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A new genus and family of copepods (Crustacea: Copepoda) parasitic on polychaetes of the genus *Jasmineira* Langerhans, 1880 (family Sabellidae) in the northeastern Atlantic

GEOFF A. BOXSHALL¹, MYLES O'REILLY², ANDREY SIKORSKI³ & REBECCA SUMMERFIELD¹

¹Department of Life Sciences, Natural History Museum, Cromwell Road, London SW7 5BD, UK. E-mail: g.boxshall@nhm.ac.uk

²Scottish Environment Protection Agency, Angus Smith Building, 6 Parklands Avenue, Eurocentral, Holytown, North Lanarkshire ML1 4WQ, Scotland

³Akvaplan-niva AS, Framsenteret, P.O. Box 6606 Langnes, N-9296 Tromsø, Norway

Abstract

A new genus and species of copepod, *Jasmineiricola mackiei* n. gen. et n. sp., parasitic on at least three species of the sabellid polychaete genus *Jasmineira* Langerhans, 1880 is described. The adult female is mesoparasitic, living with part of its body (the endosoma) embedded within the host and part (the ectosoma) protruding through the host's body wall. The endosoma consists of a well defined head region carried anteriorly on the trunk which has paired lateral lobes housing the ovaries. The head bears a rosette-like array of eight slender lobes, which are probably derived from the mouthparts. The only limbs present on the trunk are the subchelate maxillipeds positioned immediately posterior to the head. The ectosoma consists of a posterior genito-abdominal lobe bearing paired genital apertures. The male is unknown. The new genus cannot be placed in any of the five existing families of mesoparasitic copepods on polychaete hosts and is treated as the type of a new monotypic family, the Jasmineiricolidae. The new species occurs over a depth range from 19 to 279 m, and is widely distributed from UK coastal waters to Norwegian waters inside the Arctic Circle.

Key words: Polychaete host, mesoparasite, copepod, new family, micro-CT

Introduction

Copepods live in association with virtually every other marine metazoan phylum (Huys & Boxshall 1991), but even in the relatively well-studied seas around Europe, the diversity of copepods utilizing polychaetes as hosts has been significantly underestimated. Focussing only on the nereicoliform copepods, Kim *et al.* (2013) described three new genera and six new species of the family Clausiidae Giesbrecht, 1895, four new species of the family Nereicolidae Claus, 1875, one new species of the family Spiophanicolidae Ho, 1984, and one highly derived new genus and species, *Notomasticola frondosus* Kim, Sikorski, O'Reilly & Boxshall, 2013, which could not be placed in any existing family.

In addition to the nereicoliform families, there are five families of mesoparasitic copepods which have adult females that are highly transformed and live partially embedded in their polychaete hosts (Boxshall & Halsey 2004); the Bradophilidae Marchenkov, 2002, Herpyllobiidae Hansen, 1892, Phyllocolidae Delamare Deboutteville & Laubier, 1961, Saccopsidae Lützen, 1964 and Xenocoelomatidae Bresciani & Lützen, 1966. Females of the family Herpyllobiidae have a bipartite body comprising an ectosoma lying external to the body wall of the host, and an endosoma which lies within the host (Lützen 1964a). The ectosoma is essentially a reproductive tagma containing the ovaries and carrying the paired egg sacs while the endosoma absorbs nutrients from the host and is a trophic tagma. Adult females in the families Bradophilidae and Phyllocolidae have a similar gross morphology, although in the latter the endosoma takes the form of a pair of elongate rootlets (Marchenkov 2002; Laubier 1961). Females of the Xenocoelomatidae are more deeply embedded within the host, with adults of *Aphanodomus* Wilson, 1924 for example, maintaining only a small aperture through the host's body wall through which paired egg sacs are extruded (Bresciani & Lützen 1974). In contrast, the adult females of *Melinnacheres* M.

Sars, 1870 (family Saccopsidae) have a large sac-like ectosoma and only a small stalked process inserted through the host's body wall which expands to form a small bulla within the host (Bresciani & Lützen 1975).

Parasitic copepods from polychaete hosts are relatively rarely reported and Kim *et al.* (2013) suggested that one of the reasons for this might be that they exist at very low prevalence rates, which means that it is necessary, on average, to search large samples of host individuals before encountering parasites. While this may well be the case for the clausiid and nereicolid parasites described by Kim *et al.* (2013), we report here on a novel mesoparasitic copepod which appears to be common on species of the sabellid genus *Jasmineira* Langerhans, 1880 across a wide area of the northeastern Atlantic. This paper is based on material found during processing of numerous large samples of macrobenthic material containing polychaetes.

Methods

Copepod specimens embedded in their polychaete hosts were immersed in lactic acid for up to 7 days before microscopic observation and dissection. Dissections were made as temporary preparations in lactophenol. Drawings were made on a Leitz Diaplan microscope equipped with differential interference optics, using a drawing tube.

Two hosts with embedded parasites were examined by micro-CT. The worms were dehydrated to 100% ethanol before being stained overnight in iodine solution (1% iodine in 100% ethanol) (Metscher 2009). They were then dried in hexamethyldisilazane before being scanned by transmission target on a Nikon HMXST 225 micro-CT system (Nikon Metrology, Tring UK). Scan parameters were 120kV, 160 μ A and 708 ms exposure, and the final voxel size was 5 μ m. The data were reconstructed using CT-Pro (Nikon Metrology, Tring), which employs a modified Feldkamp *et al.* (1984) back-projection algorithm. The dataset was segmented and rendered in Drishti 2.4 (Limaye 2006).

Material for SEM was washed three times in distilled water, dehydrated through a graded acetone series, critical point dried using liquid carbon dioxide as the exchange medium, mounted on aluminium stubs and sputter coated with palladium. Coated material was examined using a Phillips XL30 Field Emission scanning electron microscope operating at 5 Kv.

