ICES Identification Leaflets for Plankton

Fiches d'Identification du Plancton

LEAFLET NO. 186

Crustacea
Decapoda: Larvae
II. Dendrobranchiata
(Aristeidae, Benthesicymidae, Penaeidae, Solenoceridae, Sicyonidae, Sergestidae, and Luciferidae)

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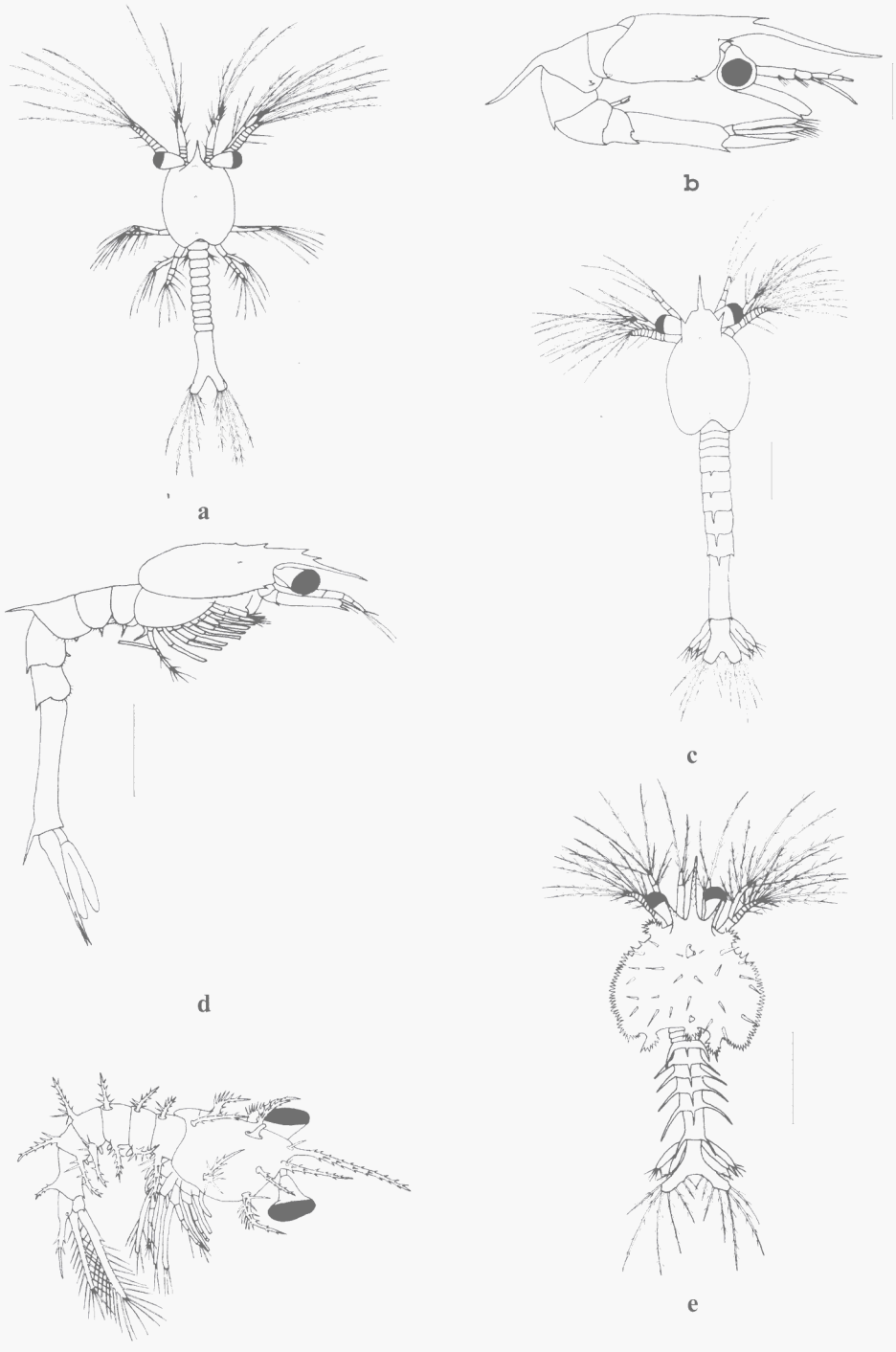

