

# Illustrated keys for the identification of the Pleocyemata (Crustacea: Decapoda) zoeal stages, from the coastal region of south-western Europe

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The identification keys of the zoeal stages of Pleocyemata decapod larvae from the coastal region of south-western Europe, based on both new and previously published descriptions and illustrations, are provided. The keys cover 127 taxa, most of them identified to genus and species level. These keys were mainly constructed upon external morphological characters, which are easy to observe under a stereomicroscope. Moreover, the presentation of detailed figures allows a non-specialist to make identifications more easily.

## INTRODUCTION

Identification of decapod larvae from plankton samples is not easy, principally because there are great morphological changes between developmental phases, although less pronounced between larval stages. Moreover, larval descriptions of many species are still unsuitable or even non-existent. Many researchers studying ecological, physiological or other aspects of decapod larvae are not taxonomy experts and they have great difficulty in recognizing a priori the family or the larval stage of one specimen in a plankton sample. Thus, a key is needed to allow identification to start at a higher level, where all decapod larval forms are placed together. Despite the requirement of accurate larval identification and information to conduct studies on this significant crustacean group, comprehensive keys are not available for many regions, and most information is restricted to individual species groups. Since Williamson (1957) prepared a key for all decapods from 40°N to 80°N in western European waters, no further keys have been published covering other European regions. The southern limit of Williamson's key extends only to the northern coast of Portugal, thus many species from the south-west European coast, and Mediterranean Sea were not included. These latter areas coincide with a region where the identification of decapod larvae is particularly difficult due to the high species diversity found off North Africa, species for which larval descriptions are not available. These limitations, in addition to the high number of larval descriptions published in the last decade, put the current keys somewhat out of date. Recently, identification keys have been made for larvae from the North Atlantic coast (Ingle, 1992; Paula 1996) and the Mediterranean Sea (Pessani et al., 1998), however, only brachyuran larvae. The present key will be a useful tool for identifying plankton, mainly in ecological and life history studies. Moreover, taking into account the lack of keys for areas such as the north-west African coast, Canary Islands, etc. it can be useful for plankton studies in

nearby areas as a complement document when identifying larval stages.

The order Decapoda comprises two suborders, the Dendrobranchiata and the Pleocyemata (Martin & Davis, 2001). A key for the identification of Dendrobranchiata larvae covering the same area of this study has been presented by dos Santos & Lindley (2001). The present keys for Pleocyemata larvae include the infraorders Stenopodidea, Caridea, Astacidea, Thalassinidea, Palinura, Anomura and Brachyura. With the previous work on the Dendrobranchiata, the keys for the identification of zoeal stages for all the decapod larvae from the south-western European coastal region are completed.

This paper starts with a general key for the identification of larvae infraorders within the Pleocyemata group, organized according to the actual classification sequence (Martin & Davis, 2001), followed by specific genus and species keys for each infraorder. In the second part of the present work a guide for the identification of the instars is provided. This comprises a list of characters which taken into account together can provide a better distinction among larval stages.

## MATERIALS AND METHODS

The present keys are based on observations made on decapod zoeae from plankton samples collected from the Portuguese and southern Spanish coasts, from other unpublished data from our own larval reference collection, and from published larval descriptions. The new or unrecognized decapod larvae found in the plankton samples were assigned a code number. The characters used to construct the key are generally external morphological ones and easy to observe under a stereomicroscope, while illustrations of specific or subjective features are included to facilitate identification by non-specialists. Larval terminology established by Williamson (1957, 1969).

## GENERAL KEY

(Figures 1 &amp; 2)

1. (a) Carapace laterally flattened (Figure 1E–I) . . . . . 2  
 (b) Carapace strongly dorso-ventrally flattened (Figure 1D). . . . . Infraorder PALINURA (part) (Key 5)  
 (c) Carapace almost spherical (Figure 1A–C) . . . . . 8
2. (a) Telson with two cylindrical rami or terminating in two sharp prongs; antennal exopod segmented throughout its length (Figure 1G) . . . . .  
 . . . . . Suborder DENDROBRANCHIATA (see dos Santos & Lindley, 2001)  
 (b) Telson flattened (Figure 2A–F, H,I); antennal exopod unsegmented or segmented near distal end only . . . . . 3
3. (a) Second telson spine not ‘hair-like’, telson usually with seven (zoea I) or eight setae (later zoeas) each half margin (Figure 2C,D) . . . . . 4  
 (b) Second telson spine represented by a fine seta, telson usually with seven (zoea I) or eight setae (later zoeas) each half margin (Figure 2A, E, F, H, I) . . . . . 6
4. (a) Telson posterior margin without median spine (Figure 2D) . . . . . 5  
 (b) Telson posterior margin with median spine (Figure 2C) . . . . . Infraorder ASTACIDEA (Key 3)
5. (a) First abdominal somite with small dorsal spines; third abdominal somite with long median dorsal spine; fifth abdominal somite with ventral hook shaped spine (Figure 2G) . . . . . Infraorder STENOPODIDEA (Key 1)  
 (b) Abdominal somites without these characters . . . . .  
 . . . . . Infraorder CARIDEA (Key 2)
6. (a) Each posterolateral margin of carapace extended into a spinous process (Figure 1E, I) . . . . .  
 . . . . . Infraorder ANOMURA (part) (Key 6)  
 (b) Each posterolateral margin of carapace rounded (Figure 1H) . . . . . 7
7. (a) Telson posterior margin with median spine (Figure 2F, H); when median spine absent, telson margin slightly convex without U-shaped central invagination (Figure 2E) and sharp rostrum present or with antennae and eyes separated from mouthparts . . . . .  
 . . . . . Infraorder THALASSINIDEA (Key 4)  
 (b) Telson posterior margin without median spine and clearly concave; when not concave, telson has U-shaped central invagination (Figure 2A, I) and large rostrum present . . . . . Infraorder ANOMURA (part) (Key 6)
8. (a) Carapace globose with more than 20 spines (Figure 1C) . . . . . Family Polychelidae  
 (b) Carapace usually globose with not more than 20 spines (Figure 1A,B) . . . . . Infraorder BRACHYURA (Key 7)

## KEY 1—Infraorder STENOPODIDEA

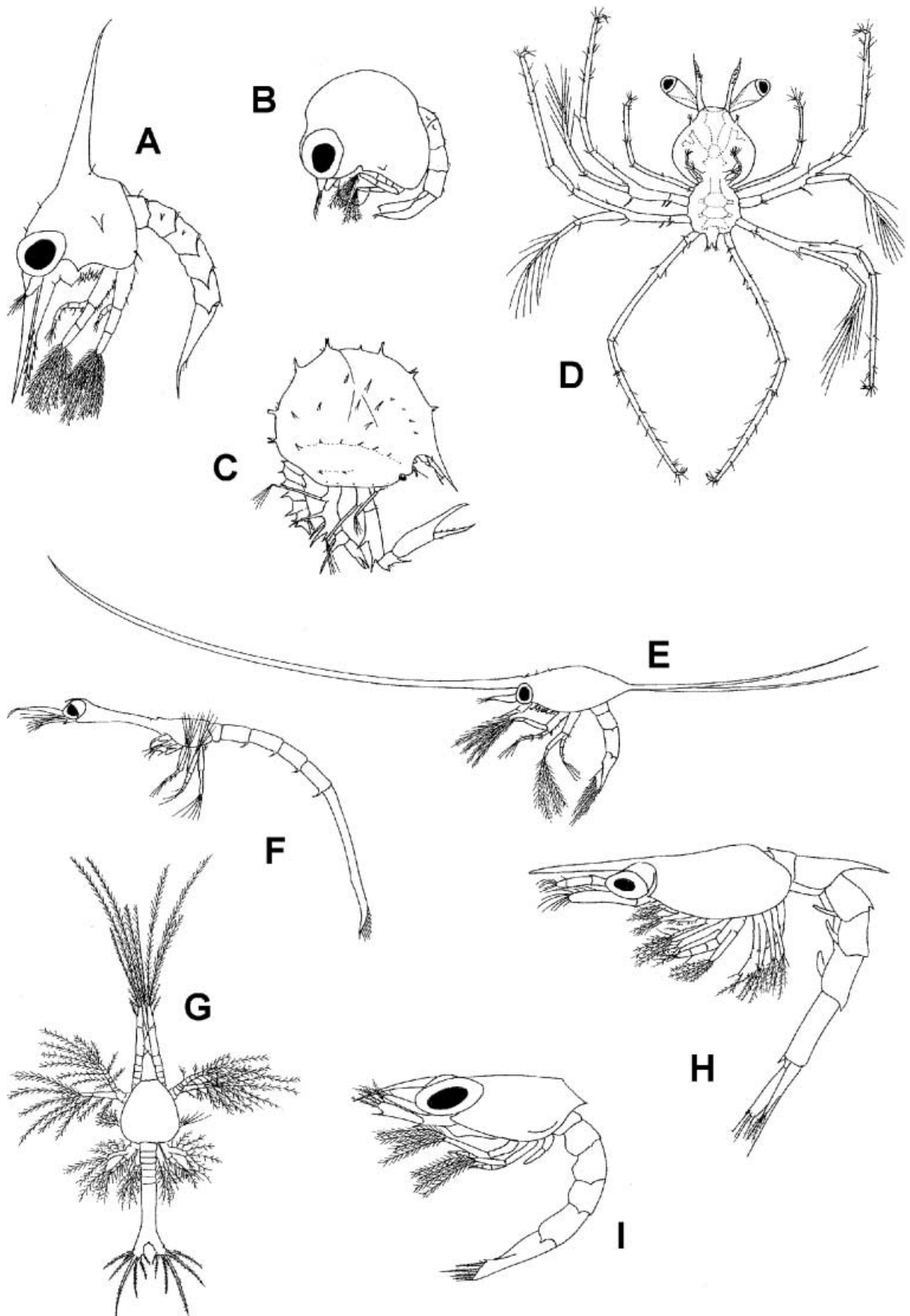
(Figure 2G)

1. (a) Pleural spines on first and third somites longer than height of abdomen; dorsal spine on third somite longer than pleural spine (Figure 2G) . . . . . *Stenopus spinosus*  
 (b) Without this combination of characters . . . . .  
 . . . . . Other species

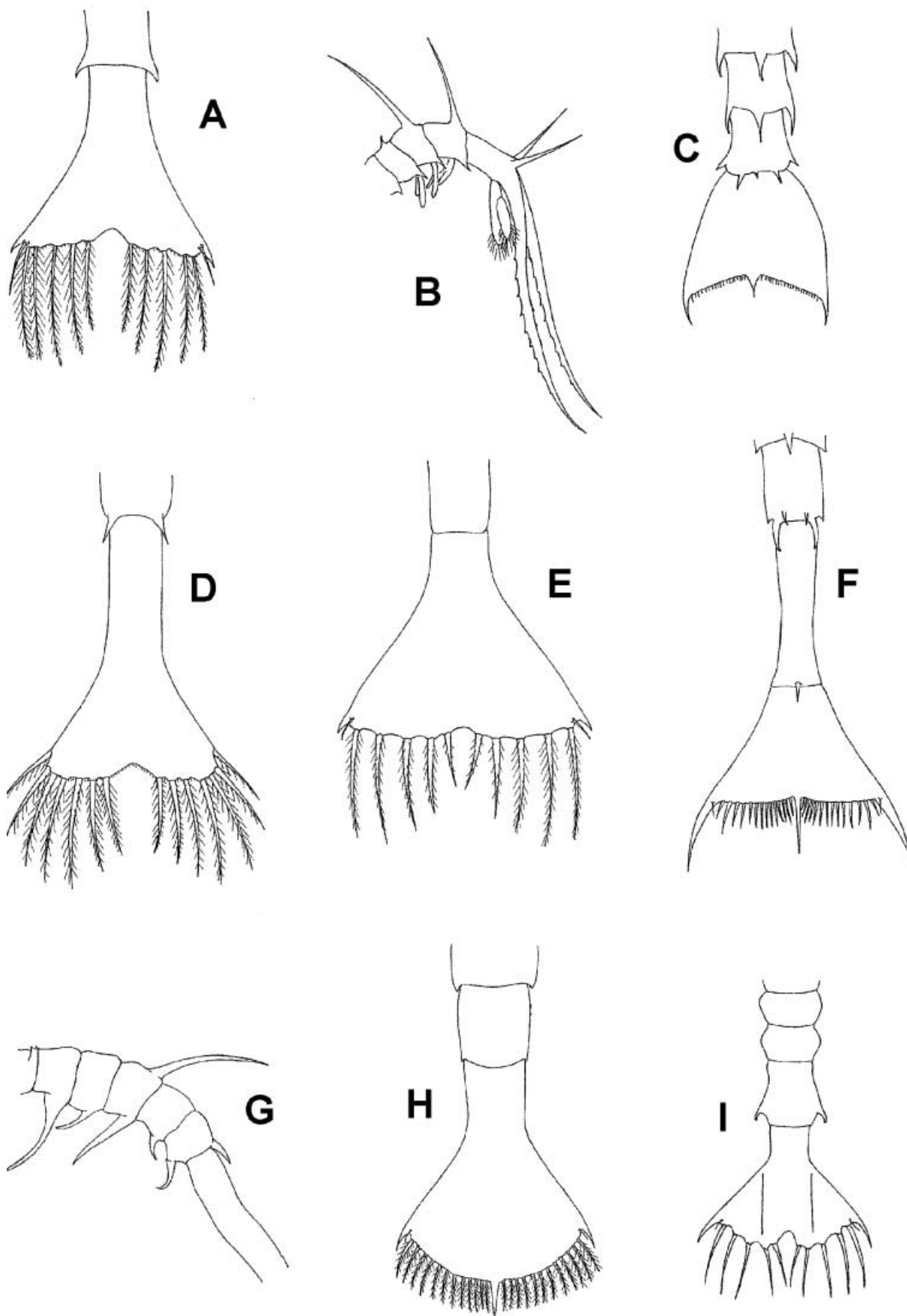
## KEY 2—Infraorder CARIDEA

(Figures 3, 4 &amp; 5)

