

Family MALDANIDAE

A guide to species in waters around the British Isles

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FAMILY MALDANIDAE

The maldanids are an easily recognised family, with their elongate body segments giving them their common name of bamboo worms. They usually inhabit a tube, sometimes attached to a hard object, often free in the sediment. They are often fragile and, as much of the literature requires knowledge of the number of setigers present, have a reputation for being difficult to identify. Worldwide the family is currently divided into 7* subfamilies, of which 6 are represented in British waters. At present, maldanid genera which are known to or suspected of belonging to the British fauna fit into the subfamilies as follows:

Lumbriclymeninae

Lumbriclymene, Praxillura,

Maldaninae

Chirimia, Maldane

Euclymeninae

Clymenella, Clymenura, Euclymene, Heteroclymene, Isocirrus, Johnstonia, Praxillella, Proclymene, Pseudoclymene

Nicomachinae

Micromaldane, Nicomache, Petaloproctus

Notoproctinae

Notoproctus

Rhodininae

Rhodine

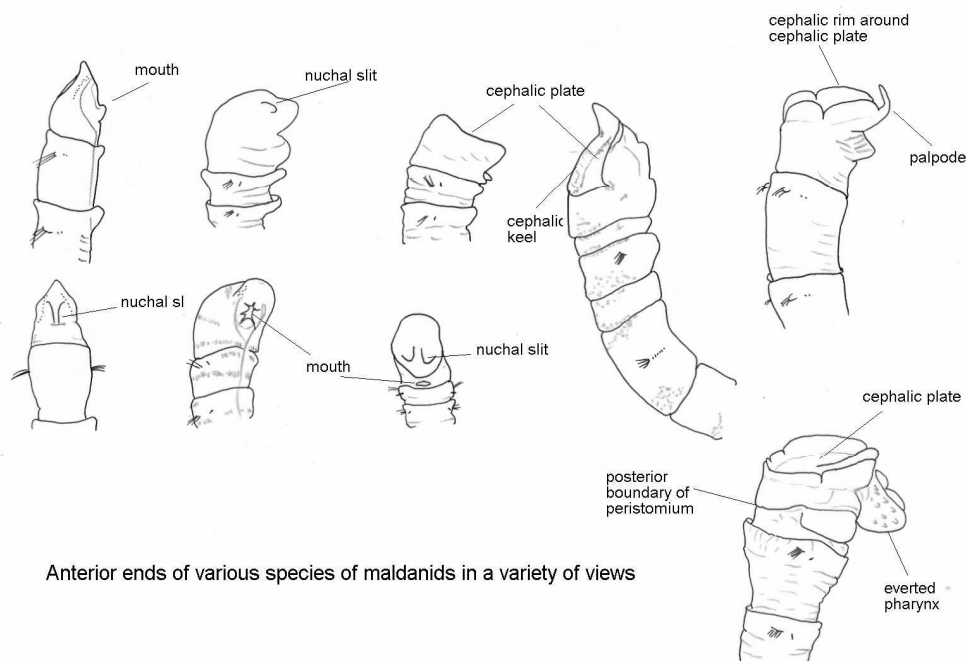
The subfamily Bogueinae Wolf, 1983, represented by two species in two genera, has not been recorded in British waters.

*The subfamily Clymenurinae, suggested by Imajima and Shiraki (1982), is not considered valid - see notes below.

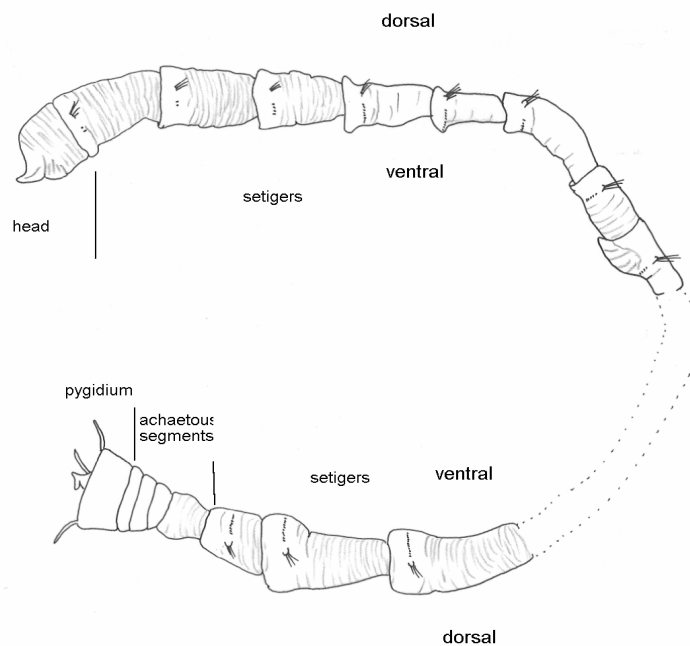
EXTERNAL MORPHOLOGY OF MALDANIDS

Maldanids consist of a head region, a number of body segments with chaetae (setigers) and a pygidium. There may be a number of achaetous segments between the last setiger and the pygidium.

The **head** of a maldanid (ie. that part of the animal anterior to the first setiger) is formed from the prostomium, the peristomium and, probably one anterior achaetous segment. The degree of development of the most anterior part of the head is variable within the family, and the anatomical origin of some of its features remain uncertain. The prostomium is represented by two **nuchal slits**, which may be separated by a raised **cephalic keel**, and it may be extended forward as a distinct **palpode**. The peristomium is represented by the region surrounding the mouth, out of which can be extended an eversible pharynx in at least some taxa, and which may bear papillae. The remainder of the head is formed by at least one achaetous segment, which may be distinguishable externally from the peristomium, by a partial segmental boundary posterior to the mouth. The anterior part of the head is generally set at an angle to the longitudinal axis of the worm, and it may be flattened, forming a **cephalic plate**, which may be surrounded by a raised **cephalic rim**, developed to a greater or lesser extent.

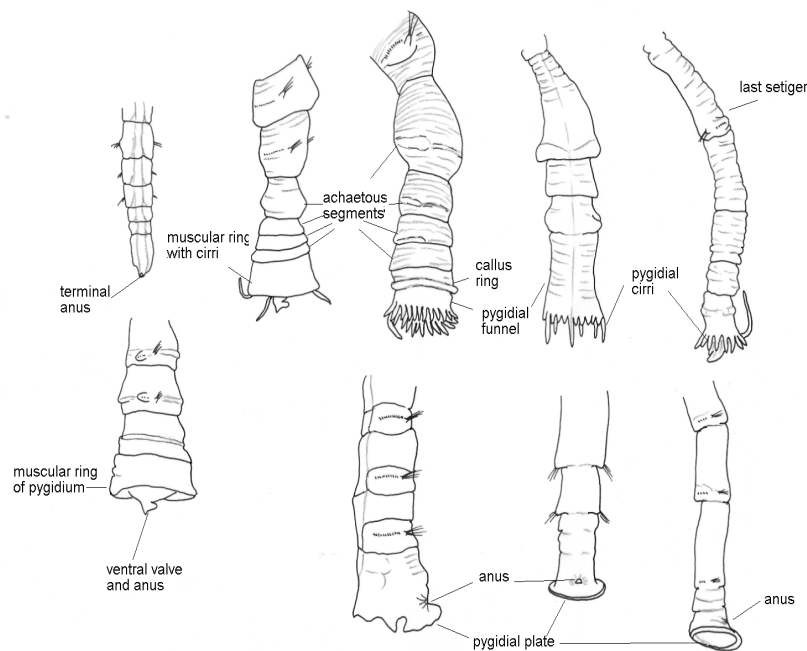


The first **setiger** normally bears both dorsal and ventral chaetae, although the latter are absent in some genera. The remaining setigers all have dorsal and ventral chaetae, although the number and type of the ventral chaetae in a number of anterior setigers are often different from those in the remaining setigers. Chaetae may originate out of distinct parapodial lobes, or simply from the body wall. The region of the segment associated with the chaetae is often highly glandular, particularly in anterior segments. In front of the pygidium, there are often a number of **achaetous segments**, which bear parapodial rudiments but have no chaetae. Setigers in some taxa are distinctly bi- or triannulate, and the position of origin of the chaetae in the segment generally changes along the length of the animal. In anterior segments, the chaetae generally originate in the anterior third of the segment, whereas in posterior segments the chaetae are close to the posterior margin of the segment. The transition between these two may be distinct, with one transitional segment, but in other cases segmental boundaries in mid-body segments may not be clear. Mid-body segments tend to be longer than anterior and posterior ones, and generally are thin walled and lacking glandular epidermal areas.



