

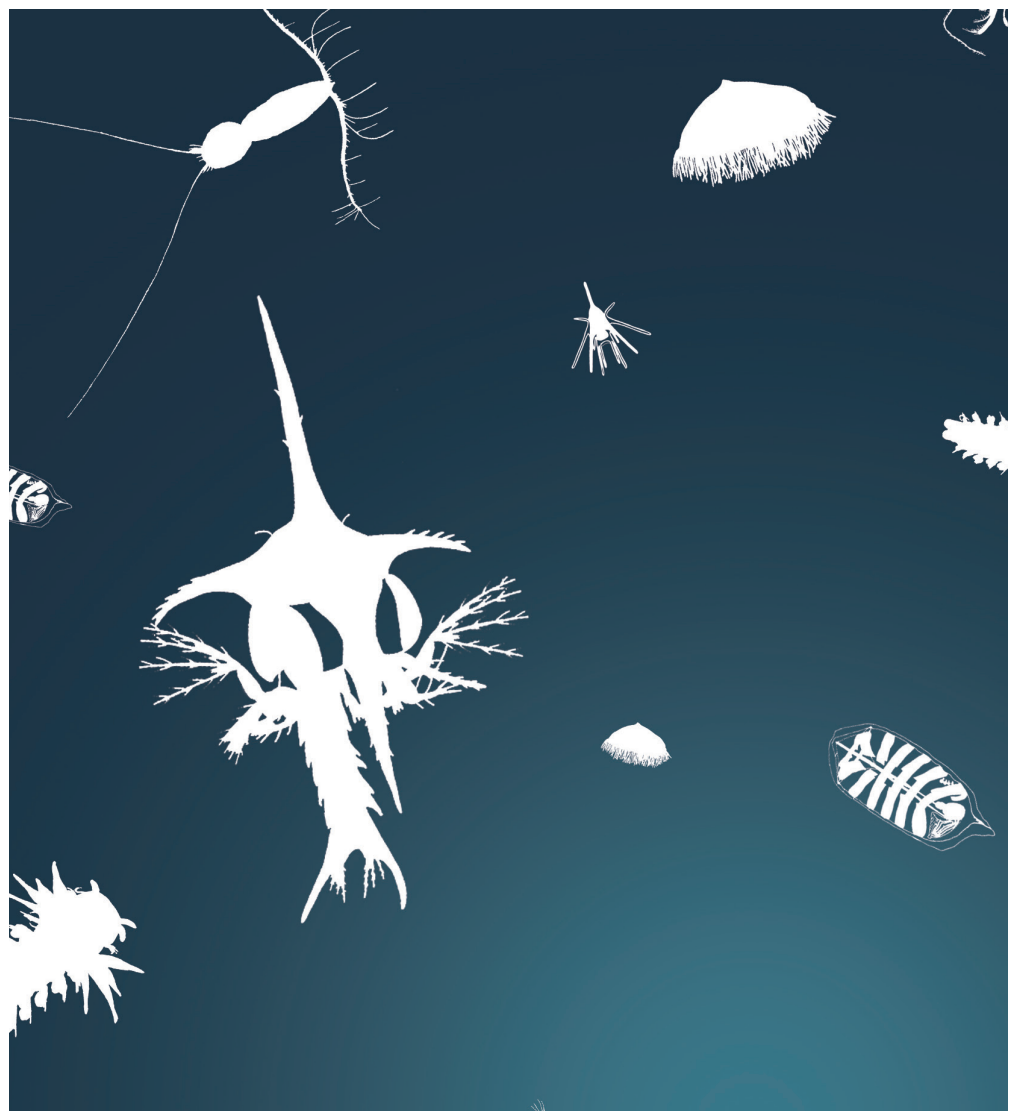
Plagusiidae Dana, 1851 and Grapsidae MacLeay, 1838

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Leaflet No. 197 | January 2022

