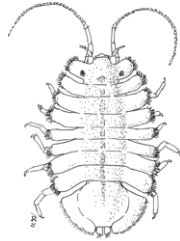


Identifying Invasive Freshwater Shrimps and Isopods

Revised edition



Michael Dobson
Freshwater Biological Association

May 2013

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Covers photographs: front - *Dikergammarus villosus* (left) (Jean-François Cart),
back - *Obesogammarus obesus* (M. Lowe), *Limnomysis benedeni* (right) (M. Lowe).



Identifying Invasive Freshwater Shrimps and Isopods

Including species that are not currently present in the UK but may accidentally be introduced in due course.

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1. Introduction

The appearance of *Dikerogammarus villosus* in England in September 2010 highlighted the potential threat faced by UK fresh waters from invasive shrimps. *Dikerogammarus villosus* is a member of the so-called Ponto-Caspian fauna, a group of species originating in the Black Sea and Caspian Sea regions that tolerate a wide range of environmental conditions and that are gradually expanding their ranges across central and western Europe.

The native freshwater shrimp and isopod fauna of the UK is relatively impoverished, and even now many species found in this country are introduced. The earliest recorded non-native species was *Crangonyx pseudogracilis*, discovered in the 1930s but believed to have been established long before its presence was confirmed. Over the years, other species have been added to the British fauna, normally through mechanisms of introduction that are unknown (although presumably accidental). There are now eight established species, compared with 10 natives (excluding subterranean species). The rapid spread of Ponto-Caspian species across mainland Europe has, however, accelerated the potential for new species to arrive in the UK: a further 14 species originating from the Ponto-Caspian region have been identified as potentially invasive into the UK.

This guide is designed to enable the identification of invasive non-native freshwater amphipods, mysids and isopods, including those species that are not currently recorded from the UK, in order to facilitate their detection should they manage to reach this country, and to draw attention to this possibility.

While this guide includes species whose invasive tendencies have been demonstrated elsewhere in Europe, it cannot anticipate every possible invader. Therefore, if you come across a specimen that does not fit any of the descriptions given here, it is recommended that specialist advice is sought on identification.

Geographical coverage

This guide covers shrimps and isopods found or expected in the UK. By extension, it will also work in the Isle of Man and the Republic of Ireland.

Species status

Each section includes a list of species, each of which is colour-coded according to its current (December 2012) status in the UK. Species in categories 1 and 2 are included in Gledhill et al. (1993) and are therefore not considered in detail here.

Definition and colour coding of categories

	1. Native
	2. Non-native, but long established in the UK
	3. Non-native, recently recorded in the UK
	4. Non-native; not yet recorded in the UK but highly invasive

Note on figures

Whole animals are depicted in lateral view unless otherwise stated, and with the head to the left.

Every attempt has been made to create figures and determine identification features using preserved specimens of the species involved. However, in the time available it was not possible to source specimens of four species - *Jaera istri*, *Paramysis lacustris*, *P. ullskyi* and *Obesogammarus crassus* - and their descriptions and figures are therefore based on published sources and photographs.

Corrections

If you find any errors or omissions, please contact the Freshwater Biological Association (info@fba.org.uk) and we will endeavour to make corrections to subsequent versions of this guide.

Reference: Gledhill T., Sutcliffe D.W. & Williams W.D. (1993) *British Freshwater Crustacea Malacostraca: a Key with Ecological Notes*. Ambleside, Freshwater Biological Association.

2. Identifying freshwater shrimps and isopods

Morphological features

This guide divides the species covered into four easily recognisable types: isopod (order Isopoda: families Asellidae and Janiridae); mysid (order Mysidacea: family Mysidae); corophiid (order Amphipoda: family Corophiidae) and gammarid (order Amphipoda: families Crangonyctidae, Gammaridae, and Talitridae).

The four groups can be distinguished by general appearance (see page 6), but further identification requires looking at specific morphological features (see **Figs 2.1 and 2.2**), of which the most important are described below.

Antennae. There are two pairs of antennae on the front of the head. Antenna 1 is dorsal and antenna 2 is ventral. Features of the antennae are diagnostic among corophiids and some gammarids.

Pereopods. These are the walking legs. Features of the most posterior these, the posterior pereopod (or pereopod 7) are important among some gammarids.

Urosome. This is the structure comprising the rear segments of the abdomen. Among gammarids, it normally supports spines, setae and/or projections, whose presence, type and arrangement are often diagnostic.

Telson. This is a plate at the rear of the urosome, partially covering the uropods. Its shape is diagnostic in many groups, especially mysids but also gammarids.

Uropods. These are the paired extensions at the end of the abdomen. Gammarids have three pairs: uropod 3 is the most dorsal of these, originating immediately below the telson, and is important in their identification. It consists of two pairs of extensions, of which the inner one is the endopod and the outer one is the exopod. Uropod 2 is important in the identification of corophiids.

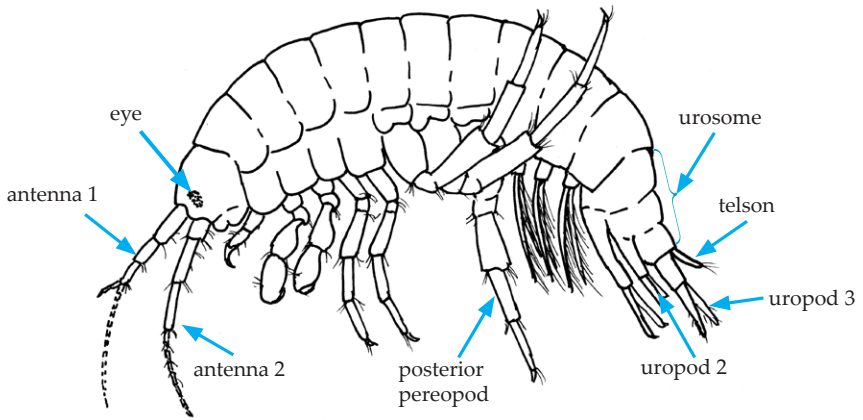


Fig. 2.1 Lateral view of a gammarid, showing location of features used in identification of shrimps.

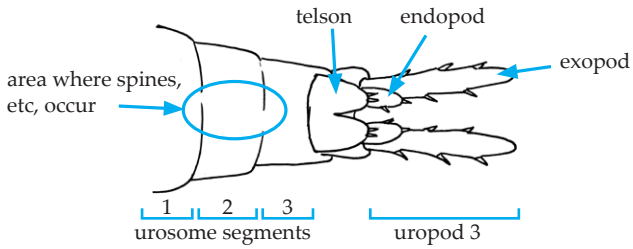
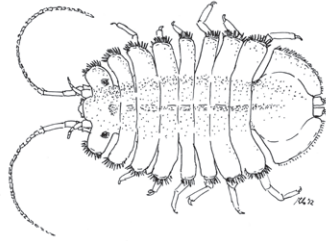


Fig. 2.2 Dorsal view of rear of abdomen of a gammarid.

