

## FIRST RECORD FOR THE UK OF THE NON-NATIVE DWARF SURF CLAM – *MULINIA LATERALIS* (SAY, 1822)

*Mulinia lateralis*<sup>1</sup>, the dwarf surf clam, is reported for the first time in the UK from samples taken from the Outer Thames Estuary. In August 2021, one live specimen was found amongst *Spisula subtruncata*<sup>2</sup> collected near Gravesend and in 2022 an additional 4 specimens were collected at two sites further east off Canvey Island. Native of the western Atlantic and Caribbean, *M. lateralis* was first discovered in Europe in 2017 in the Wadden Sea and now seems to be established there<sup>3, 4</sup>. The Conchological Society's Marine Recorder mentioned *M. lateralis* in his Marine Recorder's Report of 2019<sup>5</sup> as a horizon non-native species to look out for in the UK. It bears a great similarity to our native *S. subtruncata*, so may go unnoticed in surveys.

In the Netherlands *M. lateralis* has been recorded in high numbers of almost 6000 individuals per square meter<sup>3</sup>. Bivalves can naturally dominate some estuarine habitats both here and on the eastern seaboard of America, the native range for *M. lateralis*. In a study on estuarine bivalves at two locations in eastern Florida McKeon *et al*<sup>6</sup> found that *M. lateralis* was one of seven such species that can comprise 20% or more of the numbers of individuals at some sites. Due to its adaptability to various ecological factors a good question for researchers in the UK is whether this will provide it with a competitive edge over our native surf clams. To support recording efforts of this potentially invasive species we provide a description of *M. lateralis* along with images to aid accurate identification. We include specimens found in the Outer Thames estuary, the Netherlands and additional specimens from the east coast of USA from Amgueddfa Cymru's collections.

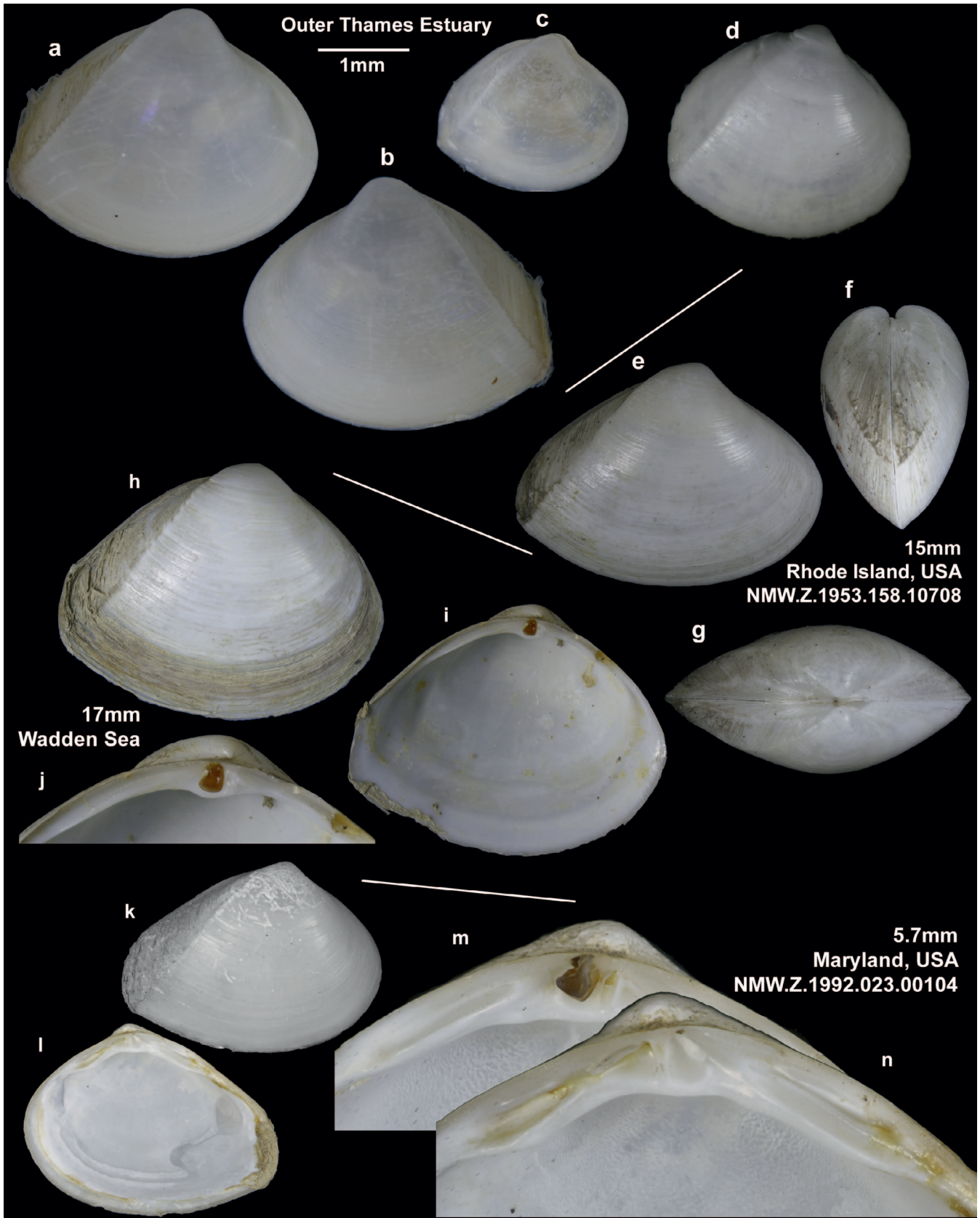
The natural range of *M. lateralis* is from Nova Scotia and south along the Atlantic coast of the United States, through the coastal areas of Gulf of Mexico and to Colombia with records also from Dominican Republic and Puerto Rico<sup>7</sup>. First discovered outside of its native range in Europe in 2017, it was discovered in the Ems-Dollard estuary in the western German Wadden Sea and then two months later in the Dutch Voordelta and subsequently from the Dutch Wadden Sea<sup>3, 4</sup>.

