

The pelagic copepods in the Strait of Dover (Eastern English Channel). A commented inventory 120 years after Eugène Canu

Jean-Michel BRYLINSKI^{1,2,3}

(1) Univ Lille Nord de France, F-59000 Lille, France

(2) ULCO, LOG, F-62930 Wimereux, France

(3) CNRS UMR 8187, F-62930 Wimereux, France.

E-mail: jm-brylinski@univ-littoral.fr

Abstract: This paper is a commented list of copepod species collected, using plankton nets, during a series of oceanologic cruises in the Strait of Dover (1975-2008). It follows in the footsteps the historic work first carried out by the French copepodologist Eugène Canu in 1888. It brings up-to-date the list carried out by Glaçon (1975). A total of 35 species are listed here, some of which have to this day rarely been seen. The copepod diversity in the Eastern English Channel is on the whole relatively low. The meroplanktonic form «*Saphirella*» (Scott, 1894) found in the Eastern English Channel and in the South of the North Sea and *Eurytemora americana* (Williams, 1906) found in the Dunkirk harbour are mentioned and described. Brief notes are given on ecological preferences of each species and their relative abundance.

Résumé : Les copépodes pélagiques du détroit du Pas de Calais (Manche orientale). Un inventaire commenté 120 ans après Eugène Canu. Ce papier présente une liste commentée des espèces de copépodes prélevés au filet (WP2 - 200 µm) dans le détroit du Pas de Calais, au cours de nombreuses campagnes océanologiques (1975-2008). Ces travaux font suite aux premiers travaux historiques du copépodologiste français Eugène Canu en 1888 et mettent à jour la dernière liste publiée par Glaçon (1975). Un total de 35 espèces a été relevé, dont certaines très rares pour la région, ce qui correspond à une diversité faible. La forme méroplanctonique «*Saphirella*» (Scott, 1894) est mentionnée et décrite pour la Manche orientale et la baie sud de la Mer du Nord, ainsi que la présence de *Eurytemora americana* (Williams, 1906) dans le port de Dunkerque. De brèves indications écologiques sont données pour chaque espèce.

Keywords: Copepods inventory • Invasive species • *Eurytemora americana* • *Saphirella* • Eastern English Channel

Introduction

Inventories of species give a view of the biodiversity at any given moment, so it is interesting to have regular information of their temporal changes. For the crustacean pelagic copepods, the last inventory in the Strait of Dover was that of Glaçon (1975). It is interesting to bring this work up-to-date and to compare it with the first works of Canu, 120 years ago (Canu, 1888a & 1892). Such observations give a qualitative approach of the long term changes of species, a present preoccupation connected with climate change (Beaugrand, 2009). This paper presents an up-to-date commented list of the pelagic copepods in the Strait of Dover - a transitional area between the North Atlantic and the North Sea via the English Channel - and comments temporal changes from those given by Canu at the end of the 19th century.

Eugene Canu (France, 1864-1952) began studying copepods in 1885 at the Maritime Laboratory of Zoology in Wimereux, Northern France. He published five articles on the subject between 1888 and 1891 under the generic title «*les copépodes du Boulonnais*». In 1892, he produced a synthetic work of 294 pages and 30 plates, with the subtitle «*morphologie, embryologie, taxonomie*». Most of Canu's studies were in fact related to the parasitic or commensal copepods, and benthic harpacticids (species not considered in this paper). At the start of 20th century, the collection of known copepods in Wimereux totalled 120 species, which included only 11 calanoids (Giard, 1913).

After Canu's original works, there was no further interest in this area of listing copepods in the Strait of Dover, until about 45 years ago - firstly by Duwoz (1963), then Brylinski (1975 & 1986) and Quisthoudt et al. (1987). Records data are now available in the South bay of the North Sea: Dunkirk harbour (Brylinski, 1979 & 1981), and off Gravelines, where a monthly plankton recording started in 1973 (Brylinski & Delesalle, 1974; Le Fèvre-Lehoërff & Cochard, 1996; Le Fèvre-Lehoërff & Le Grand, 1998; Brylinski & Vincent, 2007; Antajan, 2008). More westward in the English Channel, an inventory of mesozooplankton, including copepods, is available for the Solent-Southampton Water system (Muxagata & Williams, 2004).

Relating to these inventories, we can cite here the extensive one of C. Razouls, regularly updated and accessible on the Internet (Razouls et al., 2005-2008). As a result of this work, 315 genera and 2441 species of pelagic copepods are currently listed from all over the world, including 112 species in the North Sea subgroup, which directly concerns this paper (Eastern English Channel and South of the North Sea).