Morphological terminology follows Huys & Boxshall (1991) and host nomenclature was checked against the World Register of Marine Species (WoRMS Editorial Board 2015). The parasitological terminology follows Bush *et al.* (1997). The holotype, numerous paratypes, and some of the non-type material are deposited in the collections of the Natural History Museum, London (NHMUK). Additional specimens are deposited in the National Museum of Scotland, Edinburgh or National Museum of Wales (NMWZ), or remain in personal reference collections of the authors.

Taxonomy

Order Cyclopoida Burmeister, 1834

Jasmineiricolidae n. fam.

Jasmineiricola n. gen.

Diagnosis. Adult female highly transformed, lacking external segmentation. Body comprising endosoma embedded in host consisting of well defined head region carried anteriorly on trunk bearing paired lateral lobes, and ectosoma consisting of posterior genito-abdominal lobe bearing paired genital apertures. Adult female exhibiting torsion between endosoma and ectosoma. Head bearing rosette-like array of eight slender lobes. Trunk bearing maxillipeds immediately posterior to junction with head. Maxilliped 2-segmented, subchelate. Swimming legs lacking. Genitoabdominal lobe bearing median anus carried on small anal prominence. Caudal rami lacking. Egg sacs paired, arrangement of eggs within sac sometimes linear (uniseriate), typically biseriate or multiseriate. Male unknown.

Type species. *Jasmineiricola mackiei* n. gen. et n. sp., by original designation.

Etymology. The name of the new genus is derived from the name of the host genus *Jasmineira*, combined with *-icola*, meaning inhabitant.

Remarks. The new genus exhibits a unique combination of features that serve to distinguish it from all other copepod genera. None of the families of copepods that have highly transformed unsegmented bodies and live embedded in polychaete hosts, retains a defined cephalothorax bearing lobate vestiges of paired cephalic limbs or has paired maxillipeds on the anterior embedded part of the trunk and a functional anus on the posterior protruding part of the trunk. This unique morphology makes it difficult to place the new genus in any one of the five families of highly transformed copepods living as mesoparasites embedded in polychaetes.

The Herpyllobiidae is one of the better known families (Lützen 1964a, b, 1966, 1968) and currently comprises 27 species placed in five genera (Walter & Boxshall 2015). All adult female herpyllobiids have bodies comprising an embedded endosoma and an external ectosoma and the anus is lacking. No appendages are present in the adult female and all known species are parasites of polynoid polychaetes (Boxshall & Halsey 2004). The new genus differs considerably from herpyllobiids in the positioning of the ovaries within the endosoma rather than the ectosoma, in possessing vestiges of the oral appendages and a pair of subchelate maxillipeds on the endosoma, and in retaining a functional anus on the ectosoma. It is considerably less transformed and lacks key synapomorphies of the Herpyllobiidae, namely loss of all appendages and loss of the anus. In addition, it is found on a sabellid host (order Sabellida) not on a polynoid (order Phyllodocida). The new genus cannot be placed in the Herpyllobiidae.

The Bradophilidae is poorly known although we have been able to examine new bradophilid material from a flabelligerid host (unpublished results). Adult females of *Bradophila* Levinsen, 1878 are similar to those of the Herpyllobiidae in body form and in lacking all appendages (Marchenkov 2002). These two families differ primarily in characters of the males (Boxshall & Halsey 2004). The male of *Jasmineiricola* n. gen. is unknown, but the adult female is less transformed and lacks key synapomorphies of the Bradophilidae, such as the loss of all paired limbs. The hosts are also different, with the Bradophilidae exploiting flabelligerid hosts (order Terebellida) while the new genus uses sabellids. The new genus cannot be placed in the Bradophilidae.

The Xenocoelomatidae comprises two genera of highly transformed internal parasites which lack all trace of appendages in mature adults of both sexes. Both genera are cryptogonochoristic, with males reduced to a functional testis housed within a receptaculum masculinum within the female body (Bresciani & Lützen 1974). Species of both genera occur on terebellid hosts. The new genus has a different body organization from xenocoelomatids and utilises hosts from a different order of polychaetes. It does not belong in the Xenocoelomatidae.

Phyllocolidids are currently known only from females and they consist of an unsegmented ectosoma attached to the host by an endosoma consisting of a pair of elongate buccal rootlets (Laubier 1961). Adult females retain up to three pairs of cephalothoracic appendages (identified as antennules, antennae and maxillipeds), according to genus. However, these limbs are carried on the ectosoma, and are positioned around the origins of the buccal rootlets. Phyllocolidids occur on phyllocid polychaetes (order Phyllodocida) rather than sabellids. The lack of homology of the endosoma and the presence of limbs on the ectosoma, rather than on the endosoma, indicate that the new genus cannot be placed in the Phyllocolididae.

The Saccopsidae currently comprises four species of the genus *Melinnacheres* Sars, 1870, all of which occur on terebellid hosts. Adult females of *Melinnacheres* are similar to phyllocidids in retaining three pairs of appendages on the ectosoma. These limbs have been identified as antennules, antennae and maxillae (Bresciani & Lützen 1975) which, as in phyllocidids, originate around the base of a short stalk that arises in the oral region and penetrates the host. The fundamentally different body organization including the positioning of the ovaries within the endosoma rather than the ectosoma, and the presence of limbs on the ectosoma rather than on the endosoma, indicate that the new genus cannot be placed in the Saccopsidae.

