CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

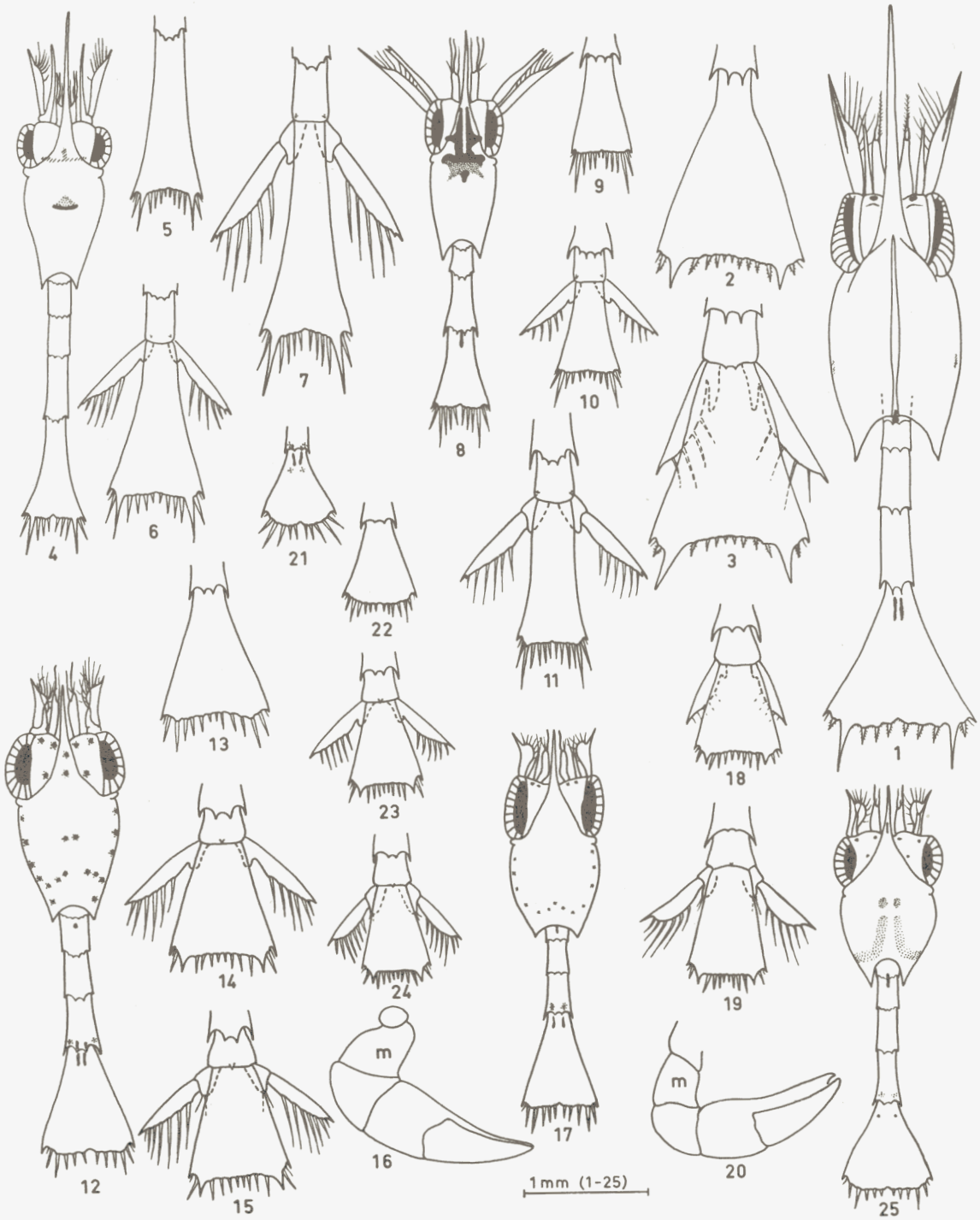
Zooplankton
Sheet 81

CRUSTACEA DECAPODA: LARVAE

XI. PAGURIDEA, COENOBITIDEA, DROMIIDEA, and HOMOLIDEA

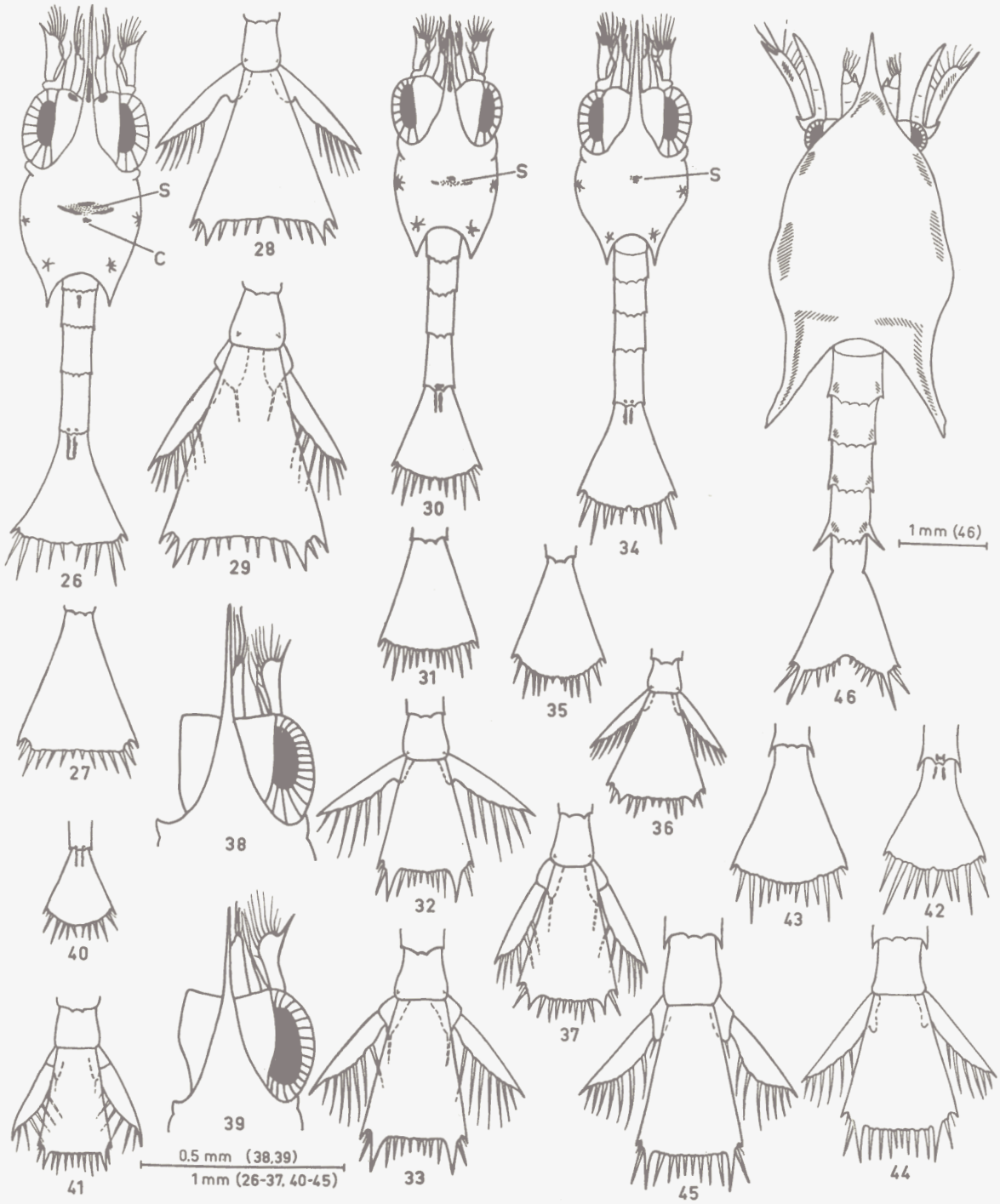
(By R. B. Pike and D. I. Williamson)

1958
(Revised 1959)



Figures 1—25: Paguridea, zoeal stages

Figs. 1—3, ? *Parapagurus pilosimanus:* 1, stage I; 2, end of abdomen, stage II; 3, the same, stage III.
Figs. 4—7, *Pagurus bernhardus:* 4, stage I; 5, end of abdomen, stage II; 6, the same, stage III; 7, the same, stage IV.
Figs. 8—11, *P. pubescens:* 8, stage I; 9, end of abdomen, stage II; 10, the same, stage III; 11, the same, stage IV.
Figs. 12—16, *P. prideauxi:* 12, stage I; 13, end of abdomen, stage II; 14, the same, stage III; 15, the same, stage IV; 16, right cheliped, stage IV (m = merus).
Figs. 17—20, *P. alatus:* 17, stage I; 18, end of abdomen, stage III; 19, the same, stage IV; 20, right cheliped, stage IV (m=merus).
Figs. 21—24, *P. cuanensis:* 21, end of abdomen, stage I; 22, the same, stage II; 23, the same, stage III; 24, the same, stage IV.
Fig. 25, ? *P. forbesii*, stage I.



