

FICHES D'IDENTIFICATION DU ZOOPLANCTON

Éditées par
J. H. FRASER

Marine Laboratory, P.O. Box 101, Victoria Road
Aberdeen AB9 8DB, Scotland

FICHE NO. 159/160

CRUSTACEA DECAPODA: LARVAE

VI. CARIDEA

Families: Palaemonidae and Processidae

by

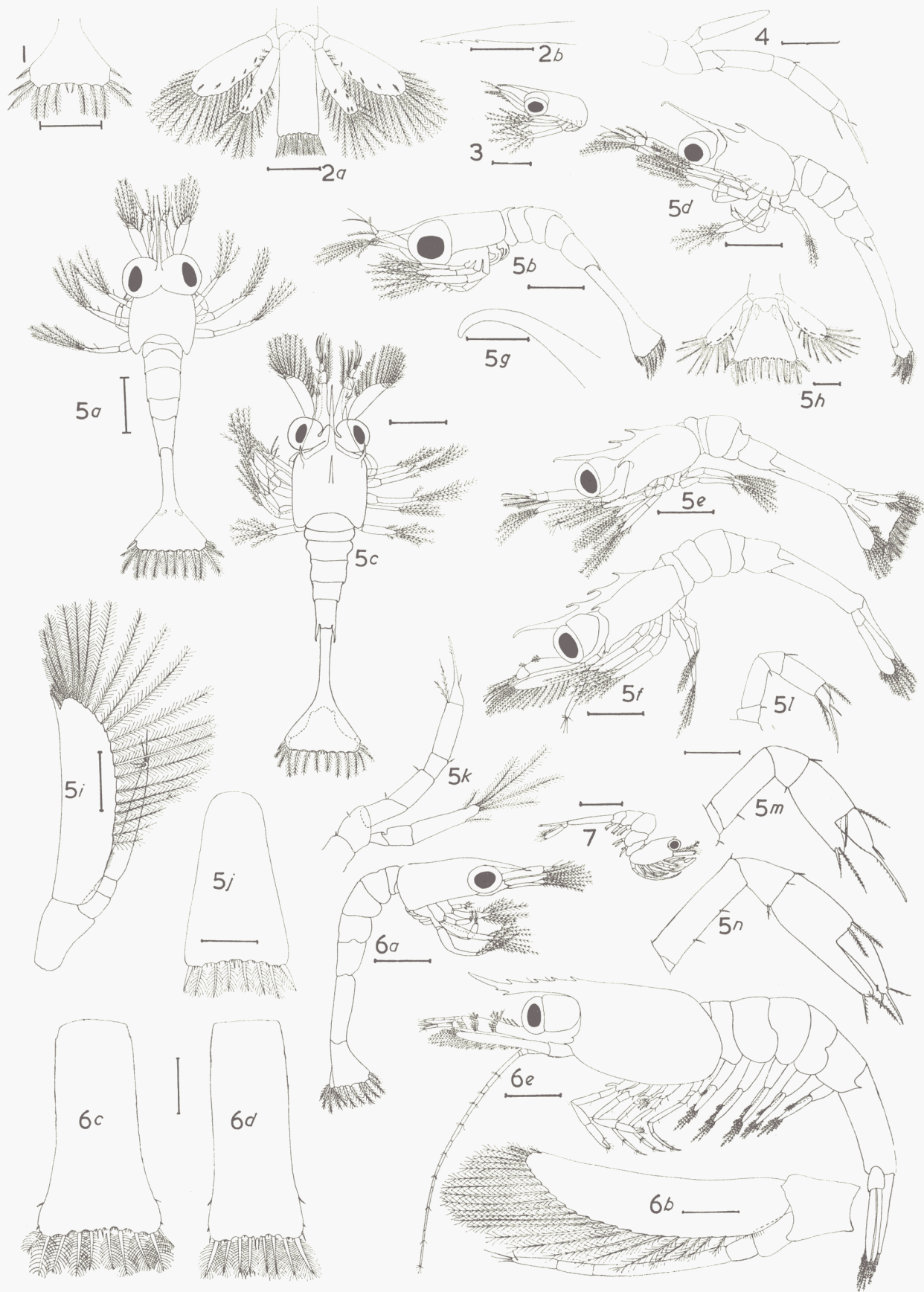
A. A. Fincham
British Museum (Nat. Hist.)
Cromwell Road
London SW7 5BD, England

D. I. Williamson
Marine Biological Station
Port Erin
Isle of Man, via England

(This publication may be referred to in the following form:
Fincham, A. A., and Williamson, D. I. 1978. Decapoda, Larvae, VI. Caridea,
Fich. Ident. Zooplankton 159/160: 8 pp.)