Maldanid chaetae are relatively conservative, and all are simple. Dorsally, chaetae are various forms of **capillaries**, and ventrally they are various types of **uncini**. Notochaetae are of two basic forms, limbate capillaries and spinose capillaries with minute, spirally arranged spines. Bilaterally spinose feather chaetae and various geniculate forms have also been described. Neurochaetae are usually long handled rostrate uncini, with a main tooth with several smaller teeth above, and a group of subrostral hairs (gular bristles) below. The handle of the uncinus usually has a swelling (node) along its length. Short handled uncini are reported from some taxa. In anterior segments, the dentition of the uncini is often reduced, and the uncini may be replaced by large acicular spines.

The **pygidium** is a post-segmental structure enclosing the **anus**, and in its simplest form in maldanids, it is a simple tube with a terminal anus. However, a number of lines of morphological modifications are seen in different taxa, and the terminology applied to the posterior end of maldanid worms can be rather confusing. It is important to distinguish between developments of the pygidium and of the area directly relating to the anus. The **pygidium** itself may be developed as a prominent muscular **ring**, which may bear a number of **cirri**, or it may elongate as a **pygidial funnel**. The pygidial funnel may be smooth or may bear crenulations or cirri of varying structure and number. A distinct raised **callus ring** may occur proximally on the pygidium, looking superficially like another posterior achaetous segment. The anus may remain in its terminal position, and may be situated at the end of an **anal cone** (see below in the Euclymeninae for a discussion of this character). It is often slightly dorsal in position, as indicated by the development of a ventral valve, which seems to act as a plug. In some cases the anus moves to a distinctly dorsal situation, and in this case, a flat **pygidial plate** may occupy the terminal position. This pygidial plate may bear lateral notches or even develop cirri or more complex structures around its edge. The homologies of morphological features of the posterior ends of maldanid taxa have not been fully established, and the anatomical origins of several morphological features remain unclear. Consequently the terms used to describe the characteristics of the tail ends of various taxa are not well defined, and standardisation of usage is difficult. In particular, in the Euclymeninae the presence or absence of a callus ring, how an achaetous pre-pygidial segment can be distinguished from a callus ring and the relationship between the callus ring, the muscular ring forming a pygidial plate and the pygidial funnel, remain uncertain.



Posterior ends of various maldanids in a variety of views

In many maldanids the number of setigers together with the number of any achaetous posterior segments is characteristic of a species. In other taxa, there would appear to be no upper limit to segment number, and growth is by increasing segment number as well as segment size. In taxa with fixed numbers of body segments, 19 setigers plus achaetous segments would appear to be the commonest number, but as few as 13 setigers and up to 23 are also known to occur. In those taxa without a definitive segment number, up to 60 setigers may be present.

When counting the number of setigers and achaetous segments in individual specimens, care is required to avoid complications due to regeneration. Maldanids are capable of regenerating in an anterior direction as well as posteriorly, and it is possible that some species undergo routine regeneration as part of asexual reproduction. Casual observations indicate that species with fixed numbers of body segments rapidly develop new segments to replace lost ones and restore their appropriate number of segments. Regenerating regions are initially obviously thinner than the remaining segments, and the segments are shorter in length. In many cases newly regenerated segments have less pigment than original segments. Where regeneration is suspected, over-reliance on counts of body segments should be avoided. In taxa where a callus ring is present as part of the pygidium, this should not be counted as an achaetous segment. Where the callus ring is well developed, this is generally quite straight forward, but deciding between an achaetous segment and a weakly developed callus ring is difficult, and in some cases almost impossible. Anterior achaetous pre-pygidial segments have quite obvious parapodial rudiments and are easy to recognise, but the most posterior achaetous segment is generally short, less well defined, and may be lacking in parapodial rudiments. This makes it much less obvious and it may be difficult to distinguish between such a segment and a poorly developed callus ring.

British species in The Species Directory, Howson and Picton (1997):

Lumbriclymeninae

- Lumbriclymene cylindricauda* M. Sars, 1872
- Lumbriclymene minor* Arwidsson, 1907
- Praxillura longissima* Arwidsson, 1907

Maldaninae

- Chirimia biceps* (M. Sars, 1861)
- Maldane glebifex* Grube, 1860
- Maldane sarsi* Malmgren, 1865

Euclymeninae

- Clymenella cincta* (Saint-Joseph, 1894)
- Clymenella torquata* (Leidy, 1855)
- Clymenura borealis* (Arwidsson, 1907)
- Clymenura clypeata* (Saint-Joseph, 1894)
- Clymenura johnstoni* (McIntosh, 1915)
- Clymenura leiopygos* (Grube, 1860)
- Euclymene droebachiensis* (M. Sars, 1872)
- Euclymene lindrothi* Eliason, 1962
- Euclymene lumbricoides* (Quatrefages, 1866)
- Euclymene oerstedii* (Claparède, 1863)
- Heteroclymene robusta* Arwidsson, 1907
- Johnstonia clymenoides* Quatrefages, 1866
- Praxillella affinis* (M. Sars, 1872)
- Praxillella gracilis* (M. Sars, 1861)
- Praxillella praetermissa* (Malmgren, 1865)
- Proclymene muelleri* (M. Sars, 1856)

Nicomachinae

- Micromaldane ornithochaeta* Mesnil, 1897
- Nicomache lumbricalis* (Fabricius, 1780)
- Nicomache personata* Johnson, 1901
- Nicomache trispinata* Arwidsson, 1907
- Petaloproctus borealis* Arwidsson, 1907
- Petaloproctus terricola* Quatrefages, 1865

Notoproctinae

- Notoproctus* sp.

Rhodinae

- Rhodine gracilior* (Tauber, 1879)
- Rhodine loveni* Malmgren, 1865

Clymenura clypeata is accepted as being a synonym of *C. leiopygos*, as suggested by Arwidsson (1907). Of the remaining species listed above, there are several which have so far been recorded only from considerably further north or east (and often in significantly deeper water) than would normally be considered as constituting British waters - *Lumbriclymene cylindricauda*, *Lumbriclymene minor*, *Clymenura borealis* and *Euclymene lindrothi*. Similarly, *Johnstonia clymenoides*, known from the Atlantic coast of France and further south has not been recorded from British shores. However, due to the generally poor standard of identification of maldanids, the presence of these species plus other northern forms like *Pseudoclymene quadrilobata*, *Isocirrus planiceps*,

Nicomache minor, *Nicomache quadrispinata* and *Petaloproctus tenuis* in British waters cannot be ruled out. Undoubtedly there are also undescribed species which will have to be added to any list of British Maldanidae. Preliminary research has shown two such species, one close to *Euclymene oerstedii* and a second of uncertain generic affinity. These will be called *Euclymene* sp. A and *Euclymeninae* sp. A respectively. A species of *Clymenura* is relatively commonly found which fits the description of *Clymenura tricirrata* (Bellan & Reys, 1967), described from the Mediterranean, although the type material has not been examined. The British representatives of the genera *Nicomache* and *Petaloproctus* remain uncertain. (Imajima and Shiraki (1982) raised *P. tenuis* var. *borealis* of Arwidsson (1907) to specific status). The genus *Notoproctus* is represented by at least one species, but perhaps there are more. This guide concentrates particularly on the *Euclymeninae*, the most speciose of the subfamilies, with little new information being added for the other subfamilies. Clearly there is a need for further research on these subfamilies, particularly the *Nicomachinae* and the *Notoproctinae*.

It is therefore suggested that this identification guide should concentrate on those species known to occur in British waters, with any other species mentioned where appropriate. This gives a basic list of 27 species, with 11 potential additions (in small print below). It should be stressed, however, that this situation reflects a personal view of the current state of maldanid taxonomy, and there will undoubtedly be changes in the future. This is intended simply as a starting point.

SUBFAMILY LUMBRICLYMENINAE

Praxillura longissima Arwidsson, 1907*Lumbriclymene cylindricauda* M. Sars, 1872*Lumbriclymene minor* Arwidsson, 1907

Praxillura longissima is the species of the Lumbriclymeninae most likely to be found in British waters. It is easily recognised by having more than 4 anterior segments with single acicular spines in the neuropodia (the exact number seems to be dependent on the size of the animal, and may exceed 12). Arwidsson (1907) described *Praxillura longissima* and two additional varieties *minor* and *paucimaculata*. *P. longissima* has an arctic distribution, var. *minor* is recorded from Trondheimfjord on the west coast of Norway, and var. *paucimaculata* in shallow water from the Kattegat. The status of the three and therefore the correct name for the species found in British waters needs further investigation.

