

Updating the zooplankton species list for the Belgian part of the North Sea

Karl Van Ginderdeuren^{1,2*}, Frank Fiers³, Annelies De Backer¹,
Magda Vincx² & Kris Hostens¹

¹ Institute for Agricultural and Fisheries Research, Animal Science Unit – Fisheries, Ankerstraat 1 8400 Oostende, Belgium.

² Ghent University (UGent), Biology Department, Marine Biology Section, Sterre Campus, Krijgslaan 281-S8 9000 Gent, Belgium.

³ Royal Belgian Institute of Natural Sciences, Vautierstraat 29 1000 Brussel, Belgium.

* Corresponding author: Karl Van Ginderdeuren, e-mail: Karl.vanginderdeuren@ilvo.vlaanderen.be

ABSTRACT. Many marine species are threatened, and given the importance of biodiversity indices in the current European marine policy, taking stock of existing species and species diversity is crucial. Zooplankton form the basis of the pelagic food web, acting as staple food for fish larvae and adult pelagic fish, but are very susceptible to a changing climate. Inventorying zooplanktonic diversity is therefore important. Based on monthly sampling campaigns in 2009 and 2010, an update is provided on the zooplankton species list for the Belgian part of the North Sea. A total of 137 taxa are listed, some of which had rarely or never been observed in the area. This inventory revealed several species new to the Belgian marine species list: the calanoid copepod *Metridia lucens*, the cyclopoids *Oithona similis* and *Giardella callianassae*, the hydrozoans *Amphinema dinema* and *Eutima gracilis*, the mysid *Acanthomysis longicornis*, the polychaete worm *Tomopteris helgolandica*, the cladoceran *Penilia avirostris* and the monstrilloid copepod *Cymbasoma germanicum*. Additionally, we identified several males of *C. germanicum*, which have never been described before. Brief discussions are presented on spatial distribution and abundance of all taxa.

KEYWORDS. zooplankton, marine biodiversity, Belgian part of the North Sea, species list, faunal additions

INTRODUCTION

Biological diversity plays a crucial role in the way ecosystems function and in the many services they provide (VITOUSEK et al., 1997; LOREAU et al., 2001). Loss of marine biodiversity nationally, regionally and globally reduces the capacity of marine ecosystems to support the provision of goods and services, essential for human well-being (COCHRANE et al., 2010). Species lists are therefore indispensable fundamental tools to study species diversity and to calculate biodiversity indices in ecological studies.

The pelagic zone is the biggest habitat in the world, and also the biggest for Belgium (COSTELLO et al., 2010). Not only is it big, it is also ecologically very important, since the vast majority of fish species have a pelagic larval phase, including commercial fishes such as sole

Solea solea, plaice *Pleuronectes platessa* and cod *Gadus morhua* (RUSSEL, 1976). These fish species must keep in step with their zooplanktonic food sources, for this is what their larvae eat. Furthermore, zooplanktonic organisms are very susceptible to a changing climate. The replacement of the cold water *Calanus finmarchicus* species assemblage in the North Sea by the warm water *C. helgolandicus*-dominated copepod assemblage with lower biomass and smaller species, is a textbook example of the severe consequences of a warming climate on marine ecosystems (RICHARDSON, 2008).

For the Belgian part of the North Sea (BPNS) very few historical lists of zooplankton species are available. The oldest known marine samples that contained zooplankton date from the early 20th century (Gilson collection, discussed in VAN LOEN & HOUZIAUX, 2002). However,

there was little to nothing published about the zooplanktonic species in these samples, as the main focus was on benthic organisms. VAN MEEL (1975) was the first to report zooplanktonic species lists from the Belgian part of the North Sea and adjacent waters.

More recent zooplanktonic research in Belgium has mainly focused on a limited number of species (e.g. VANDENDRIESSCHE et al., 2006; VAN HOEY, 2006), on diurnal zooplankton behavior (DARO, 1974) or on the interaction of calanoid copepods with the nuisance alga *Phaeocystis globosa* (SCHERFFEL, 1899) (e.g. GASPARINI et al., 2000; DARO et al., 2006; ROUSSEAU et al., 2006). In contrast, the zooplankton community structure and its dynamics in the Scheldt estuary have received considerably more attention (e.g. TACKX, 2002; MAES et al., 2002; APPELTANS et al., 2003; AZÉMAR et al., 2004; TACKX et al., 2005), but recent data on the marine part of the BPNS are extremely scarce. Considering climate change, the importance of biodiversity and the biogeographical changes in the distribution of planktonic species, an update of the zooplankton species list for the BPNS is certainly timely.

In 2010, the Flanders Marine Institute (VLIZ) compiled a species list for the Belgian marine waters (VANDEPITTE et al., 2010). For many zooplanktonic groups, the list is solely based on literature and therefore many species are geographically unverified. This study yields new and up-to-date information about the composition of zooplankton in the transitional region between the Atlantic Ocean and the North Sea and provides additional information for the Belgian Register of Marine Species (BeRMS) (VLIZ Belgian Marine Species consortium 2010).

MATERIALS AND METHODS

Sampling

Sampling was carried out monthly in 2009 and 2010 at ten monitoring stations in the BPNS

positioned along a nearshore-midshore-offshore axis (Fig. 1). A WP2 net (200µm mesh size) fitted with flow meter (SMITH et al., 1968) was towed in an oblique haul from bottom to surface. Samples were fixed and preserved in a 4% formaldehyde solution.

Data are derived from a selection of 112 samples (53 nearshore, 30 midshore, 29 offshore), taken in salinity ranges from 29.9 – 35.0 PSU and temperature ranges from 2.0 – 20.9°C.

Species list

Using compound- and stereo-microscopes, taxa were identified to species level when possible, in order to attain the highest taxonomical resolution. The classification used is according to the World Register of Marine Species (WoRMS) (APPELTANS et al., 2011). Species that form an addition to the recently published Belgian Register of Marine Species (VANDEPITTE et al., 2010) are indicated with an asterisk (*) in Table 1. In addition, the different taxa have been subdivided according to their lifestyle; we distinguish between holoplanktonic (spend their entire life as plankton in the water column, e.g. calanoid copepods), meroplanktonic (spend a part of their life as plankters, e.g. decapod larvae) and tycho planktonic taxa (are occasionally carried into the water column, e.g. species of Cumacea and Mysida).

RESULTS

Table 1 lists 137 taxa (101 identified to species level) found in the Belgian part of the North Sea in 2009 and 2010, of which 46 are considered holoplanktonic, 50 meroplanktonic and 41 tycho planktonic. Four copepods, two hydrozoans, one mysid, one cladoceran and one polychaete have never been reported from the BPNS and are new for the Belgian Register of Marine Species. Additional information on densities and the spatial and temporal occurrence of these taxa in the BPNS is presented in Table 2 (appendix).

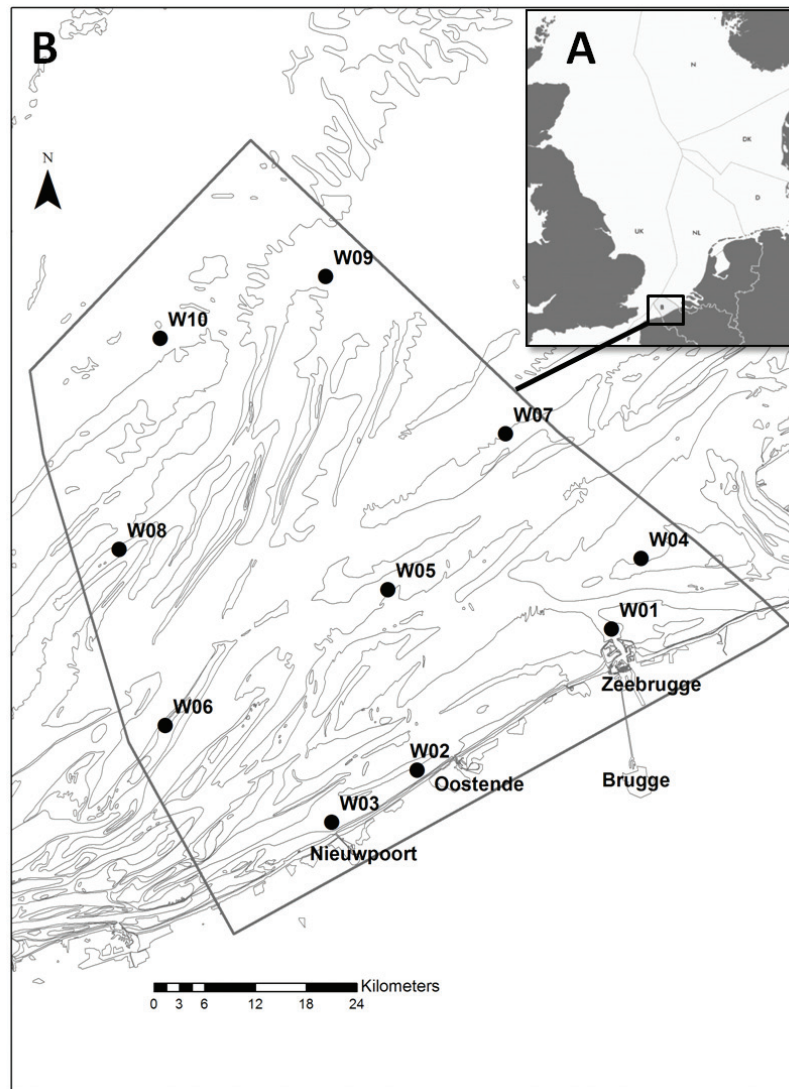


Fig. 1. – **A.** North Sea exclusive economic zones. **B.** Belgian part of the North Sea (BPNS) with ten stations (situated in nearshore W01-04-midshore W05-07-offshore areas W08-10) sampled monthly for zooplankton from January 2009 to December 2010.