Material and Methods

Lists of species

Our listing is based on the original works of Canu (1888a, b, c & 1892) and on the global faunal and floral inventory of Glaçon (1975), published by Müller (2004). The information given here about each species is a compilation of data produced previously (some as grey literature) and supplemented with over 30 years of personal records and observations. Species indicated in this work by an asterisk (*) are new in reference to Glaçon (1975).

Some species were only recorded once and have had their locations and dates subsequently indicated. Samples were collected off Boulogne-sur-Mer, Cap Gris-Nez (Strait of Dover), and in the maritime area between the bay of the Seine and the Belgian frontier (Fig. 1). Unfortunately, Glaçon's original listings did not indicate the date or location of those species collection, nor the sometimes exceptional character of these findings.

The classification used is the same as in both Razouls et al. (2005-2008) and WoRMS (2009).

Sampling methods

Samples called «littoral» by Canu were collected on foot. Canu (1888a: 78) indicated that sampling «*must be carried*

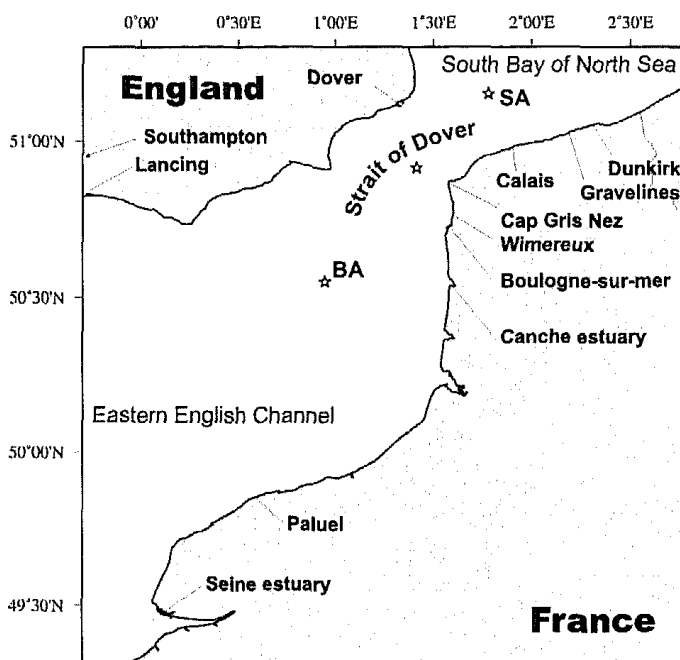


Figure 1. Chart of the Strait of Dover and location of the collected samplings in the Eastern English Channel and the South Bay of the North Sea.

Figure 1. Carte du Pas-de-Calais et localisation des prélèvements cités en Manche orientale et en Baie sud de la Mer du Nord.

out at low tide and the collector must advance as far as possible while remaining in water». Offshore samplings were carried out on board ships such as the «Ajax» (Canu, 1892: 154). There being no quantitative data (ind.m⁻³) at the time.

Originally, samples were collected using a «fine net», without precise porosity. Since 1973 however, all sampling carried out during numerous oceanographic cruises (cf. chart Fig.1) has been done so using a 'WP2 net' (mesh opening: 200 µm - UNESCO, 1968). Samples were generally collected by vertical hauls from the bottom to the surface, and their volume controlled with TSK flow-meter (except in the BA and SA stations).

Drawings (Figs 2 & 3) were made with the aid of a camera lucida and photographs.

Results and discussion

Table 1 gives the up-to-date list (2009) of pelagic copepods from the Dover Strait, including its bordering areas: the Eastern English Channel and the South Bay of the North Sea. For each of the species, comments are given. In particular, our ecological observations are, if possible, compared with those of Canu (Canu, 1892: 97, «cosmic environment»).

Order Calanoïda

Family Calanidae

Calanus helgolandicus (Claus, 1863)

This species is regularly present in offshore waters (more in the SA than BA station) but can even be found near the

Table 1. List of the pelagic copepods in the Strait of Dover (2009). Species with asterisk (*) are new in reference to Glaçon (1975).

Tableau 1. Liste des copépodes pélagiques dans le Détroit du Pas de Calais (2009). Les espèces avec un astérisque sont nouvelles par rapport à Glaçon (1975).

Order Calanoïda

Family Calanidae

Calanus helgolandicus (Claus, 1863)

Family Paracalanidae

Paracalanus parvus (Claus, 1863)

Family Clausocalanidae

Pseudocalanus elongatus (Boeck, 1872)

Family Stephidae

Stephos scotti (Sars, 1903).

