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SHORT COMMUNICATIONS

Mantis shrimps *Rissoides desmaresti* in Tremadog Bay, North Wales

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In 1999 divers discovered a population of the burrowing mantis shrimp *Rissoides (Meiosquilla) desmaresti* (Crustacea: Stomatopoda) east of the St Tudwal's Islands, North Wales. This species has only sporadically been recorded in UK waters and commonly occurs in the Mediterranean. In summer 2000 the burrow morphology and distribution of these shrimps in the area east of the St Tudwal's Islands was investigated. Burrows were found at ten of the 15 sites investigated in a survey area measuring ~18 km^2. Burrow density varied from one to 11 burrows per 100 m^2. The burrows were always recorded in sediments consisting of a mixture of mud, sand and gravel but were not present at sites with a high proportion of mud (>70%) or sandy sediments with very little mud (⩽2%). Resin casts of six burrows revealed that these have a simple elongated U-shape, with an average length of ~450 mm and depth of ~160 mm. The average diameter of the burrow entrance was 19 ±2 mm and the diameter of the burrow along the horizontal section varied between 18 and 38 mm with a distinct constriction part way along.

Rissoides desmaresti is usually found in the Mediterranean but has been recorded in the south and west of England (Marine Biological Association, 1931; Mauchline, 1984), in particular in the Solent (R.J.H. Herbert, personal communication). In UK waters, records of larvae are more numerous and widespread than records of adults (Marine Biological Association, 1931; Mauchline, 1984). Larvae have been recorded as far north as the Isle of Man, although no adults have been recorded from this location (Bruce et al., 1963). To our knowledge, this was the first ever record of adults of this species in Wales. This study investigated the distribution and burrow morphology of these shrimps in an area east of the St Tudwal's Islands.

Diver transect surveys were carried out at 15 sites to investigate the density of mantis shrimp burrows. Divers worked in pairs either side of a 50 m transect line, each recording a measured area of 1.5 m away from the line (i.e. the total area covered was 150 m^2). Numbers of burrows along the transect line were recorded and a note made of water depth and the dominant epi-flora and fauna present. The 'main' entrance of the mantis shrimp burrow was recognizable due to the relatively wide diameter (>15 mm), slight angle at which the burrow descended into the sediment and lack of any associated mound of sediment. The other entrances were constricted and usually concealed with loose sediment and could only be located by forcing water through the main entrance to create a small silt plume out of the other. One sediment sample per transect line was taken using a core with a diameter of 65 mm to sample ~15 cm depth of sediment. Sediment samples were dried, sieved and weighed as described in Holme & McIntyre (1984).

Mantis shrimp burrows were found at ten of the 15 sites surveyed in an area measuring ~18 km^2 and densities varied from one to 11 burrows per 100 m^2 (Table 1). Positive sightings of mantis shrimps were also made at five of these sites. Burrows were always recorded in mixed sediments of mud (3–28%), sand (42–78%) and gravel (2–49%). Of the sites where burrows were not found, two had muddy sediments (72 and 74% mud), one was mainly fine sand (87% sand, 11% gravel, 2% mud), one was a gravel/sand mixture (41% gravel, 59% sand) and one consisted mainly of pebbles and cobbles. The dominant epi-flora and fauna recorded at sites where mantis shrimp burrows were found were varied and included fragments of live or dead maerl (*Lithothamnion* spp.), solitary ascidians (especially *Ascidiella aspersa*), sponges and, in shallower depths (⩽16 m), red algae (Table 1).

An area with high burrow density was selected for resin casting of burrows. The site was buoyed and divers marked suitable burrows using a guideline strung between small wooden marker sticks. The resin casting method followed that described in Atkinson & Chapman (1984). Liquid polyester resin (Trylon AP101PA) was poured into 12 burrows. The following day, casts were recovered by gently excavating the surrounding sediment by hand.

Two complete and four almost complete resin casts were removed from the sediment (four were missing the top section of the narrowest opening). Each of the burrows cast had a simple elongated U-shape with two openings, one wider than the other (Figure 1). The mean distance between the two openings (outside edge to outside edge) was 44.7 ±3.6 cm. The mean depth of the burrows was 16.1 ±1.9 cm. In all six casts there was an obvious constriction along the horizontal section of the burrow. The diameter of this constriction was, on average, 12.6 mm less than the diameter of the thickest part of the horizontal section of the burrow (mean diameter thickest section 33.4 ±2.9 mm, mean diameter constriction 20.8 ±1.5 mm). The position of the constriction was variable. The mean diameter of burrow openings was 18.6 ±2.2 mm. Three mantis shrimps that were captured whilst these burrows were being cast had body lengths of 81, 82 and 90 mm (measured from the rostrum to the end of the telson).

