SCIENTIFIC SUPPORT PLAN FOR A SUSTAINABLE DEVELOPMENT POLICY

# SPSD II

# THE HINDER BANKS: YET AN IMPORTANT AREA FOR THE BELGIAN MARINE BIODIVERSITY ?

J.-S. HOUZIAUX

PART 2

GLOBAL CHANGE, ECOSYSTEMS AND BIODIVERSITY

- ATMOSPHERE AND CLIMATE
- MARINE ECOSYSTEMS AND BIODIVERSITY
- TERRESTRIAL ECOSYSTEMS AND BIODIVERSITY
- NORTH SEA
- ANTARCTICA
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SCIENTIFIC SUPPORT PLAN FOR A SUSTAINABLE DEVELOPMENT POLICY
(SPSD II)

*Part 2:*
*Global change, Ecosystems and Biodiversity*

FINAL REPORT

# The Hinder banks: yet an important area for the Belgian marine biodiversity ?

**EV/45**


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# 1 Introduction

Since the World summit of Rio in 1992, halting the human-induced degradation of biodiversity and the services it offers to Humankind has been widely recognized as a major issue to tackle. Overfishing, eutrophication, pollution and other anthropogenic impacts have caused marine resources to rarefy to a point where the sustainability of their use is put into question at the global scale. There is now grounded evidence that industrial overfishing has caused serious damage to marine ecosystems through alteration of target stocks, biogeochemical cycles, habitats and associated biodiversity, ultimately affecting food webs and ecosystem structure and functioning (de Groot and Lindeboom, 1998; Watling and Norse, 1998; Frid et al, 1999; Kaiser et al, 2002; Tillin et al, 2006); it has preceded further environmental degradation in coastal ecosystems (Jackson et al, 2001). Nowadays, global warming is expected to further affect ocean processes and fragilized marine biodiversity on the large-scale.

An "ecosystem approach" to fisheries management has thus become a major point in the framework of policies aiming at ensuring sustainable development, although the ongoing climatic change will make predictions difficult. To understand long-term changes in biodiversity and ecosystem functioning in relationship with fishery activities, a better understanding of environmental history is necessary along with the determination of baseline situations.

Reconstructing the baselines is difficult in the marine realm because marine sciences are relatively young. Indeed, significant impacts of fishery activities to coastal systems such as early retrieval of large target species or habitat destruction are old (Lotze and Milewski, 2004; Lotze et al, 2005). Proxies such as landings in relation with fishing effort can be used to reconstruct long-term trends for marine species traditionally exploited through history (e.g. herring: see Poulsen, 2006). For non-commercial benthic species however, very few reliable data might have existed prior to the 1900s. In the North Sea, very few studies have been able to track changes in lower trophic levels with the help of historical data-sets prior to the 1920s, at a time where fishery activities had likely altered ecosystem structure at least at some fishing grounds (Frid et al, 2000). De Vooys et al (2004) recently re-analyzed results of various surveys conducted in the North Sea between 1870 and 1911, but these were apparently focused on species inventories and did not provide conclusive elements yet. One extensively used data-set is that from the the Museum of Kiel, dating back to the period 1902-1912 (Stein et al, 1990; de Groot and Lindeboom, 1998; Rumohr and Kujawski, 2000; Callaway et al, 2007). Despite intrinsic weaknesses of the historical data, it enabled to evidence a strong increase of Echinodermata during the 20$^{th}$ century and a reduction of sensitive taxa (long-lived, fragile bodies) suggesting a link with bottom trawling impacts. So far, however, no old data-set ever permitted to reconstruct a "baseline" for North Sea benthos (Callaway et al, 2007).

The RBINS hosts a century-old collection of marine organisms gathered by G. Gilson, who undertook his "*exploration of the sea in front of the Belgian shore*" in 1898 (Gilson, 1900). The career of G. Gilson, who also worked a time as Director of the RBINS, is outlined in references compiled in van Loen et al (2002). The original sampling programme of Gilson was ambitious, with hundreds of predetermined stations where sampling took place with various well-designed and standardized gears. Gilson's goal was to understand how the environment shaped the distribution of marine species within a restricted and accessible area. He has therefore collected his samples in a high-resolution sampling grid and with an ecologist's mind, providing the modern researcher with a unique reference collection to analyze long-term changes in local patterns of marine biodiversity. Unfortunately, this collection is huge and was not yet accessible in digital format.

Gilson (1900) explicitly described the surroundings of the offshore sand bank "Westhinder" as strikingly differing from the surrounding sandy areas for what regards benthic richness, an opinion mirrored in the collections stored at the RBINS. Various taxa typical of hard substrata are encountered, such as branching sponges, bryozoans, hydroids or tunicates. Many of these specimens were stored in alcohol together with their substratum: shells, other animals, pebbles and cobbles. Tens of pebbles and cobbles of various sizes and compositions were also found in the petrographic repositories of the RBINS and previously described by Verbeek (1954). Last but not least, tens of specimens and shells of the indigenous European flat oyster (*Ostrea edulis*), some of which large, were also found to originate mostly from this area. This rarefied species, formerly a keystone species in the functioning of continental shelves of the North-Eastern Atlantic (Korringa, 1969), has not been mentioned alive in Belgian waters since decades.

In the older literature, Van Beneden (1883) also indicated the existence of a "*strip of rounded cobbles*", somewhere "*off Oostende*", to which wild European flat oysters and a rich invertebrate epifauna were associated. About 50 cobbles were collected and were later described by Renard (1886). Describing briefly his preliminary samples from that area, Van Beneden (1883) wrote: *"I must acknowledge that I never witnessed such a variety of animal forms in a single dredge tow"*. Van Beneden (1883) also referred to "oyster dredgers" who have seemingly exploited wild oysters in these surroundings earlier. Unfortunately, Van Beneden did not indicate the location of the considered area, which seems however to have been located on a map (Renard, 1886).

Gilson (1921) later stated that bottom trawlers increasingly targeted "*stony*" grounds in the early 1920s. Motorized trawlers thus apparently became technologically able to chase fish on such difficult grounds, yet avoided by sailing beam trawlers a decade earlier (Pype, 1911). The threat put forward by Gilson was the probable impact to North Sea herring (*Clupea harengus*) spawning success, since this species selectively target gravels to lay down its demersal eggs. Noticeably, Gilson wrote: "*For this reason and others, it might be necessary to protect these grounds against fishery activities*".

These early observations have got no echo in recent researches on marine biodiversity (Kerckhof and Houziaux, 2003). "Gravels" are known to exist in the area of the Westhinder, as evidenced by Veenstra on the basis of Van Veen grab samples (1964, 1969) and Gullentops et al (1978), but the Belgian maritime zone is considered essentially sandy and muddy. Lanckneus et al (2002), Roche (2002) and Reyns et al (2005) documented occurrence of coarse deposits between gullies of the Flemish sand banks and south to the Thornton bank. Deleu (2002) performed preliminary acoustic surveys which evidenced the occurrence of similar grounds in the Westhinder area, supporting suggestions by Veenstra. However, these findings did not provide conclusive elements on the nature of the seafloor and the associated fauna remained undocumented. The description as "gravels and pebbles of fluviatile origin" provided by Veenstra (1969) does not match the large angular fragments gathered by Van Beneden (1883) and Gilson (Verbeek, 1954).

Govaere (1980) suggested an increasing gradient of macrobenthic species richness from the coast toward offshore waters. However, the review by Degraer and Cattrijsse (in Cattrijsse and Vincx, 2001) pointed at low macrobenthic densities offshore as compared to the coastal waters of the Western coast. Van Hoey et al (2004) even considered that the coarse nature of the sediment much explained lower species-richness and densities offshore. These conclusions are probably valid for the infauna of sand banks, as they were all obtained with Van Veen grabs. They are however unlikely to be representative of benthos occurring at the aforementioned pebble and cobble fields, due to poor sampling efficiency on such seafloor, where large fragments obviously used to occur. It seems thus likely that the absence of recent information on biodiversity associated to gravel grounds is due to poor sampling efficiency, although drastic changes in the habitat could be involved as well.

Gravel grounds of the Westhinder area thus apparently used to support some important ecosystem functions in a remote past, with a biodiversity markedly differing from that of the surrounding sandy areas, whereas their present health status is undocumented. It seems likely that Gilson's data could provide important clues to reconstruct the baseline at gravel fields, since these grounds were yet avoided by sailing trawlers in the early 1900s, on the contrary to coastal areas impacted by trawling since the early 1820s (Anonymous, 1866; De Zuttere, 1909). This project therefore focuses on gravels of the Westhinder area and addresses the following questions:

1. What does the Gilson collection and the historic literature tell us about the historic status (baseline) and fate of benthos in the surroundings of the Westhinder sand bank?
2. What is the current status of the benthos of this area, and what changes can be identified?
3. Can we identify causes for observed long-term changes?

# 2 Situation map

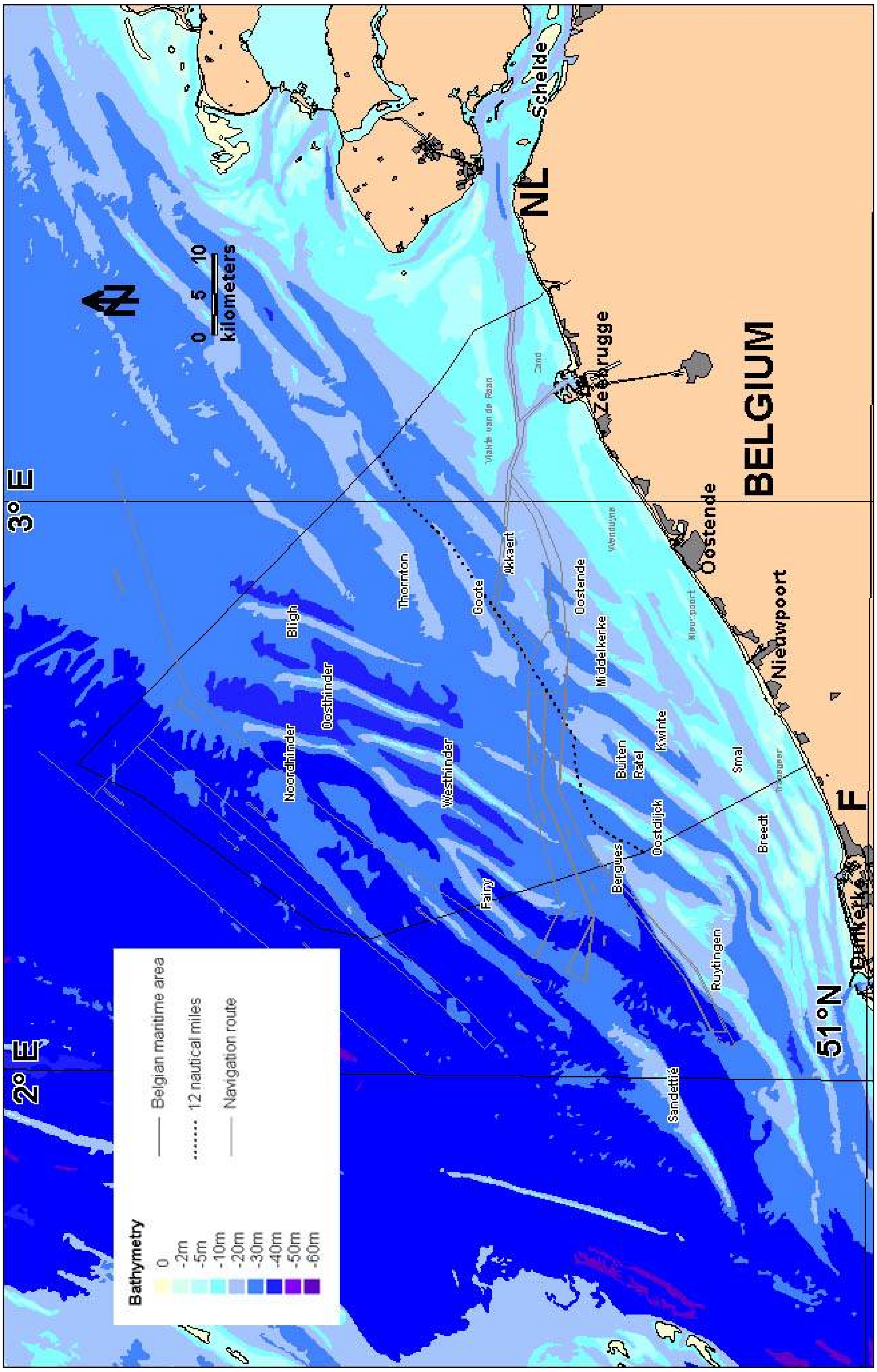


Figure 2-1. General map of major sand banks of the Belgian marine area. Background data from MUMM data centre website (www.mumm.ac.be/datacentre).

# 3 Methods

## 3.1 Historical data gathering

### 3.1.1 Digitization of the collection of G. Gilson

The biological material of G. Gilson consists of tens of thousands of specimens, representing hundreds of marine species collected in the southern bight of the North Sea and the English Channel (Belgian, French, English and French waters; see van Loen et al, 2002, for a synthetic map of Gilson's various sampling programmes). This collection is spread amongst the various repositories of the RBINS according to the Linnean classification system, and is mixed with samples provided by other collectors before or after Gilson. This organization of collections implies that digitization with a view to reconstruct the original species content of samples must be carried out on a taxonomy-based approach, i.e. prioritization of taxa of interest to achieve project's goals. Preliminary surveys made in the collections (e.g. Neogastropods; van Loen et al, 2002) suggest that Gilson's material represents about 80 % of the regional marine invertebrates archived at the RBINS. Therefore, the overall material available for selected taxa was digitized first and Gilson's data were extracted subsequently.

This material was collected with tens of different sampling gears which were generally well-documented (see van Loen et al, 2002 and annex 1). Our first goal being to evaluate whether the gravels of the Westhinder area differ from the surrounding sandy areas in terms of benthic richness, we made a selection on sampling gears and target species. Samples collected with dredges will be considered in this analysis, and only representative species of the macro-epibenthos will be taken into account (i.e. specimens larger than 5mm living above the sediment).

Dredging was performed by Gilson in a systematic manner (Gilson, 1900). About 1000 sampling events are reported for this sampling method, most of which carried out between 1900 and 1908 in well-defined sampling grids in front of the Belgian and Dutch coasts (Figure 3 1). This gear appears as most appropriate for the invertebrate epifauna, although other methods such as "bottom plankton" nets or beam trawls also gathered representatives of this compartment. Gilson's dredge was also designed to collect infauna through the use of a "rake" disturbing soft sediments in front of the dredge (see annex 1, section 2.1.). Many macrobenthic species typical of soft sediments were indeed collected with this gear (see Gilson, 1900). However, this method is unlikely to provide a representative sample of the soft sediment infauna, as the dredge was towed on a considerable distance (one nautical mile), while it is likely that the majority of species will escape either the spines of the rake or the collecting bag located at the sediment surface.

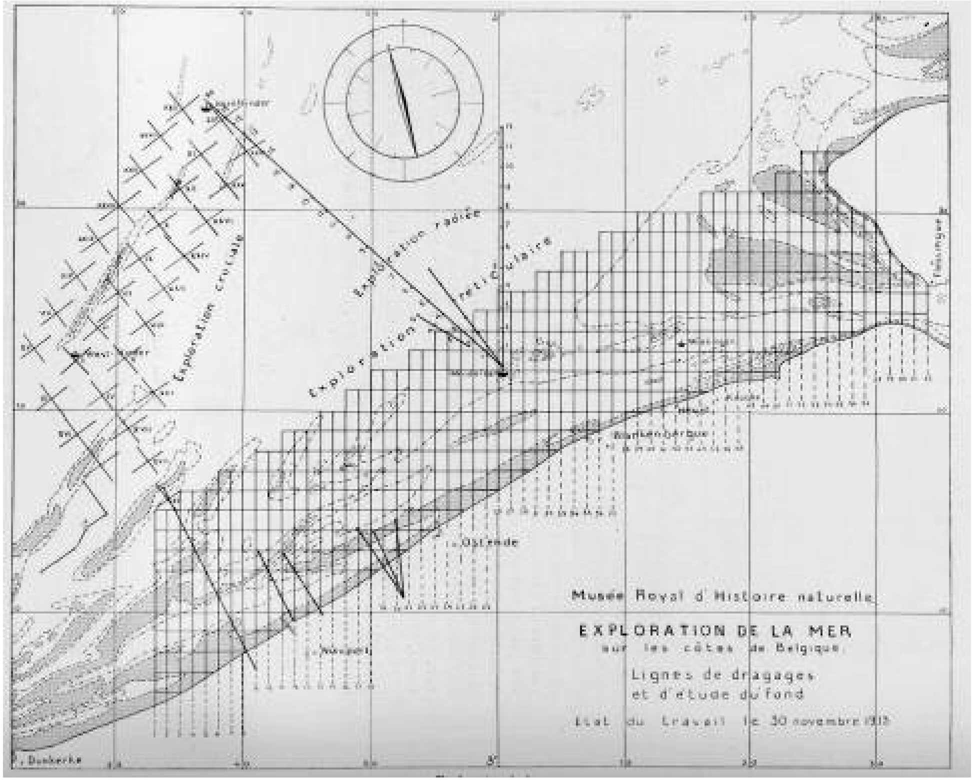


Figure 3-1 : Sampling grids of G. Gilson in front of the Belgian and Dutch coasts (original map; Gilson, 1914).

Dredging for benthos was performed sequentially with sediment sampling. van Loen et al (2002) already suggested that sediment information provided by Gilson in the form of fresh sample descriptions could be processed to enable mapping of the seafloor composition. A total of about 3000 sampling events are recorded for the "ground-collector" of Gilson (see annex I) in sampling inventories. The sampling events had to be validated and the verbose description processed to provide thematic maps of sediment parameters.

The work on the sediment data of Gilson was initiated in 2002 and resulted in a first importation of 1785 sampling events with their associated sediment descriptions in the IDOD database of the Belgian Marine Data Centre (hereafter referred to as "BMDC": www.mumm.ac.be/datacentre). In the framework of this project, we have continued the work on sediment data to provide a complete data-set along with well-defined sediment factors. As our initial plan was to ultimately link benthic information with sediment nature, the validation of the geographic positioning was a complicated but most important topic to solve as well.

Digitizing the collection of G. Gilson has thus been performed along three major axes:

1. Digitization and validation of sampling information for the "ground-collector" and the dredge samples, focusing on Gilson's sampling grids in front of the Belgian and Dutch coasts.
2. Processing of Gilson's sediment descriptions to provide data on the seafloor nature, in order to build historical sedimentological maps and to create habitat factors to plot against species diversity patterns.
3. Digitization and "taxonomic upgrade" of epibenthic invertebrates held in the different repositories of the RBINS, to provide species lists for every Gilson's dredge sampling event comparable with the modern nomenclature.

#### *3.1.1.1 Sampling information*

Processing and validation of Gilson's sampling information is thoroughly described in annex 1. Validating the sampling information proved a most time-consuming procedure since documentation sometimes lack or is inaccurate (e.g. several information sources providing different values for dates, positions and others). However, the process has resulted in well-defined sampling grids for the dredge and for the sediment samples of Gilson, within which geo-referencing accuracy could be ranked for subsequent sample selection and analyses. Precision ranking is used in analyses involving small-scale mapping and interpolations, to enable removal of doubtful samples when there is a risk of bias with neighbour samples.

In the Westhinder sampling grid ("exploration cruciale", see Figure 3 1) a "circular dredging" was furthermore carried out at every "cross" by Gilson. According to information found in his archives, these were performed around the centre of the cross, with a radius of about half a nautical mile. Some of these samples are among the most species-rich. They have been positioned on the center of the cross for mapping purposes.

#### *3.1.1.2 Sediment information processing*

A large part of Gilson's original sediment samples have been lost through time. Gilson himself did not perform many analyses on his samples, and a part of these results could not be found back. Only few analyses were performed on remaining samples later on (see annex I). However, Gilson always carefully described samples brought onboard. These field descriptions are very detailed (Table 3 I), what led us to consider their use to characterize the benthic biotope.

| Sample number | Sediment description |
|---|---|
| **GS059** | *Hard clay, in form of pieces, red and breakable, neritic coarse sand, grey mud, small stones* |
| **G2648** | *Sandy black mud, pure black mud, grey mud, fine sand, several shells* |
| **G1847** | *Hard black mud, a bit of grey mud, non muddy fine sand (more than in the previous sample)* |
| **G2670** | *Coarse sand, a bit neritic, surface grey mud in form of lumps* |
| **G6448** | *Broken shells* |
| **G3572** | *Stones, gravel, greyish fine sand, sandy black mud* |
| **G6485** | *Gravel, pebbles, broken shells, pieces of coal* |

Table 3-I. Examples of Gilson's field sediment descriptions (translated from French).

Different methods were tested to code Gilson's sediment descriptions. Despite a relative standardization in the way sediments are described, we were confronted to heterogeneity in Gilson's semantics. On the other hand, the sediments are often described as a succession of layers, but no indication is provided on their vertical order. It is thus generally impossible to know whether the items described are found at the surface or the bottom of the sample. When tentatively coding Gilson's descriptions, we therefore considered the sample as a whole, establishing an average value for multiplayer descriptions for each item considered (sand grain-size estimate, mud content, shell and shell debris content, gravel content).

In a first step, we have coded the descriptions into two main compartments : the main sediment and the additional constituents. This approach enabled a first raw classification of the sediments based on their dominant constituent : "mud", "sand" or "gravel" (mineral or shells). For sand, detailed descriptions (*e.g.* "fine sand", "rather coarse sand") enabled us to create categories of average sand grain-size (which must thus be considered as restricted to the strict sand fraction: 63µ < X < 1000µ). Additional constituents were initially separated into 7 categories: shells, shell debris, mud content (separated layer), mud content (mixed), sand content (separated layer), sand content (mixed) and gravel.

Prior to this project, 62 sandy samples were analyzed for sand grain-size in order to check the agreement of real mean and median grain-sizes with categories based on estimates of Gilson (Houziaux and Francken, unpublished data). The conclusions were that "fine" and "coarse" sands are two significantly distinct categories, the latter corresponding to "medium" sand in the Uden-Wentworth's grain-size scale (Tucker, 1998). "Fine sand" correspond to an average median grain-size <200 µm, "coarse sands" correspond to an average median grain-size > 300 µm. Average values of "In-between" categories (e.g. "rather fine sand", "medium sand") do display a significant gradient of coarseness from "fine" to "coarse" sand (non-parametric statistics), but pairwise tests failed in evidencing significant differences. This is interpreted as resulting from the very thin interval which separates these categories. Although the amount of control analyses are yet insufficient to draw clear conclusions, we can state that areas depicted as hosting "fine" and "coarse" sands respectively are significantly different for what regards their average sand grain-size spectrum. These data were used to draw maps of median sand grain-size, using real values at stations where samples had ben analyzed and extrapolated values in the rest of the sampling grid.

We faced difficulties in making thematic maps for the various other sediment constituents (mud content, shells, gravel) with the initial approach. For instance, we could not differentiate "very sandy mud" from "muddy sand". For mud content, an alternative approach was therefore developed (see Fettweis et al, 2007). Based on the descriptions, we estimated the proportions of "mud" and "sand" in the sediments in a stepwise process, all other constituents (shells, gravel, etc.) being excluded from the analysis. This exclusion was necessary to minimize uncertainty since estimates of relative proportions of constituents are not always available. By restricting the constituents considered to sand and mud, it becomes possible to compare mud contents of the samples relatively to every other and to generate a reliable map for this parameter, although obtained values shouldn't be used as *absolute* values.

Firstly, 4 categories were created: "pure mud"; "mud with sand"; "sand with mud"; "pure sand". Semi-quantitative information was used where provided to further divide every interval into 4 sub-categories. The 16 categories obtained were normalized to obtain a "mud content" scale. Methodological problems arise from the fact that not all descriptions contain semi-quantitative indications. For these, the basic categories were considered (e.g. "muddy sand" corresponds to a generic content estimate of 25 %).

For shells and shell debris, we have considered two approaches. Firstly, we flagged presence or absence to identify every sediment samples containing shells or shell debris. Secondly, the semi-quantitative indications provided in the descriptions (e.g. "*very* neritic sand" or "sand with some shell remains") were coded where available in a simple form: nul, low, medium and high contents, taking respectvely the arbitray values 0, 1, 2 and 3. This process was carried out separately for "shells" and "shell debris". To come out with one integrated map, the two parameters were merged to obtain a general pattern. When semi-quantitative indications were not provided, we assigned a "medium" content.

Regarding gravel fields, many of the cobbles stored in repositories (of which a part was described by Verbeek, 1954) were brought by dredges, beam trawls or even bottom plankton nets instead of the ground-collector, whereas occurrence of smaller gravel was mentioned in some sediment descriptions. These cobbles were found in repositories of both biological (as substratum to attached species) and petrographic collections. It rapidly appeared that "gravel" comprises fragments of different sizes and natures (from small rounded flint pebbles to larger granite fragments), as outlined in Verbeek (1954). Gravel areas can thus not be identified solely on the basis of sediment descriptions, because the "ground-collector" is not accurate for the collection of such large fragments (see annex 1, section 2.2.). We therefore mapped all "stone" occurrences from both sediment descriptions and cobbles stored in collections to identify the distribution of "gravel". The average geographic position (average between start and end points) was considered to map samples obtained from towed instruments (dredge, trawls). Gravel areas were manually drawn on the basis of oberved occurrences.

#### *3.1.1.3 Epibenthos information digitization and processing*

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Gilson's procedure to benthos sample processing is detailed in Gilson (1900). After collection, bulk sample was kept in formalin and brought back to the laboratory. Gilson noted species he could identify himself on field log-books. We could not find them back so far, but summary sheets with draft-like species lists have been recovered in archives of the RBINS in the course of this project, where a large proportion of information is provided at a high taxonomic level (family, order of classis). These will be used at a later stage to control overall content of Gilson's samples. The sample was then transferred to alcohol and sorted out according to taxonomy to provide raw "lots" to be dispatched to group specialists for species determinations.

Up to about the 1940s, handling, identification and storage of specimens resulting from various "explorations" of the RBINS were carried out based on a well-defined procedure implemented by Gilson when he was Director. After the Second World War, it seems that this procedure was not followed anymore for all groups. In particular, taxonomic revisions were not systematically recorded in separate registers anymore. On the other hand, a serious amount of samples are still undetermined and are consequently not listed in the registers. As a consequence, the species registers are not up-to-date and it is necessary to examine labels of every jar to know who made a determination or a revision of the samples and when.

For some groups, it is therefore impossible to rely on species inventories as previously expected to estimate amounts of samples of every species in the collections and their taxonomic history. A remarkable exception to this is represented by the Crustaceans, for which species-based registers are representative of the collection content and could be fully used (although recent revisions cannot be considered unless specimens are examined individually).

The sub-samples are stored in jars (alcohol storage) or drawers (dry storage) according to taxonomy in different repositories (figure 3-2), together with their original sampling number. On examination of jars of sessile groups (Hydrozoa, Anthozoa, Bryozoa, Porifera), it appeared that many species can be found in the same jar, either as substratum or e.g. colonizer to the flagship" species used for storing purposes (e.g. samples of oysters stored with Ascidians, of which some specimens were found to colonize the bivalve). This means that a serious amount of specimens of various species might be "hidden" because they are stored in a different repository than their conspecifics. As a consequence, it is impossible to build exhaustive species inventory for every sample unless the whole collection is digitized. Another serious practical obstacle to a fast and accurate inventory of the collection content is the frequent usage of large containers to regroup jars from different samples based on species (sometimes up to 100).


Figure 3-2 : A typical row of a RBINS repository for invertebrates preserved in alcohol or formalin.

The taxonomic upgrade represents a challenge as well. Indeed, the taxonomy of many groups has considerably evolved since earliest determinations: phylogenetic linkage, species discrimination criteria, synonymy, etc. It would be unrealistic to consider true taxonomic revisions in the framework of a set-term, management-oriented research project. Indeed, many species are hard to identify for the non-specialist, while specialists are hardly available for such a large revision operation. However, specialists know where difficulties can be expected within a list of species. The substratum (e.g. bivalve shell or stone), the locality (e.g. offshore or estuarine water) and the "taxonomic history" (i.e. successive revisions and their authors) are important features to help a specialist propose a diagnostic based on a species list.

Once a group was considered as completely digitized, the species list was made together with any useful information (e.g. taxonomic history, substrata, locality comment, etc.). A first upgrade of species names was made where possible, using various sources of information, at the lowest taxonomic level possible, taking into account recent evolution of the taxonomy of the group. "Current names" were given accordingly to the nomenclature of the European Register of Marine Species (Costello et al, 2004; versions 2005 and 2006).

Where possible, the file was then submitted to an expert taxonomist to accept or reject the species names. Bryozoans are a major exception: for this group, a full revision of specimens was performed by H. De Blauwe (see De Blauwe et al, 2006). However, digitization of jars from other repositories (e.g. Hydrozoa) revealed that a serious amount of additional, yet unrecorded specimens of bryozoans existed outside the dedicated repository. In order to avoid another time-consuming revision process, H. De Blauwe used the species list and determinator's name recorded in the data-base to accept, upgrade or reject the species names.

A further criterion to accept or reject a species for subsequent analysis is its living habits. We target "epibenthic" species which are representative of dredge samples. Therefore, endobenthic, hyperbenthic and planktonic species were excluded. For these species, taxonomic upgrade was not carried out (see annex 2).

**Digitization strategy**

For all attached species (mainly Bryozoans, Hydrozoans, Anthozoans and Porifera), an exhaustive inventory of the physical collection of specimens within a dedicated database was necessary for reasons mentioned above. This work was carried out though designing a project-oriented "collection-management" database, taking into account the specificities of the Gilson's collection[1]. It was not possible to carry out the necessary "production" steps to implement this tool in the framework of this set-term project, given the level of complexity that it had to deal with, and it has thus remained in a quite primitive status. However, it enabled us to extract the target information (e.g. status of old shells encountered (fresh or old), presence of species not registered, etc).

Crustaceans (amphipods excepted) and pycnogonids were considered through separate digitization of species-based inventories, since these are in full agreement with collection content. The list of species was reviewed and

[1] Note. Since 2006, the RBINS has launched a collection database ("Darwin") in the framework of a federal digitization project (''DIGIT05, Belgian Federal Science), which is fed by a team of dedicated encoders and is expected much facilitates data recording. The efforts made in the frame of this project to digitize Gilson's benthos data have enabled to enhance its architecture to store information about historic specimens. Further data are thus expected to be more readily acquired.

commented by C. d'Udekem d'Acoz, a recognized expert of decapods knowing the collections of the RBINS.

For molluscs, a species selection was performed to take into account epibenthic species. The list of neogastropods, built up and reviewed by H. van Loen (see van Loen et al., 2002), was used. However, the distinction between fresh and old shells in the dry collections was not clearly stated in this data-set, what hampers analysis on "live catches". Doubtful data were flagged for subsequent data selection. Further specimens found in other repositories were added to the list and fully documented. Other Gastropods – including Opisthobranchs - were digitised based on registers and quick inspection of stored material by the author. Opisthobranchs are currently reviewed by an amateur expert (A. Vanhaelen, RBINS research associate), but only a "taxonomic update" could be carried out so far.

Only some bivalves could be considered. The list of samples of common mussels was extracted from a former revision by L. Bruyndonkx and M. Caers (unpublished data). *Mytilus* was considered as one complex due to the unclear status of the two species *Mytilus edulis* and *M. galloprovincialis*. Additional specimens found in other repositories (as substratum for attached species) were taken into account as for Neogastropods. European flat oyster (*Ostrea edulis*) samples were fully digitized, including samples collected with other instruments, due to particular emphasis put on this species in this project. Specimens collected alive by Gilson were measured to the nearest mm using callipers and their associated epifauna was briefly described.