DISCUSSION

This manuscript presents the first zooplanktonic inventory for the Belgian part of the North Sea in nearly forty years. Overall, 137 taxa were found in the net samples of which nine species (four copepods, two hydrozoans, one mysid, one cladoceran and one polychaete worm) were new to the Belgian Register of Marine Species (VANDEPITTE et al., 2010).

Species new for the BPNS

Cymbasoma germanicum is a rare monstilloid

species known only from a few female specimens collected at the Doggersbank, off Helgoland and Cuxhaven (RAZOULS et al., 2005-2011). We found 16 specimens, both males and females. The differences between *C. germanicum*, *C. rigidum* THOMPSON, 1888 and *C. zetlandicus* T. SCOTT, 1904 are subtle. A redescription of *C. germanicum*, including the description of the male, and comparison with its close relatives will be given elsewhere (FIERS & VAN GINDERDEUREN, in prep.).

Metridia lucens is a copepod most commonly found in the northern North Sea and northern

TABLE 1

List of holo-, mero- and tycho planktonic taxa in the BPNS observed in the period 2009 - 2010. Species with asterisk (*) are new to the Belgian fauna (VANDEPITTE et al. 2010).

HOLOPLANKTON	
<p>Protozoa Dinoflagellata Order Noctilucales Family Noctilucaeae <i>Noctiluca scintillans</i> (Macartney) KOFOID & SWEZY, 1921</p> <p>Cnidaria Scyphozoa Order Semaestomeae Family Cyaneidae <i>Cyanea lamarckii</i> PÉRON & LESUEUR, 1810 Family Pelagiidae <i>Chrysaora hysoscella</i> (LINNAEUS, 1767) Family Ulmaridae <i>Aurelia aurita</i> (LINNAEUS, 1758)</p> <p>Order Rhizostomeae Family Rhizostomatidae <i>Rhizostoma pulmo</i> (MACRI, 1778)</p> <p>Cnidaria Hydrozoa Order Anthoathecata Family Pandeidae <i>Amphinema dinema</i> (PÉRON & LESUEUR, 1810)* Family Bougainvilliidae <i>Nemopsis bachei</i> L. AGASSIZ, 1849 Family Margelopsidae <i>Margelopsis haeckeli</i> (HARTLAUB, 1897) Family Rathkeidae <i>Rathkea octopunctata</i> (M. SARS, 1835) Family Corynidae <i>Sarsia tubulosa</i> (M. SARS, 1835)</p> <p>Order Leptothecata Family Campanulariidae <i>Clytia hemisphaerica</i> (LINNAEUS, 1767) <i>Obelia</i> sp. Family Lovenellidae <i>Eucheilota maculata</i> HARTLAUB, 1894 Lovenellidae sp. Family Eirenidae <i>Eutima gracilis</i> (FORBES & GOODSIR, 1853)* <i>Eutonina indicans</i> (ROMANES, 1876)</p>	<p>Ctenophora Order Beroida Family Beroidae <i>Beroe gracilis</i> (KÜNNE, 1939) Family Bolinopsidae <i>Mnemiopsis leidyi</i> (A. AGASSIZ, 1865) Family Pleurobrachiidae <i>Pleurobrachia pileus</i> (O. F. MÜLLER, 1776)</p> <p>Annelida Polychaeta Order Phyllodocida Family Tomopteridae <i>Tomopteris (Johnstonella) helgolandica</i> (GREEFF, 1879)*</p> <p>Arthropoda Crustacea Branchiopoda Order Diplostraca Family Podonidae <i>Evadne nordmanni</i> LOVÉN, 1836 <i>Podon leuckartii</i> (G.O. SARS, 1862) Family Sididae <i>Penilia avirostris</i> DANA, 1849*</p> <p>Arthropoda Crustacea Copepoda Order Calanoida Family Acartiidae <i>Acartia (Acartiura) clausi</i> (GIESBRECHT, 1889) Family Calanidae <i>Calanus helgolandicus</i> (CLAUS, 1863) Family Candacidae <i>Candacia armata</i> (BOECK, 1872) Family Centropagidae <i>Centropages hamatus</i> (LILLJEBORG, 1853) <i>Centropages typicus</i> (KRØYER, 1849) <i>Isias clavipes</i> (BOECK, 1865) Family Pontellidae <i>Labidocera wollastoni</i> (LUBBOCK, 1857) Family Metridinae <i>Metridia lucens</i> (BOECK, 1865)*</p>

<p>Family Paracalanidae <i>Paracalanus parvus</i> (CLAUS, 1863)</p> <p>Family Clausocalanidae <i>Pseudocalanus elongatus</i> (BOECK, 1865)</p> <p>Family Temoridae <i>Temora longicornis</i> (MÜLLER O.F., 1785)</p> <p>Order Cyclopoida Family Corycaeidae <i>Corycaeus anglicus</i> (LUBBOCK, 1857)</p> <p>Family Cyclopinidae <i>Cyclopinoides littoralis</i> (BRADY, 1872)</p> <p>Family Oithonidae <i>Oithona nana</i> (GIESBRECHT, 1893) <i>Oithona similis</i> (CLAUS, 1866)*</p> <p>Family Oncaeidae <i>Oncaea</i> sp.</p> <p>Order Harpacticoida Family Euterpinidae <i>Euterpina acutifrons</i> (DANA, 1847)</p> <p>Order Monstrilloida Family Monstrillidae <i>Cymbasoma germanicum</i> (TIMM, 1893)*</p>	<p>Arthropoda Crustacea Eucarida Order Euphausiacea Family Euphausiidae <i>Nyctiphanes couchii</i> (BELL, 1853)</p> <p>Arthropoda Crustacea Peracarida Order Amphipoda Family Hyperiididae <i>Hyperia galba</i> (MONTAGU, 1815)</p> <p>Chordata Tunicata Order Copelata Family Oikopleuridae <i>Oikopleura (Vexillaria) dioica</i> FOL, 1872</p> <p>Chaetognatha Order Aphragmophora Family Sagittidae <i>Parasagitta elegans</i> (VERRILL, 1873) <i>Parasagitta setosa</i> (MÜLLER, 1847)</p>
MEROPLANKTON	
<p>Mollusca Bivalvia sp. Gastropoda sp.</p> <p>Order Pectinoida Family Pectinidae Pectinidae sp.</p> <p>Order Euheterodonta Family Pharidae <i>Ensis</i> sp.</p> <p>Order Myopsida Family Loliginidae <i>Loligo</i> sp.</p> <p>Arthropoda Crustacea Copepoda Family Clausidiidae <i>Giardella callianassae</i> CANU, 1888*</p> <p>Cirripedia Cirripedia sp.</p> <p>Order Decapoda Anomura sp.</p>	<p>Brachyura sp. Caridea sp. Decapoda sp. Family Callianassidae <i>Callianassa</i> sp. Family Crangonidae <i>Crangon crangon</i> (LINNAEUS, 1758) Family Porcellanidae <i>Pisidia longicornis</i> (LINNAEUS, 1767)</p> <p>Order Isopoda Isopoda sp.</p> <p>Order Tanaidacea Family Tanaidae <i>Tanais dulongii</i> (AUDOUIN, 1826)</p> <p>Cephalochordata Order Amphioxiformes Family Branchiostomidae <i>Branchiostoma lanceolatum</i> (PALLAS, 1774)</p>