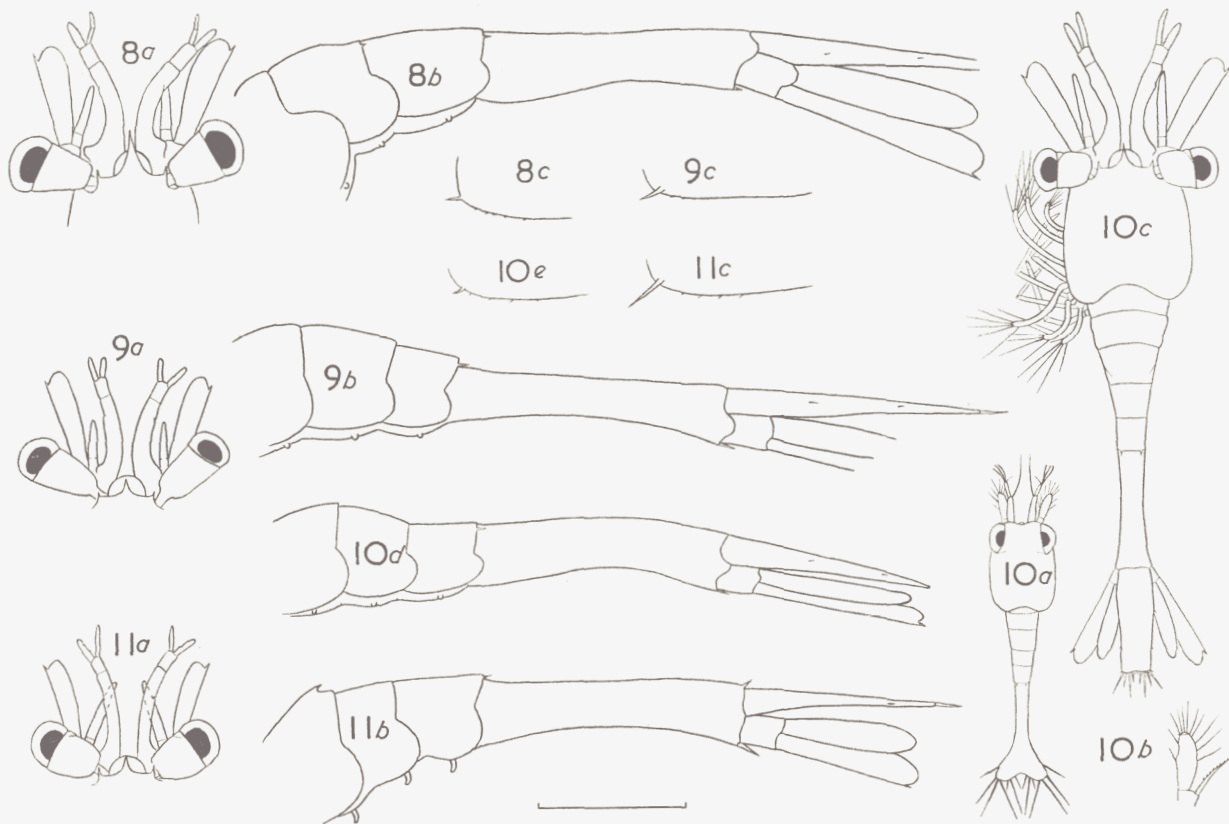
Conseil International pour l'Exploration de la Mer
Charlottenlund Slot, DK-2920 Charlottenlund
Danemark