Figures 26—46: Paguridea, zoeal stages (continued)

Figs. 26—29, *Anapagurus laevis:* 26, stage I; 27, end of abdomen, stage II; 28, the same, stage III; 29, the same, stage IV.

Figs. 30—33, *A. hyndmanni:* 30, stage I; 31, end of abdomen, stage II; 32, the same, stage III; 33, the same, stage IV.

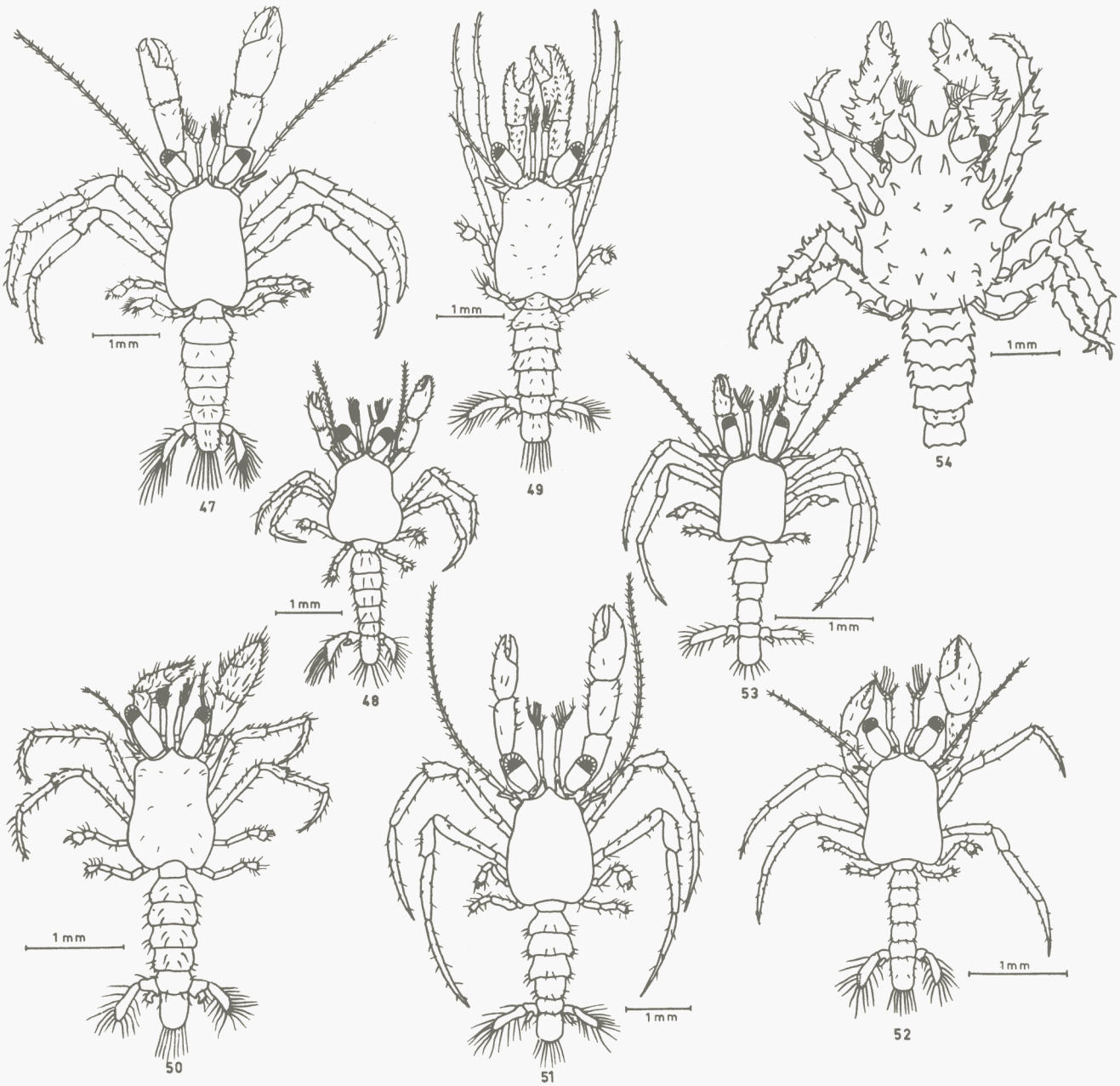
Figs. 34—38, *A. chiroacanthus:* 34, stage I; 35, end of abdomen, stage II; 36, the same, stage III; 37, the same, stage IV; 38, front of head, stage I.

Figs. 39—41, *A. breviaculeatus:* 39, front of head, stage I; 40, end of abdomen, stage I; 41, the same, stage IV.

