CHAPTER 2

UPDATING THE ZOOPLANKTON SPECIES LIST FOR THE BELGIAN PART OF THE NORTH SEA

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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 at ten monitoring stations in the Belgian part of the North Sea, an update is provided on the zooplankton species list of 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 nine species new to the Belgian marine species list: the calanoid copepod *Metridia lucens*, the cyclopoid *Oithona similis*, the poecilostomatoid copepod *Giardella callianassae*, the hydrozoans *Amphinema dinema* and *Eutima gracilis*, the mysid *Acanthomysis longicornis*, the cladoceran *Penilia avirostris*, the polychaete worm *Tomopteris helgolandica* and the monstrilloid copepod *Cymbasoma germanicum*. Additionally, we identified several males of *C. germanicum*, which have never been described before.

Spatial distribution and abundance of all taxa are briefly discussed.

keywords: zooplankton, marine biodiversity, Belgian part of the North Sea, species list, faunal additions

1. 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 locally, 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 an indispensable fundamental tool 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* (Russell 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 warmer water *C. helgolandicus*-dominated copepod assemblage, with lower biomass and smaller species, is a text book 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 zooplankton samples date from the early 20th century (Gilson collection, discussed in Van Loen and 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, yet the data in this older benchmark study are qualitative instead of quantitative, hence they serve best for presence-absence comparisons. Albeit often unclear where exactly the samples originated from.[1]

[1] Van Meel produced a lot of info on zooplankton in the southern North Sea and his thesis (1975) is by far the most detailed work on zooplankton we came across. It was our initial intention to compare our species list with his vast amount of species info. Yet after thoroughly studying his work it became clear that it is very difficult to be sure where exactly his species info relates to. His campaigns consisted of long transects and most of his samples seem to have originated from waters outside the BPNS. This makes it often difficult to draw conclusions when for example one species was present in his study and absent in our data. In the discussion of this chapter we compare our data with Van Meel where possible. For the calanoid copepod *Calanus finmarchicus* we were able to present detailed info on its disappearance from the southern North Sea by verifying Gilson samples (more than a century old) as well as Van Meel specimens and data.

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, 1985a,b) or on the interaction of calanoid copepods with the harmful alga *Phaeocystis globosa* (Scherffel, 1899) (e.g. Gasparini *et al*. 2000, Antajan 2004, 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. Bakker and De Pauw 1975, Soetaert and Van Rijswijk 1993, Appeltans *et al*. 2003, Azémar *et al*. 2004, Tackx *et al*. 2004, Maes *et al*. 2005, 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 the current geographical distribution of many species is 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).

2. Materials And Methods

2.1 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 (57 cm, 200 µm mesh size, Fraser 1968) 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.