Figure 1. a. *Aristeus antennatus*, Protozoea II. Scale: 0.5 mm. b. *Gennadas elegans*, Last zoea. Scale: 1.0 mm. c. *Parapenaeus longirostris*, protozoea III. Scale: 0.5 mm. d. *Parapenaeus longirostris*, zoea I. Scale: 1.0 mm. e. *Solenocera membranacea*, protozoea III. Scale: 1.0 mm. f. *Sergestes sargassi*, zoea I. Scale: 0.5 mm.

Figure 2. a. *S. atlanticus* protozoea I dorsal. b. *S. vigilax* protozoea I carapace dorsal. c. *S. arcticus* protozoea 1 telson fork dorsal. d. *S. curvatus* protozoea I carapace dorsal. e. "*S. robustus* C" (*S. japonica*?) protozoea 1 carapace dorsal. f. *S. atlanticus* protozoea II dorsal. g. *S. henseni* protozoea III carapace lateral. h. *S. arcticus* protozoea II carapace lateral. i. *S. vigilax* protozoea III. j. *S. robusta* protozoea II carapace dorsal. k. "*S. robustus* C" (*S. japonica*?) protozoea III carapace dorsal. l. *S. atlanticus*, zoea I, dorsal. m. *S. henseni* zoea II, abdomen dorsal. n. *S. arcticus* zoea II carapace lateral. o. *S. vigilax* zoea II dorsal. p. *S. robusta* zoea II dorsal. q. "*S. robusta* C" (S. japonica?) zoea II dorsal. All after Gurney and Lebour (1940) except c after Wasserloos (1908).

Decapoda, Dendrobranchiata

Taxonomy and nomenclature follow Pérez-Farfante and Kensley (1997). Keys to family level are modified from Dall *et al.* (1990).

Larval stages

Numbers of larval stages in NE Atlantic Dendrobranchiates

Family	Nauplius	Protozoea	Zoea (Mysis)	Post-larva (Megalopa)
Aristeidae	?	3	?	?
Benthesicymidae	?	3	4+	?
Penaeidae	3–8	3	(2–)3–5	1–6
Sicyonidae	8	3	4	Many?
Solenoceridae	?	3	4+	1?
Sergestidae	2+	3	2	Many
Luciferidae	2+	3	2	Many

Nauplii

The nauplii of the Eucaridea are distinguished from those of other crustacean superorders by the lack of masticatory spines at the base of the antenna or mandible (Williamson, 1982). The first nauplii are pyriform, with two posterior spines in Dendrobranchiates (absent in NI stage of Euphausiacea) and only three pairs of limbs. The last stages are metanauplii with buds of maxillules, maxillae and maxillipeds present and with distinct abdomen. The abdomen extends well beyond the posterior margin of the carapace and is distinctly bilobed. In contrast, the abdomen of euphausiid metanauplii has no more than a slight median indentation and barely extends beyond the posterior margin of the carapace.

Key to genera

Protozoea (Elaphocaris)

1. Carapace with spines or processes — 2
   Carapace smooth — 4
2. Carapace margin serrate, spines robust — *Solenocera* (Fig. 1e)
   Carapace posterior margin with 3 small spines — *Lucifer*
   Carapace margin smooth, spines long and slender — 3
3. Protozoea II and III: lateral and posterior processes without long spines — *Sergia* (Fig. 2j–k)
   Protozoea II and III: lateral and posterior processes with long lateral spines or long spines at their bases — *Sergestes* (Fig. 2f–i)
4. Rostrum very short, length of antennule (A1) 2× that of (A2) antenna — *Sicyonia*
   Rostrum at least reaching the ocular peduncle, antennule length <2× antenna length — 5
5. Carapace with two pairs of supraorbital spines — 6
   Carapace with or without one pair of supraorbital spines — 7
6. Supraorbital spines small; telson with 7+7 terminal spines — *Peneopsis*
   Supraorbital spines prominent; telson with 8+8 terminal spines — *Parapenaeus* (Fig. 1c)
7. Posterior end of supraorbital spines bifurcate — *Melicertus* and *Marsupenaeus*
   When present, supraorbital spines never bifurcate — 8
8. Telson with deep invagination; Protozoea III with dorsal spines on abdominal segments — *Gennadas*
   Telson with median invagination; Protozoea III without dorsal spines on abdominal segments — 9
9. Antennule shorter than antenna; rostrum slender at base — *Aristeus* (Fig. 1a)
   Antenna shorter than antennule; rostrum enlarged at base — *Aristaeomorpha*