Head without cephalic plate; area between nuchal slits often elevated; anterior setigers biannulate with chaetae in first annulus; some taxa with fixed number of segments; neurochaetae of first 3-10? setigers single spines; remaining neurochaetae rostrate uncini; notochaetae capillaries; pygidium simple with anus terminal; no callus ring.

	SETIGERS	ACHAETOUS SEGMENTS	
<i>Praxillura longissima</i>	many	6 or 7	Arwidsson 1907
<i>Lumbriclymene cylindricauda</i>	19	3 or 4	Arwidsson 1907
<i>Lumbriclymene minor</i>	18?	2 or 3	Arwidsson 1907

SUBFAMILY MALDANINAE

Chirimia biceps (M.Sars, 1861)*Maldane sarsi* Malmgren, 1865*Maldane glebifex* Grube, 1860

The subfamily Maldaninae has been reviewed and revised by Light (1991). He divided it into five genera, of which two are represented in British waters. *Maldane sarsi* is the most likely member of the subfamily to be found in British waters, and *Chirimia biceps* (formerly *Asychis biceps*) may occur in northern waters. *Maldane glebifex*, originally described from the Mediterranean, has been described by Wesenburg-Lund (1948) from Greenland, and so may occur around the western and northern fringes of British waters.

Head with cephalic plate, often with keel and rim, and prominent palpode; anterior segments biannulate, with chaetae in first annulus; anterior collar may be present on setiger 1; each species with a fixed number of segments; neurochaetae often absent from first setiger; neurochaetae rostrate uncini; notochaetae various capillaries, including spinulose forms; pygidium with distinct terminal plate, variously developed, sometimes with lobes or cirri; anus dorsal; no callus ring.

	SETIGERS	ACHAETOUS SEGMENTS	
<i>Chirimia biceps</i>	19	1	Wesenburg-Lund 1948
<i>Maldane sarsi</i>	19	2	Wesenburg-Lund 1948
<i>Maldane glebifex</i>	19	2	Wesenburg-Lund 1948

SUBFAMILY EUCLYMENINAE

Clymenella cincta (Saint-Joseph, 1894)
Clymenella torquata (Leidy, 1855)
Clymenura johnstoni (McIntosh, 1915)
Clymenura leiopygos (Grube, 1860)
Clymenura tricirrata (Bellan & Reys, 1967)
Euclymene droebachiensis (M. Sars, 1872)
*Euclymene lombricoides** (Quatrefages, 1865)
Euclymene oerstedii (Claparède, 1863)
Euclymene sp. A
Heteroclymene robusta Arwidsson, 1907
Praxillella affinis (M. Sars, 1872)
Praxillella gracilis (M. Sars, 1861)
Praxillella praetermissa (Malmgren, 1865)
Proclymene muelleri (Sars, 1851)
 Euclymeninae sp. A
Clymenura borealis (Arwidsson, 1907)
Euclymene lindrothi Eliason, 1962
Johnstonia clymenoides Quatrefages, 1866
Isocirrus planiceps (Sars, 1872)
Pseudoclymene quadrilobata (Sars, 1856)

* This is the spelling used by Quatrefages in the original description.

The two species of the genus *Clymenella* are readily separated if the anterior ends are present. *C. torquata* is known from shores in south-east England, believed to have been imported with american oysters, and it has recently been found in Strangford Lough.

The position of the genus *Clymenura* has caused problems as it currently includes species with a well developed cephalic plate with a cephalic rim and species in which the cephalic plate appears to be absent. The feature they all have in common is the presence of a ventral glandular shield on setiger 8. *Clymenura* was originally included in the Euclymeninae by Arwidsson (1907) (Imajima and Shiraki's (1982) assertion that Arwidsson referred it to his subfamily Lumbriclymeninae is incorrect) and Fauchald (1977) agreed. Day (1967), however, put the genus into the subfamily Lumbriclymeninae, whilst giving no reasons for so doing. Imajima and Shiraki (1982) suggested a new subfamily to include all of these species, the Clymenurinae, suggesting that the subfamily consisted of a single genus, with two subgenera, *Clymenura* (*Clymenura*) to include the species with no cephalic plate and *Clymenura* (*Cephalata*) to include species with a cephalic plate.

Clearly, the species which have a cephalic plate with well developed rim could easily be included in the Euclymeninae, but the situation regarding the species which appear to lack a cephalic plate is more problematic. At first sight, it would appear that Day's (1967) view of the genus belonging to the Lumbriclymeninae would be appropriate for these species, but closer examination reveals this not to be the case. Apart from the absence of a cephalic plate, the species of the nominate subgenus of Imajima and Shiraki (1982) look very like members of the Euclymeninae. In particular, they show externally signs of the same body regions as described by Pilgrim (1967) for species of the Euclymeninae. The structure of the pygidium fits within the range shown by species of the genera *Microclymene* and *Praxillella*, and the head is also far more like that of species of Euclymeninae than it is that of species of the Lumbriclymeninae. There is a well developed prostomial palpode, and the mouth is a transverse slit whereas in the Lumbriclymeninae, Nicomachinae and Rhodininae, there is no prostomial palpode, and the mouth is a longitudinal slit. It is perhaps more correct to regard these species as having a reduced cephalic plate rather than none at all, as the outer margins of the nuchal slits are bounded by flaps of tissue which appear analogous to the cephalic rim of many species of the

Euclymeninae. As far as I am aware, there is no anatomical evidence to support this view, but the similarity between the head of a specimen of a species such as *Praxillella affinis* which has been fixed in its tube and so has the cephalic plate compressed and that of a species such as *Clymenura leiopygos* is striking. In common with other members of the Euclymeninae, species of *Clymenura* lacking a well defined cephalic plate seem to have a simple axial pharynx, whilst the Lumbriclymeninae, Maldaninae and Rhodininae all have a muscular ventral buccal mass (Dales 1962; Orrhage 1973). Of course the inclusion of these species of *Clymenura* within the Euclymeninae necessitates a re-definition of the subfamily to include species with a poorly developed cephalic plate and rim.

As far as the species of *Clymenura* found in British waters is concerned, 3 are definitely present, all with a reduced cephalic plate. Other species may well be present, and indeed *C. borealis*, a species with a well developed cephalic plate, known from western Norway into the arctic, can be expected. However, in the past there would appear to have been confusion between this species and Euclymeninae sp. A, which has no glandular shield on setiger 8, has only one achaetous pre-pygidial segment plus a callus ring, and which has a prominent glandular patch posterior to the mouth.

In the genus *Euclymene*, *E. lombricoides* is readily identifiable, and *Euclymene* sp. A, with its very poorly developed cephalic rim should also cause few problems. The anterior ends of *E. droebachiensis* and *E. oerstedii*, however, illustrate some of the outstanding problems in the genus. Typically *E. droebachiensis* has a distinct posterior notch as well as lateral folds in the cephalic rim, and it has no ocelli. Typically *E. oerstedii* has ocelli, and the cephalic rim either shows no folds, or slight lateral folds, and in the largest specimens, a slight posterior notch. However, specimens which have all the characteristics of *E. droebachiensis* except that they have ocelli and are of relatively small size are found in the Channel, such specimens having been assigned to *E. modesta* (Quatrefages, 1866) by Arwidsson (1907). Similarly specimens which are undoubtedly *E. oerstedii* are found which lack ocelli. A further species, *E. lindrothi* may be present, but its morphology is currently poorly known and re-examination of Eliason's material is needed.

In the genus *Praxillella*, *P. gracilis*, with its characteristic elongate palpode, is readily recognised. Nolte (1912) described a new variety, *borealis*, from 112m depth off the Moray Firth, and its relationship to the more northerly form requires investigation. Distinguishing the anterior ends of *P. affinis* and *P. praetermissa* depends on whether or not ocelli are present, a characteristic that should be treated with some caution.

Proclymene muelleri is readily recognised, and would appear to be absent from the North Sea, though present to the west of Scotland. Other potential members of the British fauna in the Euclymeninae are *Isocirrus planiceps* and *Pseudoclymene quadrilobata*.

