

**RECORDS OF THE INTRODUCED AMPHIPOD
GRANDIDIERELLA JAPONICA STEPHENSEN 1938
(CRUSTACEA: AMPHIPODA: GAMMARIDEA: AORIDAE)
FROM THE ORWELL ESTUARY, SUFFOLK.**

CHRIS ASHELBY

Introduction

The Japanese amphipod *Grandidierella japonica* Stephensen, 1938 was first recorded in the British Isles from Southampton Water (Smith *et al.*, 1999). The species has not been reported from Britain in the literature since that date and recent sampling in the Southampton area has not revealed its presence there (M. Faasse *pers comm.*). It is the only member of the genus to have been recorded, thus far, from British waters and has not yet been found on the continent. *Grandidierella japonica* has also been introduced to the west coast of North America and has become widespread there (Chapman & Dorman, 1975; Cohen *et al.*, 1998; 2002).

As a recent introduction, *G. japonica* does not appear in Lincoln (1979), the most commonly used work on British amphipods, or in the directory of non-native species (Eno, Clark & Sanderson, 1997). It is also absent from the lists in the marine species directory for the British Isles (Howson & Picton, 1997) and the European register of marine species (Costello, Emblow & White, 2001). Its exclusion from Lincoln (1979) in combination with superficial similarities to other taxa may have lead to the species being overlooked in the past.

Methods

Littoral surveys of the Stour and Orwell estuaries (Essex and Suffolk) were carried out by the Environment Agency (EA) in 2004 and 2005 as part of a study to evaluate the effects of intertidal algal-mats on infauna. Nine 0.01m² core samples were taken from Copperas Bay on the Stour Estuary and nine from Cliff Quay on the Orwell Estuary, just upstream from the Orwell Bridge. All samples were fixed in 7% formaldehyde. Unicomarine Ltd was contracted to carry out faunal analysis of the samples.

The samples were sieved at 500 µm to remove the fine sediment. The majority of the remaining fauna was then separated from the heavier sediment by elutriation. All of the samples contained a large amount of the seaweed *Enteromorpha* spp.; this was agitated in a bucket of water to remove entangled fauna and the process repeated until all animals were removed. The samples were analysed using stereo microscopy and the fauna extracted and separated into major groups (usually families). All sediment residues were checked by another member of staff to ensure that no animals were missed. Following extraction, animals were identified to the most accurate level practicable (species in most cases) using standard literature. A reference collection of all taxa encountered was prepared to aid consistency with future projects.

Results

Grandidierella japonica Material Examined – 1 male, (anterior portion only) – East: 617891, North: 240707; 1 female (4.3 mm), 1 male (4.6 mm) – East: 618028, North: 240511.

As is common in preserved material, none of the *Grandidierella japonica* specimens were complete. All were missing their antennae and, with the exception of one specimen, pereopods 3–7. As mentioned above one of the male specimens was represented by an anterior portion only, it did, however, have pereopod 5 right. The second male was also missing gnathopod 2 right and the female was missing gnathopods 1 and 2 left. The general body form of *G. japonica* can be seen in Figure 1 and detail of the male gnathopod is shown in Figure 2.

All samples contained a large amount of the alga *Enteromorpha* (Link). The fauna was dominated by the gastropod *Hydrobia ulvae* (Pennant, 1777), the cockle *Cerastoderma edule* (Linnaeus, 1758), the polychaetes *Streblospio shrubsolii* (Buchanan, 1890) and an undescribed species of *Tharyx*, and the oligochaetes *Tubificoides benedii* (Udekem, 1855) and *Tubificoides* c.f. *pseudogaster* (Dahl, 1960). In addition to *G. japonica*, five other non-native species were recorded from the present samples: the ostracod *Eusarsiella zostericola* (Cushman, 1906), the barnacle *Elminius modestus* Darwin, 1854, the gastropod *Potamopyrgus antipodarum* (J.E. Gray, 1843) and the bivalves *Tapes philippinarum* (Adams & Reeve 1850) and *Mya arenaria* Linnaeus, 1758. These additional non-native species have been previously recorded in the area (Ashelby, 2005).

Other aorids found in the Orwell Estuary include *Aora gracilis* (Bate, 1857), *Microdeutopus anomalus* (Rathke, 1843), *M. gryllotalpa* Costa, 1853 and *Leptocheirus pilosus* Zaddach, 1844.