The four types of shrimp and isopod

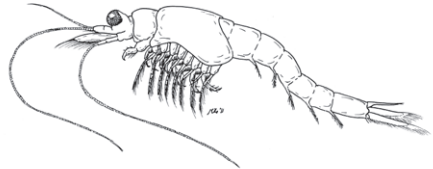
Isopod types

Head and body dorso-ventrally flattened, so dead specimens lie on their front or back. Antenna 1 very short; antenna 2 long. See page 8



Mysid types

Slender, with a carapace (single large plate) covering anterior segments. Distinct protruding eyes; very long slender antennae. See page 10



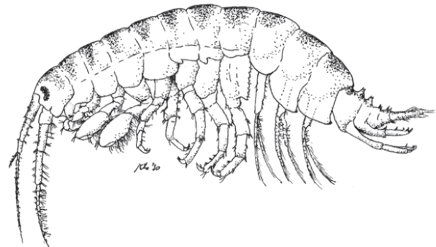
Corophiid types

Antenna 1 slender; antenna 2 very large and robust. Head and body not markedly flattened. See page 14



Gammarid types

Antenna 2 not large and robust. Head and body laterally flattened, so dead specimens normally lie on their sides. See page 18



3. Species not covered by this guide

This guide does not cover subterranean species or most of the marine species that may turn up in coastal fresh waters. For more information about these species, see Gledhill et al. (1993 - full reference on page 3).

If your specimen has **no eyes**, it will be a subterranean species. These are normally found in groundwater or underground rivers, but some, such as *Niphargus aquilex* (Fig. 3.1), occasionally occur in surface waters.

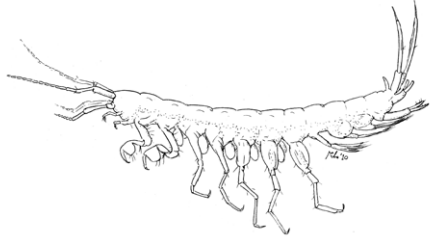


Fig. 3.1 *Niphargus aquilex*.

If you are in a **coastal region**, fresh waters in direct contact with the sea (e.g. upper estuarine parts of rivers; freshwater pools at the edge of salt marshes) may contain marine species that are tolerant of low salinity water. Examples are shown in Fig. 3.2.

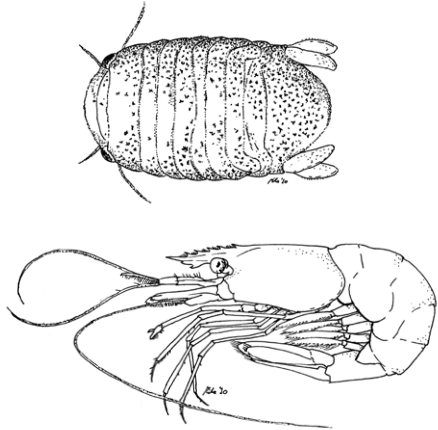


Fig. 3.2 Top: *Lekanephaera rugicauda* (dorsal view); Bottom: *Palaemonetes varians*.

4. Isopod types

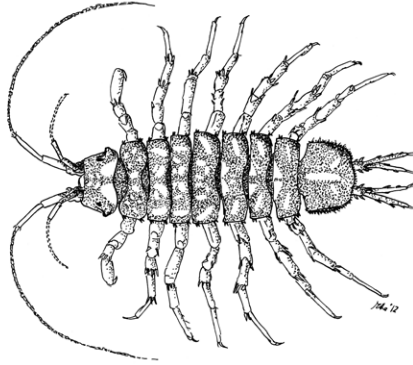


Fig. 4.1 *Asellus aquaticus* (dorsal view).

There are two native surface water species of the family Asellidae: *Asellus aquaticus* (Fig. 4.1) and *Proasellus meridianus* (plus one subterranean species – *Proasellus cavaticus*). An introduced member of this family, *Caecidotea communis*, has been recorded from a single site in England, and there is currently no evidence that it is spreading.

There is concern that *Jaera istri* (Janiridae) (Fig. 4.2) may reach the UK. It is easily distinguishable from members of the Asellidae by its oval shape, relatively short legs and by its uropods (Fig. 4.3).

- Asellidae - Last segment rounded or blunted pointed, with long, clearly forked uropods extending a considerable distance beyond the end of the abdomen.
- *Jaera istri* – last abdominal segment with a small indentation, within which very short uropods are found, barely extending beyond the end of the abdomen.

Jaera istri is very similar to the native *J. nordmanni*, which occurs in intertidal zones, particularly where streams flow across a beach to the sea. Inland from the immediate coastal area, any species of *Jaera* encountered is almost certainly going to be *J. istri*.

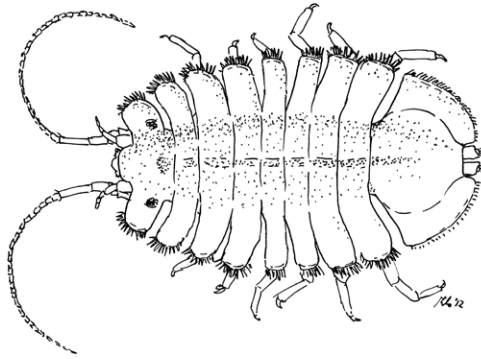


Fig. 4.2 *Jaera istri*, (dorsal view).

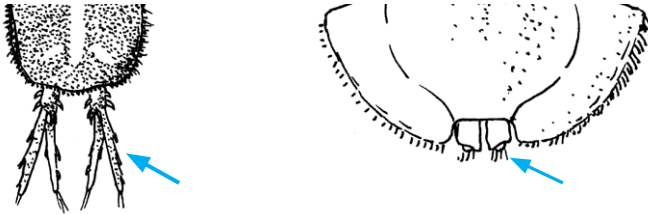


Fig. 4.3 End of abdomen of isopods, showing uropods (arrowed). Left: Asellidae; right: *Jaera istri*.

Summary of species and status

Asellidae

	<i>Asellus aquaticus</i> . Up to 15 mm long. Widespread and common.
	<i>Proasellus meridianus</i> . Up to 15 mm long. Widespread and common.
	<i>Caecidotea communis</i> . Up to 15 mm long. North American; first recorded in 1972. Known from a single location in the UK: Bolam Lake, Northumberland.