Head with a cephalic plate, though sometimes poorly developed; cephalic plate with keel, rim and palpode developed to various degrees; anterior setigers with one annulus only, although anterior of each may be glandular; chaetae in anterior third of anterior segments; setiger 8 usually transitional, with chaetae in mid-segment; posterior segments with chaetae close to posterior margin; species usually with a fixed number of body segments; neurochaetae of first 3 or 4 setigers often reduced in number and of different structure to those from more posterior segments; neurochaetae occasionally absent from setiger 1; neurochaetae may be acicular spines in first few setigers, otherwise rostrate uncini; notochaetae various types of capillaries, including spinulose forms; pygidium variously developed, with or without cirri or crenulations, with or without funnel; anal cone with or without prominent ventral valve; anus terminal; callus ring usually present, often well developed.

	SETIGERS	ACHAETOUS SEGMENTS	CALLUS RING	
<i>Clymenella cincta</i>	22	2	+	pers. obs.
<i>Clymenella torquata</i>	18	2	+	Pilgrim 1966
<i>Clymenura johnstoni</i>	19	4	+	Arwidsson 1922
<i>Clymenura leiopygos</i>	24 or 25	1	+	Arwidsson 1922
<i>Clymenura tricirrata</i>	19	3	+	pers. obs.
<i>Euclymene droebachiensis</i>	20	3	+	pers. obs.
<i>Euclymene lombricoides</i>	19	3	+	pers. obs.
<i>Euclymene oerstedii</i>	19	2	+	pers. obs.
<i>Euclymene</i> sp. A	21	1	+	pers. obs.
<i>Heteroclymene robusta</i>	19	5 (4)	-(+)	pers. obs.
<i>Praxillella affinis</i>	18	3	+	pers. obs.
<i>Praxillella gracilis</i>	18	4	+	pers. obs.
<i>Praxillella praetermissa</i>	19	4	+	pers. obs.
<i>Proclymene muelleri</i>	19	5(4)	-(+)	Arwidsson 1907
<i>Euclymeninae</i> sp. A	22 (21?)	1	+	pers. obs.
<i>Clymenura borealis</i>	19	5	-	Arwidsson 1907
<i>Clymenura clypeata</i>	25 or 26	1	-	Fauvel 1927
<i>Euclymene lindrothi</i>	18 (19)	4	+	Eliason 1962
<i>Isocirrus planiceps</i>	23	1	?	Arwidsson 1907
<i>Johnstonia clymenoides</i>	22	1	-	Mackie and Gobin 1993
<i>Pseudoclymene quadrilobata</i>	19	5	-	Arwidsson 1907

SUBFAMILY NICOMACHINAE

Micromaldane ornithochaeta Mesnil, 1897

Nicomache lumbricalis (Fabricius, 1780)

Nicomache personata Johnson, 1901

Nicomache trispinata Arwidsson, 1907

Petaloproctus borealis Arwidsson, 1907

Petaloproctus terricola Quatrefages, 1865

Nicomache minor Arwidsson, 1907

Nicomache quadrispinata Arwidsson, 1907

Petaloproctus tenuis (Theel, 1879)

Both *Nicomache* and *Petaloproctus* have characteristic long filamentous chaetae in the notopodia of a number of mid-body segments, accompanying the normal types of capillary chaetae. These are not found in species of *Micromaldane*, the genus being characterised by the presence of avicular rostrate uncini in the neuropodia of all setigers. The number and identity of species of the genus *Nicomache* present in British waters is currently uncertain, and the more northerly species, *N. minor* and *N. quadrispinata* have been added to the 3 species in the Species Directory. Arwidsson (1907) attributed specimens of *N. lumbricalis* from the area around Bergen to his variety *borealis*, but the significance of this separation remains unclear. *N. lumbricalis* is recognised by having 2 pre-pygidial achaetous segments, whilst the other 4 species have only 1. *N. quadrispinata* has acicular spines in the neuropodia of the first 4 setigers, in contrast to the other species which have them only in the first 3. Both *N. trispinata*

and *N. quadrispinata* have the pygidial funnel at an angle to the longitudinal axis of the worm, and are considered as belonging to the subgenus *Loxochona* by some workers. Differences in the shapes of the nuchal organs may be useful in the separation of the species, and the value of differences in setiger number requires further investigation.

The genus *Petaloproctus* is similarly confused, with *P. borealis* and *P. terricola* being the most likely members of the British fauna, *P. tenuis* being an arctic species. The presence of pre-pygidial achaetous segments requires examination. Many drawings of tail ends of species show incomplete rings at the base of the pygidial funnel, but whether or not these represent achaetous segments is not clear. *P. tenuis* has a pygidial funnel with a serrated edge, whilst it is smooth in the other species.

Head without a cephalic plate; cephalic keel normally well developed, anterior of prostomium widely rounded; anterior setigers with one annulus only; species with fixed numbers of segments; neurochaetae of first 3 or 4 setigers acicular spines; neurochaetae of subsequent setigers rostrate uncini; notochaetae various types of capillaries, sometimes including very long filamentous types; pygidium variously developed as a funnel, smooth, or with crenulations or cirri, sometimes asymmetrical; anus terminal; no callus ring.

	SETIGERS	ACHAETOUS SEGMENTS	
<i>Micromaldane ornithochaeta</i>	13-17	1	Fauvel 1927
<i>Nicomache lumbricalis</i>	22	2	Wesenburg-Lund 1948
<i>Nicomache personata</i>	22	1	Imajima and Shiraki 1982
<i>Nicomache trispinata</i>	23	1	Arwidsson 1907
<i>Petaloproctus borealis</i>	21	2	Imajima and Shiraki 1982
<i>Petaloproctus terricola</i>	22	0	Fauvel 1927
<i>Nicomache minor</i>	23	1	Arwidsson 1907
<i>Nicomache quadrispinata</i>	22	1	Arwidsson 1907
<i>Petaloproctus tenuis</i>	20	1	Wesenburg-Lund 1948

SUBFAMILY NOTOPROCTINAE

Notoproctus spp.

The subfamily Notoproctinae was erected by Detinova (1985) for the genus *Notoproctus*. The genus is undoubtedly present in British waters, but at present the number of species and their identities remain uncertain. Arwidsson (1907) described *Notoproctus oculatus* and 2 additional varieties, *minor* and *arctica*. All 3 have 3 pre-pygidial achaetous segments, but *N. oculatus* has 19 setigers, var. *minor* has 18 and var. *arctica* 18 or occasionally 17. The relationships between these three forms requires examination.

Head with cephalic plate; cephalic plate without keel or raised rim; anterior setigers with one annulus, with chaetae in anterior third; species with a fixed number of segments; neurochaetae of first 4 setigers acicular spines; neurochaetae of subsequent setigers rostrate uncini; notochaetae various types of capillaries; pygidium developed as a terminal plate, with a smooth rim, and sometimes a ventral shield; anus dorsal; no callus ring.

SUBFAMILY RHODININAE

Rhodine gracilior (Tauber, 1879)*Rhodine loveni* Malmgren, 1865

The subfamily Rhodininae is very distinct, composed of the single genus *Rhodine*. The two species in British waters are well established, and readily separated.

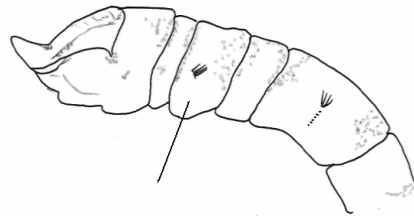
Head without a cephalic plate; cephalic keel usually developed, anterior of prostomium widely rounded; anteriorly directed collars on setigers 2 and 3; posterior setigers with posteriorly directed skirts; number of segments not fixed; setiger 9 appearing to be transitional; neurochaetae absent from first 4 setigers; subsequent neuropodia with rostrate uncini in double rows; notochaetae various types of capillaries; pygidium a simple tube; anus terminal; no callus ring.

	SETIGERS	ACHAETOUS SEGMENTS	
<i>Rhodine gracilior</i>	many	0	pers. obs.
<i>Rhodine loveni</i>	many	0	pers. obs.