Family Pseudocyclopiidae

Pseudocyclopia sp.* (Thompson 1895)

Family Temoridae

Temora longicornis (O.F. Müller, 1792)

Eurytemora affinis (Poppe, 1880)

*Eurytemora americana** (Williams, 1906)

Family Metridinidae

*Metridia lucens** (Boeck, 1864)

Family Centropagidae

Centropages hamatus (Lilljeborg, 1853)

Centropages typicus (Kroyer, 1849)

Isias clavipes (Boeck, 1864)

Family Arietellidae

*Paramisophria cluthae** (Scott, 1897)

Family Pseudocyclopidae

*Pseudocyclops obtusatus** (Brady & Robertson, 1873)

Family Candaciidae

*Candacia armata** (Boeck, 1872)

Family Pontellidae

Labidocera wollastoni (Lubbock, 1857)

Anomalocera patersoni (Templeton, 1837)

*Pontella lobiancoi** (Canu, 1888)

Family Parapontellidae

Parapontella brevicornis (Lubbock, 1857)

Family Acartiidae

Acartia (Acartiura) clausi (Giesbrecht, 1889)

Acartia (Acartiura) discaudata (Giesbrecht, 1881)

*Acartia (Acartiura) omorii** (Bradford, 1976)

*Acartia (Acanthacartia) bifilosa** (Giesbrecht, 1881)

*Acartia (Acanthacartia) tonsa** (Dana, 1848)

*Paracartia grani** (Sars, 1904)

Order Cyclopoida

Family Oithonidae

*Oithona nana** (Giesbrecht, 1892)

Family Cyclopinidae

*Cyclopina (Cyclopinoïdes) littoralis** (Brady, 1872)

Family Lichomolgidae

*Pseudanthessius sauvagei** (Canu, 1891)

Family Corycaidae

Coryceus anglicus (Lubbock, 1855)

Family Oncaeidae

Oncaea sp.* (Sars, 1916)

Family Clausidiidae

*Saphirella** (Scott, 1894) (*Giardella callianassae*, Canu, 1888).

Order Platycopioida

Family Platycopiidae

*Platycopia perplexa** (Sars, 1911)

Order Harpacticoida

Family Euterpinae

Euterpina acutifrons (Dana, 1848)

Order Monstrilloida

Family Monstrillidae

Monstrilla helgolandica (Claus, 1863)

*Monstrilla grandis** (Giesbrecht, 1892)