ICES IDENTIFICATION
LEAFLETS FOR PLANKTON

FICHES D'IDENTIFICATION
DU ZOOPLANCTON



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Series editor: Antonina dos Santos and Lidia Yebra
Prepared under the auspices of the ICES Working Group on Zooplankton Ecology (WGZE)
This leaflet has undergone a formal external peer-review process

Recommended format for purpose of citation:

Cuesta, J. A. and González-Gordillo, J. I. 2022. Plagusiidae Dana, 1851 and Grapsidae MacLeay, 1838. ICES Identification Leaflets for Plankton No. 197. 14 pp. <http://doi.org/10.17895/ices.pub.7642>

ISBN number: 978-87-7482-969-0

ISSN number: 2707-675X

Cover Image: Inês M. Dias and Lígia F. de Sousa for ICES ID Plankton Leaflets

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Decapoda

Infraorder:	Brachyura
Section:	Eubrachyura
Subsection:	Thoracotremata
Families:	Plagusiidae Dana, 1851 and Grapsidae MacLeay, 1838

Authors: Jose A. Cuesta and Juan Ignacio González-Gordillo

1 Summary

Plagusids and grapsids are Thoracotremata crabs inhabiting a variety of habitats in the tropical and temperate regions, from marine benthonic communities at 500 m depth (e.g. *Euchirograpsus* spp.) to intertidal (e.g. *Pachygrapsus* spp.) or terrestrial habitats (e.g. *Geograpsus* spp.) Some peculiar cases such as species of *Planes* live on floating objects, from algae or drifting debris to marine turtles. Larval development of these species is always linked to the sea, and pass through a minimum of 5 zoeal stages and a megalopa. Plagusiidae comprises 5 genera and 20 species, and larval stages are known for 6 of them. Grapsidae comprises 7 genera and 42 species, and for 22 of them there are larval stages known. Although both plagusids and grapsids share larval characters with the rest of the grapsoids, there are a combination of larval features allowing for distinction at a familial level. This leaflet presents the known larval stages of 6 species, out of the 7 (3 plagusids and 4 grapsids) distributed in the ICES area: *Euchirograpsus americanus*, *E. liguricus*, *Plagusia depressa*, *Pachygrapsus gracilis*, *P. marmoratus*, *P. transversus*, and *Planes minutus*. The leaflet includes a key to identifying zoea and megalopa stages of these species.

2 Introduction

Plagusiidae Dana, 1851 and Grapsidae MacLeay, 1838 are Grapsoidea MacLeay, 1838 families that belong to the brachyuran subsection Thoracotremata Guinot, 1977. Both were considered to be subfamilies, Plagusiinae and Grapsinae, of the former family Grapsidae, but after the works of Schubart *et al.* (2000, 2002) they were elevated to family level. This also included changes in their generic composition, based on larval morphology and molecular data. The genus *Euchirograpsus* H. Milne Edwards, 1853, previously considered as Varuninae H. Milne Edwards, 1853, was placed on Plagusiidae; the genus *Percnon* Gistel, 1848, previously

considered as Plagusiinae was replaced by its own family Percnidae Števíć, 2005 (Schubart and Cuesta, 2010).

Listed below are the species belonging to Plagusiidae and Grapsidae, which are currently recorded in or close to the ICES area. The taxonomic status is listed according to WoRMS (2021):

Order Decapoda

Family Plagusiidae Dana, 1851

Euchirograpsus americanus A. Milne-Edwards, 1880

Euchirograpsus liguricus H. Milne Edwards, 1853

Plagusia depressa (J.C. Fabricius, 1775)

Family Grapsidae MacLeay, 1838

Pachygrapsus gracilis (de Saussure, 1858)

Pachygrapsus marmoratus (J.C. Fabricius, 1787)

Pachygrapsus transversus (Gibbes, 1850)

Planes minutus (Linnaeus, 1758)

3 Distribution

Euchirograpsus americanus Adult habitat: marine benthonic, from 31 to 508 m depth (Williams, 1984).