IDENTIFICATION OF ANTERIOR ENDS OF BRITISH MALDANIDAE

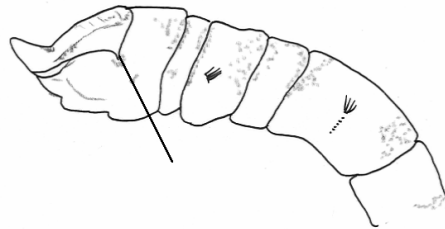
Taxa in which the head shows a **well developed cephalic plate**, usually with a rim around its lateral and posterior margins, and a palpode extending anteriorly

- 1 Neurochaetae absent from the first setiger 2

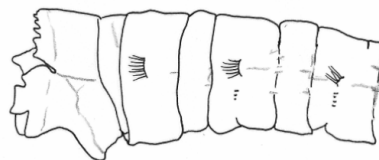


- Neurochaetae present on all setigers 3

- 2 Cephalic rim with lateral notches only *Maldane sarsi*
Maldane glebifex



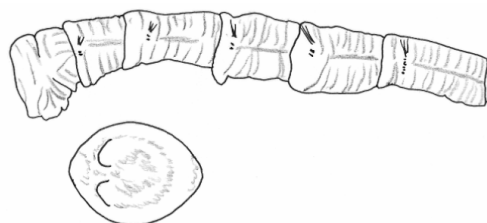
Cephalic rim serrated along its posterior margin, and with irregularly wrinkled lateral lobes *Chirimia biceps*



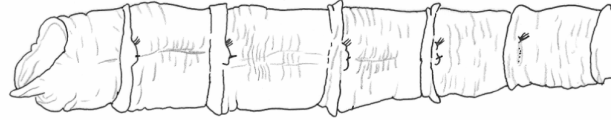
- 3 Each neuropodium of the **first 4 setigers** with a reduced number of chaetae compared to subsequent setigers 4

- Each neuropodium of the **first 3 setigers only** with a reduced number of chaetae compared with subsequent setigers 5

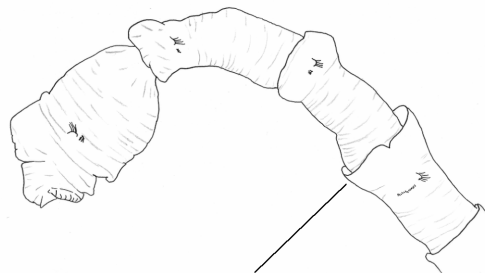
- 4 Cephalic plate with no rim, flat and set at an obtuse angle to the longitudinal axis of the worm (animal quite robust, with no cirri on the pygidial plate) *Notoproctus* spp.



- Cephalic plate with a low but distinct rim, often showing irregular wrinkles (body robust, pygidium bearing a number of cirri) *Proclymene muelleri*

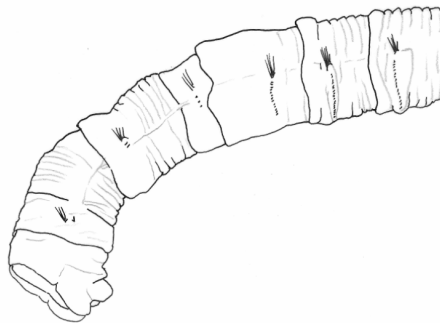


- 5 Setiger 4 with a distinct thin anteriorly directed collar on its anterior margin, extending forward over the posterior part of setiger 3 6



- No such collar on setiger 4 (a thickened glandular lip may be present) 7

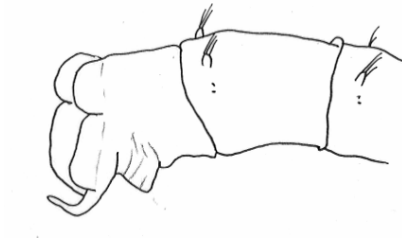
- 6 Each neuropodium of setigers 1-3 with 1 or 2 stout chaetae (occasionally 3); collar on setiger 4 with a pair of lateral notches *Clymenella cincta*



- Each neuropodium of setigers 1-3 with 4 or more chaetae; collar on setiger 4 with a dorsal notch, and slight crenulations laterally and ventrally *Clymenella torquata*

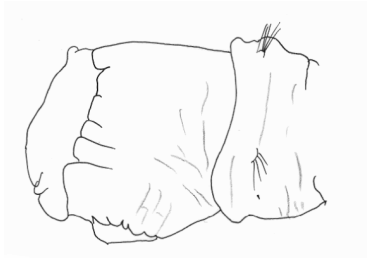


- 7 Palpode distinctly elongate *Praxillella gracilis*



- Palpode not markedly elongate, comparable in length to the height of the cephalic rim 8

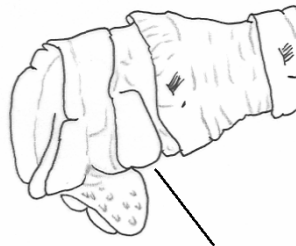
- 8 Cephalic rim with its posterior edge more or less regularly crenulate *Euclymene lombricoides*
Johnstonia clymenoides



Johnstonia clymenoides has characteristic vascular cirri on some posterior segments.

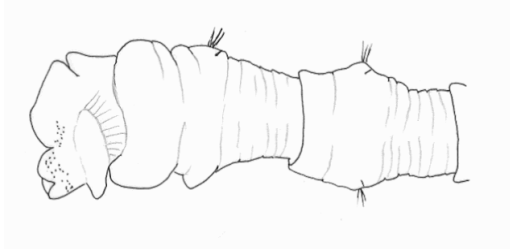
- Cephalic rim with at most a single posterior and a lateral notch on each side 9

- 9 Head with a distinct glandular patch ventrally, posterior to the mouth 10

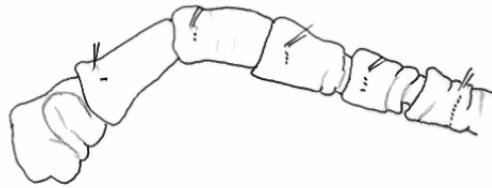


- Head with no glandular patch posterior to the mouth 11

- 10 Cephalic rim well developed, with lateral notches; ocelli present *Heteroclymene robusta*



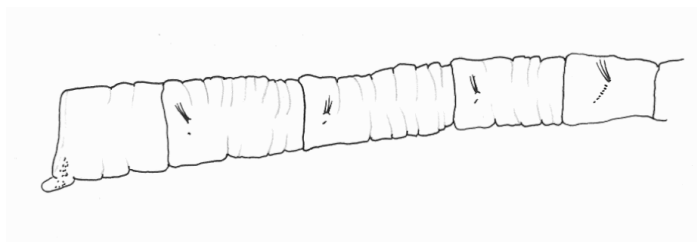
- Cephalic rim low, with no distinct notches; ocelli absent
..... Euclymeninae sp. A



- 11 Each neuropodium of setigers 1-3 with only 1 or 2 stout chaetae present 12

- Each neuropodium of setigers 1-3 with 3-6 stout chaetae present 14

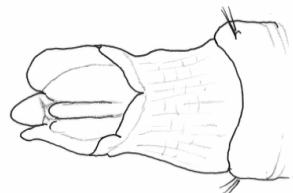
- 12 Cephalic plate well developed but rim not raised and barely noticeable
..... *Euclymene* sp. A
Isocirrus planiceps



Isocirrus planiceps has a transverse furrow across the cephalic plate, close to the posterior ends of the short nuchal slits.

- Cephalic rim developed and obvious 13

- 13 Cephalic rim well developed, with lateral folds and a distinct posterior notch; ocelli absent..... *Euclymene droebachiensis*
Euclymene lindrothi?
Clymenura borealis
Pseudoclymene quadrilobata?



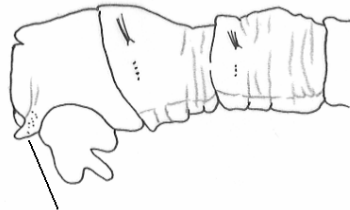
Clymenura borealis can be distinguished by the presence of ventral glandular shield on setiger 8. *Pseudoclymene quadrilobata* has very short nuchal slits, extending no more than a quarter of the length of the cephalic plate.

- Cephalic rim low, with or without lateral folds; usually with no posterior notch but larger specimens may have a slight one; ocellii present *Euclymene oerstedii*



NB typical *E. droebachiensis* from the North Sea have no ocelli, but smaller specimens from the Channel coast definitely have ocelli present. These specimens fit the description of *Euclymene modesta* (Quatrefages, 1866) given by Arwidsson (1922), but it is not certain that this represents a distinct species. If it is, then whether or not the name *E. modesta* is appropriate would need to be addressed. Separation of specimens of '*E. modesta*' and *E. oerstedii* based only on anterior ends may not be possible.