The biotope (Connor *et al.*, 2004) most closely resembles LS.LMu.UEst.NhomStr (*Nephtys hombergii* and *Streblospio shrubsolii* in littoral mud) but contained more cockles (*Cerastoderma edule*) than a typical form of this biotope. The dominant biotopes of the Stour and Orwell have been mapped using the older classification (Connor *et al.*, 1997) and the most widespread littoral biotope in the upper Orwell is LMU.HedStr (*Hediste diversicolor* and *Streblospio shrubsolii* in littoral mud) (Worsfold, 2002). The salinity at the site was not noted, but previous studies (Ashelby, Worsfold & Fransen, 2004) have shown the salinity at the Orwell Bridge to vary between 27.6 and 32.2 ppt.

Discussion

Two male and one female *Grandidierella japonica* were identified from samples from the Orwell Estuary using published descriptions (Smith *et al.*, 1999; Chapman & Dorman, 1975). These specimens represent the first known records of *G. japonica* from the east coast of Britain and are the first published British records since those of Smith *et al.* (1999).

It is probable that *G. japonica* is much more widespread in the UK than records would suggest and that the species has been misidentified in the past. Most workers involved in macrobenthic analysis would use Lincoln (1979) as



Figure 1. Male *Grandidierella japonica* Stephensen, 1938, from the Orwell Estuary, Suffolk. Scale bar = 1 mm.

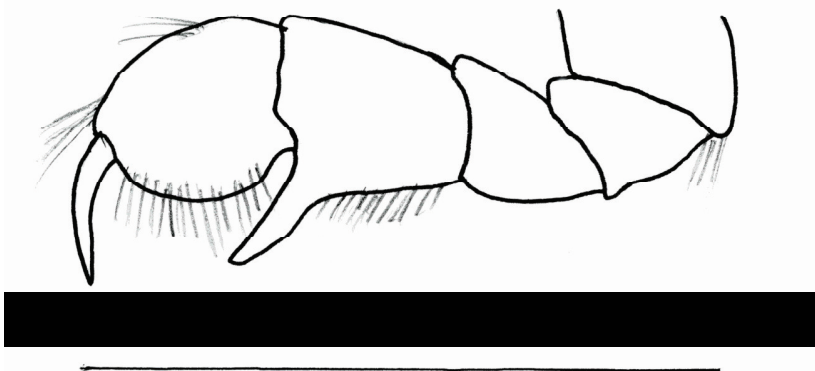


Figure 2. Male gnathopod 1 right. Scale bar = 0.5 mm.

the standard identification work for most groups of amphipods; as a recent introduction, *G. japonica* is not included in this work. Using Lincoln (1979), *G. japonica* would be identified as belonging to the Aoridae; if the specimen were female it would not be identified beyond family level. Males would most likely be identified as *Microdeutopus* spp., although careful analysis would show that they do not fit any of these perfectly. *Grandidierella japonica* can be easily separated from all other British members of the family by possessing a uniramous uropod 3. Female aorids are notoriously difficult to identify to species and are not treated by the key of Lincoln (1979), however the aforementioned character will allow identification of female *G. japonica* where males are known. The shape of gnathopod 1 is also a useful character for identification. The propodus of gnathopod 1 in female *G. japonica* is much more rounded than in native aorids; in males the posterodistal margin of the carpus is produced into a single large tooth (Figure 2). It should also be noted that, many references to *G. japonica* cite the family as Corophiidae (e.g. Chapman & Dorman, 1975; Barnard & Karaman, 1991). This is based on an expanded definition of that family, to include aorids and isauids, suggested by Barnard, (1973).

It is interesting that, despite intensive surveying of the Stour and Orwell estuaries for Harwich Haven Authority (HHA) and the EA, *G. japonica* has not previously been detected. Past material was reviewed following the present discovery, to ensure the species had not previously been overlooked but no examples of *G. japonica* were found. This suggests that *G. japonica* is a recent arrival in the area.

In addition to *G. japonica*, fifteen introduced and three cryptogenic species have previously been recorded from the Stour and Orwell estuaries and are discussed in other publications (Ashelby *et al.*, 2004; Ashelby 2005; Welch & Lucas, 2002). Included in the review of Ashelby (2005) are two other amphipod species recorded from the Orwell: *Monocorophium sextonae* (Crawford, 1937) and *Caprella mutica* Schurin, 1935. It is also possible that the non-native, freshwater species *Gammarus tigrinus* Sexton, 1939 may occur in the upper reaches, although this has not been verified. Faasse and van Moorsel (2003) have recorded the American species *Melita nitida* Smith 1873 and *Incisocalliope aestuarius* (Watling & Maurer 1973) in The Netherlands, where they exploit niches that are not used by any native species. Spread of the latter two species has been slow (M. Faasse, *pers comm.*) but it is possible that they may be found in Britain in future. The pontocaspian species *Dikerogammarus villosus* Sowinsky, 1894 is also known from The Netherlands (de Vaate & Klink, 1995) and should be looked for in British samples.

