DECAPOD CRUSTACEAN LARVAE OF SCOTTISH COASTS.

A PHOTOGRAPHIC IDENTIFICATION GUIDE (EXCLUDING INFRAORDER BRACHYURA)

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1. Introduction

Identification of decapod crustacean larvae can be a difficult task. These taxa present complex life cycles with the presence of several morphologically different phases. In addition, the different phases will each pass through several morphological stages, although these differ little from each other compared with the differences between phases. Complete larval descriptions are not available for some species (e.g. some species belonging to family Paguridae) or in other cases, the information available is not enough to provide an accurate identification of the specimen; such is the case for *Liocarcinus* species and other polybiinae larvae. Another source of difficulty is that some bibliographic references necessary to identify decapod larvae are dispersed and sometimes restricted to specific areas or species groups. In addition to this, some species have been ascribed in the past to other species or genera, making it more difficult to compile all the references available for the species of interest.

For western European waters, from 40°N to 80°N and from 20°W to 60°E, the main bibliographic references for identification of decapod larvae are part of the *Fiches d'Identification du Zooplancton* (Williamson 1957a, 1957b, 1960, 1962, 1967, 1983; Pike and Williamson 1972, 1958; Fincham and Williamson 1978 and dos Santos and Lindley, 2001), published by the Conseil International pour l'Exploration de la Mer (ICES). More recently, the works of dos Santos and González-Gordillo (2004), covering south-western Europe, provided updated illustrated keys for the identification of the suborder Pleocyemata. The works of Barnich (1996) and Martin (2000) on the larvae of decapod crustaceans of the French Mediterranean coast and the French coasts of the English Channel respectively, provided pictures to facilitate larval identification. Barnich included in her work pictures made by scanning electron microscope. Martin, along with dichotomous keys, gave descriptions of zoeal and megalopae stages and graphs of abundances, including photographs of every species described.

In the particular case of brachyuran species, it is necessary to mention the important contributions made by A.L. Rice, R.W. Ingle and J. Paula in the North East Atlantic region and Bourdillon-Casanova in the Mediterranean Sea, along with the more recent work by Pessani et al. (1998). D’Udekem d’Acoz (1999) published an inventory of decapod crustaceans present in Europe, North Africa, Near East and Middle East (from 25°N to 90°N and from 60°E to 35°W) including a detailed synthesis of the information regarding their distribution, habitat and bathymetry, which was otherwise dispersed in multiple publications.
From this publication the data about the adult distributions is provided in the following sections.

In summary, identification of decapod larvae requires a combination of dichotomous keys, larval descriptions and figures and the use of photographs can be extremely helpful. In many cases, figures represent a type specimen obtained by rearing and where the important morphological features are always present and easy to recognise. However, specimens from plankton samples can lack some important characters or these may not be as easy to recognise as in a figure (e.g. the presence or absence of a 2nd hair-like setae in the telson, which indicates the infraorder to which a specimen belongs). For expert taxonomists pictures can be redundant and do not provide the important information that it is present in a figure. But for those who do not have previous experience on decapod larvae, photographs allow workers to become familiar with a real representation of the specimen and the features needed for their identification. Ideally, a combination of figures, pictures, keys and descriptions allow an accurate identification, which cannot rely on a single published work. Photographs of decapod larvae in plankton manuals (e.g. Todd and Laverack, 1991; Larink and Wetheide, 2006) tend to be general pictures of a few specimens to show how to distinguish decapod larvae from any other planktonic organism. Nevertheless, the book from Martin (2000), focused on decapod larvae, contains pictures from fresh larvae that conserve their coloration. This is a very important aspect for the identification of some larvae such as paguridae, where the presence, number, color and/or distribution of chromatophores are main identification characters, which are lost in specimens that have been preserved for a long time. In this study the pictures are not from fresh but preserved larvae and the coloration is lost, but the main important identification characters for each species have been captured. Plankton samples in many occasions have to wait until they can be analysed.

The basic bibliographic references while identifying decapod larvae have been the ICES (Williamson 1957a, 1957b, 1960, 1962, 1967, 1983, Pike and Williamson 1972, 1958 and Fincham and Williamson 1978) and dos Santos and González-Gordillo (2004) keys and figures. Those references have been complemented by larval descriptions and many other published sources. In this respect, the work of González-Gordillo et al. (2001) has been extremely useful for pointing out the main references on larval descriptions and synonyms for most of the species covered by this study. In some cases identification to species level was not possible since only the larvae of a few species of some genera are known (e.g. Hippolyte). In
other cases (e.g. *Galathea, Upogebia*), although the full larval description for the species present in the area is available, the accuracy of their identification was uncertain and they were grouped at genus level. For the species not collected during this study and for hence not treated here, the dichotomous keys from dos Santos and González-Gordillo (2004) and also from Williamson (1957a, 1957b, 1960, 1962, 1967, 1983), Pike and Williamson (1972, 1958), Fincham and Williamson (1978) will allow their identification.

The lack of the infraorder brachyura in this manual is an important concern. The ecological and economic importance of the infraorder brachyura warrants its inclusion in a manual of this kind. Brachyurans were, among decapods, the most abundant infraorder found in the plankton samples analysed and identification to species would require more time than was available. For that reason they were not identified beyond infraorder level. In the future, the work presented here should be complemented with this information and with other decapod species that may be found to occur in the study area. Ideally, more sampling points could be included in order to get a better representation of the decapod species present in coastal Scottish waters. In addition, the inclusion of megalopae stages, and even juveniles, to provide a wider view of their life cycles and their morphological differences would be of benefit. Megalopa and juvenile stages require different keys than those from zoeal and adult stages respectively and their identification can be complicated.

The main aim of this manual is to provide a photographic identification guide for the species most frequently found in Scottish coastal waters, with the exception of infraorder Brachyura. It represents a valuable resource for workers in the future and provides an overview of the decapod species present in the meroplankton and their seasonal abundance in this area.
2. Methodology and approach

This manual is designed in a similar way to Martin (2000). It is intended to be a practical document, based on illustrations of the most important identification features, which could help to identify the most common species found in Scottish coastal waters. Nevertheless, the identification of decapod larvae is too complex to rely solely on photographic images, therefore it is advise the use of the dichotomous keys and drawings from dos Santos and González-Gordillo (2004) and also from Williamson (1957a, 1957b, 1960, 1962, 1967, 1983), Pike and Williamson (1972, 1958), Fincham and Williamson (1978). González-Gordillo et al. (2001) provided a list with all the references available regarding all the descriptions of decapod larvae from the Southwestern European coast. In that list are included the species that were found during this study, except *Caridion gordoni*, *Caridion steveni* and *Crangon allmanni*, and most of those that occur in the British Isles.

The guide includes the systematic classification of all decapod species that occur in the waters of the British Isles (from *The Species Directory of the Marine Fauna and Flora of the British Isles and Surrounding Seas*), and those species that have appeared in our plankton samples analysed are marked in bold. After that, there are several subsections corresponding with every infraorder found in the samples. Inside every subsection a description of each species identified, pictures, adult distribution (from d’Udekem d’Acoz, 1999), larval distribution, important bibliographic references for each species and, when available, the seasonality and abundances in sampling locations are provided. The larval distribution refers only to the observations made by Lindley (1987) in the north-eastern Atlantic and the North Sea; Rees (1952) in the North Sea; Thorson (1946) in the Danish Sound (strait that separates Denmark and Sweden); Williamson (1956) in the Irish Sea; Martin (2001) in the English Channel; Lebour in Plymouth (from Plymouth Marine Fauna, 1957); Barnich (1996) in the French Mediterranean coast; Bourdillon-Casanova (1960) in the Marseille Gulf; Fusté (1987) in the Spanish Mediterranean coast; dos Santos (1999) along the Portuguese coast; and Paula (1987b) in south-western Portugal (S. Torpes bay). Some of the morphological characters refer to pictures presented at the end of the manual.

Decapod larvae, excluding the infraorder Brachyura which was aggregated, were identified from 147 plankton samples, collected off two locations in the Scottish coast, from January 2002 until June 2006 in the case of the East Coast (Stonehaven, 56° 57.8’ N, 02° 06.2’ W) and from April 2002 until April 2004 in the sampling point located in the West coast (Loch Ewe,
57°50.14'N, 05°36.61'W) (figure 1). Usually, two samples per month were analysed. Plankton samples were obtained by a 40 cm diameter Bongo net of 200 µm mesh size, towed vertically from near sea bed (45m and 35m for Stonehaven and Loch Ewe respectively). Samples were immediately preserved in borax buffered 4% formaldehyde.