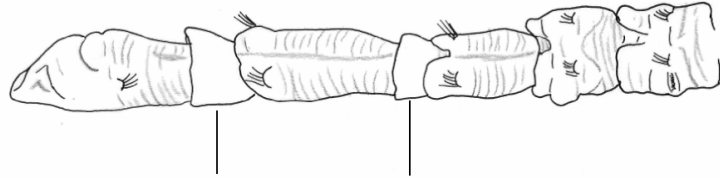
- 14 Ocelli present on the underside of the palpode and extending some way along the cephalic rim *Praxillella affinis*



- Ocelli absent *Praxillella praetermissa*

Taxa in which **no cephalic plate** is present; at its best developed, the head has a cephalic keel between the nuchal slits, with a broad palpode

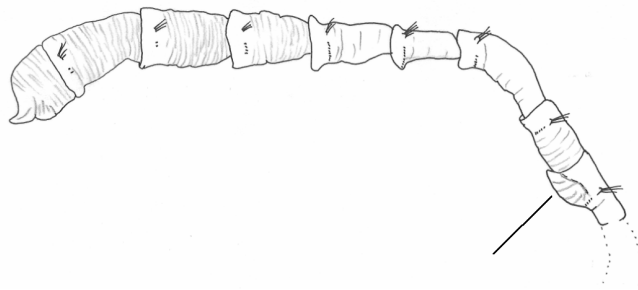
- 1 Setigers 2 and 3 with anteriorly directed membranous collars; first 4 setigers with no neurochaetae; a crescentic muscular ridge across the dorsum of the head 2



- No collars on setigers 2 or 3; neurochaetae present from setiger 1 3

- 2 Setiger 4 darkly pigmented compared to the other setigers *Rhodine loveni*
- Setiger 4 not markedly different from the other setigers *Rhodine gracilior*

- 3 (If at least 8 setigers are present) a ventral glandular shield present between the parapodia of setiger 8 *Clymenura leiopygos*
Clymenura johnstoni
Clymenura tricirrata



According to Arwidsson (1922) *C. leiopygos* has some brown pigment on the head, in addition to ocelli, this pigment being absent from *C. johnstoni* and apparently also from *C. tricirrata*.

- (Fewer than 8 setigers present or) no glandular shield on setiger 8 4

- 4 Anterior neuropodia with avicular uncini, no different to those of more posterior setigers; numbers of uncini per neuropodium low throughout body length; body length of only a few mm. *Micromaldane ornithochaeta*

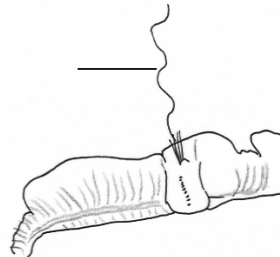


- Anterior neuropodia with either stout acicular spines or uncini with reduced numbers of teeth on them compared with those of more posterior segments; neuropodia of anterior segments with fewer chaetae than more posterior segments 5
- 5 Neuropodia of **first 3 setigers** with reduced numbers of chaetae compared with subsequent setigers, or chaetae of these setigers of a different form to those of subsequent ones 6

Neuropodia of **first 4 setigers or more** with single acicular spines
 *Praxillura longissima*
Lumbriclymene cylindricauda
Lumbriclymene minor
Nicomache quadrispinata

Lumbriclymene cylindricauda and *Lumbriclymene minor* both have single acicular spines in the neuropodia of a maximum of the first 4 setigers only. *Praxillura longissima* normally has at least the first 6 and up to 15 setigers with single spines in the neuropodia. The elongate filamentous notochaetae of *Nicomache quadrispinata* should be visible.

- 6 A few very long filamentous chaetae present in the notopodia from approximately setiger 6 *Nicomache lumbricalis*
Nicomache personata
Nicomache trispinata
Petaloproctus borealis
Petaloproctus terricola
Nicomache minor
Petaloproctus tenuis



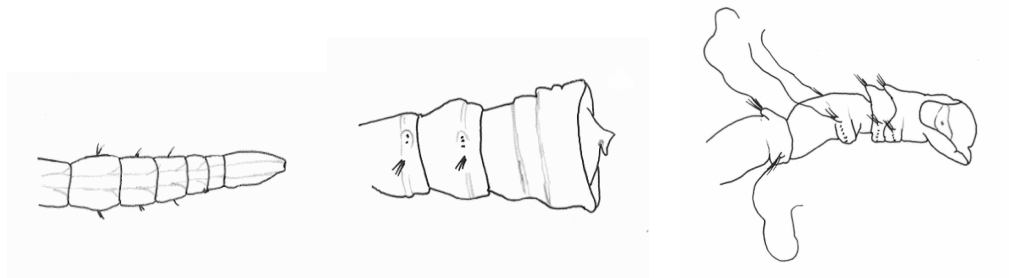
- No chaetae particularly longer than any others in the notopodia
 *Clymenura leiopygos*
Clymenura johnstoni
Clymenura tricirrata

According to Arwidsson (1922) *C. leiopygos* has some brown pigment on the head, in addition to ocelli, this pigment being absent from *C. johnstoni* and apparently also from *C. tricirrata*.

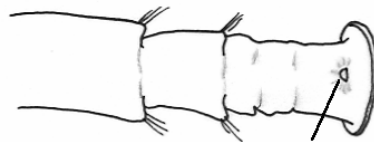
IDENTIFICATION OF POSTERIOR ENDS OF BRITISH MALDANIDAE

Taxa in which the **pygidium** is variously developed, but **without cirri**; anus terminal or dorsal.

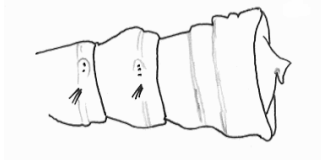
- 1 Anus **terminal**, pygidium simple, tube-like, or with a muscular ring, or produced as an asymmetrical funnel 2



- Anus **dorsal** to a pygidial plate 6



- 2 Pygidium with a muscular ring forming a pygidial plate and an anal cone with a well developed ventral valve *Clymenura leiopygos*



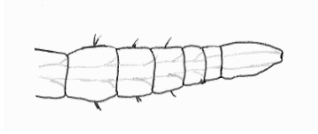
- Pygidium without a muscular ring and neither anal cone or ventral valve well developed 3

- 3 Pygidium in the form of an asymmetrical funnel, extending further ventrally than dorsally; all but the last 2-3 setigers with some long filamentous chaetae in the notopodia *Petaloproctus borealis*
Petaloproctus terricola
Petaloproctus tenuis

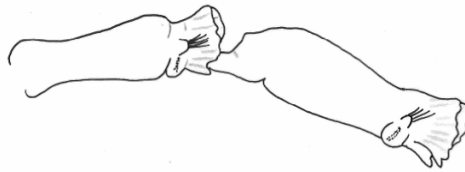
Petaloproctus tenuis has a serrate margin to the pygidial funnel, whereas it is smooth in the other 2 species.



- Pygidium simple, tube-like 4

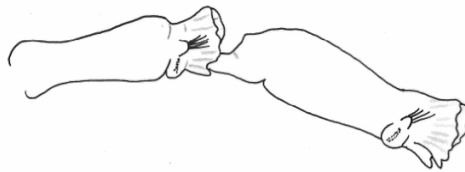


- 4 Posterior segments with posteriorly directed membranous skirts, overlapping the anterior portion of the next segment 5

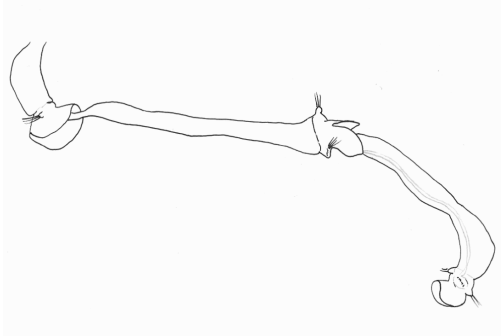


- No posteriorly directed skirts *Praxillura longissima*
Lumbriclymene cylindricauda
Lumbriclymene minor

- 5 Skirts with a frilled edge *Rhodine gracilior*



- Skirts with edge not frilled, but with a dorsal notch *Rhodine loveni*



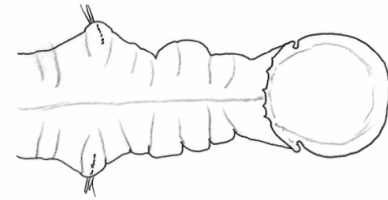
- 6 Pygidial plate with smooth rim, without notches or crenulations *Notoproctus* spp.