Zoea (Mysis or Acanthosoma)

1. Carapace with many spines or processes — 2
   Carapace smooth — 3
2. Carapace margin serrate, spines robust — *Solenocera*
   Carapace margin smooth, spines long and slender — *Sergestes* and *Sergia* (Figs 1f, 2l–q)
3. Dorsomedian spines absent on abdominal somites 1–5 — 4
   Dorsomedian spines present, at least on abdominal somite 5 — 7
4. Rostrum short, not reaching the ocular peduncles — 5

	Rostrum longer than ocular peduncles	6
5.	Abdominal somites with ventral spines	*Lucifer*
	Abdominal somites without ventral spines	*Sicyonia*
6.	Carapace with pterogostomian spine	*Aristeus*
	Carapace without pterogostomian spine	*Aristaeomorpha*
7.	Four or five ventral-median spines on abdominal somite 6	*Funchalia*
	Ventral margin of abdominal segment 6 without spines	8
8.	Dorsomedian spine on abdominal somite 2	9
	Without dorsomedian spine on abdominal somite 2	10
9.	Dorsomedian spine on abdominal somite 2 longer than the others	*Gennadas* (Fig. 1b)
	Dorsomedian spine on abdominal somite 2 very minute	*Melicertus*
10.	Large dorsomedian spine on abdominal somite 3	*Parapenaeus* (Fig. 1d)
	Minute dorsomedian spine in Z1 only	*Marsupenaeus*
	Without dorsomedian spine on abdominal somite 3	*Penaeopsis*

Post-larva (mastigopus or megalopa) – Key to families

1.	Pereopods 1–3 all chelate	2
	Pereopods 1 or 2 non-chelate, 4 or 5 rudimentary or absent	Sergestoidae
2.	Cervical sulcus present	Solenoceridae
	Cervical sulcus absent	3
3.	Ventromedian spines on abdominal somites	Penaeidae
	No ventromedian spines on abdominal somites	Aristeidae and Benthesicymidae

Sergestidae

Key to described protozoea and zoea stages mainly from descriptions in Gurney and Lebour (1940).

The larvae described by Gurney and Lebour as "*Sergestes robustus* C" are tentatively referred to *Sergia japonica*. The larvae have been recorded off Bermuda and New Zealand (Gurney and Lebour, 1940) as well as off the Portuguese coast (A. dos Santos, unpublished). Known distributions within the North Atlantic (Vereshchaka, 1994) and globally (Pérez-Farfante and Kensley, 1997) indicate that *Sergia japonica* is the only species of the genus with undescribed larvae with distributions consistent with the occurrences of the larvae. Also, the larvae described by Gurney and Lebour as "*Sergestes corniculum* Form A" are probably *Sergestes curvatus*. The larvae have been recorded off the Portuguese coast (A. dos Santos, unpublished). Crosnier and Forest (1973) showed that "*Sergestes corniculum* Form B" of Gurney and Lebour are larvae of *S. henseni*.

Key to species

Protozoea I (eyes sessile, no rostrum, abdomen unsegmented).

1.	Anterior carapace processes with 4 branches	2
	Anterior carapace spines with 3 branches	3
2.	Branches of anterior carapace spines smooth	"*S. robustus* C" (*Sergia japonica*?) (Fig. 2e)
	Branches of anterior carapace spines denticulate	3
3.	Lateral processes with 6 basal spines	*Sergestes curvatus* (Fig. 2d)
	Lateral processes with 3 basal spines	*Sergestes henseni*
4.	Median branch only of anterior carapace process with denticles	*Sergestes vigilax* (Fig 2b)
	All branches of anterior carapace process with denticles	5
5.	Telson forks length $>3\times$ width	*Sergestes atlanticus* (Fig. 2a)
	Telson forks length only slightly greater than width	*Sergestes arcticus* (Fig. 2c).