<p>Echinodermata Order Camarodonta Family Parechinidae <i>Psammechinus miliaris</i> (P.L.S. MÜLLER, 1771)</p> <p>Order Forcipulatida Family Asteroiidae <i>Asterias rubens</i> LINNAEUS, 1758</p> <p>Order Ophiurida Family Ophiotrichidae <i>Ophiothrix fragilis</i> (ABILDGAARD, in O.F. MÜLLER, 1789) Family Ophiuridae <i>Ophiura</i> sp.</p> <p>Order Spatangoida Family Loveniidae <i>Echinocardium</i> sp.</p> <p>Bryozoa Bryozoa sp.</p> <p>Phoronida Phoronida sp.</p> <p>Chordata Pisces Pisces sp.</p> <p>Order Perciformes Family Ammodytidae Ammodytidae sp. <i>Ammodytes marinus</i> RAITT, 1934 <i>Ammodytes tobianus</i> LINNAEUS, 1758 <i>Hyperoplus lanceolatus</i> (LE SAUVAGE, 1824) Family Callionymidae <i>Callionymus</i> sp. Family Trachinidae <i>Echiichthys vipera</i> (CUVIER, 1829) <i>Trachinus draco</i> (LINNAEUS, 1758)</p>	<p>Family Gobiidae Gobiidae sp. <i>Pomatoschistus</i> sp. Family Carangidae <i>Trachurus trachurus</i> (Linnaeus, 1758)</p> <p>Order Pleuronectiformes Family Bothidae <i>Arnoglossus laterna</i> (WALBAUM, 1792) Family Soleidae <i>Buglossidium luteum</i> (RISSO, 1810) <i>Solea solea</i> (LINNAEUS, 1758) Family Pleuronectidae <i>Limanda limanda</i> (LINNAEUS, 1758) <i>Pleuronectes platessa</i> LINNAEUS, 1758</p> <p>Order Clupeiformes Family Clupeidae Clupeidae sp. <i>Clupea harengus</i> LINNAEUS, 1758 <i>Sardina pilchardus</i> (WALBAUM, 1792) <i>Sprattus sprattus</i> (LINNAEUS, 1758) Family Engraulidae <i>Engraulis encrasicolus</i> (LINNAEUS, 1758)</p> <p>Order Gadiformes Family Gadidae <i>Merlangius merlangus</i> (LINNAEUS, 1758)</p> <p>Order Osmeriformes Family Osmeridae <i>Osmerus eperlanus</i> (LINNAEUS, 1758)</p> <p>Order Syngnathiformes Family Syngnathidae <i>Syngnathus rostellatus</i> NILSSON, 1855</p> <p>Order Scorpaeniformes Family Triglidae Triglidae sp.</p>
TYCHOPLANKTON	
<p>Platyhelminthes Platyhelminthes sp.</p> <p>Nemertea Nemertea sp.</p> <p>Annelida Oligochaeta sp.</p>	<p>Arthropoda Arachnida Acarina sp.</p> <p>Arthropoda Crustacea Eucarida Order Decapoda</p>

<p>Family Processidae <i>Processa modica</i> WILLIAMSON, 1979</p> <p>Peracarida Order Amphipoda Family Amphilochidae <i>Amphilochus neapolitanus</i> DELLA VALLE, 1893 Family Calliopiidae <i>Apherusa bispinosa</i> (BATE, 1857) <i>Apherusa ovalipes</i> NORMAN & SCOTT, 1906 Family Atylidae <i>Atylus falcatus</i> (METZGER, 1871) <i>Atylus swammerdami</i> (MILNE-EDWARDS, 1830) Family Pontoporeiidae <i>Bathyporeia</i> sp. Family Corophiidae <i>Corophium</i> sp. Family Gammaridae <i>Gammarus crinicornis</i> (STOCK, 1966) <i>Gammarus salinus</i> (SPOONER, 1947) Family Caprellidae <i>Caprella linearis</i> (LINNAEUS, 1767) <i>Pariambus typicus</i> (KRØYER, 1884) Family Ischyroceridae <i>Jassa herdmani</i> (WALKER, 1893) Family Leucothoidae <i>Leucothoe incisa</i> (ROBERTSON, 1892) Family Megaluropidae <i>Megaluropus agilis</i> (HOECK, 1889) Family Microprotopidae <i>Microprotopus maculatus</i> (NORMAN, 1867) Family Microprotopidae <i>Orchomenella nana</i> (KROYER, 1846)</p>	<p>Family Oedicerotidae <i>Pontocrates altamarinus</i> (BATE & WESTWOOD, 1862) <i>Pontocrates arenarius</i> (BATE, 1858)</p> <p>Order Cumacea Family Bodotriidae <i>Bodotria arenosa</i> (GOODSIR, 1843) <i>Bodotria scorpioides</i> (MONTAGU, 1804) Family Diastylidae <i>Diastylis rathkei</i> (KRØYER, 1841) Family Pseudocumatidae <i>Pseudocuma</i> sp. <i>Monopseudocuma gilsoni</i> (GILSON, 1906) <i>Pseudocuma (Pseudocuma) longicorne</i> (BATE, 1858) <i>Pseudocuma (Pseudocuma) simile</i> G.O. SARS, 1900</p> <p>Order Isopoda Family Cirolanidae <i>Eurydice spinigera</i> HANSEN, 1890</p> <p>Order Mysida Family Mysidae <i>Acanthomysis longicornis</i> (MILNE-EDWARDS, 1837)* <i>Anchialina agilis</i> (G.O. SARS, 1877) <i>Gastrosaccus</i> sp. <i>Gastrosaccus sanctus</i> (VAN BENEDEN, 1861) <i>Gastrosaccus spinifer</i> (GOËS, 1864) <i>Mesopodopsis slabberi</i> (VAN BENEDEN, 1861) <i>Schistomysis kervillei</i> (G.O. SARS, 1885) <i>Schistomysis ornata</i> (G.O. SARS, 1864) <i>Schistomysis spiritus</i> (NORMAN, 1860) <i>Siriella armata</i> (MILNE-EDWARDS, 1837)</p>
--	--

Atlantic (FRASER, 1965; BARNARD et al., 2004). Its occurrence in the southern part of the North Sea appears to be rare: VAN MEEL (1975) detected the species in 1902-1910 samples. BRYLINSKI (2009) reported the find of a single male specimen in the Strait of Dover over a period of 30 years and FRANSZ (2000) emphasized the low abundance of the copepod among the zooplankton in the Dutch Part of the North Sea.

VAN MEEL (1975) considered *Oithona similis* as a species typical for the central part of the North Sea. In the southern part *O. similis* was reported near Gravelines (ANTAÏAN, 2008) and

in the Solent, English Channel (MUXAGATA & WILLIAMS, 2004). VAN MEEL (1975) however reported this species from a transect between Blankenberge (Belgium) and Orfordness (England), indicating that *O. similis* was found in the BPNS region.

Saphirella (SCOTT, 1894) morphs are now considered as the first copepodite stages (C1) of certain Clausiidae (BRYLINSKI, 2009). The adults of these pelagic larvae are parasitic species of Cyclopoida (RAZOULS et al., 2005-2011). BRYLINSKI (2009) identified *Saphirella* specimens in the French Channel corresponding to C1 of *Giardella callianassae*, a species never

reported from Belgian waters (VANDEPITTE et al., 2010). These copepodites of *Giardella* were also found in high numbers in our samples (Table 2).

The hydrozoan *Amphinema dinema* was collected by Gilson near Calais in 1905 (mentioned by VAN MEEL 1975). FRASER (1965) found *A. dinema* in the English Channel. Its presence off the Belgian coast was reported previously (LELOUP, 1952) but the species was omitted in the Belgian Register of Marine Species. The present study confirms its presence in the BPNS.

Eutima gracilis is a hydrozoan not mentioned from the North Sea or the English Channel by FRASER (1965) and VAN MEEL (1975), but it has been observed in English waters by others (RUSSEL, 1953; MEDIN, 2011). It appears to be restricted to European waters.

The mysid *Acanthomysis longicornis* has been observed in the vicinity of the BPNS. MEES et al. (1993) found it in the Westerschelde estuary close to the Belgian border, MÜLLER (2004) found it at Wimereux and ZIMMER (1933) as well reported *A. longicornis* from the southern North Sea.

Penilia avirostris is an abundant and widely distributed cladoceran in neritic tropical and subtropical waters, which has expanded north to temperate latitudes in the 20th century (ATIENZA et al., 2008). JOHNS et al. (2005) described how *P. avirostris* has increased in the North Sea since 1999, most probably due to warmer sea surface temperatures. The egg-carrying female found in this study proves that this species occurs and reproduces in the Belgian part of the North sea. *Evadne nordmanni* is a cladoceran not mentioned in the BeRMS (VANDEPITTE et al., 2010) and as such could be regarded as new for Belgian waters. However, VAN MEEL (1975) reports it present in high numbers in the BPNS in the early 20th century, indicating that this species has been found in the past.

Tomopteris (Johnstonella) helgolandica is the only holoplanktonic polychaete in the southern

North Sea. It is known from Dutch waters, although rare (FRANSZ, 2000), and in the French Channel near Wimereux (DAUVIN et al., 2003).