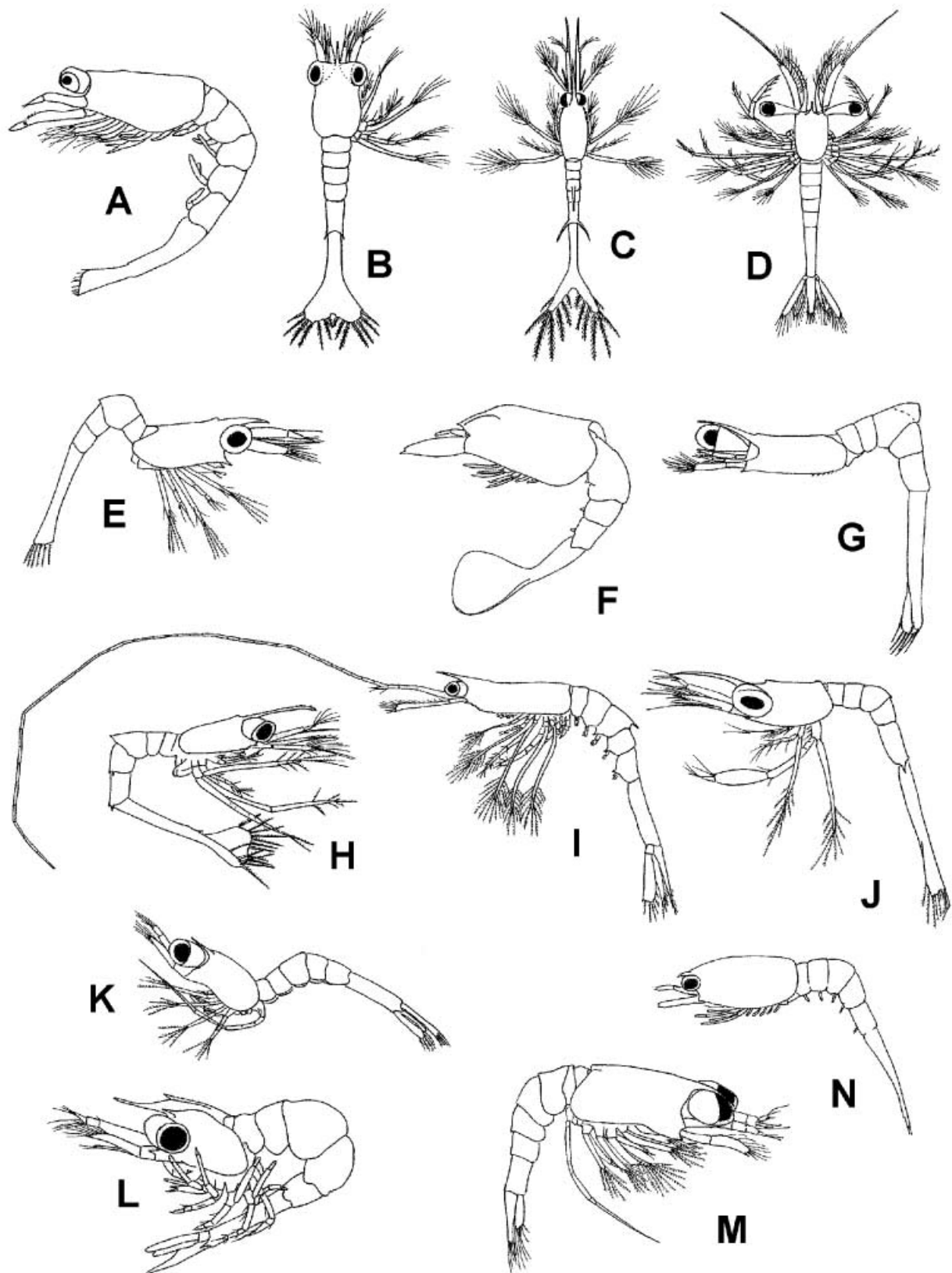
1. (a) Sessile eyes (Figures 3B, E, N; 4A, B, E, H) . . . . .  
 . . . . . (Zoea I; except for *Athanas nitescens*) 2  
 (b) Movable eyes (Figures 3G–I, K; 4C, F, G, I, J) 29
2. (a) Antennal scale not segmented (Figure 4A) . . . . . 3  
 (b) Antennal scale segmented (Figures 3B; 4B, E, K; 5E, L) . . . . . 13
3. (a) Pleopod buds present (Figure 3A, F, N) . . . . . 4  
 (b) Without pleopod buds . . . . . 7
4. (a) Eyes small (Figure 3F, N) . . . . . 5  
 (b) Eyes well developed (Figure 3A) . . . . . 6
5. (a) Eyes unpigmented; telson very broad and round apically . . . . . Genus *Parapasiphaea*  
 (b) Eyes pigmented; telson not very broad with 7+7 setae; carapace full of red yolk (Figure 3N) . . . . .  
 . . . . . *Styellaspis debilis*
6. (a) Telson with 10+10 setae . . . . . *Pasiphaea sivado*  
 (b) Telson with 18+18 setae . . . . . *Pasiphaea multidentata*
7. (a) Fifth pereopod well developed (Figure 5Q) . . . . .  
 . . . . . Genus *Synalpheus*  
 (b) Without fifth pereopod . . . . . 8
8. (a) Telson with deep central invagination (Figure 3C) . . . . . Genus *Pontophilus*  
 (b) Telson without the above character . . . . . 9
9. (a) Antennule exopod placed subterminally on peduncle; third abdominal somite with a prominent median dorsal spine (Figure 3I) . . . . . Genus *Aegaeon*  
 (b) Antennule exopod placed terminally on peduncle (Figures 4B, K; 5O) . . . . . 10
10. (a) Bases of antennules separated by more than width of one of them (Figure 4A) . . . . . Genus *Processa*  
 (b) Bases of antennules close or separated by not more than width of one of them (Figure 4H) . . . . . 11
11. (a) Third abdominal somite with a median dorsal spine; fifth abdominal somite with a pair of spines (Figure 5K) . . . . . *Crangon crangon*  
 (b) Third abdominal somite without median dorsal spine (Figure 5L) . . . . . 12



**Figure 1.** Aspects of whole decapod larvae. (A) Zoea II of *Xantho poressa*; (B) zoea II of *Ebalia tuberosa*; (C) indeterminate zoeal stage of Polychelidae; (D) zoea I of *Scyllarus posteli*; (E) zoea I of *Porcellana platycheles*; (F) zoea II of *Jaxea nocturna*; (G) protozoea I of *Sicyonia carinata*; (H) zoea V of *Callinassa subterranea*; (I) zoea I of *Catapaguroides timidus*. (A, redrawn from Rodríguez & Martín, 1997; B, from Salman, 1982; C, from Selbie, 1914; D, from González-Gordillo & Rodríguez, 2000; E, from González-Gordillo et al., 1996; F, H, from Gurney, 1942; G, from Heldt, 1938; I, from Pike & Williamson, 1960).

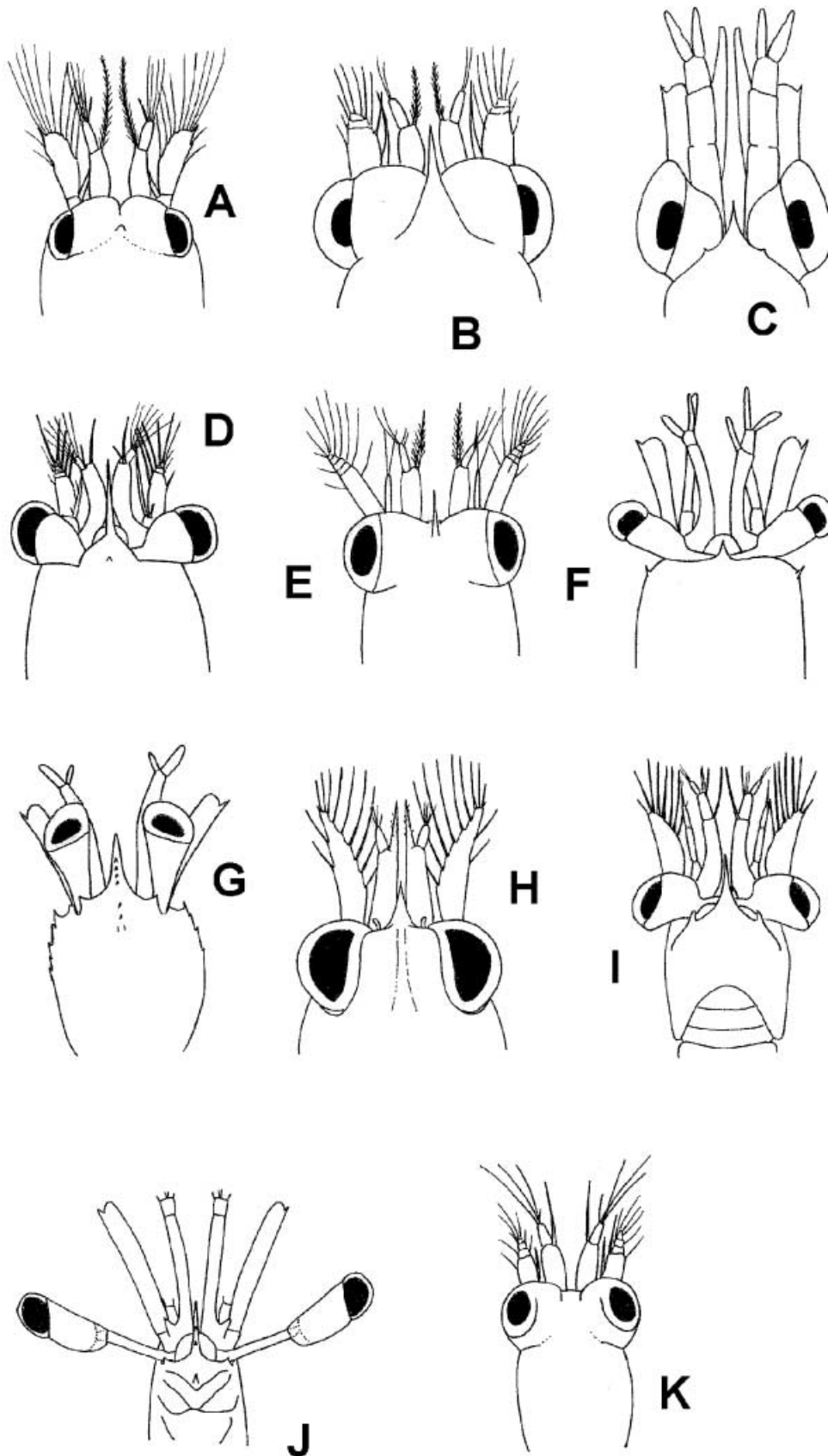


**Figure 2.** Telsons and abdomens of some decapod larvae. (A) Zoea I of *Diogenes pugilator*; (B) zoea III of *Nephrops norvegicus*; (C) zoea I of *Homarus gammarus*; (D) zoea I of *Philocheras monacanthus*; (E) zoea I of *Upogebia* sp.; (F) zoea II of *Axius stirhynchus*; (G) zoea I of *Stenopus spinosus*; (H) zoea I of *Callinassa* sp.; (I) zoea I of *Dardanus arrosor*. (B, redrawn from Gurney, 1942; C, from Ingle, 1992; D, from González-Gordillo et al., 2000; I, from Pike & Williamson, 1960).