Protozoea II–III (eyes stalked; PII uropods absent; PIII uropods present)

1.	Lateral and posterior carapace processes without lateral spines but with long spines around the base	2
	Lateral and posterior carapace processes without long lateral spines, spinules present at base	3
	Supraorbital, lateral and posterior carapace processes with numerous long lateral spines	4
2.	Lateral lappets of carapace with >9 spines	*Sergestes henseni*

	Lateral lappets of carapace with <10 spines	*S. curvatus* (Fig. 2g)
3.	Carapace processes shorter than carapace, lateral carapace processes almost parallel with body	"*Sergia robustus* C" (*S. japonica*?) (Fig. 2k)
	Carapace processes longer than carapace, lateral carapace processes clearly diverging from the body	*S. robusta* (Fig. 2j)
4.	Spines on carapace processes multifid at tip ("brush-ended")	*Sergestes arcticus* (Fig. 2h)
	Spines on carapace processes smooth at tip	5
5.	Spines arising from swollen base of posterior carapace process, none from distal part	*Sergestes atlanticus* (Fig. 2f)
	No swollen base to posterior carapace process, spines on distal part	*Sergestes vigilax* (Fig. 2i)

Zoea

1.	Carapace without posterior dorsal spine, eye asymmetrical, supraorbital spine longer than eyestalk, lateral spines on abdominal segments approximately equal with long spinules	2
	Carapace with posterior dorsal spine	3
2.	Eyestalk about 2× width of eye	*Sergestes curvatus*
	Eyestalk <1.5× width of eye	*Sergestes henseni* (Fig. 2m)
3.	Lateral spines on abdominal segment 3 longest, those on segments 1–3 with spinules on 4 and 5 simple, eye asymmetrical, eyestalk length 1.5–2× width of eye supraorbital spine about equal to eyestalk	*Sergestes vigilax* (Fig. 2o)
	Lateral spines on segment 3 not the longest	4
4.	Lateral spines on abdominal segments >2× length of segments from which they arise, those on segment 5 longest, eye ± symmetrical, eyestalk >2× eye width, supraorbital spine shorter than eyestalk	*Sergia robusta* (Fig. 2p)
	Lateral spines on abdominal segments 1 and 5 the longest, those on segment 3 about equal to segment, eyestalk >2× eye width, supraorbital spine shorter than eyestalk	"*S. robustus* C" (*Sergia japonica*?) (Fig. 2q)
	Lateral spines on abdominal segments with long spinules at base, eye asymmetrical, eyestalk approximately equals width of eye, supraorbital spines longer than eyestalk	*Sergestes sargassi* (Fig. 1e)
	Lateral spines on abdominal segments decrease in length from segment 1 to segment 5	5
5.	Eye ± symmetrical, eyestalk length about 3× width of eye, supraorbital spine shorter than eyestalk	*Sergestes arcticus* (Fig. 2n)
	Eye asymmetrical, eyestalk about 1.5× width of eye, supraorbital spine about equal to eyestalk length	*Sergestes atlanticus* (Fig. 2l)

References to descriptions and figures

Superfamily Penaeoidea
Family Benthesicymidae
Gennadas Bate

Gennadas larvae: Gurney (1924) Fig. 1 (protozoea I); Fig. 2 (protozoea I–III, zoea I–IV); Fig. 3 (protozoea III); Fig. 4 (zoea II) (as *Gennadas* sp.). Subrahmanyam and Gunter (1970) Fig. 1 (protozoea III) (as *Gennadas* sp.). Criales and McGowan (1993) Fig. 2 (zoea I); Fig. 3 (zoea II); Fig. 4 (zoea III); Fig. 5 (zoea IV) (as probable *Gennadas valens* larvae).

1. *Gennadas tinayrei* Bouvier. Larvae not described.
2. *Gennadas valens* (Smith). Larvae not described.
3. *Gennadas brevirostris* Bouvier. Larvae not described.
4. *Gennadas elegans* (Smith). Heldt (1938) described 4 zoeas whereas Kurian (1956) described 6, so the actual number is uncertain or may be variable.