Plankton samples were examined and decapod larvae identified under a Zeiss Stemi SV11 stereo-microscope, with a magnification range of 12.8x up to 80x. Pictures were taken under a Nikon SMZ1000 stereo-microscope with a magnification range of 4x up to 160x, using a mounted Lumenera INFINITY 2 camera and the Infinity capture imaging software (Lumenera corporation).

Figure 1. Location of the sampling points are indicated by black dots.
3. The identification guide

3.1. Species present in the study area

The systematic classification shown below includes the decapod crustacean species present in the British Isles, in the area defined by the 200 m isobath and the latitudes 48°N to 62.5°N and longitudes 13°W to 6°E (from *The Species Directory of the Marine Fauna and Flora of the British Isles and Surrounding Seas*. Howson and B. Picton (eds.). Ulster Museum & the Marine Conservation Society, 1997). The taxa found in the samples analysed, which will be treated in more detail in the following subsections, appear in bold. The page number where each taxa is treated appears next to it.

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Genus Systellaspis
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Family Atyidae
Genus Atyaephyra
Atyaephyra desmaresti

Superfamily Pasiphaeoidea
Family Pasiphaeidae
Genus Pasiphaea
Pasiphaea multidentata
Pasiphaea sivado
Pasiphaea tarda

Superfamily Palaemonoidea
Family Palaemonidae
Subfamily Palaemoninae
Genus *Leander*
  *Leander tenuicornis*
Genus *Palaemon*
  *Palaemon adspersus*
  *Palaemon elegans*
  *Palaemon longirostris*
  *Palaemon serratus*
Genus *Palaemonetes*
  *Palaemonetes varians*
Subfamily Pontoniinae
Genus *Periclimenes*
  *Periclimenes sagittifer*
Genus *Typton*
  *Typton spongicola*
Superfamily *Alpheoidea*
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Genus *Caridion*
  *Caridion gordoni*
  *Caridion steveni*
Genus *Cryptocheles*
  *Cryptocheles pygmaea*
Genus *Hippolyte*
  *Hippolyte hunti*
  *Hippolyte inermis*
  *Hippolyte longirostris*
  *Hippolyte varians*
Genus *Eualus*
  *Eualus gaimardii*
  *Eualus occultus*
  *Eualus pusiulus*
Genus *Lebbeus*
  *Lebbeus polaris*
Genus *Lysmata*
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Infraorder **Palinura**
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*Polycheles granulatus*
Superfamily **Palinuroidea**
Family **Palinuridae**
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*Palinurus elephas*
*Palinurus mauritanicus*
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*Jaxea nocturna*

**Family Upogebiidae**  
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*Upogebia pusilla  
*Upogebia stellata*

Infraorder **Brachyura**  
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Superfamily Dromioidea  
Family Dromiidae  
Genus *Dromia*  
*Dromia personata*

Section Archaeobrachyura  
Superfamily Tymoloidea  
Family Cymonomidae  
Genus *Cymonomus*  
*Cymonomus granulatus*

Superfamily Homoloidea  
Family Homolidae  
Genus *Paromola*  
*Paromola cuvieri*

Section Oxystomata  
Superfamily Leucosioidea  
Family Leucosiidae  
Subfamily Ebaliinae  
Genus *Ebalia*  
*Ebalia cranchii  
Ebalia granulosa  
Ebalia nux  
Ebalia tuberosa  
Ebalia tumefacta*

Section Oxyrhyncha  
Superfamily Majoida  
Family Majidae  
Subfamily Majinae  
Genus *Maja*  
*Maja brachydactyla*

Subfamily Oregoniinae  
Genus *Hyas*  
*Hyas araneus  
Hyas coarctatus*

Subfamily Inachinae  
Genus *Achaeus*  
*Achaeus cranchii*

Genus *Dorhynchus*  
*Dorhynchus thomsoni*

Genus *Inachus*  
*Inachus dorsettensis  
Inachus leptochirus  
Inachus phalangium*

Genus *Macropodia*  
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Macropodia linaresi*
Macropodia rostrata
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Genus Eurynome
Eurynome aspera
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Genus Pisa
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Genus Rochinia
Rochinia carpenteri

Superfamily Parthenopoidea
Family Parthenopidae
Subfamily Parthenopinae
Genus Parthenope
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Section Cancridea
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Family Thiidae
Genus Thia
Thia scutellata
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Section Brachyrhyncha
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Liocarcinus corrugatus
Liocarcinus depurator
Liocarcinus holsatus
Liocarcinus marmoratus
Liocarcinus pusillus
Liocarcinus zariquieyi
Genus Macropipus
Macropipus tuberculatus
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   *Polybius henslowii*
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   Genus *Portumnus*
      *Portumnus latipes*
Genus *Xaiva*
   *Xaiva biguttata*
Family Geryonidae
   Genus *Geryon*
      *Geryon trispinosus*
Superfamily Xanthoidea
   Family Goneplacidae
      Subfamily Goneplacinae
         Genus *Goneplax*
            *Goneplax rhomboides*
   Family Xanthidae
      Genus *Monodaeus*
         *Monodaeus couchi*
      Genus *Neopanope*
         *Neopanope sayi*
      Genus *Pilumnoides*
         *Pilumnoides inglei*
      Genus *Pilumnus*
         *Pilumnus hirtellus*
      Genus *Rhithropanopeus*
         *Rhithropanopeus harrisii*
      Genus *Xanthonidae*
         *Xanthon incisus*
         *Xanthon pilipes*
Superfamily Grapsidoidea
   Family Grapsidae
      Subfamily Grapsinae
         Genus *Pachygrapsus*
            *Pachygrapsus marmoratus*
         Genus *Planes*
            *Planes minutus*
      Subfamily Varuninae
         Genus *Brachynotus*
            *Brachynotus sexdentatus*
         Genus *Eriocheir*
            *Eriocheir sinensis*
Superfamily Pinnotheroidea
   Family Pinnotheridae
      Subfamily Pinnotherinae
         Genus *Pinnotheres*
            *Pinnotheres pinnotheres* (now, *Nepinnotheres pinnotheres*)
            *Pinnotheres pisum*
      Subfamily Asthenognathinae
         Genus *Asthenognathus*
            *Asthenognathus atlanticus*
3.2. Important identification characters

Figure 2. Important identification characters. Modified from Barnich (1996) and Martin (2000).
Identification of larval stages:

- Setose exopods on some or all of thoracic appendages.

  Pleopods absent or rudimentary .................................................. Zoea

Some examples of zoeal stages:

- Setose exopods on some or all of thoracic appendages. Pleopods absent or rudimentary .................................................. Zoea

Some examples of megalopae stages (pleopods setose and functional):

- Pleopods setose and functional .................................................. Megalopa

Some examples of megalopae stages (pleopods setose and functional):

- Pleopods setose and functional .................................................. Megalopa
3.3. *Infraorder Anomura* MacLeay, 1838

General remarks:
- Carapace laterally flattened (in opposition to Infraorders Brachyura (photo 2) and Palinura).
- Telson flattened (photo 3).
- Antennal exopod unsegmented or segmented near distal end only.
- Second telson spine represented by a fine-setae (in opposition to Infraorders Caridea (photo 5), Astacidea and Stenopodidea)
- Spine formula of telson: 6-7+6-7 (without the fine setae).
- Each posterio-lateral margin of carapace extended into a spinous process (photo 6) (except *Clibanarius erythropus*, *Diogenes pugilator* and *Parapagurus pilosimanus*).

- **Family Paguridae** Latreille, 1803

General remarks:
- Posterio-lateral margins of carapace without denticles (photos 6 and 7)
- 4 zoal stages

According to Pike and Williamson (1958) in the identification of this family the chromatophores are very important, but in samples that have been preserved in formaldehyde for a long time, this character is lost. Larval development is not well described for all *Pagurus* and *Anapagurus* species that occur in the area of study. To avoid erroneous identification, except for *P. pubescens* and *P. berhnardus*, identification to genus level is recommended.

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<td>III</td>
<td>Moveable</td>
<td>7+7</td>
<td>Articulated</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>IV</td>
<td>Moveable</td>
<td>7+7</td>
<td>Articulated</td>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>
Genus *Anapagurus* Henderson, 1887

General remarks:
- Antennal scale broad and curved.
- Lateral spines on abdomen 5 small or absent and without medio-dorsal spines (photo 8).
- Stage IV with 2 or 3 pairs pleopods (photos 9, 10).