MAI 1978



Figures 1–7 (opposite). Palaemonidae. 1. *Leander tenuicornis*: zoea I telson. – 2. *Palaemon (Palaemon) adpersus*: 2a, zoea IV telson; 2b, zoea II rostrum. – 3. *Palaemon (Palaemon) longirostris*: lateral view head and carapace. – 4. *Palaemon (Palaemon) serratus*: zoea V leg 4. – 5. *Palaemon (Palaemon) elegans*: 5a, zoea I dorsal view; 5b, zoea I lateral view; 5c, zoea II dorsal view; 5d, zoea II lateral view; 5e, zoea III lateral view; 5f, zoea IV lateral view; 5g, zoea II rostrum; 5h, zoea III telson; 5i, zoea IV antenna 2; 5j, zoea IV telson; 5k, zoea V leg 4; 5l, m and n, development of fixed finger of chela in legs 1 and 2 (5l, zoea IV leg 1; 5m, zoea VI; 5n, zoea VIII). – 6. *Palaemonetes (Palaemonetes) varians*: 6a, zoea I lateral view; 6b, zoea IV antenna 2; 6c, zoea IV telson; 6d, zoea V telson; 6e, post larva lateral view. – 7. *Typton spongicola*: last larva lateral view.

Scale lines represent 0.05 mm in Figures 2b and 5g; 0.2 mm in Figures 4, 5h–n, and 6b–d; 0.5 mm in Figures 1, 2a, 3, 5a–f, and 6a, e; 1.0 cm in Figure 7. Figure 1 after GURNEY, 1938; 2a after MORTENSEN; 3, after GURNEY, 1924a; 7 after LEBOUR, 1949; others from FINCHAM, 1977, and in press.



Figures 8–11. Processidae. 8. *Processa canaliculata*: zoea VI: 8a, head, dorsal; 8b, abdomen, lateral; 8c, pterygostomial region of carapace. – 9. *Processa edulis crassipes*: zoea VI: 9a, head, dorsal; 9b, abdomen, lateral; 9c, pterygostomial region of carapace. – 10. *Processa noveli holthuisi*: zoea I: 10a, dorsal view; 10b, antenna; zoea VI: 10c, dorsal view; 10d, abdomen, lateral; 10e, pterygostomial region of carapace. – 11. *Processa modica modica*: zoea V: 11a, head, dorsal; 11b, abdomen, lateral; 11c, pterygostomial region of carapace.

Scale line represents 1 mm in Figures 8a, 9a, 10a, 10c, and 11a; 0.5 mm in all other figures. All figures adapted from WILLIAMSON and ROCHANABURANON, 1978.

Family Palaemonidae

KEY TO SUBFAMILIES IN ZOEAL STAGES

- Body straight or abdomen curved ventrally; rostrum never much shorter than peduncle of antenna 1; at least one dorsal rostral spine present in stage II and subsequent stages (Figs. 5c–5f) Palaemoninae
- Body with double bend (mesocaris form), rather feebly developed in stage I, acutely angled or “humped” in later stages (Fig. 7); rostrum about half length of peduncle in stage I, shorter in later stages; without dorsal carapace spines Pontoniinae
(only one species: *Typton spongicola*)

Subfamily Palaemoninae

KEY TO ZOEAL STAGE

1. Natatory exopods present, no functional pleopods (Figs. 5a–f, 6a) 2
Exopods absent, functional pleopods with fringing plumose setae (Fig. 6e) Post larva (= megalopa)
2. Carapace with no dorso-medial spines, telson entire (Figs. 3, 5a and b, 6a) Zoea I
Carapace with dorso-medial spine(s) (Figs. 5c–f) 3
3. Carapace with 1 dorso-medial spine, telson entire (developing uropods visible beneath exoskeleton (Figs. 5c, d) ... Zoea II
Carapace with 2 or more dorso-medial spines (Figs. 5e, f) 4
4. Carapace with 2 dorso-medial spines, uropods present, the uropod exopod with plumose setae, endopod with none (Figs. 5e, h) Zoea III
Carapace with 3 dorso-medial spines (Fig. 5f), the uropod endopod with plumose setae (Fig. 2a) 5
5. Fixed finger of chela of legs 1 and 2 absent or no more than half length of dactylus (Fig. 5l) Zoea IV
Fixed finger of chela of legs 1 and 2 produced forward to at least half length of dactylus (excluding terminal setae and spines) (Figs. 5m, n) Zoea V or later

KEY TO SPECIES

Larvae of northeast Atlantic species of Palaemoninae (family Palaemonidae) are very similar but often variable in meristic characters and in total number of zoeal stages. Dichotomous keys are inadequate for separating the species. A tabular form, in which taxonomically useful characters are compared for all species and weighted according to “reliability”, was developed by HARDING & SMITH (1974) for copepods, and a similar arrangement is followed in this paper.