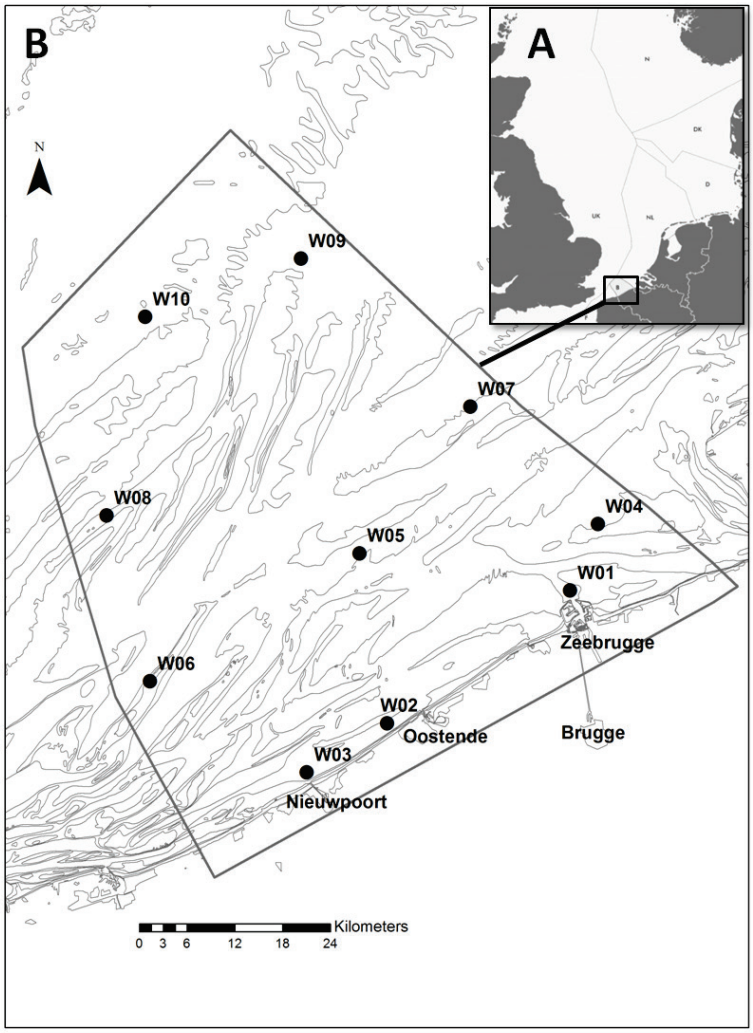

Figure 1: A) North Sea exclusive economic zones; B) Belgian part of the North Sea (BPNS) with ten stations (situated in nearshore W01-04-midshore W05-07-offshore areas W08-10) sampled monthly for zooplankton from January 2009 to December 2010.

2.2 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 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 tychoplanktonic taxa (are occasionally carried into the water column, e.g. benthic species). Certain species groups such as mysids, amphipods and cumaceans that are often referred to as hyperbenthic, were also

counted as tychoplanktonic. Decapod larvae were lumped and not identified to species level, since pigmentation (necessary for identification) disappears due to fixation in formaline.

3. Results and discussion

Table 1 lists 137 taxa (98 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 tychoplanktonic. Four copepods, two hydrozoans, one cladoceran, one mysid and one polychaete have never been reported from the BPNS and are new for the Belgian Register of Marine Species. Additional info on densities and the spatial and temporal occurrence of these taxa in the BPNS is presented in Addendum 1.

Table 1: List of holo- (H), mero- (M) and tychoplanktonic (T) taxa in the BPNS observed in the period 2009-2010. Species with asterisk (*) are new to the Belgian fauna (Vandepitte *et al*. 2010). "LS" = lifestage.

Higher Taxon	Order	Family	Species	LS
Dinoflagellata				
Noctilucea	**Noctilucales**	Noctilucaceae	*Noctiluca scintillans* (Macartney) Kofoid and Swezy, 1921	H
Cnidaria				
Scyphozoa	**Semaeostomeae**	Cyaneidae	*Cyanea lamarckii* Péron and Lesueur, 1810	H
		Pelagiidae	*Chrysaora hysoscella* (Linnaeus, 1767)	H
		Ulmaridae	*Aurelia aurita* (Linnaeus, 1758)	H
	Rhizostomeae	Rhizostomatidae	*Rhizostoma pulmo* (Macri, 1778)	H
Hydrozoa	**Anthoathecata**	Pandeidae	*Amphinema dinema* (Péron and Lesueur, 1810)*	H
		Bougainvilliidae	*Nemopsis bachei* L. Agassiz, 1849	H
		Margelopsidae	*Margelopsis haeckeli* (Hartlaub, 1897)	H
		Rathkeidae	*Rathkea octopunctata* (M. Sars, 1835)	H
		Corynidae	*Sarsia tubulosa* (M. Sars, 1835)	H
	Leptothecata	Campanulariidae	*Clytia hemisphaerica* (Linnaeus, 1767)	H
			Obelia sp.	H
		Lovenellidae	*Eucheilota maculata* Hartlaub, 1894	H
			Lovenellidae sp.	H
		Eirenidae	*Eutima gracilis* (Forbes and Goodsir, 1853)*	H
			Eutonina indicans (Romanes, 1876)	H
Ctenophora	**Beroida**	Beroidae	*Beroe gracilis* (Künne, 1939)	H
		Bolinopsidae	*Mnemiopsis leidyi* (A. Agassiz, 1865)	H
		Pleurobrachiidae	*Pleurobrachia pileus* (O. F. Müller, 1776)	H
Platyhelminthes			Platyhelminthes sp.	T
Nemertea			Nemertea sp.	T
Annelida				
Oligochaeta			Oligochaeta sp.	T
Polychaeta	**Phyllodocida**	Tomopteridae	*Tomopteris (Johnstonella) helgolandica (Greeff, 1879)**	H