Additional observations

The most abundant copepods (Table 2) were the calanoids *Acartia clausi*, *Temora longicornis*, *Paracalanus parvus*, *Centropages hamatus*, *Pseudocalanus elongatus* and the harpacticoid copepod *Euterpina acutifrons*. This corresponds with the observations by VAN MEEL (1975), DARO et al. (2006) and BRYLINSKI (2009).

In the North Sea, *Calanus finmarchicus* has shifted progressively northwards, while *C. helgolandicus* became more abundant and widely distributed in the 1980s (REID et al., 2003). In 2009-2010 only *C. helgolandicus* and not *C. finmarchicus* occurred in the samples taken in the BPNS, corresponding with the results of BRYLINSKI (2009) finding only the former species of *Calanus*. VAN MEEL (1975) on the other hand, mentions the calanoid *C. finmarchicus* attaining high densities in the southern North Sea in the '70s, while in the 19th century CANU (1892) reported only *C. finmarchicus* from the Boulonnais. SARS (1903) reported “*C. helgolandicus* has been recorded from the western coast of France by Dr. Canu”, suggesting he did not agree with Canu's identification. This indicates that confusions exist in older literature between the two species *C. helgolandicus* and *C. finmarchicus*.

We investigated *Calanus* specimens from VAN MEEL (1975), sampled in the region of the BPNS in the early 20th century (stored in the RBINS collections in Brussels). They were *C. finmarchicus*, in contrast to the *C. helgolandicus* in our 2009 and 2010 samples.

In the present study, *C. helgolandicus* typically occurred around/on the offshore stations and was only occasionally caught nearshore. This copepod is known to reach high densities in the English Channel (BARNARD et al., 2004), and

TABLE 2

Average density (#m⁻³), maximum density (#m⁻³), and seasonal and spatial occurrence (near-mid-offshore) of all 137 taxa found in this study from January 2009 to December 2010. Spatial regimes (near-mid-offshore) with highest density are bold.

Taxon/Species	Average density	Maximum density	Seasonal occurrence	Spatial occurrence	Remarks
HOLOPLANKTON					
Dinoflagellata					
<i>Noctiluca scintillans</i>	1294,4	39806,3	Jul-Aug	off < near < mid	Summer species, but also very low densities found until October
Scyphozoa					
<i>Aurelia aurita</i>	< 0,1	< 0,1	Apr-Jul	off < mid < near	
<i>Chrysaora hysoscella</i>	< 0,1	< 0,1	Jun-Nov	off < mid < near	
<i>Cyanea lamarckii</i>	< 0,1	0,4	Mar-Jul	near < mid < off	
<i>Rhizostoma pulmo</i>	< 0,1	< 0,1	Sep-Nov	off < mid < near	
Hydrozoa					
<i>Amphinema dinema</i> *	< 0,1	< 0,1			Six specimens found at W09: on 19/8/2009, 5/10/2009 and 11/8/2010
<i>Clytia hemisphaerica</i>	18,9	204,6	May-Dec	off < near < mid	
<i>Eucheilota maculata</i>	< 0,1	< 0,1			Two specimens found at W07 on 11/8/2010 and 6/9/2010
<i>Eutima gracilis</i> *	< 0,1	0,84	Aug-Sept	near < off	Seventeen specimens found, almost all of them offshore. Seen just once at station W02 on 7/4/2009
<i>Eutonina indicans</i>	< 0,1	< 0,1			Twelve specimens found at W06, W08, W09 and W10
Lovenellidae sp.	< 0,1	0,5	Jul-Oct	mid < off	
<i>Margelopsis haeckeli</i>	12,5	268,4	Apr-Oct	off < mid < near	Mainly found at station W01
<i>Nemopsis bachei</i>	1,0	23,6	May-Sep	mid < near	Only found at station W01 and W02
<i>Obelia</i> sp.	2,2	104,4	Mar-Oct	off < mid < near	Five specimens found at stations W02, W07 and W09
<i>Rathkea octopunctata</i>	59,7	1402,2	Mar-Jun	near	
<i>Sarsia tubulosa</i>	< 0,1	< 0,1	Mar-Oct		
Ctenophora					
<i>Beroe gracilis</i>	6,9	139,4	Apr-Dec	off < mid < near	Peak in June,
<i>Mnemiopsis leidyi</i>	< 0,1	0,8	Sep-Dec	off < mid < near	Peak in October
<i>Pleurobrachia pileus</i>	1,6	79,3	All year	off < mid < near	Peak in spring (March-May)
Polychaeta					
<i>Tomopteris helgolandica</i> *	< 0,1	< 0,1			Two specimens at W09 (11/8/2010 and 6/9/2010) and W10 (6/7/2009)

Taxon/Species	Average density	Maximum density	Seasonal occurrence	Spatial occurrence	Remarks
Branchiopoda <i>Evadne nordmanni</i> <i>Penilia avirostris</i> * <i>Podon leuckartii</i>	39,6 <0,1 26,6	1085,2 <0,1 800,1	Feb-Jul May-Oct	off < mid < near near < mid < off	One specimen (female carrying eggs) found at W07 on 5/10/2009
Copepoda <i>Acartia clausi</i> <i>Calanus helgolandicus</i> <i>Candacia armata</i> <i>Centropages hamatus</i> <i>Centropages typicus</i> <i>Corycaeus anglicus</i> <i>Cyclopinoidea littoralis</i> <i>Cymbasoma germanicum</i> * <i>Euterpina acutifrons</i> <i>Isias clavipes</i> <i>Labidocera wollastoni</i> <i>Metridia lucens</i> * <i>Oithona nana</i> <i>Oithona similis</i> * <i>Oncaea</i> sp. <i>Paracalanus parvus</i> <i>Pseudocalanus elongatus</i> <i>Temora longicornis</i>	753,6 5,0 <0,1 265,3 9,9 9,8 11,9 <0,1 348,8 4,4 2,2 <0,01 4,9 20,6 <0,1 241,1 17,1 713,6	3735,4 96,7 <0,1 4500,2 116,9 108,3 118,1 1,5 4250,0 46,7 18,4 15,6 40,4 283,0 85,1 1663,0 540,5 7616,9	All year All year All year All year Aug-Feb All year Jul-Sep Jul-Dec Jun-Oct Aug-Sept Jul-Oct Jul-Dec All year All year All year	near < mid < off near < mid < off off < near < mid off < near < mid near < mid < off near < mid < off near < mid off < mid < near off < near < mid off < mid < near off < mid < near off < mid < near near < mid < off near < mid < off off < near < mid	Highest densities in autumn and offshore Much lower densities in winter One adult individual was caught on 6/12/2010 at station W09 Highest densities in spring and summer 16 specimens found (8 ♀, 1 copepodite and 7 ♂) at W01-05-06-07 Very low numbers seen in Jan, Feb and May higher abundance at Westcoast (w03,w06) than at Eastcoast Only found at W02: 6 individuals on 18/10/2010 and 1 on 8/11/2010 Much higher numbers at the coastal stations Only seen on 9/12/2009 at station W09 Highest densities in summer and autumn Highest densities in spring and summer
Euphausiacea <i>Nyctiphanes couchii</i>	<0,1	0,2	Jan-Feb	mid < off	In total 6 specimens were found
Amphipoda <i>Hyperia galba</i>	<0,1	<0,1	All year	off < near < mid	One specimen found at W01 on 11/6/2009 and 1 at W09 on 11/6/2010
Tunicata <i>Oikopleura dioica</i>	445,1	4153,8	All year	near < mid < off	Peak in spring (May-June)
Chaetognatha <i>Parasagitta elegans</i> <i>Parasagitta setosa</i>	<0,1 40,6	<0,1 492,0	All year	near < mid < off	Only 1 specimen was found, on 11/6/2010 at station W02, Densities much higher in summer than in other seasons

