BioInvasions Records (2013) Volume 2 in press

Rapid Communication

First confirmed record of the genus *Insulodrilus* (Benham, 1903) (Annelida: Clitellata: Phreodrilidae) in Europe

Adrian M. Pinder[1], Pascal Sweeney[2] and Philip R.J. Smith[3]*

1 *Dept of Environment and Conservation, PO Box 51, Wanneroo, 6946, Western Australia*
2 *Sweeney Consultancy, Rahan, Mallow, Co. Cork, Ireland*
3 *Aquatonics Ltd, Glenthorne, Searle Street, Crediton, Devon, EX17 2DB, UK*

E-mail: adrian.pinder@dpaw.wa.gov.au (AMP), pascalsweeney@eircom.net (PS), phil@aquatonics.com (PRJS)

**Corresponding author*

Received: 8 May 2013 / Accepted: 10 July 2013 / Published online: 18 July 2013

Handling editor: Sarah Stewart-Clark

Abstract

Eight specimens of phreodrilid oligochaetes belonging to the genus *Insulodrilus* were found in intertidal sediment in the upper Thames estuary (Wandsworth, London) in November 2012. This is the first confirmed record of *Insulodrilus* in the northern hemisphere, although immature specimens previously collected in Northern Ireland may belong in this genus.

Key words: Thames; Britain; intertidal; *Insulodrilus*; oligochaetes; Clitellata; non-native

Introduction

A survey by Aquatonics Ltd of an intertidal area of the upper Thames estuary at Wandsworth in London produced eight specimens of an oligochaete species that was distinctive but not native to Europe. All specimens belong to the same genus, are morphologically similar to *Insulodrilus* and most closely resemble *Insulodrilus lacustris* Benham, 1903 and related species.

The global distribution of the family Phreodrilidae indicates a Gondwanan origin (Martin et al. 2008). Most species occur in the Southern Hemisphere, although a few have been recorded in the Northern Hemisphere: *Astacopsidrilus* from Morocco (Giani et al. 1995), *Nesodrilus* from Sri Lanka (Stephenson 1913), *Phreodrilus* and *Antarctodrilus* from the Arabian Peninsula (Martínez-Ansemil et al. 2002), *Astacopsidrilus* from Japan (Martin and Ohtaka 2008) and an unidentified phreodrilid from Ireland (Gunn et al. 2003). The latter two are the only other non-Gondwanan landmasses from which the family has been recorded and the occurrence of phreodrilids on these landmasses is likely to represent human-mediated introductions.

Methods

On November 17, 2012 Aquatonics Ltd sampled intertidal habitats at Wandsworth, on the upper Thames estuary in London. The survey included ten core samples (each 0.009 m^2), which were taken to a depth of 15 cm at different heights on the shore, spanning the full intertidal range where sediments were present, from the base of the sea wall to low water spring tide, and covering the full range of sediment types. The length of intertidal zone surveyed was 220 m. Samples were placed in labelled plastic bags and sieved through a 0.5 mm mesh the following day. Material retained on the sieve was preserved in 5% formalin, buffered with borax. Samples were later sorted and specimens identified as far as practicable. Some of the oligochaetes were sent for external quality assurance to Sweeney Consultancy, including the specimens later identified as

Figure 1. Core Sampling at Site C2, Wandsworth (London) 17 November 2012. Photograph by Anne Smith, Aquatonics Ltd.

Table 1. Invertebrates present at Core Site C2.

Taxon	Taxonomic group	Number present in 0.009 m^2
Trocheta bykowskii Gedroyc, 1913	Hirudinea	1
Insulodrilus sp.	Oligochaeta	8
Sparganophilus tamesis Benham, 1892	Oligochaeta	1
Psammoryctides barbatus (Grube, 1861)	Oligochaeta	1
Enchytraeidae	Oligochaeta	5
Potamopyrgus antipodarum (J.E. Gray, 1843)	Gastropoda	2

Insulodrilus cf. *lacustris*. Three specimens were mounted in Kaiser's glycerine jelly for transport to the senior author. Two of these (both semi-mature specimens) were then removed, soaked in water, then transferred to 70% ethanol, stained with carmine, cleared with Histoclear and slide mounted in Permount.