Mollusca				
Gastropoda			Gastropoda sp.	M
Bivalvia			Bivalvia sp.	M
	Pectinoida	Pectinidae	Pectinidae sp.	M
	Euheterodonta	Pharidae	*Ensis* sp.	M
	Myopsida	Loliginidae	*Loligo* sp.	M
Crustacea				
Arachnida			Acarina sp.	T
Branchiopoda	**Diplostraca**	Bosminidae	*Bosmina* sp.	H
		Podonidae	*Evadne* sp.	H
			Podon sp.	H
			Penilia avirostris Dana, 1849*	H
Copepoda	**Calanoida**	Acartiidae	*Acartia* (Acartiura) clausi (Giesbrecht, 1889)	H
		Calanidae	*Calanus helgolandicus* (Claus, 1863)	H
		Candacidae	*Candacia armata* (Boeck, 1872)	H
		Centropagidae	*Centropages hamatus* (Lilljeborg, 1853)	H
			Centropages typicus (Krøyer, 1849)	H
			Isias clavipes (Boeck, 1865)	H
		Pontellidae	*Labidocera wollastoni* (Lubbock, 1857)	H
		Metridinae	*Metridia lucens* (Boeck, 1865)*	H
		Paracalanidae	*Paracalanus parvus* (Claus, 1863)	H
		Clausocalanidae	*Pseudocalanus elongatus* (Boeck, 1865)	H
		Temoridae	*Temora longicornis* (Müller O.F., 1785)	H
	Cyclopoida	Corycaeidae	*Corycaeus anglicus* (Lubbock, 1857)	H
		Cyclopinidae	*Cyclopinoides littoralis* (Brady, 1872)	H
		Oithonidae	*Oithona nana* (Giesbrecht, 1893)	H
			Oithona similis (Claus, 1866)*	H
		Oncaeidae	*Oncaea* sp.	H
	Harpacticoida		Harpacticoida sp.	T
		Euterpinidae	*Euterpina acutifrons* (Dana, 1847)	H
	Monstrilloida	Monstrillidae	*Cymbasoma germanicum* (Timm, 1893)*	H
	Poecilostomatoida	Clausidiidae	*Giardella callianassae* Canu, 1888*	M
Cirripedia			Cirripedia sp.	M
Eucarida	**Euphausiacea**	Euphausiidae	*Nyctiphanes couchii* (Bell, 1853)	H
	Decapoda		Anomura sp.	M
			Brachyura sp.	M
			Caridea sp.	M
			Decapoda sp.	M
		Callianassidae	*Callianassa* sp.	M
		Crangonidae	*Crangon crangon* (Linnaeus, 1758)	M
		Porcellanidae	*Pisidia longicornis* (Linnaeus, 1767)	M
		Processidae	*Processa modica* Williamson, 1979	T
Peracarida	**Cumacea**	Bodotriidae	*Bodotria arenosa* (Goodsir, 1843)	T
			Bodotria scorpioides (Montagu, 1804)	T
		Diastylidae	*Diastylis rathkei* (Krøyer, 1841)	T
		Pseudocumatidae	*Pseudocuma* sp.	T