Formula key to the larvae of N.E. Atlantic Palaemoninae characters used in Table 1

Z = zoea; PL = post larva; R = rudimentary (Fig. 5b); + = fully developed; – = absent; * = information not available.

- A. Rostrum: comparison with length of antenna 1 peduncle in zoea I.
 - a. shorter than peduncle of antenna 1 (Fig. 6a).
 - b. longer than peduncle but not reaching to the end of antenna 1 (Figs. 5a, 5b).
 - c. as long as or longer than antenna 1 (Fig. 3).
- B. Rostrum: distal end in zoea II.
 - a. downturned to form a small hook, no ventral retrorse teeth (Fig. 5g).
 - b. straight, with up to 4 ventral retrorse teeth (Fig. 2b).
- C. Antenna 2: terminal spine on exopod present (+) (Fig. 5i) or absent (–) (Fig. 6b) on outer distal edge.

	ZI	ZII	ZIII	ZIV	ZV	PL
a.	–	–	–	+	+	+
b.	–	–	–	–	–	+

D. Sequence of leg development.

		ZI	ZII	ZIII	ZIV	ZV			ZI	ZII	ZIII	ZIV	ZV			ZI	ZII	ZIII	ZIV	ZV				
a.	{	P1	R	+	+	+	+	b.	{	P1	R	+	+	+	+	c.	{	P1	R	+	+	+	+	
		P2	R	+	+	+	+			P2	R	+	+	+	+			P2	R	+	+	+	+	
		P3	—	R	R	+	+			P3	R	R	+	+	+			P3	R	R	R	+	+	
		P4	—	R	R	R	+			P4	R	R	R	+	+			+	P4	R	R	R	+	+
		P5	—	R	R	+	+			P5	R	+	+	+	+			+	P5	R	R	+	+	+

E. Leg 4: exopod in zoea V.

a. functional, with plumose setae (Fig. 5k); b. incompletely developed, without plumose setae (Fig. 4); c. absent.

F. Abdomen: posterior margin of somite 5 with (+) (Figs. 5a–f) or without (–) (Fig. 6a) pair of spines.

	ZI	ZII	ZIII	ZIV	ZV	PL
a.	+	+	+	+	+	—
b.	—	+	+	+	+	+
c.	—	+	+	+	+	—

G. Telson: spine formula (figures in brackets = small lateral spines).

	ZI	ZII	ZIII	ZIV	ZV
a.	7+7 (Fig. 5a)	7+7 (Fig. 5c)	(1)6+6(1) (Fig. 5h)	4+4 (Fig. 5j)	4+4
b.	7+7	7+7	(1)6+6(1)	(2)5+5(2) (Fig. 6c)	(3)4+4(3) (Fig. 6d)
c.	7+7	7+7	(1)6+6(1)	(3)4+4(3)	*
d.	7+7	7+7	6+6 ¹	4+4	4+4 ²

¹ Minute spines present on one or both sides in some specimens.

² MORTENSEN's drawing (Table 4, Fig. 1, V) not clear.

Length of the various larval stages has been omitted from the list of characters used since considerable variation has been recorded from different parts of the geographical range of species. In general, also, the greater the number of zoeal stages before metamorphosis, the larger the individual becomes (FINCHAM, 1977). However, zoea I larvae are usually in the range 2.2–3.5 mm and last larval stages may reach 8 mm. Breeding seasons of N.E. Atlantic species of Palaemoninae are extensive and overlap, but GURNEY (1924) noted that any palaemonid larva taken off British coasts before June will almost certainly belong to *Palaemon* (*Palaemon*) *serratus*.

Table 1. Key to the larvae of N.E. Atlantic Palaemoninae

The letters in the matrix indicate character states which are detailed above (pp. 4–5).

Reliable characters printed **bold**.

* = no information available.