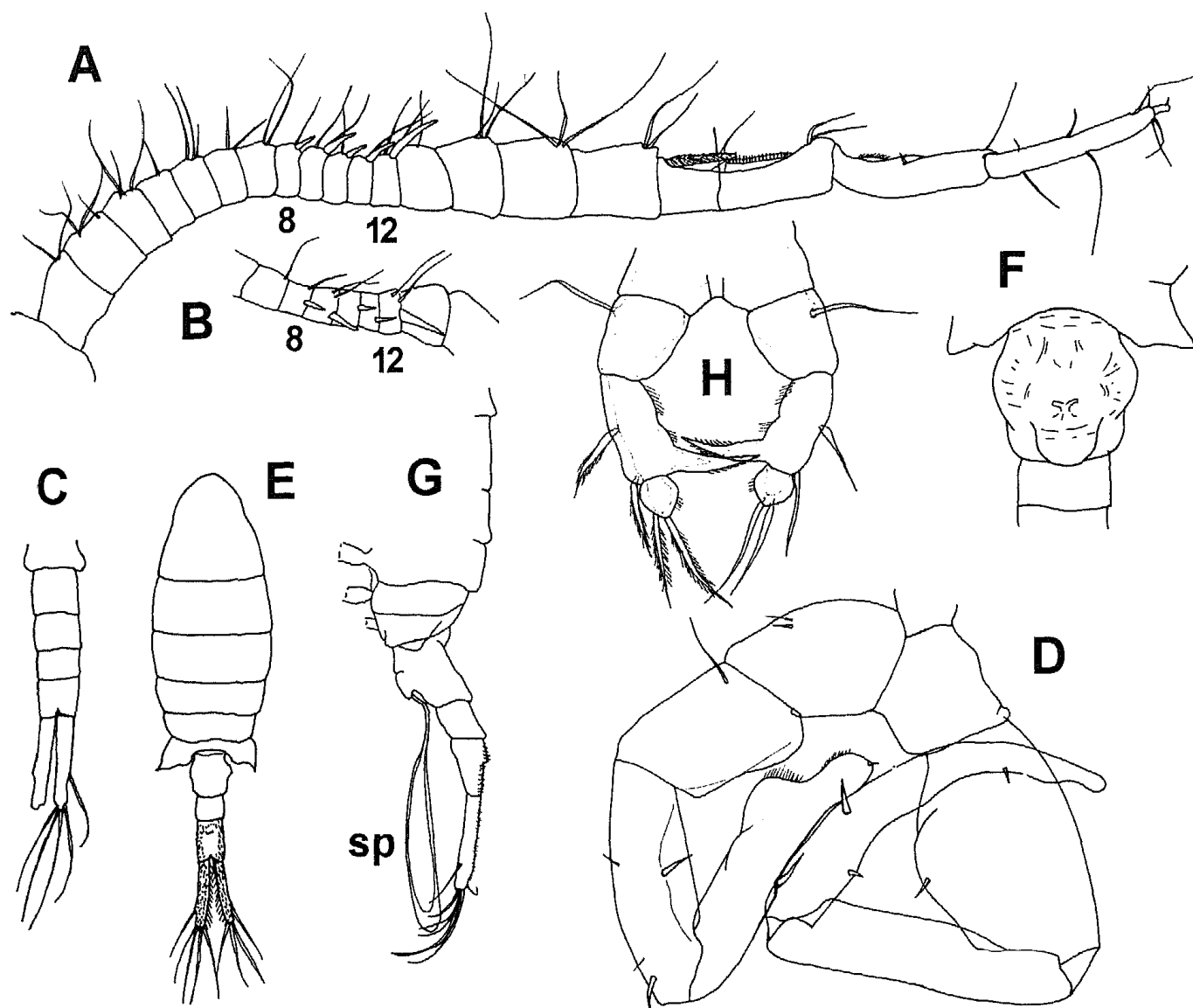


Figure 2. *Eurytemora americana* found in Dunkirk harbour. **A.** Right antennule of male. **B.** Detail of segments 8-12 with spines. **C.** Male abdomen. **D.** Leg 5 of male, posterior view. **E.** Habitus of female, dorsal view. **F.** Detail of genital segment, ventral view. **G.** Abdomen of female with spermatophore (sp), lateral view. **H.** Leg 5 of female.

Figure 2. *Eurytemora americana* trouvé dans le port de Dunkerque. **A.** Antennule droite du mâle. **B.** Détail des segments 8-12 avec épines. **C.** Abdomen du mâle. **D.** Patte 5 du mâle, vue postérieure. **E.** Habitus de la femelle, face dorsale. **F.** Détail du segment génital, face ventrale. **G.** Abdomen de la femelle avec spermatophore (sp), vue latérale. **H.** Patte 5 de la femelle.

coast. Canu (1892) reported only finding the congener-species *C. finmarchicus* (Gunnerus, 1770), which we never did. Long term studies in the North Sea have revealed that *C. helgolandicus* - Northeast Atlantic species - progressively replaces *C. finmarchicus* - boreal species (Planque & Fromentin, 1996; Reid et al., 2003; Beaugrand, 2009).

However, confusions exist in literature between the two species (Rose, 1933; Razouls et al., 2005-2008), and unfortunately the description and drawings given by Canu (1892: 170 and 297) are insufficient to confirm his specific identification.

Family Paracalanidae

Paracalanus parvus (Claus, 1863)

The occurrence of this common species slightly increases from inshore to offshore.

Family Clausocalanidae

Pseudocalanus elongatus (Boeck, 1872)

This spring species shows no preference to either coastal or offshore waters.

Family Stephidae

Stephos scotti (Sars, 1903).

This species was listed by Glaçon (1975), citing Duwoz (1963) who recorded one male specimen. Except for several carcasses (empty carapaces) found on 06/05/2008 near Boulogne, no living specimen was recorded. The species *S. minor* was recorded in Gravelines (Le Fèvre-Lehoërff & Le Grand, 1998) and the two congener-species have since been recorded in Southampton waters (Muxagata & Williams, 2004).

Family Pseudocyclopiidae

*Pseudocyclopia sp.** (Thompson 1895)

One unidentified male species and one female were found in surface waters in the BA station on 03/10/1982 and 12/10/1982 respectively.

Family Temoridae

Temora longicornis (O.F. Müller, 1792)

This species is a dominant for the area, found all the year round, but principally during spring and summer.

Eurytemora affinis (Poppe, 1880)

Canu (1892:103) did not cite this species in the Strait of Dover but collected it in the mouth of the Seine River where it is numerous (Mouny & Dauvin, 2002). *E. hirundoïdes* (Nordquist, 1888) was listed by Glaçon (1975), citing Duwoz (1963, off Boulogne-sur-Mer), who indicated this one as incidental. According to Bush & Brenning (1992), *E. hirundoïdes* is a synonym of *Eurytemora affinis*. This species is not developed in the Strait of Dover but is more characteristic of brackish waters, yet it was not detected in the Canche estuary (February to May 2008), which empties completely at low tide. This may explain why no autochthonous population can establish there. *E. affinis* was reported one in Gravelines (03/30/1995) during spring dessalures (Le Fèvre-Lehoërff & Cochard, 1996).