			Monopseudocuma gilsoni (Gilson, 1906)	T
			Pseudocuma (Pseudocuma) longicorne (Bate, 1858)	T
			Pseudocuma (Pseudocuma) simile G.O. Sars, 1900	T
	Amphipoda	Hyperiidae	*Hyperia galba* (Montagu, 1815)	H
		Amphilochidae	*Amphilochus neapolitanus* Della Valle, 1893	T
		Calliopiidae	*Apherusa bispinosa* (Bate, 1857)	T
			Apherusa ovalipes Norman and Scott, 1906	T
		Atylidae	*Atylus falcatus* (Metzger, 1871)	T
			Atylus swammerdami (Milne-Edwards, 1830)	T
		Pontopereiidae	*Bathyporeia* sp.	T
		Corophiidae	*Corophium* sp.	T
		Gammaridae	*Gammarus crinicornis* (Stock, 1966)	T
			Gammarus salinus (Spooner, 1947)	T
		Caprellidae	*Caprella linearis* (Linnaeus, 1767)	T
			Pariambus typicus (Krøyer, 1884)	T
		Ischyroceridae	*Jassa herdmani* (Walker, 1893)	T
		Leucothoidae	*Leucothoe incisa* (Robertson, 1892)	T
		Megaluropidae	*Megaluropus agilis* (Hoeck, 1889)	T
		Microprotopidae	*Microprotopus maculatus* (Norman, 1867)	T
			Orchomenella nana (Kroyer, 1846)	T
		Oedicerotidae	*Pontocrates altamarinus* (Bate and Westwood, 1862)	T
			Pontocrates arenarius (Bate, 1858)	T
	Isopoda		Isopoda sp.	M
		Cirolanidae	*Eurydice spinigera* Hansen, 1890	T
	Mysida	Mysidae	*Acanthomysis longicornis* (Milne-Edwards, 1837)*	T
			Anchialina agilis (G.O. Sars, 1877)	T
			Gastrosaccus sp.	T
			Gastrosaccus sanctus (van Beneden, 1861)	T
			Gastrosaccus spinifer (Goës, 1864)	T
			Mesopodopsis slabberi (van Beneden, 1861)	T
			Schistomysis kervillei (G.O. Sars, 1885)	T
			Schistomysis ornata (G.O. Sars, 1864)	T
			Schistomysis spiritus (Norman, 1860)	T
			Siriella armata (Milne-Edwards, 1837)	T
	Tanaidacea	Tanaidae	*Tanais dulongii* (Audouin, 1826)	H
Chaetognatha	**Aphragmophora**	Sagittidae	*Parasagitta elegans* (Verrill, 1873)	H
			Parasagitta setosa (Müller, 1847)	H
Echinodermata	**Camarodonta**	Parechinidae	*Psammechinus miliaris* (P.L.S. Müller, 1771)	M
	Forcipulatida	Asteriidae	*Asterias rubens* Linnaeus, 1758	M
	Ophiurida	Ophiotrichidae	*Ophiothrix fragilis* (Abildgaard, in O.F. Müller, 1789)	M
		Ophiuridae	*Ophiura* sp.	M
	Spatangoida	Loveniidae	*Echinocardium* sp.	M
Bryozoa			Bryozoa sp.	M
Phoronida			Phoronida sp.	M
Chordata				

Tunicata	**Copelata**	Oikopleuridae	*Oikopleura (Vexillaria) dioica* Fol, 1872	H
Cephalochordata	**Amphioxiformes**	Branchiostomidae	*Branchiostoma lanceolatum* (Pallas, 1774)	M
Pisces			Pisces sp.	M
	Perciformes	Ammodytidae	Ammodytidae sp.	M
			Ammodytes marinus Raitt, 1934	M
			Ammodytes tobianus Linnaeus, 1758	M
			Hyperoplus lanceolatus (Le Sauvage, 1824)	M
		Callionymidae	*Callionymus* sp.	M
		Trachinidae	*Echiichthys vipera* (Cuvier, 1829)	M
			Trachinus draco (Linnaeus, 1758)	M
		Gobiidae	Gobiidae sp.	M
			Pomatoschistus sp.	M
		Carangidae	*Trachurus trachurus* (Linnaeus, 1758)	M
	Pleuronectiformes	Bothidae	*Arnoglossus laterna* (Walbaum, 1792)	M
		Soleidae	*Buglossidium luteum* (Risso, 1810)	M
			Solea solea (Linnaeus, 1758)	M
		Pleuronectidae	*Limanda limanda* (Linnaeus, 1758)	M
			Pleuronectes platessa Linnaeus, 1758	M
	Clupeiformes	Clupeidae	Clupeidae sp.	M
			Clupea harengus Linnaeus, 1758	M
			Sardina pilchardus (Walbaum, 1792)	M
			Sprattus sprattus (Linnaeus, 1758)	M
		Engraulidae	*Engraulis encrasicolus* (Linnaeus, 1758)	M
	Gadiformes	Gadidae	*Merlangius merlangus* (Linnaeus, 1758)	M
	Osmeriformes	Osmeridae	*Osmerus eperlanus* (Linnaeus, 1758)	M
	Syngnathiformes	Syngnathidae	*Syngnathus rostellatus* Nilsson, 1855	M
	Scorpaeniformes	Triglidae	Triglidae sp.	M