Janiridae

	<i>Jaera istri</i> . Up to 5 mm long. Ponto-Caspian.
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5. Mysid types

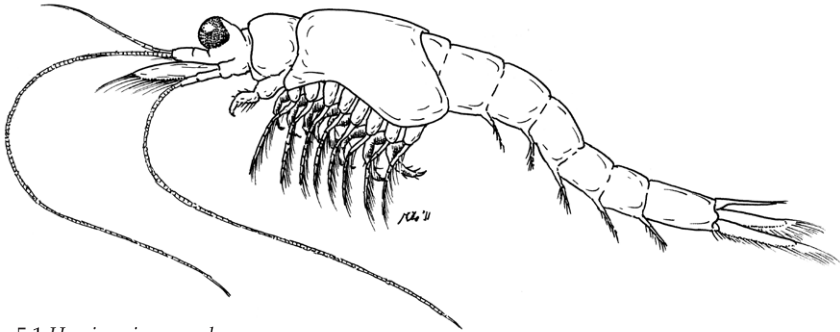


Fig. 5.1 *Hemimysis anomala*.

There are five invasive species: *Hemimysis anomala*, *Limnomysis benedeni* and three species of *Paramysis*. These can be distinguished from native species and from each other by looking at the shape of the telson (Fig. 5.4), which can be seen by examining the rear of the abdomen from the upper side (Fig. 5.3), and at the shape of the antennal scale (Fig. 5.2), a flattened structure on antenna 2. Note that if the telson is pale it can be difficult to see; examining it against a dark background may help in increasing visibility. All are in the family Mysidae.

Group 1. Antennal scale with setae on its outer edge and with a rounded or pointed distal end (Fig. 5.2 a,c,d), lacking a spine.

a) Telson with a V-shaped cleft (Fig 5.4a,b).

- *Mysis salemaai**. Telson with a V-shaped cleft lined with many small spines; edges of telson with c. 15 spines on each side (Fig 5.4a).
- *Limnomysis benedeni*. Telson with a V-shaped cleft lined with four spines; edges of telson with c. 8 spines on each side (Fig 5.4b).

b) Telson with a pointed or flattened end (Fig 5.4c,d).

- *Hemimysis anomala*. Telson truncate (Fig 5.4c).
- *Neomysis integer*. Telson tapers to a flattened point (Fig 5.4d).

Group 2. Antennal scale without setae on its outer edge and with a small spine towards the outer distal end (Fig. 5.2 b).

Paramysis species: *P. lacustris*, *P. intermedia* and *P. ullskyi*.

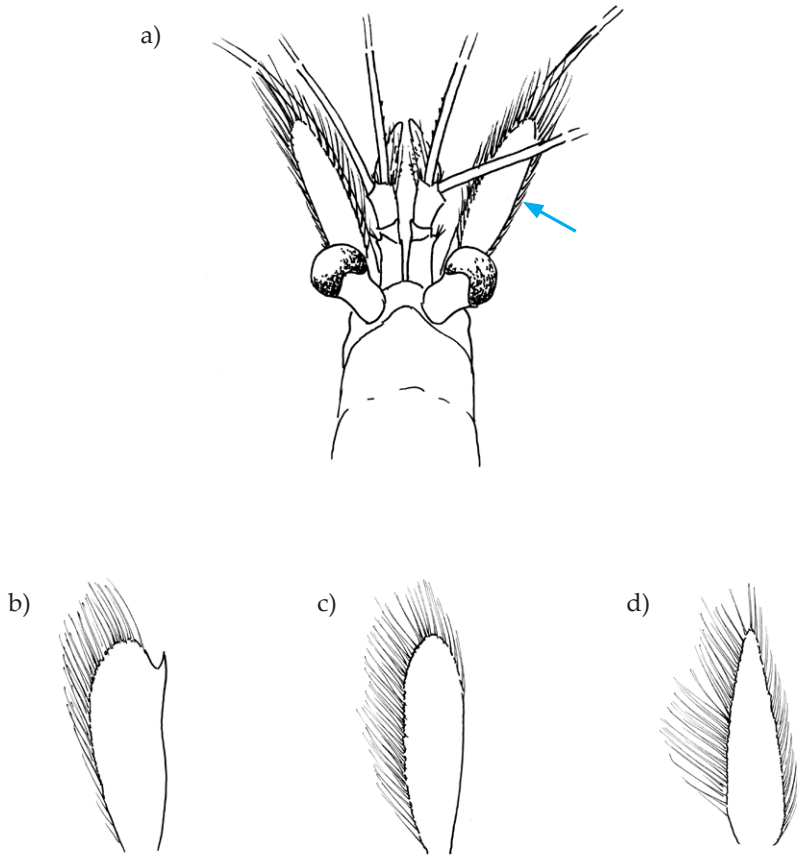


Fig. 5.2. (a) Anterior region of *Mysis salemaai* (dorsal view), showing location of antennal scale (arrowed). (b-d) antennal scale, with the outer edge to the right, of (b) *Paramysis* sp., (c) *Hemimysis anomala*; (d) *Limnomysis benedeni*.

* *Mysis salemaai* was previously known as *M. relict*a; the latter species is now considered to be restricted in distribution to Scandinavia and the Baltic Sea region.

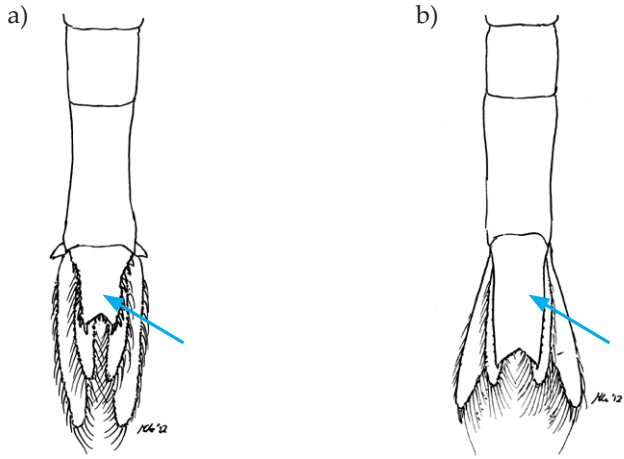


Fig. 5.3 Rear of abdomen (dorsal view), showing location of the telson (arrowed) of (a) *Limnomysis benedeni*; (b) *Mysis salemaai*.