*Eurytemora americana** (Williams, 1906)
(Fig. 2)

This species is present in the wet docks of Dunkirk harbour (1977-1978) when the salinity is below 31. Brylinski (1979) cited *E. hirundoïdes*, but further examination (1984) revealed that specimens corresponded to *E. americana* (Fig. 2). This species was probably imported in from ballasts water tankers.

Gurney (1933) first reported this species in three separate locations around Great Britain: in the Plymouth Sound (a single egg-bearing female in ordinary plankton); in the «Canoe Lake» of Sandown, Isle of Wight; and lastly near Lancing

(Sussex) in large shallow pools not connected with the sea, but with brackish water. But this species has not been cited in the Solent-Southampton Water system by Muxagata & Williams (2004). This alien species is permanently established in Dutch waters (Bakker, 1972, in Wolff, 2005).

Family Metridinidae

*Metridia lucens** (Boeck, 1864)

One male specimen was found in the BA station on 01/05/1983.

Family Centropagidae

Centropages hamatus (Lilljeborg, 1853)

This spring and summer species is found among other dominant species, and has a clear affinity for coastal waters (Brylinski, 1986).

Centropages typicus (Kroyer, 1849)

This species is in relatively low abundance with a clear affinity for offshore waters and clearly indicates the flux of Atlantic waters to the North Sea. This species is opposed to the coastal species *C. hamatus* (Quisthoudt et al., 1987).

Isias clavipes (Boeck, 1864)

A species in low abundance, but regularly present in the summer plankton. Canu (1888b) described this species as *I. bonnieri*, but quickly admitted the synonymy with *I. clavipes* (Canu, 1890: 475). He considered this species as ordinary off Wimereux.

Family Arietellidae

*Paramisophria cluthae** (Scott, 1897)

A single female specimen was found in the BA station on both 03/10/1982 and 10/15/1985.

Family Pseudocyclopidae

*Pseudocyclops obtusatus** (Brady & Robertson, 1873)

A single female and one male were found in the BA station on 12/10/1982 and on 01/05/1983 respectively.

Family Candaciidae

*Candacia armata** (Boeck, 1872)

Specimens of this species have been regularly reported in very low numbers during winter months.

Family Pontellidae

Labidocera wollastoni (Lubbock, 1857)

Specimens of this species have been quite regularly

reported in very low numbers. According to Canu (1888a), this species is very common offshore during the summer months.

Anomalocera patersoni (Templeton, 1837)

An offshore species found during the summer months, but very seldom.

Pontella lobiancoi * (Canu, 1888)

Two specimens were found in the SA station on 25 and 30 august 1981. According to Canu, (1888a: 102) «*Pontellina lobiancoi* is common off Wimereux during the summer. We can obtain some specimens by pelagic fishing when *Pontella wollastoni* is itself very abundant». He indicated elsewhere (1892: 178) that the species has not since then been found in the same locality. Moreover this species was not listed by Glaçon (1975). Franc (1953) cited it in the mouth of the Rance River (French Western English Channel) and indicated that it was present in a compact swarm which extended several meters, and which disappeared in a few hours. Neustonic behaviour and patchy distribution of this copepod (as many pontellidae) could explain why it is rarely observed in our net samples.

Family Parapontellidae

Parapontella brevicornis (Lubbock, 1857)

This offshore species is not very abundant and appears usually during the spring months (Brylinski, 1986). Canu (1892: 175) indicated that he had collected it sometimes in abundance in summer on the surface at several nautical miles from the Boulogne shores.

Family Acartiidae

Acartia (Acartiura) clausi (Giesbrecht, 1889)

This common species is dominant in the area during the summer months, and has a small affinity for offshore waters (Brylinski & Aelbrecht, 1993). Canu (1892: 174) indicated that *A. clausi* is abundant from April to September but curiously specifies that however «it never exists in considerable troops, as it does for many other Calanoida». It should be noted that this species was only officially described in 1889.

Acartia (Acartiura) discaudata (Giesbrecht, 1881)

This species is present in the wet docks of Dunkirk harbour (Brylinski, 1981). It is very rarely collected in the sea, and then only near the coast due to its affinity for brackish waters. According to Canu (1892), this species is very common near the coast. This observation was probably a consequence of samplings carried out directly on foot on

the seashore. The stagnation of Wimereux River in the former «Napoleon harbour» (currently filled) has allowed the establishment of this species and its subsequent access into the sea. He quoted only this *Acartia* species (*Dias discaudatus*) in his first list (Canu, 1888 a).