Species present in the coasts of British Isles and North Sea:

*Anapagurus chiroacanthus* (Lilljeborg, 1856); *Anapagurus hyndmanni* (Bell, 1845); *Anapagurus laevis* (Bell, 1845)

Occurrence and abundance of *Anapagurus* spp. in the samples analysed:

![Graphs showing the occurrence and abundance of Anapagurus spp.](image-url)
**Anapagurus hyndmanni** (Bell, 1845)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Atlantic oriental: Shetland; Northeast, West and South of Britain; all Irish coasts; Southwest North Sea; English Channel; Portugal; Spain
  Mediterranean: Alboran Sea

- **Larval distribution**: English Channel, northwest North Sea, west Scotland (Lindley, 1987); English Channel (Martin, 2001); North Sea (Rees, 1952), uncertain identification; southwestern Portugal (Paula, 1987).

- **Reference**: MacDonald JD, Pike RB and Williamson DI, 1957

- Abdomen 5 with lateral spines very small or absent; no medio-dorsal spines
- 3rd telson spine (not considering the fine setae) the longest
- Zoea I: posterior margin of telson distinctly convex
- Zoea II-IV: posterior margin of telson slightly convex
- Zoea IV with 2 pairs pleopods
- Zoea length: 2.4-3.9 mm (Macdonald, Pike & Williamson, 1957)

Notes: In Zoea I *A. hyndmanni* is morphologically indistinguishable from *A. chiroacanthus*. In general, it is difficult to distinguish this species from *A. laevis* (except in Zoea IV when *A. hyndmanni* has 2 pleopods and *A. laevis* 3).
Anapagurus laevis (Bell, 1846)

- Adult distribution (d’Udekem d’Acoz, 1999):
  Atlantic: Faeroe Islands; Southwest Norway; Sweden; Denmark; Shetland Islands; East and West of Scotland; English Channel; Portugal; Southwest of Spain; Atlantic North Morocco; Mauritania
  Mediterranean: Alboran Sea; Aegean Sea

- Larval distribution: North Sea and north-eastern Atlantic (Lindley, 1987); North Sea (Rees, 1952), uncertain identification; English Channel (Martin, 2001); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); south-western Portugal (Paula, 1987).

- Reference: MacDonald JD, Pike RB and Williamson DI, 1957

- Notes: Difficult to distinguish from A. hyndmanni (except in Zoea IV where A. laevis has 3 pleopods and A. hyndmanni 2)

- Abdomen 5 with lateral spines very small or absent; no medio-dorsal spines
- 3rd telson spine the longest in all stages
- Stage I: posterior margin of telson very slightly convex
- Stage II-IV: posterior margin of telson straight
- Stage IV with 3 pairs pleopods
- Zoea length: 2.9-5.6 mm (Macdonald, Pike & Williamson, 1957)
**Anapagurus chiroacanthus** (Liljeborg, 1855)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Atlantic: Southwest of Norway; Sweden; Denmark; Shetland Islands; East and West of Scotland; West English Channel; Bay of Biscay; Galicia; Portugal; Atlantic Morocco; Occident Sahara; Azores; Canary Islands; Cape Verde Islands.
  Mediterranean: Occidental Mediterranean; Adriatic; Aegean Sea; South Mediterranean; Ionian Sea.

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952), uncertain identification; Danish Sound (Thorson, 1946); English Channel (Martin, 2001); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Spanish Mediterranean coast (Fusté, 1987).

- **References**: MacDonald JD, Pike RB and Williamson DI, 1957; Ingle, 1990

- Abdomen 5 with lateral spines very small or absent; no medio-dorsal spines
- Stage I: posterior margin of telson distinctly convex
- Stage II: 4th and 5th telson spines about equal
- Stage II-IV: posterior margin of telson slightly convex
- Stages III-IV: 5th telson spine the longest
- Stages III-IV: 3rd telson spine shorter than 2nd and 4th
- Stage IV with 3 pairs pleopods
- Zoea length: 2.2-3.5 mm (Macdonald, Pike & Williamson, 1957)

Notes: In Zoea I *A. chiroacanthus* is morphologically indistinguishable from *A. hyndmanni*. Sometimes difficult distinguish from *A. laevis*.
Genus *Pagurus* J.C. Fabricius, 1775

General remarks:

- Antennal scale straight or curved.
- Abdomen 5th with large lateral spines and without or with more than one dorsal spine (photo 11).
- Stage IV with 4 pairs pleopods.
- Stages III and IV: 3rd telson spine shorter than 2nd and 4th

Species present in the Coasts of British Isles and North Sea:

*Pagurus alatus* (J.C. Fabricius, 1775); *Pagurus anachorethus* Risso, 1826; *Pagurus bernhardus* (Linnaeus, 1758); *Pagurus carneus* Pocock, 1889; *Pagurus chevreuxi* (Bouvier, 1896); *Pagurus cuanensis* Bell, 1845; *Pagurus forbesii* Bell, 1845; *Pagurus prideaux* Leach, 1815; *Pagurus pubescens* Krøyer, 1838; *Pagurus pubescentus* (A Milne-Edwards & Bouvier, 1892)

Occurrence and abundance of *Pagurus* spp. (except *P. bernhardus* and *P. pubescens*) in the samples analysed:
**Pagurus bernhardus** (Linnaeus, 1758)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Iceland; Faeroe Islands; South of Spitzbergen; Murmansk Sea; Norway; Sweden; Denmark; Orkney Islands; all British coast; North Sea; South Baltic Sea; English Channel; Biscay Bay; Galicia; West and South of Portugal.

- **Larval distribution**: North Sea, Irish Sea, English Channel (Lindley, 1987); North Sea (Rees, 1952, 1955), as *Eupagurus bernhardus*; Danish Sound (Thorson, 1946), as *Eupagurus bernhardus*; Irish Sea (Williamson, 1956), as *Eupagurus bernhardus*; English Channel (Martin, 2001); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- **Reference**: MacDonald JD, Pike RB and Williamson DI, 1957

- **Zoea III**
  - Antennal scale straight and at least 6 times breadth
  - Abdomen 5 with rather small lateral spines
  - Rostrum reaching well beyond spine on antennal scale
  - Zoea length: 3.6-8.2 mm
    (Macdonald, Pike & Williamson, 1957)
Occurrence and abundance of *P. bernhardus* in the samples analysed:
Pagurus prideaux Leach, 1815

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Southwest of Norway; Shetland Islands; Orkney Islands; all British coasts; Ireland; North Sea; English Channel; Biscay Bay; Galicia; Portugal; Southwest of Spain; Atlantic Morocco; Mauritania; Guinea; Madeira; Canary Islands; Cape Verde Islands Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Marmora Sea; South-central Mediterranean Sea; Levant.

- **Larval distribution**: north North Sea and Irish Sea (Lindley, 1987), as Pagurus prideauxii; North Sea (Rees, 1952), as Eupagurus prideauxii; Irish Sea (Williamson, 1956), as Eupagurus prideauxii; English Channel (Martin, 2001); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960), as Pagurus prideauxi; Spanish Mediterranean coast (Fusté, 1987), as Pagurus prideauxi.

- **References**: MacDonald JD, Pike RB and Williamson DI, 1957; Goldstein B and Bookhout CG, 1972

- Antennal scale curved and less than 4 times breadth
- Posterior end of the telson slightly concave between the 4th processes
- Zoea I-II: 4th telson process less than one-third the width of the telson
- Zoea III: small mid-dorsal spine on posterior end of abdomen 6
- Zoea III-IV: 3rd telson spine shorter than 2nd and 4th
- Zoea IV: merus of developing cheliped slightly longer than broader
- Zoea length: 2.9-4.9 mm (Goldstein & Bookhout, 1972); 3.4-6 mm (Macdonald, Pike & Williamson, 1957)
**Pagurus pubescens** (Linnaeus, 1758)

- **Adult distribution** (d’Udekem d’Acoz, 1999): Cold waters of Occidental Atlantic
  Oriental Atlantic: Iceland; Faeroe Islands; Spitzbergen; Norway; Sweden; Denmark; Ireland; all British coasts; English Channel.

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952, 1955), as *Eupagurus pubescens*; Northern part of the Sound (Thorson, 1946), as *Eupagurus pubescens*; Irish Sea (Williamson, 1956), as *Eupagurus pubescens*; English Channel (Martin, 2001).

- **Reference**: MacDonald JD, Pike RB and Williamson DI, 1957
Occurrence and abundance of *P. pubescens* in the samples analysed:
- **Family Galatheidae** Samouelle, 1819

General remarks:

- Posterio-lateral margins of carapace denticulate (photo 12).
- 4 or 5 zoal stages (zoea V generally larger than zoea IV and appendages usually more developed).