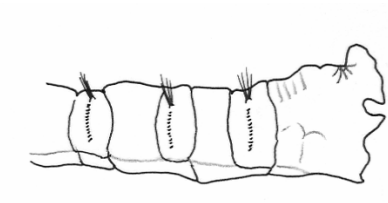
- Pygidial plate with a complex rim, including at least lateral notches

..... 7

- 7 Pygidial plate with lateral notches and with a smooth dorsal margin and ventral margin with serrations or crenulations *Maldane sarsi*
Maldane glebifex

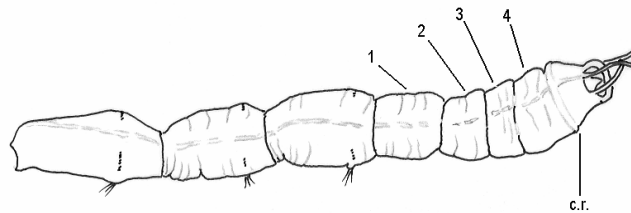


- Pygidial plate with lateral notches and with both dorsal and ventral margins serrated, crenulate or produced into irregular lobes *Chirimia biceps*



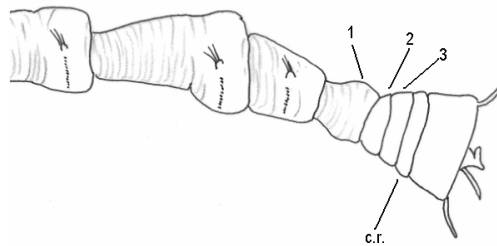
Taxa with **pygidium** variously developed, **with cirri** or at least regular well developed crenulations; anus terminal, with or without the development of an anal cone.

- 1 Fewer than 10 well spaced cirri present on the pygidium 2
- More than 10 cirri or crenulations present on the pygidium 4
- 2 1-7 cirri originating from a narrow muscular ring through which the anal cone projects; 4 pre-pygidial achaetous segments plus a callus ring *Clymenura johnstoni*

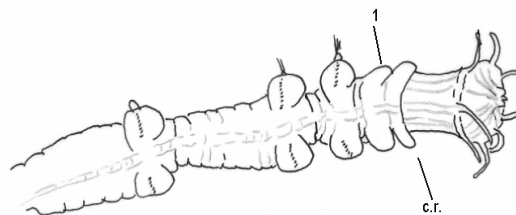


Pygidial cirri originating from a broad muscular ring forming a pygidial plate; fewer than 4 pre-pygidial achaetous segments plus a callus ring 3

- 3 1-3 cirri originating from a muscular ring on the pygidium; anal cone present, with a well developed ventral valve; 3 pre-pygidial achaetous segments, plus a callus ring *Clymenura tricirrata*

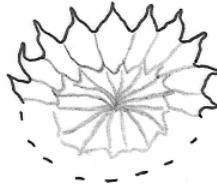


- 7-9 cirri originating from a muscular ring on the pygidium; anal cone not prominent and ventral valve not well developed; 1 pre-pygidial achaetous segment, plus a callus ring Euclymeninae sp. A

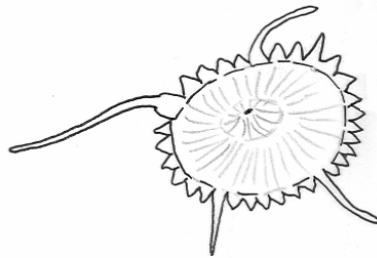


Clymenura borealis combines characters of these two taxa, having a pygidial plate with 9 cirri arising from its edge, and a projecting anal cone with ventral valve

- 4 Pygidium with all cirri or crenulations of essentially the same length ... 5



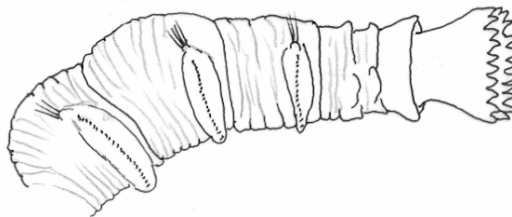
- Pygidium with cirri showing distinct variation in length10



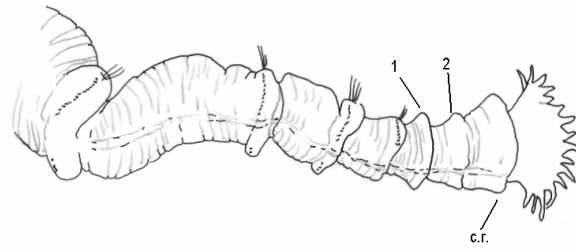
- 5 Pygidial ornamentation simply crenulations rather than cirri; neurochaetae avicular rostrate uncini; body length of only a few mm. *Micromaldane ornithochaeta*



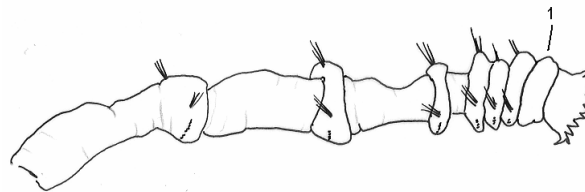
- Pygidium with distinct triangular cirri 6



- 6 Pygidium includes a distinct callus ring, followed by a constriction at the base of the pygidial funnel; 2 pre-pygidial achaetous segments 7



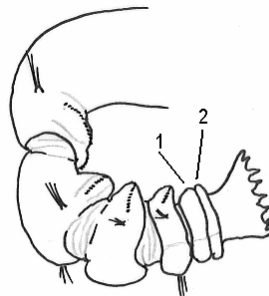
- Pygidium without a callus ring; pygidial funnel attached directly to the last achaetous segment; 1 or 2 pre-pygidial achaetous segments; all but the last 2-6 setigers with some long filamentous chaetae accompanying ordinary ones in the notopodia 8



- 7 Numerous small protruberances present on the inside of the pygidial funnel (these may be difficult to see) *Clymenella cincta*

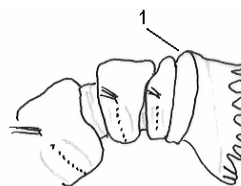
- No protruberances on the inside of the pygidial funnel; species known from south-east England and Strangford Lough *Clymenella torquata*

- 8 2 distinct achaetous segments anterior to the pygidium *Nicomache lumbricalis*
Isocirrus planiceps would key out here

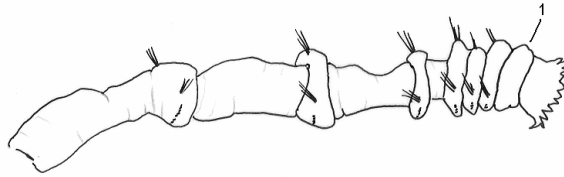


- Only 1 achaetous segment anterior to the pygidium 9

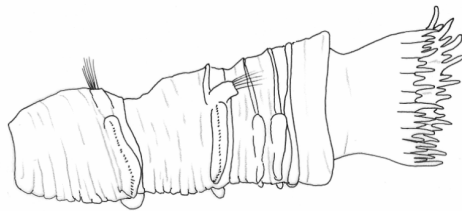
- 9 Margin of the pygidial funnel at an angle to the longitudinal axis of the animal, longer ventrally than dorsally; anus closer to ventral margin of pygidial funnel than dorsal *Nicomache trispinata*
Nicomache quadrispinata



- Pygidial funnel symmetrical, with margin more or less at right angles to the axis of the animal *Nicomache personata*
Nicomache minor

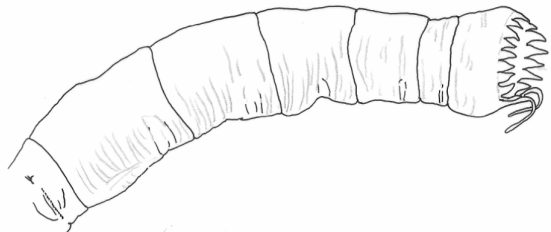


- 10 Mid-ventral cirrus not noticeably longer than the others; cirri showing a regular pattern of variation in length *Euclymene lombricoides*



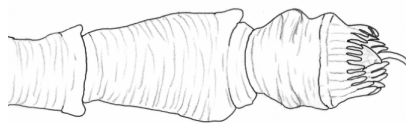
- 1 or 2 cirri on the ventral side of the pygidial funnel noticeably longer than the others; other cirri either all of a similar length, or showing a regular pattern of variation in length 11