Figs. 42—45, *Catapaguroides timidus:* 42, end of abdomen, stage I; 43, the same, stage II; 44, the same, stage III; 45, the same, stage IV.

Fig. 46, *Lithodes maja*, stage I.

(The chromatophore 's' in Figs. 26, 30, and 34 is on the stomach and should not be confused with a chromotophore on the surface of the carapace as shown by 'c' in Fig. 26.)



Figures 47—54: Paguridea, megalopa stage.
(A scale-line respresenting 1 mm is given for each figure.)

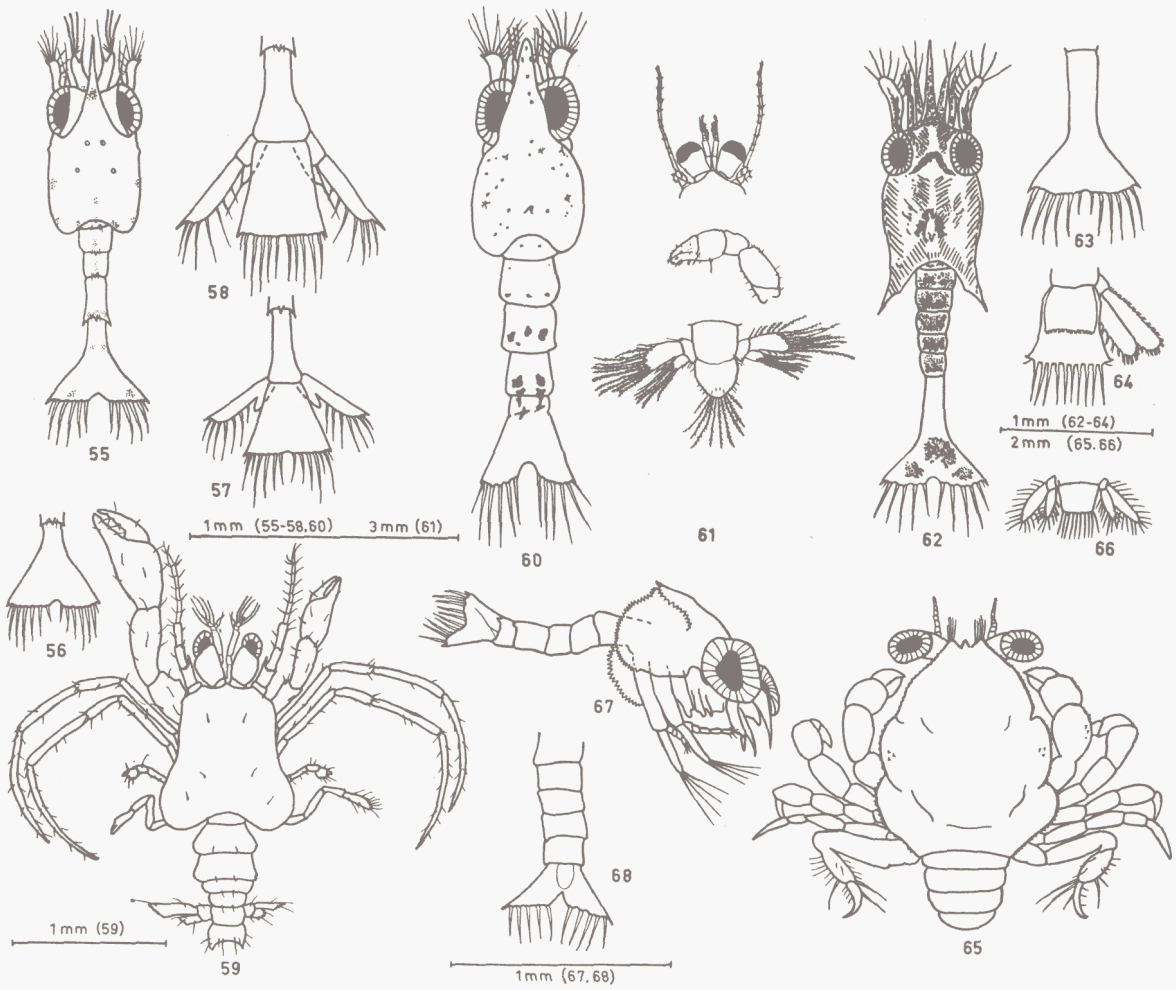
Fig. 47, *Pagurus bernhardus*. Fig. 48, *P. pubescens*. Fig. 49, *P. prideauxi*. Fig. 50, *P. cuanensis*. Fig. 51, *Anapagurus laevis*. Fig. 52, *A. hyndmanni*. Fig. 53, *A. chiroacanthus*. Fig. 54, *Lithodes maja*.