Taxon/Species	Average density	Maximum density	Seasonal occurrence	Spatial occurrence	Remarks
MEROPLANKTON					
Mollusca					
<i>Bivalvia</i> sp.	102,9	1753,2	Feb-Dec	off < mid < near	Veliger larvae and juvenile bivalvia
Pectinidae sp.	<0,1	0,2			Found at 3 sites: W07 (8/9/2009), W09 (19/8/2009) and W10 (7/9/2009)
<i>Ensis</i> sp.	19,6	363,6	Mar-Oct	off < mid < near	<i>Ensis</i> spat., densities much higher nearshore (peak observed at W04).
<i>Loligo</i> sp.	<0,1	<0,1			One juvenile (1cm) found at W06 on 9/9/2009
Gastropoda sp.	5,1	65,0	May-Dec	near < off < mid	Juveniles, not identifiable
Copepoda					
<i>Giardella callianassae</i> *	104,2	1198,0	Jul-Dec	off < near < mid	Autumn species, peaking in October and November
Cirripedia					
Cirripedia sp.	115,4	987,6	All year	off < near < mid	Nauplius larvae and cyprid larvae
Decapoda					
Anomura sp.	<0,1	0,4	Jul-Oct	near < mid < off	Zoea larvae, present in low densities
Brachyura sp.	6,1	73,2	All year	off < near < mid	Zoea larvae
Caridea sp.	6,4	45,2	All year	mid < near < off	Zoea larvae
<i>Callinassa</i> sp.	<0,1	<0,1			Three juvenile specimens caught on 11/8/2010 (W09) and 6/9/2010
<i>Crangon crangon</i>	0,3	3,1	May-Nov	off < mid < near	(W07), Zoea larvae, only counted when clearly identifiable, if not
Decapoda sp.	1,2	25,5	All year	near < off < mid	then record added to Caridea sp.
<i>Pisidia longicornis</i>	11,6	221,1	May-Oct	near < mid < off	Megalopa larvae, peak in numbers from Jul-Sep
Isopoda					
Isopoda sp.	1,8	21,6		near < off < mid	Zoea larvae, also 1 individual at W09 on 9/12/2009
Tanaidacea					
<i>Tanais dulongii</i>	<0,1	<0,1			Microniscus larvae, found in Jan, Aug, Sep and Dec.
Cephalochordata					
<i>Branchiostoma lanceolatum</i>	1,1	11,3	Jul-Sep	mid < off	One specimen found on 15/7/2010 at W02
Echinodermata					
<i>Asterias rubens</i>	30,5	592,5	Mar-Sep	off < mid < near	Bipinnaria and brachiolaria larvae
<i>Echinocardium</i> sp.	411,5	2881,5	May-Jul	off < near < mid	Echinopluteus larvae

Taxon/Species	Average density	Maximum density	Seasonal occurrence	Spatial occurrence	Remarks
<i>Ophiolithrix fragilis</i>	263,3	10861,3	May-Dec	near < mid < off	Ophiopluteus larvae
<i>Ophiura</i> sp.	62,1	1593,9	All year	off < mid < near	Ophiopluteus larvae
<i>Psammochinus miliaris</i>	4,6	58,5	May-Jul	off < near < mid	Echinopluteus larvae
Bryozoa					
Bryozoa sp.	18,2	230,9	All year	off < near < mid	Cyphonanta larvae of Bryozoa
Phoronida					
Phoronida sp.	<0,1	<0,1			Actinotrocha larvae, 3 at W02 (14/05/09) and 1 at W07 (10/6/2010)
Pisces					
Ammodytidae sp.	2,2	31,5	Jan-Jul	near < mid < off	Larvae, found at W09 on 11/3/2009 and 10/3/2010
<i>Ammodytes marinus</i>	<0,1	7,2			Larvae, found at W03 on 17/2/2009 and at W08 on 26/1/2009
<i>Ammodytes tobianus</i>	<0,1	<0,1	Jan-Jul	near < mid < off	Larvae, no larvae were recorded in nearshore samples
<i>Arnoglossus laterna</i>	<0,1	0,8	Jun-Aug	mid < off	Larvae, 1 individual found at W05 on 8/7/2009
<i>Buglossidium luteum</i>	<0,1	<0,1			Larvae
<i>Callionymus</i> sp.	0,2	1,6	May-Aug	mid < off	Larvae, too small to be identifiable to species level
Clupeidae sp.	0,3	2,9	Mar-Jul	near < off < mid	Larvae
<i>Clupea harengus</i>	1,1	16,8	Jan-May	near < mid < off	Larvae, 1 specimen at W09 on 19/8/2009
<i>Echiichthys vipera</i>	<0,1	<0,1			Larvae, only seen at station W01 and W02. Five specimens found
<i>Engraulis encrasicolus</i>	<0,1	0,9	Jul-Aug	near	Larvae
Gobiidae sp.	0,4	13,1	Jun-Oct	off < mid < near	Larvae, 8 specimens could be identified with certainty
<i>Hyperoplus lanceolatus</i>	<0,1	0,6			Larvae, not found in nearshore and midshore samples
<i>Limanda limanda</i>	<0,1	0,87	Feb-May	off	Larvae, scarce
<i>Merlangius merlangus</i>	<0,1	0,9	Apr-May	mid < off	Larvae, 1 specimen found at station W01 on 15/7/2010
<i>Osmerus eperlanus</i>	<0,1	<0,1			Larvae, too small to be identifiable to order/family level
Pisces sp.	11,7	221,1	All year	near < off < mid	Larvae, positively identified once on 17/2/2009 at station W06
<i>Pleuronectes platessa</i>	<0,1	<0,1			Larvae, too small to be identifiable to family level
<i>Pleuronectiformes</i> sp.	<0,1	0,5	Jan-Sep	near < mid < off	Larvae, only counted when clearly identifiable, if not then added to
<i>Pomatoschistus</i> sp.	<0,1	0,6	July-Dec	off < mid < near	Gobiidae
<i>Sardina pilchardus</i>	0,5	4,7	Jun-Jul	mid < off	Larvae, not recorded nearshore
<i>Solea solea</i>	<0,1	0,6	May-Jul	mid < off	Larvae, found in low numbers, not found in nearshore samples
<i>Sprattus sprattus</i>	0,9	26,1	Apr-Jul	near < mid < off	Larvae
<i>Syngnathus rostellatus</i>	<0,1	<0,1			Larvae, 1 specimen found at station W01 on 10/8/2010
<i>Trachinus draco</i>	<0,1	<0,1			Larvae, 1 specimen at W09 on 14/7/2010
<i>Trachurus trachurus</i>	0,2	1,9	Jun-Sep	mid < off	Larvae, no larvae were recorded in nearshore samples
Triglidae sp.	<0,1	<0,1			Larvae, 4 specimens found at W05, W07 and W09 in July 2009

Taxon/Species	Average density	Maximum density	Seasonal occurrence	Spatial occurrence	Remarks
TYCHOPLANKTON					
Platyhelminthes <i>Platyhelminthes</i> sp.	3,3	63,8	Jun-Oct	near < off	Found twice on 14/5/2009, at station W08 and W10
Nemertea <i>Nemertea</i> sp.	< 0,1	< 0,1			Four specimens found at W01 on 26/1/2009
Annelida <i>Oligochaeta</i> sp.	< 0,1	0,9			Two specimens found, at station W02 (14/5/2009) and W07 (8/7/2009)
Arachnida <i>Acarina</i> sp.	< 0,1	< 0,1			Only 1 specimen found at station W09 on 14/7/2010
Decapoda <i>Processa modica</i>	< 0,1	< 0,1			Found once at station W06 (9/9/2009) and once at W07 (6/9/2010) Found once at station W05 on 26/1/2009
Amphipoda <i>Amphiochus neapolitanus</i>	< 0,1	< 0,1			Strikingly, only found once, at W01 (6/10/2009)
<i>Apherusa bispinosa</i>	< 0,1	< 0,1			Very common in pelagic samples, caught at each station each month
<i>Apherusa ovalipes</i>	0,2	4,6	All year	near < mid < off	Only juveniles were caught in pelagic samples
<i>Atylus falcatus</i>	< 0,1	< 0,1			Found once at W01 on 11/6/2009
<i>Atylus swammerdami</i>	4,2	122,0	All year	near < off < mid	Two specimens found: 1 at W01 (11/6/2009) and 1 at W02 (9/3/2010)
<i>Bathyporeia</i> sp.	< 0,1	0,6	Jan-Sep	mid < off < near	Found once at W09 on 6/7/2009
<i>Corophium</i> sp.	0,1	3,2	Jan-Jun	near < off < mid	Found once at W01 on 15/7/2010
<i>Gammarus crinicornis</i>	< 0,1	< 0,1			Found once at W06 on 10/7/2009
<i>Gammarus salinus</i>	< 0,1	< 0,1			
<i>Caprella linearis</i>	< 0,1	< 0,1			
<i>Pariambus typicus</i>	0,9	21,6	Aug-Sep	mid < near	
<i>Jassa herdmani</i>	< 0,1	< 0,1			
<i>Leucothoe incisa</i>	< 0,1	< 0,1			
<i>Megalotropus agilis</i>	0,9	31,6	All year	near < off < mid	
<i>Microprotopus maculatus</i>	0,1	6,1	Aug-Mar	off < mid < near	One found at W02 (6/10/2009), W03 (9/9/2009) and W06 (17/2/2009)
<i>Orchomenella nana</i>	< 0,1	< 0,1			
<i>Pontocrates altamarinus</i>	< 0,1	0,5			Found once at W01 (7/12/2010) and once at W09 (9/11/2010)
<i>Pontocrates arenarius</i>	< 0,1	0,2	Feb-Dec	near < off < mid	