ICES area distribution: Bay of Fundy (Canada); Carolinas in Toms/Mey Canyon and Baltimore Canyon, Massachusetts; Oceanographer Canyon at the edge of Georges Bank, New England; off Oregon inlet, North Carolina (USA) (Nizinski, 2003; Wilson and Pohle, 2016).

Worldwide distribution: western Atlantic, from Georges Bank, New England, to Florida (USA); Venezuela, Colombia, and the West Indies to Rio Grande do Sul (Brazil) (Nizinski, 2003; Alves-Júnior *et al.*, 2016; Wilson and Pohle, 2016).

Euchirograpsus liguricus Adult habitat: marine benthonic, in bottoms of sand, sandy mud, mud, rock with gorgonians and sponges, from 10 to 359 m depth (Manning and Holthuis, 1981).

ICES area distribution: Portugal, west coast with two records: Avieira (Nobre, 1936) and 38°16.8' N 8°56.4' W (Nunes-Ruivo, 1961) and Azores (d'Udekem d'Acoz, 1999).

Worldwide distribution: East Atlantic, from west of Portugal, Madeira, and Azores to southwest Africa, including Morocco, Mauritania, Senegal, Congo, Angola; also present in western Mediterranean (d'Udekem d'Acoz, 1999).

Plagusia depressa Adult habitat: a littoral species, inhabits rocky shores, on jetties, rocks on sandy beaches and tidal pools; also found in drifting

substrata such as debris, buoys, oil platforms, and ship hulls (Manning and Holthuis, 1981; Schubart *et al.*, 2001).

ICES area distribution: Beaufort, North Carolina (USA), and Azores (d'Udekem d'Acoz, 1999; Nizinski, 2003).

Worldwide distribution: amphi-Atlantic. West Atlantic, from North Carolina to Brazil, including Gulf of Mexico, and West Indies. East Atlantic, from Azores, Madeira, and Canary Islands, to Angola, including Morocco, Cape Verde Islands, St Helena Island, Liberia, Ghana, and Congo (Manning and Holthuis, 1981; d'Udekem d'Acoz, 1999; Nizinski, 2003).

*Pachygrapsus
gracilis*

Adult habitat: intertidal. Among mangrove roots and on riverbanks near the sea (Poupin *et al.*, 2005), under and among stones, pieces of wood, etc. (Manning and Holthuis, 1981).

ICES area distribution: Introduced species in European waters, probably not established. Recorded in Bremerhaven (Germany) (Lenz *et al.*, 2000), and Galicia (Spain) (Cuesta *et al.*, 2016).

Worldwide distribution: amphi-Atlantic. Western Atlantic: Caribbean, Texas, Florida, French Guiana, Brazil, and Argentina. East Atlantic: Senegal to Angola (Manning and Holthuis, 1981; Poupin *et al.*, 2005).

*Pachygrapsus
marmoratus*

Adult habitat: Rocky shores from intertidal zone to 6 m depth, and under stones on sandy mud in estuaries and lagoons (d'Udekem d'Acoz, 1999; Poupin *et al.*, 2005).

ICES area distribution: East Atlantic, from Blainville-sur-Mer and Roscoff (France) to Gulf of Cadiz (Spain), and Azores, with some records from the south coast of UK (d'Udekem d'Acoz, 1999; Ingle and Clark, 2008; Pezy and Dauvin, 2015).

Worldwide distribution: northeast Atlantic, from south coasts of UK to Morocco, including Portugal, Azores, Madeira, Canary Islands; Mediterranean and Black seas (d'Udekem d'Acoz, 1999; Poupin *et al.*, 2005; Pezy and Dauvin, 2015).

*Pachygrapsus
transversus*

Adult habitat: Intertidal on rocky shores; also recorded on sandy shores and mangroves (d'Udekem d'Acoz, 1999; Poupin *et al.*, 2005).

ICES area distribution: amphi-Atlantic. West Atlantic: Cape Lookout, North Carolina (USA); East Atlantic: Algarve, South of Portugal (d'Udekem d'Acoz, 1999), and Gulf of Cádiz (González-Gordillo *et al.*, 1990). It has been recorded in Denmark, but likely to be an introduction from a ship coming from Bermuda (Christiansen, 1969).

