at x10 magnification (top) and (bottom) close up on antennal scale at x40 magnification showing rounded shape, lack of spine and setae absent on much of outer edge as is identifying features of *Hemimysis anomala*. Credit of images: Tom Cameron.

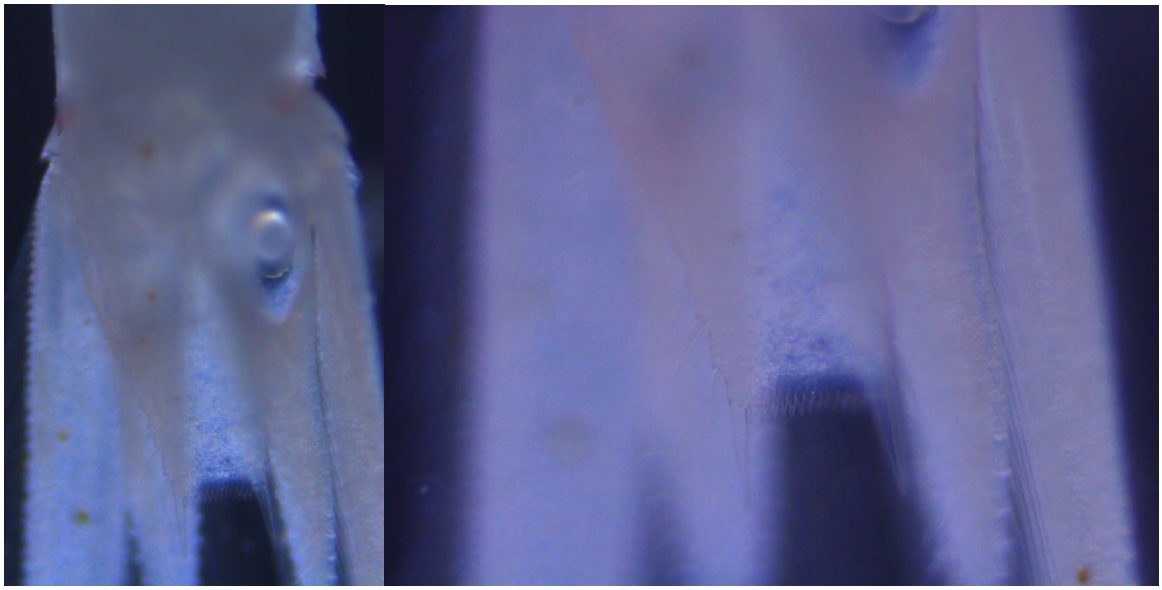

Figure 3. High resolution images under inverted light microscope to capture shape of telson x10 magnification (left) and (bottom) close up on telson at x40 magnification showing telson with a truncated flattened end as is an identifying feature of *Hemimysis anomala*. Credit of images: Tom Cameron.

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