3.1 Species new for the BPNS

Cymbasoma germanicum is a rare monstrilloid species known only from a few female specimens collected at the Doggersbank, off Helgoland (in 1892) and Cuxhaven (Razouls *et al*. 2005-2011, Suárez-Morales 2006). Monstrilloid copepods are protelean parasites of benthic macroinvertebrates such as polychaetes and mollusks (Davis 1984). Protelean parasites start as (often internal) parasites that continue their lives as free living adults after killing or consuming the host.

We found 16 specimens, both males and females (Fig. 2). The differences between *C. germanicum*, *Cymbasoma rigidum* Thompson, 1888 and *Cymbasoma zetlandicus* T. Scott, 1904 are subtle. *Cymbasoma germanicum* can be distinguished from the different morphotypes related to the nominal species *Cymbasoma rigidum* by a combination of characteristics, including a large inner lobe of the fifth leg, an innermost fifth leg seta nearly

as long as the other two, the relative length of the antennules, and the shape of the second antennular segment. The main distinguishing character is the presence of two knob-like processes (Fig. 3) on the posterior margin of the genital somite (Suárez-Morales 2006).

A redescription, including the description of the male, and comparison with its close relatives is planned for the future (Fiers and Van Ginderdeuren in prep.).

Metridia lucens is a copepod most found in the northern North Sea and northern Atlantic (Fraser 1965, Barnard *et al*. 2004). Its occurrence in the southern part of the North Sea, appears to be scanty: 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.