General Notes

Length is taken from tip of rostrum to end of telson, excluding telson spines. The range in length between an average first zoea and an average last zoea and the length of an average megalopa are given, when possible, for each species; individuals within the area considered may differ from these averages by up to ±15 %. Where sizes are based on Mediterranean specimens, those from northern Europe are likely to be appreciably larger.

Chromatophore patterns usually remain constant throughout the zoeal stages, but are variable in the megalopa. In the figures red is shown by solid black, pink or diffuse red by parallel lines, yellow by stippling, and white by open circles.

Telson spines are numbered from the outside. The fine hair between the two outermost, although representing a reduced spine, is excluded from the numbering.



Figures 55—68: Coenobitidea, Dromiidea and Homolidea.

Figs. 55—59, *Diogenes pugilator:* 55, stage I; 56, end of abdomen, stage II; 57, the same, stage III; 58, the same, stage IV; 59, megalopa.

Fig. 60, 61, *Clibanarius erythropus:* 60, stage I; 61, megalopa.

Figs. 62—66, *Dromia personatus:* 62, stage I; 63, end of abdomen, stage II; 64, the same, stage V (showing developing telson of megalopa); 65, megalopa; 66, end of abdomen of same.

Figs. 67, 68, *Paromola japonica:* 67, stage I; 68, abdomen of same.

(67, 68 after Aikawa; 61 after Dechancé and Forest; 62—66 after Lebour.)

PAGURIDEA

Zoeal Stages: Key to Families

Telson with little or no invagination and 6 or 7 pairs spines; longitudinal diameter of eye greater than width of abdomen; 4 zoeal stages; uropods present in stages III and IV (Figs. 1—45) ..... PAGURIDAE

Telson with broad and deep invagination and 8 or 9 pairs spines; longitudinal diameter of eye less than width of abdomen; 2 zoeal stages; no uropods, but abd. 6 bears small pleopods in stage II (Fig. 46) ..... LITHODIDAE

Megalopa Stage: Key to Families

Uropods present; body and legs not extremely spiny (Figs. 47—53) ..... PAGURIDAE

Uropods absent, but abd. 6 bears small pleopods; body and legs extremely spiny (Fig. 54) ..... LITHODIDAE

PAGURIDAE: ZOEAL STAGES

Separation of the four stages

Stage	Eyes	Telson spines	Telson and abd. 6	Uropods	Pleopods
I	Fixed	6 + 6	Fused	Absent	Absent
II	Moveable	7 + 7	Fused	Absent	Absent
III	Moveable	7 + 7	Articulated	Present	Absent
IV	Moveable	7 + 7	Articulated	Present	Present

Key to Species

I. Carapace with a mid-dorsal carina (Fig. 1) ..... ?*Parapagurus pilosimanus*
Carapace without a mid-dorsal carina II

II. Longest telson spine longer than half greatest width of telson; length of antennal scale (excluding terminal spine) at least 6 times breadth, scale straight (Figs. 4—11) III
Longest telson spine shorter than half greatest width of telson (except in *Catapaguroides timidus*, stage I [Fig. 42]); length of antennal scale less than 4 times breadth, scale curved (Figs. 12—45) IV

III. Abd. 5 with large lateral spines (Figs. 8—11); rostrum reaching about as far as spine on antennal scale ..... *Pagurus pubescens*
Abd. 5 with rather small lateral spines (Figs. 4—7); rostrum reaching well beyond spine on antennal scale ..... *Pagurus bernhardus*

IV. Abd. 5 with large lateral spines (Figs. 12—25, 42—45); stage IV with 4 pairs pleopods V
Abd. 5 with lateral spines very small or absent (Figs. 26—41); stage IV with 2 or 3 pairs pleopods ..... (*Anapagurus*) IX

V. No yellow chromatophores on abd. 5 or 6; stages III and IV: 3rd telson spine the longest (Figs. 44, 45) ..... *Catapaguroides timidus*
At least one pair yellow chromatophores on abd. 5 and 6; stages III and IV: 3rd telson spine shorter than 2nd and 4th (Figs. 14, 15 etc.) VI

VI. Paired yellow chromatophores on both abd. 5 and abd. 6 (Fig. 21); (from 0—6 yellow chromatophores on lateral carapace); stages I and II: posterior margin of telson convex (Figs. 21, 22); stages III and IV: length less than 4 mm ..... *Pagurus cuanensis*
Paired yellow chromatophores on abd. 5 only (Figs. 12, 17, 25); stages I and II posterior margin of telson straight or slightly concave (Figs. 12, 13 etc.); stages III and IV: length more than 4 mm VII