Taxon/Species	Average density	Maximum density	Seasonal occurrence	Spatial occurrence	Remarks
Cumacea <i>Bodotria arenosa</i> <i>Bodotria scorpionoides</i> <i>Diastylis rathkei</i> <i>Monopseudocuma gilsoni</i> <i>Pseudocuma</i> sp. <i>Pseudocuma longicornis</i> <i>Pseudocuma simile</i>	< 0,1 < 0,1 < 0,1 0,3 9,8 < 0,1 < 0,1	0,3 < 0,1 0,6 6,6 169,3 < 0,1 6,2			Five specimens found at W03, W06, W07 and W09 One specimen found at W09 on 6/12/2010 Three found at W01 (8/9/2010) and W02 (12/5/2010 and 8/11/2010) 11 found at stations W02, W07 and W09 from February until March Juvenile <i>Pseudocuma</i> sp. Were sometimes found in very high densities One specimen found at W09 on 13/05/2009 Seen at W07 (8/4/2009 and 11/8/2010) and W09 (11/3/2009)
Isopoda <i>Eurydice spinigera</i>	< 0,1	< 0,1			Only 1 specimen found at station W10 on 21/1/2009
Mysida <i>Acanthomysis longicornis</i> * <i>Anchialina agilis</i> <i>Gastrosaccus</i> sp. <i>Gastrosaccus sanctus</i> <i>Gastrosaccus spinifer</i> <i>Mesopodopsis slabberi</i> <i>Schistomysis kervillei</i> <i>Schistomysis ornata</i> <i>Schistomysis spiritus</i> <i>Siriella armata</i>	< 0,1 < 0,1 1,4 0,2 0,2 1,3 0,8 < 0,1 0,8 < 0,1	0,5 < 0,1 174,7 2,4 14,4 43,3 32,8 < 0,1 69,0 0,6	Feb-Dec All year Jan-Sep All year All year All year All year	off mid < off < near near < off mid < near < off off < mid < near off < mid < near mid < near	10 specimens found in Feb, Sep and Dec, at stations W08, W09 and W10 Found once at W09 on 16/2/2009 Many juvenile <i>Gastrosaccus</i> were observed Found once at W03 on 14/5/2009 Almost all specimens were caught nearshore Three specimens found at W07 (8/9/2009) and 1 at W09 (21/1/2009)

is often transported to the BPNS by prevailing marine currents conveying Atlantic water through the Channel towards the southern North Sea (HOWARTH, 2001).

Parasagitta elegans is a chaetognath from the Atlantic Ocean and the more boreal parts of the North Sea (FRASER, 1965). VAN MEEL (1975) described how the species sometimes occurred in the Channel when conveyed in Atlantic currents reaching the North Sea. The fact that we caught only one individual of *P. elegans* but many thousands of *P. setosa* suggests that it is (or has become) a very rare species. Although species discrimination in chaetognaths is difficult, the present study confirms the presence of *P. elegans* in the BPNS.

Nyctiphanes couchii is the only euphausiid recorded in the present study. It occurs in high densities in the central and northern North Sea, straying into the BPNS, especially during the colder winter months (RUSSEL, 1935; VAN MEEL, 1975). It has previously been reported from Belgian waters by CATRIJSSE & VINCX (2001) and LOCK et al. (2011).

The invasive ctenophore *Mnemiopsis leidyi* was first reported from the North Sea in Dutch coastal waters in August 2006 (HOLSTEIJN, 2002). Reports of autumn blooms of lobate ctenophores off the Dutch coast prior to the first *M. leidyi* sightings were previously attributed to *Bolinopsis infundibulum* (O.F. MÜLLER, 1779) (FAASSE & BAYHA, 2006). Whether *M. leidyi* was present along the Dutch coast before 2006 remains to be settled as the two ctenophores can easily be confused. *Bolinopsis infundibulum* is a cold-water species and considered rare along the Dutch coasts. It was only in August 2007 that *M. leidyi* was first seen in the BPNS, in the port of Zeebrugge (DUMOULIN, 2007). Because of its presence within the port, its introduction into Belgian waters is most probably related to ballast water transport in cargo ships, as was indicated for *M. leidyi* in the Black and Caspian Seas and in the Dutch part of the North Sea (VINOGRADOV et al., 1989; IVANOV et al., 2000;

FAASSE & BAYHA, 2006). Today, only four years after the first sighting/observation in 2007, *M. leidyi* occurs all along the Belgian coastline, up to 27 km offshore at the Thornton wind park as well as in all ports. Sightings of adult individuals in the coldest winter months imply that the species can survive Belgian winters. The spatial and temporal distribution along the Belgian coastal zone of *M. leidyi* is separately described in VAN GINDERDEUREN et al. (subm.).

Another invasive coelenterate recorded in this study is the hydrozoan *Nemopsis bachei*. This species was caught along the entire coastline, most abundantly around the port of Zeebrugge, where it was discovered in 1996 (DUMOULIN, 1997).

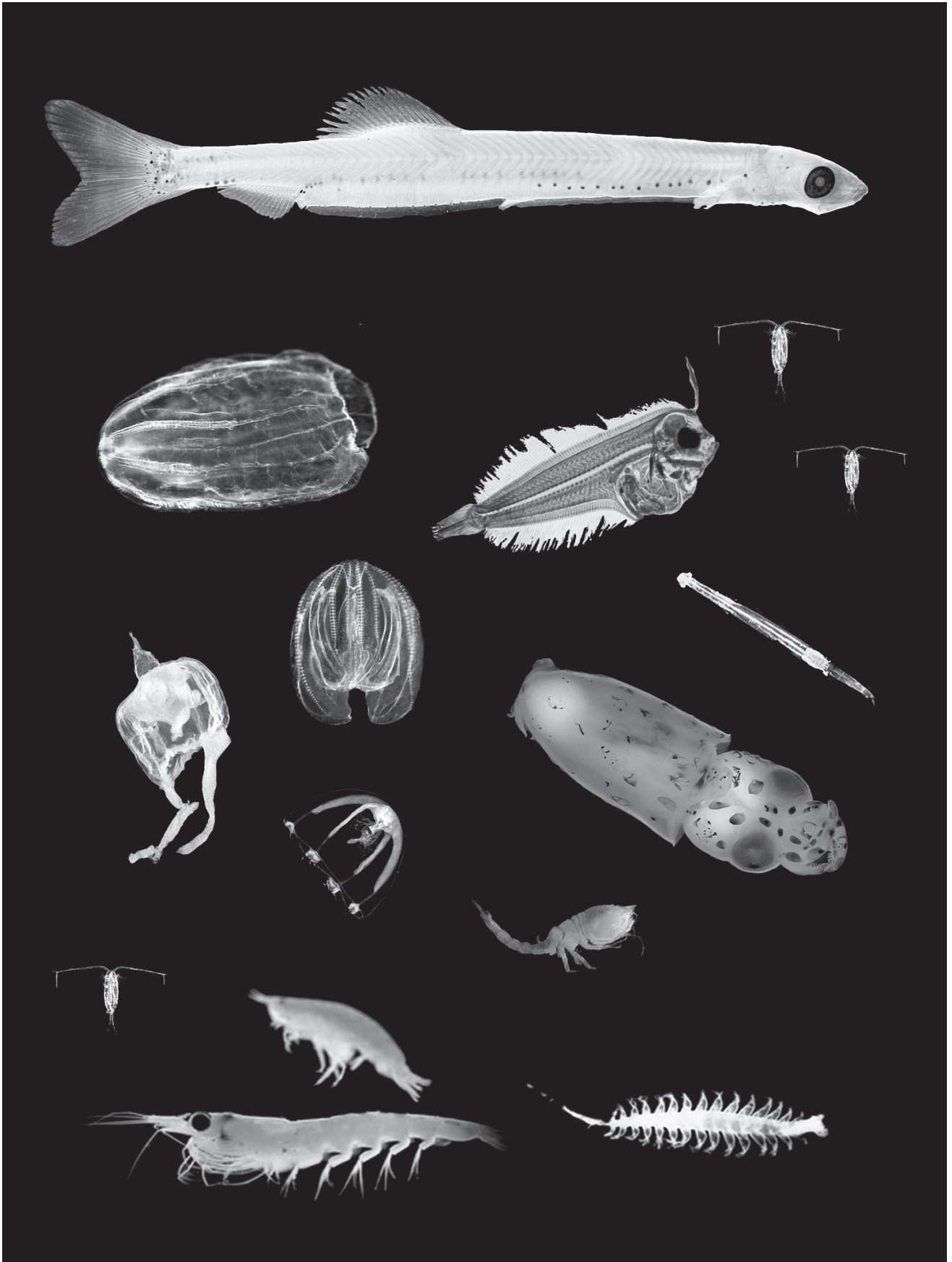
Cyanea lamarckii is the most frequently observed scyphozoan in this study. Its occurrence is in accordance with other jellyfish studies in the southern North Sea (BARZ & HIRCHE, 2007). In contrast to other species of Scyphozoa encountered, this jellyfish reached its highest densities offshore rather than nearshore (Table 2).