Other bivalve molluscs were not considered in this project because species-based registers appear to be much incomplete compared to the vast amounts of samples found in the collection, while many species are endobenthic and thus out of our scope. Furthermore, most of these samples are in the form of dry shells (either sub-fossil or fresh), which calls for investigations on specimen status at sampling (alive or empty shell). Their digitisation has been initiated in 2007.

Samples of Echinoderms were reviewed in 1999 – 2001 by van Loen, Caers and Bruyndonckx (unpublished data). The material resulting from their work has been used.

Ascidians and polychaete could not be considered in the time-frame.

Small benthic fishes such as dragonets (*Callionymus* sp.) or gobies (*Gobiidae*) could not be considered within the project. Indeed, samples are listed in registers, but they do not show the original sampling number, making it once again necessary to examine every jar. On the other hand, it was not possible to validate sampling information for beam trawls in the time-frame of this project. However, information compiled by Poll (1947) on the collection content is used to derive historic information on these species, which were collected in re-sampling operations conducted in 2005.

**Building-up the data-set**

The raw file resulting from overall digitization of considered collections ("Belgian" marine invertebrates except bivalves, annelids and amphipods) so far provided a total of 646 "taxa" (see annex 2) split into 18,560 taxa records, of which 15,617 are from Gilson.

From the bulk file, step-by-step extraction of data of Gilson was performed to provide an initial file for the target epibenthos analysis (see annex 2, columns "status for analysis" and "General selection coment"):

1. The bulk list of "taxa" was cleaned by removal of determinations at a taxonomic level higher than family, non-relevant taxa (e.g. planktonic, hyperbenthic, endobenthic or freshwater species) and non relevant objects (e.g. fossils). Taxa not considered in the digitization framework but occasionally encountered were generally removed from the initial file as well (e.g. Polychaeta such as *Lanice conchilega*) to avoid fuzzy bias in sample contents. Taxonomic updates were carried out with a focus on species considered for analyses.
2. Sampling numbers corresponding to dredge samples were extracted.
3. A classification was made to distinguish various levels of "freshness" at sampling in the stored molluscs. "Old" shells were removed from the data-set.
4. Two data-sets were created for subsequent analysis (see annex 2, last two columns). 1. A "broad" data-set includes molluscs with "unknown" shell status. 2. A "conservative" data-set was made by removal of all remaining suspect records of bivalves and gastropods (dry shells, except where obviously fresh). "Fresh" shells were assimilated to living organisms considering that they are indicative of either specimens which died shortly prior to sampling or alive specimens processed to be stored dry.
5. Specimen counts were considered for enumerable species. For colonial species and sponges, only presence/absence (values 1 or 0) was recorded as it is generally hard to distinguish full colonies from fragments. An exception to this procedure was made for the dead-man finger *Alcyonium digitatum* due to the well-individualized morphology of its colony. When more than one jar contained specimens of a species from the same station, the specimen counts were summed up except for colonial species.

The resulting files were processed to obtain a species by sample matrix on which multivariate analyses could be performed using the "Primer-E" suite (v6; Clarke and Gorley, 2006).

## Analyses

Basic biodiversity indices were calculated: species richness and "taxonomic distinctness" (Clarke and Warwick, 2001), and for mobile (enumerable) species, Shannon-weaver diversity and total specimen counts. Results obtained with Shannon-weaver and taxonomic distinctness indices are not displayed at this stage owing to doubts on their signification since further sample processing remains to carry out on certain taxa.

The specificity of the invertebrate epifauna collected in the Westhinder area as compared to the rest of the sampling grid was tested using large areas, displayed on figure 4-5, as factors against which multivariate analysis of species content was carried out. Multivariate ordination of all samples was attempted but proved difficult to interpret globally due to amounts of stations and species and the heterogeneity of sample content in coastal waters. Results were therefore presented with reference to aforementioned areas (average values).

In a second step, offshore stations were subjected to clustering in order to identify stations bearing similar species associations and to obtain a first list of characteristic species. Clusters were created and tested with the SIMPROF procedure for various data treatments, at species and genus levels: sessile and mobile species together (P/A transform); sessile species (P/A transform) and mobile species (observed abundance).

This procedure resulted in 6 different sets of clusters. For every set of clusters, the minimum distance at which SIMPROF procedure has indicated variance inside clusters statistically lower than distance between clusters (significance level set at $p<0.05$) was used to create group factors. These group factors were plot on MDS ordination of samples using zero-adjusted Bray-Curtiss similarity matrix (see Clarke et al, 2005). In general, high levels of heterogeneity were observed at this distance, making it difficult to identify clear patterns. Cluster trees were therefore examined at lower distances to track more general patterns and identify larger clusters of samples. The agreement with MDS plots was checked at different distance values until reaching a meaningful and interpretable broad view (i.e. meaningful groups with minor amounts of outliers). Obtained clusters were then examined, compared and integrated into one general, average pattern. The validity of these clusters, created partly with arbitrary decisions, was finally re-tested using ANOSIM permutation test.

For every average cluster, the frequency of occurrence of all species was then calculated (amount of stations where present / total amount of stations of the cluster). These frequencies of species occurrences represent the probability of occurrence of the species at a station of the considered clusters.

### 3.1.2 Review of historical literature

The historic literature of the 18th, 19th and 20th centuries was investigated with the aim to find additional information on gravel ground biodiversity, oyster bed distribution and herring spawning before and after onset of Gilson's survey. The primary goal of this literature review was to give the collection a context in order to evaluate its relevance as a "reference point" for the benthic fauna and to complete gaps in information since Gilson's survey.

### 3.1.3 Historic data mapping

A large part of the work carried out in the frame of this project consisted in spatial analysis of the historic situation. To that purpose, a GIS was used to combine the considered parameters on maps. However, background layers such as coastline, bathymetry, *etc* only exist in a digital format for the modern situation. Geo-referenced raster images were created for two ancient nautical charts (Stessels, 1866 and Urbain, 1909) upon which historic data could be superimposed and better interpreted. This has however not been possible due to obvious mistakes on these charts relatively to the position of the Noordhinder lightship and, subsequently, the position of the northern portion of the Westhinder sand bank (Houziaux, unpublished data: the northern part of the Westhinder sand bank is located two kilometer West to its real position on these maps, while the position of Flemish banks matches the modern bathymetry).

Gilson, on the contrary, obviously positioned his samples accurately in this area, and we thus observe a discrepancy between Gilson's data and the position of the Westhinder sand bank on historic nautical charts. We therefore decided to use of modern digital background data from the Flemish Hydrographic Services, obtained on the website of the MUMM data center (www.mumm.ac.be/datacentre), for mapping purposes.

## *3.2 Re-sampling selected stations of G. Gilson*

Re-sampling cruises took place onboard the R/V Belgica during campaigns 2004/25b (November 2004; tests), 2005/14 and 2005/15 (June 2005).

Based on preliminary investigations in the collections, a series of Gilson's dredge tracks were selected in the Westhinder bank area where targeted re-sampling took place. The selection of station was based on benthic species richness and taxonomic breadth, presence of alive specimens of the European flat oyster (*Ostrea edulis*) and occurrence of cobbles.

A multi-disciplinary assessment of the seafloor was carried out at these stations based on existing guidelines (Brown et al, 2001; Boyd, 2002). Firstly, the local epifauna was sampled with a two-meter beam trawl to compare with Gilson's epibenthos samples. Secondly, based on experienced gained during surveys of the Fund for Sand Extraction (Roche, 2002), the stations were surveyed with a multibeam echosounder permanently available onboard the R/V Belgica. Thirdly, the marine landscape was investigated through underwater video recordings by the team investigating biodiversity of shipwrecks (see Mallefet et al, 2007).

### 3.2.1 Epifauna sampling

Despite questions on efficiency of Gilson's dredge, which call for tests with a reconstructed identical dredge, we considered that the use of an instrument compatible with modern standards was essential. Major large-scale investigations of epibenthos of the North Sea used a 2m beam trawl (*e.g.* Dyer et al., 1983; Kaiser et al., 1994; Jennings et al., 1999; Zühlke et al., 2001; Callaway et al., 2002); they all pointed at a lower species diversity in the (sandy and shallow) southern bight as compared to more northern (deeper) areas, but none of them included stations south of 52°N. On the other hand, point sampling instruments such as the "Raillier du Baty" dredge have proved efficient to sample "stony" grounds quantitatively in the neighbour French waters (Prygiel et al, 1988; Alizier, 2005; Foveau, 2005), but we considered point sampling inaccurate to achieve faunistic comparisons with historical samples obtained with a dredge towed on a distance of one nautical mile (1852 meter). Based on Jennings et al. (1999), Brown et al. (2001) and Callaway et al (2002), we decided to consider use of a robust 2m beam trawl equipped with a chain-matrix in order to re-sample these coarse grounds where large fragments were expected to occur (figure 3-3).

Figure 3-3. 2m beam trawl on rear deck of the R/V Belgica, spring 2005. Photograph : M. Fettweis, MUMM.

The instrument was built at the Vlaamse Visserij Cooperative (Oostende workshop). Its frame is more robust and heavier than the instrument used by Jennings et al. (1999). The dimensions of the chain-matrix are those described by Jennings (1999). Two nets were attached to the frame. An outer robust net (80mm mesh) was equipped with belly protection. The choice of an inner net was more problematic. Knotless 5 mm nets were not available. Knotless 3 mm nets were considered as too fragile to resist to abrasion by expected cobbles. We have therefore chosen a more robust 10 mm mesh net.

The net structure differs from that of Jennings et al. (1999). Indeed, the latter is based on a British standard which is much shorter than those used by Belgian fishermen (H. Goutsmit, personal communication). It is likely that a deeper net will be more efficient (especially when collecting large fragments) and we decided on the Belgian typical standard structure adapted to the 2-meter frame.

### *3.2.1.1 Re-sampling strategy*

The standard tow distance of Gilson is very long (one nautical mile, 1852 m). Jennings et al. (1999) suggested to limit tow length to 100 meters to obtain a representative but manageable sample size with a two meter beam trawl. On the other hand, Gilson's geo-referencing precision reaches and probably sometimes exceeds 100-200m.

At selected stations, we consequently defined areas around Gilson's theoretical tow position with rectangles of 400m * 2000m (figure 3-4). Within each area, 4 tows of 500 meter were carried out, as much as possible fishing against tidal currents. Towing speed varied between 1 and 2 knots.

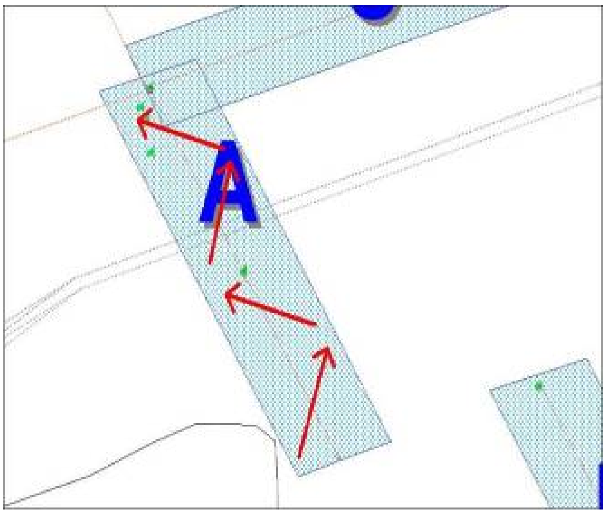

Figure 3-4. Re-sampling strategy with the two-meter beam trawl : an area is drawn 200m on each side of theoretical position of a dredge tow of Gilson (red dotted line). Four 500 m long tracks (red arrows) are carried out with the 2m beam trawl within this area.

A first series of tests could be performed onboard the R/V Belgica in November 2004 (campaign 2004 / 25b). The results (5 samples located North to the Westhinder sand bank; figure 3-5, left) were satisfactory (manageable sample size, fair amount of cobbles and epibenthos) and the procedure was therefore kept for campaigns of June.

### *3.2.1.2 Sampling operations: June 2005*

Sampling was performed during R/V Belgica campaigns 2005/14 and 2005/15 (June 2005). A total of 58 samples were collected from 14 of the initially 17 planned stations (figure 3-5; see Annex 5 and Annex 6 for sampling details). Minor damages to the inner net occurred in the last samples, with serious damage to the outer net in the very last samples. This demonstrates the practical adequacy of this instrument for these "rough" grounds.

UTC time was manually recorded at the release and haul of the beam trawl. The ODAS datafile of the campaigns (Satellite geo-positioning of the Belgica recorded every 10 seconds) was obtained from MUMM and the recorded times were used to geo-reference the tracks. These show a typical signature on the Belgica track as the ship reduced its speed in order to be in the range 1-2 knot at the time of sampling, which ascertains most of the length of the tracks. The approximative length of every track was determined using the position of the vessels (ODAS datafile) at start and end times (see annex 5). During campaign 15, a part of the samples were collected with chain-matrix wrongly mounted: it did not efficiently cover net entrance, which resulted in collection of a very large boulder (length > 1 meter).

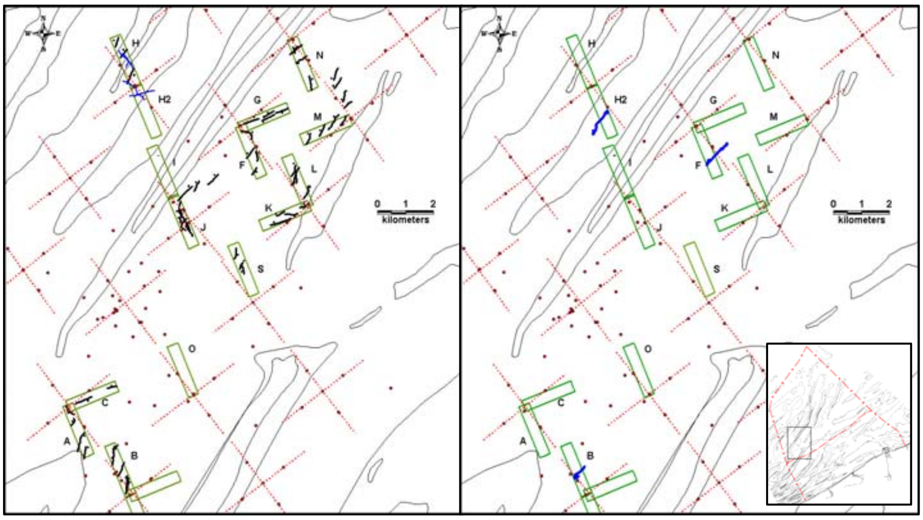


Figure 3-5. Map of target sampling areas, Belgica campaigns 2005/14 and 2005/15, June 2005. Background: theoretical position of Gilson's dredge tracks (red lines : theoretical tracks of the "exploration cruciale" as displayed on figure 3-1; red points: median points of all tows carried out, including additional samples to the regular programme) and areas surveyed with the multibeam echosounder (green frames; frame "S" was finally not surveyed). Left: black lines: 2 m beam trawl sample tracks, june 2005. Blue lines: test tracks, campaign 2004/25b, November 2004. Right: tracks of scuba-operated video transects (blue lines). The shift between original dredge tracks of Gilson and designated re-sampling areas is due to late detection of an error in the geographic positioning of Gilson's samples (see text).

The sampling areas were fixed with reference to positions of Gilson's dredge tracks as available in spring 2005. Theses positions were assigned using the position of the cross center (accurately determined and documented in most cases) and indications by Gilson on the azimut used to draw the arms and the length of tows (one nautical mile). However, since then, these positions were corrected due to a confusion in the azimut of the arms, made visible through use of a geo-referenced raster image of the original sampling map of Gilson (figure 3-1). This adjustement resulted in a slight shift for most areas apparent on figure 3-5 (survey areas are not exactly matching Gilson's dredge tracks). One cross sampling has however significantly moved after correction (erroneous position of the center), what imposed a specific treatment for long-term comparison purposes in the zones I (on the sand bank; no new sample taken) and J (different dredge tracks constitute the basis for long-term comparisons).

The 2m beam trawl samples (as well as the scuba-operated video footages) were acquired prior to multibeam echosounder data processing (blind sampling).

#### *3.2.1.3 Sample processing and storage*

The full sample was processed except on some occasions when sample volume (bulk of cobbles) exceeded staff capabilities; in these cases, cobbles were counted and photographed and a sub-sample was taken. The initially set-up procedure was to sieve the sample content on 5mm and 1mm sieves; this task could however not be achieved due to sample volumes and sampling rythm (size of sampling windows during Belgica cruises: 2 or 4 hours, with 2 tows carried out per hour), and whole samples were therefore finally processed.

Cobbles were put apart in seawater, whereas the remainder of the sample (mobile species and detached sessile species) was fixed in 4 % formalin. Large cobbles were rinsed to collect small mobile species in a sieve (0.5 mm aperture) and were stored apart for subsequent examination. Given time-windows allocated to our operations and the volume of certain samples, we were not able to perform quick determinations and specimen counts, and therefore decided to immediately fix whole samples. Anaesthesia of certain taxa (e.g. sea anemones) with $MgCl2$ prior to fixation was planned to ensure subsequent accurate determinations, but it could only be carried out on few occasions. At the end of each sampling window, the cobbles stored apart in seawater were examined. Their epibenthic cover was removed manually and fixed in formalin. The water used to store them was then sieved (0.5 mm aperture) to further collect small associated species.

Given the amount of cobbles collected (much higher than expected based on november 2004 tests), we discarded most of them but kept some representative samples to build a reference collection upon which further analyses will be possible. After the campaigns, biological samples were transferred from formalin to ethanol.

Only a part of the samples could be processed within the time-frame of this project. Pre-sorting has been carried out for 40 samples. 18 samples were screened to build species lists, with approximative specimen counts for conspicuous and abundant species, while 13 were fully processed. Size measurements were carried out for *Asterias rubens* (length of the largest arm) and *Psammechinus miliaris* (test diameter) using callipers at the nearer mm on a part of the material.

### 3.2.2 Multibeam echosounding

Fourteen frames (2049 hectares; figure 3-5) have been surveyed using a Kongsberg Simrad EM1002 multibeam echosounder. The EM1002 provides 111 beams and works at a nominal frequency of 95 kHz. The data are corrected real-time for the roll, pitch and heave using a Seatex MRU 5 motion sensor. Heading is provided by an Anschütz Standard 20 gyrocompass. The positioning system is a Thales Aquarius 02 DGPS. The soundings are tide-corrected using the specific tidal reduction for the Belgian coastal zone and referenced to the level of mean lowest low water at springtide (MLLWS).

The backscatter intensities recorded by the EM1002 (dB corrected backscatter values time-series for each beam) were processed with a specific software, "Poseidon" (© Kongsberg Simrad, 2001), which mosaics the backscatter values and produces a grid of the backscatter strength expressed in dB (seabed map). Maps of backscatter superimposed on seafloor morphology were produced for every sampling frame. The software "Triton" (© Kongsberg Simrad, 2003) was used for the supervised classification, which was performed for a few frames only. The 5 classes used in this study have been defined on the Kwinte sand bank area (Roche, 2002; see table 4-I, page 85). They are representative of the main types of sediment observed offshore on the Belgian Continental Shelf so far. Roughly, class 1 represents the gravels, classes 2 and 5 characterize the coarse to medium sands, class 3 is more variable and represents bioturbated muddy sands to sandy gravels, and class 4 corresponds to the fine sands.

### 3.2.3 Scuba-operated underwater video footages

Geo- and time-referenced video recordings were acquired with methods adapted from Munro, 2001 by the team of the parallel project "BeWreMaBi" (Mallefet et al, 2007) on zones F, H2 and B (figure 3-5, right) during the 2005/14 cruise. Additional dives were conducted in September 2005 at zone "F" under conditions of poor visibility. Scuba techniques were chosen because this site is accessible to divers (depth 30-35 m, occasional conditions of good visibility) and because additional measurements (sand layer thickness) and targeted sampling (cobbles) can be carried out. First tests carried out with a video-camera operated vertically from the Belgica were considered inaccurate in the frame of this project to visualize the "seascape" and investigate the biotope. Transects were preferred to such small-scale vertical profiles given the expected high heterogeneity of the seafloor. A digital camera recorder (Sony PC 330, 3.2 Mpix) in a Light and Motion Mako housing was used. The images were geo-referenced using DGPS track data (Garmin GPSMAP76s) of a surface marker towed by a diver. The resulting positioning error is estimated to be of +/- 10m. A video-track of approximately 700 meter (60 min) was acquired on each zone by two successive teams of three scientific divers.

Data resulting from underwater video surveys were used qualitatively at this stage of the research.

#### 3.2.4 Long-term analysis of epibenthos composition

Due to incomplete status of both historic and modern epibenthic data-sets, it was not possible to carry out in-depth long-term analysis. However, sufficient data were collected to provide a preliminary analysis.

Three assumptions are made prior to data processing. Firstly, we consider that the material stored at the RBINS is the whole catch for invertebrate benthos collected with the dredge. The assumption is based upon the fact that Gilson's explicitly stated that he kept the full catch (Gilson, 1900), whereas we have indeed some cases of exceptional species abundances. Secondly, the dredge of Gilson provided non quantitative results, but the probability of catch of a given species is dependent upon some biological traits (swimming abilities, size and trend to aggregation) and abundance in the sampled area. Thus, the frequency of occurrence of a given species within a given area can be indicative of its abundance in the area, provided enough samples are collected and the spectrum of considered species is adequately defined (see section 3.1.1.3.). Thirdly, the dredge of Gilson is less efficient than the 2m beam trawl due to its small size and its light weight (although the towing cable was equipped with lead weights in front of the instrument, see annex 1), whereas both instruments should be considered "semi-quantitative". It seems likely that the collecting bag oF Gilson's dredge was quickly filled up with pebbles and cobbles, but examination of available comments by Gilson provided no information on this question so far. On the other hand, only cobbles smaller than 20 cm could be collected by his gear

In the survey of 2005, species lists were built-up for 31 samples distributed throughout the survey area in various biotopes (sand banks, gullies and intermediate zones; figure 3-6 and annex 8). The total surface covered by these samples amounts at about 29,548 square meters. In 13 samples, specimen counts were carried out. Where possible, an estimate was made for abundant species in the remaining 18 samples (visual inspection). Nearly all samples were photographed during the survey, and remaining samples were visually inspected onboard. At this stage, we can thus calculate average frequencies of occurrence and densities of selected species in the 31 samples considered and state whether the obtained figures are likely to change when further sample processing will be carried out. To calculate frequencies of occurrence, data were transformed to presence/absence. Where counts were performed, the density (n/square meter) was calculated with reference to trawled surface (tow length * 2). Average density and standard deviation were determined for the survey area. Results were expressed as number of specimens per 100 square meters.

The 26 samples of Gilson collected in the area surveyed in 2005 were selected and frequencies of occurrence were calculated after original data (annex 7) were transformed to presence/absence. Densities were calculated for enumerable species using a reference area of 1481.6 square meters (1852*0.8 m) and results were expressed as number of specimens per 100 square meters. The surveyed surface thus amounts at about 38,522 square meters. In order to account for expected lower gear efficiency, we further adjusted densities by multiplying them by a factor 10. Average densities were then calculated for the entire area for both data-sets (raw and adjusted).

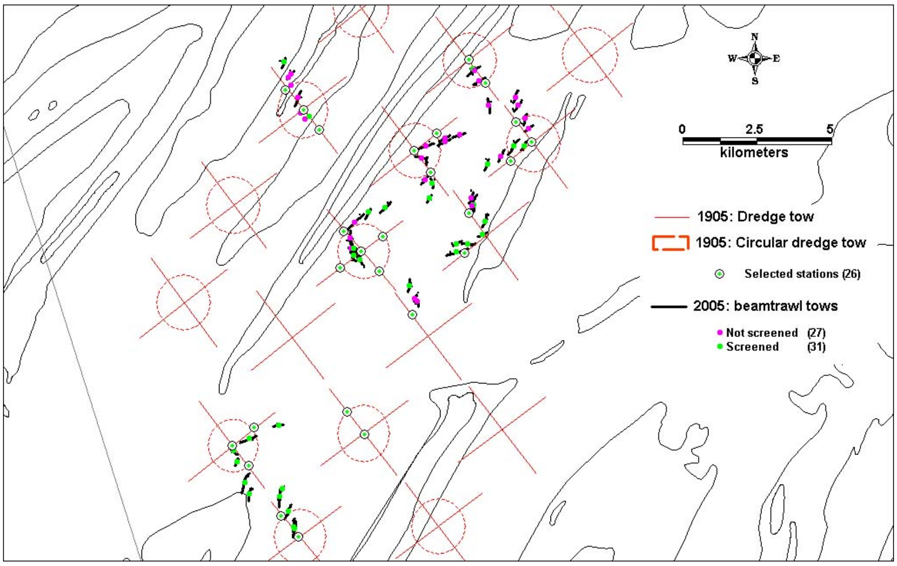


Figure 3-6: Distribution of samples selected for preliminary long-term analysis in the historic and new surveys (green dots, median position of the tow).

# 4 Results and discussion

## *4.1 Reconstruction of the sedimentary environment of the Belgian part of the North Sea, years 1899 - 1910*

### 4.1.1 Sediment thematic maps

The following maps were drawn on the basis of visual description of sediments brought onboard by Gilson. This description-based approach imposes a case-to-case examination of considered parameters, since we have so far not been able to estimate the relative proportions of each constituent in all samples. The "values" hereafter mapped must thus be considered as "relative" rather than "absolute" values. The approach we propose is to perform spatial analysis in the historic data-set to identify the relative expression of sediment parameters across the sampled area. In a second step, the maps obtained for individual parameters are superimposed to obtain a general map of sediments in front of Belgian shores. From the latter, areas where long-term changes are most likely to have occurred based on modern data can be identified, provided the latter are treated following the same approach.

#### *4.1.1.1 Sand grain-size*

Given the nature of data used (extrapolation from verbose categories) and low amount of control samples used so far, the map of sand grain-size (figure 4-1) must be interpreted with care. At this stage, areas dominated by "fine" (<200µm) and "coarse" (> 300µm) can be considered as significantly different, but the two intermediate categories created to reflect a gradient of "coarseness" between the two extremes are less clear. On the large-scale, the interval 200-250µm should reflect finer sediments and the interval 250-300 should reflect coarser sands indeed, but local imprecisions are expected to occur. The usefulness of this map lays mainly in the identification of areas deserving further investigations in specific long-term analyses.

The use of "non conventional" categories (compared to the generally used Uden-Wentworth scale: 63-250 µm = "fine sands", 250-500 µm = "medium" sands; Tucker, 1998) enables to observe specific patterns which would otherwise not be detected (e.g. the strip of finer sand on the Oosthinder sand bank). The limit of 250 µm generally used to discriminate "fine" from "medium" grain-size cannot be applied to our historic data.

In coastal waters between Oostende and Zeebrugge, estimates of average sand grain-size cannot be mapped due to low amount of samples with information on sand grain-size. This is due to the larger mud content of samples within this area (see figure 4-2). They have been left blank accordingly.

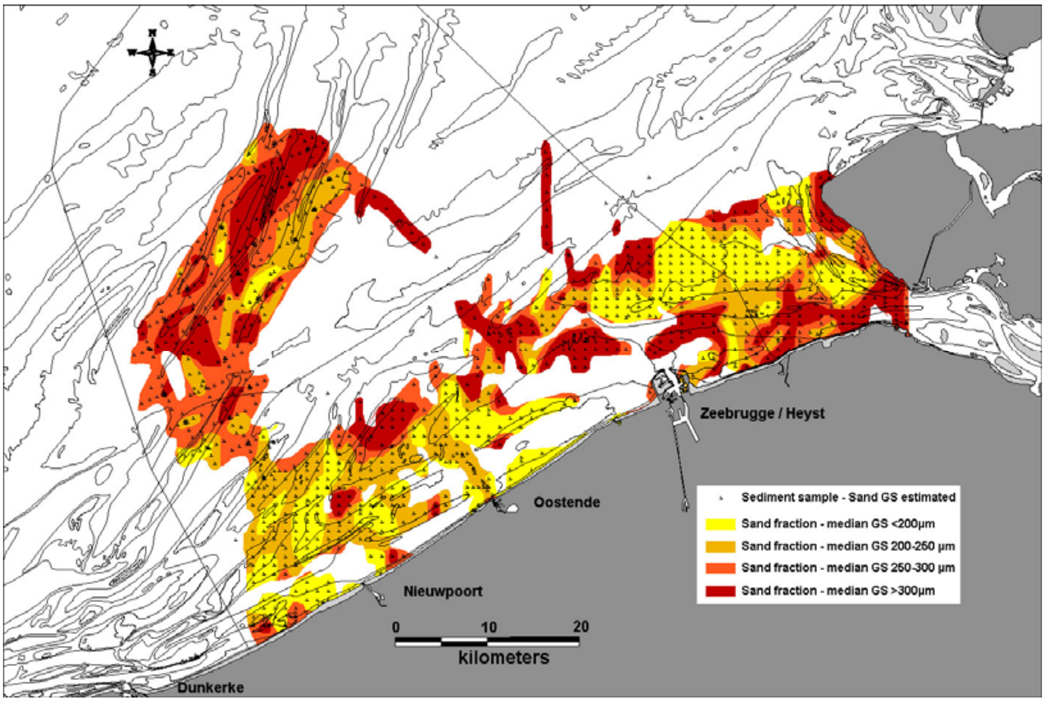


Figure 4-1. Distribution of sand median grain-size values calculated from Gilson's sand grain-size estimates (see material and methods for details). Only stations at which information on sand grain-size are considered. The map is based upon an interpolation of average sand median grain-sizes (Average Distance Weighting) using 4 major categories reflecting Gilson's verbose categories. Sands finer than 200µm correspond to "fine" sands, sands coarser than 300µm were described as "coarse" sands. Between 200µm and 300µm, sand is described as "medium" under different categories ("rather fine sand", "medium sand" or "rather coarse sand") which display a significant gradient of coarsening but are not significantly different from every other using pairwise non-parametric statistical tests. The interval was split at 250 µm to reflect the probability that samples display trends toward finer (200-250µ) or coarser (250-300µm) grain-sizes.

On the large-scale, the map of sand grain-size built upon Gilson's descriptions is relatively consistent with available recent information of the Belgian Continental Shelf (e.g. Lanckneus et al., 2004), with on average a coarsening of grain-size toward offshore (figure 4-1).

A strip of coarser sand is visible approximately from the Akkaert sand bank (see figure 2-1) to the Schelde mouth. A large patch of "fine" sand is visible on the area North and East to the Vlakte van de Raan (around the Dutch border). Another interesting observation from the obtained map is the occurrence of a patch of true "fine" sand East to the kink of the Westhinder bank, which is part of larger strip of finer sand more on the northern part of the Oosthinder bank. This observation matches a recent map of the kink area (Deleu, 2002).

This map must now be compared to recent maps based on grain-size analyses in order to:

1. Define the limits of the defined method for conversion of descriptions into grain-size categories (notably perform additional grain-size analyses on available samples).

2. Identify areas where long-term changes in sand coarseness might have occurred.

#### *4.1.1.2 Relative "mud contents"*

Mud content estimates derived from Gilson's descriptions have been more particularly investigated in the context of the MOCHA project (Fettweis et al, 2007). See this report and Fettweis *et al* (submitted) for further details on mud content related data, long-term analyses and maps in coastal waters. The percentage given in figure 4-2 refers to the strict content in sand and mud, after retrieval of all other features (shells and gravel), and are thus not to be considered as "absolute" values (see material and methods). They are rather an indication of relative proportions of mud in the considered samples.