<table>
<thead>
<tr>
<th>Zoal Stage</th>
<th>Eyes</th>
<th>Uropods</th>
<th>Pleopods</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Sessile</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>II</td>
<td>Movable</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>III</td>
<td>Movable</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>IV</td>
<td>Movable</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>(V)</td>
<td>(Movable)</td>
<td>(Present)</td>
<td>(Present)</td>
</tr>
</tbody>
</table>
Genus *Galathea* J.C. Fabricius, 1792

General remarks:

- Rostrum narrower than diameter of eye.
- Carapace with posterior spine on each side (photos 13, 14).
- Margin of carapace serrated (photo 12).
- Antennal exopod flattened (photo 15) (in opposition to aciculate, present in *Munida* (photo 16)).

- Species present in the Coasts of British Isles and North Sea:
  
  *Galathea dispersa* Bate, 1859; *Galathea intermedia* Lilljeborg, 1851; *Galathea machadoi* Barrois, 1888; *Galathea nexa* Embleton, 1834; *Galathea squamifera* Leach, 1814; *Galathea strigosa* (Linnaeus, 1767)

- Occurrence and abundance of *Galathea* spp. in the samples analysed:

![Stonehaven: Galathea spp. (monthly averages)](image1)

![Stonehaven: Galathea spp. (yearly monthly averages)](image2)

![Loch Ewe: Galathea spp. (monthly averages)](image3)

![Loch Ewe: Galathea spp. (yearly monthly averages)](image4)
**Galathea dispersa** Bate, 1859

- **Adult distribution** (d'Udekem d'Acoz, 1999):
  Oriental Atlantic: Norway; all British and Irish coasts; South of North Sea; Occidental English Channel; Biscay Bay; Portugal; Atlantic Morocco.
  Mediterranean: Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Marmara Sea; South-central Mediterranean sea; Levant (south of Turkey).

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987), as *Galatheia dispersa*.

- **Reference**: Lebour MV, 1930a

- **Lateral spines distinct on abdomen 5 only**
- **Posterior carapace spines reaching to or beyond anterior margin of abdomen 4**
- **Larvae larger than *G. intermedia***
- **Zoea length: 2.5-6.7 mm** (Pike & Williamson, 1972)
\textit{Galathea intermedia} Liljeborg, 1851

- **Adult distribution** (d’Udekem d’Acoz, 1999):  
  Oriental Atlantic: Faeroe Islands; Norway; all British coasts; Shetland Islands; Ireland; Southern North Sea; English Channel; Biscay Bay; Galicia; south west of Spain; north Atlantic Morocco.

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Spanish Mediterranean coast (Fusté, 1987); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987), as \textit{Galatheia intermedia}.

- **References**: Lebour MV, 1931b; Christiansen ME and Anger K, 1990

- Lateral spines distinct on abdomen 5 only
- Posterior carapace spines not reaching anterior margin of abdomen 4
- Zoea length: 2.2-4 mm (Pike & Williamson, 1972)
- Larvae smaller than \textit{G. dispersa}
**Galathea nexa** Embleton, 1834

- **Adult distribution** (d’Udekem d’Acoz, 1999):  
  Oriental Atlantic: Faeroe Islands; Norway; Shetland Islands; East of England; West of Scotland; Ireland; Southwest of North Sea; English Channel; West and South of Portugal; Canary Islands.  
  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea.

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987), as *Galathea nexa*.

- **References**: Pike RB and Williamson DI, 1972; Barnich R, 1996
Galathea squamifera Leach, 1814

- Adult distribution (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: South of Norway; Ireland; all British coasts; Shetland Islands; South of North Sea; English Channel; Biscay Bay; Galicia; Portugal; Atlantic Morocco; North of Mauritania; Azores; Canary Islands; Cape Verde Islands.
  Mediterranean: Alboran Sea; Occidental Mediterranean; Ionian Sea; Aegean Sea; Marmara Sea; South central Mediterranean; Levant.

- Larval distribution: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987), as Galatheia squamifera.

- Reference: Lebour MV 1931b
Genus *Munida* Leach, 1820

General remarks:
- Rostrum narrower than diameter of eye.
- Carapace with posterior spine on each side (photos 13, 14).
- Margin of carapace serrated (photo 12).
- Antennal exopod aciculate (photo 16) (in opposition to flattened, as in *Galathea* species (photo 15)).

➤ Species present in the Coasts of British Isles and North Sea:

*Munida rugosa* (J.C. Fabricius, 1775); *Munida sarsi* Huus, 1935

➤ Occurrence and abundance of *Munida* spp. in the samples analysed:

![Graphs showing the occurrence and abundance of Munida spp. in Stonehaven and Loch Ewe](image)
Munida rugosa (Fabricius, 1775)

- Adult distribution (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Norway; Shetland Islands; West of Scotland; South west of Britain; East of Britain; Occidental English Channel; Biscay Bay; Portugal; Madeira
  Mediterranean: Occidental Mediterranean; Adriatic; Ionian Sea; Aegean Sea.

- Larval distribution: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952), as Munida bamffia; Danish Sound (Thorson, 1946), as Munida bamffica; Irish Sea (Williamson, 1956), as Munida bamffica; English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957), as Munida bamffica; Portuguese coast (dos Santos, 1999).

- Reference: Pike RB and Williamson DI, 1972

- Zoea I-II: outermost telson spine about as long as posterior width of telson (between bases of long spines)
- Zoea III: 10 setae between longest spines on posterior margin of telson.
- Zoea IV: 11-13 setae between longest spines. Longest telson spine longer than width of abdomen
- Zoea length: 6.3-11.5 mm (Pike & Williamson, 1972)
Family **Porcellanidae** Haworth, 1825

General remarks:
- Posterior margins of carapace without denticles.
- Rostrum much longer than body (photos 17, 18).
- Posterior carapace spines extended beyond the end of telson (photos 17, 18).
- 2 zoeal stages.
- Easy identification. Two species present in the area: *Pisidia longicornis* and *Porcellana platycheles*.

<table>
<thead>
<tr>
<th>Zoeal Stage</th>
<th>Pleopods</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Absent</td>
</tr>
<tr>
<td>II</td>
<td>Present</td>
</tr>
</tbody>
</table>

Genus **Pisidia** Leach, 1820

General remarks:
- Tip of second telson spine with hooks (absent in *Porcellana platycheles*)
- Zoa I: posterior carapace spines with 2 conspicuous spines (absent in *Porcellana platycheles*)
- Zoa II: posterior carapace spines without 2 spines. Pleopods on 2nd to 4th abdominal somites (on 2nd to 5th abdominal somites in *Porcellana platycheles*)

- Species present in the Coasts of British Isles and North Sea: *Pisidia longicornis* (Linnaeus, 1767)
*Pisidia longicornis* (Linnaeus, 1767)

**Adult distribution** (d’Udekem d’Acoz, 1999):

Oriental Atlantic: South west of Norway; Ireland; South west of Scotland; East of Britain; South of North Sea; English Channel; Galicia; Portugal; South west of Spain; occidental Sahara; African coasts from Angola to Mauritania.

Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic; Ionian Sea; Aegean Sea; Marmara Sea; Levant.

**Larval distribution:** north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952), as *Porcellana longicornis*; Danish Sound (Thorson, 1946), as *Porcellana longicornis*; Irish Sea (Williamson, 1956), as *Porcellana longicornis*; English Channel.
(Martin, 2001), as *Pisidia longicornis longicornis*; French Mediterranean coast (Barnich, 1996), uncertain identification; Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- **Reference:** Lebour MV, 1943 (as *Porcellana longicornis*)

➢ Occurrence and abundance of *P. longicornis* in the samples analysed:
Genus *Porcellana* Leach, 1820

General remarks:

- Tip of second telson spine without hooks (present in *Pisidia longicornis*).
- Zoea I: posterior carapace spines without 2 conspicuous spines (present in *Pisidia longicornis*).
- Zoea II: Pleopods on 2nd to 5th abdominal somites (on 2nd to 4th abdominal somites in *Pisidia longicornis*).

- Species present in the Coasts of British Isles and North Sea:

  *Porcellana platycheles* (Pennant, 1777)
Porcellana platycheles (Pennant, 1777)

- Adult distribution (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Ireland; Orkney Isles; south-west of Scotland; East of England; South of North Sea; English Channel; Galicia; Portugal; south-west of Spain; Atlantic coast of Morocco; Canary Islands.
  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Marmara Sea; Levant.

- Larval distribution: English Channel, Bay of Biscay, portuguese coasts (Lindley, 1987); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Spanish Mediterranean coast (Fusté, 1987); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987), as Porcellana platycheles.