CONCLUSIONS

This study presents the first zooplanktonic inventory for the Belgian part of the North Sea in nearly 40 years. Among the 137 taxa encountered, nine are additions to the Belgian Register of Marine Species (BeRMS). We found 16 specimens of the very rare monstilloid *Cymbasoma germanicum*, including several male specimens, which have not previously been described.

The calanoid copepod *Calanus finmarchicus* appears to have completely disappeared from the scene. The sole member of this genus in the collected samples is *C. helgolandicus*.

The distribution of the invasive coelenterates *Nemopsis bachei* and *Mnemiopsis leidyi* appears to have considerably expanded since their introduction in 1996 and 2007 respectively, as



they now occur along the entire Belgian coastline in well established populations.

This list contributes to the present-day knowledge of the total species richness in the southern North Sea and as such forms a valuable basis for ecological surveys.

ACKNOWLEDGEMENTS

The authors are grateful to the Flanders Marine Institute, especially Dr. André Cattrijsse, for planning the sampling campaigns with RV Zeeleeuw.

This study could not have taken place without the adept help of taxonomical experts verifying our work. We want to express our gratitude to Dr. Elvire Antajan for verifying the identification of copepod species, Prof. Dr. Jean-Michel Brylinski for help with hydrozoans and copepodites of *Giardella*, Jan Wittoeck for checking tychoplanktonic species, Hans De Blauwe for the cnidarians, Steve Hay for giving advice on *Mnemiopsis leidyi* identification and Dr. Christophe Loots for verifying fish larvae.

REFERENCES

- ANTAJAN E (2008). Surveillance écologique et halieutique. Site de Gravelines, novembre 2006-octobre 2007. IFREMER LER/BL/RST/05/01, pp. 69-93.
- APPELTANS W, HANNOUTI A, VAN DAMME S, SOETAERT K, VANTHOMME R & TACKX M (2003). Zooplankton in the Schelde estuary (Belgium/The Netherlands). The distribution of *Eurytemora affinis*: effect of oxygen? Journal of Plankton Research, 25(11): 1441-1445.
- APPELTANS W, BOUCHET P, BOXSHALL GA, FAUCHALD K, GORDON DP, HOEKSEMA BW, POORE GCB, VAN SOEST RWM, STÖHR S, WALTER TC & COSTELLO MJ (Eds.) (2011). World Register of Marine Species. (Internet address: <http://www.marinespecies.org>) (Accessed April 28, 2011).
- ATIENZA D, SAIZ E, SKOVGAARD A, TREPAT I & CALBET A (2008). Life history and population dynamics of the marine cladoceran *Penilia avirostris* (Branchiopoda: Cladocera) in the Catalan Sea (NW Mediterranean). Journal of Plankton Research, 30(4): 345-357.
- AZÉMAR F, FIERS F & TACKX M (2004). Zooplankton distribution across the brackish and freshwater zone of the Scheldt estuary *In*: MEES J et al. (eds.), VLIZ Young Scientists' Day. Brugge, Belgium 5 March 2004, book of abstracts. VLIZ Special Publication, 17: 33.
- BARNARD R, BATTEN SS, BEAUGRAND G, BUCKLAND C, CONWAY DVP, EDWARDS M, FINLAYSON J, GREGORY LW, HALLIDAY NC, JOHN AWG, JOHNS DG, JOHNSON AD, JONAS TD, LINDLEY JA & NYMAN J (2004). Continuous Plankton Records: Plankton Atlas of the North Atlantic Ocean (1958-1999). 2. Biogeographical charts. Marine ecology progress series, Suppl: 11-75.
- BARZ K & HIRCHE HJ (2007). Abundance, distribution and prey composition of scyphomedusae in the southern North Sea. Marine Biology, 151(3): 1021-1033.

Fig. 2. – The pelagic is the biggest habitat in Belgium, in fact on a broader scale it is the biggest habitat in the world. Not only is it big, it is also very important. Almost all fish species - including all commercial fish we want on our plate such as sole *Solea solea*, plaice *Pleuronectes platessa* and cod *Gadus morhua* - have a pelagic larval phase. These fish species must keep in step with their planktonic food sources, for this is what their larvae eat. Therefore we must consider this as a possible “planktonic bottleneck”. Combine this with the fact that the zooplankton is very susceptible to a changing climate (some species are moving north by 40km/y), due to shifts in sea water temperature, oceanic inflow and phytoplankton production and it becomes easy to understand why in many countries lots of minds are bent towards zooplanktonic research.

I hope that this illustration draws attention to the great zooplanktonic biodiversity in the Belgian part of the North Sea, portrayed in this manuscript.

From top to bottom and left to right: *Clupea harengus* larva; *Cymbasoma germanicum* female and male, *Arnoglossus laterna* larva, two *Calanus helgolandicus*, *Mnemiopsis leidyi*, *Sagitta setosa*, *Amphinema dinema*, *Nemopsis bachei*, *Loligo* sp. juvenile, *Diastylis rathkei*, *Aurelia aurita*, *Nyctiphanes couchii*, *Tomopteris helgolandica*.

- BRYLINSKI JM (2009). The pelagic copepods in the Strait of Dover (Eastern English Channel). A commented inventory 120 years after Eugène Canu. *Cahiers de Biologie Marine*, 50: 251-260.
- CANU E (1892). Les copepods du Boulonnais, morphologie, embryologie, taxonomie. *Travaux du laboratoire de zoologie maritime de Wimereux-Ambleteuse*. L. Dane led., Lille, pp. 1-292, 30 planches.
- CATRIJSSE A & VINCX M (2001). Biodiversity of the benthos and the avifauna of the Belgian coastal waters: summary of data collected between 1970 and 1998. Sustainable Management of the North Sea. Federal Office for Scientific, Technical and Cultural Affairs, Brussel, Belgium. 48 pp.
- COCHRANE SKJ, CONNOR DW, NILSSON P, MITCHELL I, REKER J, FRANCO J, VALAVANIS V, MONCHEVA S, EKEBOM J, NYGAARD K, SERRÃO SANTOS R, NABERHAUS I, PACKEISER T, VAN DE BUND W & CARDOSO AC (2010). Marine Strategy Framework Directive Task Group 1 Report: Biological diversity. JRC Scientific and Technical Reports. Office for Official Publications of the European Communities, Luxembourg, ISBN 978-92-79-15650-2, 111 pp.
- COSTELLO MJ, CHEUNG A & DE HAUWERE N (2010). Surface area and the seabed area, volume, depth, slope, and topographic variation for the World's seas, oceans, and countries. *Environmental Science and Technology*, 44(23): 8821-8828.
- DARO MH (1974). Etude des migrations nyctémérales du zooplankton dans un milieu marin peu profond. *Hydrobiologia*, 44(1-2): 149-160.
- DARO MH, BRETON E, ANTAJAN E, GASPARINI S & ROUSSEAU V (2006). Do *Phaeocystis* colony blooms affect zooplankton in the Belgian coastal zone? In: ROUSSEAU V. et al. (eds.), Current status of eutrophication in the Belgian coastal zone. pp. 61-72.
- DAUVIN JC, DEWARUMEZ JM & GENTIL F (2003). Liste actualisée des espèces d'Annélides Polychètes présentes en Manche. *Cahiers de Biologie Marine*, 44(1): 67-95.
- DUMOULIN E (1997). Het invasieachtig voorkomen in de zuidelijke Noordzee van de hydromedusen *Nemopsis bachei* L. Agassiz, 1849 en *Eucheilota maculata* Hartlaub, 1894 in augustus-september 1996 (met aanvullende data voor 1997) (Hydrozoa: Athecata, Thecata). *De Strandvlo*, 17(4): 102-126.
- DUMOULIN E (2007). De Leidy's ribkwal (*Mnemiopsis leidyi* A. Agassiz, 1865) al massaal in het havengebied Zeebrugge-Brugge, of: exoten als de spiegel van al té menselijk handelen. *De Strandvlo*, 27(2): 44-60.
- FAASSE MA & BAYHA KM (2006). The ctenophore *Mnemiopsis leidyi* A. Agassiz 1865 in coastal waters of the Netherlands: an unrecognized invasion? *Aquatic Invasions*, 1(4): 270-277.
- FRANZ HG (2000). Graadmeter soortendiversiteit zooplankton. *Gonz2000 rapport*. 19pp.
- FRASER JH (1965). Zooplankton indicator species in the North Sea; The trace elements. *Serial Atlas of the Marine Environment*, Folio 8. American Geographical Society, New York, 6, Map (1 plate).
- GASPARINI S, DARO MH, ANTAJAN E, TACKX M, ROUSSEAU V, PARENT JY & LANCELOT C (2000). Mesozooplankton grazing during the *Phaeocystis globosa* bloom in the southern Bight of the North Sea. *Journal of Sea Research*, 43: 345-356.
- HOLSTEIJN H (2002). Toch nog een beetje nieuw: *Bolinopsis infundibulum* (Müller 1776) en *Beroe cucumis* (Fabricius 1780) aan onze kust. *Het Zeepaard*, 62(5): 142-150.
- HOWARTH MJ (2001). North Sea Circulation. In: STEELE (ed.), *Encyclopaedia of Ocean Science* volume IV. J.H. Academic Press: 1912-1921.
- IVANOV VP, KAMAKIN AM, USHIVTZEV VB, SHIGANOVA T, ZHUKOVA O, ALADIN NV, WILSON SI, HARBISON GR & DUMONT HJ (2000). Invasion of the Caspian Sea by the comb jellyfish *Mnemiopsis leidyi* (Ctenophora). *Biological Invasions*, 2(3): 255-258.
- JOHNS DG, EDWARDS M, GREVE W & JOHN AWG (2005). Increasing prevalence of the marine cladoceran *Penilia avirostris* (Dana, 1852) in the North Sea. *Helgoland Marine Research* 59(3): 214-218.
- LELOUP E (1952). Faune de Belgique. Coelentérés. Institut royal des Sciences naturelles de Belgique: Brussels, Belgium, 283 pp.
- LOCK K, MEES J, VINCX M & GOETHALS PLM (2011). Did global warming and alien invasions affect surf zone hyperbenthic communities on sandy beaches in Belgium? *Hydrobiologia*, 664: 173-181.
- LOREAU M, NAEEM S, INCHAUSTI P, BENGTTSSON J, GRIME JP, HECTOR A, HOOPER DU, HUSTON MA, RAFFAELLI D, SCHMID B, TILMAN D & WARDLE DA (2001). Biodiversity and ecosystem