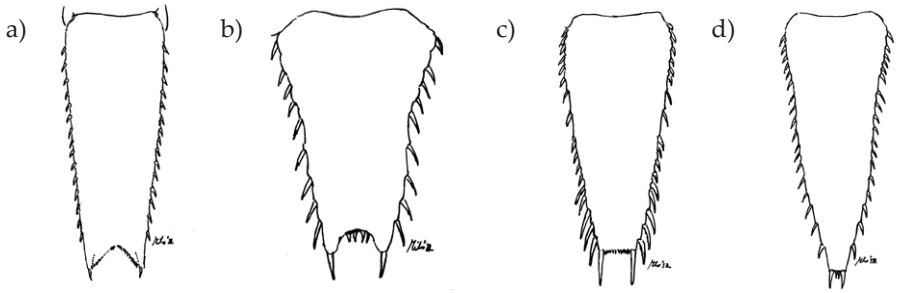


Fig. 5.4 Telson, dorsal view, of (a) *Mysis salemaai*; (b) *Limnomysis benedeni*; (c) *Hemimysis anomala*; (d) *Neomysis integer*.

Summary of species and status

Mysidae

	<i>Mysis salemaai</i> . Up to 18 mm long. In the UK confined to Ennerdale Water, Cumbria (where probably extinct) and several large loughs in Northern Ireland.
	<i>Neomysis integer</i> . Up to 17 mm long. A coastal brackish-water species that is able to survive long periods of isolation in fresh water.
	<i>Hemimysis anomala</i> . Up to 11 mm long. Ponto-Caspian; first recorded in Britain in 2004 and Ireland in 2008 and now rapidly expanding in the English Midlands.
	<i>Limnomysis benedeni</i> . Up to 12 mm long. Ponto-Caspian.
	<i>Paramysis intermedia</i> . Up to 12 mm long. Ponto-Caspian.
	<i>Paramysis lacustris</i> . Up to 12 mm long. Ponto-Caspian.
	<i>Paramysis ullskyi</i> . Up to 12 mm long. Ponto-Caspian.

6. Corophiid types

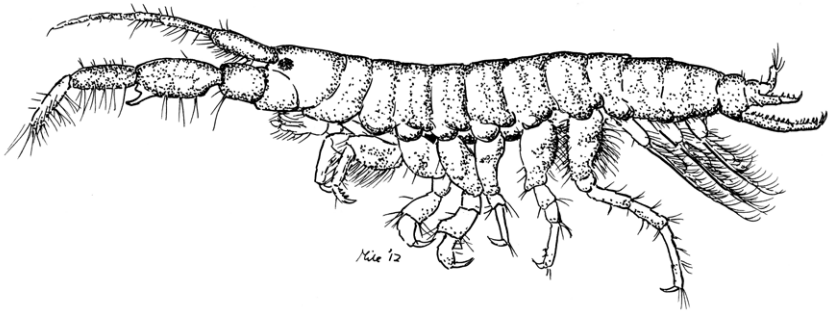


Fig. 6.1 *Chelicorophium curvispinum*.

There are several species native to the marine littoral, two of which can penetrate into fresh water in coastal rivers.

There are two invasive species of particular concern. These can be differentiated from native species by looking at antenna 2 (the large antenna). All species have a pointed projection in the lower corner of the third segment (Fig. 6.2a: arrow A), but the invasive species also possess one or more adjacent blunt projections, immediately above the larger spine-like projection (Fig. 6.2a: arrow B). These may be pale and obscured by setae, so look carefully; they are best seen by examining the inner side of the antenna.

Chelicorophium robustum has a large downward pointing spine on the lower corner of the fourth segment of antenna 2 (Fig. 6.2a: arrow C). This is absent or very small in *C. curvispinum*.

An alternative method for distinguishing these species is to look at the arrangement of spines on uropod 2, best viewed from the side (Fig. 6.3). The outer edge of uropod 2 of *C. curvispinum* has 3-4 spines, while *C. robustum* has 6-7 spines.

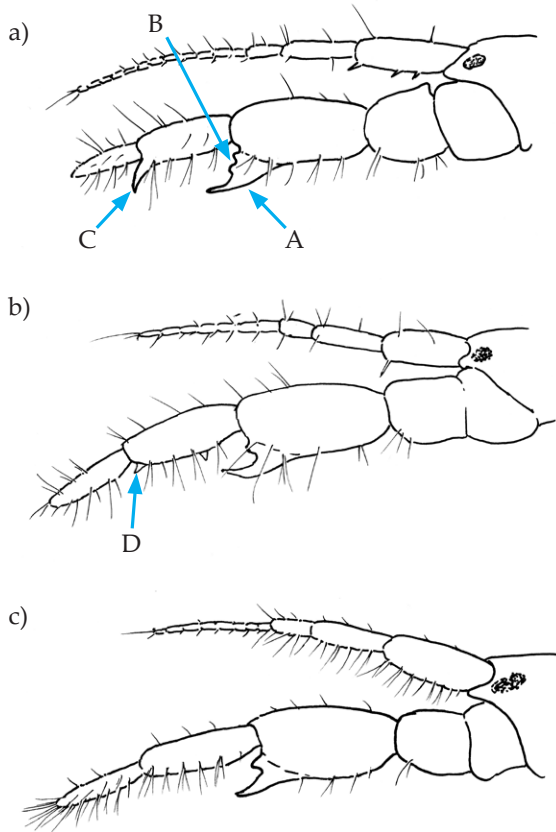


Fig. 6.2 *Chelicorophium* antennae (a) *C. robustum*; (b) *C. curvispinum* female; (c) *C. curvispinum* male. Arrow A: large projection at the end of segment 3; Arrow B: blunt projections on segment 3; Arrow C: large projection at the end of segment 4; Arrow D: small projection on segment 4.

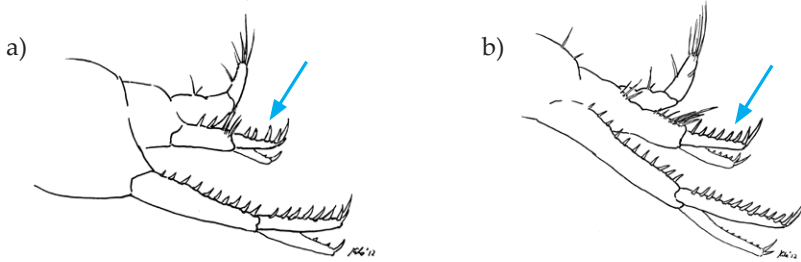


Fig. 6.3 *Chelicorophium* rear of the abdomen in lateral view, showing uropod 2 spines (arrowed). (a) *C. curvispinum*; (b) *C. robustum*.

A third species of possible concern, *Chelicorophium sowinskyi*, is very similar to *C. curvispinum*.