Species number (see below)	1	2	3	4	5	6
A. Rostrum: length in zoea I.....	b	a	c	b	b	a
B. Rostrum: tip in zoea II.....	*	b	a	a	a	b
C. Antenna 2: exopod.....	a	b	a	b	a	b
D. Sequence of leg development.....	*	a	c	a	a	b
E. Leg 4: exopod in zoea V.....	c	a	c	b	a	a
F. Abdomen: posterior margin somite 5.....	a	b	c	b	a	b
G. Telson: spine formula.....	*	d	b	c	a	b

1: *Leander tenuicornis*. – 2: *Palaemon* (*Palaemon*) *adspersus*. – 3: *P.* (*Palaemon*) *longirostris*. – 4: *P.* (*Palaemon*) *serratus*. – 5: *P.* (*Palaemon*) *elegans*. – 6: *Palaemonetes* (*Palaemonetes*) *varians*.

This table and the formulae above do not separate all stages of the seven species of N.E. Atlantic Palaemoninae and there is some overlapping of character states. They do, however, separate most of the early larvae likely to be encountered in the plankton and also reflect the paucity of data for some species. Where extended larval series have been recorded, such as in *Palaemon* (*Palaemon*) *elegans*, morphogenetic changes in stages beyond zoea V are small, involving, for example, an increase in the number of plumose setae.

SYNOPSIS OF PUBLISHED LARVAL DATA

Subfamily Palaemoninae

Leander E. Desmarest

1. *L. tenuicornis* (Say). Only zoeae I, II, and V? and post larva (PL) 1 have been described. Leg 5 precociously developed while legs 3 and 4 are still rudimentary in zoea V?; no exopod on leg 4 and no evidence of chela development on the propod of legs 1 and 2. Probably seven zoeal stages. GURNEY, 1938, Figs. 8–16 (zoeae I, II) laboratory reared; 1939, Figs. 1a–d (zoea V? and PL 1) plankton.

Palaemon FabriciusSubgenus *Palaemon* Fabricius

2. *P. (Palaemon) adspersus* Rathke. In zoea I rostrum does not reach to end of antenna 1; posterior margin of somite 5 of abdomen rounded and not produced into spines; legs 1 and 2 rudimentary, no trace of legs 3–5. In zoea II, legs 3–5 rudimentary; posterior margin of somite 5 of abdomen produced into a pair of spines. In zoea IV, leg 3 developed with natatory exopod, leg 4 rudimentary, leg 5 developed without exopod. In zoea V, leg 4 developed with natatory exopod; internal distal margin of propod, forming fixed finger of chela on legs 1 and 2, produced slightly forward. Five zoeal stages. CZERNIAVSKY, 1884, Figs. 30, 31 (zoea I) (as *Leander rectirostris*). MORTENSEN, 1897, Plate 1, Figs. 1–3, 5–8; Plates 2, 3; Plate 4, Figs. 1, 3 and 4 (zoeae I–V, post larvae) plankton (as *Palaemon fabricii*). WILLIAMSON, 1915, Figs. 115–119 (zoeae I, III, PL) (as *Palaemon fabricii*).
3. *P. (Palaemon) longirostris* (Milne Edwards). In zoea I the rostrum reaches to or beyond end of antenna 1; legs 1 and 2 present as large rudiments, legs 3–5 as smaller rudiments. In zoea III, leg 5 is developed; in later zoeal stages when all legs are developed, leg 5 not noticeably longer than legs 3 and 4; no exopod developed on leg 4. Dactylus of leg 2 relatively long compared with other palaemonid larvae. Eight (or nine) zoeal stages in laboratory-reared material. GURNEY, 1924a, Figs. 1–7 (zoeae I–III, V, PL 1, 2) laboratory reared and plankton.
4. *P. (Palaemon) serratus* (Pennant). In zoea I legs 1 and 2 present as rudiments, legs 3–5 not developed. In zoea IV, legs 3 and 5 developed, leg 4 still rudimentary. In zoea V leg 4 is developed, exopod without marginal plumose setae; internal distal margin of propod, forming fixed finger of chela in legs 1 and 2, produced slightly forward. Variable number of larval stages reported from V–X before metamorphosis to post larva. THOMPSON, 1836, Figs. 1–5 (zoeae I, III and V) laboratory reared and plankton. COUCH, 1845, Fig. 1 (zoeae I, II) laboratory reared. MAYER, 1877, Fig. 49 (zoea I, telson). KEEBLE & GAMBLE, 1904 (zoea I chromatophores). SOLLAUD, 1912 (zoeae I–IX) laboratory reared; WILLIAMSON, 1915, Figs. 120–125 (zoea II, not I), Figs. 126–128 (zoea I), Figs. 129–132 (last zoea); SOLLAUD, 1923, Figs. 1–9, 25, Plates 16, 17 and 18 (Figs. 1–4 only) (zoeae I–IX, PL 1) laboratory reared and plankton. REEVE, 1969, Fig. 7 (zoeae I–V, late larva) laboratory reared. SUTTON *et al.*, 1969, Fig. 1 (zoea I) laboratory reared.