The high contents observed along the Eastern Belgian coast coincide with a turbidity maximum (Fettweis and Van den Eynde, 2003) likely to induce tidally-driven, more or less prolonged alternance of mud deposition and erosion processes. The area where such deposition/erosion occurs coincides with the area with mud contents above 20% (Fettweis et al, submitted). This configuration is likely to better explain the poor benthic richness of this zone than pollution from the Schelde river suggested in Cattrijsse and Vincx (2001), and we do not expect major long-term changes to have occurred in the area provided other environmental parameters (such as temperature) have remained similar. More to the East, a decrease in mud content is observed and can be expected to be mirrored by an increase of benthic richness.

A close-up on the southern portion of the Westhinder area indicates the occurrence of slight but significant amounts of mud as compared to the mud-free surroundings. These are of various natures according to Gilson's descriptions. Occurrence of tidally driven deposition ("fluffy" layers) is indicated by descriptions as "surficial (grey) mud" or "liquid (grey) mud". Mud mixed to sand is also mentioned as well as hard "pieces" of mud. The latter have been considered as "medium to highly consolidated muds" in Fettweis et al (2007). "Grey" muds could indicate occurrence of clay, but "black" consolidated mud is also mentioned in the descriptions, which is indicative of anaerobic degradation of organic matter and incompatible with tide-driven superficial deposition.

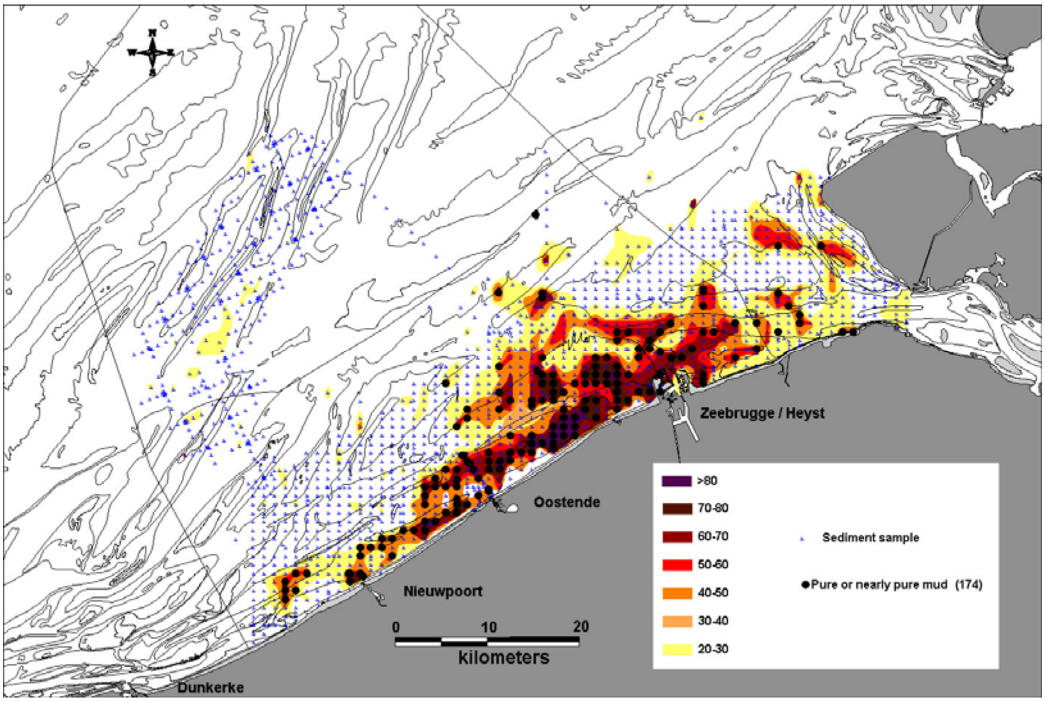


Figure 4-2. Distribution of mud content estimates (in %) derived from Gilson's description. The value represents the proportion of mud in the sand, all coarser elements being excluded (shell debris, shells, gravels). Therefore, the figures are exaggerated in comparisons with true "mud contents" and shouldn't be regarded as absolute figures. The map was drawn on the basis of an interpolation (Inverse Distance Weighting) of calculated mud content estimates. Stations where "pure mud" occurred according to Gilson's descriptions are superimposed on the interpolation map.

It thus seems that non negligible amounts of mud not originating from tidally driven deposition used to occur in the superficial sediment of this area. These occurrences are surprising and hardly explainable sedimentologicaly at this stage (V. Van Lancker and M. Fettweis, com.pers.). The observation might be related with the former occurrence of flat oyster beds in these surroundings (see section X), as dense oyster beds are known to considerably enrich the underneath seafloor.

#### *4.1.1.3 Shell and shell debris content*

To our knowledge, only one map of shell contents of sediments is available for the Belgian part of the North Sea (Gullentops et al, 1978). Despite the empiric nature of our approach, Gilson's data enable to locate areas with high shell contents with a great precision (figure 4-3). Many of these patches coincide with gravel grounds (see figure 4-4). In general, contents are low in coastal waters from Nieuwpoort to the Dutch border. A strip of medium to high contents is observed along the southern border of the navigation channel "Scheur", which were not yet artificially deepened by then. We expect that shingle patches will provide a particular microhabitat and thus substratum for a variety of species. On the other hand, high shell contents are likely to mirror local patches of high bivalve densities such as oyster beds (see section 4.3.2.). Species were however generally not provided in the sediment descriptions and data must be crossed with benthos content at corresponding dredge samples.

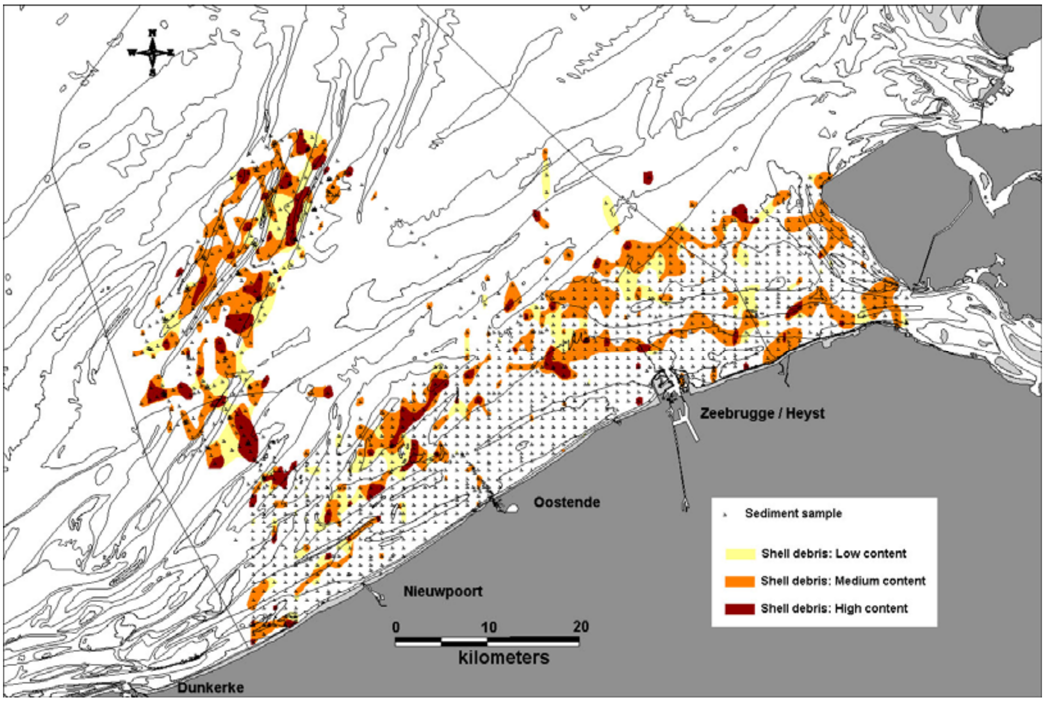


Figure 4-3. Distribution of shell and shell debris contents in the surface sediment according to Gilson's descriptions.

### *4.1.1.4 Gravels*

On the basis of Gilson's data, gravel areas appear to occur between offshore sand banks (figure 4-4) and their position matches fairly well modern data (see Van Lancker et al, 2007). However, the precision of gravel field delimitation is low at small-scale due to the use of transversal dredge tows (length: one nautical mile), what results in a probable exaggeration of effective surface covered by these coarse deposits (i.e. true gravel fields should be narrower than drawn) in the area of the Hinder banks.

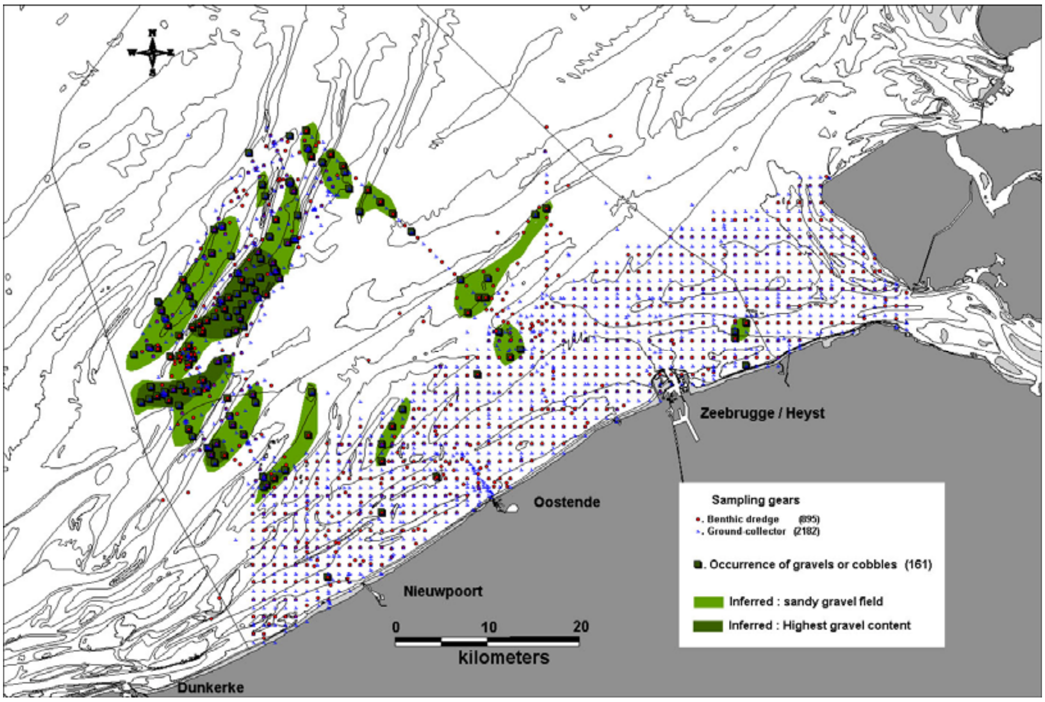


Figure 4-4. Distribution of gravel in the surface sediment, based on Gilson's sediment descriptions and occurrence of cobbles in towed gears (dredges and trawls). For the latter, the median position of the tow was used for mapping purposes. Gravel grounds were inferred and drawn manually (green). Areas where all samples gathered gravels or cobbles are highlighted in dark green.

Along the south-Eastern flank and near the southern tip of the Westhinder sand bank, all samples taken with the ground-collector and the dredge have brought gravel and cobbles. This suggests that the amount of cobbles at the surface of the sediment is maximum in these areas. However, figure 4-1 evidences the fact that sand was collected in the whole area, pointing at a sandy gravel field. Interestingly, finer sands were collected along the Oosthinder bank.

Gilson's data reveal existence of a gravel patch near the Dutch border, at a location nowadays artificially deepened for navigation purposes ("Scheur" channel). This gravel patch has thus disappeared.

As highlighted by Verbeek (1954), the nature and dimension of these fragments is highly variable. We have found broken fragments of about 30 cm in length, what tends to suggest that large cobbles do occur in the area, whereas granite, flintstone, limestone or sandstone, among others, are indeed found. This is consistent with results provided by Van Beneden (1883) and Renard (1886) regarding occurrence of a "strip of rounded cobbles". It can be questioned whether "gravel" is an appropriate term to describe such coarse and heterogeneous deposit, to which shingle patches are locally associated (see figure 4-3).

The historic data demonstrate that conventional grabs generally used to sample macrobenthos and sediments (Van Veen grabs as well as Hamon grabs) will not be accurate to characterize the invertebrate fauna in these surroundings due to fragment size, what certainly explains the lack of recent accurate data in this area. The "Raillier du Baty" dredge, thoroughly used in French waters (e.g. see Prygiel et al, 1988 or Alizier, 2005), is more appropriate.

#### 4.1.2 Integrated historic seafloor map

The main patterns obtained for sediment parameter were gathered on a composite map (figure 4-5). The map highlights the large heterogeneity of sediments in the considered area.

In order to summarize the principal seabed features in front of Belgian and Dutch coasts and to evaluate the specificities of the Westhinder area, large sub-zones were arbitrarily drawn in the Gilson's sampling grid (figure 4-5). Ideally, such a zonation should be made on a smaller-scale, taking into account local patterns of geo-morphology, but such a level of detail falls out of the purpose and time-frame of the project. For our goals, we have drawn areas taking into account general geomorphological units (e.g. the Flemish banks), distance to the shore and, where possible, amounts of samples available. For the "Central area / offshore" however, note that amount of samples is much smaller, and these were collected mainly along two transects. For this reason, results obtained in this area should not be generalized at this stage.

Data analysis was carried out to check whether the arbitrarily defined areas, although large and obviously heterogeneous, significantly differ from each other with respect to considered sediment parameters. On one hand, average values of sediment parameters were calculated for every area. On the other hand, the significance of apparent differences was tested using non-parametric multivariate statistics.

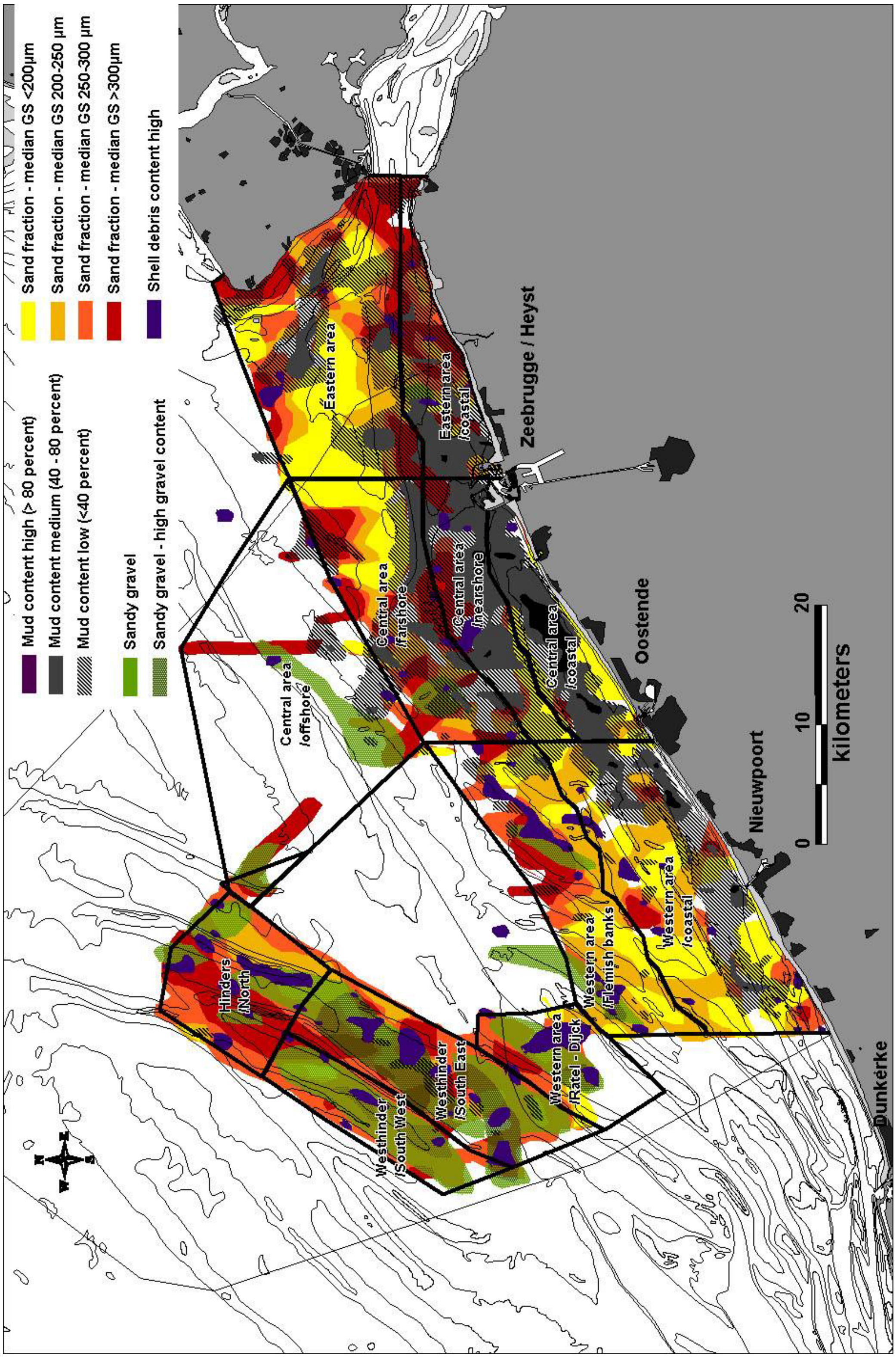


Figure 4-5. Composite map of sediment parameters derived from Gilson's descriptions. Arbitrarily defined sub-areas are superimposed to enable a preliminary characterization of trends in surface sediment composition within Gilson's sampling grid and further analysis of benthos data.

### 4.1.2.1 *Average patterns*

In front of the Western coast, sands increase offshore (figure 4-6). In the central part, the situation is more complicated, with finer sand close to the coast and on the "Vlakte van de Raan" in the "farshore" section.

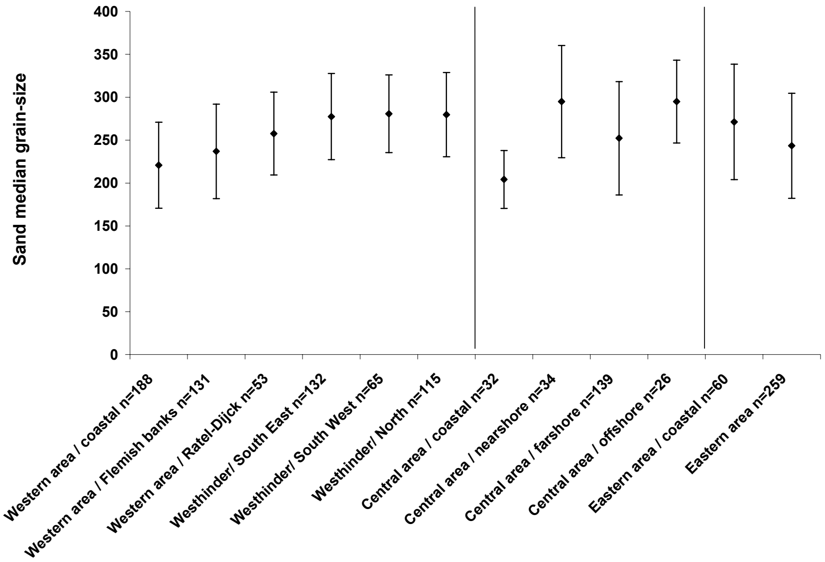


Figure 4-6. Mean values of estimated median sand-grain-size (µm) in the arbitrarily defined areas. Amounts of samples bearing sand grain-size values in every area are indicated. Error bars are Standard Deviation.

Owing to the arbitrary character of shell content categories, this parameter is highly variable within every area but increases offshore (figure 4-7), except in the Eastern portion of the grid.

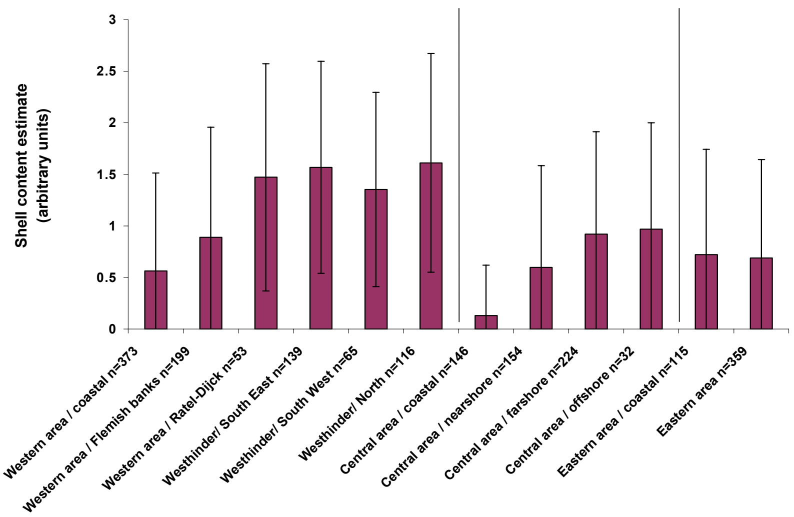


Figure 4-7. Mean values (arbitratry units: 1= "low"; 2="medium"; 3="high") of estimated shell and shell debris content in the arbitrarily defined areas. Amounts of samples bearing shell debris estimates in every area are indicated. Error bars are Standard Deviation.

Mud content displays a clear decreasing gradient toward offshore areas, with maximum mud contents found in the central and eastern coastal areas (figure 4-8). This distribution of mud contents is consistent with observation made more recently.

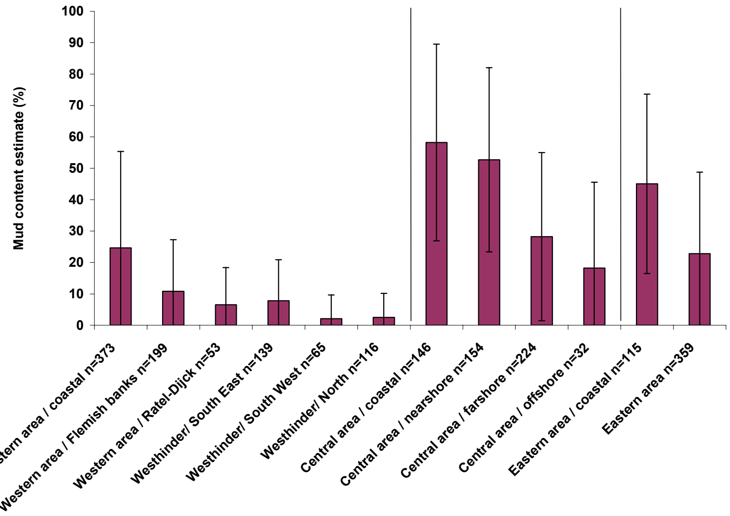


Figure 4-8. Mean values of estimated mud-to-sand ratio ("mud content", excluding coarser material from the analysis) in the arbitrarily defined areas. Amounts of samples bearing relative mud content estimates in every area are indicated. Error bars are Standard Deviation.

The average gravel content is indicated by a proxy, the proportion of samples in which gravel was present *according to sediment descriptions only* (e.g. gravels and cobbles collected with towed gears are not included in figure 4-9). It clearly shows that surface sediments of the Westhinder / South-East and Ratel-Dijck areas bear higher amounts of gravels, an observation consistent with figure 4-4 (in which towed sampling gears were included).

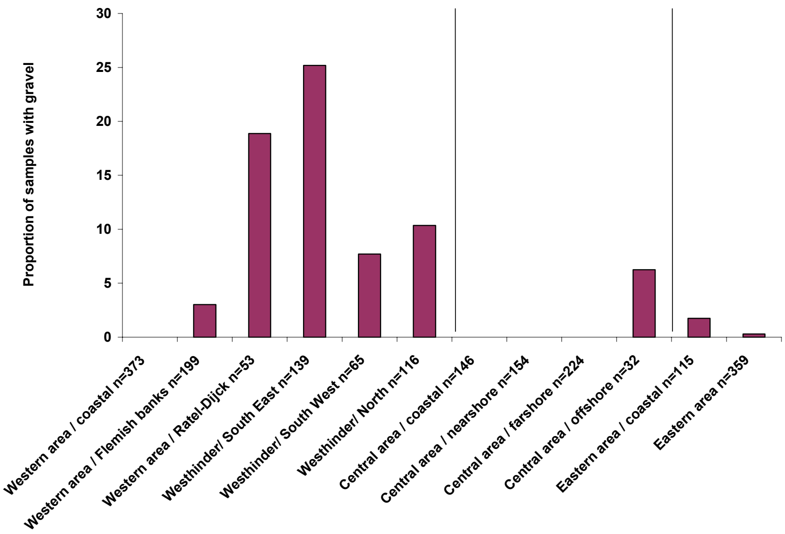


Figure 4-9. Proportions (%) of sediment samples described as containing gravel in every arbitrarily defined area.

### *4.1.2.2 Multivariate analyses of sediment parameters*

Our goal is to determine whether the Hinders area significantly differs from other areas in terms of seafloor composition. To that purpose, normalized values of sediment parameters were firstly averaged per area and submitted to a cluster analysis (Euclidean distance, group average; figure 4-10a). The Westhinder zones form a well-individualized group together with the Ratel-Dijck area, which can thus be viewed as part of the “Hinders” geographic unit. Results for the “central area / offshore” should be considered with care due to low amounts of samples. A multivariate ordination (MDS) of the Euclidean distances between areas was drawn (figure 4-10, b) as well as bubble plots of average values for every considered parameter (figure 4-10 c to f).

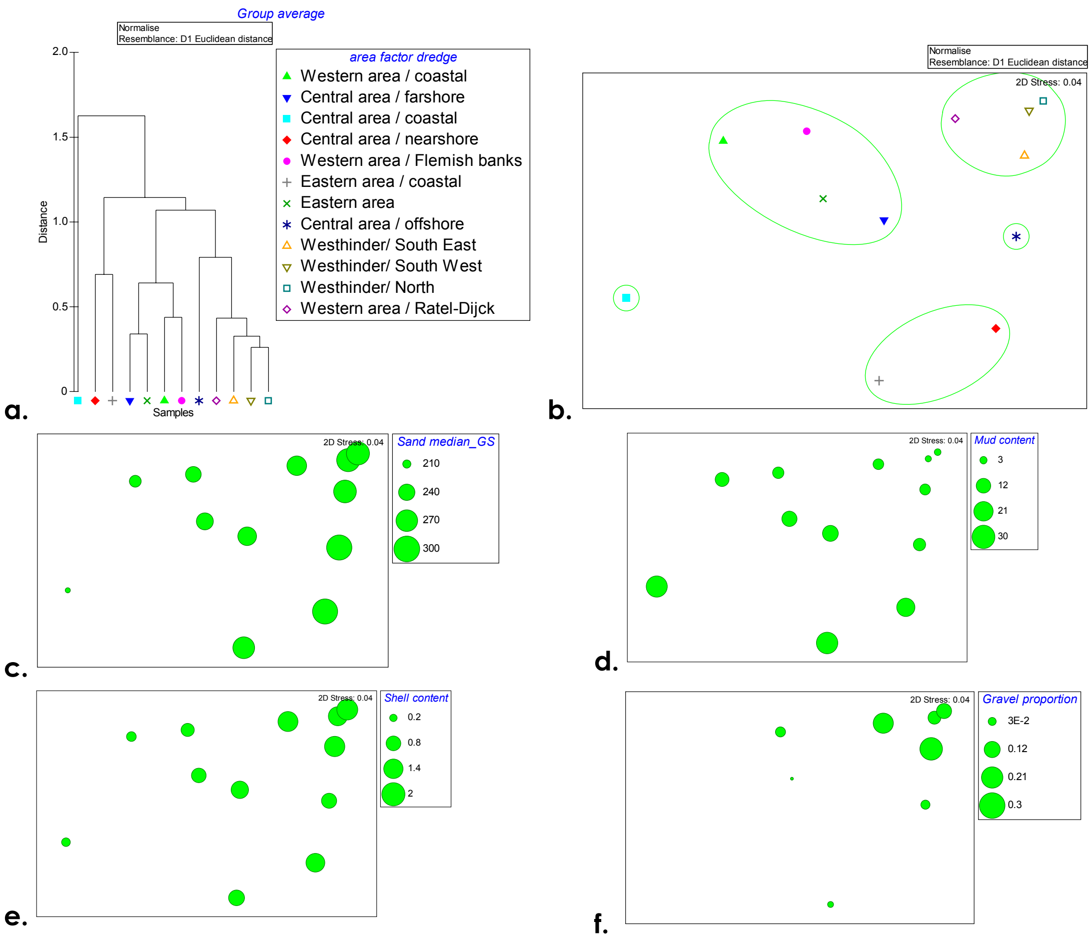


Figure 4-10. a. Clustering of areas (Euclidean distance; group-average clustering) based on averaged values of considered sediment parameters. b. Multi-Dimensional Scaling (MDS) ordination of areas with superimposed clusters (distance 0.7). c. Same MDS plot, with scaled bubbles representing average values of sand median grain-sizes (µm). d. Same MDS plot, with scaled bubbles representing average values of average mud contents (in %). e. Same MDS plot, with scaled bubbles representing average values of shell and shell debris contents (arbitrary units of quantity). f. Same MDS plot, with scaled bubbles representing proportions of sediment samples described as bearing gravels (excluding data obtained with towed gears).

To test whether the match between average sediment parameters and areas is statistically significant, an analysis of similarity was also performed on the initial data-set (resemblance matrix: Euclidean distance) using geographic areas as discriminant factor, and significance of observed differences was tested with a permutation test ("ANOSIM" ; Clarke and Warwick, 2001). Despite heterogeneity of values causing multivariate ordination patterns difficult to visually interpret on such large amount of stations (not illustrated), differences between areas are highly significant ($R=0.118$, $p<0.001$) and confirm ordination of average figures. Within the Hinders group, only differences between the Ratel/Dijck and respectively Westhinder/North and Westhinder / South West area are significant ($p<0.01$).

Although large, the areas arbitrarily drawn do reflect trends in seafloor composition matching most recent observations available (e.g. Van Lancker et al, 2007). These enable to separate the sampling grid of Gilson into four main groups for what regards sedimentology (excepting "central area / offshore", where too few samples were collected to be representative of the whole area):

1. The Westhinder area forms a well-individualized group of samples with on average higher shell content, much higher amounts of gravel, slight mud contents and contrasted sand median grain-sizes. The Ratel-Dijck area belongs to the Westhinder unit. In general, sand was collected in the ground collector at the gravel field, which is thus indicative of a sandy gravel field.
2. The coastal part of the central area is characterized by very high mud contents, quasi-absence of shells, absence of gravels and, where described, fine sands.
3. The nearshore part of central area and the coastal part of eastern areas are contiguous and are characterized by high mud content, higher but heterogeneous sand median grain-size and shell content, and quasi absence of gravels.
4. The coastal part of the Western area and the most coastal Flemish banks (e.g. Kwinte, Middelkerke) are more similar to the farshore part of central area and to the eastern area in that their proportions of muddy and gravel samples are low, while values of median sand grain-size and shell content are much variable but on average lower. Obviously, for these highly heterogeneous areas, intern subdivisions would be more appropriate to make accurate distinctions.

The results obtained on the seafloor nature suggests that significantly differing epibenthic communities can be expected to occur in the considered areas in agreement with the East-West and coast-open sea gradients highlighted by previous authors (see Cattrijsse and Vincx, 2001). Noticeably, these gradients coincide roughly with an increasing gradient of "Schelde influence" from the Northwest of the grid to the Schelde mouth, which probably also exerts an influence on the compostion of benthic communities. Further investigation on benthic communities and sediments should be carried out inside group 4 (Western coastal banks vs Eastern area), since relatively similar sediment conditions occur whereas different hydrologic regimes and amounts of Suspended Particulate Matter are likely to influence composition of benthic communities (relative influence of North Sea and Channel waters; Fettweis and Van den Eynde, 2003; Lacroix et al, 2004).