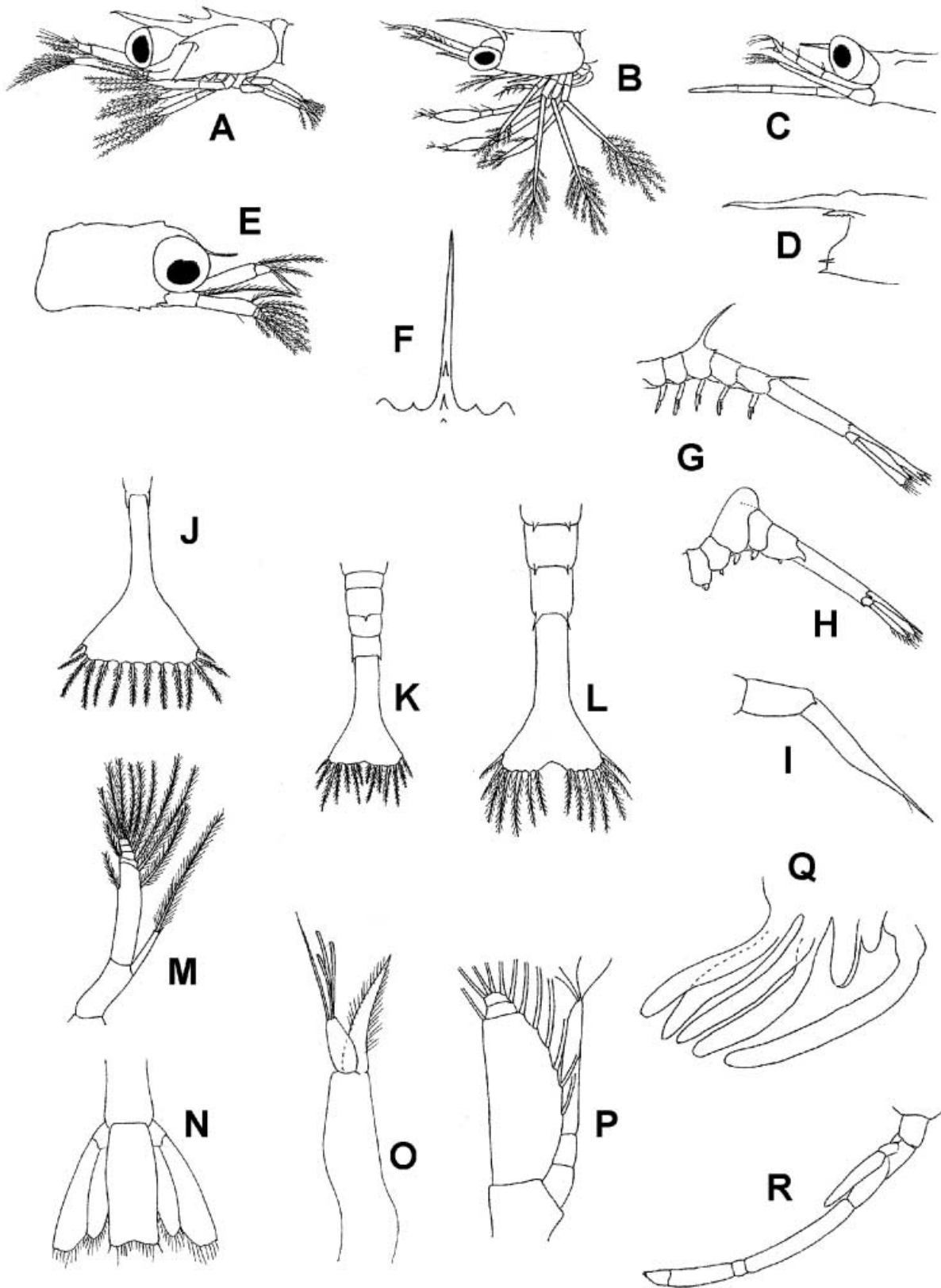


**Figure 3.** General aspects of caridean larvae. (A) Zoea I of *Pasiphaea sivado*; (B) zoea I of *Dichelopandalus bonnieri*; (C) zoea I of *Pontophylus spinosus*; (D) zoea V of *Stylopandalus richardi*; (E) zoea I of *Pontonia pinnophylax*; (F) zoea I of *Parapasiphaea sulcatifrons*; (G) zoea II of *Acantheephyra*; (H) zoea I of Pandalidae sp. 1; (I) zoea IV (?) of *Aegaeon cataphractus*; (J) zoea I of *Caridion gordonii*; (K) zoea III of *Athanas nitescens*; (L) zoea IV of Pontoninae F8; (M) zoea II of *Synalpheus* sp.; (N) zoea I of *Systellaspis debilis*. (A, I (as *Pontocaris cataphractus*), redrawn from Williamson, 1960; B, D (as *Parapandalus richardii*), from Lebour, 1940; C, from Sars, 1890; E, from Bourdillon-Casanova, 1960; F, from Kemp, 1910; G, H, K, L, from dos Santos, 1999; J, from Sars, 1900; N (as *Acantheephyra debilis*), from Kemp, 1910).

12. (a) Third to fifth abdominal somites with a pair of lateral spines (Figure 5L) . . . . . Genus *Philocheirus*  
 (b) Only fifth abdominal somite with a pair of strong lateral spines . . . . . *Crangon allmani*
13. (a) Abdomen with six somites. . . *Chlorotocus crassicornis*  
 (b) Abdomen with five somites (Figure 3B, E, H) . . 14
14. (a) Third abdominal somite with hump (Figure 3G) 15  
 (b) Third abdominal somite without hump (Figure 3E, H–J) . . . . . 16
15. (a) Anterior and posterior margins of carapace with denticles (Figure 3G) . . . . . Genus *AcanthePHYra*  
 (b) Anterior and posterior margins of carapace without denticles . . . . . Genus *Nematocarcinus*
16. (a) Fifth pereopod well developed (Figure 3K) . . . 17  
 (b) Fifth pereopod as bud, when present (Figure 3H) . . . . . 18
17. (a) Eyes pointed (Figure 4C) . . . . . *Alpheus glaber*  
 (b) Eyes rounded. . . . . *Alpheus* spp.
18. (a) Dorsal connection between carapace and abdomen almost make 90° angle (Figure 3E) . . . . .  
 . . . . . Subfamily Pontoninae  
 (b) Dorsal connection between carapace and abdomen almost make 180° angle (Figure 3H–J) . . . . . 19
19. (a) Bases of antennules separated by more than width of one of them (Figures 3B; 4A, D, E) . . . . . 20  
 (b) Bases of antennules close together (Figures 3C; 4B, H, K) . . . . . 25
20. (a) Fifth abdominal somite with a pair of lateral spines (Figure 3B, H, J) . . . . . 22  
 (b) Fifth abdominal somite without a pair of lateral spines . . . . . 21
21. (a) Rostrum small (Figure 4E) . . *Pandalina brevirostris*  
 (b) Rostrum long (Figure 4D) . . . . Genus *Plesionika*
22. (a) Fifth abdominal somite with 1–3 median dorsal spines (Figure 3H) . . . . . *Pandalidae* sp. 1  
 (b) Fifth abdominal somite without median dorsal spines (Figure 3B) . . . . . 23
23. (a) Denticles on the ventral margin of carapace (Figure 5E) . . . . . 24  
 (b) Ventral margin of carapace not denticulate . . . . . Genus *Caridion*
24. (a) Antennule with two aesthetascs and two setae; antennal endopod with two spines, the shorter reaching the tip of the scale . . *Dichelopandalus bonnierii*  
 (b) Antennule with four aesthetascs and one seta; antennal endopod with one long spine and a very short seta (Figure 5M) . . . . . Genus *Lysmata*
25. (a) Telson enlarged apically without central invagination (Figure 5J) . . . . . Genus *Palaemon*  
 (b) Telson not enlarged (Figure 5K, L) . . . . . 26
26. (a) Ventral margin of carapace denticulate (Figure 3I) . . . . . 27  
 (b) Ventral margin of carapace not denticulate . . . . . Genus *Cinetorhynchus*
27. (a) Fifth abdominal somite with a pair of spines (Figure 5I) . . . . . 28  
 (b) Fifth abdominal somite without spines . . . . .  
 . . . . . Genus *Eualus*
28. (a) Rostrum long (Figure 4B) . . . . . Genus *Hippolyte*  
 (b) Rostrum absent, or when present very small (Figure 4K) . . . . . Genus *Thoralus*
29. (a) Dorsal connection between the carapace and the abdomen making a 90° angle (Figure 3E, K) . . . . 30  
 (b) Third abdominal somite with a hump (Figures 3G; 5H) . . . . . 34  
 (c) Body-shape without any of the above characters (Figure 3I, M) . . . . . 35
30. (a) Carapace with supra-orbital spines (Figures 3L; 4I; 5D) . . . . . 31  
 (b) Carapace without supra-orbital spines . . . . .  
 . . . . . *Athanas nitescens*
31. (a) Carapace with a median-dorsal carina (Figure 3L) . . . . . Pontoninae F8  
 (b) Carapace without a median-dorsal carina (Figure 4I) . . . . . 32
32. (a) Supra-orbital spine short and smooth (Figure 4I) . . . . . 33  
 (b) Supra-orbital spine long and serrated (Figure 5D) . . . . . Genus *Periclimenes*
33. (a) Antennal endopod very long, at least twice the length of the antennal scale (Figure 5C) . . . . .  
 . . . . . Family Rhynchocinetidae  
 (b) Antennal endopod not reaching or slightly exceeding the distal margin of antennal scale (Figure 5P) . . . . . Genus *Pontonia*
34. (a) Fifth abdominal somite with dorso-lateral spines (Figure 5H) . . . . . Genus *AcanthePHYra*  
 (b) Fifth abdominal somite without dorso-lateral spines . . . . . Genus *Nematocarcinus*
35. (a) Eye-stalk long and slender (Figure 4J) . . . . .  
 . . . . . Genus *Lysmata*  
 (b) Eye-stalk funnel-shaped (Figure 4G) . . . . .  
 . . . . . Genus *Plesionika*  
 (c) Eye-stalk without the characters described above (Figures 3M; 4F) . . . . . 36
36. (a) Fifth pereopod very long reaching the anterior part of carapace (Figure 3M) . . . . .  
 . . . . . Genus *Alpheus* and Genus *Synalpheus*  
 (b) When present fifth pereopod not long, the same size as the others pereopods . . . . . 37
37. (a) Fifth pereopod with exopod (Figure 5R) . . . . 38  
 (b) When present fifth pereopod without exopod . 39



**Figure 4.** Cephalic appendages of caridean larvae. (A) Zoea I of *Processa macrodactyla*; (B) zoea I of *Hippolyte varians*; (C) zoea VI of *Alpheus glaber*; (D) zoea II of *Plesionika* FSL12; (E) zoea I of *Pandalina brevisrostris*; (F) zoea V of *Processa edulis*; (G) zoea V of *Plesionika*; (H) zoea I of *Philocheas monacanthus*; (I) zoea III of *Pontonia pinnophylax*; (J) zoea VIII of *Lysmata seticaudata*; (K) zoea I of *Thoralus cranchii*. (A, redrawn from González-Gordillo & Rodríguez, 2000; B, from Sars, 1911; C, F, G, J, from Paula, 1993; D, from dos Santos, 1999; E, from Gurney, 1942; H, from González-Gordillo et al., 2000; I, from Calafiore et al., 1991; K (as *Spirontocaris cranchii*), from Lebour, 1932).



**Figure 5.** Some appendages of caridean larvae. (A) Zoea III of *Palaemon elegans*; (B) zoea IV of *Caridion gordonii*; (C) antero-lateral view of zoea IV of *Rhynchocinetes rigens*; (D) carapace of zoea IV of *Periclimenes* sp.; (E) zoea I of *Lysmata seticaudata*; (F) front of carapace of antepenultimate stage of *Stylopandalus richardi*; (G) last stage of *Pontophilus norvegicus*; (H) abdomen of zoea VIII (?) of *AcanthePHYra purpurea*; (I) abdomen of zoea I of *Hippolyte* sp.; (J) telson of zoea I of *Palaemon adspersus*; (K) abdomen of zoea I of *Crangon crangon*; (L) abdomen of zoea I of *Philocheras monacanthus*; (M) zoea I of *Lysmata seticaudata*; (N) last zoeal stage of *Pasiphaea sivado*; (O) antennule of zoea I of *Philocheras monacanthus*; (P) antennal scale of zoea III of *Pontonia pinnophylax*; (Q) pereiopods I-V of zoea I of Alpheidae; (R) fifth pereiopod of *Pasiphaea*. (A, redrawn from Fincham & Williamson, 1978; B, from Williamson, 1957; C, from Gurney & Lebour, 1941; D, from Bourdillon-Casanova, 1960; F (as *Parapandalus richardi*), from Lebour, 1940; G, from Williamson, 1960; H, from Gurney, 1942; L, O, from González-Gordillo et al., 2000; N, from Williamson, 1960a; P, from Calafiore et al., 1991).