Worldwide distribution: amphi-Atlantic and Mediterranean. West Atlantic: from North Carolina (USA) to Montevideo (Uruguay), including Caribbean and Bermuda; northeast Atlantic, from south of Portugal to Namibia, including Madeira, Canary Islands, Morocco, Gulf of Guinea; Congo, and Angola; Mediterranean

(Manning and Holthuis, 1981; d'Udekem d'Acoz, 1999; Poupin *et al.*, 2005).

Planes minutus Adult habitat: pelagic, living on most floating objects in open waters, in a variety of flotsam types including pelagic marine animals (sea turtles, jellyfish, siphonophores and gastropods), *Sargassum* seaweed and artificial objects like buoys and plastic debris (Tutman *et al.*, 2017).

ICES area distribution: there are records of this species in the east Atlantic: North Sea, Ireland, France, Portugal, and Spain; and the west Atlantic: south Newfoundland (Canada) to North Carolina (USA) (d'Udekem d'Acoz, 1999; Nizinski, 2003).

Worldwide distribution: It is considered a cosmopolitan species, recorded in the tropical and subtropical Pacific, Indian, and Atlantic oceans, as well as the Mediterranean Sea (Yaghmour and Al Naqbi, 2020).

4 Number and general morphology of larval stages

Like almost all brachyuran crabs, the larval development of Plagusiidae and Grapsidae is comprised of two phases: zoea and megalopa. Zoeal stages are characterized by a globose carapace with conspicuous dorsal, rostral, and lateral spines, maxillipeds with long distal setae that are used for swimming, and a pleon that ends in a fork-shaped telson. Plagusiidae zoeal development is probably comprised of 6 stages (ZI–ZVI), although it has not been confirmed in laboratory culture. Grapsidae, meanwhile, presents a longer zoeal development with a minimum of 5 zoea in the genus *Metopograpsus*, but with 6 in *Pachygrapsus*, and a maximum of 8 zoeal stages in *Geograpsus* (Cuesta *et al.*, 2011). Megalopae of both families are characterized by their large size in comparison to other brachyurans, and show a morphology similar to juvenile crabs; this includes a depressed carapace, 5 well-developed pereopod pairs (first chelate) and the pleon provided with pleopods that allow them to move in the water column. Species of both families only present one stage of megalopa before the metamorphosis to juvenile. In Plagusiidae, complete laboratory-reared larval development is not available for any species, and for Grapsidae it is only known from some species of *Metopograpsus* and for *Geograpsus lividus*. For the remaining grapsid's genera, only the early zoeal stages hatched in the laboratory or the megalopa from plankton samples have been described.

Larval diagnostic features for Plagusiidae

Characteristics of the zoeal stages:

- i) Presence of dorsal, rostral, and lateral spines on the carapace.
- ii) Antennal exopod developed with 1-2 long terminal setae, and 0-2 terminal short setae or spines.
- iii) Maxillule with setation pattern 1, 5 on the endopod.
- iv) Maxilla with setation pattern 2 + 3 on the endopod, and zoea I with 4 + 1 marginal setae on the exopod (scaphognatite).

- v) Maxilliped I basis with 2 + 2 + 2/3 + 2/3 setae, zoea I with 2, 2, 1, 2, 5 setae on the endopod.
- vi) Maxilliped II basis with 1 + 1 + 1 + 1 setae, and 1, 1, 5/6 setae on the endopod.
- vii) Dorsolateral knobs on pleonites 2 to 5.
- viii) Telson furcated with median notch, and furcal rami with- or without minute lateral spine.