Subgenus *Palaeander* Holthuis

5. *P. (Palaeander) elegans* Rathke. In zoea I the rostrum does not reach to the end of antenna 1; posterior margin of somite 5 of abdomen produced into a pair of small spines. Leg developmental sequence as for *P. (Palaemon) adspersus* above. Variable number of zoeal stages recorded (VI–IX). STUXBERG, 1873 (zoea I) plankton (as *Leander squilla*). KEEBLE & GAMBLE, 1904, Figs. 29–33 (zoea I) (as *Leander squilla*). WILLIAMSON, 1915, Figs. 133, 133a (zoea I) (as *Palaemon squilla*). GURNEY, 1924a, Figs. 8–12 (zoeae I, II, post larva (as zoea V)) laboratory reared and plankton (as *Leander squilla*). WIMPENNY & TITTERINGTON, 1936, Figs. 7–13 (zoeae I–VI, post larva) laboratory reared and plankton (as *Leander squilla elegans*). HÖGLUND, 1943, Plates 1–4 (zoeae I–VI, post larva) laboratory reared and plankton (as *Leander squilla typica*). TSURNAMAL, 1963, Figs. 1–51 (zoeae I–VIII, post larva) laboratory reared. FINCHAM, 1977, Figs. 2–20 (zoeae I–IX, post larva) laboratory reared.

Palaemonetes HellerSubgenus *Palaemonetes* Heller

6. *P. (Palaemonetes) varians* (Leach). There is considerable variation, especially in meristic characters. In zoea I, legs 1–5 rudimentary; posterior margin of somite 5 of abdomen rounded and not produced into spines. In zoea II, legs 1 and 2 developed with natatory exopods, legs 3 and 4 rudimentary, leg 5 developed, uniramous; posterior margin of somite 5 of abdomen produced into a pair of spines. In zoea III, internal distal margin of propod of legs 1 and 2 produced slightly forward; leg 3 developed with natatory exopod. In zoea IV, leg 4 developed with natatory exopod. Five zoeal stages. DU CANE, 1839, Figs. 1–7 (zoeae I–IV) plankton (as *Palaemon variabilis*). BOAS, 1880, Plate 1, Figs. 4, 24; Plate 2, Figs. 44, 79; Plate 5, Figs. 158–160; Plate 6, Figs. 192, 192a–d (appendages of early zoeae and post larvae). MAYER, 1880, Figs. 1–20 (zoeae I–IV, post

larvae). BOAS, 1889, Figs. 1–6 (selected appendages of zoeae, post larvae). MORTENSEN, 1897, Plate 1, Fig. 4; Plate 3, Fig. 5: IV; Plate 4, Fig. 2 (zoeae I, IV) plankton. WILLIAMSON, 1915, Figs. 134–136 (zoeae I, III, IV) Figs. 137–139 [zoea II (as I), III, post larva (as zoea IV)] (as *Palaemon varians*). SOLLAUD, 1923, Figs. 11–13, 23:3 (zoeae I–V, post larva) (as *Palaemonetes varians occidentalis*). GURNEY, 1924, Figs. 1–3, 4a, b, 5–11 (zoeae I–V, post larvae) laboratory reared and plankton. FINCHAM, in press, Figs. 1–11 (zoeae I–V, post larvae) laboratory reared.