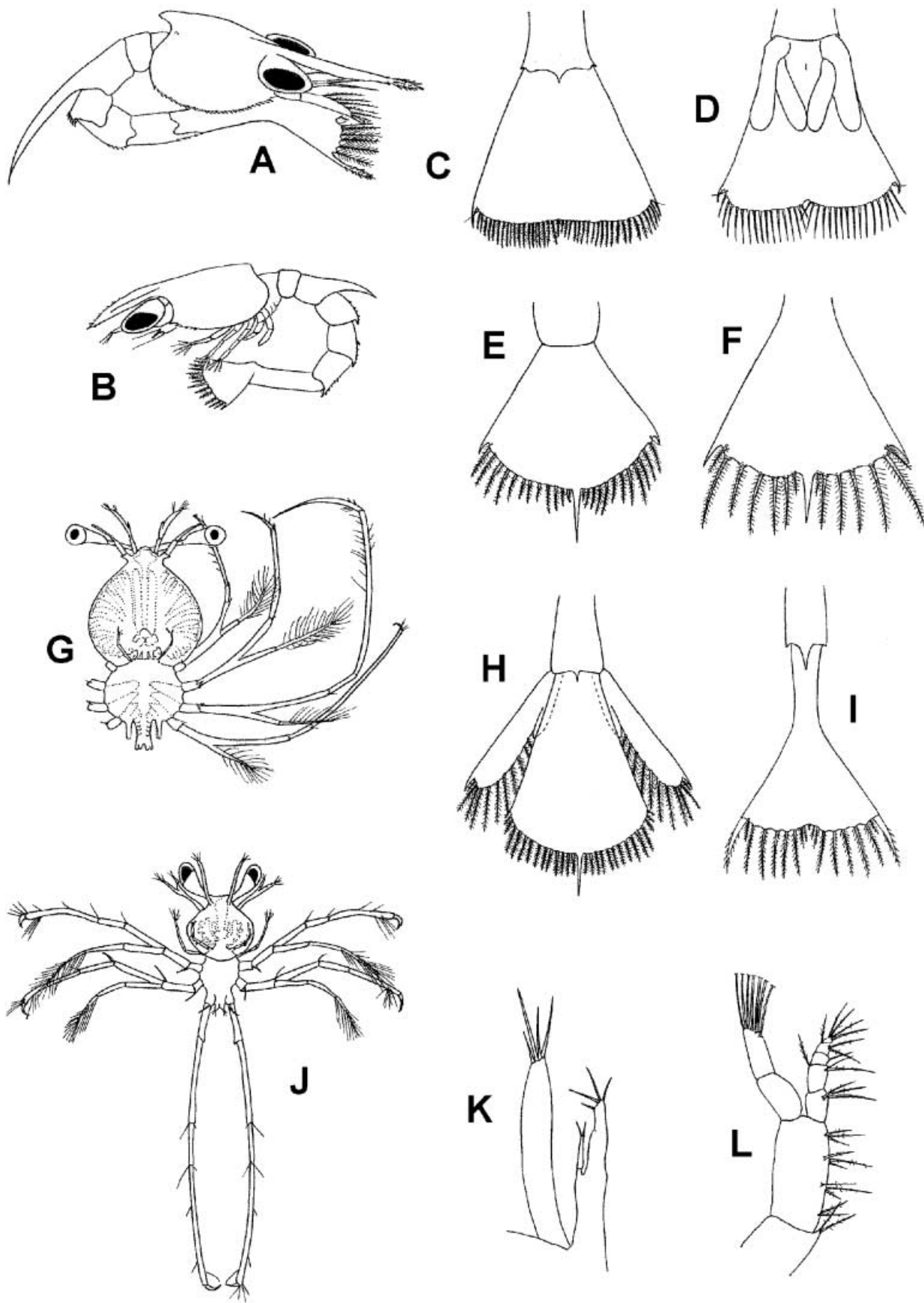
38. (a) Telson posterior margin enlarged, with 20 or more setae (Figure 5N) . . . . . Genus *Pasiphaea*  
 (b) Without these above characters. . Genus *Systellaspis*
39. (a) Bases of antennules separated by more than width of one of them (Figures 3D; 4A, E, F) . . . . . 40  
 (b) Bases of antennules close or separated by not more than width of one of them (Figure 4B, H) . . . . . 43
40. (a) Endopods of third maxilliped, first and second pereopod expanded (Figure 5B) . . . . Genus *Caridion*  
 (b) Endopods not expanded (Figure 5A) . . . . . 41
41. (a) Rostrum never toothed; antennal scale never segmented (Figure 4F) . . . . . Genus *Processa*  
 (b) Rostrum with small teeth (Figure 5F) or antennal scale segmented at tip (Figure 4E) . . . . . 42
42. (a) First to third pereopods bearing exopods . . . . .  
 . . . . . *Pandalina brevirostris*  
 (b) First to fourth pereopods bearing exopods (Figure 3D) . . . . . Genus *Stylopandalus*
43. (a) Rostrum short (Figures 3D; 4F) . . . . . 45  
 (b) Rostrum long. . . . . 44
44. (a) Carapace with 1–3 dorso-median teeth on the anterior part (Figure 5A) . . . . . Genus *Palaemon*  
 (b) Very large dorso-median spine on third abdominal somite (Figure 5G) . . . . . Genus *Pontophilus*
45. Third abdominal somite with a dorso-median spine (Figures 3I; 5G) . . . . . 46  
 (b) Third abdominal somite without dorso-median spine (Figure 5L) . . . . . 47
46. (a) Dorso-median spine on third abdominal somite very large (Figure 5G) . . . . . Genus *Pontophilus*  
 (b) Dorso-median spine on third abdominal somite small (Figures 3I; 5K) . . . . . 46
47. (a) Fifth abdominal somite with a pair of dorso-lateral spines (Figure 5K) . . . . . *Crangon crangon*  
 (b) Fifth abdominal somite without dorso-lateral spines; endopod of antennule bigger than the body and segmented (Figure 3I) . . . . . Genus *Aegaon*
48. (a) Eyes rounded; rostrum enlarged at base; endopod of antennule cylindrical shaped (Figures 4H; 5O) . . . . .  
 . . . . . Genus *Philocheras*, *Crangon almanni*  
 (b) Rostrum narrow; endopod of antennule long and thin (Figure 4B) . . . . .  
 . . . . . Genus *Hippolyte*, Genus *Eualus* or Genus *Thoralus*

KEY 3—Infraorder ASTACIDEA  
 (Figure 2B, C)

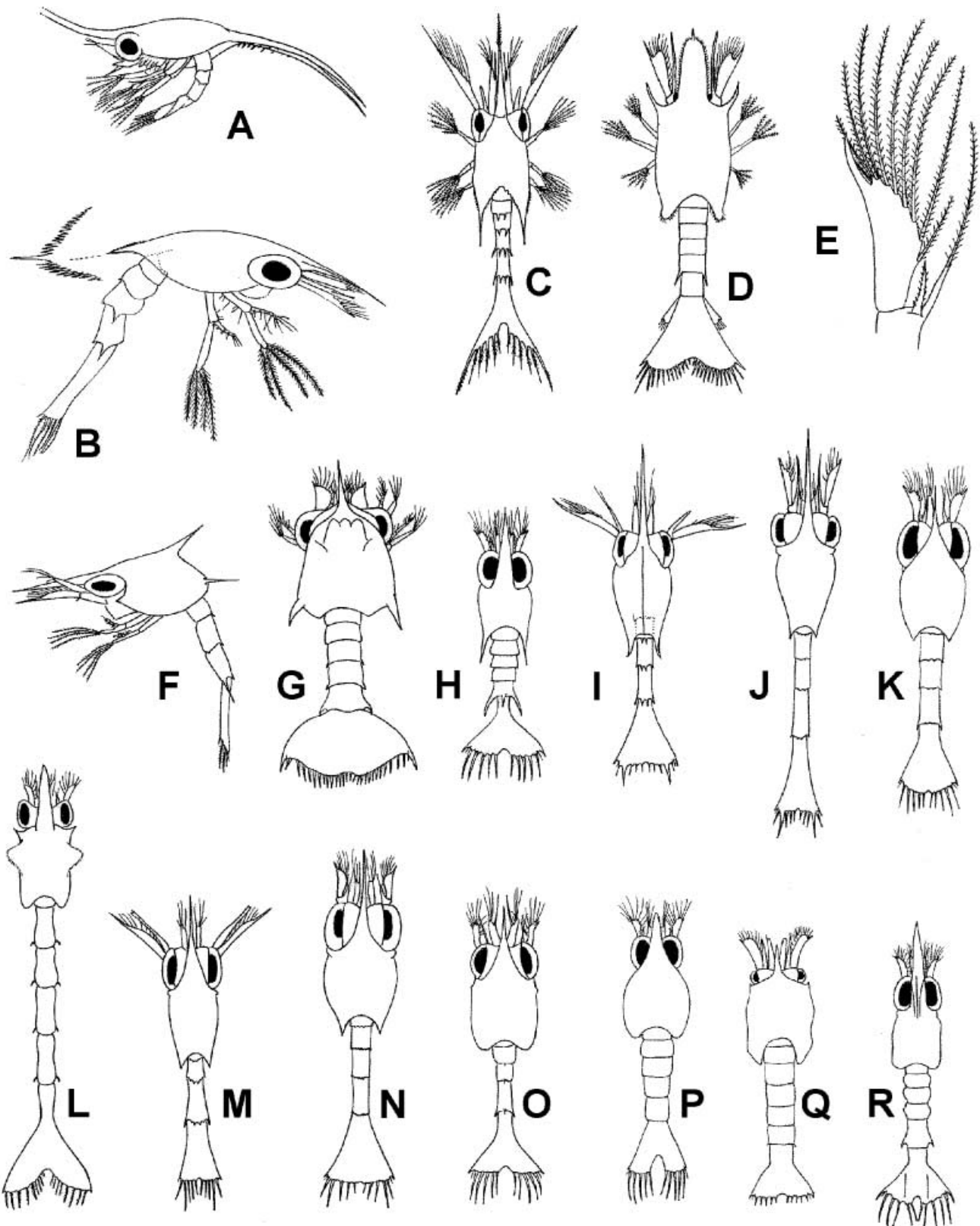
1. (a) Telson posteroexternal spines very long; fourth and fifth abdominal somites with a long dorsally directed median spine (Figure 2B) . . . . . *Nephrops norvegicus*  
 (b) Telson posteroexternal spines very short; second to fourth abdominal somites with a short posterior directed median spine (Figure 2C) . . *Homarus gammarus*

KEY 4—Infraorder THALASSINIDEA  
 (Figures 1F, H; 2F, H; 6A–F, H, I, L)

1. (a) Anterior part of carapace elongated; antennae and eyes separated from mouthparts (Figure 1F) . . . . .  
 . . . . . *Jaxea nocturna*  
 (b) Anterior part of carapace never elongated; antennae near the mouthparts (Figure 1H) . . . . . 2
2. (a) Abdominal segments without dorsal spines . . . . .  
 . . . . . (Genus *Upogebia*) 3  
 (b) At least one abdominal segment with dorsal spines (Figures 2F; 6A, B) . . . . . 4
3. (a) Endopod of first maxilliped with 3, 2, 1, 2+1, 4 setae . . . . . *Upogebia deltaura*  
 (b) Endopod of first maxilliped with 3, 2+1, 1, 2+1, 4 setae (Figure 6L) . . . . . *Upogebia pusilla*
4. (a) Fifth abdominal somite without lateral spines . . . 5  
 (b) Fifth abdominal somite with two pairs of dorso-lateral spines; four pairs of pleopods; telson triangular with posterior central margin slightly concave (Figure 2F) . . . . . *Axius stirhynchus*
5. (a) Posterior central margin of the telson slightly concave, without a distinct central seta (Figure 6C, D) . . . . . 6  
 (b) Posterior margin of the telson with differentiated central spine (Figure 6E, F, H, I) . (Genus *Callianassa*) 7
6. (a) Posterior margin of the telson with 18–19+18–19 setae (Figure 6D) . . . . . *Calocaris macandreae*  
 (b) Posterior margin of the telson with 22–23+22–23 setae (Figure 6C) . . . . . *Calocarides coronatus*
7. (a) Telson spine formula: 7–9+1+7–9 (Figure 6F) . . 8  
 (b) Telson spine formula: 13–18+1+13–18 (Figure 6E, H) . . . . . 10
8. (a) All ventral margin of carapace denticulate (Figure 6A); second abdominal somite with very long median dorsal spine reaching the fifth abdominal somite; first spine of telson denticulate (Figure 6I) . . . . .  
 . . . . . Callianassidae SL16  
 (b) When present, denticles only on the anterior ventral margin of carapace (Figure 6B); second abdominal somite reaching only to the fourth abdominal somite (Figure 1H); first spine of telson without denticles (Figure 6F) . . . . . 9
9. (a) Six abdominal somites, without medio-dorsal spine on sixth one; uropods present from zoea II . . . . .  
 . . . . . *Callianassa subterranea*  
 (b) Five abdominal somites in zoea I; medio-dorsal spine on sixth abdominal somite when presents (Figure 6B); uropods present from zoea III . *Callianassa truncata*
10. (a) Three zoeal stages: zoea I with median telson spine the same size as the others spines, zoea II without uropods, zoea III with exopod of uropods well developed (Figure 6H); telson spine formula: 14, 1, 14 . . . . . *Callianassa tyrrenna*



**Figure 6.** General aspects and appendages of thalassinidean and palinuran larvae. (A) Zoea I of Callianassidae SL16; (B) zoea I of *Callianassa truncata*; (C) telson of zoea II of *Calocarides coronatus*; (D) telson of zoea II of *Calocaris macandreae*; (E) telson of zoea I of Callianassidae L17; (F) telson of zoea I of *Callianassa subterranea*; (G) zoea III of *Palinurus elephas*; (H) telson of zoea III of *Callianassa tyrrhena*; (I) telson of zoea I of Callianassidae SL16; (J) zoea I of *Scyllarides latus*; (K) antennule and antenna of zoea I of *Scyllarides latus*; (L) first maxilliped of zoea II of *Upogebia pusilla*. (A, B, H, I, redrawn from dos Santos, 1999; C, Elofsson (1959); D, F, G from Gurney, 1942; J, K, from Santucci, 1925).