Results

A total of eight specimens were found at Core Site C2 (Figure 1; Lat 51°27'59.09"N Long 0°10'57.42"W, WGS84 datum). Core Site C2, located approximately 13 m from the seawall, was one of ten core sampling sites in the intertidal sediments. The sediment was firm muddy gravel with some sand deeper down. Approximately 70% of the sediment was covered by filamentous algae (mainly *Vaucheria* spp. with some *Blidingia marginata, Blidingia minima, Cladophora* spp. *and Rhizoclonium riparium*) with colonial diatoms also present. Core Site C2 was the only one of the ten core sites where *Vaucheria* covered most of the surface. Salinity readings at low water and high water were both 0.3 psu (practical salinity units, equivalent to parts per thousand, ppt). Invertebrates present at Core Site C2 are shown in Table 1.

Description of specimens

Description is primarily based on slide mounted specimens examined by senior author: one stained and almost fully mature (but unmated), one stained and semi-mature and one unstained and immature. All three specimens had missing

tail ends. Prostomium without a proboscis. Number of segments >31. Length >3 mm, width of slide mounted worms 0.19 to 0.20 mm at V and 0.18 to 0.25 mm at XII. Secondary annulations present at about 2/3rds of the distance between anterior and posterior septa. Ventral chaetae (Figures 2 and 3) paired from II, located in posterior half of each segment and in post-clitellar segments located near posterior septa, all bifid with upper tooth about ½ length of the lower tooth. Somatic ventral chaetae 40 to 65 µm (largest between III and the genital segments) with nodulus (up to 4 µm wide) slightly distal (except for in first few segments where it is more medial to slightly proximal). Ventral chaetae absent on XII and modified as spermathecal chaetae on XIII (Figure 5). Spermathecal chaetae paired within glandular sac behind spermathecal ampullae, with one chaetae apparently longer (85 µm) and wider (3 µm) than the other (which was partly obscured but possibly only 60 um); at least the larger chaeta (but perhaps both) hollow-tipped with a sharp distal end. Dorsal chaetae (Figure 4) from III, each bundle with 1 (rarely 2) hair chaetae, each with a pair of 'support' chaetae of width 1 µm, not emerging from the body wall. Hairs mostly broken, but intact hairs up to 115 µm x 1.5 to 2 µm, tapering evenly towards tip.

Clitellum covering all of XII and most of XIII but absent ventrally, consisting of cells 15 to 20 µm tall of which about 2/3rds are granular and the rest hyaline. Pharyngeal glands between IV and VII, best developed laterally and dorsally in V and VI. Gut widening in X.

Male pores ventro-lateral in anterior half of XII, spermathecal pores ventro-lateral behind septa 12/13 and female pores not visible. Ovaries in XII, egg sacs extending to XV. Testes not observed. Male genitalia not fully developed. Male funnel not developed. Pendant penis present in muscular sac, fed by tubular atrium that is folded twice in the only specimen in which they are sufficiently developed. Spermathecal vestibulae 120 µm long (about half height of body) (Figure 5). Spermathecal duct (width 20 µm) connecting apically to vestibule and leading to a sperm trap, beyond which the duct cannot be followed.

Three immature specimens of these phreodrilids have been deposited at the Natural History Museum, London (reference numbers NHM ANEA 2013.412-414). Three more, including 2 semi-mature used for the description below, are retained in the collection of the first author (Adrian Pinder).

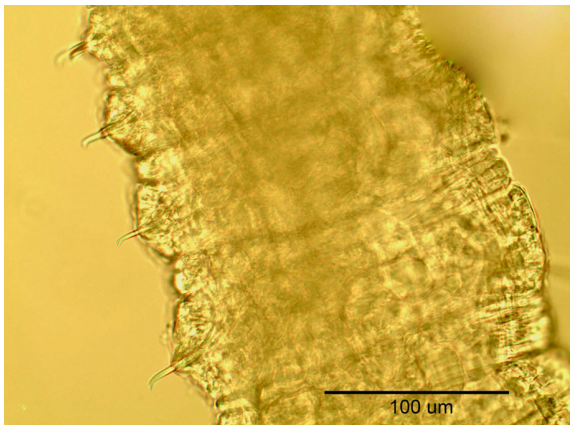

Figure 2. Anterior ventral chaetae, two per bundle. Photomicrograph by Phil Smith, Aquatonics Ltd.