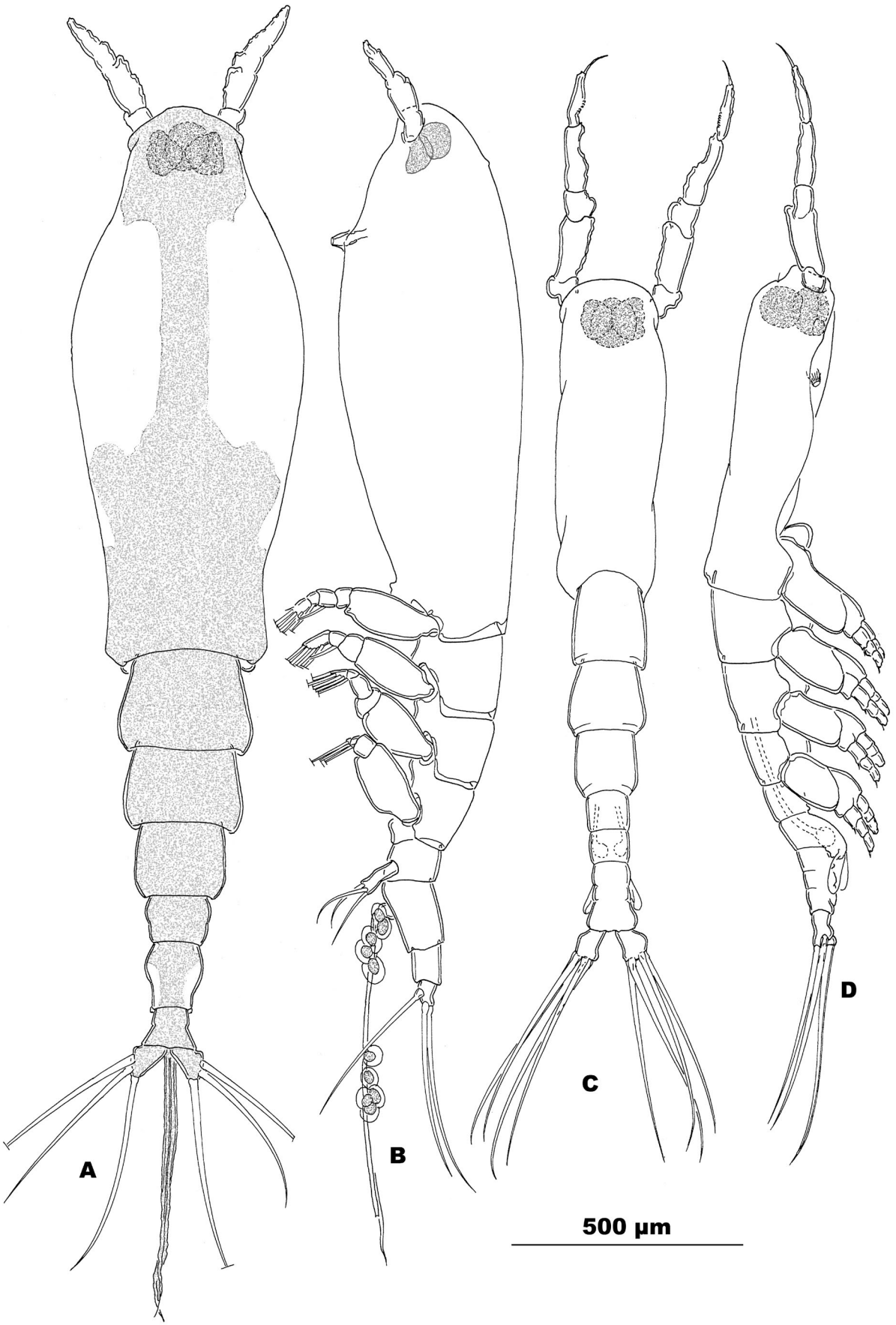

Figure 2: *Cymbasoma germanicum* female and male habitus drawn from specimens collected in the BPNS. A-B: Female, dorsal and lateral view; C-D: Male, dorsal and lateral view (Fiers and Van Ginderdeuren in prep.).