## *4.2 Epibenthic biodiversity patterns, years 1899-1910, and relationship with the habitat*

### 4.2.1 General patterns of invertebrate species diversity in considered taxa

A total of 364 taxa are so far considered as relevant for analyses based on dredge stations, of which 310 at the species level, 42 at the genus level and 12 at the family level. A small half of this amount is represented by taxa mostly represented by mobile species: arthropods (crustaceans and pycnogonids) and molluscs (mainly gastropods). Overall, the taxonomic breadth of Gilson's dredged material so far considered is large (figure 4-11), although important groups have yet been omitted (bulk of bivalves, amphipods and polychaetes).

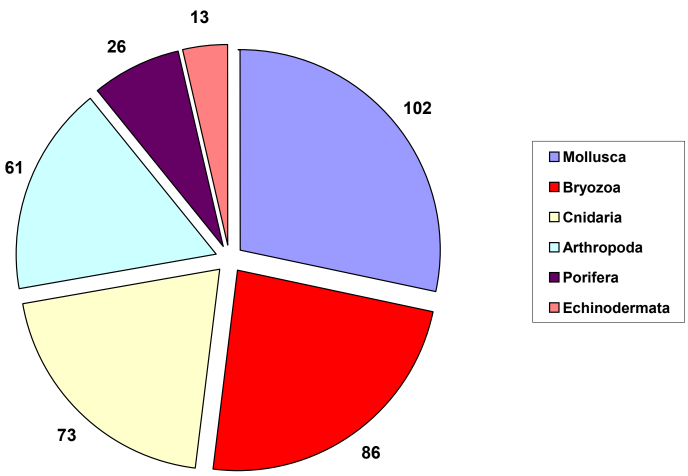


Figure 4-11. Overall taxonomic breadth of Gilson's epibenthic invertebrates so far considered (counts of valid species per phylum).

A large part of the observed taxonomic breadth is explained by inclusion of species typical of hard substrates (e.g. Porifera, Hydrozoa), which mostly originate from the sampling area of the Westhinder and Ratel-Dijck, as illustrated by the distribution of phyla richness accross previously defined sub-areas (figure 4-12). This figure is to compare with average sediment parameter values of the areas of figures 4-6 to 4-9.

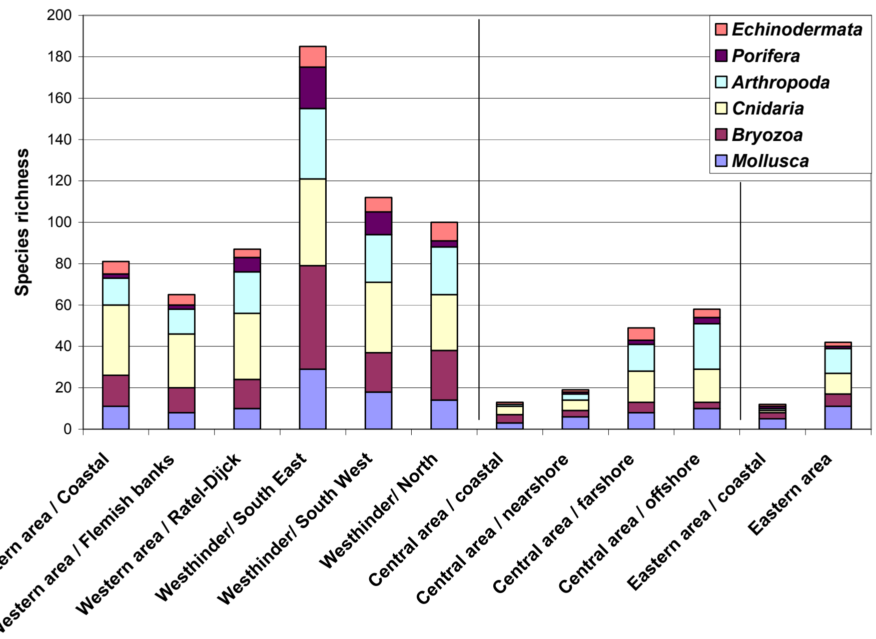


Figure 4-12. Overall species richness in the arbitrarily defined areas (see figure 4-5), ranked by phylum. Taxa determined at genus and family levels are not included.

The Western coast bears highest levels of epibenthic species richness, and species richness generally increases with distance from the shore in all areas. By contrast, the coastal areas between Oostende and the Schelde mouth clearly bear much lower values of species richness. The south-eastern flank of the Westhinder sand bank clearly appears as bearing highest and more even species richness for every phyla, with a minimum of 180 valid species recorded so far. If taxa determined at a higher level were to be included, 200 species would be surpassed. Considering that additional species are expected to be obtained once Bivalvia, Amphipods and Polychaeta will be considered, it is likely that the amount of strictly "epibenthic" invertebrates in this area can be expected to reach about 300 species.

### 4.2.2 Geographic distribution of epibenthic species richness

In the following maps, only stations considered as securely positioned relatively to each other are considered to avoid bias in the resulting maps (141 "suspect" stations omitted).

The distribution of species richness across the sampling grid (figure 4-13) indicates that areas where highest quantities of gravels were inferred from sediment parameters (see figure 4-4) host highest values of epibenthic species richness. The South-Eastern flank of Westhinder flank carries out the largest amount of samples with more than 20 species, which explains the higher species richness of the area as compared to all others (figure 4-12).

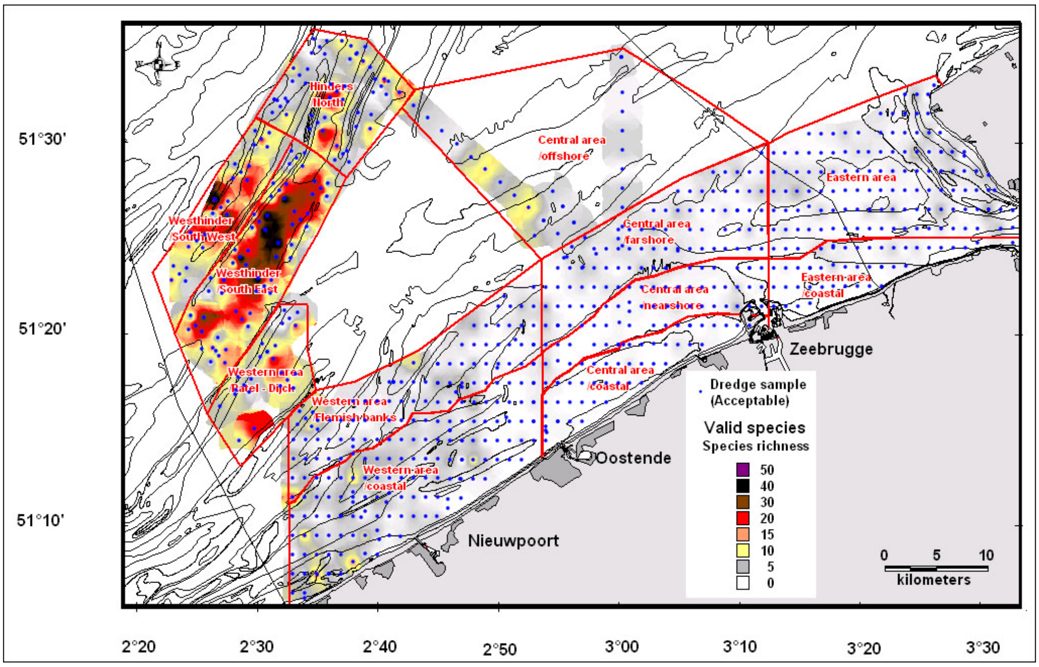


Figure 4-13. Interpolation map (Inverse Distance Weighting) of overall species richness values (valid species) at accurately geo-referenced dredge stations (blue dots; suspect positions were eliminated from analysis). Arbitrarily defined areas of figure 4-5 are superimposed on the map.

Fewer species-rich stations are found at gravel fiels along the western flank and between the Buiten Ratel and the Oostdijck sand banks. More to the North, only two patches of higher species richness remain. These observation remains true when data are aggregated at genus and family levels to incorporate specimens omitted at the species level (figure 4-14). As a consequence, long-term analyses using Gilson's data will be robust at genus or family level, and the variable levels of taxonomic precision will not significantly hamper conclusions.

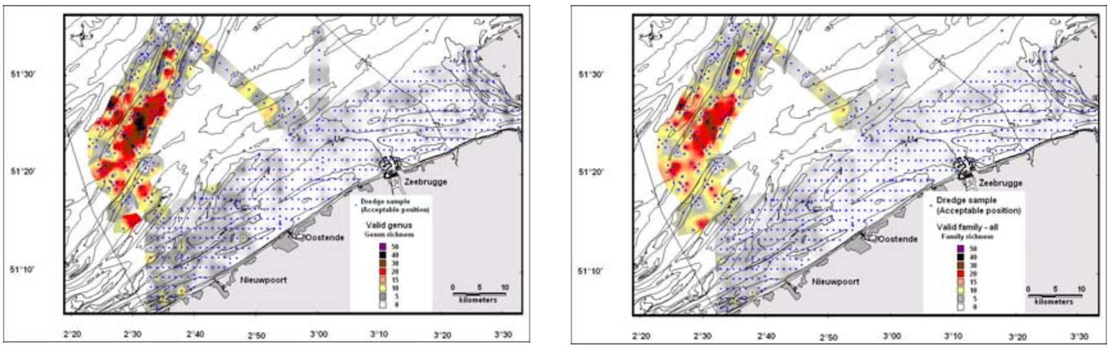


Figure 4-14. Interpolation maps (Inverse Distance Weighting) of taxon richness values at accurately geo-referenced dredge stations (suspect positions eliminated from the analysis). Left: valid Genera; right: valid Families.

When data are split between mobile and sessile taxa, two relatively different patterns appear (figure 4-15). Richness in sessile fauna is relatively spread across the gullies to the east and to the West of the Westhinder mainly. Mobile species richness seems to be more localized, with fewer neighbour stations bearing high richness values, mainly South and East to the Westhinder sand bank. This more localized occurrence of mobile species richness coincides well with areas where we inferred maximum cobble density at the surface of the seafloor (see figure 4-4).

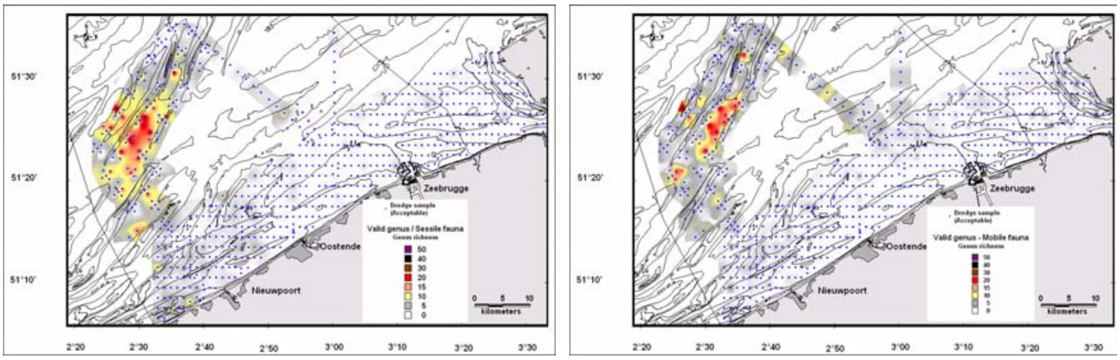


Figure 4-15. Interpolation maps (Inverse Distance Weighting) of species richness (taxonomic level: Genera) at accurately geo-referenced dredge stations (suspect positions eliminated from the analysis). Left: sessile taxa; right: mobile taxa.

A distribution map was further created for the total specimen counts of mobile species, where the same areas are highlighted (figure 4-16). Some other parts of the BCS seemingly host higher amounts of mobile epibenthic invertebrates. The coastal area roughly from Nieuwpoort to the Dutch border, which was highlighted as enriched with mud and is known to bear highest levels of turbidity (Fettweis and Van den Eynde, 2003), is nearly devoid of the considered epibenthic species. However, there is an increase in both specimen counts and species richness east to the Dutch border, especially along the northern coast of the Schelde mouth (surroundings of the Deurloo channel). This observation contradicts former suggestions that the eastern Belgian coast could be impoverished as a result of Schelde pollution (Cattrijsse and Vincx, 2001).

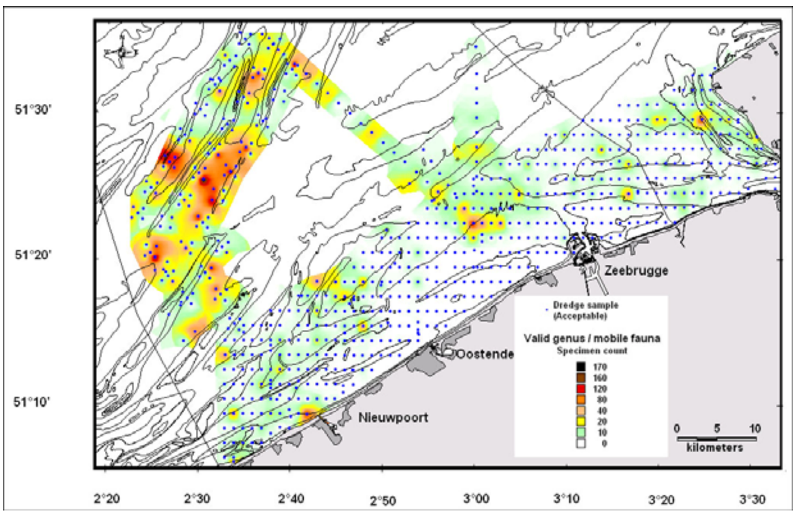


Figure 4-16. Interpolation map (Inverse Distance Weighting) of overall mobile specimen abundances at accurately geo-referenced dredge stations (suspect positions eliminated from the analysis).

Thus, the geographic distribution of basic biodiversity indices derived from Gilson's data clearly points at a specific pattern of epibenthos diversity and abundance along the south-eastern flank of the Westhinder sand bank. Attempts at using "taxonomic distincness" have been carried out but are not illustrated here because they do not bring aditional information, whereas further data processing (and species digitization) must be carried out to ensure accurate use of this indice on such a large amount of taxa. It is clear that gravels of the southern surroundings of the Westhinder sand bank host a much larger taxonomic breadth than any other area of Gilson's sampling grid. The southwestern flank and the gully between the Buiten Ratel and Oostdyck sand banks appear as bearing a similar but more spatially restricted gravel community, probably mirrored by a similar seafloor composition.

### 4.2.3 Multivariate analysis

Multivariate ordination of samples was performed at the level of valid species transformed to presence/absence data, using zero-adjusted and normal Bray-Curtiss similarity matrices. The same analyses at the genus level did not reveal major differences apart from the inclusion of some importantly represented genera not considered at the species level (e.g. *Alcyonidium* sp). "Zero-adjusted" B-C (Clarke et al, 2006) creates an artificial species with value "1" in every sample, what enables to diminish the influence of empty or nearly empty samples, very abundant in our data-set (coastal samples), on the calculation of distances. When B-C is not adjusted to zero values, empty samples must be removed from the data-set prior to analysis to avoid undefined values in the resemblance matrix.

Due to the large amount of samples and species considered and to the heterogeneity of their species composition, an overall ordination of distances between samples by means of MDS did not generate an interpretable figure yet, although species-rich samples of the eastern Westhinder area clearly differ from the bulk data-set. However, an ANOSIM procedure using geographic clusters as discriminant factor indicates that on average, the species composition significantly differ from an area to another (zero-adjusted B-C: $R=0.16$; normal B-C: $R=0{,}153$; $p<0.001$).

Adding the dummy species better separates samples with lowest and highest species richnesses (figure 4-17, a). When working without a dummy species, this differentiation is weakened and remaining samples are more comparable in terms of taxonomic composition (figure 4-17, b). Thus, using both approaches enables to capture different information to analyze average patterns in the arbitrarily defined areas.

Using zero-adjusted Bray-Curtiss similarity, the areas located in the southern portion of the Westhinder sand bank appears to form a unit apart, characterized by highest species richness, whereas the northern portion of the

Westhinder and the central area form another well-differentiated group. Using normal Bray-Curtiss with exclusion of empty samples, the pattern is less clear but a rightward ordination of geographic clusters, from species poor (central and eastern coastal areas) to species-rich (westhinder southeast), clearly appears. In the later case, the most offshore stations remain apart, probably indicative of a different species composition despite generally low values of species richness, whereas other stations tend to show a gradual Westward change in the species composition.

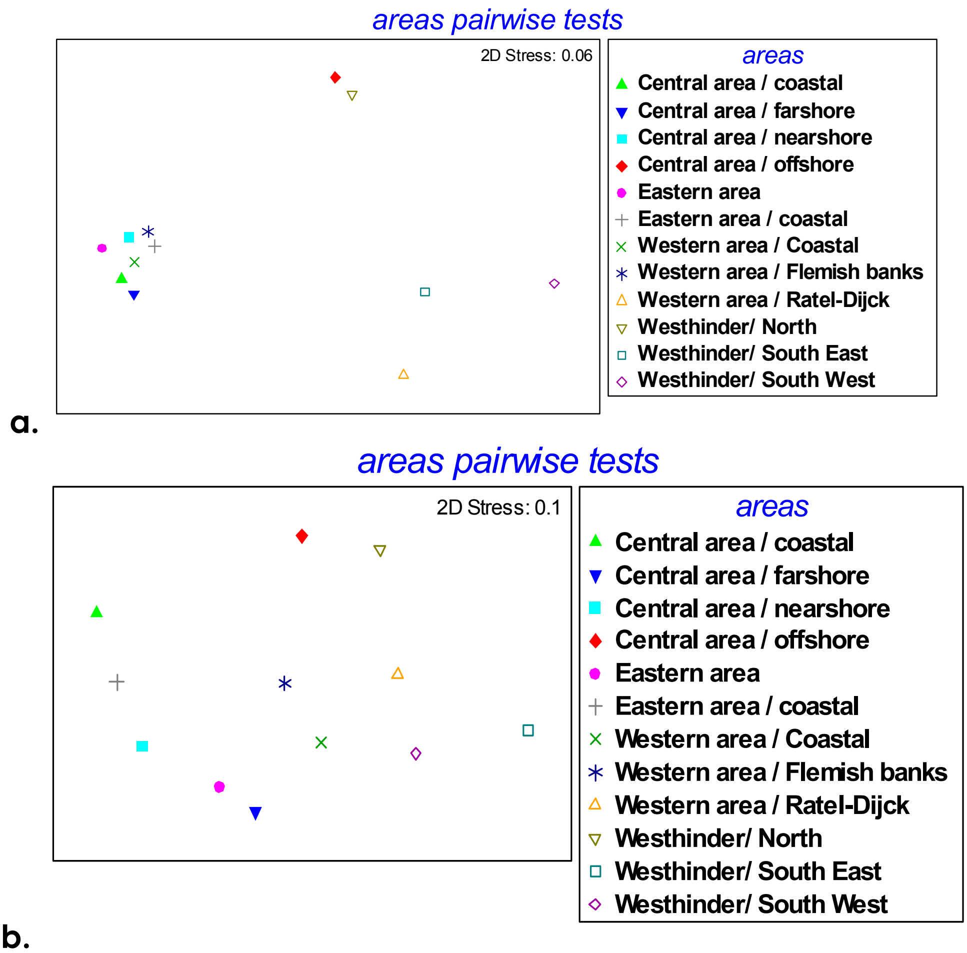


Figure 4-17. Multivariate ordination (MDS plots) of epibenthos samples grouped per arbitrarily defined area, based on the similarity matrix resulting from ANOSIM procedure (pairwise tests) applied to the entire data-set (presence / absence of valid species), using areas as discriminant factors. **a:** Primary resemblance matrix calculated using zero-adjusted Bray-Curtiss similarity (Clarke et al, 2006); **b:** Primary resemblance matrix calculated using normal Bray-Curtiss similarity, after removal of samples with 0 and 1 species.

Cumulative ranked abundance curves were drawn using samples clustered by arbitrarily defined areas, considering frequencies of occurrence (amount of samples where the species occurs / total amount of samples) as a proxy to species abundance (figure 4-18, left). Species are ranked in decreasing order of "abundance" at each area. The South-Eastern flank of the Westhinder sand bank displays a significantly different species-dominance curve (figure

4-18, right; ANOSIM test: p<0.001), with a much more even representation of species and occurence of many rarer species, whereas total species richness gradually diminishes Eastward in the sampling grid, as indicated by steeper curves (much fewer species dominate the assemblage). The central and eastern coastal areas are clearly much impoverished as compared to the rest of the sampling grid.

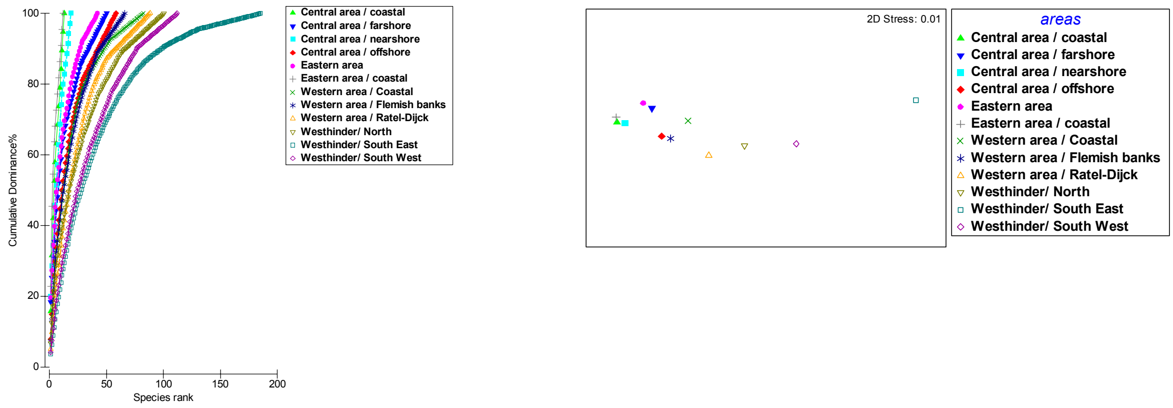


Figure 4-18. Left: cumulative species dominance curves of every arbitrarily defined area (frequencies of occurrence at clustered stations). Right: MDS plot of the resemblance matrix resulting from application of the "DomDis" procedure to test significance in the species-dominance curves obtained at every arbitrarily defined area.

A SIMPER procedure was run on the data-set (all taxa, Presence-Absence data, valid species) in order to identify characteristic species of the arbitrarily defined areas (see Annex 3). The data clearly show the close relationship existing between the three areas of the southern portion of the Westhinder sand bank, with many species shared, although the south-eastern flank shelters a more even and richer species assemblage. However, the low average within-group similarity indicates high levels of heterogeneity within the geographic clusters, which are obviously too large to perform finely tuned analyses. The genera accounting for 80% of within-group similarity at the Westhinder / south-East area are displayed in figure 4-19.

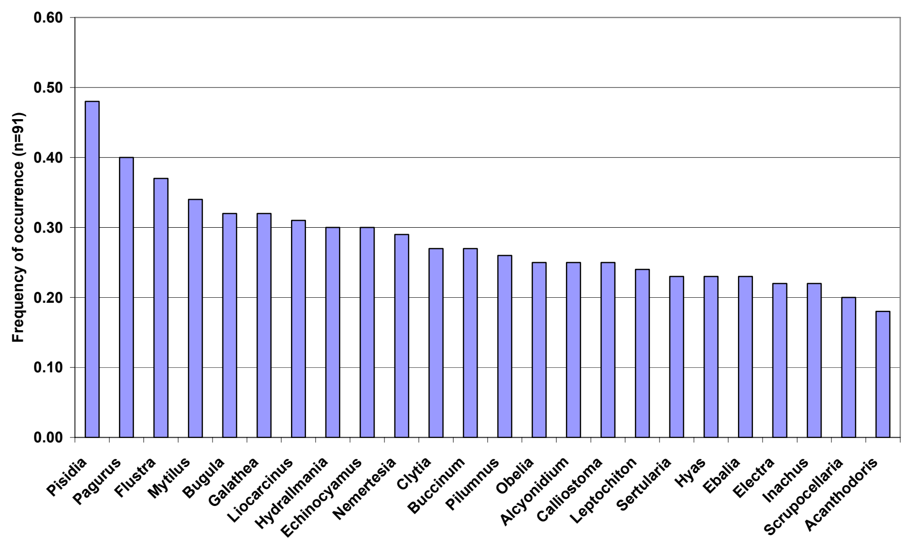


Figure 4-19: Frequencies of occurrence of genera accounting for 80% of within-group similarity in the Westhinder / South-East area.

The close relationship between the two most offshore stations is also obvious from their most characteristic species lists, although their within-group similarities are low, which is due to an average poorer species content. In these stations, apart from the mussel *Mytilus edulis*, no sessile species contributes significantly to this within-group similarity.

The multivariate analyses also show that the Western coastal areas (coastal and Flemish banks) are next neighbours to the Westhinder areas in terms of species composition. When species lists are considered, these areas share a limited amount of species, including some sessile species (e.g. *Flustra)*. Thus, the aforementioned East > West and Coast > Open-sea gradients of benthic species diversity is fully confirmed by Gilson's historic epibenthos data-set.

### 4.2.4 Analysis of biological communities at offshore stations

In order to determine the "baseline" composition of benthic communities at offshore stations, in particular on gravel grounds, a clustering analysis was carried out at two major determination levels (valid species and valid genera) on three distinct data-sets: 1: all taxa, transformation to presence/absence; 2. Sessile fauna, transformation to presence/absence; 3. Mobile fauna, taking into account specimen counts (considered as a proxy of the real species abundance at the station). This analysis was restricted to offshore stations to avoid "fuzz" iinduced by the large amount and heterogeneity of species-poor coastal samples. It must be born in mind that results are likely to be altered by inclusion of new species in future analyses.

In all cases, clusters were created (Bray-Curtiss similarity matrix), tested (SIMPROF permutation test) and mapped to track consistency with gravel and species richness distributions. At this stage of the research, the distance used to discriminate among clusters is set high to obtain few meaningful groups instead of many significantly different but hardly interpretable clusters.

When all data are considered respectively at the valid species and genera levels (figure 4-20), three main clusters can be defined and are geographically distributed as follows: a first species-rich cluster is found on the gravels, a second cluster appears in the surrounding of the gravels, and a third, species-poor cluster is found elsewhere. Some further clusters are also defined, which can be considered as transitions between the three aforementioned main clusters. Slight differences are observed between both data-sets, which are due to the fact that some abundant genera (e.g. *Alcyonidium*) were not represented at the species level, whereas certain species of a genus might display different biotope preferences (e.g. *Ophiura albida* and *O. ophiura*, the latter preferentially collected at coastal sandy stations).

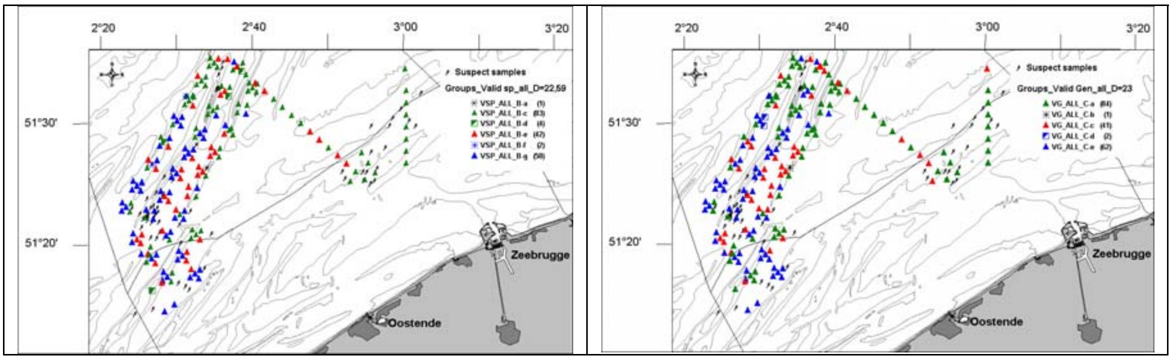


Figure 4-20. Left: distribution of significantly different large clusters obtained from SIMPROF procedure applied to valid species of offshore stations (all taxa: presence/absence data) at the distance 22.59. Right: distribution of clusters obtained on valid genera (all taxa: presence/absence data) at the distance 23.

A discrimination between sessile and mobile species at both determination levels (species and genera) indicate that the species composition is more homogeneous for mobile species at the species-rich stations of the gravel grounds along the south-eastern flank of the Westhinder (figure 4-21). The distribution of clusters of sessile species matches the pattern observed in figure 4-15, since similar species-rich stations are found on the gravel patches as well as in other locations.

The observed difference in distributions of mobile and sessile species is likely to be due to random settlement of many sessile species in the whole area, whereas mobile species typical of hard substrata will actively colonize the main gravel ground. The pattern thus indicates an "optimum" geographic area for a typical community characterized by certain mobile species, and a "sub-optimum" habitat where heterogeneity is higher due to settlement of a large array of sessile species on sparser gravels less attractive to the associated mobile fauna (increased sand content).

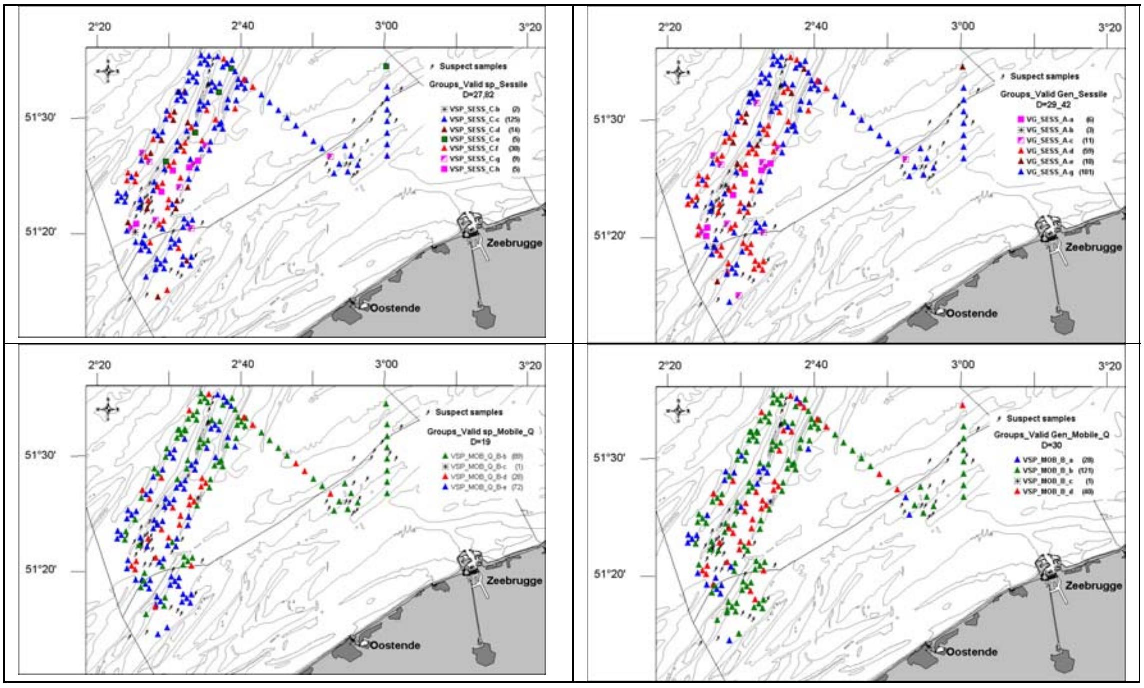


Figure 4-21. Above: distribution of clusters obtained from SIMPROF procedure applied to sessile taxa at offshore stations (presence/absence data; right: valid species, distance = 27.82; left: valid genera, distance = 29.42). Below: Clusters obtained for mobile taxa (abundance data) for valid species (left; distance = 19) and valid genera (right; distance = 30).