- functioning: Current knowledge and future challenges. *Science* 294: 804-808.
- MAES J, TACKX M & SOETAERT K (2002). The predation impact of herring and sprat on estuarine zooplankton in the Scheldt estuary. ECSA Local Meeting: ecological structures and functions in the Scheldt Estuary: from past to future, Antwerp, Belgium October 7-10, 2002, abstract book, pp. 16.
- MEDIN (2011). UK checklist of marine species derived from the applications Marine Recorder and UNICORN, version 1.0. (Internet address: <http://www.marinespecies.org/aphia.php?p=sourcedetails&id=149081>) (Accessed June 1, 2011).
- MEES J, CATTRIJSE A & HAMERLYNCK O (1993). Distribution and abundance of shallow-water hyperbenthic mysids (Crustacea, Mysidacea) and euphausiids (Crustacea, Euphausiacea) in the Voordelta and the Westerschelde, Southwest Netherlands. *Cahiers de Biologie Marine*, 34(2): 165-186.
- MULLER Y (2004). Faune et flore du littoral du Nord, du Pas-de-Calais et de la Belgique: inventaire. Commission Régionale de Biologie Région Nord Pas-de-Calais, France., 307 pp.
- MUXAGATA E & WILLIAMS JA (2004). The mesozooplankton of the Solent-Southampton Water system: A photographic guide. 2004. Southampton Oceanography Centre Internal Document, No.97: 103 pp.
- RAZOULS C, DE BOVÉE F, KOUWENBERG J & DESREUMAUX N 2005-2011. Diversity and Geographic Distribution of Marine Planktonic Copepods. (Internet address: <http://copepodes.obs-banyuls.fr/en>) (Accessed May 30, 2011).
- REID PC, EDWARDS M, BEAUGRAND G, SKOGEN M & STEVENS D (2003). Periodic changes in the zooplankton of the North Sea during the twentieth century linked to oceanic inflow. *Fisheries Oceanography*, 12: 260-269.
- RICHARDSON AJ (2008). In hot water: zooplankton and climate change. *ICES Journal of Marine Science*, 65(3): 279-295.
- ROUSSEAU V, LANCELOT C & COX D (eds) (2006). Current Status of Eutrophication in the Belgian Coastal Zone. Presses Universitaires de Bruxelles, Bruxelles, 121 pp.
- RUSSELL FS (1935). On the value of certain plankton animals as indicators of water movements in the English Channel and North Sea. *Journal of the Marine Biological Association of the United Kingdom*, 20(2): 309-332.
- RUSSELL FS (1953). The Medusae of the British Isles: Anthomedusae, Leptomedusae, Limnomedusae, Trachymedusae and Narcomedusae Cambridge University Press, Cambridge, XIII, 529 pp. + 35 plates.
- RUSSELL FS (1976). The eggs and planktonic stages of British marine fishes. Academic Press, London, ISBN 0-12-604050-8, 524 pp.
- SARS GO (1903). An account of the Crustacea of Norway, with short descriptions and figures of all the species: IV. Copepoda Calanoida. Bergens Museum, Bergen, 171, Plates I-CII & suppl. I-VI pp.
- SMITH PE, COUNTS RC & CLUTTER RI (1968). Changes in Filtering Efficiency of Plankton Nets Due to Clogging Under Tow. *Ices Journal of Marine Science*, 32(2): 232-248.
- TACKX M (2002). Spring zooplankton communities in the Scheldt estuary: from the 60'ties till present. ECSA Local Meeting: ecological structures and functions in the Scheldt Estuary: from past to future, Antwerp, Belgium. October 7-10, 2002, abstract book, 15 pp.
- TACKX M, AZÉMAR F, BOULÉTREAU S, DE PAUW N, BAKKER K, SAUTOUR B, GASPARINI S, SOETAERT K, VAN DAMME S & MEIRE P (2005). Zooplankton in the Schelde estuary, Belgium and the Netherlands: long-term trends in spring populations. *Hydrobiologia*, 540(1-3): 275-278.
- VANDENDRIESSCHE S, VINCX M & DEGRAER S (2006). Floating seaweed in the neustonic environment: a case study from Belgian coastal waters. *Journal of Sea Research*, 55(2): 103-112.
- VANDEPITTE L, DECOCK W & MEES J (2010). The Belgian Register of Marine Species, compiled and validated by the VLIZ Belgian Marine Species Consortium. VLIZ Special Publication, 46. Vlaams Instituut voor de Zee (VLIZ): Oostende, Belgium, 78 pp, ISBN 978-90-812900-8-1.
- VAN HOEY G (2006). Spatio-temporal variability within the macrobenthic *Abra alba* community, with emphasis on the structuring role of *Lanice conchilega*. PhD Thesis, Universiteit Gent, Faculteit Wetenschappen, 187 pp.
- VAN LOEN H & HOUZIAUX JS (2002). De verzameling Gustave Gilson als historisch referentiekader voor de Belgische mariene fauna: een haalbaarheidstudie: samenvatting van het onderzoek. Scientific Support Plan

for a Sustainable Development Policy (SPSD I): Programme “Sustainable Management of the North Sea” = Plan voor wetenschappelijke ondersteuning van een beleid gericht op duurzame ontwikkeling (PODO I): Programma “Duurzaam beheer van de Noordzee”. Federale Diensten voor Wetenschappelijke, Technische en Culturele Aangelegenheden (DWTC), Brussel, 4 pp.

VAN MEEL LIJ (1975). La mer du Nord méridionale, le Pas de Calais et la Manche. Etude d'écologie marine, principalement en ce qui concerne le microplankton. Vol. II Etude planctonique. Bruxelles, Institut Royal des Sciences Naturelles de Belgique, 655 pp. + Tableaux annexes.

VINOGRADOV ME, SHUSHKINA EA, MUSAYEVA EI & SOROKIN PY (1989). A newly acclimated species in the Black Sea: the ctenophore *Mnemiopsis leidyi* (Ctenophora: Lobata). *Oceanology*, 29: 220-224.

VLIZ BELGIAN MARINE SPECIES CONSORTIUM (2010). The Belgian Register of Marine Species. (internet address: <http://www.marinespecies.org/berms>) (Accessed October 26, 2011).

VITOUSEK PM, LUBCHENCO J, MOONEY HA & MELILLO J (1997). Human domination of Earth's ecosystems. *Science*, 277: 494-499.

ZIMMER C (1933). Mysidacea. Die Tierwelt der Nord- und Ostsee, 23(10.g3). Akademische Verlagsgesellschaft, Leipzig: 29-69.

Received: August 10th, 2011

Accepted: December 27th, 2011

Branch editor: De Troch Marleen