- Females* of *C. curvispinum* have a very small spine the lower corner of the fourth segment of antenna 2 (Fig. 6.2b: Arrow D), while *C. sowinskyi* has no spine. This spine may be almost transparent and facing strongly inwards, so look very carefully before concluding that it is absent.
- Males* of *C. curvispinum* and *C. sowinskyi* are distinguished by looking at Antenna 1 (the small antenna). The flagellum of *C. sowinskyi* is about the same length as the peduncle (Fig. 6.4a); while that of *C. curvispinum* is around $\frac{1}{2}$ (Fig. 6.4b) to $\frac{2}{3}$ (Fig. 6.1) the length of the peduncle.
- One feature that may be of help (although I have not tested it on many specimens so far) is the apparent number of segments in the flagellum of antenna 1. Males of *C. sowinskyi* have 8-11; males of *C. curvispinum* have 6-7, or occasionally 8.

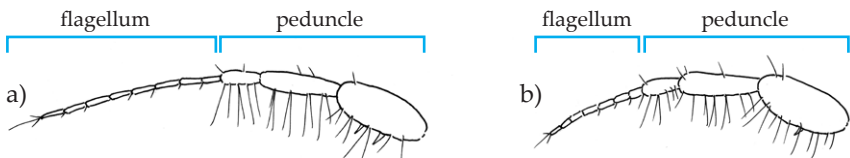


Fig. 6.4. Antenna 1 of male. (a) *Chelicorophium sowinskyi*; (b) *C. curvispinum*.

*Mature females are distinguished from males by possession of oostegites, flat plates fringed with long setae that are used to hold eggs; do not confuse these with gills, which are present in both sexes and which lack long filaments (Fig. 6.5). Mature females are often also carrying large round eggs on the underside of the thorax under the oostegites.

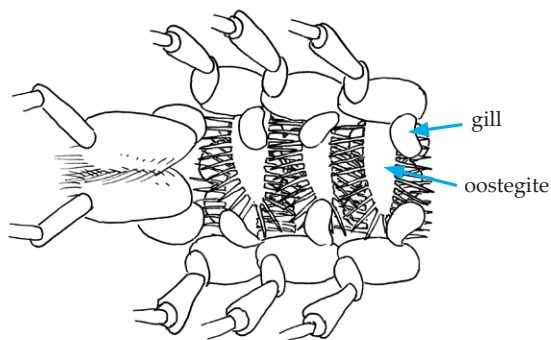


Fig. 6.5 Diagrammatic view of underside of thorax of female *Chelicorophium*, showing oostegites and gills situated between the pereopods.

Summary of species and status

Corophiidae

	<i>Corophium multisetosum</i> . Up to 9 mm long. Occasionally found in the lower reaches of rivers, near the coast.
	<i>Corophium lacustre</i> . Up to 6 mm long. Occasionally found in the lower reaches of rivers, near the coast.
	<i>Chelicorophium curvispinum</i> . Up to 8 mm long. Ponto-Caspian; first recorded in Britain in 1935 and now widespread in the English Midlands. First recorded in Ireland in 2000.
	<i>Chelicorophium robustum</i> . Up to 8 mm long. Ponto-Caspian.
	<i>Chelicorophium sowinskyi</i> . Up to 8 mm long. Ponto-Caspian.

7. Gammarid types

Note: having eliminated *Orchestia* and *Crangonyx*, which are straightforward to identify, look at the lengths of the uropods. If the endopod is very short, or apparently absent (hidden under the telson), then you have a non-native species. If the endopod is at least half the length of the exopod, then you have either a native *Gammarus* species or the non-native *G. tigrinus*.

a. Key to groups of gammarid types

- 1 Antenna 1 shorter than the first two segments of antenna 2 and considerably narrower (Fig. 7.3); telson oval in shape (Fig. 7.4)—
Talitridae: *Orchestia cavimana* (page 21)
- Antenna 1 and 2 similar in size, or the shorter antenna at least 1/2 as long as the longer one; telson clearly divided into two parts or with a central cleft (Fig 7.2)— **2**
- 2 Urosome 1 and 2 smooth, without spines or long setae (Fig. 7.1a); telson with a central V-shaped depression, but clearly a single structure (Fig. 7.2b)— **Crangonyctidae: *Crangonyx* (page 22)**
- Urosome 1 and 2 with spines and/or setae (Fig. 7.1b, c); telson centrally divided to its base, or nearly so, giving the impression of a paired structure (Fig. 7.2a, c, d)— **Gammaridae: 3**
- 3 Urosome with distinct conical projections on two segments (Fig. 7.1b)— ***Dikerogammarus** (page 24)**
- Urosome without conical projections (Fig. 7.1c)— **4**
- 4 Exopod short, approximately as long as the width of the urosome, and fringed with very long setae (Fig. 7.2a)— ***Obesogammarus obesus* (page 23)**
- Exopod considerably longer than the width of the urosome, and of any setae (Fig. 7.2c, d)— **5**

- 5 Endopod more than 40% length of exopod (Fig. 7.2c)—
Gammarus (page 22)
- Endopod no more than 30% length of exopod (Fig. 7.2d)— 6
- 6 Large segment at base of posterior pereopod distinctly widened on its rear side (Fig. 7.12)— 7
- Large segment at base of posterior pereopod not widened—
Echinogammarus (page 26)
- 7 Antennae short, 1/5 to 1/4 body length, and generally similar in length and appearance—
Pontogammarus and *Obesogammarus crassus* (page 26)
- Antennae long, at least 1/3 body length; antenna 1 (upper antenna) clearly longer and more slender than antenna 2 (lower antenna)—
*Dikerogammarus haemobaphes** (page 24)

* NB Some individuals of *Dikerogammarus haemobaphes* have poorly developed conical projections, so this species can key out in two separate places.

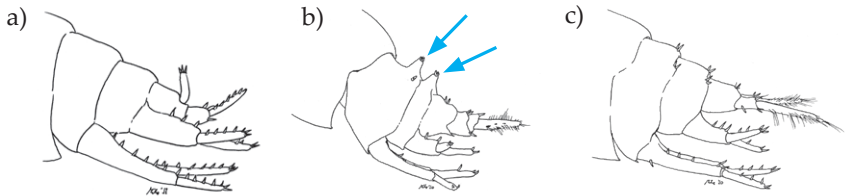


Fig 7.1 lateral view of posterior of abdomen of gammarid shrimps. (a) *Crangonyx pseudogracilis*; (b) *Dikerogammarus*, with arrows pointing to urosome projections; (c) *Gammarus* sp.

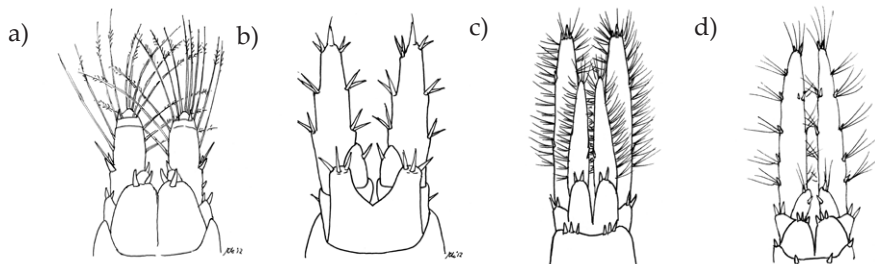


Fig 7.2 Dorsal view of rear of abdomen of (a) *Obesogammarus obesus*; (b) *Crangonyx pseudogracilis*; (c) *Gammarus* sp.; (d) *Echinogammarus* sp.