**Figure 7.** General aspects and appendages of anomuran larvae. (A) Zoea I of *Pisidia longicornis*; (B) zoea I of *Galathea squamifera*; (C) zoea II of *Munida rugosa*; (D) zoea I of *Munidopsis tridentata*; (E) antenna of Zoea I of *Galathea intermedia*; (F) zoea I of *Nematopagurus longicornis*; (G) zoea I of *Albunea carabus*; (H) zoea I of *Calcinus tubularis*; (I) zoea I of *Pagurus alatus*; (J) zoea I of *Pagurus bernhardus*; (K) zoea I of *Pagurus anachoretus*; (L) zoea I of *Parapagurus pilosimanus*; (M) zoea I of *Pagurus pubescens*; (N) zoea I of *Anapagurus laevis*; (O) zoea I of *Diogenes pugilator*; (P) zoea I of *Clibanarius erythropus*; (Q) zoea I of *Paguristes eremita*; (R) zoea I of *Dardanus arrosor*. (B, redrawn from Ingle, 1992; C (as *M. banffica*), from Lebour, 1930; D, from Pike & Williamson, 1972; E, from Christiansen & Anger, 1990; F, (as Species N.3); H, (as *Calcinus tubularis*); K, P, Q, (as *Paguristes oculatus*); R, from Pike & Williamson, 1960; G, from Seridji, 1988; I (as *Pagurus variabilis*), from Samuelsen, 1972; J, M, N, O, from Pike & Williamson, 1958; L, from Saint Laurent, 1964).

(b) Two zoeal stages: zoea I with median telson spine longer than the others (Figure 6E), zoea II with buds of uropods; telson spine formula: 17, 1, 17 . . . . . Callianassidae L17

KEY 5 – Infraorder PALINURA (excluding Family Polychelidae)  
(Figures 1D; 6G, J, K)

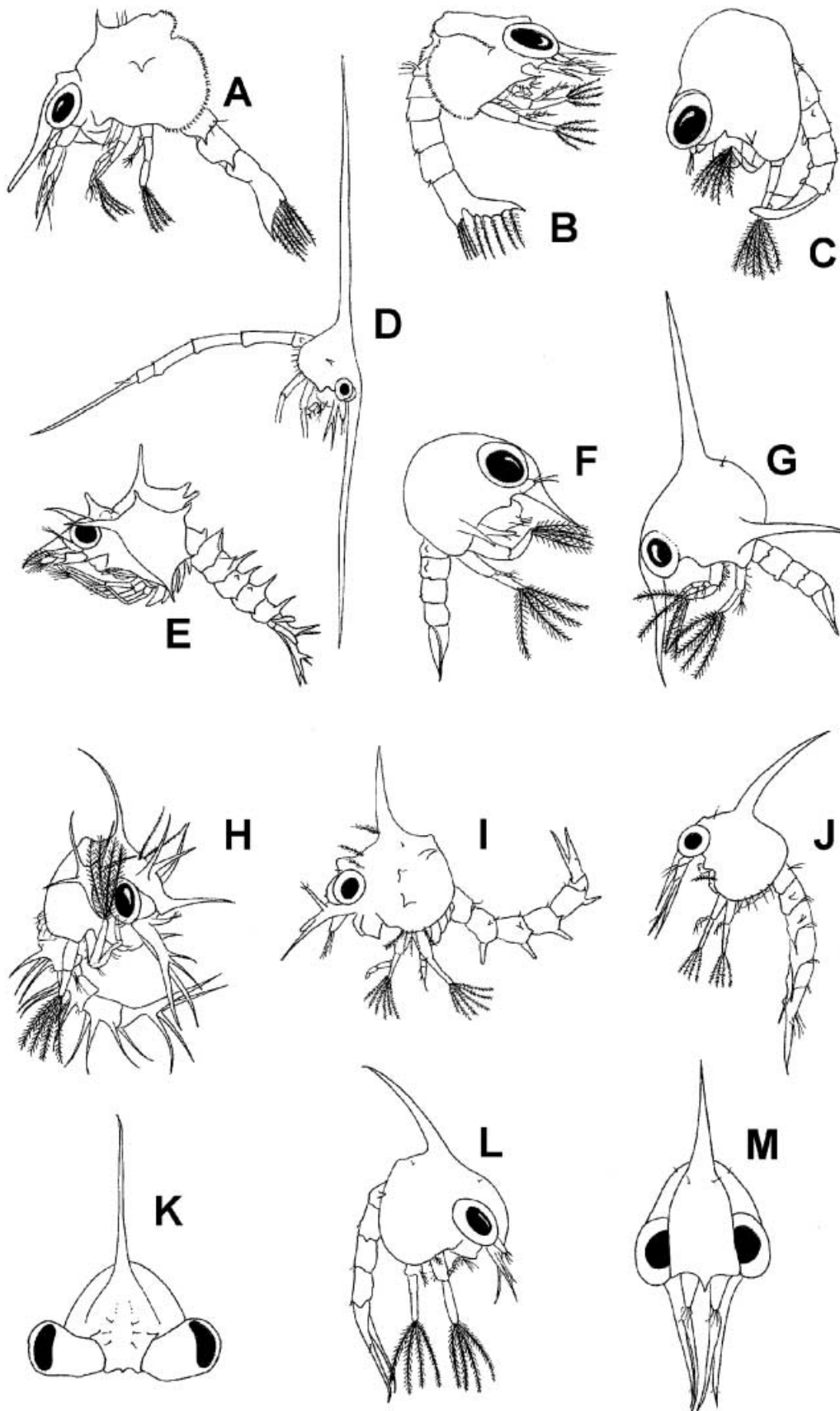
1. (a) Third maxilliped without exopod (Figures 1D; 6J) . . . . . (Family Scyllaridae) 2  
(b) Third maxilliped with exopod (Figure 6G) . . . . . Genus *Palinurus*
2. (a) Carapace pear-shape; antennule with exopod in first zoea (Figure 6K); third pereopod larger than second pereopod (Figure 6J) . . . . . *Scyllarides latus*  
(b) Carapace as long as width; antennule without exopod in first zoea (Figure 1H); third pereopod the same size as second pereopod (Figure 1D) . . . . . Genus *Scyllarus*

KEY 6 – Infraorder ANOMURA  
(Figures 1E, I; 2A, I, 7A–R)

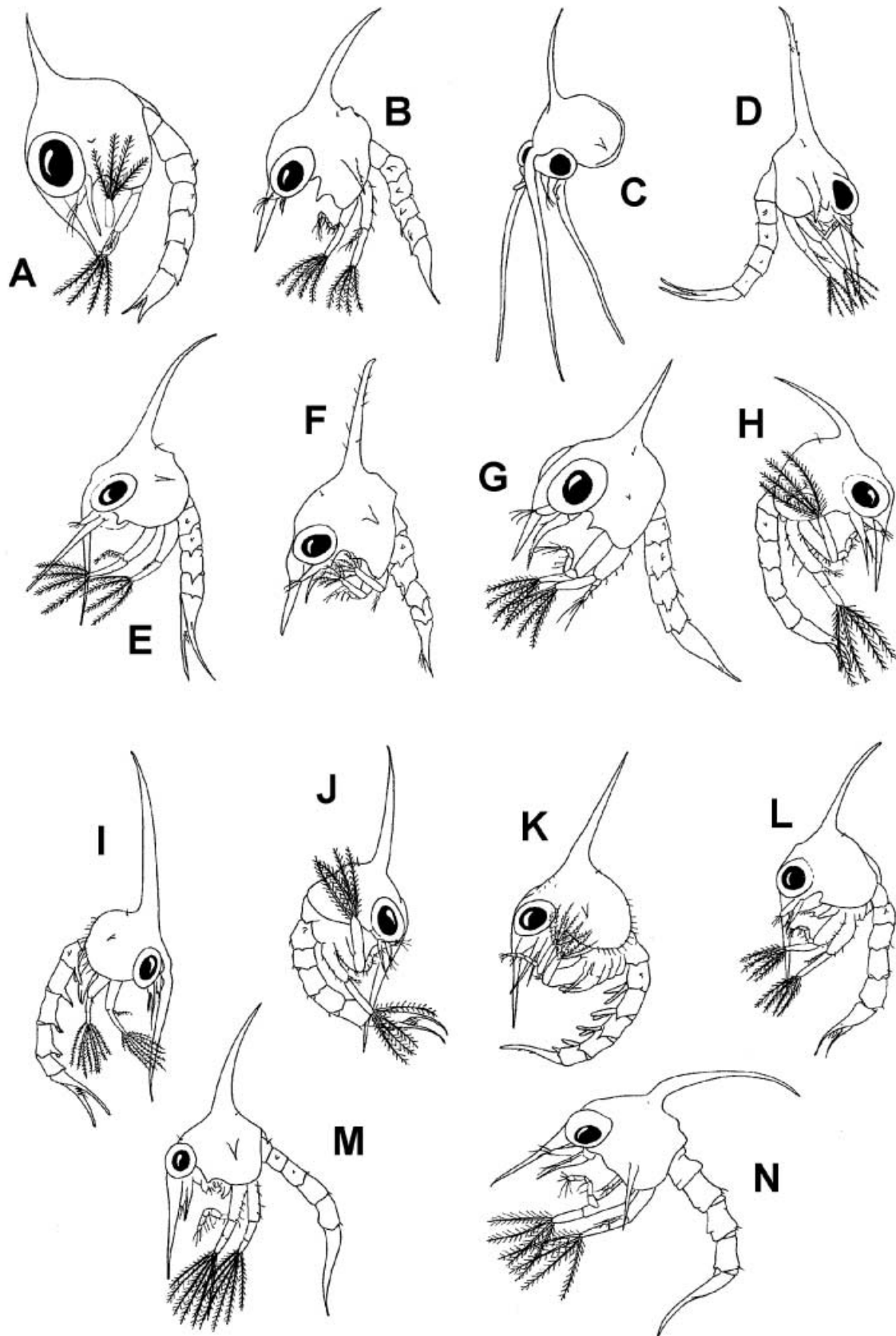
1. (a) Postero-lateral margin of carapace extended into a spinous process (Figures 1E, I; 7F–K, M, N) . . . . . 2  
(b) Postero-lateral margin of carapace rounded (Figure 7L, O, Q, R) . . . . . 12
2. (a) Rostrum much longer than body; postero-lateral margin process of carapace extended beyond the end of telson (Figures 1E; 7A) . . . . . (Family Porcellanidae) 3  
(b) Rostrum shorter than body; postero-lateral margin process of carapace never extending beyond the end of telson (Figures 1I; 7B, F–K, M, N) . . . . . 4
3. (a) Posterior carapace spines at least half length of rostrum, without conspicuous ventral spines (Figure 1E) or with pleopods on second to fifth abdominal somites . . . . . *Porcellana platycheles*  
(b) Posterior carapace spines less than half length of rostrum, with two conspicuous ventral spines (Figure 7A) or with pleopods on second to fourth abdominal somites . . . . . *Pisidia longicornis*
4. (a) Posterolateral margins of carapace denticulate (Figure 7B–D) . . . . . (Family Galatheididae) 5  
(b) Posterolateral margins of carapace without denticles but with terminal spine (Figures 1I; 7F–K, M, N) . . . . . 6
5. (a) Antennal exopod aciculate; rostrum narrower than diameter of eye (Figure 7C) . . . . . Genus *Munida*  
(b) Antennal exopod flattened (Figure 7E); rostrum narrower than diameter of eye (Figure 7B) . . . . . Genus *Galathea*