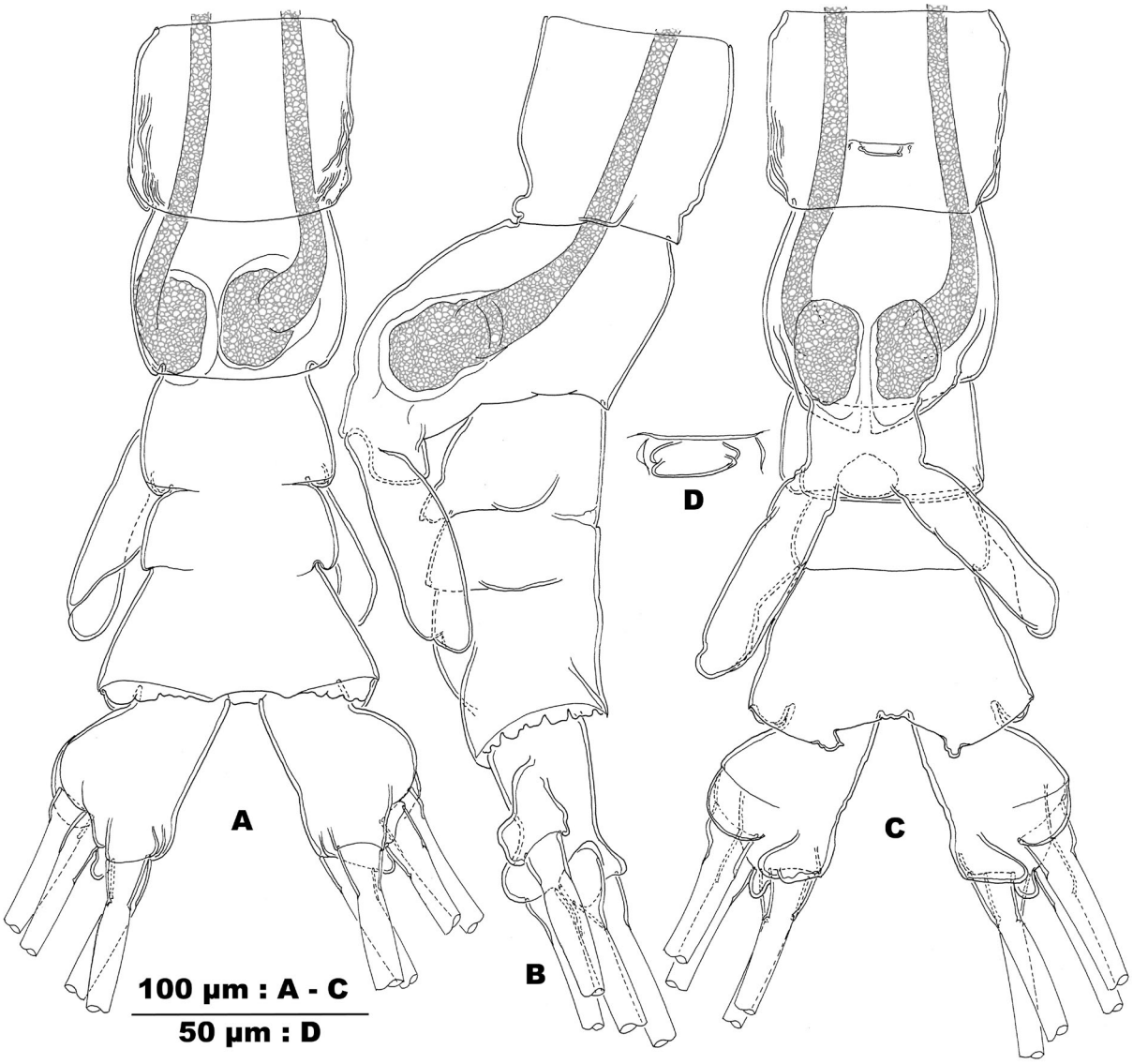

Figure 3: *Cymbasoma germanicum* male urosome habitus drawn from specimens collected in the BPNS. A: Dorsal view; B lateral view; C: ventral view; D: anus (Fiers and Van Ginderdeuren in prep.).

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 (Antajan 2008) and in the Solent, English Channel (Muxagata and 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 Clausiididae (Brylinski 2009). The adults of these pelagic larvae are parasitic Cyclopoida (Razouls *et al*. 2005-2011). Brylinski (2009) identified *Saphirella* specimens in the

English Channel corresponding to C1 of *Giardella callianassae*, a species never reported from Belgian waters (Vandepitte *et al*. 2010). These *Giardella* copepodites were also found in high numbers in our samples (Addendum 1).

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 and the English Channel by Fraser (1965) and Van Meel (1975), but it has been observed in English waters by others (Russell 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 (1994) found it in 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 English Channel near Wimereux (Dauvin *et al*. 2003).

3.2 Additional observations

The most abundant copepods 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 vicinity 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 is often transported to the BPNS by prevailing marine currents conveying Atlantic water through the English 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) describes how the species sometimes occurs in the English Channel when conveyed in Atlantic currents reaching the North Sea. The fact that we caught only one individual of *P. elegans* while 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 euphausid 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 (Russell 1935, Van Meel 1975). It has previously been reported from Belgian waters by Cattrijsse and Vincx (2001) and Lock *et al*. (2011).

The non-indigenous 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 and 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 and 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 (Also see Chapter 2 Annex 1 for info on *M. leidyi*).

Another non-indigenous coelenterate recorded in this study is the hydrozoan *Nemopsis bachei*, a species generally considered to originate from the Atlantic coast of North America (Hargitt 1901). This hydrozoan naturally occurs in coastal areas and tolerates a wide array of salinities from 15 - 45 (75) PSU (Moore 1962). *Nemopsis bachei* was caught along the entire Belgian 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 and Hirche 2007). In contrast to other species of Scyphozoa encountered, this jellyfish reached its highest densities offshore rather than nearshore (Addendum 1).

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