Subfamily Pontoniinae

Typton Costa

7. *T. spongicola* Costa. Few published records of larval development. In zoea I, rostrum reaches beyond eyes; maxilla 2 has only three inner lobes; legs 1 and 2 present as rudiments; conspicuous hump at somite 3 of abdomen. In later larval stages, rostrum very short; legs 1–5 fully developed, 1 and 2 chelate, 1–4 with natatory exopod fringed with setae; abdomen still strongly humped, i.e. distinctly of the *Mesocaris* group (GURNEY, 1938), posterior part of somite 5 rounded, somite 6 very long. Number of zoeal stages not known largely owing to the difficulty in keeping this commensal, sponge-dwelling species in the laboratory. LEBOUR, 1925, Figs. 1–3 (zoea I) dredged. CAROLI, 1926 (zoea I). LEBOUR, 1949, Figs. 1–3 (last zoea, post larva) plankton and laboratory reared.

Family Processidae

All species in the ICES area belong to the genus *Processa* Leach.

SPECIFIC CHARACTERS IN ZOEAL STAGES OF PROCESSA

	<i>P. canaliculata</i> (Figs. 8a–c)	<i>P. edulis</i> (Figs. 9a–c)	<i>P. nouveli</i> (Figs. 10a–c)	<i>P. modica</i> (Figs. 11a–c)
Median abdominal spines	None	None	None	Somites 3 (and 6*)
Paired abdominal spines	Somites 4 and 5	Somite 5	Somite 5	Somite 5
Length rostrum: frontal lobe*	About twice	Shorter	Similar II, III, longer IV–IX	Similar
Eye length: maximum width*	About 1.5	About 2	About 1.5	About 1.5
Pterygostomian spine	Marginal	Sub-marginal*	Short, almost marginal	Long, (sub-marginal*)
Carapace denticles	5–8	0–2	3	4

* Characters not applicable in zoeal stage I.

ADDITIONAL CHARACTERS AND REFERENCES TO PUBLISHED DESCRIPTIONS

Processa Leach

8. *P. canaliculata* Leach [= *P. mediterranea* (Parisi)]. Eight or nine zoeal stages; stage I about 2 mm, last stage 7–9 mm. LEBOUR, 1936, Plate V, Figures 1–3, Plate VI, Figure 4 (zoeal stages I and VIII, megalopa). WILLIAMSON & ROCHANABURANON, 1978, Figure 9A (zoeal stage VI).
9. *P. edulis* (Risso).
- 9a. Subsp. *crassipes* Nouvel & Holthuis. Eight or nine zoeal stages, stage I about 2 mm, last stage 5–7 mm. GURNEY, 1923, Figures 1–5 (zoeal stages I–IV, as *P. canaliculata*. Stages VII–IX probably *P. nouveli*). GURNEY, 1942, Figure 77 (zoeal stage I). LEBOUR, 1936, Plate V, Figures 4, 5; Plate VI, Figures 1–3. WILLIAMSON & ROCHANABURANON, 1978, Figure 9B (zoeal stage VI).
- 9b. Subsp. *arcassonensis* Nouvel & Holthuis. Larvae not described.
10. *P. nouveli* Al-Adhub & Williamson [= *P. canaliculata*: Nouvel & Holthuis non Leach].
- 10a. Subsp. *holthuisi* Al-Adhub & Williamson. Eight or nine zoeal stages; stage I about 2 mm, last stage 5–9 mm. GURNEY, 1923,

Figures 6-9 (zoecal stages VII-IX, megalopa, as *P. canaliculata*). WILLIAMSON & ROCHANABURANON (in press), Figures 7, 8, 9 C (zoecal stages).

11. *P. modica* Williamson.

11a. Subsp. *modica* Williamson. Records from northern Europe of "*P. aequimana* (Paulson)" and "*P. parva* Holthuis" should be referred to this subspecies. Seven zoecal stages; stage I about 1.4 mm, last stage about 5 mm. WILLIAMSON & ROCHANABURANON, 1978, Figures 4, 5, 9D (zoecal stages).