Determining the phylogenetic affinities of secondarily reduced parasitic forms is problematic in the absence of molecular data, but the presence of a large endosoma bearing lobate vestiges of oral appendages and subchelate maxillipeds, plus the retention of a functional anus on the ectosoma is a unique combination of apomorphic and plesiomorphic states and we are unable to place this genus in any existing family. We therefore propose to place it in a new monotypic family, the *Jasmineiricolidae*, the diagnosis of which corresponds to that of the genus *Jasmineiricola* n. gen., given above.

Jasmineiricola mackiei n. gen. et n. sp.

Type material. Holotype ♀ plus 4♀♀ paratypes from single specimen of *Jasmineira caudata*, Huldra, Stn 8-2 (60.8463°N, 2.616804°E), depth 123 m, 05 June 1999; collected by A. Sikorski; NHMUK Reg. No. Holotype ♀ 2015.447, paratypes ♀♀. 2015.448-451.

Northern North Sea. 1♀ paratype from *J. caudata*, North Sea, Conoco Lyell Field (60° 53' 56.62"N, 01° 16' 17.23"W), depth 140 m; July 1991; collected by S. Hamilton. 10♀♀ paratypes from 7 specimens of *J. caudata*, northern North Sea from Statfjord Field (Blocks 33/34); 1996: collected by S. Hamilton. 1♀ paratype from *J. caudata*, Oseberg Sør, Stn 13-3 (60.3965°N, 2.784167°E), depth 99 m, 04 May 1998; collected by A. Sikorski. 2♀♀ paratypes from 2 specimens of *J. caudata*, Nordøstflanken, Stn 2-2, (61.35°N, 1.9475°E), depth 152 m, 17 May 1998; collected by A. Sikorski. 3♀♀ paratypes from *J. caudata*, Nordøstflanken, Stn 1-2, (61.33333°N, 1.9605°E), depth 150 m, 17 May 1998; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Nordøstflanken, Stn 6-2, (61.36917°N, 1.942166°E), depth 170 m, 17 May 1998; collected by A. Sikorski. 2♀♀ paratypes from 2 specimens of *J. caudata*, Nordøstflanken, Stn 9-2, 4, (61.361°N, 1.92°E), depth 153 m, 18 May 1998; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Nordøstflanken, Stn 10-4, (61.3705°N, 1.928666°E), depth 161 m, 18 May 1998; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Nordøstflanken, Stn 12-6, (61.40317°N, 1.879166°E), depth 161 m, 18 May 1998; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Vigdis, Stn 9-3 (61.3782°N, 2.104756°E), depth 279 m, 30 May 1999; collected by A. Sikorski. 2♀♀ paratypes from *J. caudata*, Vigdis, Stn 15-3 (61.37692°N, 2.094748°E), depth 276 m, 30 May 1999; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Tordis, Stn 4-3 (61.2751°N, 2.120787°E), depth 202 m, 30 May 1999; collected by A. Sikorski. 2♀♀ paratypes from 2 specimens of *J. caudata*, Huldra, Stn 9-2, 3, (60.8564°N, 2.652572°E), depth 123 m, 04 June 1999; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Huldra, Stn 1-1 (60.85328°N, 2.650849°E), depth 123 m, 04 June 1999; collected by A. Sikorski. 2♀♀ paratypes from *J. caudata*, Huldra, Stn 11-1 (60.85974°N, 2.664455°E), depth 123 m, 04 June 1999; collected by A. Sikorski, [Specimens used for SEM]. 1♀ paratype from *J. caudata*, Huldra, Stn 16-1 (60.93292°N, 2.555287°E), depth 125 m, 05 June 1999; collected by A. Sikorski. 2♀♀ paratypes from *J. caudata*, Statfjord Øst, SFEK Stn 8-2 (61.37767°N, 1.9095°E), depth 156 m, 13 June 1999; collected by A. Sikorski. 3♀♀ paratypes from *J. caudata*, Gullfaks, Stn 1-8 (61.09441°N, 2.19321°E), depth 133 m, 17 June 1999; collected by A. Sikorski. 2♀♀ paratypes from *J. caudata*, Gullfaks, Stn 12-3 (59.2054°N, 2.212357°E), depth 218 m, 19 June 1999; collected by A. Sikorski, [Specimens used for SEM]. 2♀♀ paratypes from *J. caudata*, Regional IV, Stn 9-3 (61.12257°N, 2.397248°E), depth 188 m, 19 June 1999; collected by A. Sikorski, [Specimens used for SEM]. 1♀ paratype from *J. caudata*, Veslefrikk, Stn 7-1 (60.78652°N, 2.9121°E), depth 177 m, 24 May 2004; collected by A. Sikorski. 1♀ paratype from *J. caudata*, Veslefrikk, Stn 1 (60.7432°N, 2.942°E), depth 168 m, 24 May 2004; collected by A. Sikorski, [Specimen used for SEM]. 1♀ paratype from *J. caudata*, Vigdis F 2005, Stn 5-3 (61.31358°N, 2.077643°E), depth 222 m, 14 June 2005; collected by A. Sikorski. Registration numbers NHMUK 2015.452-461.