Heldt (1938) Fig. 71 (protozoea II); Fig. 74, 76 (protozoea III); Fig. 127.1 (zoea I); Fig. 127.2, 127.3 (zoea II); Fig. 126, 127.4–10 (zoea IV); Fig. 127.11–13 (postlarva). Gurney (1942) Fig. 52 (protozoea II); 53 (zoea I). Kurian (1956) Figs. 1–7 (zoea I–VI); PII 1.6–1.81 mm, PIII 2.3–3.0 mm, ZI 3.6–3.8, last zoea 6.0–7.4 mm.

Bentheogennema Burkenroad

5. *Bentheogennema intermedia* (Bate). Larvae not described

Benthesicymus Bate

Probable *Benthesicymus* larvae: Gurney (1924) Fig. 6 (zoea I).

6. *Benthesicymus bartletti* Smith. Larvae not described.
7. *Benthesicymus brasiliensis* Bate. Larvae not described.
8. *Benthesicymus iridescens* Bate. Larvae not described.

Family Aristeidae

Aristeomorpha Wood-Mason

9. *Aristeomorpha foliacea* (Risso).

Heldt (1955a) Pl. III (metanauplius); Pl. IV, V (protozoea II); Pl. VI, VII (protozoea III); Pl. VIII, IX (zoea I).
N (last metanauplius) 0.8 mm, PII 1.9 mm, PIII 3.0 mm, ZI 4.3 mm.

Plesiopenaeus Bate

10. *Plesiopenaeus armatus* (Bate). Larvae not described.
11. *Plesiopenaeus edwardsianus* (Johnson). Larvae not described.

Aristeus Duvernoy

12. *Aristeus antennatus* (Risso).

Heldt (1955a) Pl. X, XI (protozoea I); Pl. XII, XIII (protozoea II); Pl. XIV, XV (protozoea III); Pl. XVI, XVII (zoea I). PI 1.6 mm, PII 1.5–2.0 mm, PIII 2.9 mm, ZI 3.0 mm.

Family Penaeidae

Melicertus Raffinesque-Schmalz

13. *Melicertus kerathurus* (Förskal).

Heldt (1938) Fig. 47–54 (nauplius); Fig. 59, 62 (1–3) (protozoea I); Fig. 60 (protozoea II); Fig. 61, 62 (4–5) (protozoea III); Fig. 80–91 (zoea) (as *Penaeus trisulcatus*). Lumare and Gozzo (1972) Fig. 1 (nauplius I–VI). Dall *et al.* (1990) with other references. N 0.4–0.6 mm, PI 1.0–1.2 mm, PII 1.4–1.8 mm, PIII 2.2 mm, ZI 3.6–4.0 mm, ZII 4.3 mm, ZIII 4.5–4.7 mm, PLI 4.8 mm

Marsupenaeus Tirmizi

14. *Marsupenaeus japonicus* (Bate)*.

Hudinaga (1942) Figs. 6–11 and Pl. XXVIII, XIX (nauplius); Fig. 12 and Pl. XXX, XXXI (protozoea I); Figs. 12–13 (protozoea II); Figs. 12 and 14 (protozoea III); Figs. 15–24 and Pl. XXXII and XXXIII (zoea); Figs. 25, 28–30 and Pl. XXXIV–XLVI (post-larva). Al-Kholy and El-Hawary (1970) Pl. XXII–XXIII (protozoea I); Pl. XXIV–XXVII (protozoea III); Pl. XXVIII–XXXIII (zoea I–III). (All as *Penaeus japonicus*.) N 0.3–0.5 mm, PI 0.9–1.3 mm, PII 1.3–2.1 mm, PIII 2.1–2.6 mm, ZI 2.7–3.1 mm, ZII 3.0–3.6 mm, ZIII 3.8–4.5 mm, PL1 4.9 mm.
*Recorded in the area from adults (presumably escaped from aquaculture), not so far shown to breed in the wild.

Funchalia Johnson

15. *Funchalia woodwardi* Johnson.