On the basis on these data, "adjusted" clusters were created to delineate a preliminary average pattern in species composition of stations. This approach enables to delimitate the geographic extent of species-rich gravel fields and "intermediate" gravelly sand areas and to determine preliminary frequencies of occurrences o characteristic species or genera within every cluster. To that purpose, the species compositions of small clusters considered as "transitional" between the three main clusters were individually examined. Stations with very low and heterogeneous species contents (1 to 3) were considered as closer to the species-poor cluster. Stations with lower species richness but bearing species typical of gravel stations were considered as part of the species-rich cluster. Intermediate cases were considered as being part of the intermediate cluster. The validity of clusters obtained through this arbitrary re-classification was further tested using ANOSIM procedure, which revealed highly significant difference between them (e.g. at valid species level: $R=0.654$; $p<0.001$).

Resulting clusters were mapped to identify their geographic distribution (figure 4-22). This map clearly shows that similar species-rich communities occur in the three gullies of the south-western portion of the sampling grid but is most represented between the Westhinder and Oosthinder sand banks. A "core" community is observed in the center. Along each flank of the Westhinder bank, the northern limit of this cluster coincides with the scarp located south to the kink of this bank, where depth substantially increases (see figure 2-1). A mixed community with decreased contribution by mobile taxa typifies the transition area between the gully and the sand bank. The "transitional" character of this latter group might be partly due to the fact that a towed sampling gear was used, resulting in aggregation of communities found on different seafloors encountered along the dredge tow. It is however likely to track transitional areas where proportion of sand increases, as seems to be the case more to the North. The "species-poor" cluster coincides fairly well with the position of the sand banks and is elsewhere likely to mirror sandy seafloors.

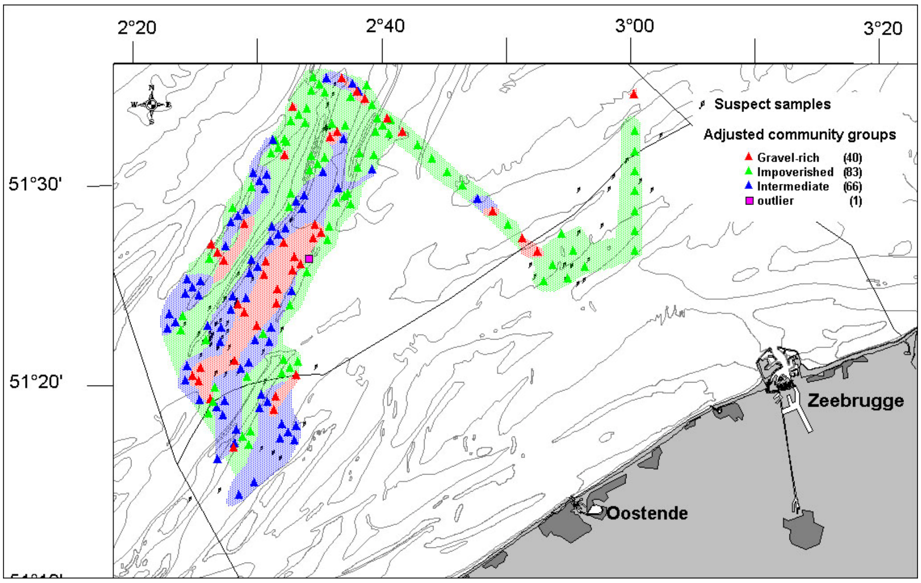

Figure 4-22. Geographic distribution of the three main clusters resulting from analysis of species composition at the offshore stations (see text for details). The species composition of 1 station was considered too different to be included in one of the three main clusters and is thus flagged as "outlier".

The frequencies of occurrences of species were finally calculated for every cluster based on presence/absence data at species and genus levels, to provide a probability of species encounter. These are listed in annex 4. The "impoverished" group contains fewer species typical of gravels, and overall low probabilities of encounter likely to mirror low densities. This group can be considered as representative of species-poor sandy areas. The "intermediate" group is dominated by the bryozoan *Flustra foliacea*, represented in 60 % of the samples, with some other frequent species. In this group, sessile colonial organisms (bryozoans, hydrozoans) are most abundant, whereas mobile species typical of the "rich" group are encountered as well. The "species-rich" group is dominated by some abundantly represented species or genera which are typical of gravels or sandy gravels, whereas the dominant sessile species of the intermediate group remain abundant (e.g. *F. foliacea*).

Results gathered so far thus clearly indicate that the areas where gravels have been considered as most abundant at the surface of the sediment in the sediment analysis carry a typical, species-rich community of organisms. The composition in sessile upright species is heterogeneous but shelters a typical community of mobile species. *Flustra foliacea* used to be the most abundant upright species of the Belgian gravel fields, which is in agreement with the abundance noted for this species recently in the nearby Dover Strait area (Foveau, 2005). The dominance of certain mobile species (e.g. the small crab *Pisidia longicornis*) is also in agreement with observations made in the adjacent French gravels (Davoult, 1988), although the brittle-star *Ophiothirx fragilis*, considered as dominant in French waters, is absent from our historic data-set. These observations, together with overall species compositions, confirm that the area of the Westhinder sand bank is under strong influence of the English Channel, as indicated by M'harzi et al (1998) for planktonic communities. It contradicts statement by Davoult (1988) and Davoult et al (1988), yet recalled in recent studies (Alizier, 2005 and Foveau, 2005) that reduced hydrodynamics to the east of the French border is responsible for increased sand content and extinction of this typical gravel community.

### 4.2.5 Tentative correlation with sediment composition

Preliminary investigations on the relationship between species composition and dredge-averaged sediment parameters have also tentatively been carried out using the "BV-Step" procedure. To that purpose, sediment parameters were averaged along dredge tows (1 to 5 sediment samples collected) and plotted as factors on multivariate ordination of benthos data. In addition, a simple "coarseness" indice was built on normalized sediment parameters to plot against benthic species richness patterns. However, this work provided results yet difficult to display due to the high amounts of samples and species and the heterogeneous distribution of sediment parameters. Further detailed analyses are needed and results are therefore not presented at this stage.

## 4.3 Historic distribution and fate of wild beds of the European flat oyster (Ostrea edulis) along eastern coasts of the southern bight

### 4.3.1 General background

The European flat oyster *Ostrea edulis* (Linnaeus, 1758) used to be extremely abundant along the coasts of the Northeastern Atlantic, where humans exploited it since their early settlement, until the early nineteenth century (Yonge, 1960). By this time, the development of railroad communications and increasing demand for oysters led to overexploitation of all beds along European shores, including wild offshore beds, which exhausted the resource throughout its distribution range (Gross and Smyth, 1946; Korringa, 1946a). During the 20th century, attempts were made to revive the depleted resource, but adverse environmental conditions, parasitic diseases, pests and competitors imported through e.g. frequent oyster translocations decimated remnant exploited populations (Korringa, 1969; Laing et al, 2005). This led oyster farmers to turn to the imported, more robust and intertidal pacific oyster *Crassostrea gigas*, nowadays so successfully adapted that it forms wild beds on the North Sea shores (Nehls et al, 2006).[2]

Nowadays, exploitation of native flat oysters can be said, to the least, to be anecdotal, with some small production centers left such as the Solent (UK) (Laing et al, 2005; Laing et al, 2006), the "river" Bono in French Brittany (Levasseur, 2006) or the Limfjorden (Denmark), where beds seemingly provide "good yields" since the late 1990s (Laing et al, 2005)[3]. FAO data quoted by Laing et al (2005) indicate overall production of flat oysters in Europe to have fallen from 9,000 to 3,000 tons in the period 1991-2002. Supposing a low average weight of 300g for marketed oysters (Desmedt, 1951 used 500 g), the overall European production rates thus amounted at a maximum of 30 million oysters in the 1990s.

Korringa (1946b, 1969) stated that a revival of wild flat oyster populations was improbable in most formerly productive locations due to the low overall amount of pelagic larvae yet emitted in the water. Gross and Smyth (1946) suggested that overfishing had caused a reduction in the genetic variability

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[2] The two species occupy different ecological niches. The native *Ostrea edulis* is sub-tidal, and intolerant to reduced salinity, increased siltation rates and exposure to air. It is thus occurring under the low tide levels, down to 80 meters. On the contrary, *Crassostrea gigas* is well-adapted to the specific environmental stresses of intertidal habitats (e.g. see Ranson, 1951 or Yonge, 1960). Initially imported for cultivation purposes, *C. gigas* now forms wild beds alongshore and enters in competition with the mussel *M. edulis* for this habitat (Nehls et al, 2006).

[3] The beds of the Limfjorden are natural but appeared in 1825 with the breakthrough of the North Sea in this area. These beds yielded about 5 million oysters (~1,500 tons) annually by the mid-nineteenth century (Korringa, 1969).

(bottleneck effect) and thus permanently altered the capacity to adapt to environmental change on the long run. Korringa (1969) suggested that genetically distinct populations used to exist before over-exploitation, and that the typically northern population, more able to stand colder waters, had vanished. There is some recent debate on the question of determining level of inbreeding in this rarefied species (e.g. Launey et al, 2002; Vercaeme et al, 2003). The relatively homogenous genetic composition recently observed on populations could have partly resulted from the many translocations operated across the species range since the 18th century.

The impacts of various diseases (*Marteilla*, *Bonamia*) during the 20th century, which are much put forward to explain stock failures during the 20th century, have certainly been dramatically emphasized by the strongly reduced size of the population as compared to two centuries earlier. Nevertheless, the species is still present nowadays across its former distribution range, though considerably reduced (Laing et al, 2005). Korringa (1969) noted that "*specimens over twenty year with shells up to 19cm*" were yet occasionally caught in the North Sea in the 1960s. Such large wild specimens are still sparsely occurring nowadays in fishing grounds of the southern North Sea and English Channel nowadays (figure 4-23). Wild flat oysters are also regularly encountered by divers in Zeeland (Sheridan et Massin, 1998).

Figure 4-23: a giant specimen (largest length: ~22 cm) of European flat oyster (*O. edulis*) collected by a bottom trawler in the 1980s in the English Channel. The count of growth increments of the umbo (right) indicates that the specimen could be over 35 years (pictures by F. Kerckhof).

The fact that the species has been able to maintain a scattered wild population tends to contradict the statement by Korringa (1969) that restoring healthy populations was hardly feasible due to shortage at larvae. Obviously, the species is nowadays "cryptic" in its original habitats but yet effectively reproduces in the wild.

Oysters are key-species to coastal ecosystem functioning. Indeed, their high filtration rates can alter local patterns of turbidity when their abundance is high. The underneath sediment is organically enriched by their faeces. Last but not least, their beds form biogenic reefs offering a wide range of micro-habitats which considerably enhance local biodiversity (*e.g.* Cranfield et al, 1999; OSPAR, 2004). The recovery of such habitat-forming species in its natural range is thus nowadays a matter of concern to ensure preservation of marine biodiversity, which in turn influences ecosystem health at least locally (e.g. see Milewski and Chapman, 2002). The major stock collapse which occurred in the late 19th century not only had a dramatic impact on coastal economies; it has most probably significantly affected the functioning of coastal ecosystems throughout the species distribution range, to an extent that can hardly be reckoned nowadays.

The idea of restoring a healthy flat oyster population was recently brought back by Laing et al (2005, 2006) for both ecological and economical purposes. Indeed, a return of the native triggers back questions on possible re-exploitation. Their study concluded that although exploitation rates will never return to their initial values, a revival of the species seems feasible in coastal waters of the UK, at least where natural beds used to occur, since some small-scale fishing activity still persists in some locations such as the Solent. The authors recommend implementation of measures in coastal areas rather than offshore, where regulation and effective surveillance of fishing activity might be difficult. However, they acknowledge a lack of data on importance of depth on the species biology. Noticeably, all open-sea beds went depleted by the end of the 19$^{th}$ century, and certain small beds nowadays under limited exploitation, such as in the Solent (UK) or French Brittany (Morbihan; Levasseur, 2006), are found in deeper waters.

Occurrence of oyster settlement in a given location is dependant upon production of planktonic larvae from other locations, circulation patterns and local biotope suitability. Indeed, once emitted, the larvae spend 9 – 17 days in the planktonic compartment before settling down, a duration depending upon growth rate, which is affected by conditions of temperature and available food (Korringa, 1941). The existence of a pelagic larval phase implies that beds are fed by larvae emitted from other locations, except in semi-enclosed areas such as formerly the Oosterschelde (NL). To investigate feasibility of restoration of a healthy native oyster population, it is thus necessary to reconstruct the locations where stable natural beds used to occur prior to targeted exploitation (19$^{th}$ century). This approach will provide a baseline situation from which coherent management plans can be drawn on the larger scale.

To achieve that goal for Belgian waters, where we had indications that beds used to occur in a remote past, we carried out a thorough survey of the abundant historical literature dealing with this species, covering mainly the 18$^{th}$, 19$^{th}$ and 20$^{th}$ centuries. On the other hand, flat oysters collected alive by Gilson in the early 20$^{th}$ century were examined to check consistency with information retrieved from the literature.

### 4.3.2 Historic literature review: flat oysters in Belgian waters

#### *4.3.2.1 Accounts on oysters and oyster trade in Flanders*

According to Hostyn (1988), the large amounts of flat oyster shells discovered in the so-named "Roman Camp", in the locality of De Panne, is indicative of early heavy use of oysters along our coasts, which he assumed to occur in tidal channels. Up to the 15$^{th}$ century, we have no indication on the occurrence or trade of flat oysters along our coasts apart from archaelogical evidences, which we have not investigated here. However, there are elements of information in the British literature to suggest that flat oysters were imported very early to Flanders.

The British methods of oyster cultivation were brought in by the Romans, which held the British oysters in high esteem, based on their experience in the Mediterranean sea (for further information on this abundantly commented topic, see e.g. Eyton, 1858 or Yonge, 1960). It is thus not unlikely that oyster shells found in Roman settlements in Belgium already originated from English beds, although settlement of sparse individuals probably occurred in coastal waters. There seems to be no information available on this practice up to the 12$^{th}$ century. In the Jacob's "history of Faversham" (1774; in Eyton, 1858), reference is made to the existence of a company of free dredgers exploiting oyster grounds in the Thames area as early as under the reign of Henri II (1154-1189). This account thus ascertains the early organization of this fishery in "guilds" . Yonge (1960) considered that the cultivation methods quoted afterwards were very similar to those described in Roman texts, suggesting a perpetuation of the tradition across centuries at least in the Thames estuary. Jacob reported returns from oyster trade with The Netherlands, thus indicating early exportation of British oysters.

In Belgium, flat oysters are mentioned in the earliest documents ruling the fish market at Brugge, dating back to the 15th century (Van Houterive, 1975). In a document of 1400, it is forbidden "*to mix fresh with old oysters, and those from Sluis with those from Nieuwpoort*". The origin of the oysters is not provided; the differentiation between the two localities maybe points at different trade paths. In the 16$^{th}$, 17$^{th}$ and 18th century, oysters sold at this market mainly originated from France (Lambert, 1931), Great-Britain and Zeeland (Van Houterive, 1975).

In 1729, a regulation imposed that "*oysters from the country should be sold preferentially to those foreign*" (Vanhoutryve, 1975). This could be the first positive indication of oysters harvested or cultivated in vicinity of the Belgian coast, whereas it also points at intervention of local authorities to favor the local products. 50 years later, a regulation (17/06/1779) similarly imposed differential prices for "*oysters from the banks of the country*" as opposed to the "*foreign oysters*", sold at higher prices. These local "oyster banks" were however artificial. The beginning of the oyster cultivation in Oostende is considered to date back to 1763 by Desmedt (1951). Bacon (1768) wrote:

"*People from Holland often undertook installation of oyster pits in their area without believing they would succeed, and after serious losses, they have had to leave this trade to those of Zirichzee. I however hope that those of Oostende will achieve the goal set by the government, but many things yet lack to that purpose*".

Prior to the nineteenth century, we could thus not find evidence of gathering of wild oysters along or off Belgian coasts in the historical literature. An analysis of the history of importation and cultivation of oysters in Belgium falls out of our scope, although it is interesting to note that figures provided by Desmedt (1951) suggest that the volume of traded *relaid* oysters in Belgium, in the 1770s and on, probably exceeded 10 million oysters a year. The demand for this product was thus significant in Belgium in the late 18$^{th}$ century. An important point to note is also that the consumers were accustomed to "*relaid*" oysters (oysters fished in the wild and cultivated in areas with reduced salinities, where they "fatten" and acquire their famous taste) rather than to the much less appreciated "open-sea" oysters. This might partly explain why wild beds eventually occurring off Flemish coasts were of limited interest if at all to Flemish fishermen, as suggested by Lanszweert (1868). Furthermore, these fishermen were also not equipped to harvest this resource on the "coarse" grounds where it occurred. The first beam trawls appeared in the Flemish fleet in the 1820s, whereas seines were previously employed as towed gears (De Zuttere, 1909). There is thus little chance that Flemish fishermen operated at locations where wild beds occurred, due to technological impediment, what explains the absence of information prior to the 19$^{th}$ century.

#### *4.3.2.2 Occurrence of wild beds off Belgian coasts*

The occurrence of wild beds of flat oysters in Belgian waters was suggested by Olsen (1883) on the basis of information provided by fishermen of Grimsby (UK). According to his map (figure 4-24), wild beds would have occurred in the whole Belgian coastal waters.

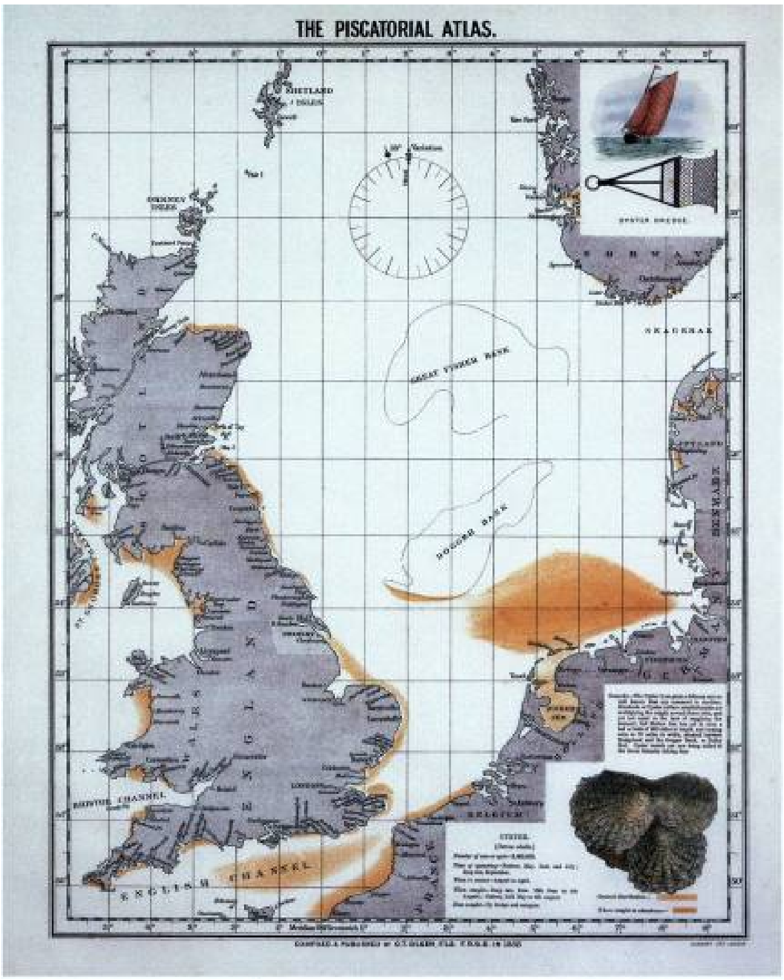



Figure 4-24. Distribution of the European flat oyster *O. edulis* according to Olsen (1883), on the basis of Grimsby fishermen's accounts. Darker colour marks indicate higher abundances. The notice indicates that oyster dredging vessels were by then added to the Grimsby fleet to exploit the vast oyster bed laying in the Dutch and German sectors.

Much more detailed information on wild oysters occurring off the Belgian coast is found in Lanszweert (1868). This malacologist discovered an oyster bed in the area of the Westhinder bank, some 30 km off the western Belgian coast, through a dredging operation carried out in 1862. He did not carry out any further sampling himself but left his dredge to the crew of the lightship "Westhinder", positioned on the southern tip of the sand bank, with the hope to get more information on oyster abundance; some years later, he heard that the crew was daily eating oysters without providing any report, what points at high amounts of oysters in vicinity of the lightship. According to Lanszweert (1868), earlier than 1862, British oystermen were already exploring the Ruytingen banks, in French waters, between Dunkerke and Gravelines, some 9 nautical miles off each of those cities (see figure 4-27). Lanszweert reported that oysters from this area were sold under the name "Callies *oysters*" (most probably oysters "from *Calais*"), and that these were "*identical to those collected by Flemish fishermen*".

By 1867, the fleet moved eastward and found "*vast amounts of oysters inside the Westhinder bank until the East end of the Oosthinder bank, at a depth of 17-19 fathoms* [20-25 meters], *at some 18 nautical miles from the shore*". Moving northward to the Noordhinder lightship, at greater depths, where Oostende fishermen had indicated oyster catches as well, they did not find any exploitable oyster bed. To finish with, the British fleet moved closer to the coast and found a "*most fruitful*" bed at 12 nautical miles off Oostende and Blankenberge, at a depth of 11-12 fathoms (12-14 meters) (see figure 4-27).

Lanszweert noticed that these beds all occurred along the coastward flank of large offshore sand banks, suggesting that they were thus protected from storms coming from the North, the most impacting ones along Belgian shores. In other words, Lanszweert (1868) suggests particular hydrodynamical conditions to occur in these areas and favour development of flat oyster beds.

Mr. H. Polley, an oysterman from Brightlingsea, provided the list of localities he visited during his 40 years of duty to a "Select Committee" on oyster fishery gathered to enquiry upon the strong decrease of the resource throughout the UK (Anonymous, 1876). We have plot this information on a preliminary map (figure 4-25). Off Belgian coasts, these localities were: "*a ground off Oostende*", the Westhinder area (which is highlighted as very "stony"), The Deurloo Channel, and the West-Kappelle area in Dutch waters. Polley further stated that these beds located East to the Dover Strait were all exceptionally rich in "brood" oysters, which is indicative of active reproduction in this area.

H. Polley further stated that up to 20,000 oysters per ship were fished in a day on newly discovered beds, an impressive figure consistent with others found elsewhere in the earlier literature: in the Baie du Mont Saint-Michel, Dicquemare (in Lambert, 1931) quoted a dayly catch of 20,000 oysters per ship for the mid-18th century; based on a local report dating back to 1866, Neudecker (1990) indicated that in the 18th century, up to 1000 oysters could be gathered in a single dredge tow by German oyster dredgers on the open sea beds of the Helgoland area (see figure.4-24). "Deep-sea" oyster beds were thus by no means fed by larvae swept out from heavily stocked coastal waters as stated by Cole and Knight-Jones (1949)[4]. This then widespread opinion, which suggests that efforts at reviving stocks should be directed in coastal areas, has influenced efforts aimed at reviving the stocks during the 20th century (e.g. see Korringa, 1946). Oyster scientists of the 20th century obviously ignored evidence from earlier accounts that open-sea beds were formerly extensive and largely distributed aside "most productive" (in terms of exploitation) bays and inlets. The former existence of wild beds off Belgian coasts confirms this view.

[4] " *The revival of the so-called deep-sea beds, such as existed in the second half of the last century around the shores of Great-Britain, the Channel Islands and France, is not a practical proposition since these beds were maintained largely by larvae swept out to the sea from the intensively stocked beds in the adjacent bays, inlet and river estuaries."*

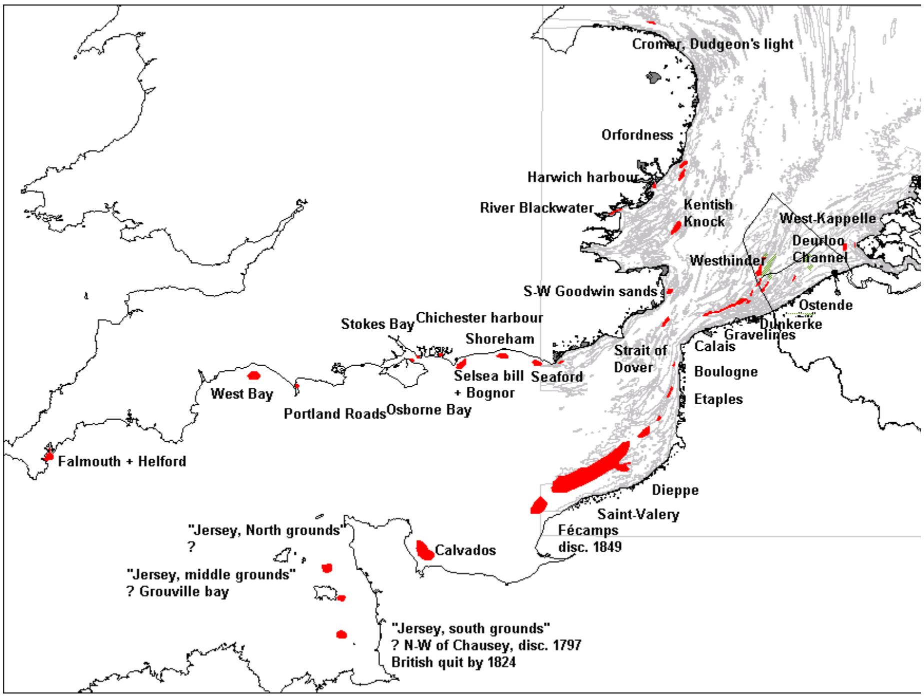



Figure 4-25. Preliminary map of the wild "deep-sea" oyster beds visited by M. H. Polley, oysterman from Brightlingsea (UK), between the 1830s and 1876 (Anonymous, 1876). The extent of the bed off Dieppe is probably exaggerated because its exact position is not yet known with precision, whereas it was described as large and hugely stocked.

A confirmation of Lanszweert's and Polley's accounts could further be gathered in the archives of the fish trade at the city of Oostende. They indicate that more than 300 British smacks were engaged in the oyster fishery off Belgian coasts, mainly "*between the two Hinders*". Most of these probably originated from Colchester and Brightlingsea (H. Polley, in Anonymous, 1876; Benham, 1955). Their product was brought to Oostende and sent to the UK in "*large cutters*", what confirms that serious amounts of oysters were fished indeed, in the early years of exploitation at least. "*Small oysters are relaid in creeks, the larger are used to produce alimentary pastes and canned food*" (De Zuttere, 1909). In these times indeed, "common" oysters (oysters from wild beds) were considered "food for the poor" (Yonge, 1960). According to these archives, the British dredgers exploited the area of the Westhinder during 5 years, from 1868 to 1873; the oystermen then left the area due to stock depletion.

The contribution of H. Polley further provides details on the procedure followed to explore, exploit and finally leave a fishing spot. Oyster dredgers thus usually went abroad for fishing campaigns with a fleet of 50-60 sails. Once navigating in suitable depth conditions, one dredge was heaved by every ship for short periods (5-6 minutes) until a minimum of half a dozen of oysters was discovered in the dredge. Then, all ships concentrated in the area, deploying 4 dredges (80-140 Kg) per ship, and forming a front line of five to six nautical miles (about ten kilometers). 30-40 oysters per dredge was seemingly considered as a minimum rewarding amount, and good spots (named "*hauls*") were marked with a buoy and a light-boat fastened to it, to further harvest them during the next days and nights until average production was not judged profitable anymore. The fleet subsequently moved in search for more oysters to harvest.

The appearance of these far-ranging "deep-sea" oystermen in the North Sea, which were formerly active in the English Channel together with the Solent and Jersey fleets since the late 18$^{th}$ century (Eyton, 1858; Lambert, 1931; Benham, 1955), seems to have been triggered by a convention between France and the UK, first established in 1839 and renewed in 1843, which forbidded oyster dredging in the Channel during summer months. Since Jersey oystermen have seemingly respected this convention only after 1852 (Philpotts, 1890), we can suggest that this search for new beds in the North Sea began in the course of the 1850s. This assumption is consistent with information provided by Lanszweert (1868) on exploitation of open-sea beds off French and Belgian coasts in the early 1860s. On the other hand, oyster-dredging smacks were large ships, and it is certain that oyster fishing occurred in the Channel during the rest of the year (Philpotts, 1890; Benham, 1955).

It is very difficult to estimate the exact amounts of oysters that were extirpated from the Belgian beds, but it can be deduced from Polley's account that to deserve such targeted exploitation, the Belgian beds must have provided millions of oysters and "brood" in a short span of time, at least during the first years of targeted exploitation. Assuming a final average annual production of 65 oysters per ship and per day prior to leaving the spot (i.e. a decrease from 100 to 30 oyster in the dredge in the course of the season), say for 50 ships during a 50 days fishing time, we can suggest that about 230,000 specimens were yet fished during the last year, representing a biomass of 69 tons of small oysters (average weight of 300g, including shell). Supposing a decrease in the yield by a factor of hundred in the five-year period of active fishing, as is documented elsewhere, a minimum of 6,900 tons of oysters must thus have existed in Belgian waters prior to exploitation. Assuming that dredgers abandoned the spot once no more than 30 oysters were gathered per ship and per day, about 30 tons of scattered flat oysters (~100,000 small specimens) must have been left in the area after exploitation.

Polley's contribution further emphasizes the high heterogeneity of oyster density on these beds, as contrasted catches could be obtained by closely working ships. Those dredgers specifically targeted the surroundings of offshore sand banks, where they considered that tidal eddies were favourable to "spatfall" (larvae settlement), because wild oysters were seemingly particularly abundant in these areas. This tends to confirm the aforementioned statement by Lanszweert (1868) on occurrence of oysters between offshore sand banks (that is, on sandy gravels).

Densely populated offshore beds were thus scattered and probably interconnected ("stepping-stones" for larvae dispersal) at some distance off the French and Belgian coasts of the North Sea, in sandy gravels. Given the fact that Belgian offshore areas lay under strong influence of Channel waters (Lacroix et al, 2004), these beds were fed with settling larvae originating from the English Channel and should be considered as belonging to the same "stock". This is perhaps not the case for oyster beds along the shores of the more famous Thames estuary in England, more under influence of the North Sea through higher dominance of western southward currents.

The Belgian offshore beds thus certainly existed long before being documented. There are also indications that beds existed further offshore toward English coasts, which maybe established some "connection" with beds located off and along the shores of the Thames estuary. Eyton (1858) suggested that many discoveries of smaller beds were not divulgated at all by fishermen to ensure exclusivity of exploitation, with only large good "hauls" communicated and subsequently overexploited by a multitude of smacks. This indicates that undocumented exhaustion probably occurred in many such open-sea beds throughout the species distribution range.

Van Beneden (1883) provided another key-account on occurrence of oysters in Belgian waters. He referred to occurrence of "horseshoe" flat oysters and their exploitation by British dredgers. However, Van Beneden described these grounds as "*a field of rounded cobbles*", in which epibenthic species diversity was described as exceptionally high as compared to the surrounding sandy grounds. The contribution of H. Polley to Anonymous (1876), stating that the Westhinder and Oostende areas were "very stony", fully agrees with this view.