High Latitude Norwegian waters (non-type). 2♀♀ from *J. caudata*, Resi Stangnes 06, Stn 5-1 (68° 48.459'N, 16° 36.753'E), depth 74 m, 28 June 2006; collected by A. Sikorski. 1♀ from *J. caudata*, Vega 2006, Stn 2-1 (65.70004°N, 12.133338°E), depth 130 m, 04 December 2006; collected by A. Sikorski. 9♀♀ from 7 specimens of *J. caudata*, Mainstram F-07, Forsan Stn G4-1 (67.95466°N, 15.626°E), depth 33 m, 11 May 2007; collected by A. Sikorski. 2♀♀ from 2 specimens of *J. caudata*, Mainstram F-07, Stn 2-1 (67.95734°N, 15.63483°E), depth 32 m, 11 May 2007; collected by A. Sikorski. 4♀♀ from 4 specimens of *J. caudata*, Narvik Kom, Taraldsvik, Stn T4 (68.45305°N, 17.43757°E), depth 90 m, 19 July 2009; collected by A. Sikorski. 2♀♀ from *J. caudata*, Ellingsen, Stn T3-2 (67.8961°N, 16.22328°E), depth 166 m, 14 October 2009; collected by A. Sikorski. 1♀ from *J. caudata*, Oseberg Sør, Stn OSS 16 (60.61029°N 02.777862°E), depth 104 m, 26 May 2013; collected by A. Sikorski. 3♀♀ from 2 specimens of *J. caudata*, Storvika, Stn 3A (67°32.222'N, 15°17.995'E), depth 19 m, 21 May 2014; collected by A. Sikorski. 3♀♀ from 2 specimens of *J. caudata*, Storvika, Stn 4B (67°32.272'N, 15°18.420'E), depth 32 m, 21 May 2014; collected by A. Sikorski. Registration numbers NHMUK 2015.452-461.

Scotland (non-type). 2♀♀ from *J. caudata*, NW Scotland, Loch Fyne, Meall Mhor, SEPA Stn 9; depth 25 m; August 1993; collected by M.O'Reilly; NHMUK Reg. No. 2015.452-461. 1♀ from *J. caudata*, NW Scotland, Loch Linnhe, Gorston Stn 2, depth unknown, 7 July 2004; collected by P. Garwood; NHMUK Reg. No. 2015.452-461. 1♀ from *J. caudata*, NW Scotland, Loch Hourn, Stn 3a, depth unknown, 11 May 2005; collected by P. Garwood. 1♀ from *J. caudata*, NW Scotland, Sound of Mull, Funiary Stn 5E REF (56° 33.280'N, 05° 64.620'W) depth 19 m;

17 August 2006; collected by J. Hunter & S. Hamilton; NHMUK Reg. No. 2015.452-461. 1♀ from *J. caudata*, NW Scotland, Ullapool, Ardmair, Fish Farm Stn AC1 b; depth unknown; 29 June 2010; collected by J. Hunter/S. Hamilton. 1♀ from *J. caudata*, (Unico. sample 47557) NW Scotland, Western Isles, Gardline Survey 843510, Dev Site 20-MFB, depth unknown; 15 July 2010.

Ireland (non-type). 1♀ from *J. caudata*, Ireland, Dunmore 07-1 UCL, depth unknown, 2008; collected by P. Garwood; NHMUK Reg. No. 2015.452-461. 1♀ from *J. caudata*, (Unico. sample 43870) Irish Sea, CEFAS Stn G05, ADJSED, (53° 30.600'N, 05° 14.400'W), depth unknown; 2008.

Additional non-type material. 2♀♀ from 2 specimens of *J. caudata*, Sweden, Kosterfjord, SW of Yttre Vattenholm, depth unknown, 27 August 1986; collected by Andy Mackie (National Museum of Wales), Reg. No. NMWZ 1986.108. 1♀ from *J. caudata*, Sweden, Kosterfjord, SW of Yttre Vattenholm, depth unknown, 28 October 1989; collected by Andy Mackie (National Museum of Wales).

1♀ from *Jasmineira* sp. (posterior missing), North Sea, Osprey Oilfield, Stn 4A (61° 10'N, 01° 10'E), depth 150-180 m, 1990; collected by Brian Cleator. 2♀♀ from *J. candela*, Veslefrikk-98, Stn 2-2 (60.7645°N, 2.920833°E), depth 174 m, 16 May 1998; collected by A. Sikorski; NHMUK Reg. No. 2015.462-463. 1♀ from *J. elegans*, (Unico. sample 34024), Northern Ireland, Belfast Lough, NIEA Stn SDCS, (54° 50.526'N, 05° 42.852'W), depth unknown; 31 March 2004; collected by Tim Mackie. 1♀ from *J. elegans*, (Unico. sample 46849), North Sea, Arundel/Farragon Oilfield, Gardline Survey GDLARUFA10, Stn A09-24-a, depth unknown, 09 September 2009. 1♀ damaged, ectosoma broken off from host *Jasmineira* sp. fragment; (Unico. sample 40611); North Sea, Brent Oilfield, Gardline Survey GDL211290, Stn BRA GR11FA, depth 140 m; 17 April 2007. 2♀♀ from *Jasmineira* sp. fragment, (Unico. sample 41005), North Sea, Brent Oilfield, Gardline Survey GDL211290, Stn BRA GR18FA, depth 141 m; 20 June 2007. 1♀ on *Jasmineira* sp., NW Scotland, Little Loch Broom, Ardesie Fish Farm site ABC 2b, depth unknown, 26 December 2010; collected by J. Hunter/S. Hamilton. 1♀ on *Jasmineira* sp., NW Scotland, Little Loch Broom, Ardesie Fish Farm site AA 1b, depth unknown, 12 July 2011; collected by J. Hunter/S. Hamilton. 1♀ from *Jasmineira* sp. fragment, (Unico. sample 43872) Irish Sea, CEFAS Stn G05 ADJSED, (53° 28.800'N 05° 16.800'W), depth unknown; 2008. 1♀ from *Jasmineira* sp. fragment, (Unico. sample 43879) Irish Sea, CEFAS Stn G18 MDAC, (53° 28.800'N 05° 16.800'W), depth unknown; 2008.

Etymology. The name of the new species honours Dr. Andy Mackie (National Museum of Wales) who found material of this parasite in 1986.