- 11 2 ventral cirri, 1 either side of the ventral nerve chord, longer than all the other cirri, which are of similar length *Proclymene muelleri*

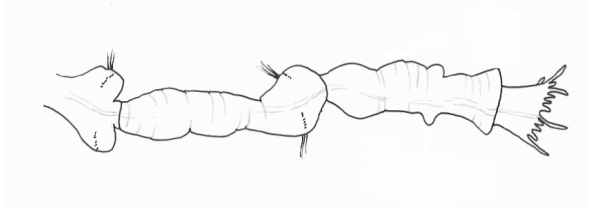


- Only 1 mid-ventral cirrus clearly longer than all the others, which may all be of similar length or show a regular pattern of variation in length 12

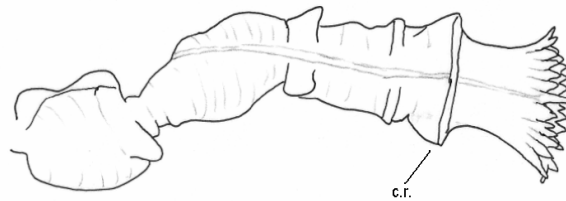
- 12 Apart from the long mid-ventral cirrus, all other pygidial cirri essentially similar in length 13



- As well as having a long mid-ventral cirrus, the other pygidial cirri show a pattern of variation in length 16



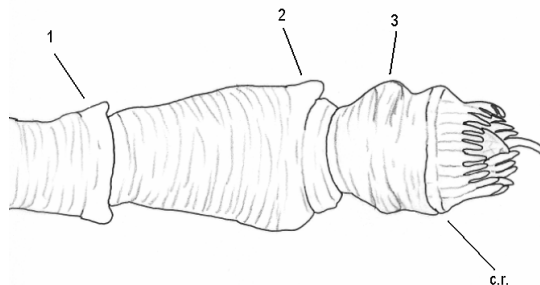
- 13 Pygidial funnel relatively long with a well developed callus ring; anal cone poorly developed, not projecting beyond the pygidial cirri *Euclymene droebachiensis*



Johnstonia clymenoides would key out here, except that it has no callus ring, and only 1 pre-pygidial achaetous segment.

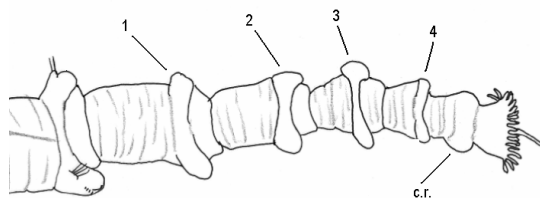
- Pygidial funnel relatively short, with a poorly developed callus ring; anal cone well developed, as long as or longer than the majority of pygidial cirri 14

- 14 3 pre-pygidial achaetous segments plus a callus ring; pygidial cirri finger-shaped with rounded tips *Praxillella affinis*

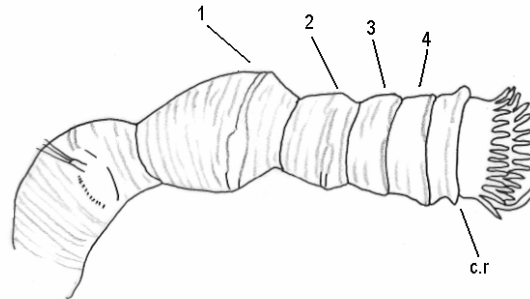


- 4 pre-pygidial achaetous segments plus a callus ring 15

- 15 Mid-ventral cirrus at least 4x length of other pygidial cirri, which are finger-shaped with rounded tips *Praxillella gracilis*

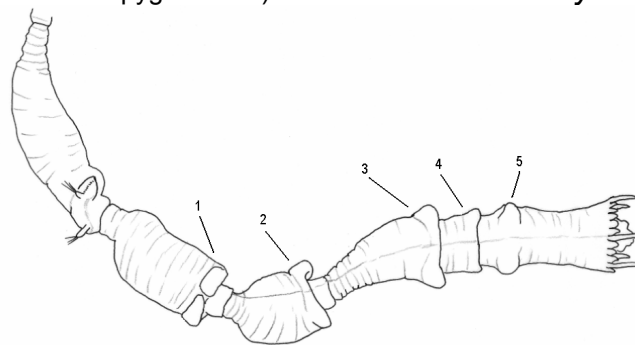


- Mid-ventral cirrus no more than 2x length of other pygidial cirri, which are flattened, with relatively wide bases and tapering to rounded tips *Praxillella praetermissa*



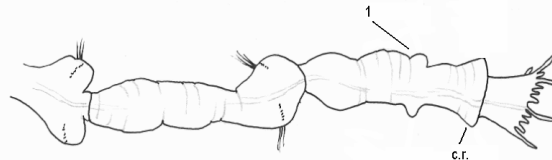
Pseudoclymene quadrilobata probably keys out here.

- 16 5 pre-pygidial achaetous segments; no callus ring (N.B. the 5th achaetous segment looks like a callus ring, but it has ventro-lateral notches on it; the anus is at the level of the bases of the pygidial cirri) *Heteroclymene robusta*

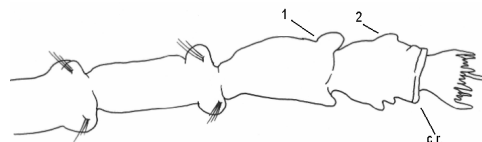


- A maximum of 4 pre-pygidial achaetous segments plus a distinct callus ring.. 17

- 17 1 pre-pygidial achaetous segment plus a callus ring .. *Euclymene* sp. A



- 2 pre-pygidial achaetous segments plus a callus ring
..... *Euclymene oerstedii*
Euclymene lindrothi



Euclymene lindrothi has 3 or 4 pre-pygidial achaetous segments, with a callus ring (?); needs re-examination

REFERENCES

- Arwidsson, I., 1907.** Studien über die skandinavischen und arktischen Maldaniden nebst Zusammenstellung der übrigen bisher bekannten Arten dieser Familie. *Zoologisches Jahrbuch Supplement 9*: 1-308.
- Dales, R.P., 1962.** The polychaete stomodeum and the inter-relationships of the families of the Polychaeta. *Proceedings of the Zoological Society of London 139*: 389-428.
- Day, J.H., 1967.** *A Monograph on the Polychaeta of Southern Africa. Part 2 Sedentaria*. British Museum of Natural History Publication 656. Trustees of the British Museum (National History): London: 459-878.
- Detinova, N.N., 1985.** Polychaetous annelids of Reykjanes Ridge (North Atlantic). [Bottom Fauna from Mid-Ocean Rises in the North Atlantic]. *Trudy Instituta Okeanologii 120*; 96-136.
- Fauchald, K., 1977.** The Polychaete worms. Definitions and keys to the orders, families and genera. *Natural History Museum of Los Angeles County, Science Series 28*; 1-188.
- Howson, C.M. and Picton, B.E., 1997.** *The species directory of the marine fauna and flora of the British Isles and surrounding seas*. Ulster Museum and The Marine Conservation Society, Belfast and Ross-on-Wye 508 pp.
- Imajima, M., and Shiraki, Y., 1982.** Maldanidae (Annelida:Polychata) from Japan (Part 1). *Bulletin of the National Science Museum 8*:7-46.
- Light, W.J.H., 1991.** Systematic revision of the genera of the polychaete subfamily Maldaninae Arwidsson. Pp. 133-146 in Petersen, M.E. and Kirkegaard, J.B. (eds.) *Systematics, Biology and Morphology of World Polychaeta*. Proceedings of the Second International Polychaete Conference, Copenhagen, August 18-23, 1986. *Ophelia supplement 5*.
- Nolte, W., 1912.** Zur Kenntnis der Maldaniden der Nord- und Ostsee. *Wissenschaftliche Meeresuntersuchungen Kiel 15*; 1-94.
- Orrhage, L., 1973.** Two fundamental requirements for phylogenetic-scientific works as a background for an analysis of Dales (1962) and Webb's (1969) theories. *Zeitschrift für Zoologische Systematik und Evolutionforschung 11*; 161-173.
- Wesenburg-Lund, E., 1948.** Maldanidae (Polychaeta) from West Greenland waters. *Meddelelser om Grønland 134*; 1-58.