Characteristics of the megalopa stage:

- i) Antennular accessory flagellum present.
- ii) Antenna with 3-articled peduncle and 8-articled flagellum.
- iii) Mandibular palp 3-articled, with 0/1, 1-6, 15–30 setae.
- iv) Scaphognathite with 73-180 marginal plumose setae.
- v) Epipod present in the second maxilliped.
- vi) Pleopods with 9-17 cincinnuli on the endopod.
- vii) Uropod setation: 5-9 (protopod), 27–36 (exopod).

Larval diagnostic features for Grapsidae

Characteristics of the zoeal stages:

- i) Presence of dorsal and rostral spines on the carapace. Lateral spines present in zoea I as minute rounded knob-like or small hooked projections and well developed in posterior stages.
- ii) Antennal exopod absent or reduced to small bud with a terminal simple seta.
- iii) Maxillule with setation pattern 1, 5 on the endopod.
- iv) Maxilla with setation pattern 2 + 2 on the endopod, and zoea I with 4 + 1 marginal setae on the exopod (scaphognathite).
- v) Maxilliped I basis with 2 + 2 + 2 + 2 setae, zoea I with 1, 2, 1, 2, 5 setae on the endopod.
- vi) Maxilliped II basis with 1 + 1 + 1 + 1 setae and 0, 1, 4/5 setae on the endopod.
- vii) Pleonal somites 3-5 with clear posterolateral projections. Pleon with lateral expansions and distolateral processes on pleonite 5 in *Metopograpsus*.
- viii) Dorsolateral knobs on pleonites 2-3, 2-4, or 2-5.
- ix) Anterior part of the telson elongated and always longer than the furcal arms, at least in the early zoeal stages. Telson with 1-3 outer lateral spines, except for *Metopograpsus*.

Characteristics of the megalopa stage:

- i) Antennular accessory flagellum present.
- ii) Antenna with 3-articled peduncle and 8-articled flagellum.
- iii) Mandibular palp 2-articled (with 0-1, 11-15 setae), except for *Metopograpsus*, 3-articled (with 0, 0, 7-8 setae).
- iv) Scaphognathite with 63–86 marginal plumose setae.
- v) Epipod present in the second maxilliped.

- vi) Pleopods with 3-6 cincinnuli on the endopod.
- vii) Uropod setation: 0-3 (protopod), 13-23 (exopod).

Selected references

- *Euchirograpsus americanus*: Wilson (1980) description of zoeal stages (ZI-ZV, additional ZVI) reared at the laboratory.
- *Plagusia depressa*: Wilson and Gore (1980) description of zoeal stages (ZI-ZV) reared at the laboratory. Schubart *et al.* (2001) description of megalopa collected from plankton.
- *Pachygrapsus gracilis*: Ingle (1987) description of the first zoea stage from larvae hatched at the laboratory. Cházaro-Olvera and Rocha-Ramírez (2007) and Arruda and Abrunhosa (2011) description of the megalopa collected from plankton.
- *Pachygrapsus marmoratus*: Zoea I described from larvae hatched at the laboratory by Paula (1985) and Ingle (1987), zoea I and II described by Cuesta and Rodríguez (1994) from larvae hatched and cultured at the laboratory. Cuesta and Rodríguez (2000) description of zoeal stages (ZI-ZVI) reared at the laboratory. Guerao *et al.* (1997) description of the megalopa collected from plankton.
- *Pachygrapsus transversus*: Zoea I described from larvae hatched at the laboratory by Ingle (1987), zoea I and II described by Cuesta and Rodríguez (1994) from larvae hatched and cultured at the laboratory. Flores *et al.* (1998) description of the megalopa collected from plankton.
- *Planes minutus*: Zoea I described from larvae hatched at the laboratory by Cuesta *et al.* (1997). Lebour (1944) brief description of megalopa collected from plankton.

For *Euchirograpsus liguricus*, larval descriptions are not available.

