

TWO INVASIVE BIVALVES, *RANGIA CUNEATA* (G.B. SOWERBY I, 1831) AND *MYTILOPSIS LEUCOPHAEATA* (CONRAD, 1831), LIVING IN FRESHWATER IN LINCOLNSHIRE, EASTERN ENGLAND

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Abstract The invasive Gulf Wedge Clam, *Rangia cuneata* is reported new to the UK from two sites along an artificial channel joining the lower reaches of the River Witham in Lincolnshire. This bivalve occurred in association with another invasive North American species, the False Dark Mussel, *Mytilopsis leucophaeata*, at its fourth UK site. Both of these species, known previously only from brackish-water, were living in freshwater associated with typical freshwater molluscs. Shell morphometrics suggest that both species have been present in the channel for at least 6 years, when they are likely to have been introduced as a consequence of discharge of boat ballast water.

Key words *Rangia cuneata*, *Mytilopsis leucophaeata*, invasive species, Mactridae, Dreissenidae, South Forty Foot Drain, River Witham

INTRODUCTION

Alien and invasive fresh- and brackish-water bivalves have been increasingly reported from and spreading in the British Isles with *Mytilopsis leucophaeata*, *Corbicula fluminea* and *Dreissena rostriformis bugensis* currently recognised (NNSS, 2015). This paper reports the first occurrence of the Gulf Wedge Clam (Atlantic *Rangia* or Common *Rangia*) *Rangia cuneata* (Mactridae) and a fourth record of the Dark False Mussel *Mytilopsis leucophaeata* (Dreissenidae), for the British Isles.

RESULTS

Identification

Externally the shells of *Rangia* (Fig. 1) resemble those of the Corbiculidae, but they are readily identified by the internal dark brown ligament lying within a triangular pit. Verween *et al.* (2006) distinguish *Rangia* from native European mactrids and noted similarity to the marine *Spisula subtruncata*.

Mytilopsis can be distinguished from other British dreissenids by the presence of a tooth in the umbonal cavity (Killeen *et al.*, 2004).

Specimens of both *R. cuneata* and *M. leucophaeata* from South Forty Foot Drain have been placed into the collections of the National Museum of Wales (NMW.Z.2015.019.01–03), The Natural

History Museum (London) and the University Museum of Zoology, Cambridge.

Location and Habitat

Rangia and *Mytilopsis* were found together at two localities on the South Forty Foot Drain at Hubbert's Bridge (TF 26771 43654) and near the Skirbeck Farm Bridge, sometimes known as the A52 Bridge (TF 30392 43379), located 5.75km and 2.25km respectively from the River Witham in Boston.

This artificial water channel was created under the orders of the Earl of Lindsey between 1635 and 1638 with further work taking place after 1765 to drain the Lincolnshire fens lying to the west and south of Boston (Darby 1968). The drain runs for a distance of 31km between Guthram Gowt (west of Spalding) and Boston. Boats enter and leave the drain at periods either side of high water in the tidal Witham, but boat navigation was only restored to the South Forty Foot Drain in 2009 after a break of 38 years.

Samples were collected at Hubbert's Bridge from an Environment Agency pontoon (using an extendable sampling net with a 2mm mesh, 25cm width and length of 4.8m) at depths of 2.5–3.5m from unconsolidated black anoxic organic mud and from concrete pontoon foundations. At Skirbeck Farm Bridge, approximately 3.5km downstream, samples were taken by wading from the bank and by using the same equipment



Figure 1 *Rangia cuneata* shells from South Forty Foot Drain, Lincolnshire, England. National Museum of Wales, NMW.Z.2015.019.01.

to sample muddy gravel at depths of about 2–2.5m.

South Forty Foot Drain joins the River Witham below Black Sluice Lock in Boston (TF 32649 42870) to become The Haven, where the water becomes brackish and tidal. Both sample sites are, however, entirely freshwater. At Hubbert's Bridge the associated molluscan fauna included live *Bithynia tentaculata* and *Anodonta anatina* and other freshly dead freshwater taxa including *Valvata piscinalis*, *Potamopyrgus antipodarum*, *Radix balthica*, *R. auricularia*, *Lymnaea stagnalis*, *Physa fontinalis*, *Physella acuta*, *Planorbis planorbis*, *Anisus vortex*, *Bathyophalus contortus* and *Sphaerium corneum*.

Most of the molluscan biomass at Hubbert's Bridge was represented by *R. cuneata*.