**Conclusion of the literature review**

We can thus conclude that wild oyster beds of Belgian waters occurred on offshore "gravel" grounds and had never been targeted until arrival of British oystermen in the 1860s due to the coarse nature of the seafloor and low commercial interest for these "common" oysters. These beds were typically populated with large, older oysters ("horseshoe" oysters), and they were thus highly fecund, since oyster larvae production steadily increases with age. The importance of such bed for the overall larvae supply has obviously been underestimated by writers of the 20$^{th}$ century. On discovery, they were strongly overexploited and quickly destroyed by skilled and well-equipped oystermen from Kent and Essex, England, in search for brood to relay on their home beds. They were seemingly abandoned, with very low densities remaining on the seafloor, during the next decades. From Pype (1911), we learn that Belgian sailing beam trawlers still tended to avoid these stony areas due to the risks of instrument breakage on cobbles and boulders in the first decade of the 20$^{th}$ century. This indicates that in Belgian waters, the grounds have probably been left at rest at least a few decades afterwards.

On the larger scale, exploitation of open-sea beds by skilled fleets began in the 18th century in the English Channel and extended northward as a response to increasing demand. The open-sea beds of the North Sea were mainly exploited from the 1860s up to the 1890s, when far-ranging oyster dredgers ceased their activities on the Helgoland bed because it was not profitable anymore (Benham, 1955). Overall stock collapse (early 20th century) has been preceded by exhaustion of open-sea beds everywhere. This observation suggests that open-sea beds might have been more important to the overall population than so far thought. When considering the fact that larger oysters were found on these beds, it seems much likely that average larvae production was larger on offshore beds. In addition, open-sea beds were less subject to strong environmental variations occurring in coastal waters, what suggests that their stability might have been larger on the long-run.

#### 4.3.3 European flat oysters collected by G. Gilson (period 1899 – 1939)

G. Gilson collected live flat oysters in 23 samples from the Belgian part of the North Sea, of which 22 were accurately geo-referenced. These were preserved in alcohol with their associated fauna and stored at the RBINS (see figure 4-26). Most original determinations were carried out by a reknown oyster specialist, G. Ranson (see Ranson, 1967). 8 specimens are represented by only one valve but bore the animal or were obviously fresh (5 left [curved] and 3 right [flat]). Two specimens of the collection were borrowed and could not be examined.

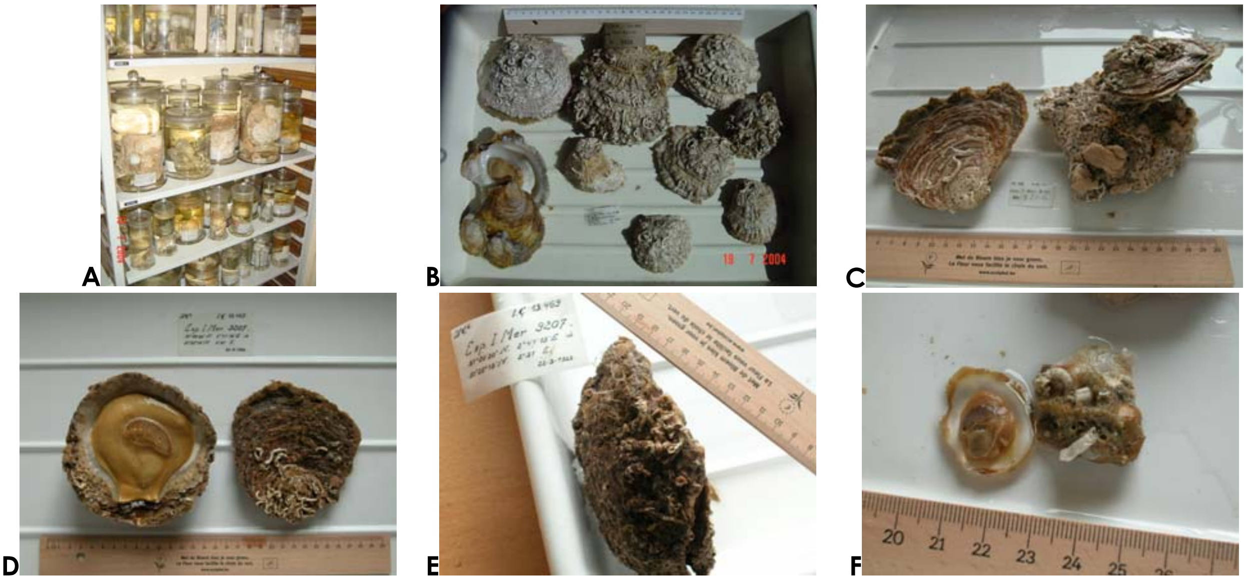



Figure 4-26. a. Jars of flat oysters in the repository at RBINS. b. Oysters of different sizes collected alive at station G3335 (South-Eastern flank of the Westhinder bank). Note the whitish colour of the curved valves and the occurrence of two smaller specimens upon the shell of one specimen. c. Cluster of two medium flat oysters collected alive by Gilson at station G3806 (South-Eastern flank of the Westhinder bank). Colonies of the Dead-man finger (*Alcyonium digitatum)* are visible on the curved valve of the colonized specimen. d. A large specimen collected alive by Gilson at station G9207, inside the Middelkerke bank (1933). e. Same as the former, showing shell thickness (> 2 cm) and colonization by hydrozoans and tube-dwelling polychaetes (*Sabellaria spinulosa*, *Pomatoceros triqueter*). f. Young oyster (year one) collected by Gilson, showing precocious colonization of the curved valve *Sabellaria* and *Pomatoceros.*

The distribution of collected specimens strikingly matches the scheme outlined on the basis of previous historical accounts (figure 4-27): most oysters were collected between the Westhinder and the Oosthinder banks, at the position suggested by Lanszweert (1868). Spare specimens were further collected more to the North, and south to the Goote bank. The sample collected inside the Middelkerke bank, one single very large specimen, dates back to 1933, and can be considered as the last official record of large wild oysters in Belgian waters. One sample was collected in 1908 on the hull of the Wandelaar lightship (two specimens) and was not mapped.

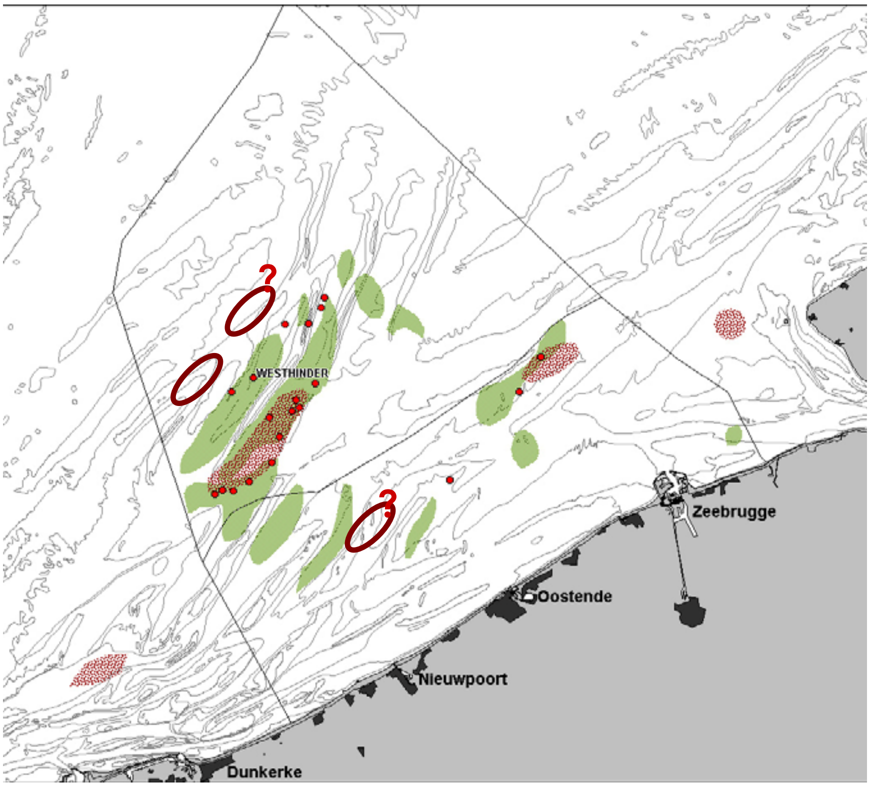



Figure 4-27. Geographic distribution of flat oyster samples collected alive by Gilson in Belgian waters, years 1900s. The data are superimposed on the distribution of natural beds inferrefd from indications given by Lanszweert (1868) and Polley (in Anonymous, 1876), and on the suggested distribution of mixed gravel and sands of figure 4-4. The bed in front of Dunkerke is likely to be larger than drawn. The bed of the Deurloo channel (NL waters) was located by combining information from Polley and distribution of high shell content in Gilson's sediment descriptions (see figure 4-3).

Some further specimens were collected in the central North Sea (UK waters). In all these places, the bottom can be described as mixed sand and gravel and depth exceeds 20 meters. Most samples were collected between 1904 and 1908, 2 samples were collected in 1914. Noticeably, no sample was collected in coastal waters.

A large array of sizes, from recently settled spat to old specimens, were collected at these stations, but the amounts of specimens are always relatively low (figures 4-28 and 4-29). This indicates presence of reproductively active older specimens as well as settlement of larvae most probably originating from the English Channel or the Strait of Dover.

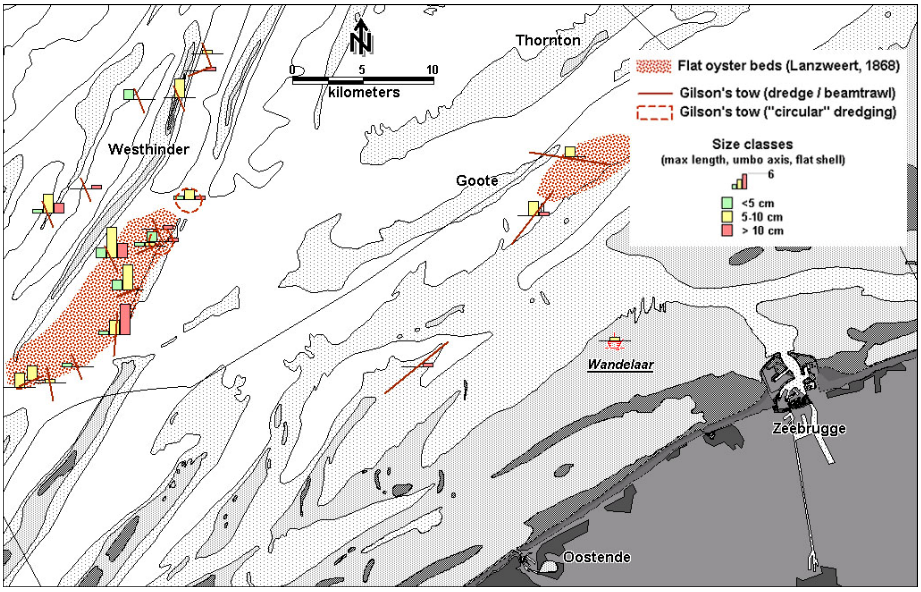



Figure 4-28. Geographic distribution of size-class abundances of *Ostrea edulis* in samples collected by Gilson. Original tow lengths are represented instead of median positions (red lines and red-dotted circles, which correspond to "circular" dredging). The "Wandelaar" station was the hull of the lightship which laid at this position; the oyster was detached during a hull cleaning operation on land and was therefore not illustrated on figure 4-26.

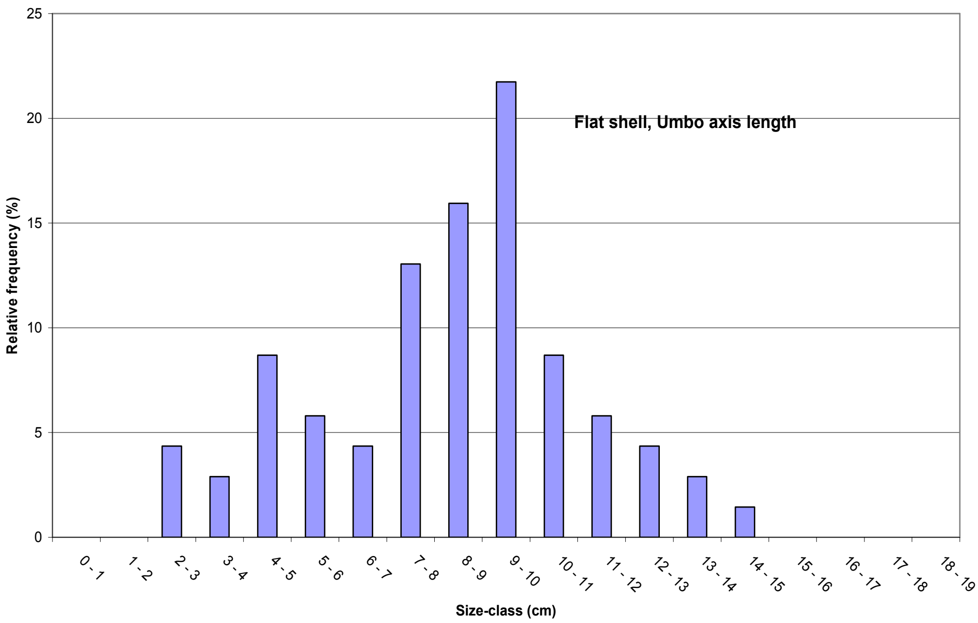



Figure 4-29. Overall size structure (flat shell, umbo axis, maximum length) of flat oysters collected alive by G. Gilson (1904 – 1933). N=69.

Based on the distribution of patches of high shell and shell debris contents (figure 4-3), we can suggest occurrence of 6 "core" beds in the southern portion of the gully between the Westhinder and the Oosthinder sand banks (figure 4-30), where a typical species-rich benthic community was identified in section 4.2. However, the species composition of these shell patches must yet be ascertained to confirm abundance of flat oysters shells indicating former occurrence of a "bed" at each patch. It is not unlikely that some of these patches were not really separated as Gilson's sediment data tend to indicate, due to absence of samples between them (see figure 4-3).

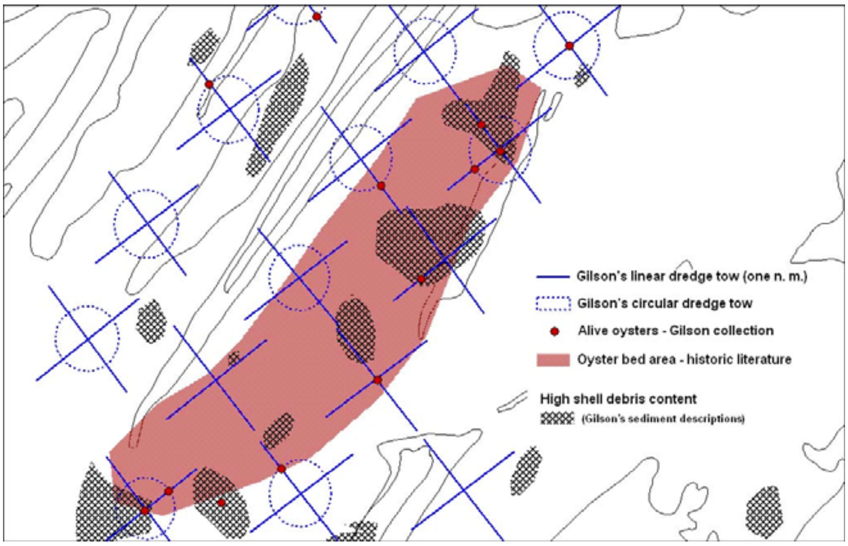



Figure 4-30: distribution of patches of high shells and shingle contents (see figure4-3), superimposed on distribution of wild beds and Gilson's flat oyster catches (see figure 4-27).

## Associated fauna

The position of oyster samples from the Westhinder area coincides with highest levels of epibenthic species richness (see figure 4-14), what suggest a co-occurrence of oyster beds and high epibenthic richness. Most specimens of oysters, including the smallest ones, were colonized by a varied and abundant sessile epifauna. The commonest species found on shells, apart from various undetermined encrusting bryozoans, were respectively the tubeworms *Pomatoceros triqueter* (covering all shells) and *Sabellaria spinulosa*, the dead-man finger *Alcyonium digitatum* and the boring sponge *Cliona cellata*. The latter has always been considered as a pest to oyster beds but seems to be a normal inhabitant of the thick shell of older oysters, which tends to indicate that its presence and boring activity do not necessary kill its host on natural beds. All old shells found in this study bear *Cliona* (specimens or empty holes) and old *Pomatoceros* tubes. In nearly all cases, the curved valve was colonized and whitish, whereas the flat valve was generally bare and brownish (figure 4-31).

Figure 4-31. Pictures of flat and curved valves of a flat oyster collected alive in sample G3766 (South-Eastern flank of the Westhinder sand bank). The sample shows the amount of colonization often observed on curved shells of large (old) specimens, with a typical association of the tube-dwelling polychaetes *Sabellaria* and *Pomatoceros*, relatively large colonies of the dead-man finger *A. digitatum* and other species such as bryozoans, hydrozoans or ascidians (here *P. pomaria*).
The specimen was archived with ascidians in the repositories. The flat shell is typically nearly devoid of species and brownish.

West to the Westhinder bank, the station "G3509" was found to shelter highest levels of species richness. Hundreds of large colonies of the deadman finger *A. digitatum*, together with lots of empty shells covered with tubes of *Pomatoceros* and *Sabellaria spinulosa*, all bearing holes of the perforating sponge *Cliona cellata*, were found (figure 4-32).

Figure 4-32. A sub-sample of colonies of the dead-man fingers *A. digitatum* collected at station G3509 (250 large colonies in total), mixed with old shells of flat oysters, and stored in the repository of Anthozoans; alive oysters were collected as well at this station and were stored with other oyster samples. This sample is probably representative of a typical oyster bed-associated benthic community.

This assemblage is very similar to descriptions provided by other authors on species associated to wild oyster beds, noticeably Hagmeier and Kandler (1927). In Irish waters, old oysters overgrown with *Sabellaria* tubes were called "mums" by oyster dredgers (Holt, 1901), suggesting that this species is a common inhabitant of open-sea beds. This station might be representative of a typical community of oyster beds. Unfortunately, this sample is located along the north-western border of Gilson's sampling grid, and it is impossible to track the extent of this community. However, this station suggests that either this area had been omitted by former oystermen, either it has recovered better than along the southeastern flank.

### 4.3.4 Bed structure: a comparison with *Ostrea chilensis* in New-Zealand waters

The low densities observed by Gilson, together with occurrence of oyster clusters, tend to indicate a patchy settlement and oyster distribution. This is in agreement with bed structure described by Cranfield at al (1968) for the close relative (also larviparous) *Ostrea chilensis* in an unfished offshore area of New Zealand temperate waters, with tide-driven hydrodynamic conditions (maximum current speed ~ 1.2 $ms^{-1}$) and seafloor nature (sandy pebbles and cobbles) similar to those of the Westhinder area.

The New-Zealand bed (figure 4-33) occupied an area of 200 * 900m($180.10^3$ $m^2$) and is characterized by disseminated small cores of high densities (up to 110 oysters per square meters) along the axis of main tidal currents, from which a radiating decrease in average oyster density down to 1-5 oysters per square meter can be drawn, with a high small-scale heterogeneity. This structure is fully consistent with the indication by H. Polley (in Anonymous, 1876) that dredging ships operating very close to each other could obtain very contrasted yields on newly discovered beds of *Ostrea edulis*. Philpotts (1890) also indicated that yields were highly variable when the sailing smacks were obliged to fish parallel to the currents and the elongated beds, whereas conditions of wind enabling transversal dredging yielded more homogenous results among fleeting smacks.

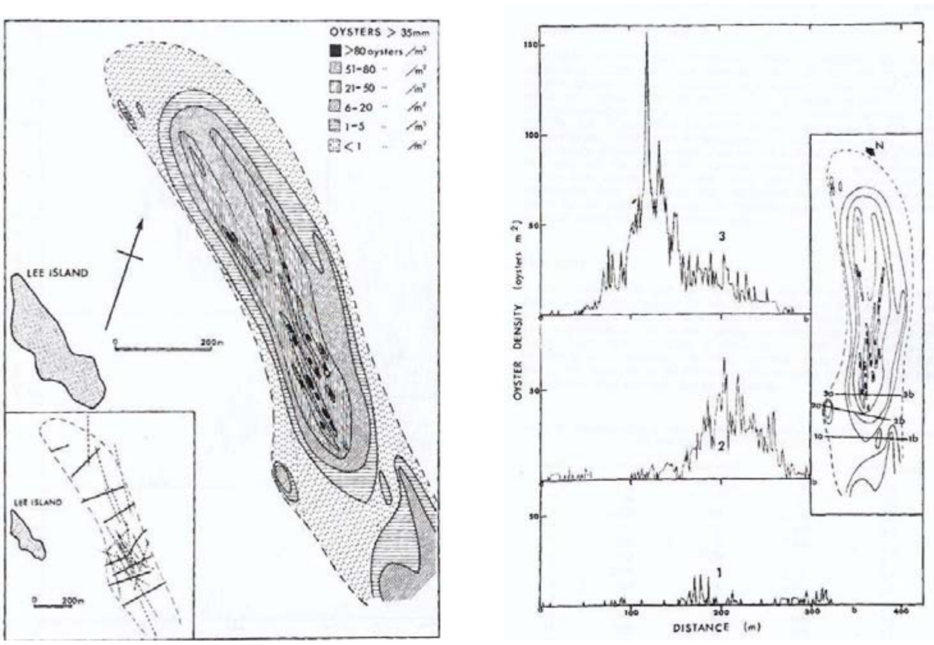



Figure 4-33. Structure of a wild unfished bed of the subtidal larviparous oyster *Ostrea chilensis* in New Zealand waters. Depth (15-18m), temperature (9-19 °C), hydrodynamics (tidal currents up to 120 cm/s) and seafloor (sandy pebbles and cobbles) conditions are similar to those encountered in the surroundings of Belgian offshore sand banks. Reproduced from Cranfield et al, 1968.

Total oyster abundance in this small bed was estimated by Cranfield et al (1968) to amount at 3.3 million oysters. Along the southeastern flank of the Westhinder sand bank, the area where the oyster beds were indicated to thrive measures 15 * 2 km, thus representing a surface of $30*10^6$ $m^2$. This is 167 times the surface of the bed described by Cranfield et al (1968). Assuming that only five "beds" of *Ostrea edulis*, structurally similar to that described by Cranfield et al (1968) for *Ostrea chilensis*, used to occur indeed in this area, the amount of oysters thus must have reached a conservative minimum of 15 million oysters, representing a low biomass estimate (for 300g average weight) of 4,500 metric tons. This weight represents an average density of 0,5 oyster per square meter (0.15 kg/m2) over the whole area. This figure is thus plausible, considering the fact that beds must have been patchily distributed. It is furthermore of similar magnitude to the estimate of 6,900 tons based on assumed exploitation rates (section 4.3.1.2). It seems thus much likely that wild bed structure in *O. edulis* used to match that described for *O. chilensis* in New-Zealand waters.

### 4.3.5 Summary: baseline, present and future of flat oyster populations along the eastern coasts of the southern bight of the North Sea

At this stage of the research, we can propose a first schematic model of the environmental history of wild flat oyster beds along the eastern coasts of the southern bight of the North Sea, together with predictive scenarii (figure 4-34).

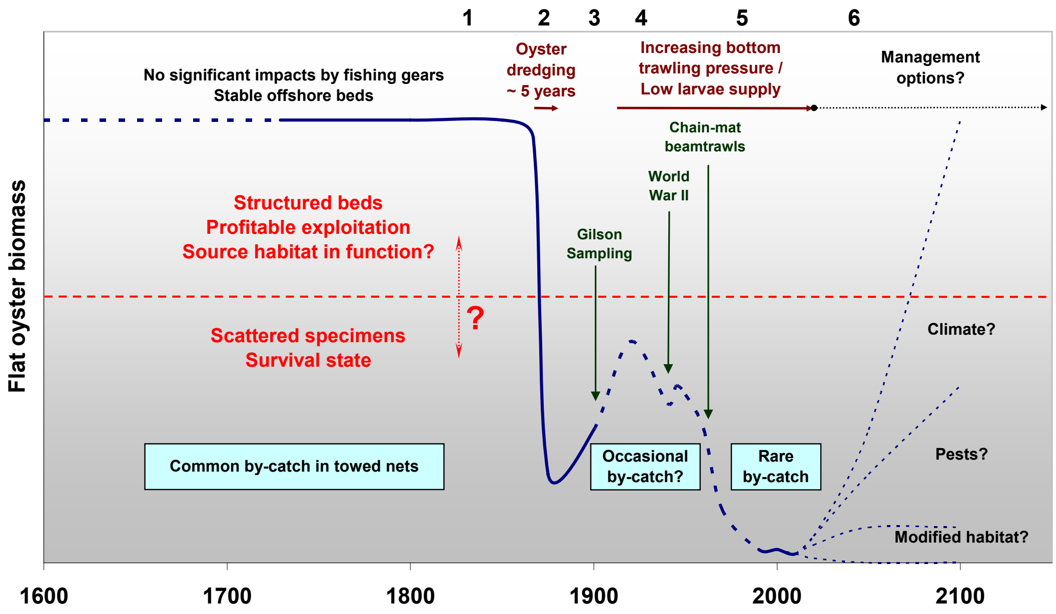



Figure 4-34. Environmental history and predictive scenarii for the flat oyster (*O. edulis*) population in the Belgian marine area. See text for details.

**1.** Offshore beds of the flat oysters used to exist since a very long span of time in sandy gravels off Belgian and French coasts, with probable but unknown fluctuations in standing stock biomass through time. Along the south-eastern flank of the Westhinder bank, the "baseline" biotope can thus be described as a strip of beds forming biogenic reefs. These were colonized and surrounded by species-rich communities typical of gravel grounds. Local fishermen were not interested by this resource but knew where to find it. Oyster by-catches were probably frequent in the area.

**2.** By 1868, these beds were discovered by "deep-sea" oyster dredgers from Kent and Essex (UK) in search for brood to relay on their depleted home beds. These skilled fishermen destroyed the Belgian beds in less than five years. This destruction was part of a larger scale overall "deep-sea" stock exhaustion, which took place from the late 18th century to the late 19th century throughout the species distribution range. It preceded overall stock collapse in the early 20th century.

**3.** In the 1900s, G. Gilson recorded low densities of oysters (adults and yearlings) on the ground, probably indicative of an ongoing slow recovery.

**4.** After the First World War, direct impacts to offshore gravels increased subsequently to the introduction of new fishing methods, noticeably motorized bottom trawling, as indicated by Gilson (1921) and Le Gall (1931) – see section 4.4. This impact should be mirrored by a decrease in the amounts of by-catch oysters in trawls in the first decades of the 20th century. Increasing pressure by bottom trawling thus prevented re-installation of stable wild beds through seafloor disturbance, and such is likely to have been the case on the larger scale. Noteworthy, in this period, efforts to revive oyster populations in formerly reknown production centres focused on coastal areas.

**5.** From the 1950s on, much higher level of pressure was put on these offshore gravels by bottom trawling targeting spawning herring (1950s-1960s; see section 4.4), then through use of heavy beam trawls equipped with chain-matrices to chase flatfishes (1960s-on). By-catches of flat oysters became rare, and the species has not been quoted at all in the scientific literature on benthic communities up to the present time. However, the species is still sparsely collected in the English Channel and southern bight of the North Sea, indicating that the species is not "extinct" in the area, but well "cryptic". This means that a low but sufficient amount of reproduction still occurs to maintain the species in what is most probably its optimum habitat.

**6.** To predict the future evolution of oyster beds within Belgian waters, different scenarii can be considered as many parameters will interfere in the process.

To begin with, no recovery of "beds" of this species can be expected to occur at the present rates of bottom trawling. Similarly, gravel extraction activities will lead to permanent and dramatic alterations to the seafloor, which would probably not be suited to flat oyster installation anymore. This happened in the area of Borkum, in Dutch waters, which used to host wild oysters in the past and is nowadays denuded of its gravels (Lindeboom et al, 2005). Noteworthy, large pebbles and cobbles collected by Dutch beam trawlers are traditionally sold in gardening centers, an indication that the substratum is being constantly removed by trawlers (H. Lindeboom, pers. com.). In case physical disturbance would be avoided in the area, it is thus not certain yet that the habitat, which has undoubtedly been modified by decades of direct impacts, is still suitable for installation of a "bed". This aspect is addressed in section 4.5.

Pests are expected to negatively affect chances of recovery of these beds. Elsewhere, the ecological niche left empty by *Ostrea edulis* has been occupied by the invading slipper limpet *Crepidula fornicata*. Preliminary observations made in the frame of section 4.5.2 indicate that this species does not colonize the area of the Westhinder in a way that could affect flat oyster settlement. It seems that *C. fornicata* thrives best in coastal areas, an indication that offshore areas might be more suitable to flat oyster reinstallation. Parasitic diseases such as *Marteilla* or *Bonamia*, which have recently deeply affected remnant exploitations, can also be expected to play a negative role, although certain areas (e.g. the Jersey Island in the English Channel) seem to be "Bonamia-free" (Laing et al, 2005). To our knowledge, there are no data available on the differential effect of such disease on inshore and offshore beds, since the latter do not exist anymore since a century.

The effect of climatic change is expected to be positive through increase of the average yearly seawater temperature (enhanced reproduction rates in summer, diminished winter mortality). The possibility that increased storminess could affect the beds cannot be excluded. However, depth (> 20 meter) is likely to protect open-sea beds against negative impacts by storms.

**Conclusion on resource management**

Our investigation of the historic populations of the European flat oyster and the fishery pressure during the 20th century (see section 4.4. and 4.5.) indicates that bottom trawling is to a large extent responsible for the non-reinstallation of open-sea beds since their overexploitation in the 19th century. This possibility was so far neglected in all studies aiming at a revival of the resource. The widespread opinion that coastal beds "maintained" open-sea beds through larvae dispersal does not hold when the historic abundance of oysters on the latter is reconstructed. On the contrary, it is probable that larvae production at offshore beds was higher than at exploited coastal beds owing to a larger average age. From this perspective, diseases which have decimated cultivated populations during the 20th century might be considered as an epi-phenomenon.

Our results thus suggest that effective protection measures to restore this resource should be preferentially undertaken on the large-scale, targeting former locations of open-sea beds, provided habitats are still suitable for installation of such beds. The existence of a cryptic population of wild oysters in the English Channel and the North Sea suggests that restoring flat oyster populations should be feasible indeed. This species is likely to be favoured by the ongoing climate change but might have to face similarly favoured competitors.

## *4.4 On herring spawning, with a history of bottom trawling activities (20th century)*

Herring (*Clupea harengus*) is an important species for the North Sea Ecosystem functioning owing to its large biomass and the many predators foraging on it (e.g. cod, sharks, cetaceans, seabirds). It is targeted by North Sea fisheries, including the Belgian fleet, since the Middle Ages (De Zuttere, 1909), and the history of its exploitation is amongst the best documented with that of cod (e.g. see Poulsen, 2006). Up to the Second World War, this species was most important to Flemish fishermen.

Herring used to be most abundant in the area of the Eastern Channel and the southern bight of the North Sea, where it belongs to a separate stock known as the "Downs herring" (ICES, 2006). The exploitation of this stock was already subject to monitoring activities in the early 20th century, as illustrated by works of e.g. Gilson (1933, 1934) in Belgian waters or Le Gall (1931) in French waters.