5 Taxonomic keys

Zoeal stages

1. Antennal exopod short, less than 1/4 of the protopod length, but clearly recognizable, with 2 terminal simple setae (Figure 2c) 2
 Antennal exopod reduced to a minute bud with a terminal simple seta (Figure 6c) 3
2. Carapace with remarkable posterior rounded protuberances at base of dorsal spine (Figure 1a) *Euchirograpsus americanus*
 Carapace without posterior rounded protuberances, or not well-developed (Figure 2a)
 *Plagusia depressa*
3. Pleonite 4 laterally expanded (Figure 5b) 4
 Pleonite 4 not laterally expanded (Figure 4b) *Pachygrapsus marmoratus*

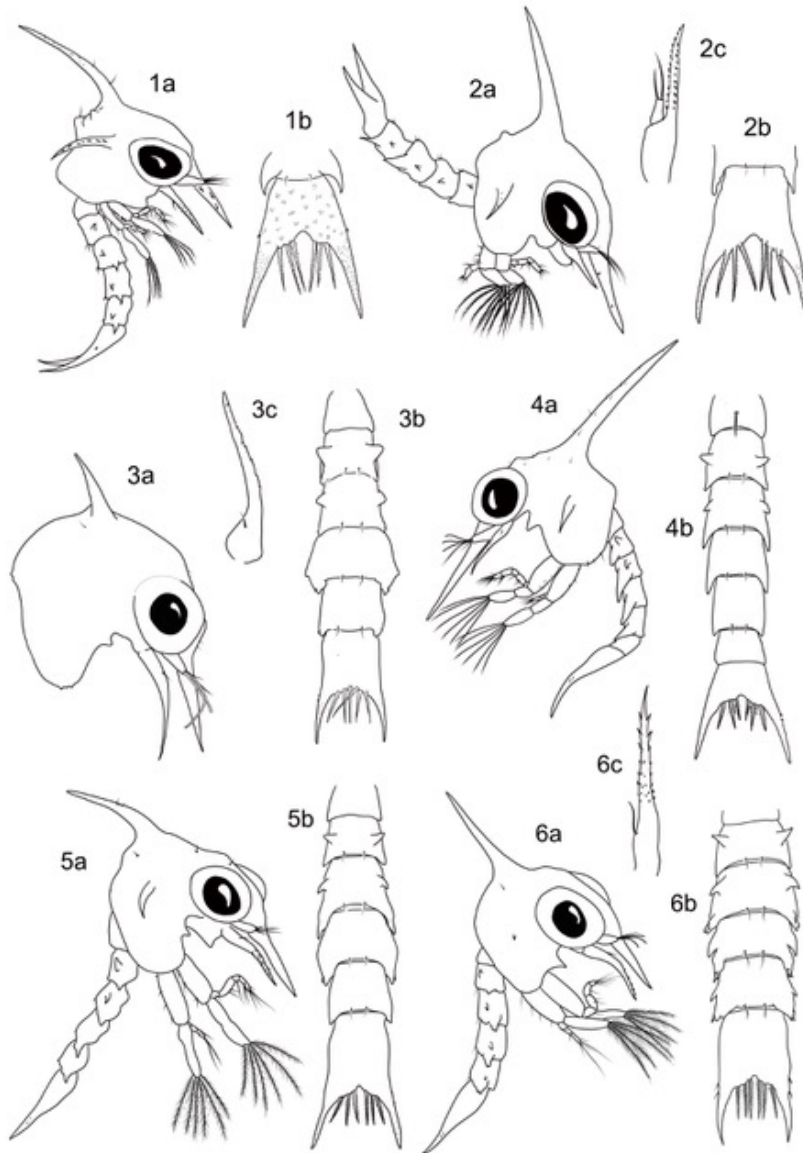
4. Antennal protopod with two rows of acute spines increasing in size distally (Figure 6c) ... 5
 Antennal protopod with few subacute spines (Figure 3c) *Pachygrapsus gracilis*
5. Dorsolateral knobs on pleonites 2 and 3, and small obtuse lateral processes on pleonite 4
 (Figure 5b) *Pachygrapsus transversus*
 Dorsolateral knobs on pleonites 2 to 5 (Figure 6b) *Planes minutus*