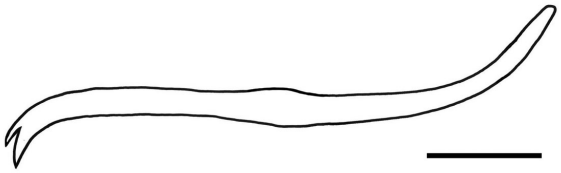

Figure 3. Ventral chaeta. Scale bar = 10 µm.

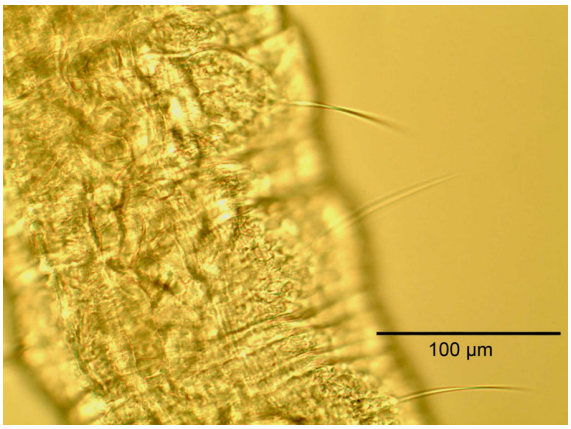

Figure 4. Anterior dorsal hair chaetae, one per bundle. Photomicrograph by Phil Smith, Aquatonics Ltd.

Discussion

Although these worms are not fully mature, the genitalia and other features suggest they belong to the genus *Insulodrilus*. *Insulodrilus* and *Astacopsidrilus* are the only genera with ventral spermathecal pores and complex genital systems. *Nesodrilus* also has ventral spermathecal pores but the genital ducts lead directly to simple pores and/or