Occurrence and abundance of *P. platycheles* in the samples analysed:
3.4. Infraorder Astacidea Latreille, 1831

General remarks:
- Carapace laterally flattened (in opposition to Infraorders Brachyura and Palinura).
- Telson flattened (photo 19).
- Antennal exopod unsegmented or segmented near distal end only.
- Second telson spine not hair-like (in opposition to Infraorders Anomura and Thalassinidea).
- Margin latero-posterior of carapace without spines or denticles (in opposition to Infraorder Anomura).
- Telson posterior margin with median spine (photo 19) (in opposition to Infraorder Stenopodidea and Caridea).
- Pereiopods 1 to 3 chelated.
- Pereiopods 1 to 5 with exopods.

- **Family Nephropidae** Leach, 1814
  Genus *Nephrops* Leach, 1814
    ➢ Species present in the Coasts of British Isles and North Sea:
      *Nephrops norvegicus* (Linnaeus, 1758)
Nephrops norvegicus (Linnaeus, 1758)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Iceland; Faeroe Islands; West of Norway; West of Hebrides; all coasts of Britain; North Sea; English Channel; Bay of Biscay; Galicia; Portugal; South-west of Spain; Atlantic Morocco; Occidental Sahara; Mauritania; Canary Islands.
  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; South-central Mediterranean; Marmara Sea.

- **Larval distribution**: North Sea and Irish Sea (Lindley, 1987); North Sea (Rees, 1952); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Portuguese coast (dos Santos, 1999).

  - Occurrence and abundance of *N. norvegicus* in the samples analysed:
    - Telson posterio-external spines very long
    - Long spines on abdominal somites 4th to 6th.
    - 3 zoeal stages
    - Zoea I: no pleopods or uropods present
    - Zoea II: pleopods present; uropods absent
    - Zoea III: pleopods more developed; uropods present
    - Zoea length: 6.5-10 mm (excluding prolongations of telson) (Williamson, 1983)
Stonehaven: *Nephrops norvegicus* (monthly averages)

Stonehaven: *Nephrops norvegicus* (yearly monthly averages)

Loch Ewe: *Nephrops norvegicus* (monthly averages)

Loch Ewe: *Nephrops norvegicus* (yearly monthly averages)
3.5. **Infraorder Caridea** Dana, 1852

General remarks:
- Carapace laterally flattened (photo 1).
- Telson flattened (photos 5).
- Antennal exopod unsegmented or segmented near distal end only (photo 20, 21, 22, 23).
- Second telson spine not hair-like (photo 5) (in opposition to Infraorder Anomura).
- Telson posterior margin without median spine (photos 5, 24, 25) (in opposition to Infraorder Thalassinidea (photo 4)).

- **Family Alpheidae** Rafinesque, 1815

General remarks:
- 5th pereiopod much longer than the others.

<table>
<thead>
<tr>
<th>Zoal stage</th>
<th>Eyes</th>
<th>Uropods</th>
<th>Telson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sessile</td>
<td>Absent</td>
<td>7+7 setae</td>
</tr>
<tr>
<td>II</td>
<td>Movable</td>
<td>Absent</td>
<td>8+8 setae</td>
</tr>
<tr>
<td>III</td>
<td>Movable</td>
<td>Present</td>
<td>Posterior width of telson about twice anterior width</td>
</tr>
<tr>
<td>IV</td>
<td>Movable</td>
<td>Present</td>
<td>Posterior width of telson slightly greater than anterior width or parallel-side</td>
</tr>
<tr>
<td>V and later</td>
<td>Movable</td>
<td>Present</td>
<td>Telson parallel-side or widest in anterior half</td>
</tr>
</tbody>
</table>

Genus *Athanas* Leach, 1814

- Species present in the Coasts of British Isles and North Sea:

  *Athanas nitescens* (Leach, 1814)
**Athanas nitescens** (Leach, 1814)

- Adult distribution (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: South of Scandinavia; Southwest Baltic Sea; Netherlands; Ireland; South, southwest and west of Britain; English Channel; Bay of Biscay; Galicia; Portugal; Atlantic Morocco; Occidental Sahara; Guinea; Congo; Madeira; Canary Islands; Cape Verde Islands; Guinea Bay Islands.
  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Maramara Sea; South-central Mediterranean; Levant.

- Larval distribution: Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Spanish Mediterranean coast (Fusté, 1987); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- References: Lebour MV, 1932b; Bartilotti et al. 2005.

- **Zoea III**
  - 5th pereiopod longer than the others
  - Pereiopods 1 and 2 with exopods (3 to 5 uniramous)
  - Carapace without supraorbital spines
  - Body S-shaped
  - 9 zoal stages
  - Zoea length: 1.6-3 mm
    (Williamson, 1967)
Occurrence and abundance of *A. nitescens* in the samples analysed:
- **Family Hippolytidae** Dana, 1852

  General remarks:
  - Bases of antennules separated by not more than the width of one of them (photos 21, 26) (except genus *Caridion*).
  - Number of zoeal stages variable.

Genus *Caridion* Goës, 1863

General remarks:
- Base of antennules separated by more than width of one of them.
- Rostrum about as long as carapace.
- Endopods of third maxilliped, first and second pereiopods expanded.
- Ventral margin of carapace not denticulated.
- Dorso-lateral spines on posterior margin of abdominal somite 5.
- Long antennal flagellae.

- Species present in the Coasts of British Isles and North Sea:
  
  *Caridion gordoni* (Bate, 1858); *Caridion steveni* Lebour, 1930
**Caridion gordoni** (Bate, 1858)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Occidental Atlantic: Canada
  Oriental Atlantic: Iceland; Faeroe Islands; Norway; Sweden; Shetland Islands; Hebrides; North of Scotland; North Sea; Helgoland; Ireland Sea; Firth of Clyde; Plymouth; North of Bay of Biscay

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999).

- **Reference**: Lebour MV, 1930b; Williamson DI, 1957b

- **Zoea VIII**

  - Carapace with two supraorbital spines (in stage II and later)
  - Carapace smooth without horns or spines
  - 4 terminal setae on maxillipeds 2 and 3 (3 setae in *Caridion steveni*)
  - Rostrum very long
  - 9 zoeal stages
  - Zoea length: 3-12 mm (Williamson, 1957b)
Occurrence and abundance of *C. gordoni* in the samples analysed:
**Caridion steveni** Lebour, 1930

- **Adult distribution** (d’Udekem d’Acoz, 1999): North-oriental Atlantic: Faeroe Islands; Norway; Sweden; Helgoland; west of Ireland; west of Scotland; east of Britain; south-west of Britain; south-west of North Sea; south-oriental English Channel.

- **Larval distribution:** South western England and western Ireland (Lindley, 1987); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- **Reference:** Lebour MV, 1930b; Williamson DI, 1957b; Barnich R, 1996

- **Carapace with a pair of dorsal horns (from zoea II)**
- **3 terminal setae on maxillipeds 2 and 3 (4 setae in Caridion gordoni)**
- **Rostrum very long**
- **Long antennal flagellum**
- **9 zoeal stages**
- **Zoea length: 2.5-9 mm** (Williamson, 1957)

Note: Although Williamson (1957b) do not record the presence of supraorbital spines, these are present according to Barnich (1996)
Occurrence and abundance of *C. steveni* in the samples analysed:

Stonehaven: *Caridion steveni* (monthly averages)

Loch Ewe: *Caridion steveni* (monthly averages)
Genus *Hippolyte* Bate, 1888

General remarks:
- Bases of antennules close or separated by not more than the width of one of them (photos 21, 26, 27).
- Rostrum narrow.
- Endopod of antennule long and thin (photo 27).
- Anal spine not developed until zoea IV.
- A seta on outer side of base of maxillule (very important character to distinguish this genus from *Eualus* and *Thoralus*).
- Late stages with exopods on pereiopods 1 and 2 only.
- Antennal scale segmented in zoea I (photo 27, although not very clear) with the tip slightly pointed.
- With or without paired spines on posterior margin of abdomen 5.
- 5 to 9 zoeal stages. Small larvae.

- References: Lebour MV, 1931a, 1936a; Williamson DI, 1957; Barnich R, 1996

- Species present in the Coasts of British Isles and North Sea:
  *Hippolyte hunti* (Heller, 1863), *Hippolyte inermis* Leach, 1815; *Hippolyte longirostris* (Czerniavski, 1868); *Hippolyte varians* Leach, 1814
Genus *Eualus* Thallwitz, 1892

General remarks:

- Base of antennules close or separated by not more than the width of one of them (photos 26, 27).
- Rostrum narrow.
- Endopod of antennule long and thin (photo 27).
- Anal spine present from zoea I.
- Without seta on outer side of base of maxillule (present in *Hippolyte*).
- Antennal scale segmented in zoea I (photo 27, although not very clear) with the tip slightly pointed.