Stephensen (1923) Fig. 6 (late zoea 9 mm) (as *Aristaeomorpha foliacea*). Paulinose (1974) Fig. 1 (late zoea) (as *Aristaeomorpha foliacea*). Gurney (1924) Fig. 11 (juvenile).

Parapenaeus Smith

16. *Parapenaeus longirostris* (Lucas).

Heldt (1938) Fig. 55 (nauplius); Figs. 63–64 and 68.2 (protozoea I); Figs. 67 and 68 (3–5) (protozoea II); Figs. 72, 75 (1 and 2) (protozoea III); Figs. 108–118 (zoea I-post-larva). The larvae attributed to this species by Pearson (1939) are *P. politus* Smith (Dos Santos, 1998). N 0.3–0.5 mm, PII 0.8 mm, PIII 2.8 mm, ZI 3.9 mm.

Penaeopsis Bate

Larvae of *Penaeopsis* sp.: Gurney (1943) Figs. 32–33 (protozoea I), Fig. 34 (protozoea III), Figs. 35–36 (zoea I), Figs. 37–41 (zoea II), Figs. 42–43 (post-larva). Gurney (1924) Fig. 10 (zoea); Also Paulinose (1973) for *Penaeopsis rectacuta* larvae.

17. *Penaeopsis serrata* (Bate). Larvae not described.

Solenoceridae

Solenocera Lucas

18. *Solenocera membranacea* (Risso).

Heldt (1955b) Pl. II and III (protozoea I), Pl. IV and V (protozoea II), Pl. VI and VII (protozoea III), Pl. VIII and IX (zoea I), Pl. X–XII (zoea II) Fig. 1 (post-larva). Also: Monticelli and Lo Bianco (1901) as *Solenocera siphonocera* (no figures); Kurian (1956) Figs 18–29 (protozoea II–zoea II); Heldt (1938) Figs. 77–78, 128–131 (protozoea III-post larva); Heegaard (1966) Figs. 10–14 (protozoea III–zoea II). Gurney (1942) Fig. 54 (zoea). PI 1.0–1.2 mm, PII 2.1–2.4 mm, PIII 3.6–4.5 mm, ZI 4.1–7.0 mm, ZII 7.9–12.0 mm.

Sicyoniidae

Sicyonia H.-M. Edwards

19. *Sicyonia carinata* (Brünnich).

Heldt (1938) Fig. 56 (nauplius), Figs. 65–66 (protozoea I), Figs. 68.1, 69–70 (protozoea II), Figs. 73, 75 (3–4) (protozoea III), Figs. 119–125 (zoeas). N

0.25–0.4 mm, PI 0.8 mm, PII 1.2–1.3 mm, PIII 1.8 mm, ZI 2.1–2.4 mm, ZII 2.6–2.8 mm, ZIII 3.0 mm, ZIV 3.3 mm.

Sergestoidea
Sergestidae
Sergia Stimpson

20. *Sergia robusta* (H. Milne-Edwards). Gurney and Lebour (1940) Figs. 20–24 and 26–29 (all stages); Kurian (1956) Figs 39–49 (protozoea II – post larva), Hansen (1922) Pl. VI: Fig. 3 (a–l) (post-larva) and Pl. VII: Fig. 1 (a–g) (zoea). PII 1.2 mm, PIII 2.0-2.2 mm, ZI 3.3–4.3 mm, ZII 4.0–5.0 mm, PL1 4.2–6.5 mm.
21. *Sergia japonica* Bate. Probably *S. robustus* C of Gurney and Lebour (1940) Figs. 28–29 (protozoea I–III and zoea II) PI 0.6 mm, PII 1.0 mm, PIII 2.3 mm, ZII 2.3 mm.

Sergestes H. Milne-Edwards

22. *Sergestes arcticus* Krøyer. Wasserloos (1908) Figs. 1–3 (protozoea), Figs. 4, 5 (zoea) and Fig. 6 (post-larva). Gurney and Lebour (1940) Fig. 12 (protozoea II, zoea II and post-larva); Dohrn (1870) Fig. 28 (protozoea III); Hansen (1922) Pl. III: Figs. 4 (a–k) (post-larva), Figs. 5 (a–e) (zoea), Pl. IV: Figs. 1 (a–b) (post-larva), Figs. 2 (a–c) (zoea). Kurian (1956) Figs. 32–38 (zoea I – post-larva); See also Knight and Omori (1982) for *Sergestes similis*, a closely related species. (*S. similis* N 0.3–0.5 mm) PI 0.8 mm, PII 1.2 mm, PIII 1.6–2.2 mm, ZI 3.0–3.6 mm, ZII 3.8–4.8 mm, PL1 5.0–5.1 mm.
23. *Sergestes sargassi* Ortmann.