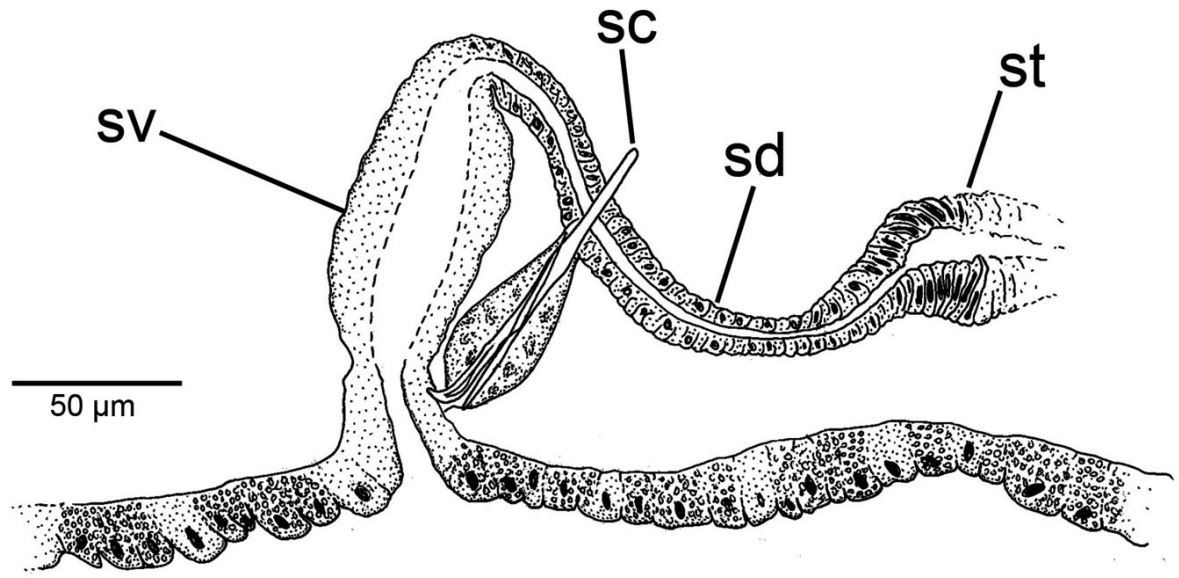

Figure 5. Spermathecal apparatus of specimen held in first author's collection. Labels: sc, spermathecal chaeta; sd, spermathecal duct; st, sperm trap; sv, spermethecal vestibule. Inner morphology of spermathecal vestibule obscured.

the male genitalia is rudimentary. *Astacopsidrilus* is distinguished from *Insulodrilus* by the presence of particularly tall and muscular spermathecal vestibulae, into which the female pores usually enter. While female pores were not seen on any of the Thames estuary specimens, the spermathecal vestibulae appears fully developed in one specimen and is not particularly muscular or tall, which suggests they belong in *Insulodrilus*. Most *Insulodrilus* are known only from Australia or New Zealand and have species-specific modified chaetae (Pinder and Brinkhurst 1997). The worms reported on here have standard phreodrilid chaetae of ventral chaetae bifid with a small upper tooth and 1 or 2 simple hairs per bundle from III. The only other *Insulodrilus* with such un-modified chaetae is *Insulodrilus* '*lacustris*' s.l. (which appears to be a complex of species occurring in Australia, New Zealand and South America) plus some species from Lake Tanganyika in eastern Africa. Of the latter, *Insulodrilus genitalisetifera* Martin and Brinkhurst, 1994 has modified genital chaetae on XI and XIII (only on XIII in the Thames specimens). *Insulodrilus genitalisetifera* also has more blade-like dorsal chaetae after about segment XXV, but as the posterior segments are missing on the Thames estuary specimens this character cannot be properly assessed. For the same reason, it is difficult to distinguish another Tanganyika species, *Insulodrilus martensi* Martin and Giani, 1995, from the Thames specimens. The third Tanganyika species, *Insulodrilus tanganyikae* Brinkhurst, 1970, is more like an *Astacopsidrilus*, with tall spermathecal vestibulae and it has cuticular penis sheaths. Of the *Insulodrilus* '*lacustris*' species, *I. lacustris* s.s. Benham, 1903 from New Zealand has spermathecal vestibulae much smaller than in the Thames specimens and has at least one ventral chaeta of each pair with upper teeth rudimentary to absent. The Thames specimens all have distinct upper teeth. There appear to be a number of Australian forms that closely resemble *I. lacustris*, mostly undescribed at present but including *Insulodrilus angelae* Pinder, 2008, which is morphologically similar to the Thames specimens – as far as comparisons are possible.

The chaetae of the phreodrilid recorded from Northern Ireland by Gunn et al. (2003) suggest that it was also either *Insulodrilus* or *Astacopsidrilus,* but, since the genitalia could not be examined, further resolution was not possible. There is little to distinguish the Thames estuary worms from the specimen collected in Northern Ireland. The lower teeth of the ventral chaetae are sharper on the English worms than on the single Irish specimen, but this can vary within a species.

There are some size differences in the chaetae but not to an extent that would preclude them being con-specific.

The low salinity (0.3 psu) recorded at the site in Wandsworth is consistent with the known preference of phreodrilid oligochaetes for freshwater, with only *Astacopsidrilus ostiensis* Pinder and Erséus 2000 being known from estuaries and no phreodrilids are known to be marine. All eight specimens recorded were from the only core site that had a mat of the algae *Vaucheria* on the surface. This may suggest a preference of this species for algal cover. Diatoms were amongst the amorphous detrital material in the gut, indicating that the specimens found had been close to the surface.

Given the location (a river heavily used by trans-national shipping for decades), the generally Gondwanan distribution of endemic populations, and the virtual lack of phreodrilid records from elsewhere in Europe (other than the Irish record), it seems very likely that these worms represent a human-mediated introduction. This was the conclusion reached by Gunn et al. (2003) for the Irish worms and by Martin and Ohtaka (2008) for the Japanese species. The most likely transport vector is in ballast water from a ship that had come from the southern hemisphere or North Africa. The aquarium trade is another possible source of introductions, as the Thames catchment is the largest in Britain, with a population of about 13 million.