VII. Carapace without lateral stellate chromatophores, but with a curved yellow band in posterior half on either side (Fig. 25); stage I: point of outer telson spine does not reach to base of 2nd spine (Fig. 25) . ?*Pagurus forbesii* (only stage I described)
Carapace with 6—16 stellate orange chromatophores on either side (Figs. 12, 17); stage I: point of outer telson spine reaches beyond base of 2nd spine (Figs. 12, 17) VIII

VIII. Stages I and II: length of longest telson spine slightly exceeds ⅓ greatest width of telson (Fig. 17); stage III: no mid-dorsal spine on posterior end of abd. 6 (Fig. 18); stage IV: merus of developing cheliped longer than broad (Fig. 20, m) ..... *Pagurus alatus*
Stages I and II: length of longest telson spine slightly less than ⅓ greatest width of telson (Figs. 12, 13); stage III: small mid-dorsal spine on posterior end of abd. 6 (Fig. 14); stage IV: merus of developing cheliped slightly broader than long (Fig. 16, m) ..... *Pagurus prideauxi*

IX. Chromatophore on mid-dorsal surface of carapace ('c' in Fig. 26) and one on each eye-stalk (Fig. 26); stage I: posterior margin of telson very slightly convex (Fig. 26); stages II—IV: posterior margin of telson straight (Figs. 27—29); (3rd telson spine the longest in all stages; stage IV with 3 pairs pleopods) ..... *Anapagurus laevis*
No chromatophore on mid-dorsal surface of carapace and seldom on eye-stalks (Figs. 30, 34; stage I: posterior margin of telson distinctly convex (Figs. 30, 34, 40); stages II—IV: posterior margin of telson slightly convex (Figs. 31—33, etc.) X

X. Chromatophores at bases of maxillipeds and one on rostrum; stages I and II: rostrum projects beyond spine on antennal scale by about length of spine (Fig. 30) (also applies to *A. chiroacanthus* [Figs. 34, 38], which is morphologically indistinguishable from *A. hyndmanni* in stage I); stage II: 4th telson spine longer than

5th (Fig. 31); stages III and IV: 3rd telson spine the longest (Figs. 32, 33); stage IV: 2 pairs pleopods ..... *Anapagurus hyndmanni*

No chromatophores at bases of maxillipeds or on rostrum; stages I and II: rostrum projects only slightly beyond spine on antennal scale in *A. breviaculeatus* (Fig. 39); stage II: 4th and 5th telson spines about equal (Fig. 35); stages III and IV: 5th telson spine the longest (Figs. 36, 37, 41); stage IV: 3 pairs pleopods XI

XI. Stages I and II: rostrum projects beyond spine on antennal scale by about length of spine (Fig. 38); stages III and IV: 3rd telson spine shorter than 2nd and 4th (Figs. 36, 37) ..... *Anapagurus chiroacanthus*

Stages I and II: rostrum projects only slightly beyond spine on antennal scale (Fig. 39); stages III and IV: 3rd telson spine slightly longer than 2nd and 4th (Fig. 41) ..... *Anapagurus breviaculeatus*

PAGURIDAE: MEGALOPA STAGE

Key to Species

I. 4 pairs functional pleopods ..... (*Pagurus* and *Catapaguroides*) II
2 or 3 pairs functional pleopods ..... (*Anapagurus*) VI

II. Propodus of chelae without spines; antennae reaching at least as far as chelae (Figs. 47, 48) III
Propodus of chelae with spines; chelae reaching beyond antennae (Figs. 49, 50) V

III. Eye-stalk 2 times as long as broad; distal tooth on carpus of 2nd and 3rd legs (Figs. 47) ..... *Pagurus bernhardus*
Eye-stalk 1½ times as long as broad; no tooth on carpus of 2nd and 3rd legs (Fig. 48) IV

IV. Right chela distinctly larger than left; eye-stalks without stripes ..... *Pagurus pubescens*
Right chela only slightly larger than left; eye-stalks usually with longitudinal red stripes .... *Catapaguroides timidus*

V. Chelae moderately hairy with many spines; no spines on carpus of 2nd and 3rd legs (Fig. 49) ... *Pagurus prideauxi*
Chelae extremely hairy with few spines; 2 spines on carpus of 2nd and 3rd legs (Fig. 50) ..... *Pagurus cuanensis*

VI. 2 pairs functional pleopods ..... *Anapagurus hyndmanni*
3 pairs functional pleopods VII

VII. Eye-stalk only a little longer than broad (Fig. 51) ..... *Anapagurus laevis*
Eye-stalk about 2 times as long as broad (Fig. 53) ..... *Anapagurus chiroacanthus*

PAGURIDAE

PARAPAGURUS Smith

1. *P. pilosimanus* Smith. Not hatched in laboratory. Probable zoeae. (Figs. 1—3). Zoeae 5·8—11 mm, megalopa unknown.