Age and time of invasion

At Hubbert's Bridge a sample of living and freshly dead shells (many containing dead animals) ranged in size between 8.9–47.6mm (n=70, mean 29.9mm, SD 8.9mm). Fourteen specimens (20%) exceeded the maximum recorded length of 40mm of the Antwerp specimens (Fig. 2). Warzocha & Drgas (2013) considered that a shell of 35mm width may be up to 3 years old, whereas in America shells up to 75.6mm are estimated to have reached 10 years of age (Wolfe & Petteway 1968). The largest (>40mm) shells from Hubbert's Bridge have growth bands suggesting ages between 5–8 years, indicating their appearance at the site around 7 or 8 years ago,

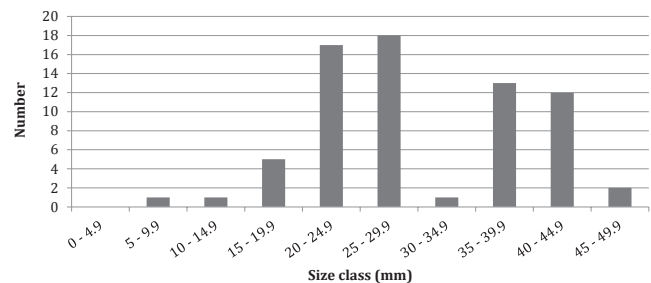


Figure 2 Size frequency distribution of *Rangia cuneata* from Hubbert's Bridge, South Forty Foot Drain sampled on 19th August 2015.

if they were introduced as larvae in ship's ballast. The bimodal size frequency distribution (Fig. 2) and the absence of small shells suggests intermittent recruitment. This broadly coincides with the period when boat traffic resumed on this waterway in 2009. At Skirbeck Farm Bridge a shorter sampling period produced further live *R. cuneata* but no dead shells (n=9, mean 32.7mm, SD 2.85mm). Assuming that *R. cuneata* occurs in the 3.5km of drain between the two South Forty Foot Drain sample sites it would seem likely that *R. cuneata* extends for some distance upstream beyond Hubbert's Bridge.

Mytilopsis leucophaeta, another invasive bivalve from North America, was associated with *R. cuneata* at both Lincolnshire sites, although this was found attached to, or beneath the concrete pontoon at Hubbert's Bridge or amongst gravel at Skirbeck Farm Bridge. Unlike *R. cuneata*, most of the specimens recovered at these sites

were freshly dead, articulated valves. Shell sizes ranged from 4.1–25.6mm (n=337, mean 13mm, SD 5.9mm), which are comparable to *M. leucophaeta* populations measured elsewhere. Killeen *et al.* (2004) gave 13mm as a typical length for it in the UK, whereas Heiler *et al.* (2010) found the mean length of a sample from the south Caspian Sea to be 13.5mm, with a maximum shell length of 22mm. Interestingly 4% of the specimens from Hubbert's Bridge exceed that by 3.5mm. In Belgium Verween *et al.* (2006) also recorded a maximum size for it of 22mm estimating its longevity to be in excess of 5 years. If the *M. leucophaeta* from Hubbert's Bridge behave similarly, then it may have colonised the site 5–6 years ago in 2009–2010 at a similar time to the introduction of *R. cuneata*, which coincides with the resumption of boat traffic in the drain.

DISCUSSION

This Lincolnshire record of *Rangia cuneata* represents the third record of this species from Europe and the first from Britain. It was first discovered in Europe in 2005 in the harbour of Antwerp along the Western Schelde River in Belgium, where it was also associated with *Mytilopsis leucophaeata* (Verween *et al.* 2006). Since this discovery *R. cuneata* has spread more widely in Belgium and has also been found in The Netherlands, so that by 2013 it was common in brackish-water in the provinces of North-Holland and Zeeland (Neckheim 2013). In 2010 *R. cuneata* was recorded in the Russian sector of the Vistula Lagoon, S.E. Baltic (Rudinskaya & Gusev 2012) and in 2011 it was also recovered from the Polish sector (Warzocha & Drgas 2013). *R. cuneata* is considered native to the Gulf of Mexico, but has an introduced range extending along the Atlantic coast of North America from Florida up to the lower portion of the Hudson River, New York (Pfitzenmeyer & Drobeck 1964, Wakidu-Kusunoke & MacKenzie 2004). *Rangia cuneata* may owe its recent spread along the US Atlantic coast to the transportation of *Crassostrea virginica* from the Gulf of Mexico to Chesapeake Bay and/or as a result of transportation of larvae in ship ballast water (Pfitzenmeyer & Drobeck 1964, Carlton 1992, Verween *et al.* 2006 & Rudinskaya & Gusev 2012).

Hitherto both *Rangia* and *Mytilopsis* have only been reported from brackish-water habitats. The discovery of both species in purely freshwater

habitats poses a potential threat to the native fauna of British freshwater ecosystems. *Rangia cuneata* is one of the few species that seems to have the physiological ability to straddle the salinity boundary between fresh and brackish-water (Bedford & Anderson 1972) and in such environments it can assume dominance as in the South Forty Foot Drain. Further work is urgently needed to clarify its distribution in both the tidal and non-tidal reaches of the River Witham and its connected waterways. Molecular phylogenetic studies may also be able to shed light on the source of this population.

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