Megalopa stage

1. Frontal region with 2 clefts (Figure 7a), dactylus of pereopod 5 with strong denticles in the
 inner margin (Figure 7b) *Plagusia depressa*
 Frontal region with rostrum strongly deflected ventrally (Figures 8, 9a, 10, 11), dactylus of
 pereopod 5 without denticles in the inner margin and with 3 long setae terminally (Figure 9b)
 2
2. Antennal flagellum with 2 setae on article 6th (Fig. 11b), antennular primary flagellum with
 0, 5 setae (Figure 11c) *Planes minutus*
 Antennal flagellum with 0-1 setae on article 6th (Fig. 9d), antennular primary flagellum with
 0, 3-4 setae (Figure 9c) *Pachygrapsus spp.**

*At present, there are no external morphological characters that allow distinction between *Pachygrapsus* megalopae. It is probable the setation pattern of sternal plaque could be useful, but all published descriptions of these species lack information on this character.

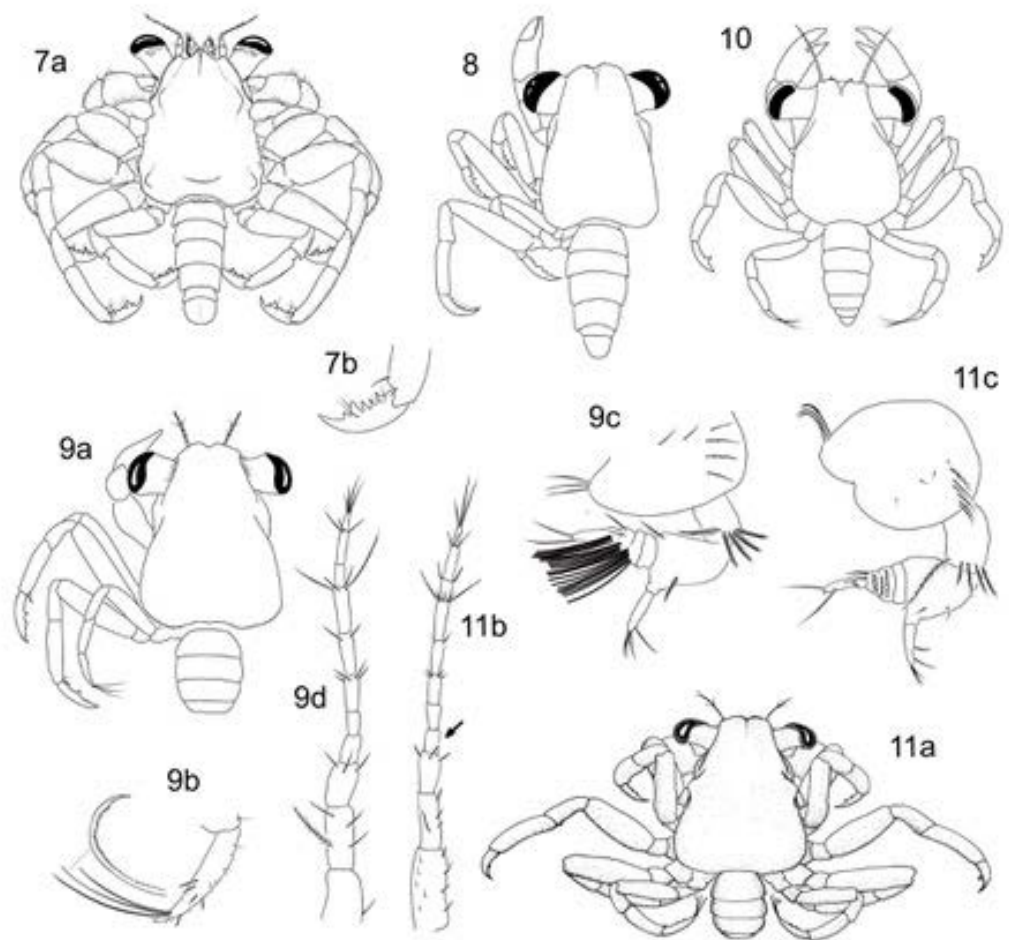
6 Figures



Figures 1–6. General morphology of Plagusiidae and Grapsidae zoeae.