It is not ruled out that the *G. japonica* from the Orwell have arrived there by natural spread from Southampton Water, however a lack of intermediate records suggests that this is unlikely. It is most likely that these records represent a separate introduction of uncertain origin, possibly the Southampton population. The sampled location is upstream of the Port of Felixstowe, very close to Ipswich Port and, as a known fouling organism, *G. japonica* could have arrived via shipping to either of these ports. Chapman and Dorman (1975) suggested that the species was introduced to America via oyster spat.

Grandidierella japonica is sensitive to high metal concentrations and is often used in toxicity tests (e.g. Nipper, Greenstein & Bay, 1989; Black & Bott, 2005). It was also noted that in Southampton Water it was absent from mudflats contaminated with oil and metals (Smith *et al.*, 1999). This sensitivity may restrict its spread.

As yet the species has not been recorded from the Stour. Its apparent absence from the Stour may be explained by the locations sampled on this estuary however, if the species is a very new arrival in the area, it may need time to spread to the Stour. A similar pattern was noted with the prawn *Palaemon macrodactylus* Rathbun, 1902. This species was first noted from the Orwell in December 2001 (Ashelby *et al.*, 2004) but was not noted in the Stour until September 2002. It is still less commonly found in the Stour than the Orwell and appears to be found in shallower locations in this estuary. *Palaemon macrodactylus* is more mobile than *G. japonica* and has a larval phase that should allow it to spread at a greater rate. As an estuarine specialist without a dispersive planktonic phase (Chapman & Dorman, 1975), *G. japonica* may be slow to colonise new areas and this may explain its apparent absence from other UK estuaries. It would seem likely that, given time, *G. japonica* will be found in the Stour.

Prior to the account by Chapman and Dorman (1975), *G. japonica* had already colonised many estuaries on the Pacific coast of America. The first records from this coast were from 1966 but it seems likely that it was introduced prior to this date. Other reviews (e.g. Cohen *et al.*, 1998; 2002) have shown that the species is still widespread in America and colonising other areas.

Whilst the present records have confirmed the recent occurrence of *G. japonica* in British waters and demonstrated an expansion in its known range, its fate in the Orwell estuary should be closely monitored. It may be that the species will form a sustained population or may die out in the area. Another recent introduction to the Orwell Estuary, *Palaemon macrodactylus*, seems now to be a permanent member of the local fauna (Ashelby *et al.*, 2004).

Acknowledgements

I would like to thank Colin Worrall of the EA (Anglian Region) for permission to use the data pertaining to *G. japonica*, Marco Faasse of Arnemuiden for sharing information about *G. japonica* and on the progress of *Melita nitida* and *Incisocalliope aestuarius* in The Netherlands, and Tim Worsfold of Unicomarine for comments that have improved this document. All data used here remain the property of the EA.

References

- Ashelby, C. W. (2005). The occurrence and distribution of non-native fauna in Harwich Harbour and the Stour and Orwell estuaries, including new records of *Caprella mutica* Schurin 1935 and *Bugula stolonifera* Ryland 1960. *Essex naturalist* (New Series) **22**: 103–116.
- Ashelby, C. W., Worsfold, T. M. & Fransen, C. H. J. M. (2004). First records of the oriental prawn *Palaemon macrodactylus* (Decapoda: Caridea), an alien species in European waters, with a revised key to the British