*Acartia (Acartiura) omorii** (Bradford, 1976)

This species was observed off the harbour of Calais in May 2004 (Seuront, 2005) in low but significant abundance (12 ind.m⁻³) but has not been seen since. It may have been imported from an unloading of ballast, or just escaped any observation due to its resemblance to *A. clausi*. We can not confirm the long-term establishment of *A. omorii* in the open sea off Calais.

*Acartia (Acanthacartia) bifilosa** (Giesbrecht, 1881)

This species is common in the wet docks in the Dunkirk harbour (Brylinski, 1981). Typical of brackish waters, it was nevertheless collected three nautical miles off the coast of Wimereux in April 1988 (Brylinski & Aelbrecht, 1993) in water of salinity 33.8. It is not listed off Gravelines.

*Acartia (Acanthacartia) tonsa** (Dana, 1848)

This species is common in the wet docks of Dunkirk's harbour (Brylinski, 1981). Probably imported in the European waters since the beginning of the 20th century (Redeke, 1934), this species develops in warm and brackish waters (as harbour) and was never recorded in the Strait of Dover. On the American coasts, Gurney (1933) noted similitude between *Acartia tonsa* and *E. americana* distributions.

*Paracartia grani** (Sars, 1904)

A single male specimen was collected off Gravelines on 07/27/2006 (Brylinski & Vincent, 2007).

Order Cyclopoida

Family Oithonidae

*Oithona nana** (Giesbrecht, 1892)

This species was not indexed by Glaçon (1975) or anyone else, and it has not been seen in the Strait of Dover until a sample of two individuals was collected near the coast South of Boulogne on the 10/05/2007 and one on the 12/12/2007. According to Canu (1892: 180), «*O. helgolandica* is quite currently recorded near the rocks of the coast». Nevertheless *O. helgolandica* is currently considered as doubtful or synonymous with *O. nana* (in Razouls et al., 2005-2008). This tiny species is certainly under recorded.

Canu did not present figures on *O. helgolandica* and his specimens could also be *O. similis* (Claus, 1866). *Oithona spp.* are regularly collected in autumn off Gravelines sometimes in great quantities, and the two species *O. similis* and

O. nana were recently identified by Antajan (2008). They also exist in the Solent (Muxagata & Williams, 2004).

Family Cyclopinidae

*Cyclopina littoralis** (Brady, 1872)

This species although rather benthonic (Rose, 1933) has been collected regularly throughout the year in sparse amounts, principally near the coast (Brylinski, 1986; Quisthoudt et al., 1987).

Family Lichomolgidae

*Pseudanthessius sauvagei** (Canu, 1891)

A specimen was collected with a net quite by accident on 04/22/1975 at the exit of the roadstead of Boulogne. According to Canu (1892: 244), it is «a curious species because of the semi-parasitic existence that it carries out in company of *Echinocardium cordatum*, an abundant irregular sea urchin in sands of the Boulogne coast».

Family Corycaeidae

Corycaeus anglicus (Lubbock, 1855)

This species was regularly collected during the autumn and winter months, but in low amounts.

Family Oncaeidae

Oncaea sp.* (Sars, 1916)

Specimens were collected in the BA station on 12/20/1982 and 01/08/1981. This tiny species is certainly under recorded.

Family Clausidiidae

Saphirella * (Scott, 1894) (Fig. 3)

Saphirella is a false genus. This form corresponds to the larval stage copepodid C1 of certain Clausidiidae in particular but not exclusively of the genus *Hemicyclops* (Vervoort & Ramirez, 1966; Itoh & Nishida, 1995). These pelagic larvae have adult forms which are parasitic on, or commensal with, invertebrates (annelids, bivalves and crustaceans) and are often described as «undetermined species». 15 forms are currently indexed in the world (Razouls et al., 2005-2008) including eight forms present just in the bay of Tokyo (Ithoh & Nishida, 1991).

Even before Scott (1894), Canu (1888c & 1892) had already indicated that he had collected in abundance in plankton the first copepodite-stage of *Giardella callianassae* (Canu, 1888c), a commensal of Callianassidae, as *Pestarella tyrrhena* (Petagna, 1792 - Crustacea, Decapoda). His drawings (Canu, 1988c: plate XXVIII) indicated that it is

without a doubt a *Saphirella* form. We present here a new description of this *Saphirella* type (Fig. 3), an easily recognizable form in the regional plankton: Oval and flattened shape. Length 0.7 mm, without furcal bristles. Frontal rostrum with a ventral point backwards. Two-segmented prosome with two pairs of swimming legs, each with one-segmented exopod and endopod. Four segmented maxillipedes. Five segmented first antenna and four segmented second antenna. Urosome with three segments and furca. One pair of spines and of setae on lateral margins of first urosome segment. Red square eye visible on the living individual, invisible on the fixed one (discolouration). Swimming is jerky, the antennules directed forwards as "horns of bull". On the fixed animal (formaldehyde), the antennae are folded back on the lateral-ventral sides, and the legs are folded back on back.