The upper Thames estuary is routinely surveyed by specialist contractors who identify oligochaetes to species level where practicable, so it is likely that this introduction has occurred in the last few years. However, as the only location in the current survey was under a mat of *Vaucheria* sp. it is possible that it has been missed in previous surveys nearby.

The small size of *Insulodrilus* and the fact that it has only been recorded at one of the ten sampling sites suggests it is unlikely to become a nuisance species in the U.K, although it may have ecosystem effects if it becomes widespread. This note should encourage ecologists to examine oligochaetes in their riverine samples to monitor its possible spread and any effects on benthic communities.

Acknowledgements

The study of the intertidal area at Wandsworth was part of an Environmental Impact Assessment of a proposed development of the site for house boats. We would like to thank Plantation Wharf Pier LLP and their consultants Greengage for permission to publish this record. Morgan Taylor of Greengage assisted during the survey. We would also like to thank Dr. Jo Rabineau, who sorted the core samples from the survey. We are very grateful to three anonymous reviewers who provided very helpful comments on the draft.

References

Benham WB (1903) On some new species of aquatic Oligochaeta from New Zealand. *Proceedings of the Zoological Society of London* 2: 202–232

Brinkhurst RO (1970) A further contribution towards a study of the aquatic Oligochaeta of Africa. *Revue de Zoologie et de Botanique Africaines* 81: 101–108

Giani N, Martin P, Juget J (1995) A new species of Phreodrilidae (Oligochaeta), *Astacopsidrilus naceri* sp. nov., from Morocco (North Africa), with notes on the biogeography of the family. *Canadian Journal of Zoology* 73: 2375–2381, http://dx.doi.org/10.1139/z95-277

Gunn RJM, Pinder AM, Walker BM (2003) Phreodrilidae (Annelida: Oligochaeta), a Family New to Europe. *The Irish Naturalists' Journal* 27: 315–317

Martin P, Brinkhurst RO (1994) A new species of *Insulodrilus* (Oligochaeta, Phreodrilidae) from Lake Tanganyika (East Africa) with notes on the oligochaete fauna of the lake. *Archiv für Hydrobiologie* 130: 249–256

Martin P, Giani N (1995) *Insulodrilus martensi*, a new species of Phreodrilidae (Oligochaeta) from lake Tanganyika (East Africa). *Annals of Limnology* 31: 3–8, http://dx.doi.org/10.1051/limn/1995003

Martin P, Ohtaka A (2008) A New Phreodrilid Species (Annelida: Clitellata: Phreodrilidae) from Lake Biwa, Japan. *Species Diversity* 13: 221–230

Martin P, Martinez-Ansemil E, Pinder A, Timm T, Wetzel M (2008) Global diversity of oligochaetous clitellates ("Oligochaeta"; Clitella) in freshwater. *Hydrobiologia* 595: 117–127, http://dx.doi.org/10.1007/s10750-007-9009-1

Martínez-Ansemil E, Giani N, Sambugar B (2002) Oligochaetes from underground waters of Oman with descriptions of two new species of Phreodrilidae (Oligochaeta): *Antarctodrilus arabicus* n. sp. and *Phreodrilus stocki* n. sp. *Contributions to Zoology* 71: 147–158

Pinder AM, Brinkhurst RO (1997) A review of the Phreodrilidae (Annelida: Oligochaeta: Tubificida) of Australia. *Invertebrate Taxonomy* 11: 443–523, http://dx.doi.org/10.1071/IT95025

Pinder AM, Erseus C (2000) New Phreodrilidae (Annelida: Clitellata) from Tasmanian Estuaries. *Papers and Proceedings of the Royal Society of Tasmania* 134: 29–33

Stephenson J (1913) On a collection of Oligochaeta, mainly from Ceylon. *Spolia Zeylanica* 8: 251–276