(c) Antennal exopod flattened; rostrum broader than diameter of eye (Figure 7D) . . . . . Genus *Munidopsis*

6. (a) Carapace with a median dorsal spine (Figure 7F) . . . . . *Nematopagurus longicornis*  
(b) Carapace without median dorsal spine (Figure 7G–K, M, N) . . . . . 7
7. (a) Telson strongly enlarged posteriorly with the outer posterior spines large, the same length as the rest of telson; spine formula: 6–7+6–7 . . . *Spiropagurus elegans*  
(b) Telson enlarged, broader than long with three short anterior carinae; spine formula: 15–19+15–19 (Figure 7G) . . . . . *Albunea carabus*  
(c) Telson not enlarged and outer posterior spines not enlarged and never the same length as rest of telson; spine formula: 6–7+6–7 (Figure 7H–K, M, N) . . . 8
8. (a) Fifth abdominal somite with a pair of lateral spines and a median dorsal one (Figure 7H) . . . . . *Calcinus tubularis*  
(b) Fifth abdominal somite with a pair of lateral spines and without or with more than one dorsal spine (Figure 7I–K, M) . . . . . (Genus *Pagurus*) 9  
(c) Fifth abdominal somite without or with very small lateral spines and without median dorsal spine (Figure 7N) . . . . . Genus *Anapagurus*
9. (a) Carapace with median dorsal carina (Figure 7I) . . . . . *Pagurus alatus*  
(b) Carapace without median dorsal carina (Figure 7J, K, M) . . . . . 10
10. (a) Longest telson spine longer than half greatest width of telson; length of antennal scale (excluding terminal spine) at least six times breadth (Figure 7J, M) . . . . . 11  
(b) Longest telson spine shorter than half greatest width of telson; length of antennal scale less than four times breadth (Figure 7K) . . . . . *Pagurus* spp.
11. (a) Fifth abdominal somite with large lateral spines; rostrum reaching around as far as spine on antennal scale (Figure 7M) . . . . . *Pagurus pubescens*  
(b) Fifth abdominal somite with small lateral spines; rostrum reaching well beyond spine on antennal scale (Figure 7J) . . . . . *Pagurus bernhardus*
12. (a) Fifth abdominal somite with a pair of ventral or lateral spines (Figures 2A; 7L, O, Q, R) . . . . . 13  
(b) Abdominal somites without lateral spines; rostrum large and rounded on distal margin (Figure 7P) . . . . . *Clibanarius erythropus*
13. (a) Second to fifth abdominal somites short, with small dorso-marginal spines (Figure 7O); telson posterior margin with a small V-shaped cleft (Figure 2A) . . . . . *Diogenes pugilator*  
(b) Second to fifth abdominal somites long, with small ventro-lateral spines (Figure 7L) . . . . . *Parapagurus pilosimanus*  
(c) Only the fifth abdominal somite with dorso-marginal spines (Figure 7Q, R) . . . . . 14



**Figure 8.** General aspects of brachyuran larvae. (A) Zoea I of *Paramola cuvieri*; (B) zoea I of (?) *Latreillia elegans*; (C) zoea III of *Ebalia tuberosa*; (D) zoea I of *Ethusa mascarone*; (E) zoea IV of *Homola barbata*; (F) zoea I of *Pinnotheres pisum*; (G) zoea I of *Nepinnotheres pinnotheres*; (H) zoea I of *Dorhynchus thomsoni*; (I) zoea II of *Stenorhynchus lanceolatus*; (J) zoea I of *Herbstia condyliata*; (K) frontal aspect of carapace of zoea I of *Inachus dorsettensis*; (L) zoea I of *Eurynome spinosa*; (M) frontal aspect of carapace of zoea I of *Pisa armata*. (A, redrawn from Samuelsen, 1976; B, from Rice & Williamson, 1977; C, from Salman, 1982; D, from Paula, 1993; E, from Rice & Levetzow, 1967; F, G, H, K, L, M, from Ingle, 1992; I, from Paula & Cartaxana, 1991; J, from Bourdillon-Casanova, 1960).



**Figure 9.** General aspects of brachyuran larvae. (A) Zoea I of *Pachygrapsus marmoratus*; (B) zoea I of *Plagusia depressa*; (C) carapace of zoea IV of *Rhithropanopeus harrisii*; (D) zoea I of *Percnon gibbesi*; (E) zoea I of *Xantho incisus*; (F) zoea III of Grapsinae ASM30; (G) zoea I of *Planes minutus*; (H) zoea I of *Pirimela denticulata*; (I) lateral aspect of zoea IV of *Thia scutellata*; (J) zoea I of *Portunus latipes*; (K) zoea V of *Necora puber*; (L) zoea I of *Carcinus maenas*; (M) zoea I of *Brachynotus sexdentatus*; (N) zoea I of *Asthenognathus atlanticus*. (A, redrawn from dos Santos, 1999; B, from Schubart et al., 2001; C, from Conolly, 1925; D, from Paula & Hartnoll, 1989; E, from Ingle, 1983; F, from Rice & Williamson, 1977; G, from Cuesta et al., 1997; H, from Ingle, 1992; I, from Ingle, 1984; J, K, from Ingle, 1992; L, from Rice & Ingle, 1975; M, from Cuesta, 1999; N, from Bocquet, 1965).

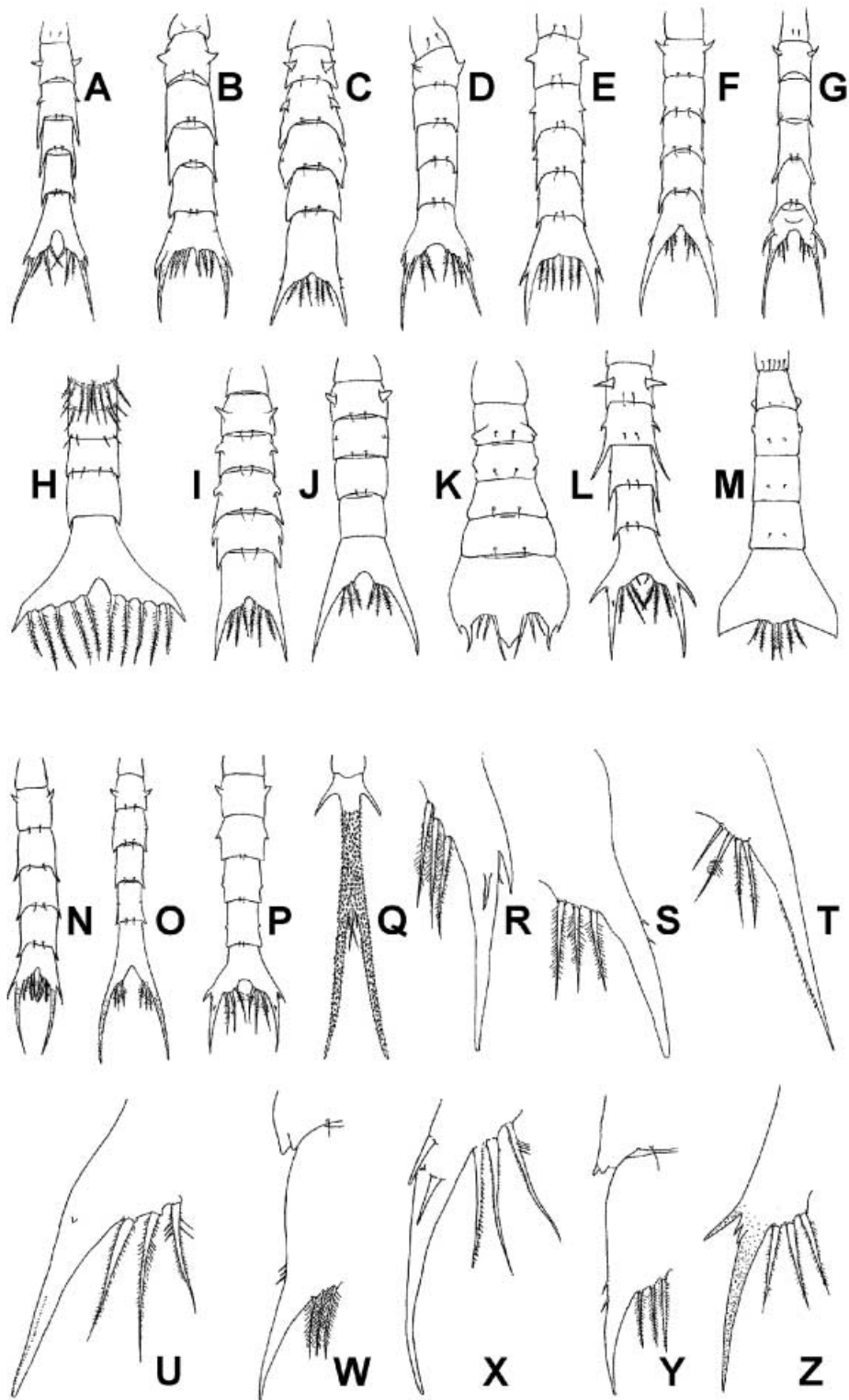
14. (a) Rostrum not reaching the end of antennule; cuticle smooth; zoea I with pleopod buds (Figure 7Q) . . . . . *Paguristes eremita*  
 (b) Rostrum longer than antennule; cuticle scaly; zoea I without pleopod buds (Figure 7R) . . . *Dardanus arrosor*

KEY 7 – Infraorder BRACHYURA  
 (Figures 8, 9, 10, 11 & 12)