Description. The adult female is highly transformed and lacks any trace of external segmentation (Fig. 1A, B). The body comprises a well defined head region carried anteriorly on the trunk which is expanded transversely to form paired anterolateral lobes and extends posteriorly to a genito-abdominal lobe. The head and anterior part of the trunk bearing the anterolateral lobes are collectively referred to as the endosoma which is embedded within the body of the host (Figs 1E, 2A–C) while the posterior genitoabdominal lobe, the ectosoma, protrudes through the body wall of the host and carries the paired egg sacs (Figs 2A, B, 3A, B). The adult female body exhibits torsion, twisting through 90° in the region between the endosoma and the ectosoma, so the posterior genitoabdominal lobe is directed towards the anterior end of the host (Figs 2A, B, 3A, B). This torsion is not shown by developing females that have not yet erupted through the body wall of the host (Fig. 1F).

The head region is clearly defined and its ventral surface bears a rosette-like array of eight slender, tapering lobes (Fig. 1C), which are arranged as four pairs and probably represent modified mouthparts. Immediately posterior to the junction of the head region and trunk are the paired maxillipeds. The maxillipeds are well developed, subchelate appendages (Fig. 1D) comprising a robust proximal segment and a curved distal claw. The claw is armed with a short stout spine proximally. No trace of swimming legs was detected.

The anterolateral trunk lobes are typically dorso-ventrally flattened but are variable in shape, depending partly on their position within the host, and also on their state of development. They contain the ovaries and in mature females (Figs 1A, 2A) the lobes are relatively larger than in developing females (Fig. 1F). The lobes can be symmetrical or asymmetrical.

The posterior genitoabdominal lobe (= ectosoma) visible externally on the host (Fig. 4A–D) is a rounded diamond-shape, approximately 180 µm long by 190 µm wide, and carries paired genital apertures posterolaterally and a median anus posteriorly (Fig. 4C, D). Each genital aperture is rounded and closed off by an unarmed genital operculum (Fig. 4C). The anus is slit-like and carried on a small anal prominence (Fig. 4D). The integument of the dorsal surface is slightly ridged and in the mid-line, dorsal to the anal prominence, there is a patch where the

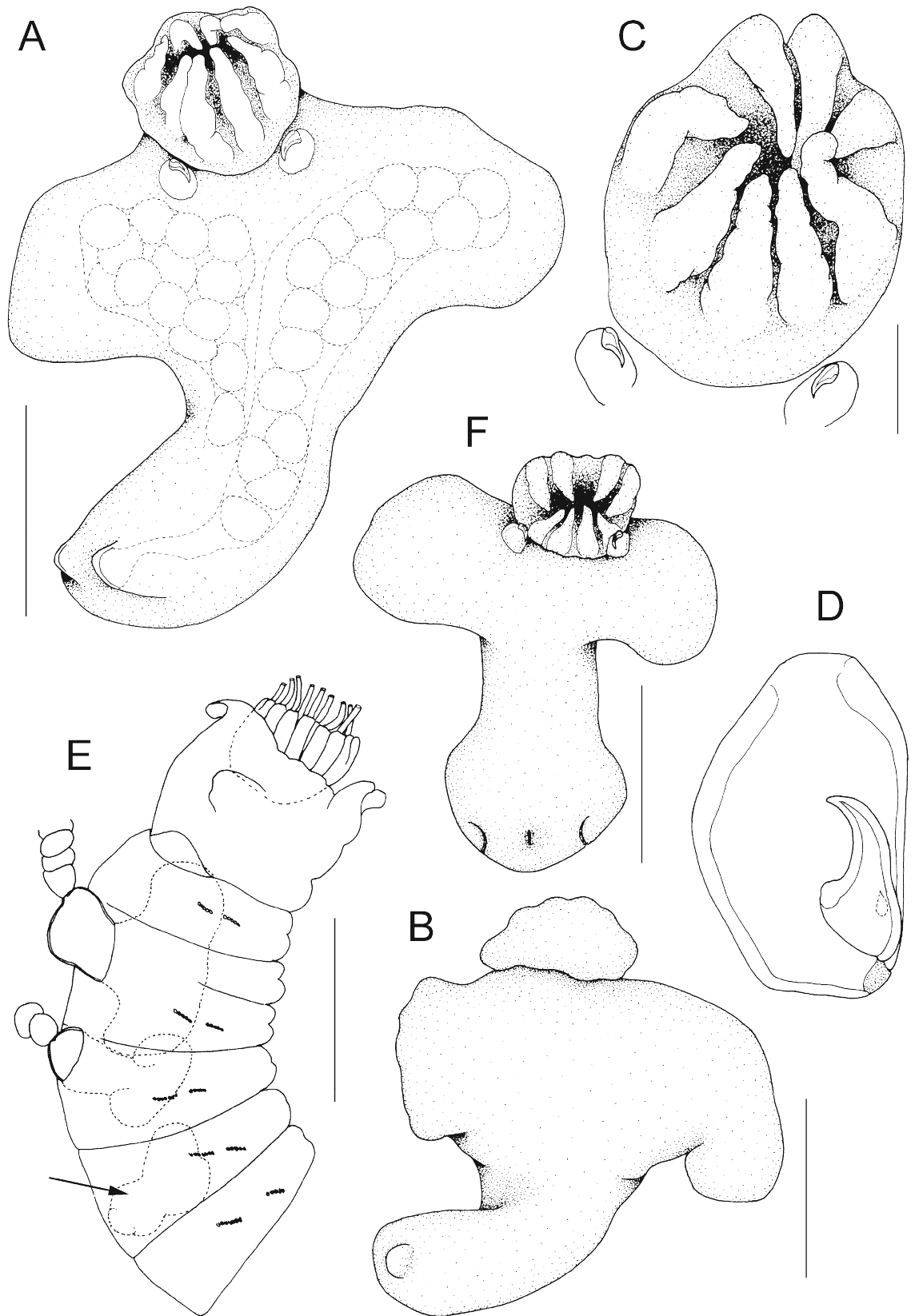


FIGURE 1. *Jasmineiricola mackiei* n. gen. et n. sp. Adult female paratypes. A, Habitus, ventral; B, Habitus, dorsal; C, Oral processes and maxillipeds, ventral view; D, Maxilliped; E, Schematic of host polychaete containing three embedded females, view from left side; F, Developing adult female (arrowed in Fig. 1E), not exhibiting torsion between endosoma and ectosoma, ventral view. Scale bars A, B, F = 200 μ m, C = 50 μ m, D = 25 μ m, E = 0.5 mm.