Since 2017 *M. lateralis* has spread to Belgium<sup>7</sup> and across the southern North Sea to the UK. It is known for its tolerance to salinity fluctuations, extreme temperatures and poor water quality and it is believed to be able to outcompete species in its native range for food and space<sup>6</sup>.

*M. lateralis* closely resembles *S. subtruncata* and can also be confused with *Macra stultorum*<sup>8</sup> and *Rangia cuneata*<sup>9</sup>, another non-native bivalve that is found in the UK. However, there are differences between the species that allow the identification of each. The outline of *M. lateralis* is rounded subtriangular, with prominent umbones and an almost truncate posterior margin. The anterior margin is broadly curved, as is the ventral margin. A posterior radial ridge runs from the umbo to the posterior-most point of the shell, which creates the truncate appearance of the posterior margin. The radial ridge is a prominent feature of this species, and the ridge often has a thickened patch of pale brown, wrinkled periostracum covering it.

Inside, the hinge plate is moderately thin and curves beneath the chondrophore, in which the triangular ligament sits. There is no trace of an external ligament. Two cardinal teeth in the left valve are anterior to the ligament and form an inverted 'v' shape, joined at the base. In the right valve the cardinals are at a right angle to each other, but do not quite touch at the base. It has paired laterals in the right valve and single laterals in the left valve, which are either smooth or finely crenulated. Pallial sinus is small, not reaching the midline.

On comparison with similar macrtrids found in UK, *M. lateralis* has a more delicate appearance as compared to *S. subtruncata* and *R. cuneata* and it has a prominent posterior radial ridge that is visible even in shells under 1mm in length (Fig. 1), which is absent in the other species. This distinctive ridge, along with presence of an entirely internal ligament<sup>10</sup> and a much smaller chondrophore, separates *M. lateralis* from *S. subtruncata*. Furthermore, the concentric sculpture of *M. lateralis* consists of much finer lines than *S. subtruncata*, which has an overall more rugged form. *M. stultorum* juveniles are similarly delicate to *M.*



**Figure 1** *Mulinia lateralis* 1–d Outer Thames Estuary, UK, 3.5mm, 1.6mm, 0.9mm; e–g Rhode Island, USA, NMW.Z.1953.10708, 15mm; h–j Wadden Sea, Netherlands, 17.5mm; k–n Maryland, USA NMW.Z.1992.023.00104, 5.7mm.

*lateralis*, but outlines differ in that *M. stultorum* is more rounded, much less tumid and lacks the radial ridge. The non-native *R. cuneata* is much heavier and thicker shelled, has large umbos and thick, uneven concentric lines and a thickened hinge plate. The line drawings in Craeymeersch<sup>3</sup> excellently demonstrate the features of *M. lateralis*, *S. subtruncata*, *R. cuneata* and *M. stultorum* and so do not need repeating here. Instead, we provide photographs of the new finds alongside specimens from Netherlands and east coast USA (Fig. 1).

The maximum size of *M. lateralis* varies depending on the publication, but the largest shell recorded is on World Register of Marine Species<sup>11</sup>, which illustrates the species using a photograph of a shell of 25mm from Natuurhistorisch Museum Rotterdam collections, collected at Guilford, Connecticut, USA. But regardless of size, *M. lateralis* retains its distinctive outline and features from 25mm down to 2mm and according to images in a paper by Sullivan<sup>12</sup>, even the larvae appear to have the angular posterior.

With regards to habitat preference of *M. lateralis*, salinity ranges can be broad suggesting that salinity is not a primary driver in habitat choice<sup>4</sup>. In the Wadden Sea *M. lateralis* was found in soft mud with large percentages of silt and Klunder *et al*<sup>4</sup> propose that the driver of habitat choice is sediment type, preferring soft, silty mud with a low grain size (72–106µm), at least in the Wadden Sea. Furthermore, Klunder *et al*<sup>4</sup> indicate that this sediment preference could restrict the spread of the species. McKeon *et al*<sup>6</sup> reported that *M. lateralis* along with *R. cuneata* abundant in the more loosely aggregated sediment in the middle reaches of the estuary. In the Outer Thames Estuary, it was found in sandy mud and muddy sand but as only 5 individuals have so far been discovered it is not possible to directly compare habitat choice with the thousands of individuals found in the Wadden Sea.

*S. subtruncata* was found with *M. lateralis* in the Dutch and British sites and *Cerastoderma edule* is also associated with *M. lateralis* in parts of the Wadden Sea. Found in high densities, *M. lateralis*, as with other non-native bivalves, may compete for food and space with native bivalves<sup>3</sup>. Adult *M. lateralis* is able to tolerate a wide salinity range<sup>13</sup>, poor water quality<sup>6</sup>, extreme temperatures and anoxia<sup>3</sup> it is reasonable to assume that

it will continue to establish in other locations globally. These factors along with a high fecundity (up to 2 million eggs at a time<sup>14</sup>), external fertilization, mobile larvae (1–3 weeks in the water column) and fast-growing juveniles (sexually mature within 2 months, i.e. 3mm in length) could, given the right conditions, allow *M. lateralis* to successfully compete in the UK context.

The Outer Thames Estuary sites are sampled annually and so numbers of *M. lateralis* can be monitored to check for population growth. It is suggested that any other bivalve samples containing *S. subtruncata* found recently in the Thames Estuary area should have their identification confirmed as it is easy to mistake *M. lateralis* for *S. subtruncata*.

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