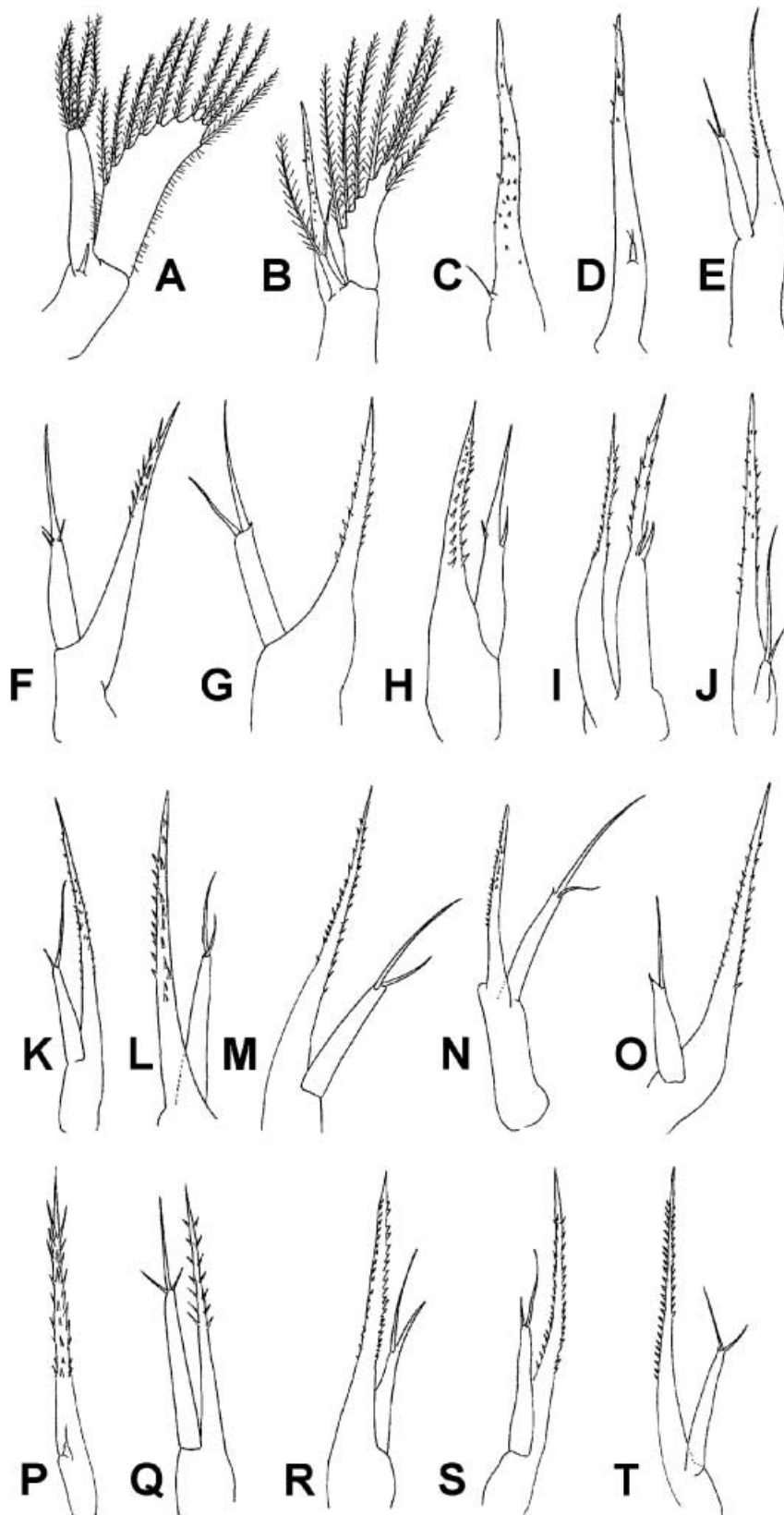
1. (a) Antennal exopod well developed and flat, with long plumose setae; spinous process vestigial (Figure 11A) . . . . . *Dromia personata*  
 (b) Antennal exopod well developed and flat, with long plumose setae; spinous process well developed (Figure 11B) . . . . . 2  
 (c) Antennal exopod well developed and styliform, spinous process well developed (Figures 11C, E–I, K, L–O, T; 12G) . . . . . 4
2. (a) Dorso and dorso-lateral processes on abdominal somites 2–4; dorso-lateral spines on telson (Figure 8E) . . . . . *Homola barbata*  
 (b) No dorso-lateral processes on abdominal somites; no dorso-lateral spines on telson (Figure 10H) . . . . . 3
3. (a) Dorso and lateral carapace spines well differentiated (Figure 8A) . . . . . *Paromola cuvieri*  
 (b) No prominent spines on carapace (Figure 8B) . . . . . (?) *Latreillia elegans*
4. (a) Very long furca with a maximum of 2+2 posterior processes (Figure 10Q); carapace rostral and dorsal spines very long (Figure 8D) . (Family Dorippidae) 5  
 (b) Without this combination of characters . . . . . 6
5. (a) Lateral spines on carapace (Figure 8D) . . . . . *Ethusa mascarone*  
 (b) No lateral spines on carapace . . . . . *Medorippe lanata*
6. (a) Telson as typical furca (Figure 10A–D, F, G, J, L, N, W, Z) . . . . . 13  
 (b) Telson non furca type (Figure 10K, M) . . . . . 7
7. (a) Telson trilobed (Figure 10K) . . . . . 8  
 (b) Telson with triangular shape (Figure 10M) . . . . . (Family Leucosiidae) 9
8. (a) Carapace with dorsal spine (Figure 8G) . . . . . *Nepinnotheres pinnotheres*  
 (b) Carapace without dorsal spine (Figure 8F) . . . . . *Pinnotheres pisum*
9. (a) Carapace with dorsal spine . . . . . *Ilia nucleus*  
 (b) Carapace without dorsal spine (Figure 8C) . . . . . (Genus *Ebalia*) 10
10. (a) Endopod of maxillule two-segmented, with four setae on distal segment (Figure 12F) . . . *Ebalia tuberosa*  
 (b) Endopod of maxillule unsegmented, with three setae (Figure 12A) . . . . . 11
11. (a) Endopod of the first maxilliped with 2, 1, 1, 2, 5 setae (Figure 12M) . . . . . *Ebalia nux*  
 (b) Endopod of the first maxilliped with 1, 1, 0, 2, 5 setae (Figure 12K) . . . . . 12
12. (a) Inter-orbital region 3-pointed (Figure 12D) . . . . . *Ebalia tumefacta*  
 (b) Inter-orbital region bilobed, with no central spine . . . . . *Ebalia cranchii*
13. (a) Two stages: first stage (four natatory setae on exopod of maxillipeds) with antennal endopod bud; second stage (six natatory setae on exopod of maxillipeds) with pleopod buds (Figure 8I); ‘majid seta’ on inner lateral margin of carapace (Figures 8I, 12N) . . . . . (Family Majidae) 14  
 (b) Four or more stages: first stage (four natatory setae on exopod of maxillipeds) without antennal endopod bud (Figures 11C, E–I, K–O, T; 12G); second stage (six natatory setae on exopod of maxillipeds) without pleopods; no ‘majid seta’ on inner lateral margin of carapace . . . . . 27
14. (a) Lateral spines on carapace (Figure 8H, I) . . . . . 15  
 (b) No lateral spines on carapace (Figure 8L) . . . . . 19
15. (a) Carapace with more than one pair of lateral spines (Figure 8H, I) . . . . . 16  
 (b) Carapace with one pair of lateral spines . . . . . 17
16. (a) Five pairs of lateral spines on carapace (Figure 8H) . . . . . *Dorhynchus thomsoni*  
 (b) Three pairs of lateral spines on carapace (Figure 8I) . . . . . *Stenorhynchus lanceolatus*
17. (a) Third abdominal somite with dorso-lateral knobs (Figure 10A) . . . . . 18  
 (b) Third abdominal somite without dorso-lateral knobs (Figure 10B) . . . . . *Rochinia carpenteri*
18. (a) Branches of telson furca with one lateral and dorsal spine (Figure 10A) . . . . . Genus *Hyas*  
 (b) Branches of telson furca with three lateral spines (Figure 10Z) . . . . . Genus *Maja*
19. (a) Rostral spine on carapace (Figure 8L, M) . . . . . 20  
 (b) No rostral spine on carapace (Figure 8K) . . . . . 25
20. (a) Rostral spine well developed (Figure 8L) . . . . . 21  
 (b) Rostral spine highly reduced (Figure 8M) . . . . . 23
21. (a) Branches of telson furca with prominent lateral and dorsal spines (Figure 10D) . . . . . Genus *Eurynome*  
 (b) Branches of telson furca without dorsal spine (Figure 10E) . . . . . 22
22. (a) Dorso-lateral knobs on abdominal somites 2 and 3 (Figure 8J) . . . . . *Herbstia condyliata*  
 (b) Dorso-lateral knobs on abdominal somites 2–5 (Figure 10E) . . . . . *Anamathia rissoana*

23. (a) Dorsal spine smaller than the diameter of the eye and armed with minute granular protuberances . . . . . *Acanthonyx lunulatus*  
(b) Dorsal spine bigger than the diameter of the eye and without protuberances. . . . . 24
24. (a) Endopod of second maxilliped armed with 0, 2, 5 setae; antennule with one simple seta and 4–5 aesthetascs in zoea I or seven in zoea II . . . . . *Lissa chiragra*  
(b) Endopod of second maxilliped armed with 0, 1, 5 setae; antennule with six aesthetascs in zoea I or eight aesthetascs in zoea II. . . . . Genus *Pisa*
25. (a) Branches of telson furca with small lateral spine (Figure 10F) . . . . . Genus *Macropodia*  
(b) Branches of telson furca with prominent lateral spine (Figure 10G, N) . . . . . 26
26. (a) Each furca of telson with a stout and curved outer lateral spine measuring slightly less than one-third furcal length (Figure 10G) . . . . . *Achaeus cranchii*  
(b) Each furca of telson with a thin and relatively straight outer spine measuring much less than one-third of furcal length (Figure 10N) . . . . . Genus *Inachus*
27. (a) Antennal exopod highly reduced (Figures 11C, J; 12G) . . . . . 28  
(b) Antennal exopod not reduced (Figure 11E–I, K–O, T) . . . . . 36
28. (a) Spinous process of antenna shorter than rostral spine (Figure 9A, B, D) . . . . . 29  
(b) Spinous process of antenna approximately of the length of rostral spine (Figure 9C, E) . . . . . 31
29. (a) Dorso-lateral knobs on abdominal somites 2–3 (Figure 10C) . . . . . *Calappa granulata*  
(b) Dorso-lateral knobs on abdominal somites 2–4 (Figure 9F) . . . . . Grapsinae ASM30  
(c) Dorso-lateral knobs on abdominal somites 2–5 (Figure 10I, O) . . . . . 30
30. (a) Rostral and dorsal spines longer than carapace in stage I (Figure 9D) and very long in subsequent stages; branches of telson furca slender and longer than proximal part of telson from stage II, with deep median notch (Figure 10O); dorsal spine with spinules at the tip; lateral spines with expanded tips (Figure 12O) . . . . . *Percnon gibbesi*  
(b) Rostral and dorsal spines no longer than carapace in stage I (Figure 9B); branches of telson furca slightly longer than proximal part of telson in all stages, with small median notch (Figure 10I) . . . . . *Plagusia depressa*
31. (a) Minute (zoea I) or well developed (later zoeas) lateral spines on carapace (Figure 9G) . . . . . 32  
(b) Well developed lateral spines on carapace (Figure 9C, E) . . . . . 33
32. (a) Antennule bearing two long and two short aesthetascs (Figure 12G); three minute lateral spines on each telson furca (Figure 10W) . . . . . *Grapsus adscensionis*  
(b) Antennule bearing two long and one short aesthetascs (Figure 12H); two lateral spines on each telson furca (Figure 10Y) . . . . . *Planes minutus*  
(c) Antennule bearing three to four aesthetascs; two lateral spines on each telson furca (Figure 10S) . . . . . Genus *Pachygrapsus*
33. (a) Rostral spine longer than twice carapace length (Figure 9C); very long posteroventral spine on abdominal somite 5 . . . . . *Rhithropanopeus harrisi*  
(b) Rostral spine less than twice carapace length (Figure 9E) . . . . . 34
34. (a) Basal segment of endopod of the first maxilliped with two setae . . . . . *Nanocassiope melanodactyla*  
(b) Basal segment of endopod of the first maxilliped with three setae . . . . . 35
35. (a) Antennal exopod with one terminal seta (Figure 11P) . . . . . *Panopeus africanus*  
(b) Antennal exopod with two terminal setae (Figure 11D) . . . . . Genus *Xantho*
36. (a) Dorso-lateral knobs on abdominal somite 2 only (Figure 9H–J, L) . . . . . 37  
(b) Dorso-lateral knobs in more than one abdominal somite, at least in first stage (Figures 9M; 10L) . . . 45
37. (a) Lateral spines on carapace (Figure 9H, I) . . . . . 38  
(b) No lateral spines on carapace (Figure 9L) . . . . . 43
38. (a) Telson with the inner margins of the outermost seta strongly serrate (Figure 10X) . . . . . 39  
(b) Telson without this character (Figure 10T) . . . 40
39. (a) First segment of endopod of the first maxilliped with three setae (Figure 12J) . . . . . Genus *Cancer*  
(b) First segment of endopod of the first maxilliped with two setae . . . . . Genus *Atelecycclus*
40. (a) Branches of telson furca with a row of teeth (Figure 10T) . . . . . *Brachynotus atlanticus*  
(b) Telson without this character . . . . . 41
41. (a) Dorsal and rostral carapace spines short, usually not exceeding carapace length (Figure 9H); antennal spinous process only just exceeding twice exopod length (Figure 11E) . . . . . *Pirimela denticulata*  
(b) Dorsal and rostral carapace spines long, well exceeding carapace length (Figure 9I); antennal spinous process exceeding twice exopod length, at least in first stage (Figure 11L) . . . . . 42
42. (a) First segment of endopod of the first maxilliped with three setae . . . . . *Corystes cassivelaunus*  
(b) First segment of endopod of the first maxilliped with two setae . . . . . *Thia scutellata*
43. (a) Antennal exopod with two subterminal spines (Figure 11Q) . . . . . *Sirpus zariquieyi*  
(b) Antennal exopod with one subterminal spine (Figure 11N) . . . . . 44