FIGURE 2. *Jasmineiricola mackiei* n. gen. et n. sp. Adult female paratypes examined using Micro-CT. A, Anterior end of host showing ovigerous *Jasmineiricola* female embedded in setiger 2, with developing eggs visible within lateral lobes; B, Same, showing outline of cement glands within ectosoma; C, Entire host showing location of embedded *Jasmineiricola* female within host. Scale bars A–B = 100 μ m, C = 1mm.

epicuticular ridges are raised into spiniform microstructures (Fig. 4D). Around the base of the anal prominence several paired integumental pores are present. No vestiges of caudal rami were found. The ectosoma contains paired cement glands which extend through into the endosoma (Fig. 2B).

The egg sacs are paired and the arrangement of eggs within the sac may be linear, biseriate, or multiseriate: the mean number of eggs per sac was 24.3 (\pm 10.2), with a range of 11 to 47 (N = 15). The egg sacs are often uniseriate near their origin at the female gonopore but most sacs contain two (Fig. 2B) or more irregular rows of eggs. The maximum number of eggs observed in a single sac was 47, and this sac had four irregular rows of eggs over much of its length.

Male. Unknown.

Hosts. The parasite is specific to the sabellid genus *Jasmineira* and has been reported from three host species. The majority of records are from the type host *J. caudata* Langerhans, 1880, but it was also found on *J. candela* (Grube, 1863) in Norwegian waters and on *J. elegans* Saint-Joseph, 1894 in UK waters.

Prevalence and intensity of infection. The number of parasites present on 58 infected *J. caudata* was 81, giving a mean intensity of 1.40 parasites per worm, and the number of adult females per infected host ranged from one to five (Fig. 5). The maximum number of adult females found on a single host was five: on this maximally infected host three females were positioned on the left side of the worm (Fig. 1E), one each in setigers 2, 3 and 4,

and two females were on the right side in setigers 2 and 3. The ectosoma of the female in setiger 2 was erupted further than that of the female on setiger 3, and the female on setiger 4 was only detected when the worm was cleared in lactic acid because it had not yet erupted through the body wall of the worm. This young female (Fig. 1F) did not exhibit the torsion in the region between the endosoma and ectosoma. We infer from this that an earlier infective stage in the life cycle must have penetrated the host, commenced metamorphosis within the host, and that the ectosoma erupts through the body wall of the host as the developing female approaches maturity.

Few data are available on the prevalence rate of *Jasmineiricola mackiei* n. gen. et n. sp., as the numbers of uninfected hosts in the samples are generally unavailable, however in one sample from Loch Fyne in Scotland, just a single *J. caudata* was infected out of a total of 11 examined, a prevalence rate of 9.1%. The discovery of an infected host containing a parasite that had not erupted through the body wall, indicates that such early stages might be difficult to detect and that prevalence rates might be underestimated.

Position on host. Post-metamorphic adult females are embedded in the anterior part of the host, usually on setiger 2 (Figs 1E, 2B, 3A–B). Viewed from the outside the posterior end of the ectosoma is directed towards the anterior end (head) of the host. The egg sacs are therefore directed towards the distal opening of the host's tube (Fig. 3A–B) and lie within the space between the worm and its tube. When multiple infections occur, one or more of the specimens may be positioned more posteriorly, on setigers 3 or 4, but the typical position is on setiger 2.

Geographical and depth distribution. Records are reported here from numerous localities off the northwestern coast of Europe extending northwards from the Irish Sea and the sea lochs on the west coast of Scotland, through the northern North Sea, as far east as the Swedish coast at Kosterfjord, and up into Norwegian waters as far north as 68.5°N, beyond the Arctic Circle.

The known depth range extends from 19 to 279 m, and the mean depth of occurrence was 136 m, based on all records for which depth data were available (39 stations).