1. *Euchiropsus americanus* (ZI): 1a, lateral view; 1b, telson. 2. *Plagusia depressa* (ZI): 2a, lateral view; 2b, telson; 2c, antenna. 3. *Pachygrapsus gracilis* (ZI): 3a, lateral view of cephalothorax; 3b, pleon; 3c, antenna. 4. *Pachygrapsus marmoratus* (ZIII): 4a, lateral view; 4b, pleon. 5. *Pachygrapsus transversus* (ZII): 5a, lateral view; 5b, pleon. 6. *Planes minutus* (ZI): 6a, lateral view; 6b, pleon; 6c, antenna.

Drawings not to scale. All figures modified from: 1. Wilson (1980); 2. Wilson and Gore (1980); 3. Ingle (1987); 4. Cuesta and Rodríguez (2000); 5. Cuesta and Rodríguez (1994); 6. Cuesta *et al.* (1997).



Figures 7–11. General morphology of Plagusiidae and Grapsidae megalopa.

7. *Plagusia depressa*: 7a, dorsal view; 7b, dactylus of pereopod 5. 8. *Pachygrapsus gracilis*, dorsal view. 9. *Pachygrapsus marmoratu*: 9a, dorsal view; 9b, dactylus of pereopod 5; 9c, antennule; 9d, antenna. 10. *Pachygrapsus transversus*, dorsal view. 11. *Planes minutus*: 11a, dorsal view; 11b, antenna (the arrow points to first article of the antennal flagellum); 11c, antennule.

Drawings not to scale. Figures redrawn from: 7. Schubart *et al.* (2001); 8. Cházaro-Olvera and Rocha-Ramírez (2007); 9. Guerao *et al.* (1997); 10. Flores *et al.* (1998); 11. Marco-Herrero *et al.* (in prep.).

7 Links to further information

WoRMS (2021)

Euchirograpsus americanus

<https://www.marinespecies.org/aphia.php?p=taxdetails&id=217262>

Euchirograpsus liguricus

<http://www.marinespecies.org/aphia.php?p=taxdetails&id=107452>

Plagusia depressa

<http://www.marinespecies.org/aphia.php?p=taxdetails&id=107459>

Pachygrapsus gracilis

<http://www.marinespecies.org/aphia.php?p=taxdetails&id=241200>

Pachygrapsus marmoratus

<http://www.marinespecies.org/aphia.php?p=taxdetails&id=107455>

Pachygrapsus transversus

<http://www.marinespecies.org/aphia.php?p=taxdetails&id=107457>

Planes minutus

<http://www.marinespecies.org/aphia.php?p=taxdetails&id=107462>

Molecular information

Links to DNA sequences of the species from the families Plagusiidae and Grapsidae present in the ICES area available in the Genbank database.

Euchirograpsus americanus <https://www.ncbi.nlm.nih.gov/nuccore/?term=txid106746>

Euchirograpsus liguricus There are no sequences available.

Plagusia depressa <https://www.ncbi.nlm.nih.gov/nuccore/?term=txid106760>

Pachygrapsus gracilis <https://www.ncbi.nlm.nih.gov/nuccore/?term=txid504416>

Pachygrapsus marmoratus <https://www.ncbi.nlm.nih.gov/nuccore/?term=txid135190>

Pachygrapsus transversus <https://www.ncbi.nlm.nih.gov/nuccore/?term=txid72636>

Planes minutus <https://www.ncbi.nlm.nih.gov/nuccore/?term=txid106762>

8 Acknowledgements

The authors wish to express their sincere thanks to the series editors, Antonina dos Santos and Lidia Yebra, for the invitation to participate in the Identification Leaflets Series, and to Antonina dos Santos and an anonymous referee for their corrections and suggestions that clearly improve the manuscript.

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