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Soft-shelled monothalamous foraminifera at an intertidal site on the south coast of England

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INTRODUCTION

There have been a number of studies of modern benthic foraminiferal assemblages at intertidal sites around the UK (Murray, 1991). Among the localities are several on the south coast of England: Christchurch Harbour (Murray, 1968), the Exe Estuary (Murray, 1983) and the Hamble Estuary (Alve & Murray 1994, 2001; Murray & Alve, 2000; Ward *et al*., 2003). These studies have focused almost exclusively on hard-shelled, mainly polythalamous foraminifera and excluded soft-shelled monothalamous taxa (organic-walled allogromiids and agglutinated saccamminids). Ellison (1984) found that an unidentified allogromiid species represented 16–80% (typically 2–50%) of live foraminifera at an intertidal site in the Tamar Estuary, SW England. Otherwise, reports of soft-shelled monothalamous forms in British waters are limited to qualitative records of particular species such as *Boderia turneri* and *Shepheardella taeniformis* (Siddall, 1880; Hedley, 1967; Hedley *et al*., 1968). The purpose of this note is to draw attention to the fact that monothalamous foraminifera are common at an intertidal site on the Hamble Estuary, southern England.

MATERIALS AND METHODS

Qualitative surface sediment samples (0–1 cm layer) were taken during low tide from the mid-part of the intertidal zone in the Hamble Estuary, Warsash, in October 2002 (one replicate) and July 2003 (two replicates) (Table 1). The general area is the same as that sampled by Alve & Murray (1994, 2001), Murray & Alve (2000) and Ward *et al.* (2003). The sediment was sieved on a 150 μm mesh sieve and the residue wet sorted for foraminifera, including soft-shelled monothalamous species, under a binocular microscope. The main purpose was to obtain foraminifera for lipid analyses and the residues, therefore, were not stained. Instead, specimens were judged to be live or dead on the basis of the presence or absence of obvious test contents. Soft-shelled specimens were placed on a glass cavity slide in glycerol to facilitate a more detailed examination. Specimens were then photographed under an Olympus BH2 photomicroscope using transmitted light and Nomarski interference contrast and under a Leica MZ8 photomicroscope using reflected light.

	October 2002	July 2002 Replicate 1	July 2002 Replicate 2
Sediment volume (ml)	2	1.5	2.5
Total live foraminifera	164	131	128
Monothalamous (% total)	96 (59%)	83 (63%)	65 (50%)

All the polythalamous foraminifera were calcareous, mainly *Haynesina germanica*

Table 1. Numbers of live foraminifera (total and monothalamous) in samples from Hamble Estuary, Warsash (0–1 cm layer, >150 μm fraction).