This *Saphirella* form is regularly found in the area during the autumn season (Brylinski, 1986; Quisthoudt et al., 1987). In September 1975, there was an exceptional abundance exceeding 4200 ind.m⁻³, which then accounted for 75% of the Copepoda off Boulogne-sur-Mer (not determined, in Brylinski, 1975). *Saphirella* is also commonly present at Gravelines and Paluel during the summer, where it had not been identified for a long time (Brylinski & Vincent, 2007). Gurney (1944) collected this form in the plankton around Plymouth where he mentions its occasional abundance. *Saphirella* was not quoted by Muxagata & Williams (2004), but it could correspond to one of the unidentified specimens of the photograph 069A (p. 48). This form has existed in the bay of Liverpool according to Thompson (1887, cited by Canu, 1892). In southern Europe, Vilela (1965) described a *Saphirella* form in Ria de Faro-Olhao (Portugal) which she assumed to be *S. indica* (Sewell, 1924). Even though her drawings of antennae (an2) and maxillipedes differ from those of Sewell, they are identical to ours.

Order Platycopioida

Family Platycopiidae

*Platycopia perplexa** (Sars, 1911)

A single specimen was collected three nautical miles from the Boulogne coast on 02/07/1975. This species is epibenthic and Sars (1921: 13) described these species as occurring from a depth of about 60 fathoms in coarse muddy sand of the Norwegian coast.

Order Harpacticoida

Family Euterpinidae

Euterpina acutifrons (Dana, 1848)

This species is dominant during autumn, and shows coastal affinity.