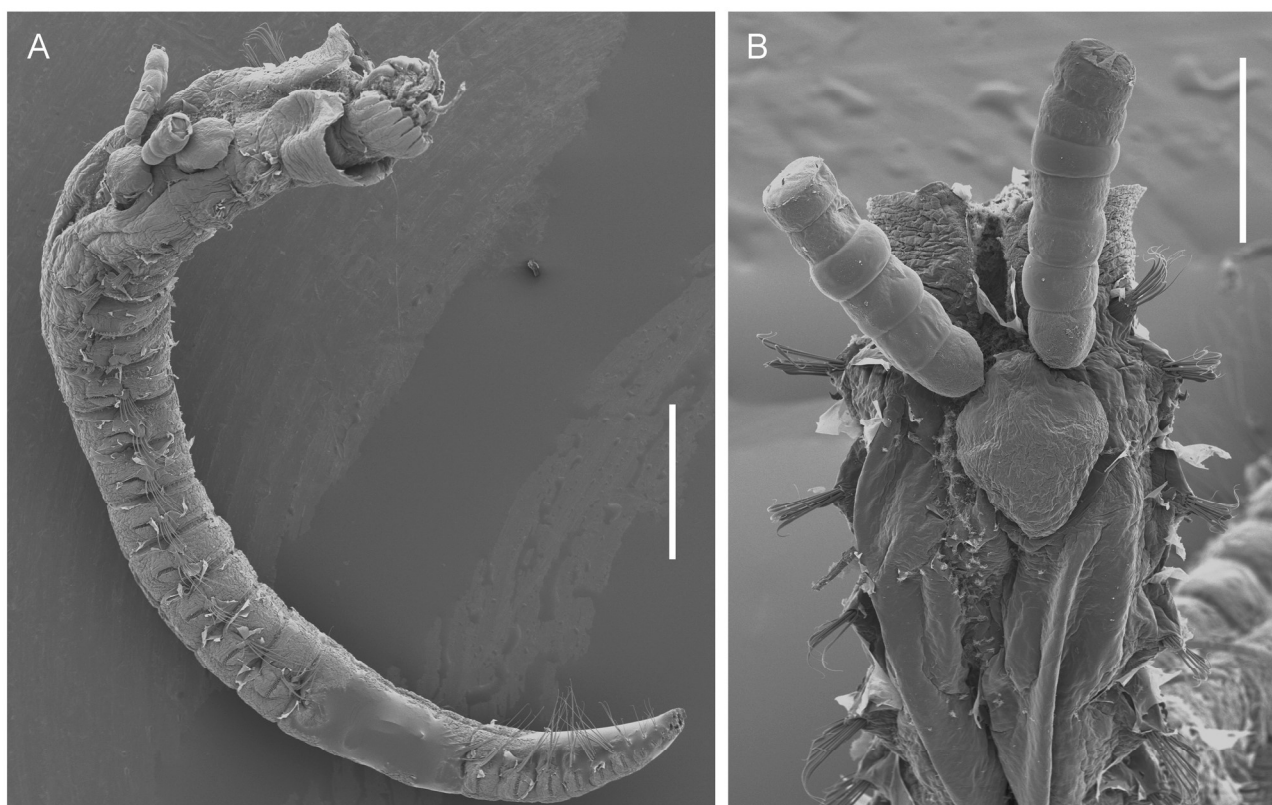


FIGURE 3. *Jasmineiricola mackiei* n. gen. et n. sp. Scanning electron micrographs of adult females on host. A, Entire host showing ectosomas of two embedded females located in setigers 2 and 3; B, Anterior end of host showing ectosoma of female bearing paired uniseriate egg sacs (incomplete). Scale bars A = 0.5 mm, B = 200 μ m.