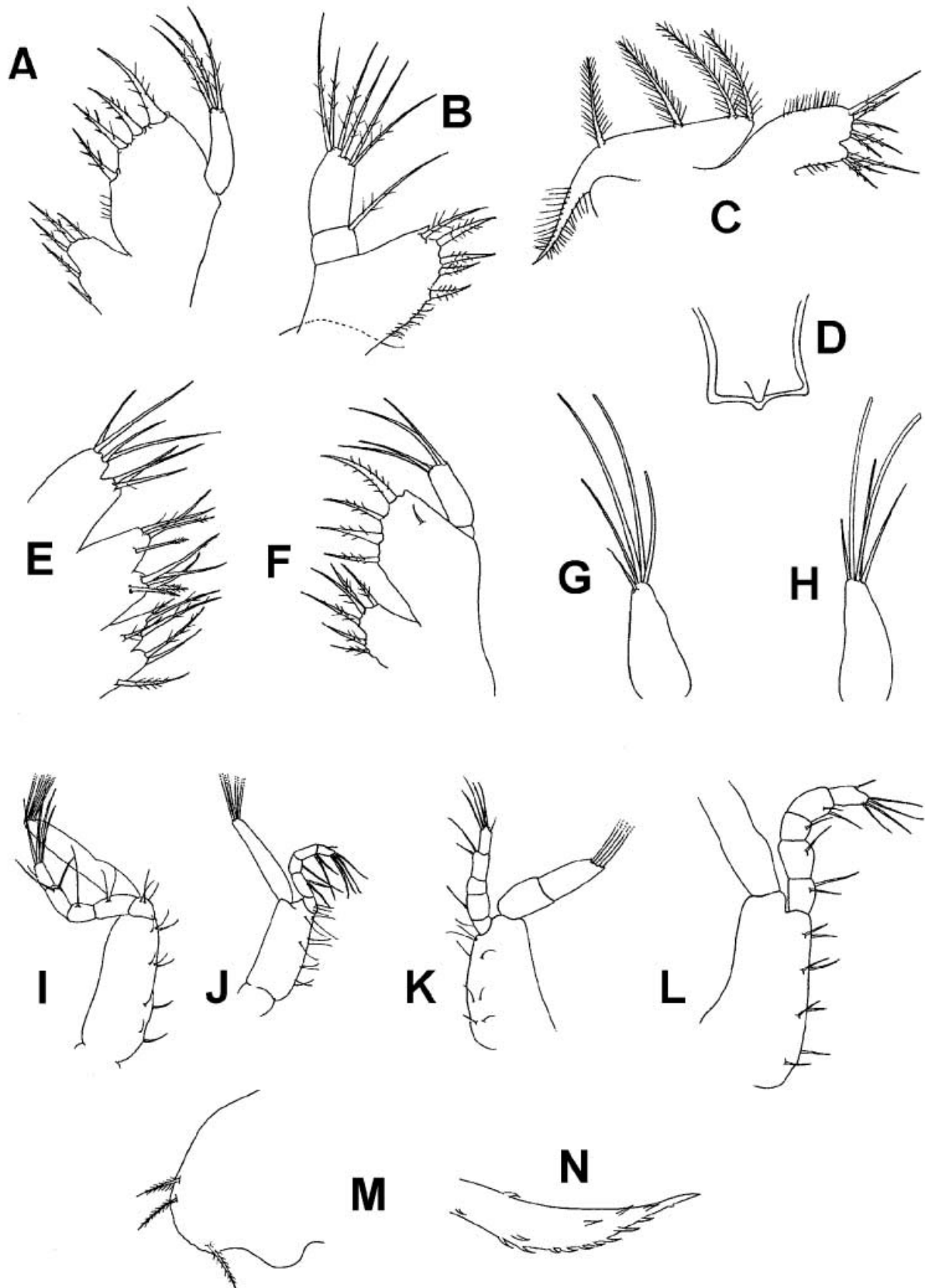




**Figure 10.** Telsons and abdomens of brachyuran larvae. (A) Zoea I *Hyas araneus*; (B) zoea I of *Rochinia carpenteri*; (C) zoea II of *Pachygrapsus transversus*; (D) zoea I of *Eurynome spinosa*; (E) zoea I of *Anamathia rissoana*; (F) zoea I of *Macropodia parva*; (G) zoea I of *Achaeus cranchii*; (H) zoea I of *Paromola cuvieri*; (I) zoea I of *Plagusia depressa*; (J) zoea I of *Brachynotus sexdentatus*; (K) zoea I of *Pinnotheres pisum*; (L) zoea II of *Geryon longipes*; (M) zoea III of *Ebalia tuberosa*; (N) zoea I of *Inachus dorsettensis*; (O) zoea II of *Percnon gibbesi*; (P) zoea I of *Eriphia verrucosa*; (Q) zoea I of *Ethusa mascaroni*; (R) right furca of telson of zoea I of *Calappa granulata*; (S) right furca of telson of zoea II of *Pachygrapsus maurus*; (T) right furca of telson of zoea III of *Brachynotus atlanticus*; (U) left furca of telson of zoea I of *Uca tangeri*; (W) left furca of telson of zoea I of *Grapsus adscensionis*; (X) left furca of telson of zoea I of *Atelecyclus rotundatus*; (Y) left furca of telson of zoea I of *Planes minutus*; (Z) left furca of telson of zoea I of *Maja goltziana*. (A, redrawn from Christiansen, 1973; B, from Ingle, 1979; C, J, S, from Cuesta, 1999; D, K, M, N, X, from Ingle, 1992; E, from Guerao & Abelló, 1996; F, from González-Gordillo & Rodríguez, 2001; G, from Bocquet, 1954; H, from Samuelson, 1976; I, from Schubart et al., 2001; L, from dos Santos, 1999; O, from Paula & Hartnoll, 1989; P, from Lumare & Gozzo, 1972; Q, from Paula, 1987; R, from Guerao et al., 1998; T, from Rodríguez et al., 1992; U, from Paula, 1985; W, Y, from Cuesta et al., 1997; Z, from Paula, 1988).



**Figure 11.** Antennas of brachyuran larvae. (A) Zoea I of *Dromia personata*; (B) zoea I of *Paromola cuvieri*; (C) zoea I of *Pachygrapsus marmoratus*; (D) zoea I of *Xantho incisus*; (E) zoea I of *Pirimela denticulata*; (F) zoea I of *Goneplax rhomboides*; (G) zoea I of *Uca tangeri*; (H) zoea I of *Brachynotus sexdentatus*; (I) zoea I of *Pilumnus hirtellus*; (J) zoea I of *Calappa granulata*; (K) zoea II of *Bathynectes longipes*; (L) zoea I of *Corystes cassivelaunus*; (M) zoea I of *Liocarcinus corrugatus*; (N) zoea I of *Carcinus maenas*; (O) zoea I of *Polybius henslowii*; (P) zoea I of *Panopeus africanus*; (Q) zoea I of *Sirpus zariquieyi*; (R) zoea I of *Geryon trispinosus*; (S) zoea I of *Macropipus tuberculatus*; (T) zoea I of *Necora puber*. (A, D, E, F, I, L, M, N, T, redrawn from Ingle, 1992; B, from Samuelsen, 1976; C, from Ingle, 1987; G, O, from Paula, 1985; H, from Cuesta et al., 2000; J, from Guerao et al., 1998a; K, from Ingle, 1985; P, from Rodríguez & Paula, 1993; Q, from Bourdillon-Casanova, 1960; R, (as *Geryon tridens*), from Brattegard & Sankarankutty, 1967; S, from Guerao & Abelló, 1999).



**Figure 12.** Appendages of brachyuran larvae. (A) Maxillule of zoea I of *Ebalia tumefacta*; (B) maxillule of zoea I of *Polybius henslowii*; (C) endopod of maxilla of zoea I of *Polybius henslowii*; (D) inter-orbital region of zoea I of *Ebalia tumefacta*; (E) maxilla of zoea I of *Necora puber*; (F) maxillule of zoea I of *Ebalia tuberosa*; (G) antennule of zoea I of *Grapsus adscensionis*; (H) antennule of zoea I of *Planes minutus*; (I) first maxilliped of zoea I of *Monodaeus couchii*; (J) first maxilliped of zoea I of *Cancer pagurus*; (K) first maxilliped of zoea I of *Ebalia nux*; (L) first maxilliped of zoea I of *Ebalia tumefacta*; (M) lateral aspect of carapace of zoea I of *Macropodia parva*; (N) lateral spine of carapace of zoea II of *Percnon gibbesi*. (A, redrawn from Salman, 1982; B, C, from Paula, 1985; D, E, from Ingle, 1992; F, from Salman, 1982; G, H, from Cuesta et al., 1997; I, from Ingle, 1983; J, from Ingle, 1981; K, from Salman, 1982; L, from Rice, 1980; M, from González-Gordillo & Rodríguez, 2001; N, from Paula & Hartnoll, 1989).

44. (a) Dorsal spine curved and nearly the same length as carapace (Figure 9L) . . . . . Genus *Carcinus*  
 (b) Dorsal spine straight and nearly 1.5 the length of carapace (Figure 9J) . . . . . *Portumnus latipes*
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46. (a) Branches of telson furca without spines . . . . . *Eriocheir sinensis*  
 (b) Branches of telson furca with two or three spines (Figure 10L, P) . . . . . 47
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 (b) Antennal exopod shorter than spinous process (Figure 11R) . . . . . 48
48. (a) Dorso-lateral knobs on abdominal somites 2–4 (Figure 10L) . . . . . Family Geryonidae  
 (b) Dorso-lateral knobs on abdominal somites 2–5 (Figure 10P) . . . . . *Eriphia verrucosa*
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 (c) Antennal exopod highest seta just extending 1/3 spinous process (Figure 11K) . . . . . Genus *Bathynectes*
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#### Identification of the Pleocyemata zoeal stages

It is so difficult to provide a list of characters by which each larval stage can be recognized as a group because there are a wide variation of forms and number of instars in the development among decapod species. We can distinguish each larval stage by a combination of characters shared by most instars, while exceptions to each combination are noted.

#### Infraorder BRACHYURA

The counting of number of distal setae on the exopods of maxillipeds is enough for the identification of zoeal stages of brachyuran larvae. In the zoea I stage there are four setae, in zoea II six setae, in zoea III eight setae, etc.

#### *The other Pleocyemata*

Zoea I: sessile eyes; abdomen with five somites; pleopods and uropods absent.

Exceptions: *Athanas nitescens* having mobile eyes; *Chlorotocus crassicornis*, Infraorder Astacidea and Family Callianassidae having the abdomen with six somites; Family Pasiphaeidae having pleopod buds and eyes semi-mobiles; *Palaemonetes zariquieyi*, Family Axiidae and Family Calocarididae having the abdomen with six somites and pleopod buds; Family Polychelidae having the abdomen with six somites and pleopod and uropod buds.

Zoea II: mobile eyes; abdomen with five somites; pleopods and uropods absent.

Exceptions: Family Porcellanidae (last stage) and Family Pasiphaeidae having pleopod buds; Family

Callianassidae having the abdomen with six somites and uropods buds; *Palaemonetes zariquieyi*, Infraorder Astacidea, Family Axiidae (last stage) and Family Calocarididae having the abdomen with six somites and pleopod buds.

Zoea III: abdomen with six somites; uropods present (endopod rudimentary); pleopods absent; antennal exopod segmented on distal margin.

Exceptions: Infraorder Stenopodidea, *Synalpheus*, *Hippolyte*, Family Processidae, Family Crangonidae, Family Laomedidae, Family Galatheidae, Family Parapaguridae, Family Diogenidae and Family Paguridae, having the antennal exopod not segmented; Family Pasiphaeidae, *Palaemonetes zariquieyi* (last stage), Infraorder Astacidea (last stage), Family Callianassidae and Family Upogebiidae having pleopod buds and the antennal exopod not segmented.

Zoea IV: pleopods absent; antennal exopod not segmented; telson almost rectangular shaped, larger on distal part; not all the pereopods present.

Exceptions: Family Palaemonidae having all the pereopods present; Family Hippolytidae, Family Crangonidae (last stage for *Philocheas fasciatus*), Family Callianassidae (last stage), Family Upogebiidae (last stage) and Family Galatheidae (last stage for *Munida* and *Munidopsis*) having all the pereopods and pleopods present; Family Pasiphaeidae (last stage), Family Laomedidae, Family Diogenidae (last stage for *Clibanarius*), Family Parapaguridae and Family Paguridae (last stage) having all the pereopods present, pleopod buds and telson triangular shaped.

Zoea V: pleopods absent; all pereopods present; telson rectangular shaped; antennule outer flagellum segmented.

Exceptions: *Hippolyte* (last stage) having pleopod buds; *Palaemonetes varians* (last stage), Family Processidae, *Philocheas* (last stage), Family Diogenidae (last stage) and *Galathea* (last stage) having pleopod buds and antennule outer flagellum not segmented; Family Laomedidae and Family Parapaguridae (last stage) having pleopod buds, antennule outer flagellum not segmented and telson triangular shaped.

Zoea VI: pleopods present as small buttons; telson pear shaped, narrower distally than proximally; antenna flagellum not segmented.

Exceptions: *Palaemon adspersus* (last stage), *Dichelopandalus bonnieri* (last stage) and Family Crangonidae (last stage) having pleopods biramous and antenna flagellum segmented; Family Laomedidae (last stage) having antenna flagellum segmented, pleopods biramous and the telson narrower proximally than distally.

Zoea VII: antenna flagellum segmented; pleopods presented as biramous buds without setae.

Exceptions: *Palaemon longirostris*, *P. xiphias* (last stage) and *Pandalina brevirostris* (last stage) having the antenna flagellum segmented and twice as long as scale and the pleopod buds with setae.

Zoea VIII & IX: these zoeal stages can be separated by the number of segments and development of the antenna flagellum, pleopods, the shape of telson and the number of rostrum spines (when is the case).

Exceptions: *Brachycarpus biunguiculatus* having 11 zoeal stages according to Gurney & Lebour (1941). In this species the zoea VIII, IX, X and XI can be separated by the development of pleopods and the chela on the pereopods 1 and 2.

## REMARKS

Although more and more new larval descriptions are being published, the characters used in the present key to distinguish between genus seems conservative. In some cases larval identification can only be taken to genus level because there are many species of the same genus occurring in the area (as in the genus *Processa*). In other cases, as in the genus *Liocarcinus*, although the complete larval development is known for all species, they show close resemblance, which render the identification a very difficult task (Clark, 1984). In a lowest identification level González-Gordillo et al. (2001) provide an annotated list of the decapod species recorded in such an area and the available references of their larval descriptions, indicating the number of larval series that remain unknown within the same area.

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