- Palaemonidae. *Journal of the Marine Biological Association of the United Kingdom* **84**: 1041–1050.
- Barnard, J. L. (1973). *Revision of Corophiidae and related families (Amphipoda)*. Smithsonian Contributions to Zoology **151**: 94 pp.
- Barnard, J. L. & Karaman G. S. (1991). The Families and Genera of Marine Gammaridean Amphipoda (Except Marine Gammaroids) Parts 1 & 2. *Records of the Australian Museum*, Supplement **13(1–2)**: 1–866.
- Black, A. & Bott, G. (2005). *CSBP ecotoxicity project: Direct toxicity assessment using resident species*. Parsons Brinckerhoff. 49 pp.
- Chapman, J. W. & Dorman, J. A. (1975). Diagnosis, systematics, and notes on *Grandidierella japonica* (Amphipoda: Gammaridea) and its introduction to the Pacific coast of the United States. *Bulletin of the Southern California Academy of Science* **74**: 104–108.
- Cohen, A. N., Mills, C. E., Berry, H., Wonham, M. J., Bingham, B., Bookheim, B., Carlton, J. T., Chapman, J. W., Cordell, J. R., Harris, L. H., Klinger, T., Kohn, A., Lambert, C. C., Lambert, G., Li, K., Secord, D. & Toft, J. (1998). *Report of the Puget Sound expedition, September 8–16, 1998; A rapid assessment survey of nonindigenous species in the shallow waters of Puget Sound*. For the Washington State Department of Natural Resources, Olympia, WA and the United States Fish and Wildlife Service, Lacey, WA. 41 pp.
- Cohen, A. N., Harris, L. H., Bingham, B. L., Carlton, J. T., Chapman, J. W., Lambert, C. C., Lambert, G., Ljubenkov, J. C., Murray, S. N., Rao, L. C., Reardon, K. & Schwindt, E. (2002). *Project report for the southern California exotics expedition 2000; A rapid assessment survey of exotic species in sheltered coastal waters*. For the California Department of Fish and Game, Sacramento, CA, State Water Resources Control Board, Sacramento, CA and National Fish and Wildlife Foundation, San Francisco, CA. 31 pp.
- Connor (co-ordinator), D. W., Brazier, D. P., Hill, T. O. & Northen, K. O. (1997). *Marine biotope classification for Britain and Ireland, version 97.06: Volume 1. Littoral biotopes*. JNCC, Peterborough, Report No. 229.
- Connor, D. W., Allen, J. H., Golding, N., Howell, K. L., Lieberknecht, L. M., Northen, K. O. & Reker, J. B. (2004). *The marine habitat classification for Britain and Ireland Version 04.05*. Littoral Sediment Section. JNCC, Peterborough, ISBN 1 861 07561 8 (internet version).
- Costello, M. J., Emblow, C. & White, R. (eds.) (2001). *European register of marine species. A checklist of the marine species in Europe and a bibliography of guides to their identification*. Patrimoines Naturels **50**: 1–463.
- Eno, N. C., Clark, R. A. & Sanderson, W. G. (eds.) (1997). *Non-native marine species in British waters: a review and directory*. Peterborough: Joint Nature Conservation Committee. 152 pp.
- Faasse, M. A. & van Moorsel, G. (2003). The North-American amphipods, *Melita nitida* Smith, 1873 and *Incisocalliope aestuarius* (Watling and Maurer, 1973) (Crustacea: Amphipoda: Gammaridea), introduced to the Western Scheldt estuary (The Netherlands). *Aquatic Ecology* **37**: 13–22.

- Howson, C. M. & Picton, B. E. (eds.) (1997). *The species directory of the marine fauna and flora of the British Isles and surrounding seas*. Belfast and Ross on Wye: Ulster Museum and the Marine Conservation Society.
- Lincoln, R. J. (1979). *British Marine Amphipoda: Gammaridea*. British Museum (Natural History), London, 658 pp.
- Nipper, M. G., Greenstein, D. J. & Bay, S. M. (1989). Short- and long-term sediment toxicity test methods with the amphipod *Grandidierella japonica*. *Environmental Toxicology and Chemistry* **8**: 1191–1200.
- Smith, P., Perrett, J., Garwood, P. & Moore, G. (1999). Two additions to the UK marine fauna: *Desdemona ornata* Banse, 1957 (Polychaeta, Sabellidae) and *Grandidierella japonica* Stephensen, 1938 (Amphipoda, Gammaridea). *Newsletter of the Porcupine Marine Natural History Society* **2**: 8–11.
- Vaate, A. bij de & Klink, A. G. (1995). *Dikerogammarus villosus* Sowinsky (Crustacea: Gammaridae) a new immigrant in the Dutch part of the Lower Rhine. *Lauterbornia* **20**: 51–54.
- Welch, S. & Lucas, I. (2002). *Uninvited Guests: A survey of non-native marine species in ports of England and Wales*. Report 114 to Department for Environment, Food and Rural Affairs (CDEP 84/5/286). School of Ocean Sciences, University of Wales, Bangor. 55 pp.
- Worsfold, T. M. (2002). *Combined intertidal and subtidal biotope report and maps for the Stour and Orwell estuaries*. Unicmarine Report HHAComBiotope02 to Harwich Haven Authority, October 2002.

Chris Ashelby
Unicmarine Ltd
7 Diamond Centre
Works Road
Letchworth
Herts. SG6 1LW.
Email: chrisashelby@unicmarine.com