Summary of species and status

Family Talitridae

Orchestia cavimana. Up to 22 mm long. Semi-terrestrial, plus marine environments. Southern European; first recorded in 1942. Currently fairly localised in England.

Family Crangonyctidae

Crangonyx pseudogracilis. Up to 10 mm long. North American; first recorded in 1935. Now widely distributed throughout the UK and often the dominant shrimp.

Family Gammaridae

Gammarus pulex. Up to 25 mm long. Widespread and common.

Not native to Northern Ireland, where introduced in the 1970s.

Gammarus lacustris. Up to 25 mm long. Widespread and common in northern Britain.

Gammarus duebeni. Up to 25 mm long. Widespread and common in Ireland. Restricted to coastal areas in Britain.

Gammarus zaddachi. Up to 20 mm long. An estuarine species occasionally occurring in rivers close to their mouths.

Gammarus tigrinus. Up to 20 mm long. North American. First recorded in the 1930s; now widespread but local in Britain and Ireland.

Dikerogammarus villosus. Up to 30 mm long. Ponto-Caspian. First recorded in 2010; currently known from Grafham Water (Cambridgeshire), Cardiff Bay and Eglwys Nunydd Reservoir (South Wales) and Barton Broad (Norfolk).

	<i>Dikerogammarus haemobaphes</i> . Up to 18 mm long. Ponto-Caspian. First recorded in 2012, but widespread distribution across Midlands and Thames Valley suggests it had been present for some time previously.
	<i>Dikerogammarus bispinosus</i> . Up to 16 mm long. Ponto-Caspian.
	<i>Echinogammarus ischnus</i> . Up to 12 mm long. Ponto-Caspian.
	<i>Echinogammarus trichiatus</i> . Up to 16 mm long. Ponto-Caspian.
	<i>Echinogammarus warpachowskyi</i> . Up to 8 mm long. Ponto-Caspian.
	<i>Obesogammarus crassus</i> . Up to 12 mm long. Ponto-Caspian.
	<i>Obesogammarus obesus</i> . Up to 11 mm long. Ponto-Caspian.
	<i>Pontogammarus robustoides</i> . Up to 20 mm long. Ponto-Caspian.

b. *Orchestia* (family Talitridae)

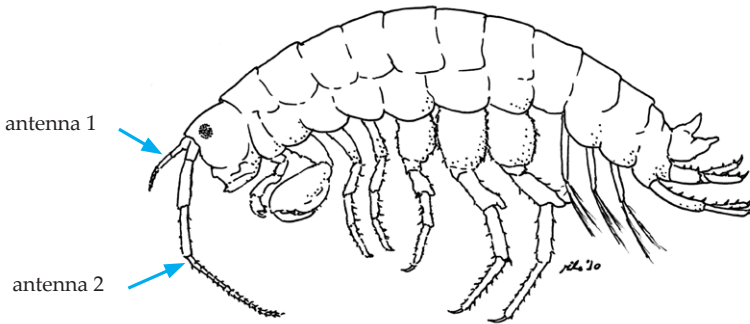


Fig. 7.3 *Orchestia cavimana*, showing different antenna lengths.

The length of antenna 1 relative to antenna 2 is diagnostic (Fig. 7.3). Its telson has a distinct but small cleft; its ramus is very short: the exopod no longer than the telson (Fig. 7.4). Its eye is circular. One species: *Orchestia cavimana*.

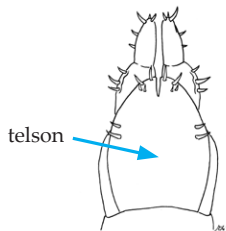


Fig. 7.4. Dorsal view of rear of abdomen of *Orchestia cavimana* with telson arrowed

c. *Crangonyx* (family Crangonyctidae)

The distinctive shape of the telson, with a deep V-shaped cleft, which does not extend close to the base, is diagnostic (**Fig. 7.2b**). Absence of spines or setae on the dorsal side of the urosome is useful (**Fig. 7.1a**), although these features may be difficult to see in small individuals of other genera. One species in surface waters: *Crangonyx pseudogracilis*.

d. *Gammarus* (family Gammaridae)

The length of the endopod relative to the exopod is diagnostic. There are four native species in fresh waters, one of which, *G. zaddachi*, is an estuarine species that is occasionally recorded in the lower freshwater reaches of rivers. One long-established introduced species, *Gammarus tigrinus*, is distinguishable from the other species when live or recently killed by the striped pattern on its body segments. Note that this pattern fades over time in preserved specimens.

Note on Irish *Gammarus*. There is only one freshwater species native to inland waters in Northern Ireland – *G. duebeni* – but two introduced species, *G. tigrinus* and *G. pulex*. There is also a single record of *G. lacustris*, presumably introduced, from the Republic of Ireland.

Gammarus pulex and *G. lacustris* have oval eyes, and the distance from the eye to the dorsum of the head is normally similar to or greater than the length of the eye (**Fig. 7.5a**). All other species have elongate eyes and the distance from the eye to the dorsum of the head is less than the length of the eye (**Fig. 7.5b**).

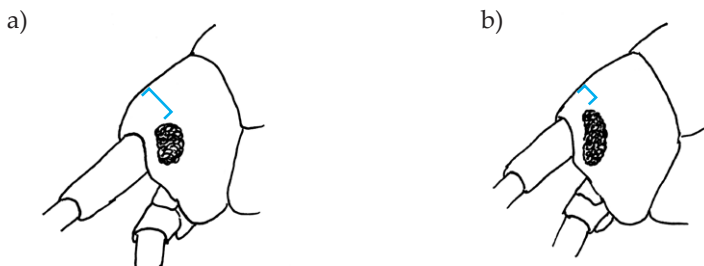


Fig 7.5. Heads of: (a) *Gammarus pulex*; (b) *G. duebeni*. Lateral view, showing the shape of the eye. Lines show space between eye and dorsum of the head.

d. *Obesogammarus obesus* (family Gammaridae)

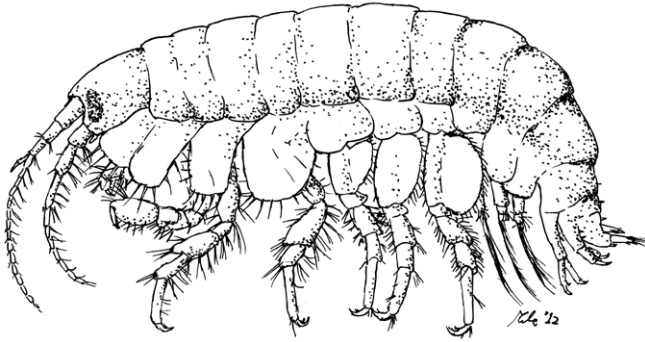


Fig. 7.6 *Obesogammarus obesus*.