- Species present in the Coasts of British Isles and North Sea: *Eualus gaimardii* (H. Milne Edwards, 1837); *Eualus occultus* (Lebour, 1936a); *Eualus pusiolus* (Krøyer, 1814)
**Eualus occultus** (Lebour, 1936)

- **Adult distribution** (d’Udekem d’Akoz, 1999):
  Oriental Atlantic: south and west of Norway; south-west of Scotland; south-west of England; Bay of Biscay; Galicia; Portugal; Azores; Madeira; Canary Islands; Cape Verde Islands. Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Aegean Sea.

- **Larval distribution**: Irish Sea (Williamson, 1956), as *Spirontocaris occulta*; English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957), as *Spirontocaris occulta*; French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- **References**: Lebour MV, 1936a; Pike RB and Williamson DI, 1961a; Barnich R, 1996.
**Eualus pusiolus** (Krøyer, 1841)

- **Adult distribution** (d’Udekem d’Akoz, 1999):
  Oriental Atlantic: Iceland; west of Spitzberg; Faeroe Islands; Norway; Murmansk Sea; White Sea; Shetland Islands; British coasts; Irish coasts; North Sea.

- **Larval distribution**: English Channel and Irish Sea (Lindley, 1987); Danish Sound (Thorson, 1946), as *Spirontocaris pusiosa*; Irish Sea (Williamson, 1956), as *Spirontocaris pusiola*; English Channel (Martin, 2001); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- **References**: Lebour MV, 1936a; Pike RB and Williamson DI, 1961a
Genus *Thoralus* Holthuis, 1947

- Species present in the Coasts of British Isles and North Sea:
  *Thoralus cranchii* (Leach, 1817)

*Thoralus cranchii* (Leach, 1817)

- Without seta on outer side of base of maxillule
- Paired spines on 5th somite
- Rostrum absent on zoea I
- Anal spine from zoea I
- When present, exopods on pereiopods 1 to 3
- Usually few small dorsal setae on 4th somite
- 3 denticles on antero ventral margin of carapace
- Anterior and posterior dorsal tubercule on the carapace
- 9 zoeal stages
- Zoea length: 1.5 mm to 4.5 mm (Lebour, 1936a)

- Larval distribution: English Channel (Lindley, 1987); Irish Sea (Williamson, 1956), as *Spirontocaris cranchii*; English Channel (Martin, 2001); Marseille Gulf (Bourdillon-Casanova, 1960), as *Thoralus cranchi*; south-western Portugal (Paula, 1987).

- Reference: Lebour MV, 1932a; 1936a; Williamson DI, 1957b; Pike RB and Williamson DI, 1961a; Barnich R, 1996.

The genus *Thoralus* is characterised by the absence of mandibular palp. Nevertheless, according to d’Udekem d’Acoz (1999), some species with mandibular palp are highly similar to *Thoralus cranchii*, and he considers that the absence of this character is not enough reason by itself to provide validity to the genus *Thoralus*. For that reason he provisionally considers this genus synonymous with the genus *Eualus*. 
Due to the uncertainty of the status of these genera and the difficulties in the identification of *Hippolyte* species, the specimens belonging to these three genera found in the samples in this study (*Hippolyte*, *Eualus* and *Thoralus*) were aggregated together. Nevertheless some specimens were selected in order to provide pictures of important identification characters. In the next table there are some of the features used during the identification of *Eualus* species and *Thoralus cranchii*.

<table>
<thead>
<tr>
<th></th>
<th><em>E. gaimardi</em></th>
<th><em>E. pusiolus</em></th>
<th><em>E. occultus</em></th>
<th><em>T. cranchii</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paired spines on som 5</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Tuft of setae on som 4</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Exopods on pereiopods</td>
<td>1-3</td>
<td>1-4</td>
<td>1-4</td>
<td>1-3</td>
</tr>
<tr>
<td>Denticles on ventral margin of carapace</td>
<td>3-4</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Rostrum in Zoa I</td>
<td>Prominent</td>
<td>Minute</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Occurrence and abundance of *Hippolyte, Eualus* and *Thoralus* in the samples analyzed:
• **Family Processidae** Ortmann, 1896

Genus *Processa* Leach, 1815

General remarks:

- Base of antennules separated by more than the width of one of them (photo 20).
- Antennal scale never segmented (photos 20, 23) with the tip rounded.
- Rostrum small (absent in zoea I); never toothed.
- Abdominal somite 5 with a pair of lateral spines (photos 28, 29).
- Exopods on pereiopods 1 to 4 in late stages.
- 8-9 zoeal stages.

▶ Species present in the Coasts of British Isles and North Sea:

Processa canaliculata Leach, 1815

- Adult distribution (d’Udekem d’Akoz, 1999):
  Oriental Atlantic: west of British Isles; North Sea; Bay of Biscay; south-west of Spain; north of Atlantic Morocco.
  Mediterranean: Alboran Sea; occidental Mediterranean; centre and south of Adriatic Sea; Ionian Sea; Aegean Sea; south-central Mediterranean.

- Larval distribution: North North Sea, western Ireland, South England, English Channel, north western Iberian Peninsula (Lindley, 1987); North Sea (Rees, 1952, 1955); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); Portuguese coast (dos Santos, 1999).

Occurrence and abundance of *P. canaliculata* in the samples analysed:

- **Stonehaven:** *Processa canaliculata* (monthly averages)
- **Loch Ewe:** *Processa canaliculata* (monthly averages)

![Graphs showing occurrence and abundance of *P. canaliculata*](image-url)
Processa nouveli holthuisi Al-Adhub & Williamson, 1975

- Adult distribution:
  Oriental Atlantic: south of Norway; west and south–west of British isles; North Sea; English Channel; Biscay Bay (d’Udekem d’Akoz, 1999).

- Larval distribution: North Sea, Irish Sea, English Channel, Portuguese coasts (Lindley, 1987), as Processa nouveli; Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Portuguese coast (dos Santos, 1999).

- References: Fincham AA and Williamson DI, 1978; Williamson DI and Rochanaburanon T, 1979; Ortega A, Queiroga H and Gonzalez-Gordillo JI, 2005

- Paired abdominal spines on somite 5
- 3-4 denticles on ventral margin of carapace
- 9 zoeal stages
Occurrence and abundance of *P. nouveli holthuisi* in the samples analyzed:
Family *Crangonidae* Haworth, 1825

General remarks:
- Eye-stalks hemispherical, almost touching in mid line.
- Antennules very close together, separated by no more than the width of one of them (photo 21, 30).
- Endopod of antennule cylindrical shaped (photo 21, 30).
- Without supraorbital spines.

Genus *Crangon* J.C. Fabricius, 1798

General remarks:
- Telson with not more than 8+8 spines.
- Flagellum of antennule shorter than carapace and not segmented (or in last stage only).
- Pairs lateral or dorsolateral spines on abdomen 5 only; with or without median dorsal spine on abdomen 3.
- Zoea IV and V with exopods on pereiopod 1 only (in *Philocheras* on pereiopods 1 and 2).
- Two segmented endopods on the maxillule.

Species present in the Coasts of British Isles and North Sea:

*Crangon allmanni* Kinahan, 1857; *Crangon crangon* (Linnaeus, 1758)
**Crangon allmanni** Kinahan, 1857

- **Adopt distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Iceland; White Sea; Faeroe Islands; Norway; Shetland Islands; Great Britain; North Sea; West of English Channel; North of Bay of Biscay.

- **Larval distribution:** north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); Portuguese coast (dos Santos, 1999).

- **References:** Lebour MV, 1931a; Williamson DI, 1960

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- No dorso median spine on 3th abdominal somite
- 5th abdominal somite with a pair of dorso-lateral spines
- Antero-ventral margin of carapace denticulated (3 teeth)
- 5 zoeal stages
- Zoea length: 2.8-6.5 mm (Williamson, 1960)
Occurrence and abundance of *C. allmanni* in the samples analysed:

- **Stonehaven:** *Crangon allmanni* (monthly averages)
- **Stonehaven:** *Crangon allmanni* (yearly monthly averages)
- **Loch Ewe:** *Crangon allmanni* (monthly averages)
- **Loch Ewe:** *Crangon allmanni* (yearly monthly averages)
*Crangon crangon* Linnaeus, 1758

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Norway; Baltic Sea; Great Britain; South of North Sea; English Channel; Bay of Biscay; Galicia; Portugal; Atlantic Morocco.
  Mediterranean: Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Marmara Sea; Black Sea; Levant; South of Turkey.