PAGURUS Fabricius

2. *P. bernhardus* (Linn.). (Figs. 4—7, 47). Zoeae 3·6—8·2 mm, megalopa 4·2 mm.
Sars, 1890, Pl. 2, Figs. 1—28 (as *Eupagurus*); Williamson, 1915, Figs. 267—284 (as *Eupagurus*, after Sars); Macdonald, Pike & Williamson, 1957, Figs. 2 (a—h), 3 (a—y).
3. *P. pubescens* Krøyer. (Figs. 8—11, 48). Zoeae 3·2—5·5 mm, megalopa 3·1 mm.
Sars, 1890, Pl. 2, Fig. 29 (stage IV only, as *Eupagurus*); Williamson, 1915, Fig. 301 (as *Eupagurus*, after Sars); Macdonald, Pike & Williamson, 1957, Fig. 4 (a—f).
4. *P. carneus* Pocock. Larvae undescribed.
5. *P. prideauxi* Leach. (Figs. 12—16, 49). Zoeae 3·4—6 mm, megalopa 4·3 mm.
Macdonald, Pike & Williamson, 1957, Fig. 5 (a—h).
6. *P. alatus* Fabricius [= *P. excavatus* Herbst]. (Figs. 17—20). Zoeae (from Naples) 3·0—5·5 mm, megalopa unknown.
7. *P. cuanensis* Bell [= *P. spinimanus* Lucas]. (Figs. 21—24, 50). Zoeae 2·7—3·9 mm, megalopa 2·9 mm.
Macdonald, Pike & Williamson, 1957, Fig. 6 (a—f).
8. *P. forbesii* Bell [= *P. sculptimanus* Lucas]. Not hatched in laboratory. Probable zoea (Fig. 25) stage I 3·2 mm; megalopa unknown.
Macdonald, Pike & Williamson, 1957, Fig. 7 (a, b) (stage I only).
9. *P. variabilis* (A. Milne-Edwards & Bouvier). Larvae undescribed, but probably very similar to *P. alatus*.
10. *P. ruber* (A. Milne-Edwards & Bouvier). Larvae undescribed.

CATAPAGUROIDES A. Milne-Edvards & Bouvier

11. *C. timidus* (Roux). (Figs. 42—45). Zoeae, megalopa 2·3 mm (from Naples). 2·2—3·8 mm.
Dechancé & Forest, 1958, Figs. 1, 3—15 (megalopa only).
Not Issel, 1910, p. 351, no fig. (stage I only).
Not Boraschi, 1921, Pl. 1, Fig. 5 (stage I only).

ANAPAGURUS Henderson

12. *A. laevis* (Bell). (Figs. 26—29, 51). Zoeae 2·9—5·6 mm, megalopa 3·6 mm.
Macdonald, Pike & Williamson, 1957, Fig. 8 (a—f).
13. *A. hyndmanni* (Bell). (Figs. 30—33, 52). Zoeae 2·4—3·9 mm, megalopa 2·7 mm.
Gurney, 1942, Figs. 106, 107. Macdonald, Pike & Williamson, 1957, Fig. 9 (a—f).
14. *A. chiroacanthus* (Lilljeborg). (Figs. 34—38, 53). Zoeae 2·2—3·5 mm, megalopa 2·3 mm.
Sars, 1890, Pl. 3, Figs. 1—27 (as *Spiropagurus*). Williamson, 1915, Figs. 287—296 (as *Pagurus*, after Sars). Macdonald, Pike & Williamson, 1957, Fig. 10 (a—f).
15. *A. breviaculeatus* Fenizia. (Figs. 39—41). Zoeae (from Naples) 1·8—3·3 mm, megalopa unknown.
16. *A. curvidactylus* Chevreux & Bouvier. Larvae undescribed.

NEMATOPAGURUS A. Milne-Edwards & Bouvier

17. *N. longicornis* A. Milne-Edwards & Bouvier. Larvae undescribed.