The exopod is diagnostic for this species. It is short, only about as long as the width of the posterior segment of the abdomen, and fringed with setae that are often as long as the exopod itself (Fig. 7.7). Where long setae occur in other genera, they are clearly considerably shorter than the exopod. The exopod setae are branched, but these branches may be very difficult to see. The squat body shape in lateral view (Fig. 7.6) is distinctive.

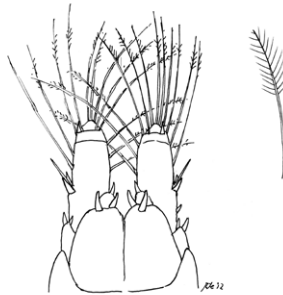


Fig. 7.7. *Obesogammarus obesus* – rear of abdomen, dorsal view, plus close up of single seta.

e. *Dikergammarus* (family Gammaridae)

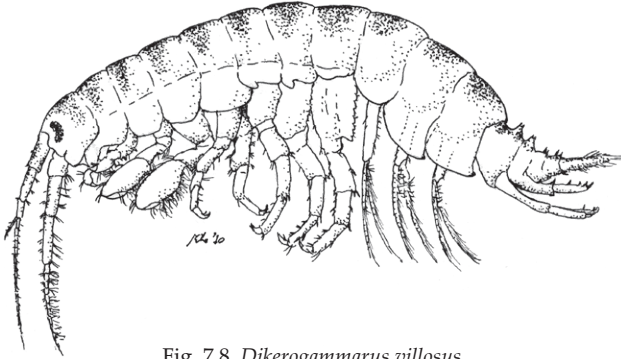


Fig. 7.8 *Dikergammarus villosus*.

The conical projections on the urosome are distinctive for this genus. However, the three species (*D. bispinosus*, *D. haemobaphes* and *D. villosus*) can be difficult to separate and in *D. haemobaphes* the projections can be flat or even appear entirely absent. The key features to look at are:

1. The shape of the conical urosome projections and number of spines they support (Fig. 7.9 left).

- *D. villosus* has conical projections normally at least as high as long; the anterior projection and normally posterior projection has at least 3 spines.
- *D. bispinosus* has conical projections normally at least as high as long; each projection with only 2 spines, and the anterior projection typically has a single long seta.
- *D. haemobaphes* has conical projections normally longer than high; each projection normally with only 2 spines (I have seen a few specimens with 3 spines), but the anterior projection also with a partial ring of long setae around the spines.

Note that the setae, and even occasionally spines, can be broken off and absent.

2. Long setae on antenna 2 (Fig. 7.9 right)

- *D. villosus* has dense tufts along the last third only
- *D. bispinosus* has dense tufts along the entire length
- *D. haemobaphes* has only sparse tufts of setae.

Important note. Several other species have urosome segments that are ‘humped’ in lateral view (e.g. **Fig. 7.10**), including the native *Gammarus duebeni*. Do not mistake this humped segment for the distinct conical projection of *Dikergammarus* (**Fig 7.8**).

When live or recently killed, the antenna and front part of *D. haemobaphes* is distinctly reddish in colour. However, this fades after only a few days in alcohol.

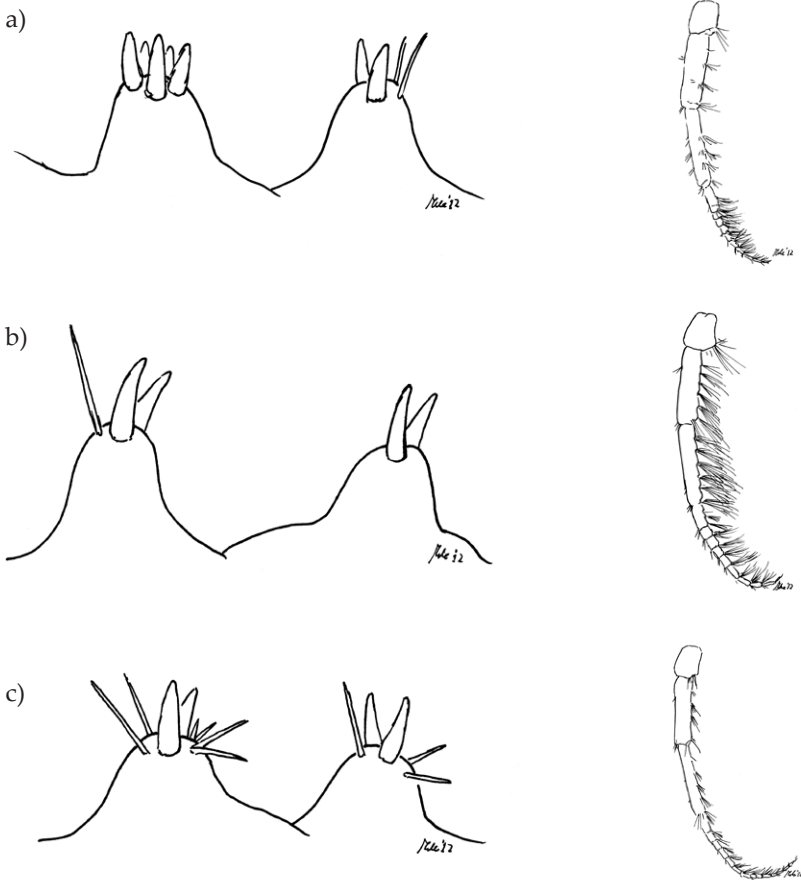


Fig.7.9 *Dikergammarus*: left – urosome projections; right - antenna 2. (a) *D. villosus*; (b) *D. bispinosus*; (c) *D. haemobaphes*.

f. *Echinogammarus*, *Pontogammarus* and *Obesogammarus crassus* (family Gammaridae)

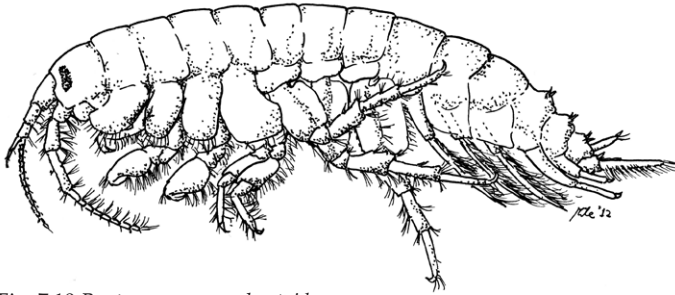


Fig. 7.10 *Pontogammarus robustoides*.