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957), as *Crangon vulgaris*; Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

- **References**: Lebour MV, 1931a; Gurney AR, 1982
Occurrence and abundance of *C. crangon* in the samples analysed:

![Graphs showing occurrence and abundance of Crangon crangon in Stonehaven and Loch Ewe.](image-url)
Genus *Philocheras* Stebbing, 1900

General remarks:

- Telson with no more than 8+8 spines.
- No median spines on abdominal somites.
- Paired spines on each of somites 3 to 5, or no abdominal spines, or pair of small spines on abdomen 5 only.
- Late stages with exopods on pereiopods 1 and 2.
- 5 zoeal stages.

<table>
<thead>
<tr>
<th>Zoal Stage</th>
<th>Eyes</th>
<th>Uropods</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Sessile</td>
<td>Absent; telson formula 7+7</td>
</tr>
<tr>
<td>II</td>
<td>Movable</td>
<td>Absent; telson formula 8+8</td>
</tr>
<tr>
<td>III</td>
<td>Movable</td>
<td>Present, endopod small</td>
</tr>
<tr>
<td>IV</td>
<td>Movable</td>
<td>Present and complete; shorter than telson</td>
</tr>
<tr>
<td>V</td>
<td>Movable</td>
<td>Present and complete; longer than telson</td>
</tr>
</tbody>
</table>

Species present in the Coasts of British Isles and North Sea:

*Philocheras bispinosus bispinosus* (Hailstone, 1835); *Philocheras bispinosus neglectus* (G.O. Sars, 1883); *Philocheras echinulatus* (M.Sars, 1861); *Philocheras fasciatus* Risso, 1816); *Philocheras sculptus* (Bell, 1847); *Philocheras trispinosus* Hailstone, 1835
Philocheras bispinosus bispinosus (Hailstone, 1835)

- Adult distribution (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Faeroe Islands; south-west of Norway; Shetland Islands; Great Britain; North Sea; English Channel; Bay of Biscay; Portugal; south-west of Spain; Angola; Azores; Madeira; Canary Islands; Cape Verde Islands.
  Mediterranean: Occidental Mediterranean; Adriatic Sea; Aegean Sea; Levant.

- Larval distribution: English Channel (Martin, 2001); French Mediterranean coast (Barnich, 1996); Portuguese coast (dos Santos, 1999).

- References: Williamson DI, 1960; Pike RB and Williamson DI, 1961b; Gonzalez-Gordillo JI, dos Santos A and Rodríguez A, 2000
Occurrence and abundance of *P. bispinosus bispinosus* in the samples analysed:
Philocheras bispinosus (Hailstone, 1835) neglectus G.O. Sars, 1883

- Adult distribution (d’Uekem d’Acoz, 1999):
  Oriental Atlantic: South of Iceland; Faeroe Islands; West of Norway; Shetland Islands; Scotland; Ireland; West of English Channel; Bay of Biscay
  Mediterranean: Adriatic Sea.

- Larval distribution: English Channel (Martin, 2001); French Mediterranean coast (Barnich, 1996); Portuguese coast (dos Santos, 1999).

Occurrence and abundance of *P. bispinosus neglectus* in the samples analysed:

![Graph showing occurrence and abundance of *P. bispinosus neglectus* in Stonehaven and Loch Ewe.](image)
**Philocheras fasciatus** (Risso, 1816)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: all British coasts; English Channel; Bay of Biscay; South of Portugal; Azores; Canary Islands.
  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Black Sea.

- **Larval distribution**: English Channel (Lindley, 1987); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

Occurrence and abundance of *P. fasciatus* in the samples analysed:

**Stonehaven:** *Philocheras fasciatus* (monthly averages)

**Loch Ewe:** *Philocheras fasciatus* (monthly averages)
**Philocheras trispinosus** (Hailstone, 1835)

- **Adult distribution** (d’Udekem d’Akoz, 1999):
  
  Oriental Atlantic: Southwest of Norway; Shetland Islands; all Britain coasts; North Sea; English Channel; Biscay Bay; Galicia; Portugal; Atlantic Morocco; Azores; Madeira; Canary Islands.

  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic; Ionian Sea; Aegean Sea; Marmara Sea; Black Sea.

- **Larval distribution**: English Channel, Portuguese coast (Lindley, 1987), as *Pontophilus trispinosus*; North Sea (Rees, 1952) , as *Pontophilus trispinosus*; Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).


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**Zoea II**

- Abdominal somites without spines (*)
- Ventral margin of carapace without or with three denticles (*)
- Length of antennule conical process at least 1.5 times exopod length
- 5 zoeal stages
- Length zoea: 2.0-4.6 mm

(*) The presence of spines on the abdominal somites and the presence of denticles on the ventral margin of carapace are variable (Pessani & Godino, 1991)
Occurrence and abundance of *P. trispinosus* in the samples analysed:
Genus *Pontophilus* (Leach, 1815)

- Telson large, with broad and deep posterior indentation (photo 24).
- Prominent dorsal spine on abdomen 3.
- Abdomen 5 with a pair of prominent dorso-lateral spines (photo 24).
- 5 zoal stages.

<table>
<thead>
<tr>
<th>Zoal Stage</th>
<th>Eyes</th>
<th>Uropods</th>
<th>Pleopods</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Sessile</td>
<td>Absent; telson formula 7+7</td>
<td>Absent</td>
</tr>
<tr>
<td>II</td>
<td>Movable</td>
<td>Absent; telson formula 8+8</td>
<td>Absent</td>
</tr>
<tr>
<td>III</td>
<td>Movable</td>
<td>Present, endopod small</td>
<td>Absent</td>
</tr>
<tr>
<td>IV</td>
<td>Movable</td>
<td>Present</td>
<td>Pleopods buds present</td>
</tr>
<tr>
<td>V</td>
<td>Movable</td>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>

Species present in the Coasts of British Isles and North Sea:

*Pontophilus norvegicus* (M. Sars, 1861); *Pontophilus spinosus* (Leach, 1815)
**Pontophilus spinosus** (Leach, 1815)

- **Adult distribution** (d’Udekem d’Akoz, 1999):
  Oriental Atlantic: Iceland; Norway; Shetland Islands; all British coasts; North Sea; Island of Jersey; Bay of Biscay; Galicia; Portugal; south-west of Spain; Atlantic Morocco.
  Mediterranean: Alboran Sea; Occidental Mediterranean; South of Adriatic; Aegean Sea; South-central of Mediterranean.

- **Larval distribution**: south western England, western Ireland (Lindley, 1987); North Sea (Rees, 1952); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999).

- **References**: Williamson DI, 1960; Barnich R, 1996
Occurrence and abundance of *P. spinosus* in the samples analysed:

![Graphs showing occurrence and abundance of Pontophilus spinosus in Stonehaven and Loch Ewe.](image)

- **Stonehaven**: Monthly and yearly monthly averages for Pontophilus spinosus.
- **Loch Ewe**: Monthly and yearly monthly averages for Pontophilus spinosus.
• **Family Pandalidae** Haworth, 1825

General remarks:
- Bases of antennules separated by more than the width of one of them (photo 22).
- Peduncles often slender and curved.
- Antennal scale usually segmented at tip in early stages.
- Rostrum present in all stages.
- Rostrum usually long and toothed in late stages (shorter in *Pandalina*).
- Exopods on pereiopods 1 to 3 in late stages (except *Plesionika* which has exopods on pereiopods 1 to 4).
- Number of zoal stages variable.

<table>
<thead>
<tr>
<th>Zoal stage</th>
<th>Eyes</th>
<th>Uropods</th>
<th>Telson</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Sessile</td>
<td>Absent</td>
<td>7+7 setae</td>
</tr>
<tr>
<td>II</td>
<td>Movable</td>
<td>Absent</td>
<td>8+8 setae</td>
</tr>
<tr>
<td>III</td>
<td>Movable</td>
<td>Present</td>
<td>Posterior width of telson about twice anterior width</td>
</tr>
<tr>
<td>IV</td>
<td>Movable</td>
<td>Present</td>
<td>Posterior width of telson slightly greater than anterior width</td>
</tr>
<tr>
<td>V and later</td>
<td>Movable</td>
<td>Present</td>
<td>Telson side parallel or widest in anterior half</td>
</tr>
</tbody>
</table>

Genus *Pandalina* Calman, 1899

General remarks:
- Abdominal somites without spines.
- Rostrum present from zoea I.
- 7-9 zoal stages.