LITHODIDAE

LITHODES Latreille

18. *L. maja* (Linn.). (Figs. 46, 54). Zoeae 7·6—7·9 mm, megalopa 4·5 mm.
Sars, 1890, Pl. 1, Figs. 1—23 (zoeal stages). Williamson, 1915, Figs. 453—458 (after Sars). Gurney, 1942, Fig. 109 (stage I only). Macdonald, Pike & Williamson, 1957, Fig. 11 (a—d).

COENOBITIDEA

DIOGENIDAE

DIOGENES Dana

19. *D. pugilator* (Roux). (Figs. 55—59).
Zoeal stages: rostrum narrow and pointed; posterior margin of telson with moderate invagination in stage I, becoming straight in later stages; last stage with 2 pairs pleopods; 5 stages. 1·3—2·8 mm.
Megalopa: left chela much larger than right; carapace at least as long as abdomen; posterior margin of telson concave; 2 pairs pleopods. 1·6 mm.
Gurney, 1927, Figs. 74, 75. Macdonald, Pike & Williamson, 1957, Fig. 1 (a—l).

CLIBANARIUS Dana

20. *Clibanarius erythropus* (Latreille) [= *C. misanthropus* (Risso)]. Figs. 60, 61.
Zoeal stage I: rostrum broad and blunt; posterior margin of telson with large invagination. 1·7 mm (from Naples). Later stages undescribed.
Megalopa: chelae sub-equal; abdomen longer than carapace; telson rounded, broader than long; endopod of uropod less than half length of exopod; 4 pairs pleopods. 2·5 mm.
Carayon, 1942, Figs. A, B (megalopa only). Dechancé & Forest, 1958, Figs. 2, 16—29 (megalopa only).
Not Bouvier, 1922, Pl. IV, Figs. 5—10 (as *Glaucothoë grimaldii*) [= *Calcinus ornatus* (Roux)].

DROMIIDEA

DROMIIDAE

DROMIA Fabricius

21. *D. personatus* (Linn.) [= *D. vulgaris* H. Milne-Edwards]. Figs. 62—66).
Zoeal stages: abdominal somites without spines; antennal endopod with 3 terminal setae in stage I; outer margin of antennal scale with very fine hairs in stage I and prominent setae in later stages; last stage with setose exopod on leg 1 and small rudiments on legs 2—4, 4 pairs biramous pleopods and endopod of uropod almost as long as exopod; 5 stages. 2·9—6·4 mm.
Megalopa: abdomen partly flexed under body; 4 pairs pleopods, well-developed uropods. Carapace 3·2 mm, rostrum-telson 4·5 mm.
Lebour, 1934, Pl. 1—5. Gurney, 1942, p. 267, no fig.

DICRANODROMIA A. Milne-Edwards

22. *D. mahyeuxi* A. Milne-Edwards. Larvae undescribed.
Late embryo: posterior margins of carapace rounded; all appendages present, including rudimentary uropods; exopods on maxillipeds and leg 1; leg 5 curved dorsally then forwards.
Caustier, 1895, p. 573, no fig. (late embryo only).

HOMOLIDEA

This group was omitted from consideration in the general key (Sheet 67).

HOMOLIDAE

PAROMOLA Wood-Mason

23. *P. cuvieri* (Risso). Larvae undescribed, but may resemble *P. japonica.*
[*P. japonica* Parisi, from Japanese waters. (Figs. 67, 68).
Zoeal stage I: carapace with rounded denticulate posterior margin and denticulate lateral fold; antenna with short endopod bearing 2 setae and with spinous process longer than scale; telson resembling that of *Dromia*, but with deeper invagination. 1·7 mm. (Later stages undescribed).
Aikawa, 1937, Fig. 4 (stage I only, as *Parahomola*).]

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Distribution of adults

Region	Species
Baltic Gulf of Bothnia, Gulf of Finland	—
Belt Sea	2, (3), (12), (14)
Kattegat	2, 3, 7, 12, 14, 18
Skagerak	2, 3, 7, 12, 14, 18
Northern North Sea	2, 3, 5, 7, 9, 12, 13, 14, 18
Southern North Sea	2, (12), 18
English Channel	2, 5, 7, (8), (11), 12, 13, (14), 19, 20, 21
Bristol Channel, Irish Sea, SW Scotland	2, 3, 5, 7, (11), 12, 13, 14, 18, 19
Faroe, Shetland, N Scotland	2, 3, 5, (7), 9, 12, 13, 14, 18
Faroe—Iceland Area	1, 2, 3, 18
W Ireland and Atlantic	1, 2, 3, 4, 5, 7, (8), 9, 12, 13, 17, 18, 23
Bay of Biscay	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23
Barents Sea	2, 3, 18
Norwegian Sea	2, 3, 18