These species can be divided into two groups by examining the uropods and the spines on the urosome.

Group 1. *Echinogammarus trichiatus*, *Obesogammarus crassus* and *Pontogammarus robustoides*. These have dense tufts of setae on uropod 3 and distinct clusters of spines on urosome 1 and 2.

They can be separated as follows (**Fig. 7.11**).

- *E. trichiatus* (**Fig. 7.11a**). Urosome spines are in clusters of 2-3 spines on urosome 1 and 2 (Arrow A). The centre of urosome 3 has a pair of widely separated robust spines (Arrow B). The exopod of uropod 3 has 5 clusters of spines on its outer edge and normally spines visible on its inner edge; the uropod setae often curl at their ends.
- *P. robustoides* (**Fig. 7.11b**). Urosome spines are in a single central line on urosome 1 and 2 (Arrow C). The centre of urosome 3 has a pair of slender spines close together (Arrow D). The exopod of uropod 3 has 3 clusters of spines on its outer edge and no spines visible on its inner edge; the uropod setae are straight, often with multiple small side branches.
- *O. crassus*. Similar to *P. robustoides*, except that urosome 2 has only a single pair of spines, at the centre (Arrow E).

Obesogammarus and *Pontogammarus* share a distinctive feature in that the large segment towards the base of the posterior pereopod is expanded (Fig. 7.12; see also Fig. 7.6: *O.obesus*). The two species can be further separated by looking at the shape of this segment.

- *O. crassus*. Rounded rear corner of segment clearly protruding downwards; few setae along the edge.
- *P. robustoides*. Rounded rear corner of segment does not protrude downwards significantly; many setae along the edge.

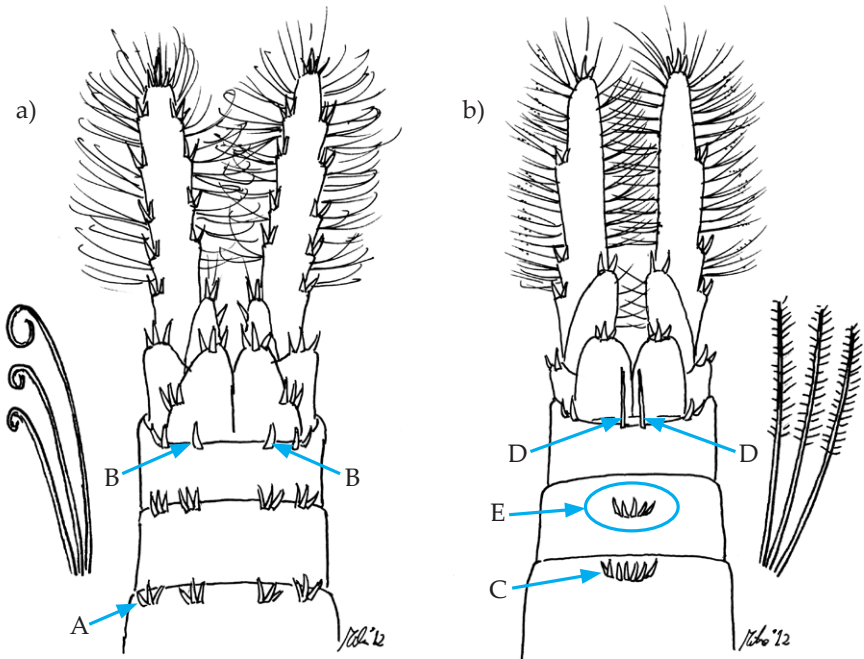


Fig. 7.11 - rear of abdomen, dorsal view, plus close up of individual setae: (a) *Echinogammarus trichiatus*; (b) *Pontogammarus robustoides*. Arrow A: cluster of 2-3 spines on urosome; Arrow B: robust spines on urosome 3; Arrow C: central cluster of spines on urosome; Arrow D: slender spines on urosome 3; Arrow E: location of cluster of spines that differs between *P. robustoides* and *O. crassus*.

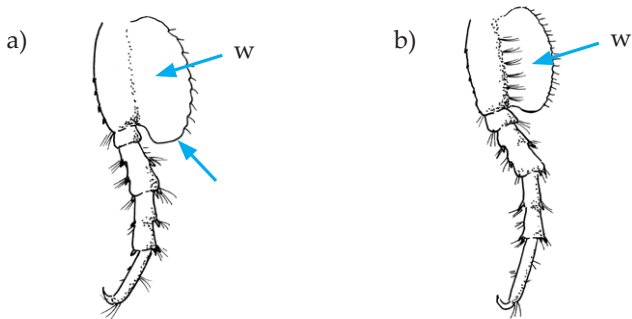


Fig. 7.12 Posterior pereopod showing widening on basal segment (w): (a) *Obesogammarus crassus*, showing downward protrusion (arrowed) ; (b). *Pontogammarus robustoides*.

Group 2. *Echinogammarus ischnus* and *E. warpachowskyi*. These both have few setae on uropod 3.

They can be separated as follows (**Fig. 7.13**).

- *E. warpachowskyi*. The exopod is relatively short, encircled by two rows of spines and tipped with a single long seta. The eye is normally no more than 1.5 times as long as wide.
- *E. ischnus*. The exopod is relatively long, encircled by up to five rows of setae and tipped with a short spine. The eye is normally twice as long as wide.

Note for coastal areas. There are several native species of *Echinogammarus* and the related *Chaetogammarus* in marine coastal waters. The western European *E. berilloni* occurs in fresh waters in the Channel Islands.

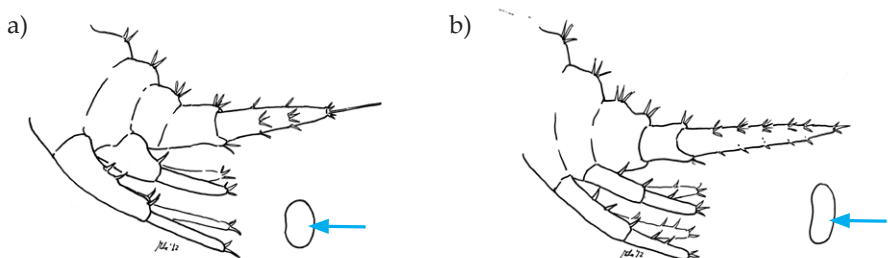


Fig. 7.13 *Echinogammarus* - rear of abdomen, lateral view, plus shape of eye (arrowed): (a) *E. warpachowskyi*; (b) *E. ischnus*.

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