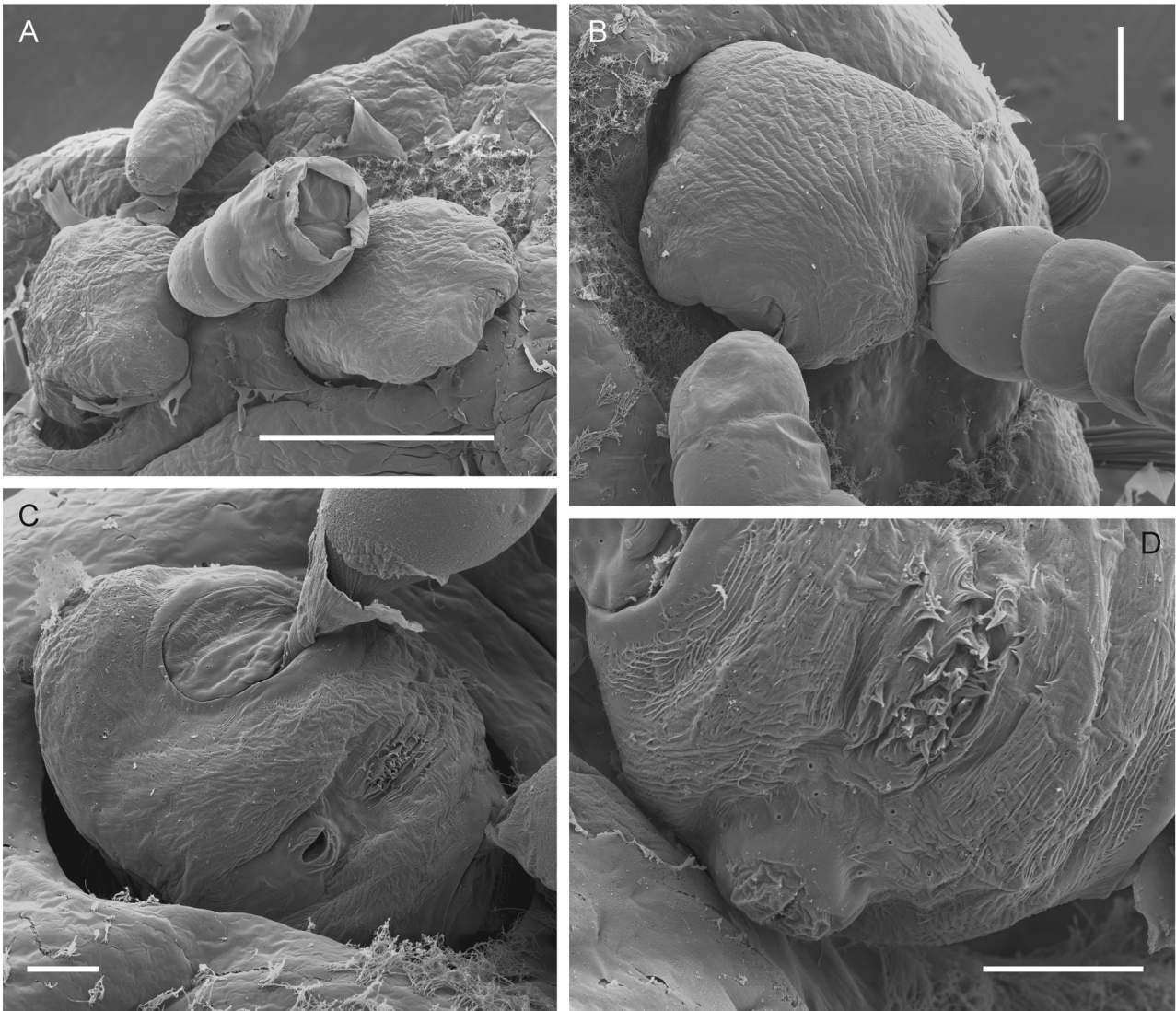


FIGURE 4. *Jasmineiricola mackiei* n. gen. et n. sp. Scanning electron micrographs of ectosomas of adult females. A, Ectosomas of two females from Figure 3A; B, Ectosoma of ovigerous female, dorsal view showing shallow cuticular folds; C, Posterior surface of ectosoma showing anus and egg sac emerging from genital aperture; D, Detail of anus on anal prominence, and showing cuticular ornamentation of ridges and pores on postero-dorsal surface. Scale bars A = 200 µm, B = 50 µm, C–D = 20 µm.

Discussion

It is remarkable that this parasite has not been reported before. It is not rare and our records indicate that it can be found over a wide geographical area off the coast of northwestern Europe, and over a depth range from 19 m to beyond the shelf break at 279m. However, its preferred hosts, *Jasmineira* spp., are all relatively small sabellid worms and the ectosoma of the parasite measures less than 200 by 200 µm and thus could easily be overlooked.

The male of this new species is unknown despite the relatively large number of infected hosts available for study. This contrasts with families such as the Herpyllobiidae and Saccopsidae where females, especially developing females, frequently carry dwarf males, attached in the vicinity of the genital apertures on the ectosoma (e.g. Lützen 1964a, 1968; Bresciani & Lützen 1975). We found no evidence that *Jasmineiricola mackiei* n. gen. et n. sp. is cryptogonochoric like *Aphanodomus* (cf. Bresciani & Lützen 1966). Given that females develop within the host and that the ectosoma erupts through the body wall of the host as a female approaches maturity, mating presumably takes place either prior to the female infecting and penetrating the host, or after eruption of the ectosoma. If the latter, then mating would seem to be a fleeting process as no males have been seen attached to the

ectosoma of females. Either way, the abundance of this parasite indicates that males are likely to be common in northwestern European coastal waters.

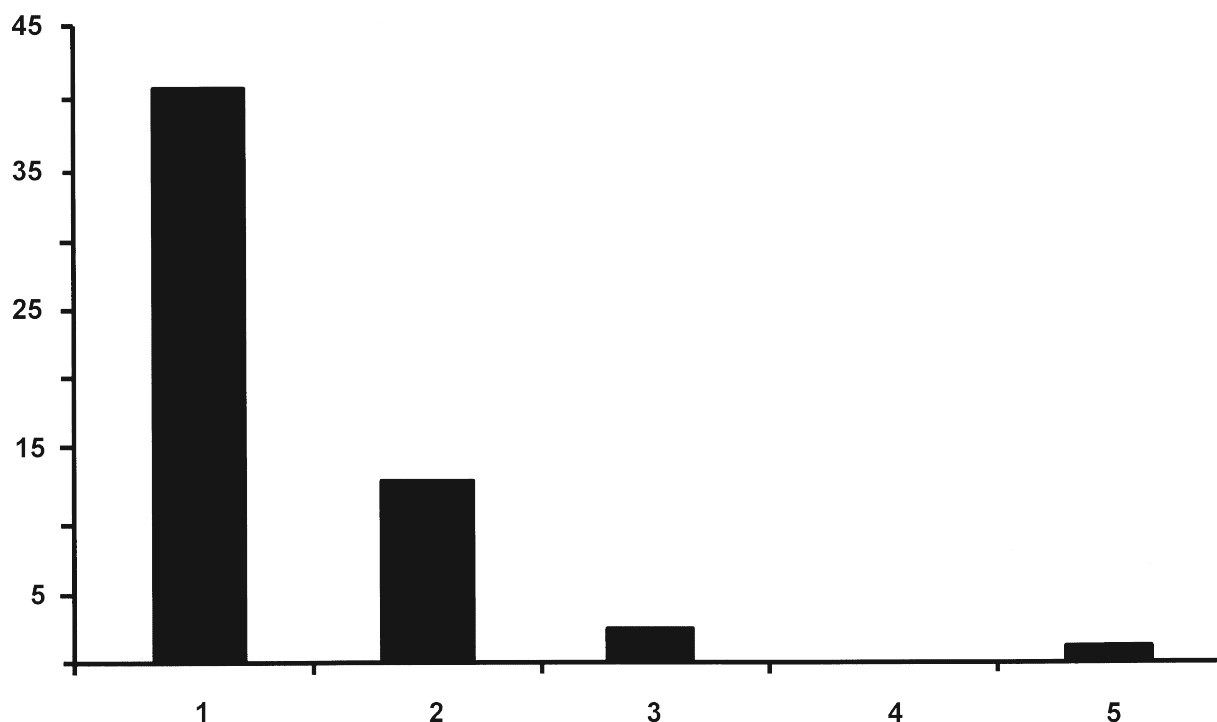


FIGURE 5. Frequency distribution showing number of *Jasmineiricola mackiei* n. gen. et n. sp. per infected host (N = 58). Vertical axis, number of infected *Jasmineira*, horizontal axis, number of parasites per infected host.

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