This stock is particular in that it spawns in autumn, unlike the North Sea stock, which spawns in spring. Herring lays demersal eggs which sink down to the bottom. These eggs are "sticky" and adhere to hard substrata such as stones, shells or seaweeds. In the southern North Sea, herring shoals thus specifically select gravel grounds to spawn (Sips, 1988).

The exploitation of herring in Belgian coastal waters (Western coast) by the Flemish fishermen is an old story that goes back to the 12$^{th}$ century (De Zuttere, 1909). "Spent herring" – i.e. herring which has spawn – was captured massively in coastal waters in the early winter. The industrialization of fisheries during the 19$^{th}$ century probably marked the beginning of overexploitation, although statistics were not available in Belgium before the early 1900s.

Fishing techniques shifted from large driftnets used since the early middle-ages to trawling in the late 19$^{th}$ century. Drifters and trawlers continued to co-exist in this area for several decades, but trawling finally appeared as more efficient to chase this fish as the stocks diminished. In 1930, Le Gall (1931) indicated that only small amounts of difters ventured in the Dijck-Sandettié area (to the S-W of the Hinder banks, in French waters), because they could not work appropriately owing to the presence of numerous trawlers. The latter made considerable catches in this area during late autumn and early winter, thus the spawning season. This contribution fully confirms the aforementioned statement by Gilson (1921) of an increasing trend of bottom trawlers to work on offshore gravel grounds, since these were the spawning grounds of herring.

Gilson (1933) located the spawning grounds "*in the triangle formed by the Ruytingen, Sandettié and Hinder sand banks*". Postuma et al (1977) have later mapped the extent of spawning grounds throughout the Eastern Channel and North Sea (figure 4-35), confirming Gilson's early statements.

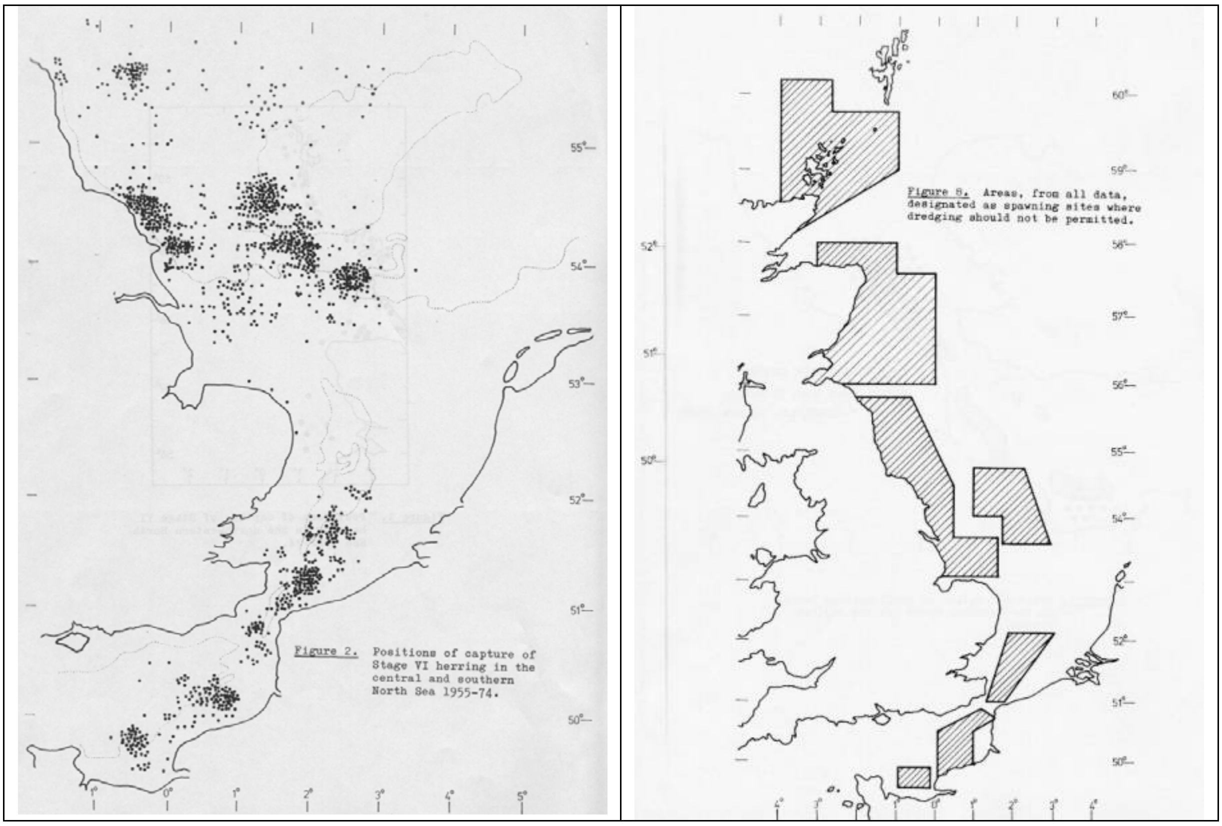



Figure 4-35: distribution of herring spawning grounds in the Eastern Channel and North Sea. Source: Postuma et al, 1977.

When further mining the ICES literature, gravels of the southern bight appear to have been targeted by herring trawlers of Germany, The Netherlands, Belgium, France and the United-Kingdom at spawning time (Burd, 1978). Trawlers concentrated on spawning grounds during the 1950s, spawning herring being used for industrial purposes. In the period 1946-1958, a sharp decrease in the larval production on the Channel spawning grounds was evidenced by Burd and Holford (1971; figure 4-36), followed by ten years of stagnation, leading the authors to consider the state of the Downs stocks as "critical". Burd and Wallace (1971) further suggested that this fishery could have been responsible for the observed shortage at herring larvae as compared to amounts expected based on spawning stock assessment. Noticeably, these authors acquired a part of their material onboard UK vessels operating at the Hinders ground.

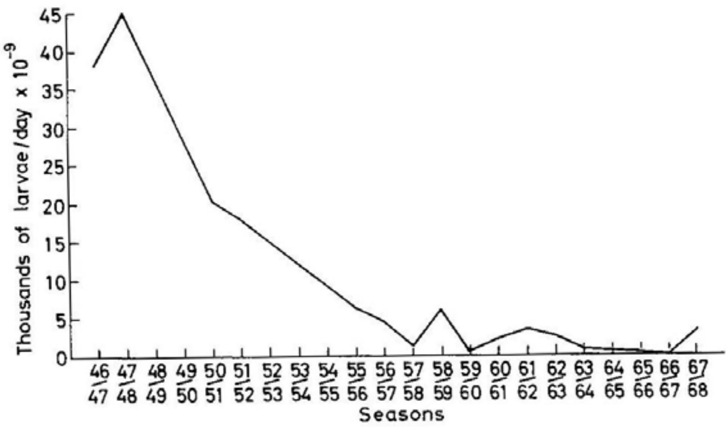



Figure 4-36: Evolution of the seasonal larval production on the Channel spawning grounds. Source: Burd and Holford, 1971.

Postuma (1977) later advised to close certain gravels to the aggregate extraction industry (see figure 4-35, right) in order to avoid impact on herring stocks and protect this fishery, but he surprisingly provided no information on impacts formerly caused by trawlers to these grounds.

The 1960s marked the return of beam trawling (de Groot and Lindeboom, 1998), using heavy iron gears equipped with chain-matrices, a system adapted to enable trawling on gravel grounds. Since then, the power of beam trawlers has steadily increased. Thus, after the dramatic collapse of herring in the 1960s, we must acknowledge undocumented but certainly high impacts to gravel habitats by beam trawlers now chasing flatfishes.

Thus, through investigation of the literature dealing with bottom trawling in the southern bight of the North Sea, we can track the historic impacts of fishing on gravels since 1900 in four stages:

1. **1900-1920.** The Belgian trawling fleet was mainly composed of sailing vessels, yet as much as possible avoiding "stony grounds" but active in the "Hinders" fishing ground (Pype, 1911). However, the area has probably been increasingly targeted by other fleets in this period, such as the UK fleet which already armed more than 1000 steamtrawlers in the early 1900s.

2. **1920 – 1940.** A clear trend to increased trawling on gravel grounds of the southern bight occurred owing to motorization of the fleets and amelioration of otter trawls. The actual impact seems impossible to estimate, but the pressure was high enough to cause concerns expressed in Gilson (1921), who recommended to undertake specific protection measures on gravel habitats. Investigation of herring exploitation rates in the southern bight before and after the Second World War carried out by Burd (1978) confirmed the accuracy of Gilson's suggestion.

3. **1945 – 1960**. After a big rise in herring production owing to cessation of fishing activities during the Second World War, heavy impact of herring trawlers (otter trawls) took again place on gravel grounds at spawning time. The impact to the habitat is hard to assess but must have been significant; there has most probably been a major impact to spawning success of the Down's herring, which underwent collapse in the late 1950s. This collapse has triggered regulations aimed at enabling the stock to recover, but none of these targeted specific protection of offshore gravels (quotas).

4. **1960 – nowadays.** Trawlers turned back to beam trawling in the southern bight with chain-matrices and increasingly powerful ships. The fishing pressure is not documented, but significant impacts to the seafloor must have occurred. The most recent impacts, with a basic estimate of trawling pressure, are addressed in secton 4.5.3.

As far as we know, the present status of herring spawning on gravel fields of the southern bight is undocumented. Our investigation of the historic literature put forward offshore gravel fields as an essential biotope to a second key species in the North Sea ecosystem functioning. It shed back light on the fact that negative interaction between different fisheries has probably led to yet under-estimated alteration of major ecological functions associated to this biotope. Such is likely to be the case at the larger scale outside the limits of territorial seas, where fishing activities long remained poorly regulated.

## *4.5 Contemporary situation of gravel habitats and epibenthos, and comparison with the baseline situation*

At this stage of the research, we will focus on a preliminary examination of gathered data to better understand the composition of the seafloor, the associated epibenthic biodiversity, their long-term trends and the causes for observed changes. A detailed inventory of information gathered so far at every target zone is provided in annex 6: acoustic map of the zone, position of 2m beam trawl and dive tracks, images of epibenthos samples, extracts of underwater video footages, qualitative description of Gilson's dredge content and observations on long-term changes at the station.

### 4.5.1 Seafloor nature

#### *4.5.1.1 Acoustic mapping*

Data gathered by means of multibeam echosounding provide detailed information on morphology (bathymetry) and nature (backscatter strength) of the seafloor in the surveyed areas (figure 4-36). The resulting small-scale acoustic images of the seafloor at target Gilson's stations enabled us to better understand *à posteriori* the habitat re-sampled with the 2-meter beam trawl in the 17 target zones drawn around selected Gilson's dredge tows. Three targeted zones were not covered with the multibeam echosounder, whereas no benthos sample could be collected at the covered zones "H2", "I" and "O". As explained in section 2, the areas are unfortunately slightly shifted as compared to Gilson's dredge tows due to late correction in the positions of the latter. However, apart from zones "I" and "J", the shift is low enough to enable comparisons between historic and modern data.

The map shows that the historic stations encompassed different biotopes. The main gravel fields are located in the gullies between sand banks and are evidenced by a typical "hillocky" morphology (see also figure 4-37), whereas their backscatter values are markedly higher than that of the sand banks. Highest backscatter values are observed in the central part between zones F, G and N on one hand and L, M on the other hand, where depth is maximal (35 m). Between the Westhinder and the Oosthinder sand banks, our main target area, the main gravel field has a breadth of about two kilometer and a length of about fifteen km.

The acoustic map also reveals that every sand bank displays a particular morphological pattern, with a marked difference between the Western and the Eastern flanks.

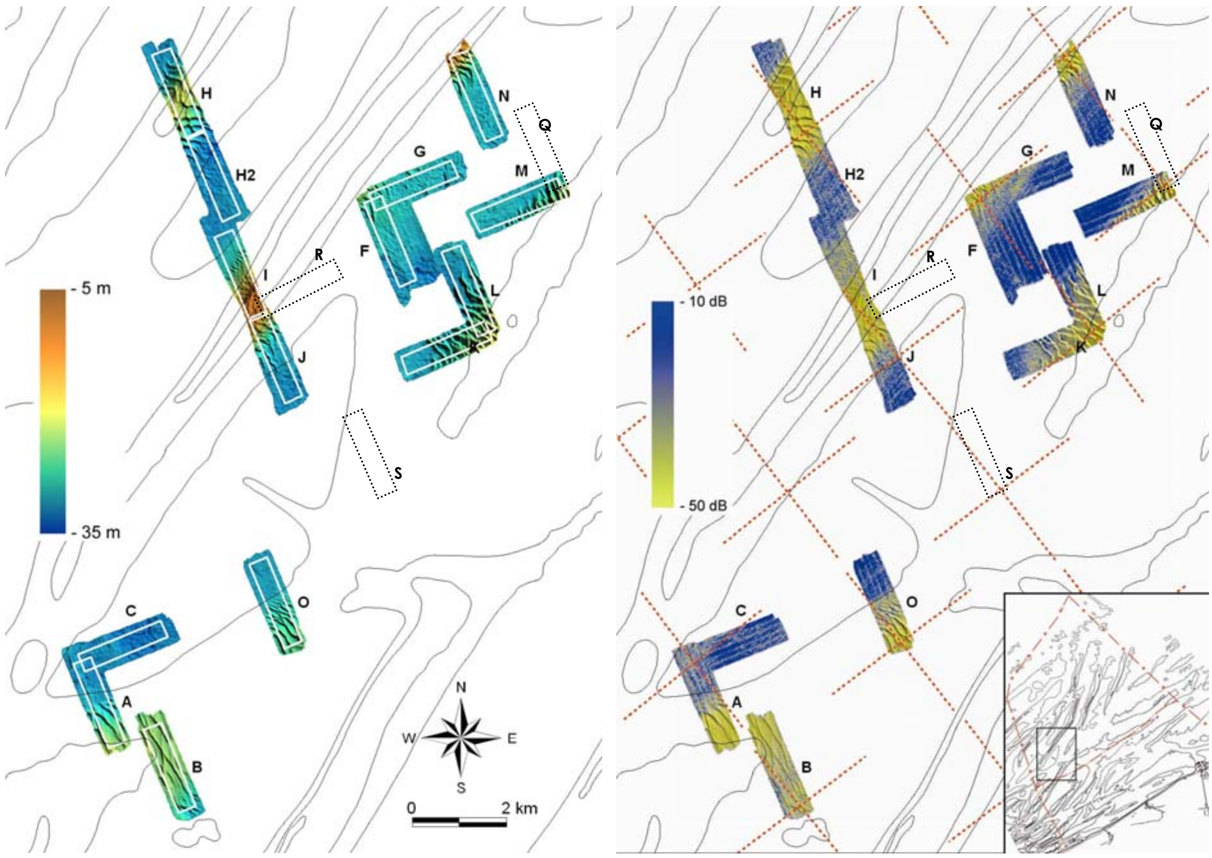



Figure 4-36: Acoustic map of areas surveyed with the multibeam echosounder. Left: bathymetry (m). Right: Acoustic backscatter strength (dB).

Three main zones can be described based on supervised seafloor classification (Reyns et al, 2005; figure 4-37). Firstly, the main gravel ground displays a typical "hillocky" morphology and minimal sand content. Secondly, the sand banks are characterized by large transversal sand waves and absence of cobbles. Thirdly, a transition area appears where sand content increases toward the sand bank. In this "transitional" zone, patches of gravels are visible between large sand waves; these are in direct connexion with the main gravel field.

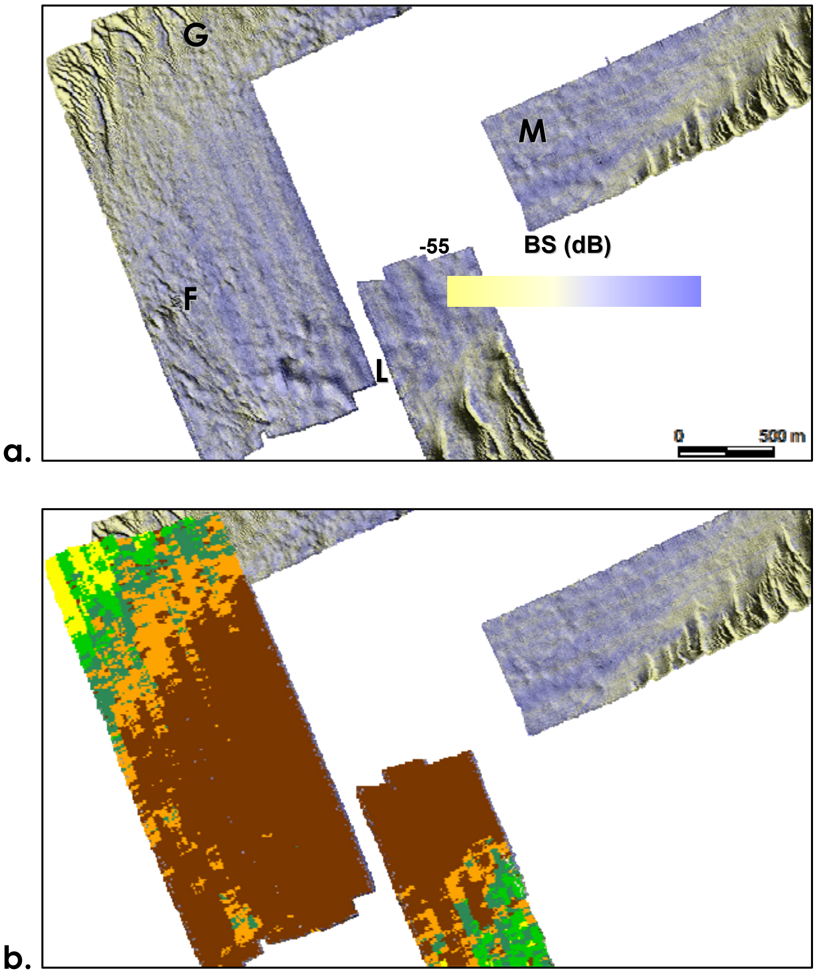



Figure 4-37: a. Backscatter values superimposed on bathymetry at zones F, G, L and M. High backscatter values (blue) coincide with gravels, low backscatter values (yellow) coincide with sands. b. Superimposed image of supervised classification on zones F and L. Colors refer to classes defined in table 4-1.

| | | | | | |
|---|---|---|---|---|---|
| C1 |  | - Highest BS<br>- Lithology :<br>Clastic gravels<br>Sandy gravels<br>- «Hillhocky » morphology<br>- Channel | C4 |  | - Lowest BS<br>- Lithology :<br>Fine homogeneous sand<br>- Highest area of the sand bank |
| C3 |  | - High BS<br>- Lithology :<br>Variable: bioturbated muddy sand to sandy gravels<br>- Channel to foot of bank slope | C2<br>C5 |  | - Moderate BS<br>- Lithology :<br>Medium to coarse sand<br>Gravely bioclastic sands (shells or shell debris)<br>- Sand bank |

Table 4-1: Supervised acoustic seafloor classes from Roche (2002). Color codes (left column) are used in figure 4-37.

#### 4.5.1.2 *"Sea-scape"*

Scuba-operated videos and images enabled to better characterize the seafloor nature in the main gravel fields thanks to exceptional conditions of visibility. Dives were carried out at zone F, B and H2 in June 2005 (see figure 3-5) and further dives were conducted in zone F in September 2005 in conditions of much reduced visibility. In zones F and H2, fragments of all sizes were encountered in patches of varying densities at the surface of the sediment, which is covered by a very thin layer of sand (5 to 15 cm; figure 4-38). Overall, the seafloor is very heterogeneous at various scales (1-100m).

In zone B, the dive was conducted on a sandy seafloor. Occasionally, isolated cobbles were encountered (see annex 6, zone B, for images of the seafloor in this zone). Measures of sand thickness confirmed the sandy nature of the area (sand layer > 50 cm), whereas these cobbles were laying on top of the sand. These were most probably thrown overboard by beam trawlers operating in the area (see section 4.5.3.).

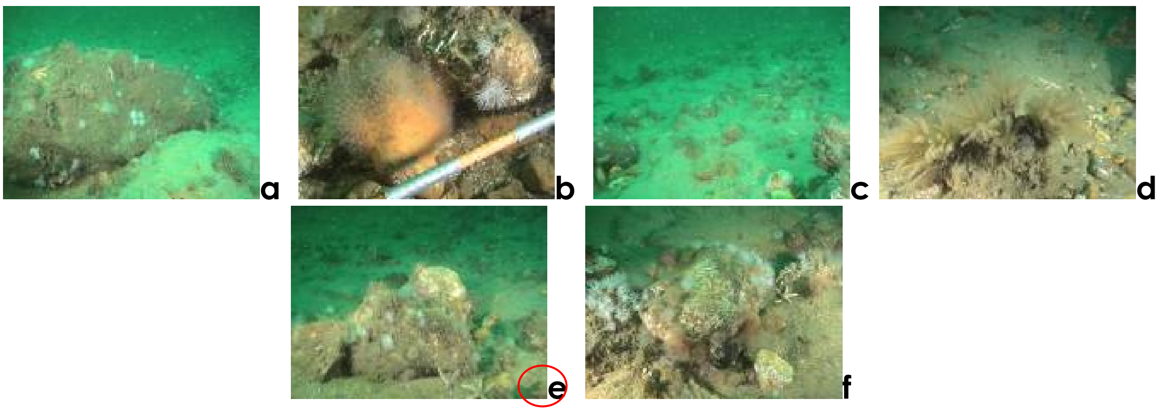



Figure 4-38. Some images of the seafloor at patches of cobbles. a. A large typically colonized cobble; b. A small colony of the dead-man finger *Alcyonium digitatum*; c. general view of the cobble field; d. a shoot of the hydroid Nemertesia sp; e. a large and typically colonized coble; note specimens of A. rubens displaying arms under regeneration (red circle) and sea urchins (*Psammechinus miliaris*) on the cobble; f. a richly colonized cobble, showing local abundance and diversity of sea anemones

Hillocks encountered by divers visually resemble sand dunes but they are made up of cobbles and pebbles covered with a similarly thin sand layer (figure 4-39), what explains their high backscatter values (figures 4-36 and 4-37).

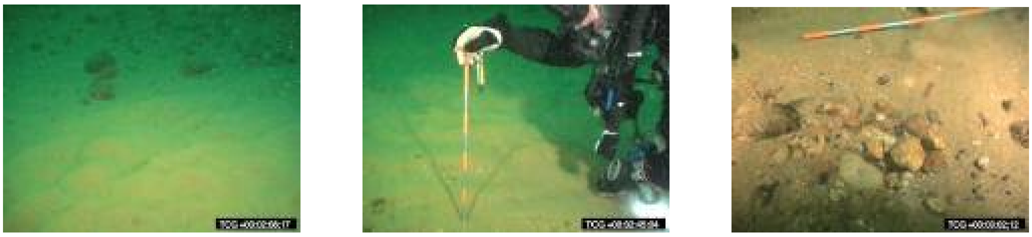


Figure 4-39: A "hillock" from zone H2. Left: view from top, showing relatively homogenous sand cover on top of the hillock, with abundance of emergent cobbles at its basis. Center: measuring the sand thickness on top of the hillock (5-10 cm). Right: cobbles found underneath the thin sand layer at the same place.

### 4.5.2 Epibenthic communities - 2m beam trawl samples

The detailed analysis of benthic samples could not be fullfilled in the time-frame of the project. However, the surveys evidenced some clear patterns which will be presented qualitatively on the basis of observations detailed in annex 6. Partial results of sample analyses carried out so far will be used to derive first observations on major long-term changes in section 4.5.5.

#### *4.5.2.1 Sand banks*

Epibenthos samples collected on sand bank flanks are very similar accross the whole sampling area and charaterized by a typical species-poor fauna, composed by few and variably abundant invertebrate species: swimming crabs *Liocarcinus* spp. (mainly *L. holsatus*), hermit crabs (mainly *Pagurus bernhardus*), the gastropod *Nassarius reticulatus* and the brittle-star *Ophiura ophiura*. Shrimps (*Crangon crangon, Hyppolyte varians*) are abundant in the hyperbenthic compartment. Fishes are dominated by the lesser weaver *Echiichtys vipera*, abundant in all samples as well as in the transitional areas, the sandeel *Hyperoplus lanceolatus*, and various juvenile flatfishes (mainly *Scophtalmidae* and *Soleidae*), by contrast with the gravel field where mainly adults were encountered.

#### *4.5.2.2 Gravel fields*

In the gravel fields, species-rich samples were gathered together with varying amounts of cobbles of all sizes. On the cobbles, few typical species are generally associated and found in almost every sampling station.

The tube worm *Pomatoceros triqueter* is present on almost all pebbles, cobbles and shells, sometimes covering 100% of the surface. When coverage by this species is high, specimens of the Polychaete worm *Eulalia viridis* are found amongst its tubes in all samples, suggesting that the species are somehow associated. The polychaete *Lepidonotus squamata* was also often encountered in holes of the stones or under *Pomatoceros* tubes. In certain portions of the sampling grids, a high proportion of the *Pomatoceros* cover was damaged but covered with other species such as sponges or sea anemones. This observation points at direct impacts by mechanical disturbance caused by bottom trawling (see section 4.5.3).

Most samples are characterized by mixed shoots of *Tubularia larynx* and *T. indivisa* (Hydromedusae), *Lanice conchilega* (Polychaeta) and the bryozoan *Electra pilosa*. The basis of the *Tubularia* shoots are often covered by tubes of small amphipods (probably of the Genus *Jassa*) which were abundant in many samples despite their small size well under our net mesh (these small species were not determined). This species assemblage, together with the widespread tubeworm *Pomatoceros triqueter*, dominates the epilithic cover of cobbles, an observation confirmed by underwater video footages. The ascidian *Ciona intestinalis* was often observed as well. The deadman fingers *Alcyonium digitatum* was encountered in many samples and can be thought of as part of this species association; however, colonies larger than a few cm were rarely observed, except in the "refuge" areas (cf section 4.5.4). In general, numerous but tiny colonies are observed. Various undetermined encrusting bryozoans are also abundant, with *Conopeum reticulum* often creating extensive crusts as compared to other species (see De Blauwe et al (2006) for further precisions on bryozoan diversity).

A wide array of small hydroids (10 to 20 species) is also presentl. Two species are regularly encountered in the samples and the underwater video footages, *Nemertesia antennina* and N. *ramosa*. Different species of sea anemones (Actiniaria) were observed but could not be determined apart from *Metridium senile*, which was sometimes abundant on certain cobbles, and some other abundant species (such as *Sagartia elegans*). Sponges (about ten species) also colonize the cobbles, with the boring species *Cliona cellata* most abundantly observed, sometimes entirely covering the cobbles. Large branching specimens of *Haliclona oculata*, of which samples were collected by Gilson, were not encountered. Solitary and colonial ascidians are also represented by about ten species, with C. *intestinalis* most commonly observed.

The mobile epibenthos is dominated by echinoderms: the starfish *Asteria rubens*, the sea urchin *Psammechinus miliaris* and the brittle-stars *Ophiura ophiura* (sandy and transitional areas) and *O. albida* (gravels). Interestingly, the population of *A. rubens* was dominated by small specimens (maximum arm length smaller than 10 cm). It is furthermore characterized by a large amount of specimens with one or more arms under regeneration, indicative of previous damage. In large specimens, this observation is likely to indicate impact by bottom trawls; however, a similar proportion of very small individuals were affected by this phenomenon, which suggests that some unidentified predator could be involved as well. The underwater videos indicate that *P. miliaris* and small *A. rubens* tend to aggregate on the cobbles, whereas larger starfishes are often encountered on sand.

The small crab *Pisidia longicornis* is represented in many samples from the main gravel field. However, it is much less abundant than the aforementioned echinoderms.

The common whelk *Buccinum undatum* was regularly encountered, but always at low densities (max 3 specimens); it was always observed on sand on the underwater videos, which confirmed the low abundance observed in the epibenthic samples. Similarly, the velvet crab *Necora puber* is a characteristic species with low densities; on underwater videos, the species was observed on few occasions under cobbles. 5 to 10 species of nudibranchs were also collected, of which *Dendronotus frondosus* was the most common.

The brittle-star *Ophiothrix fragilis* was found to form dense accumulation patches on the southern tip of the Oosthinder sand bank (zone "S"; estimated densities of minimum 1000 to 2000 specimens per square meter, see annex 6). This species is considered as a dominant component of gravels in the French part of the North Sea (Davoult et al, 1988; Alizier, 2005) and similar densities are quoted. In our survey, it was rare in other parts of our survey area, what suggests high levels of small-scale heterogeneity in the distribution of this species. However, it is possible that seasonal variation could be involved. In sample #33, more to the North (zone K), it is associated with higher abundance of the anthozoan *Metridium senile*. Strikingly, this portion of the survey area was also richer in old valves of the flat oyster *Ostrea edulis,* which is likely to indicate former position of a bed. Since both species are suspensivorous and most abundant in this part of the survey area (*O. edulis* prior to 1870 and *O. fragilis* in 2005), this observation could be indicative of heterogeneous hydrodynamics favouring this feeding mode at this very location. Interestingly, it is also in these surroundings that few samples gathered specimens of the burrowing sea urchin *Echinocardium cordatum*, confirming that the area probably bears a distinct biotope. As observed in the French area, species diversity was reduced at patches of *O. fraglis*. An edible crab *Cancer pagurus* was collected at one of these stations.

At some stations, we furthermore gathered living specimens of the boring mussel *Barnea parva*, which had not yet been recorded in Belgian waters, in cobbles (Kerckhof and Houziaux, 2006).

Benthic fishes are numerically dominated by gobies (*Pomatoschistus* spp) and dragonets (Genus *Callionymus*). *C. reticulatus* was identified in some samples. *Agonus cataphractus* is regularly encountered at low densities and isolated specimens of *Myoxocephalus scorpius* were occasionnally collected. Adult flatfishes (dab *Limanda limanda*, plaice *Pleuronectes platessa*, sole *Solea* sp and lemon-sole *Microstomus kitt*), sometimes large, were commonly encountered in samples and on video footages throughout the survey area, more often in the gravel and transitional zones. They were more abundantly collected in the northern part of our survey area. We note one occurrence of a juvenile ling (*Molva molva*), a deep-water species of which juveniles were reported as occasionally occurring in the southern bight (Gilson, 1921; Poll, 1947).

#### *4.5.2.3 Transition zone*

In the transition zone, a mixed fauna is observed where species typical of both habitats co-exist. Pagurids, britle-stars and *A. rubens* tend to be abundant everywhere on sands and gravels. Sandeels are not observed in this transition zone, but swimming crabs (mainly *Liocarcinus holsatus*) or the shrimp *Crangon crangon* often occur. Many species typical of gravels are encountered as well, including aforementioned flatfishes.

One seahorse *Hippocampus hippocampus* was collected in sample #30 (zone R). Gilson (1921) and Poll (1947) both consider this species as occasional in Belgian waters. It thus seems that off Belgian (and French) coasts, where seaweeds are absent except on coastal artificial hard substrates (Kerckhof and Houziaux, 2003), this species utilizes branching epifauna as substratum. The species is listed under the IUCN red list of threatened species, but is considered as "data deficient" for implementation of adequate management measures.

At this stage, it thus seems that the epifauna of gravels is heterogeneous at the scale of the survey area, with a common set of characteristic species together with rarer species and patches where different species thrive. The faunas of adjacent gravel and sand areas markedly differ, with the epifauna of sand banks matching species-poor epibenthic communities so far described for the Belgian waters (see review by Cattrijsse and Vincx, 2001).

Three exceptional samples were however collected within the "transition" zone: samples #37 and #38 from zone "L", and sample #51 from zone "M" (see annex 6). These samples showed a larger species diversity than other samples and unique occurrence of large specimens of branching species, noticeably *A. digitatum*, *Alcyonidium* sp or the sponge *Suberites ficus*. These samples can be considered as typical of the gravel field. They are further discussed in section 4.5.4.