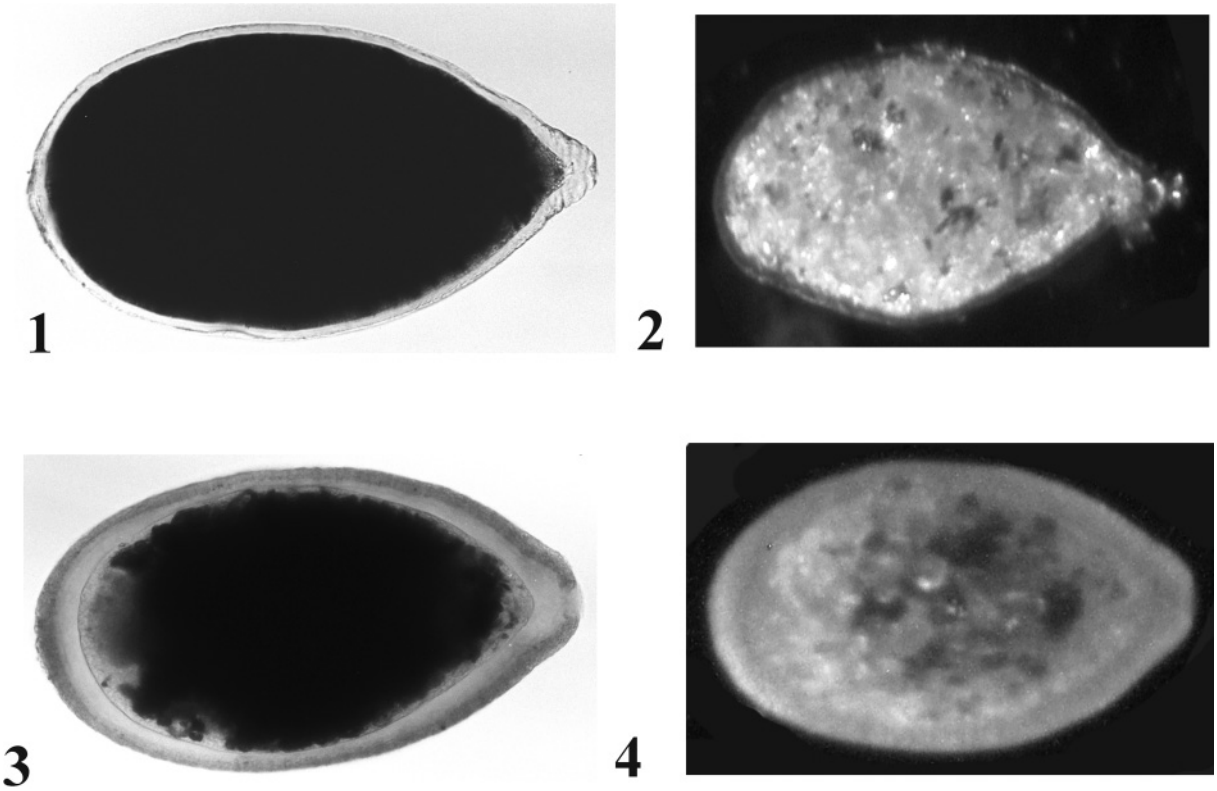
OBSERVATIONS

Soft-shelled monothalamous taxa contributed at least 50% of the live foraminiferal assemblage (Table 1). Five monothalamous taxa were present in the October 2002 sample. Two of these species, one with an agglutinated wall (*Psammophaga* sp.) and the other with an organic wall (*Allogromia crystallifera* Dahlgren, 1962) were particularly abundant. The test in *Psammophaga* sp. (40% of all live monothalamous foraminiferans in the October sample) is oval to almost spherical and measures 200–480 μm long and 140–300 μm wide (Pl. 1, figs 3–4). The apertural end varies from bluntly pointed to rounded to truncated and sometimes has a thin-walled, nipple-like projection. The flexible agglutinated wall is fairly thick, brownish in colour with a slight speckly sheen and composed of fine mineral particles. The cytoplasm, which only becomes visible in glycerol, is almost completely filled with mineral grains. Most are colourless and presumably composed of quartz, but a few are black.

In *Allogromia crystallifera* (44% of all live monothalamous foraminiferans in the October sample), the cytoplasm is also packed with mineral grains which are clearly visible through the transparent organic wall (Pl. 1, figs 1–2). The test is 240–600 μm long and 120–250 μm wide. The apertural end is bluntly pointed and sometimes prolonged slightly into a short neck. The other monothalamous foraminiferans in the October sample were a white saccamminid (200–400 μm long and 120–300 μm wide) with a circular aperture at the end of a short neck (8%), a spherical, thin-walled saccamminid with a reflective silvery surface (5%), and a brown saccamminid, 600–650 μm long and 400–440 μm wide (3%). The July 2003 samples yielded four monothalamous species, one of which, *Psammophaga* sp., accounted for 93% and 100% of the live monothalamous assemblage in replicates 1 and 2, respectively. In sample 1, *Allogromia crystallifera* was represented by three (2.3%) specimens, the brown saccamminid by two (1.5%) specimens and the white saccamminid by one specimen (0.8%).

DISCUSSION

Monothalamous foraminifera form an important component of foraminiferal assemblages in many benthic environments (Gooday, 2002). Alve & Murray (2001) established the occurrence of one saccamminid and two allogromiid species (all unnamed) at the Warsash site. These new observations on samples from Warsash, together with Ellison's (1984) report that



Explanation of Plate 1. Soft-shelled monothalamous foraminifera from an intertidal site at Warsash, Hampshire, UK. **figs 1–3.** Photographed using transmitted light and Nomarski interference contrast. **figs 2–4** Photographed using reflected light: **1**, **2,** *Allogromia crystallifera*; a species with a transparent organic wall – **1,** length 430 μm, width 210 μm, **2,** length 380 μm, width 180 μm; **3, 4,** *Psammophaga* sp; a species with a transluscent agglutinated test wall – both photographs are of the same specimen, length 350 μm, width 180 μm, note that in both species, the cytoplasm is densely packed with mineral grains.

allogromiids are abundant in the Tamar Estuary, suggest that these delicate foraminifera are a common and abundant constituent of intertidal benthic communities.

Psammophaga sp. and *Allogromia crystallifera* dominate the monothalamous component of the fauna at the Warsash site, providing the first British records of these taxa. The type species of *Psammophaga*, *P. simplora* Arnold, 1982, was described on the basis of material originating from shallow, inshore waters of Monterey Bay, California (Arnold, 1982). It was subsequently reported from salt marsh sediments on St Catherines Island (Goldstein *et al*., 1995) and the nearby Sapelo Island (Pawlowski *et al*., 2002a). The apertural end in *P. simplora* is more pointed than in the Warsash species and the concentration of mineral grains is much lower. An unnamed species of *Psammophaga* from Explorers Cove, McMurdo Sound, Antarctica (Gooday *et al.,* 1996; Pawlowski *et al*., 2002a) has a similar outline to the Warsash species, but again, the cytoplasm contains fewer mineral grains.

The only previous records of *Allogromia crystallifera* are from the Swedish west coast (Gullmarfjord and Kosterfjord) (Dahlgren, 1962; Pawlowski *et al*., 2002b). The specimens from the current study closely resemble those of Dahlgren (1962) except that, as in *Psammophaga* sp., the cytoplasm is much more densely packed with crystals. It is interesting that *Allogromia crystallifera* was common in the October 2002 sample but rare in both the July 2003 samples, suggesting that populations of this species are either spatially heterogeneous or fluctuate over time. 'Allogromiid A', the monothalamous species that is abundant on an intertidal mudflat in Cornwall (Ellison, 1984), appears not to belong to either of the Warsash species. Ellison's (1984, fig. 2 therein) small outline sketches show a monothalamous test with a protruding, flared aperture. Possibly, it is a species of the genus *Vellaria,* described by Gooday & Fernando (1992) from an Indian Estuary.

CONCLUSIONS

Soft-shelled monothalamous foraminiferans contribute at least 50% of the live foraminiferal assemblage in surface sediments from an intertidal site in the Hamble Estuary, southern England. The dominant monothalamous taxa, *Psammophaga* sp. and *Allogromia crystallifera*, are previously unreported from British waters. In both species, the cytoplasm is densely packed with mineral grains. It is suggested that these delicate foraminifera are an important, yet frequently overlooked, constituent of intertidal benthic communities.

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