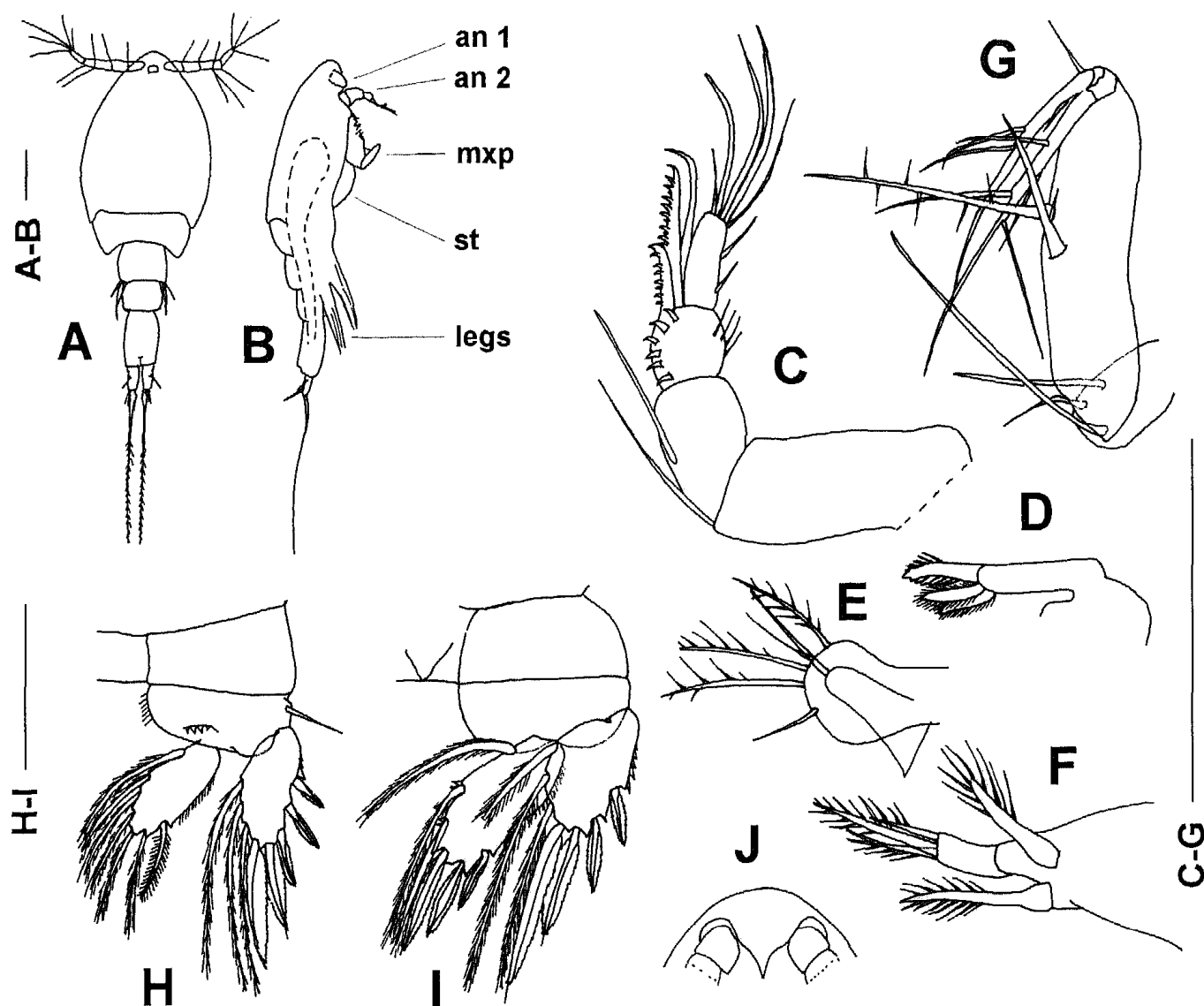


Figure 3. *Saphirella*. A. Habitus, dorsal view. B. Lateral view (st = sternal plate). C. Second antenna. D. Mandible. E, F. First and second maxillae. G. Maxillipede. H, I. First and second legs. J. Rostrum, ventral view. Scale bar = 100 µm.

Figure 3. *Saphirella*. A. Habitus, vue dorsale. B. Vue latérale (st = plaque sternale). C. Antenne 2. D. Mandibule. E, F. Première et deuxième mâchoires. G. Maxillipèdes. H, I. Première et deuxième paires de pattes. J. Rostre, vue ventrale. Echelle = 100 µm.

Order Monstrillioida

Family Monstrillidae

Monstrilla helgolandica (Claus, 1863)

This species was listed by Glaçon (1977) citing Duwoz (1963).

*Monstrilla grandis** (Giesbrecht, 1892)

One specimen was collected three nautical miles from the Boulogne coast on 09/02/1975 (Brylinski, 1975).

Conclusion

The first plankton studies in the Strait of Dover date from the end of 19th century (Canu, 1888a, b & c). Sampling then started again in 1963, and has only been regular since the end of the 1970's. This increase in sampling frequency has naturally increased the number of species which have been indexed, in particular rare ones. These additional findings were favoured by sampling in new areas such harbours, where newly introduced species were found. However,

their diversity still remains by and large low. Overall, 35 species of Copepoda were collected by net, in comparison to the 112 pelagic species listed in the North-Sea subgroup (Razouls et al., 2005-2008). We have listed here 25 Calanoida (Order) in contrast to the 11 indexed in 1913 and the 14 in 1975.

We can categorize each species as follows:

- There are 6 annual principal species: *Temora longicornis*, *Acartia clausi*, *Centropages hamatus*, *Pseudocalanus elongatus*, *Paracalanus parvus*, *Euterpina acutifrons*.

- There is 1 "meroplanctonic" species: *Saphirella*.

- There are 7 uncommon species, but quite regularly collected: *Calanus helgolandicus*, *Centropages typicus*, *Isias clavipes*, *Labidocera wollastoni*, *Parapontella brevicornis*, *Coryceus anglicus*, *Cyclopina littoralis*.

- There are 16 rare or exceptional species which could be in transit in the zone: *Anomalocera patersoni*, *Pontella lobiancoi*, *Candacia armata*, *Stephos scotti*, *Metridia lucens*, *Acartia omorii*, *Paracartia grani*, *Paramisophria cluthae*, *Oithona nana*, *Oncaea* sp., *Monstrilla helgolandica* and *M. grandis*. Their infrequent collection may also be due to their benthic or benthopelagic life: *Pseudocyclopia* sp., *Pseudocyclops obtusatus*, *Pseudanthessius sauvagei*, *Platycopia perplexa*. Several Harpacticoida were present occasionally but not determined.

- A certain number of species are typical of brackish waters, and were collected both in the wet dock of Dunkirk harbour or in the Seine estuary: *Acartia bifilosa*, *A. discaudata*, *A. tonsa*, *Eurytemora americana* and *E. affinis*.

- On species quoted by Canu which were not found: *Calanus finmarchicus*, this having been possibly confused with its congener *C. helgolandicus*.

- Lastly, 3 species can be regarded as being of exogenic origin (alien species): *Acartia tonsa* and *Eurytemora americana* are both established in Dunkirk harbour. Long-term establishment of *Acartia omorii* in the open sea (Calais) has not yet been confirmed.

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