Kurian (1956) Figs. 54–56 (zoea I–II); Gurney and Lebour (1940) Figs. 42–43 (zoea II), Fig. 44 (post-larva); Hansen (1922) Pl. IX: Fig. 3 (a–b) (post-larva). ZI 2.3 mm, ZII 3.0 mm, PL II (?) 4.35 mm.
24. *Sergestes henseni* Ortmann.

Gurney (1924) Figs. 21–23 (protozoea I–III); Gurney and Lebour (1940) Fig. 31 (protozoea III), P36 (ZII); Hansen (1922) Pl. VIII: Figs. 2 (a–d) (post-larva), Fig. 3 (a–h) (zoea). Kurian (1956) Figs. 51–53 (zoea I). PI 0.7 mm, PII 1.0–1.3 mm PIII 1.5 mm, ZI 2.5 mm, ZII 2.6 mm, PLI 3.7 mm.
25. *Sergestes curvatus* Crosnier and Forest

Gurney and Lebour (1940) Fig. 30 (PI–II), Figs. 32–35 (ZI-PL). PI 0.7, PII 1.3 mm, PIII 1.5 mm, ZI 3.3 mm, ZII 3.6 mm, PLI 3.7 mm.
26. *Sergestes atlanticus* H.-M. Edwards.

Gurney and Lebour (1940) Figs. 1–2 (protozoea), Figs. 3 and 4a. (zoea), Figs. 4b and 5 (post-larva); Hansen (1922) Pl. II: Figs. 2 (a–p) (post-larva). PI 0.8 mm, PII 1.3 mm, PIII 1.76 mm, ZI 3.0 mm ZII 3.5 mm, PL1 3.9 mm.
27. *Sergestes vigilax* Stimpson

Gurney and Lebour (1940) Fig. 45 (protozoea), Figs. 46–47 (zoea), Figs. 48–49 (post-larva); Gurney (1924) Fig. 17 (protozoea II), fig. 18 (protozoea III); Hansen (1922) Pl. X: Figs. 2 (a–g) (post-larva), Figs. 3 (a–f) (zoea). Kurian (1956) Figs. 57–64 (zoea I-post-larva). PI 1.2 mm, PII 1.6 mm, PIII 1.7–2.6 mm, ZI 2.4–2.6 mm, ZII 3.2–3.3 mm, PL1 4.0 mm.

Luciferidae
Lucifer Vaughan-Thompson

Brooks (1882) Pl. 3–7 (nauplius, protozoea, zoea and post-larvae) for *Lucifer faxoni*; Gurney (1927) Figs. 58 and 59 for *Lucifer hanseni*.

28. *Lucifer typus* H.-M. Edwards. Hashizume (1999) Figs. 2–3 (nauplius), Figs. 5–6, 8–9, 11–12 (Protozoea), Figs. 15–16 (Zoea), Fig. 17 (megalopa).

Geographical Distribution (Heegaard, 1966; Zariquiey-Alvarez, 1968; Fasham and Foxton, 1979; Lagardère, 1978; Hargreaves, 1984; Lindley, 1986; Lindley, 1987; Noël, 1993, Vereshchaka, 1994, Christiansen, 1995, Dos Santos, 1998).

Norwegian Sea	15, 20, 22
Iceland/Faroes	4, 20, 22
Faroes/Shetland/N. Scotland	4, 15, 18, 20, 22
Northern North Sea	20, 22
Western Ireland and Atlantic	1?,2, 3, 4, 15, 18, 20, 21, 22, 23
English Channel	13, 14,
Bay of Biscay	1, 2, 3, 4, 13, 14, 15, 18, 20, 21, 23, 28
Portuguese continental coast	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28

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