The presence of *R. desmaresti* off the coast of North Wales is perhaps surprising, as it is generally considered to be a Mediterranean species. The water temperature in this area of North Wales is thought to be relatively high (surface temperatures of 19°C have been recorded during summer months). Tremadog Bay is also relatively sheltered from wave action and tidal currents, being bounded by land to the north and east and by the shallow subtidal reef of Sarn Badrig to the south. Several other species with a south and western distribution have been found in this area, including the red algae *Anotrichium barbatum*, *Polysiphonia foetidissima* and *Polysiphonia sanguinea*. It is also possible that the area is supplied with larvae from the south by specific currents. Currents are known to flow from the Brittany coast

Table 1. *Details for each site. Sediment descriptions follow the Wentworth Scale and Holme & McIntyre (1984). Where sediment types are separated by a comma, this indicates that each type comprised >10% of the sample (the sediment type that made up the greatest proportion of the sample is given first). Dominant epi-flora/fauna are those observed by divers.*

Site	Position	Depth (m)	Sediment	Dominant epi-flora/fauna	Burrow density 100 m^{-2}
0*	52°48.58′N 04°27.28′W	18	sand, gravel, mud	hydroids, bryozoans, some maerl	3.3
2**	52°48.50′N 04°25.90′W	20	gravelly sand	hydroids, bryozoans, ascidians	2.7
3**	52°48.90′N 04°24.70′W	15	sand, mud, gravel	sparse, some ascidians	8.0
4	52°49.90′N 04°20.20′W	22	sandy mud	sparse fauna/flora apparent	0
5**	52°48.57′N 04°27.37′W	14	muddy sand	whelks (*Buccinum undatum*), *Philine aperta*	6.7
6	52°49.70′N 04°21.20′W	2	sandy mud	sparse fauna/flora apparent	0
8	52°48.40′N 04°27.10′W	15	sand, gravel	sponges, red algae, hydroids	0
9*	52°48.55′N 04°27.10′W	18	gravel, sand, mud	hydroids, bryozoans, some maerl	2.7
10	52°48.60′N 04°27.80′W	7	fine sand	red and brown algae	0
A*	52°49.24′N 04°23.44′W	16	sand, gravel	sparse red algae, hydroids, sponges	1.3
B**	52°49.70′N 04°25.00′W	12	gravel, sand	red algae, sponges	10.7
C*	52°49.24′N 04°25.91′W	11	cobbles, muddy sand	algae	9.3
D**	52°47.99′N 04°27.13′W	23	no sample	bryozoans, ascidians	not counted
E	52°49.70′N 04°23.44′W	14	cobbles, pebbles	sponges, sparse red algae	0
F*	52°48.98′N 04°26.51′W	17	sand, mud, gravel	ascidians, sparse red algae	5.3

*, mantis shrimp burrows found; **, mantis shrimps and burrows recorded.

Figure 1. Resin cast of a mantis shrimp burrow. Scale bar: 5 cm.

northwards into the Irish Sea (Pingree & Le Cann, 1989). *Rissoides desmaresti* might also be under-recorded in UK waters. The animals are unlikely to be captured by trawls that penetrate into the sediment less than the depth of the burrows (Laban & Lindeboom, 1991). The shrimps are also unlikely to be recorded by recreational divers who would generally not investigate burrows.

The shrimps were recorded in cohesive mixed sediments consisting of mud, sand and gravel and occasionally pebbles and cobbles but were not found in more mobile clean sandy sediments or sediments that consisted of >70% mud. It seems likely that burrows built in cohesive sediments would be more stable and therefore easier to maintain. The absence of shrimps from sediments that consisted of >70% mud could possibly be linked to prey availability, as the flora and fauna of these muddy sediments was very different to that of the more mixed sediments.

The burrow counts provide an indication of the relative density of individuals, although there was no easy way of determining whether the burrows were occupied. There were also problems distinguishing between small mantis shrimp burrows and large *Upogebia* sp. burrows and therefore the number of burrows may have been underestimated. This probably also led to a bias in the size of the cast burrows, as smaller burrows were not selected for casting. From the current results, it is difficult to estimate the size of the population in Tremadog Bay with any accuracy.

The burrow structure of *R. desmaresti* appears to be very similar to that of *Squilla mantis* and *Oratosquilla oratoria* described by Atkinson et al. (1997) and Hamano et al. (1994) respectively. A constriction in the horizontal section of the burrow appears to be a common feature of these species and it is thought that this may facilitate water flow through the burrow, although it may also serve as an anti-predator function (Atkinson et al., 1997).

Future work could examine the extent of the mantis shrimp population over a larger area and examine the behaviour of this species. Acoustic seabed discrimination techniques could be used to identify areas of suitable sediment and these could then be examined by divers. Further studies into larval transport around this area might also provide clues as to the presence of this species in North Wales.

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