- Species present in the Coasts of British Isles and North Sea:
  
  *Pandalina brevirostris* (Rathke, 1843); *Pandalina profunda* Holthuis, 1946.
**Pandalina brevirostris** (Rathke, 1843)

- **Adult distribution** (d'Udekem d'Acoz, 1999):
  
  Oriental Atlantic: Faeroe Islands; south and west of Norway; all British coasts (including Ireland); south of North Sea; French coasts of the English Channel; Bay of Biscay; Galicia; Portugal; Atlantic Morocco.
  
  Mediterranean: strait of Gibraltar; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Marmara Sea; Levant.

- **Larval distribution:** north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952); Danish Sound (Thorson, 1946); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Portuguese coast (dos Santos, 1999); south-western Portugal (Paula, 1987).

Occurrence and abundance of *P. brevirostris* in the samples analysed:
3.6. Infraorder Thalassinidea Latreille, 1831

General remarks:
- Carapace laterally flattened (photo 32).
- Telson flattened (photo 4, 33).
- Second telson spine represented by a fine setae (photo 4).
- Each posterio-lateral margin of carapace rounded (photo 31, 32).
- Telson posterior margin with median spine (sometimes absent in early stages) (photo 4, 33).
- When median telson spine absent, telson without U-shaped central invagination and margin slightly convex (photo 33) and sharp rostrum.

- **Family Callianassidae** Dana, 1852
  
  Genus *Callianassa* Leach, 1814
  
  General remarks:
  - Anterior part of carapace never elongated (photo 32).
  - At least one abdominal segment with dorsal spines.
  - Fifth abdominal somite without lateral spines.
  - Posterior margin of the telson with differentiated central spine (photo 4).

- Species present in the Coasts of British Isles and North Sea:
  *Callianassa subterranea* (Montagu, 1808); *Callianassa tyrrhena* (Petagna, 1792)
Callianassa subterranea (Montagu, 1808)

- **Adult distribution** (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: South of Scandinavia; Southwest of Scotland; South of North Sea; Northwest of the English Channel; Bay of Biscay; Portugal.
  Mediterranean: Occidental Mediterranean; Adriatic Sea; Aegean Sea; Levant; Israel.

- **Larval distribution**: north-eastern Atlantic and the North Sea (Lindley, 1987); North Sea (Rees, 1952), uncertain identification; English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Spanish Mediterranean coast (Fusté, 1987).

- **Reference**: LutzeVJ, 1938

- **Zoea I**
  - Posterior margin of telson with differentiated central spine
  - Telson spine formula: 7-9+1+7-9
  - Second abdominal somite with a long median dorsal spine
  - Rostrum long and flattened with lateral teeth from zoea II
  - Uropods present from zoea II
  - 5 zoeal stages

- **Zoea I**
  - 500 µm
  - Posterior margin of telson with differentiated central spine
  - Telson spine formula: 7-9+1+7-9
  - Second abdominal somite with a long median dorsal spine
  - Rostrum long and flattened with lateral teeth from zoea II
  - Uropods present from zoea II
  - 5 zoeal stages
Occurrence and abundance of *C. subterranea* in the samples analysed:
- **Family Laomediidae** Borradaile, 1903

  Genus *Jaxea* Nardo, 1847

  General remarks:
  - Anterior part of carapace elongated (photo 31)
  - Antennae and eyes separated from mouthparts (photo 34).
  - Posterior margin of telson with median spine but only from zoea IV

  ➢ Species present in the Coasts of British Isles and North Sea:
    *Jaxea nocturna* Nardo, 1847.

*Jaxea nocturna* Nardo, 1847

- Adult distribution (d’Udekem d’Acoz, 1999):
  Oriental Atlantic: Southwest of Scotland; Ireland; Southwest of England; Biscay Bay; Atlantic Morocco.
  Mediterranean: Alboran Sea; Occidental Mediterranean; Adriatic Sea; Ionian Sea; Aegean Sea; Marmara Sea; Levant.

- Larval distribution: Portuguese coast (Lindley, 1987); North Sea (Rees, 1952); Irish Sea (Williamson, 1956); English Channel (Martin, 2001); Plymouth (Plymouth Marine Fauna, 1957); French Mediterranean coast (Barnich, 1996); Marseille Gulf (Bourdillon-Casanova, 1960); Spanish Mediterranean coast (Fusté, 1987); Portuguese coast (dos Santos, 1999).

- Reference: Caroli E, 1924
Occurrence and abundance of *J. nocturna* in the samples analysed:

- **Stonehaven:** *Jaxea nocturna* (monthly averages)
  - **Monthly Averages:**
    - January: 0
    - February: 10
    - March: 20
    - April: 30
    - May: 40
    - June: 50
    - July: 40
    - August: 30
    - September: 20
    - October: 10
    - November: 0
    - December: 0

- **Stonehaven:** *Jaxea nocturna* (yearly monthly averages)
  - **Yearly Averages:**
    - 2002: 0
    - 2003: 10
    - 2004: 20
    - 2005: 30
    - 2006: 40

- **Loch Ewe:** *Jaxea nocturna* (monthly averages)
  - **Monthly Averages:**
    - January: 0
    - February: 10
    - March: 20
    - April: 30
    - May: 40
    - June: 50
    - July: 40
    - August: 30
    - September: 20
    - October: 10
    - November: 0
    - December: 0

- **Loch Ewe:** *Jaxea nocturna* (yearly monthly averages)
  - **Yearly Averages:**
    - 2002: 0
    - 2003: 10
    - 2004: 20
    - 2005: 30
    - 2006: 40
- **Family Upogebiidae** Borradaille, 1903
  Genus *Upogebia* Leach, 1814

  General remarks:
  - Anterior part of carapace never elongated.
  - Abdominal segments without dorsal spines.
  - Zoea I without central spine on the telson (photo 33).
  - 3 or 4 zoeal stages.

  ➢ Species present in the Coasts of British Isles and North Sea:
    *Upogebia deltaura* (Leach, 1815); *Upogebia stellata* (Montagu, 1808)

*Upogebia* sp.

- References: Webb GE, 1919
Occurrences and abundance of *Upogebia* sp. in the samples analysed:

![Graphs showing monthly and yearly averages for Stonehaven and Loch Ewe](chart.png)
3.7. **Infraorder Brachyura** Latreille, 1802

General remarks:

- Carapace almost spherical, usually with spines.
- Rostrum pointing ventrally or absent


Vi Occurrence and abundance of brachyuran larvae in the samples analysed:
4. Photographs

Photo 1. *Crangon crangon*, zoea III

Photo 2. *Necora puber*, zoea I

Photo 3. *Munida rugosa*, zoea IV

Photo 4. *Callianassa subterranea*, zoea III

Photo 5. *Thoralus cranchii*, zoea I

Photo 6. *Anapagurus laevis*, zoea IV
Photo 7. *Anapagurus laevis*, zoea IV

Photo 8. *Anapagurus hyndmanni*, zoea IV

Photo 9. *Anapagurus hyndmanni*, zoea IV

Photo 10. *Anapagurus laevis*, zoea IV

Photo 11. *Pagurus pubescens*, zoea I

Photo 12. *Munida rugosa*, zoea I
Photo 13. *Galathea dispersa*, zoea IV

Photo 14. *Galathea intermedia*, zoea IV

Photo 15. *Galathea squamifera*, zoea III

Photo 16. *Munida rugosa*, zoea IV (the arrows indicate the antennal scales)

Photo 17. *Pisidia longicornis*, zoea I (left) and zoea II (right)

Photo 18. *Pisidia longicornis*, zoea I
Photo 19. Nephrops norvegicus, zoea II

Photo 20. Processa nouveli holtwiusi, zoea I

Photo 21. Philocheras fasciatus, zoea I

Photo 22. Pandalina brevirostris, zoea I

Photo 23. Processa canaliculata, zoea III

Photo 24. Pontophilus spinosus, zoea I
Photo 25. *Philocheras trispinosus*, zoea II

Photo 26. *Eualus pusiolus*, zoea I

Photo 27. *Eualus pusiolus*, zoea I

Photo 28. *Processa canaliculata*, zoea III

Photo 29. *Processa nouveli holthuisi*, zoea III
Photo 30. *Crangon crangon*, zoea II

Photo 31. *Jaxeia nocturna*, zoea I

Photo 32. *Callianassa subterranea*, zoea V

Photo 33. *Upogebia* spp., zoea I

Photo 34. *Jaxeia nocturna*, zoea III
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