DISTRIBUTION

Region	Species
Gulf of Bothnia, Gulf of Finland.....	2
Baltic proper.....	2, 6
Belt Sea.....	2, 5, 6
Kattegat.....	2, 4, 5, 6
Skagerrak.....	2, 4, 5, 6
Northern North Sea.....	2, 4, 5, 6, 8, 10a
Southern North Sea.....	2, 3, 4, 5, 6, 9a, 10a, 11a
English Channel.....	2, 3, 4, 5, 6, 7, 8, 9a, 11a
Bristol Channel, Irish Sea, S.W. Scotland.....	2, 4, 5, 6, 8, 9a, 10a, 11a
Faroe, Shetland, N. Scotland.....	5
Faroe-Iceland Area.....	—
W. Ireland and Atlantic.....	1, 2, 3, 4, 5, 6, 8, 9a, 10a, 11a
Bay of Biscay.....	2, 3, 4, 5, 6, 7, 8, 9b, 10a, 11a
Barents Sea.....	—
Norwegian Sea.....	2

REFERENCES

- BOAS, J. E. V., 1880. K. danske Vidensk. Selsk. Skr., 6, 1: 25-210.
- BOAS, J. E. V., 1889. Zool. Jb., 4: 793-804.
- CAROLI, E., 1926. Boll. Soc. Nat. Napoli, 37: 3-5.
- COUCH, R. Q., 1845. Rep. R. Cornwall polytech. Soc., 12: 17-46.
- CZERNIAVSKY, W., 1884. Schr. naturf. Ges. Charkoff, 8: 1-268 (in Russian).
- DU CANE, Captain, 1839. Ann. Mag. nat. Hist., 2: 178-180.
- FINCHAM, A. A., 1977. Bull. Br. Mus. nat. Hist. (Zool.), 32(1): 1-28.
- FINCHAM, A. A. Bull. Br. Mus. nat. Hist. (Zool.) (in press).
- GURNEY, R., 1923. J. mar. biol. Ass. U.K., 13: 245-265.
- GURNEY, R., 1924. Proc. zool. Soc. Lond., 297-328.
- GURNEY, R., 1924a. Proc. zool. Soc. Lond., 961-984.
- GURNEY, R., 1938. Scient. Rep. Gt Barrier Reef Exped., 6(1): 1-60.
- GURNEY, R., 1939. Ann. Mag. nat. Hist., 3: 120-126.
- GURNEY, R., 1942. Larvae of Decapod Crustacea. Ray Soc., London. 306 pp.
- HARDING, J. P. & SMITH, W. A., 1974. Scient. Publs Freshwat. biol. Ass., 18, 56 pp.
- HÖGLUND, H., 1943. Svenska hydrogr.-biol. Kommn. Skr. Ny Serie: Biologi, 2: 1-58.
- KEEBLE, F. & GAMBLE, F. W., 1904. Phil. Trans. R. Soc., B, 196: 295-388.
- LEBOUR, M. V., 1925. J. mar. biol. Ass. U.K., 13: 848-853.
- LEBOUR, M. V., 1936. Proc. zool. Soc. Lond., 609-617.
- LEBOUR, M. V., 1949. J. mar. biol. Ass. U.K., 28: 667-672.
- MAYER, P., 1877. Jena. Z. Med. Naturw., 11: 188-269.
- MAYER, P., 1880. Mitt. zool. Stn Neapel, 2: 197-221.
- MORTENSEN, T., 1897. Vidensk. Undersøg. Fisk. omr. Udg. dansk Fiskerifor., 1: 1-79.
- REEVE, M. R., 1969. J. mar. biol. Ass. U.K., 49: 77-96.
- SOLLAUD, E., 1912. C. r. hebdom. Séanc. Acad. Sci., Paris, 154: 664-667.
- SOLLAUD, E., 1923. Bull. biol. Fr. Belg., 57: 510-603.
- STUXBERG, A., 1873. Öfvers. K. VetenskAkad. Förh., 9: 1-23.
- SUTTON, A. H., MAIN, G. & RONALD, A., 1969. Lab. Pract., 18: 433-436.
- THOMPSON, J. V., 1836. Edinb. New Phil. J., 21: 221-223.
- TSURNAMAL, M., 1963. Israel J. Zool., 12(1-4): 117-141.
- WILLIAMSON, D. I. & ROCHANABURANON, T. J. nat. Hist. (in press).
- WILLIAMSON, H. C., 1915. Nord. Plankt., 18: 315-588.
- WIMPENNY, R. S. & TITTERINGTON, E., 1936. Notes Mem. Fish. Res. Dir., Cairo, 14: 1-36.