### 4.5.3 Bottom trawling impacts

The acoustic map of the seafloor, combined with observations of damaged epifauna in the 2-meter beam trawl (see annex 6), indicate a heavy pressure by bottom trawling in the main gravel field, mostly visible on the adjacent "transitional" areas. An example is provided in figure 4-40.

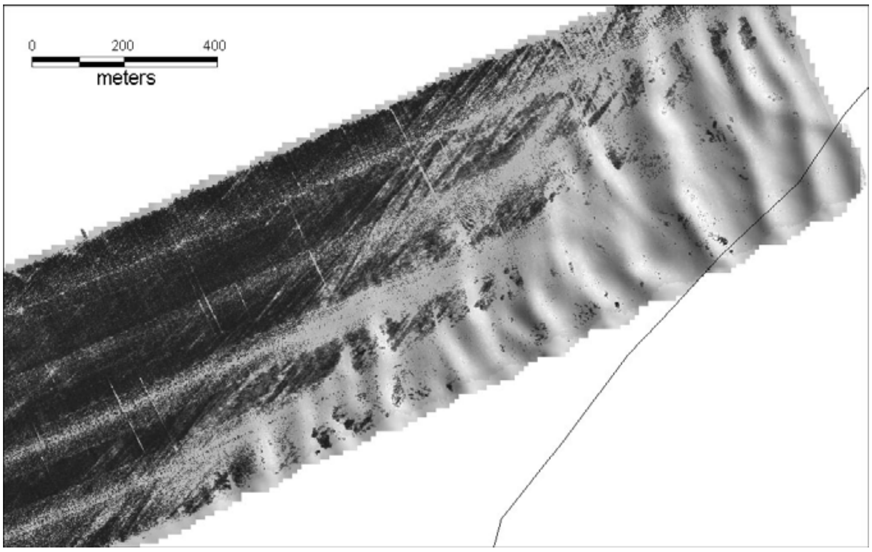



Figure 4-40. Zoom on zone "M" (see figure 4-36) visualized in levels of grey to evidence abundance of trawl marks in the transition area between the sand bank and the gully. Trawl marks (dark tracks parallel to the Oosthinder sand bank, to the right of the image) have an average breadth of 10 m. Encounters of trawls with large sandwaves, with a subsequent "jump" of the gear over the seafloor, are visible.

Backscatter strength shows higher values in the trawl path, but surprisingly the tracks cannot be detected on the bathymetric / geo-morphologic maps with this type of medium-frequency multibeam echosounder. It thus seems that high backscatter values observed are due to some compaction of the sediment and/or a removing of the small sand ripples after passage of the trawl (smoothing effect). The latter can only occur if a minimal sand thickness is present. This could explain the absence of visible tracks in the main gravel field, where the sand cover was determined as very thin (5-15 cm). This could also account for some longer duration of the trawl mark visibility in the transitional area as compared to sand dunes where sand transport is probably more active.

In the dune areas bordering the gully, encounters of trawls with large sand dunes are visible, the gear deeply entering the dune then "jumping" over the seafloor. We have experienced similar encounters with our 2m beam trawl and, despite the much reduced speed (l-2 knots) as compared to commercial trawlers (6-8 knots), we experienced high rise in the cable tension. Trawling across these sandwaves is thus dangerous, what explains the lower abundance of trawl marks closer to the sand bank. It seems likely that trawlers tend to operate more toward the central gully.

A quick estimate of the time necessary to fully trawl the area can be made, as trawlers visibly operate parallel to the axis of the Wethinder sand bank. The area is fished by two main types of beam trawls: twin beam trawls of 8m, representing a breath of 16 meter; single beam trawls of 12 meters. The gear is towed by powerful vessels of more than 2,500 kW (figure 4-41). Respectively 125 and 167 passages are thus needed to cover the 2km-wide gravel field. We can multiply the trawl coverage by a factor 2 or 3 to account for overlaps, providing respectively 250 and 334 passages or 375 and 500 passages. Assuming a low frequentation of one active trawler per day during 200 days a year, the gravel field must be entirely trawled within two years. Four years is thus the maximum span of time during which a square meter of the seafloor remains undisturbed.

Figure 4-41. A large Dutch bottom trawler operating in the surroundings of the Westhinder area. Image: J. Haelters, MUMM, 2007.

This estimate evidences that long-lived species cannot stand the current levels of beam trawling pressure, and our investigation of the literature indicates that such is likely to be the case since decades (see section 4.4.). Although no adequate measurement of proportions of damaged fauna was carried out yet, highest levels of damage were observed in the southern portion of the surveyed area (zone "C"). The 2m beam trawl also obviously brought larger amounts of large flatfishes and cobbles in the northern portion of the survey area. The pressure by bottom trawling thus appears to be highest in the southern portion of our survey area. This seems to be supported by acoustic maps of the seafloor (see annex 6).

### 4.5.4 Discovery of refuge areas: a confirmation of trawling pressure

As outlinedin section 4.5.2, three samples collected in the transition zone of areas "L" and "M" were typified by an exceptional species diversity and occurrence of large branching species (see also annex 6). Examination of the acoustic maps (figure 4-42) evidences the fact that the gravel fauna of these samples comes from two small patches of gravel located between large sand waves. These patches are connected to the main gravel field, but are obviously protected against bottom trawling pressure by the sand waves. This is evidenced by the lower amounts of trawl marks visible accross them.

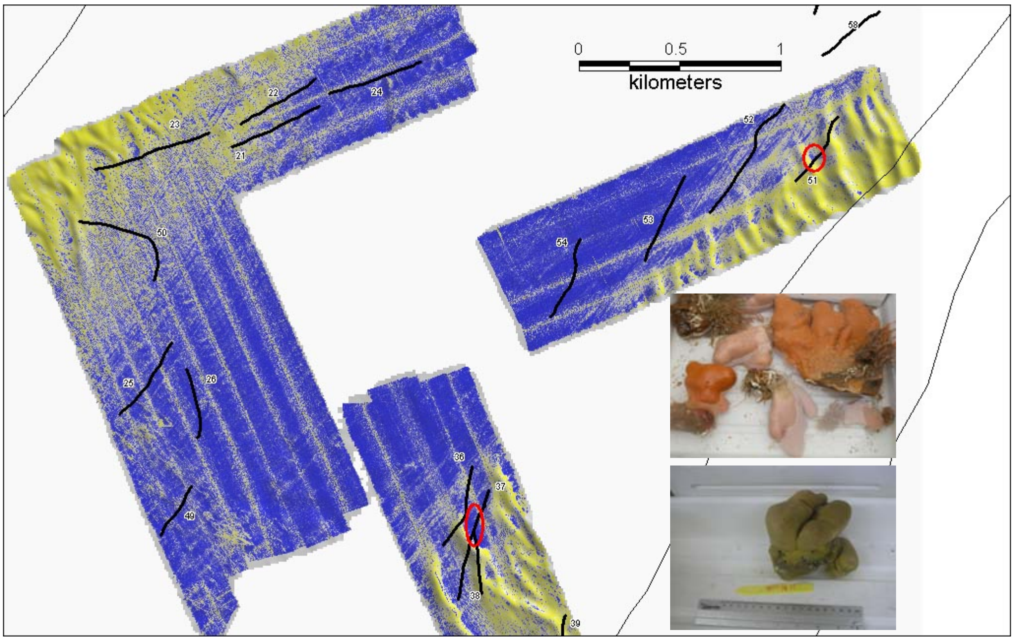



Figure 4-42: position of identified "refuges" for species ensitive to mechanical disturbance along the border of the main gravel field (red circles). Embeded images from sample #37: above, large colonies of Dead-man fingers *Alcyonum digitatum*; below, a large specimen of the sponge *Suberites ficus*.

Observations made very recently by divers fully confirmed the existence of a "refuge" area on zone "L" evidenced by samples #37 and #38 (see Houziaux et al, 2007). Images of the seafloor at the very gravel patch indicate a more uniformly flat surface than previously observed in zones F and H2. The sand layer covering cobbles and pebbles is thinner and perhaps more homogeneous. On the acoustic map, the backscatter values appear to be homogeneous and high across the patch. The epifauna conspicuously exhibits species diversity much higher than observed in the main gravel field, with e.g. nudibranchs or large sponges visible on photographs despite a much lower visibility than in June 2005. Noticeably, one image displays an item which much resembles a typical flat oyster shell, possibly a living specimen, but further investigations are needed to ascertain this assumption.

The recent dive thus fully confirmed our statement that a conspicuously richer epifauna is observed in this patch as compared to the swale. It can also be questioned whether bottom trawling is responsible for the apparently more heterogeneous seafloor surface observed on the scuba-operated videos of gravel fields at zones "F" and "H2" as compared to the seafloor of this gravel patch.

This discovery leads to two major conclusions:

1. The main gravel field is indeed suffering from major bottom trawling pressure resulting in at least a reduction in size of sensitive branching species.

2. Sensitive species are not eliminated from the system, and are likely to survive in the form of a "cryptic" population. It would not be surprising that large specimens of European flat oysters occasionally caught in the English Channel and southern North Sea originate from such marginal gravel patches along main trawling lanes.

### 4.5.5 Main observations on long-term changes

#### *4.5.5.1 Seafloor composition*

The description of the seafloor provided by the survey of 2005 is in agreement with observations based upon Gilson's sediment information and suggests that the surficial sediment has remained a "sandy gravel".

Unfortunately, the long transverse dredgings of Gilson lead to an overestimate of the breath of the main gravel field, which can be evidenced by superimposing the acoustic map of the seafloor on the historic map of gravels (figure 4-44, left). Observations of large shell abundance at zone "S" match high shell contents in sediment samples of Gilson.

When the clusters derived from multivariate ordination of Gilson's epibenthos samples are superimposed on the acoustic map of the seafloor (see section 4.2.4), an excellent match is observed between the species-rich cluster and the distribution of high backscatter values (figure 4-44, right).

Despite a lack of fine tuning, the map of gravels based on Gilson's epibenthic communities thus largely surpasses expectations intuitively arising from such historic data-set, while it indicates that the sand banks have not significantly moved over the last century.

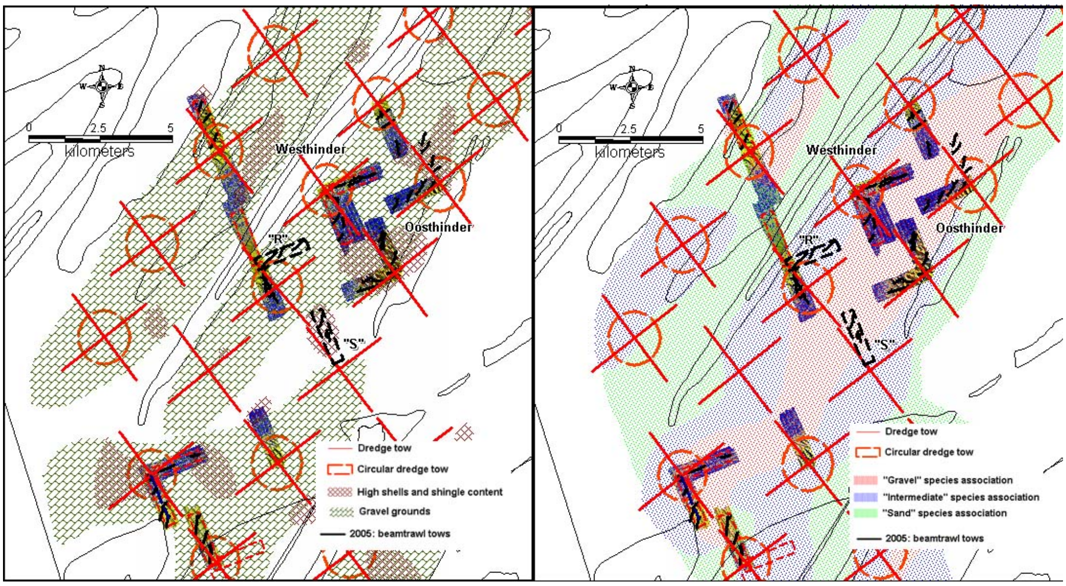



Figure 4-44: superimposition of Gilson's data on the acoustic map of the seafloor created in 2005 (multibeam echosounder). Left: initially determined distribution of gravels and shell patches (see figures 4-3 and 4-4); right: distribution of epibenthos clusters determined based on Gilson's epibenthos data so far available (see figure 4-22).

In the southern part of the surveyed area (zones A, B and perhaps C), a shift from a typical gravel epifauna toward a more typical sand bottom epifauna is suggested by qualitative long-term comparisons, possibly pointing at an increase in the sand content of the surface sediment (see annex 6). It seems to be partly confirmed by values of backscatter strength, lower than more to the north. Interestingly, it is in this area that bottom trawling pressure seems to be highest (see section 4.5.3). We can not yet eliminate the possibility that species typical of gravels were collected by Gilson outside the sandy area, at one or another extremity of the dredge tow. Deeper investigation is needed to ascertain the suggestion. Such an increase in sand content was recently observed in the Dover Straight by Carpentier et al (2005) on a 30 year time-span. Causes for this phenomenon were not elucidated and could involve either natural (long-term cycles) or human-induced (bottom trawling: removal of the hard substratum) causes, or a combination of both.

#### *4.5.5.2 Epibenthos*

From qualitative observations described in annex 6, some trends appear in the relative abundances of common species. For instance, *Asterias rubens* can be considered as a dominant species in recent samples, an observation confirmed by underwater videos, while it was much less abundantly collected by Gilson. At presently observed levels of abundance, the species should have been more abundantly represented in Gilson's samples.

These trends can be further explored by the comparison of frequencies of occurrence of some species well represented in historic and modern samples (figure 4-45; annexes 7 and 8). These data are considered as "catch probabilities". Indeed, for these species, catch probability by either Gilson's dredge or our beam trawl can be considered as proportional to abundance at the scale of the considered area.

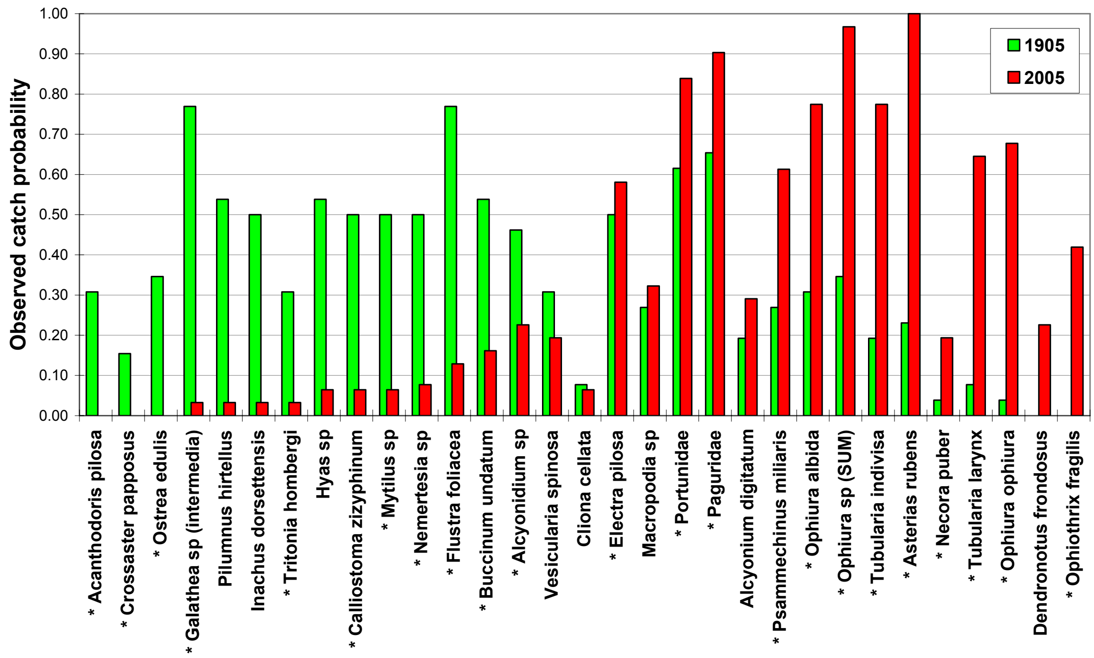



Figure 4-45: comparison of catch probability in Gilson's survey (green bars; spring-summer1905; n=21 dredge tows) and our survey (red bars; spring 2005; n=31 beam trawl tows) for 30 species commonly encountered and accurately collected by both sampling gears. Densities were further aggregated for the genus *Ophiura*. Differences in catch probabilities of species marked with an * are unlikely to change subsequently to further processing of samples from the survey of 2005.

Besides the European flat oyster *Ostrea edulis*, two occasional species, the starfish *C. papposus* and the nudibranch *A. pilosa* were not collected back at all. The first is a voracious predator, mainly feeding on other echinoderms (Gaimer et al, 2004), whereas the second forages on branching bryozoans (Mainly *Flustra* and *Alcyonidium*; McDonald and Nybakken, 1996).

The abundant decapod *Galathea* sp (mainly represented by *G. intermedia*), nudibranchs of the genus *Tritonia* (only *T. hombergi* illustrated), the Gastropods *C.zizyphinum* and *B. undatum*, the branching bryozoans *F. foliaea* and, to a lesser extent, *Alcyonidium* sp and the hydrozoans of the genus *Nemertesia* (*N. ramosa, N. antennina*) can be considered rarefied, and this is the case for some other species for which further sample or data processing is however necessary (e.g. epibenthic bivalves of the family Pectinidae, not considered in this project, are represented in the historic data but were not collected back alive in 2005). The bryozoan *Bugula flabellata* seems to be closely associated to *Flustra foliacea*, on which it is generally found in the historic collection. It wasn't collected back, what tends to confirm this association and highlights a cascading effect of species rarefaction. 0n the contrary, *Electra pilosa* overgrows a wider range of species, including *Tubularia* spp to which is was systematically associated in 2005.

Some species display similar catch probabilities in 1905 and 2005. The case of *Alcyonium digitatum* is interesting, as this species is yet abundant in the area, but mostly in the form of tiny colonies, while much larger colonies were gathered by Gilson (tiny, unconspicuous colonies are even likely to be under-recorded in this data-set). On the underwater video footage, colonies of about 5 cm length were observed on some occasions, confirming results obtained with the trawl. This observation holds for the aforementioned rarefied branching bryozoan *Alcyonidium* sp, which is scarcer (it was not detected on video footages). It is interesting to note, although inconclusive at this stage, the apparent decrease in the nudibranch *T. hombergi*, since this species feeds exclusively on *A. digitatum* (McDonald and Nybakken, 1996).

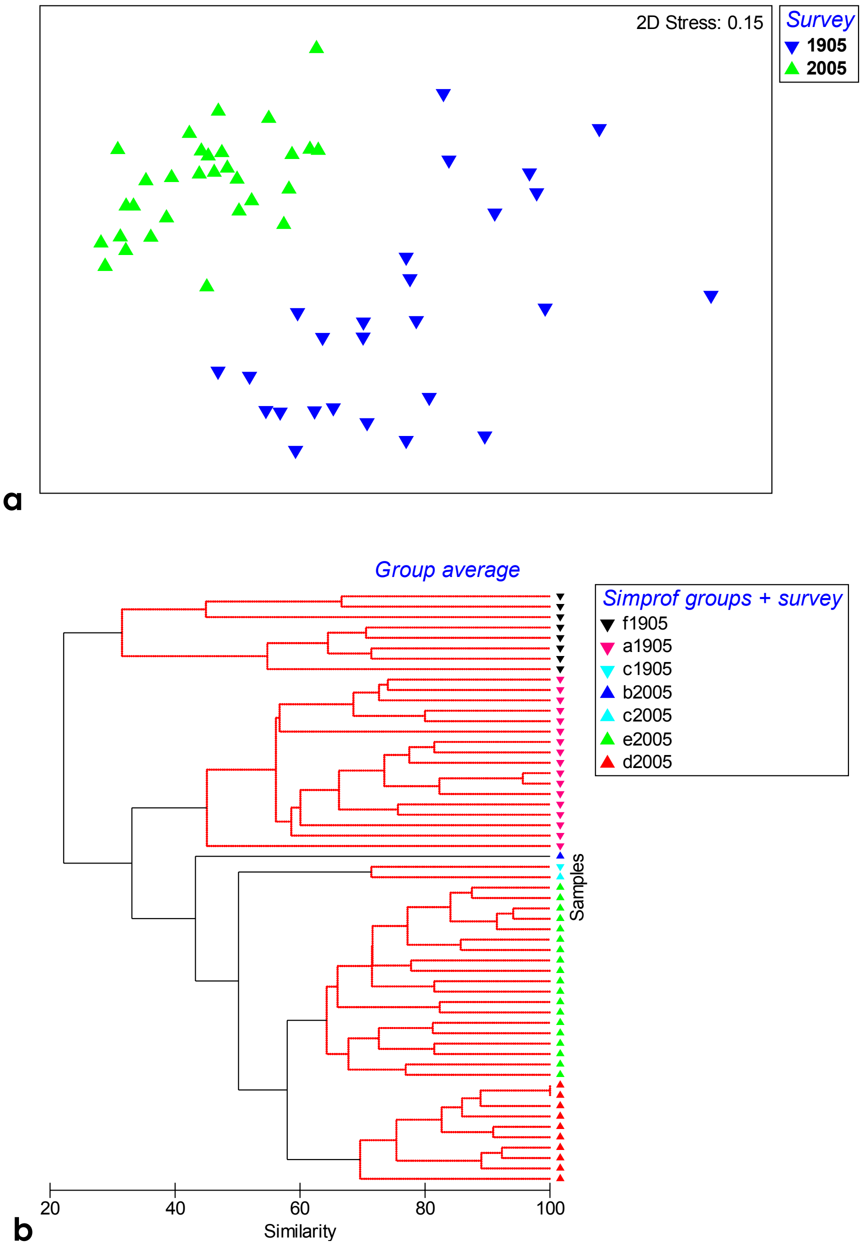
A slight and inconclusive increased catchability is observed for pagurids (hermit crabs) and for Portunidae (swimming crabs): these decapods were already abundant in 1905.

The nudibranch *D. frondosus* was only collected in 2005. The echinoderms *P. miliaris*, *A. rubens* and *O. ophiura* and the hydrozoans of the genus *Tubularia* (*T. indivisa* and *T. larynx*) display considerably higher catch probabilities in 2005. The frequency of occurrence of the brittle-star *Ophiothrix fragilis* is likely to be lower than displayed once all samples will be analyzed owing to his patchy distribution (southern tip of the Oosthinder sand bank). This species is absent from Gilson's samples; only a few specimens have been found at all in his entire collection. This species was thus rare in the first decade of the 20$^{th}$ century, while it is nowadays considered as dominant on adjacent French gravels (Davoult et al, 1988; Alizier, 2005). At our survey site, further monitoring should be carried out to determine whether it thrives on a larger area than observed in june2005.

The data (presence / absence) were further subjected to a preliminary multivariate analysis to check whether observed differences between data-sets are significant for these taxa. Indeed, despite expected modification of the multivariate pattern arising from further inclusion of rarer species, similarities between historic and recent data-sets will be heavily influenced by abundant species. Two extremely poor historic samples (2 and 1 species) were initially removed because they were too different from the bulk data-set and hampered further sample ordination. An ANOSIM permutation test revealed a highly significant difference between data-sets of 1905 and 2005 ($R=0.692$, $p<0.001$), which is clear on MDS ordination of samples (figure 4-46a). The dispersion of samples is larger in the historic samples, probably due to the more patchy distribution of many species, whereas recent samples were numerically dominated by a few species more evenly distributed throughout the survey area.

A set of 6 statistically different clusters was identified in these data (figure 4-46b and annex 9; $p < 0.05$). As indicated by ordination of samples from both surveys, the level of similarity is higher among samples of 2005 than among samples of 1905.

The characteristic species of every cluster were determined using the SIMPER procedure and are listed in annex 9. The discrimination between the major groups is strong (figure 4-46c). Samples of 1905 and 2005 are mixed in cluster "c" only, which is composed by two samples, whereas only one sample composes group "b"; these two minor groups can be considered as "outliers" at this stage.



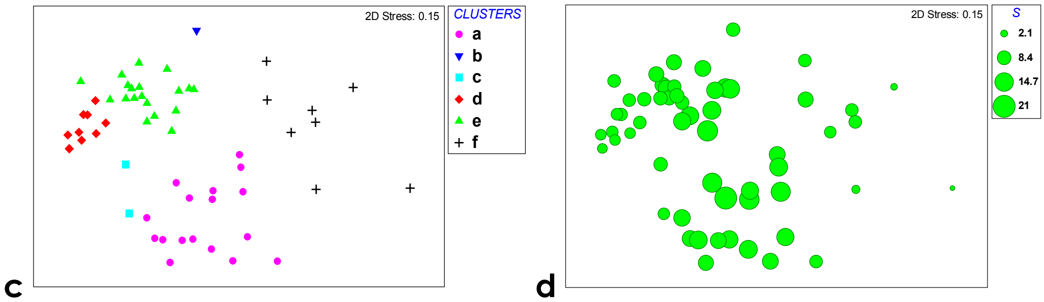



Figure 4-46. MDS ordination (Bray-Curtiss similarity) of presence/absence data for 29 species in the surveys of 1905 and 2005. a. Plot with reference to survey year. b. Cluster tree of samples, with significantly different clusters resulting from SIMPROF procedure highlighted (black branches). c. Plot of the clusters. d. Bubble plot of species richness at stations (n max = 21).

Group "f" bears samples of 1905 and forms a group apart. Only few of the considered species are represented (figure 4-46d and annex 9) and it is strongly dominated by branching bryozoans, of which *F. foliacea* is found in every sample. Samples of this group thus resemble the "intermediate" species association identified in section 4.2.4. Group "a" contains the remainder of historic samples and is characterized by the typical species of the gravel species association (section 4.2.4).

Samples of 2005 are divided into two well-separated groups. Group "d" contains species typical of sand banks, while group "e" contains species typical of the swales.

The main contributors to group dissimilarities are listed in annex 9. The shifts discussed on the basis figure 4-45 are confirmed by the multivariate analysis and are statistically significant at the scale of the survey area. They cannot be explained by different sampling gear efficiencies since contrasted results are obtained for species expected to display similar trends in catchability (e.g. *B. undatum* and *A. rubens*). The fact that the 2m beamtrawl was operated on smaller distance explains why a clear discrimination appears within samples of 2005 (sand and gravel epifaunas). On the other hand, Gilson's dredge is likely to have aggregated faunas typical of different seafloor types. This probably partly explains the larger dispersion of Gilson's species contents. However, increased representation of some abundant species in the samples of 2005 (*Asterias, Ophiura*) certainly account for observed differences in data-set homogeneity.

This limited multivariate analysis thus suggests a real shift in the composition of the communities to have occurred at the scale of the swale, the scale of which seems hardly compatible with short-term variations in the composition of the community. A regular sampling programme will be necessary to ascertain the hypothesis that the observed shift represents a true "long-term trend", since seasonal outburst of certain species is likely to occur and perhaps bias the comparison.

When densities of enumerable species of the aforementioned set are examined, some similarly contrasted results are obtained (figure 4-47). The large values of standard deviations mirror large sample-to-sample variability in abundances. The average densities of *Ophiothrix fragilis* (9,035 +/- 32,386 individuals per 100 square meters) were too high to be plotted. The standard deviation mirrors the patchy distribution of this species in our survey (one milion specimens at one station, few specimens at other stations).

When raw data of Gilson are considered, none of the species surpasses a density of 1 specimen per 100 square meters. Such low average figures seemingly confirm that Gilson's dredge efficiency must be low. However, *A. digitatum* nearly reaches this density due to one sample where it was exceptionally abundant (G3509, 250 colonies; see figure 4-32 and Annex 7). Densities surpassing this value in 2005 concern species that displayed highest change in catch probability, e.g. *P. miliaris* and *O. ophiura*. When Gilson's densities are multiplied by a factor 10 to account for expected lower gear efficiency, their average densities remain lower than in 2005.

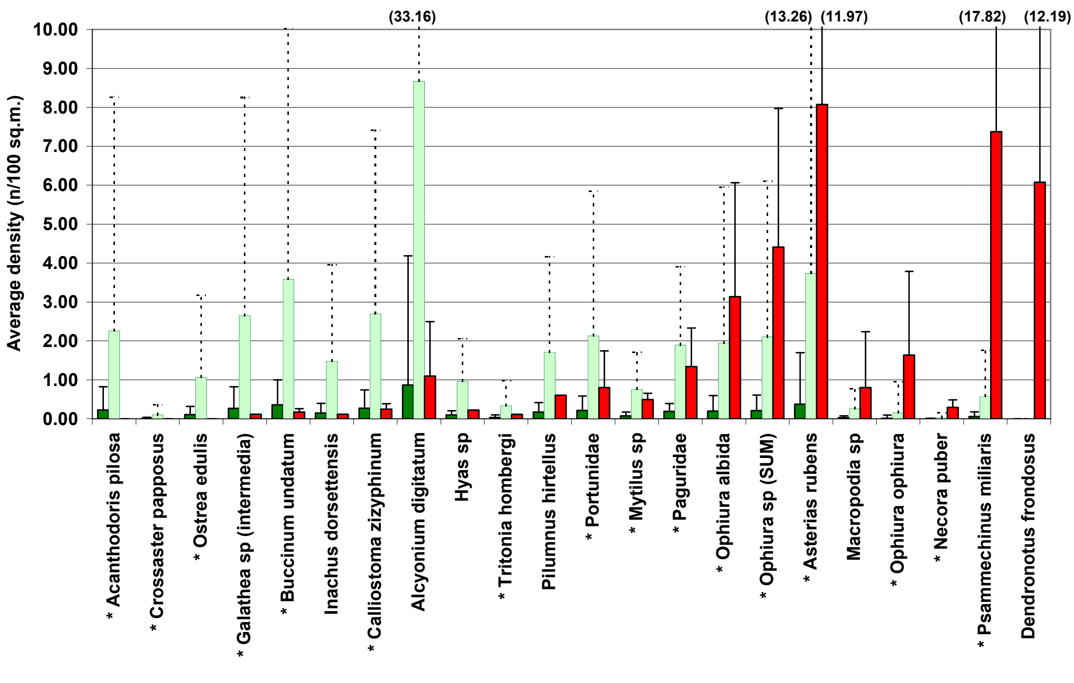



Figure 4-47. Comparison of average densities (numbers of specimens per hundred square meters) in surveys of 1905 (dark green bars; n=26) and 2005 (red bars; n=31), for a selected set of commonly encountered enumerable species. Data of 1905 were further multiplied by a factor 10 to account for expected lower sampling efficiency (light green bars). Error bars are standard deviations (with values above outscaled error bars). Average values for *Ophiothrix fragilis* in 2005 were excluded since they were out of scale (see text).

By contrast, some species such as *Galathea* sp, *B. undatum* and *C. zizyphinum* show a marked decrease of density consistently with catch probabilitiy figures. When densities of 1905 are adjusted by a factor 10, the rate of decrease thus considerably rises up. This will be the case for a further few species not accurately recorded in the samples of 2005 yet, such as *P.*

*longicornis* which is yet abundantly represented but seemingly to a much lower extent than in Gilson's samples (numerically dominant species), and *Ebalia* spp (*E. tumefacta* and *E. tuberosa*), which display much reduced abundances in 2005.

Interesting to note is the relatively similar catch probability and density of swimming crabs (Portunidae), the bulk of which is represented by *Liocarcinus holsatus* on sand banks in 2005. This group was documented as much increased in the North Sea between 1902 an 1986 by Rumohr et al (2000). Hermit crabs (Paguridae) display a similar pattern. The virtual disappearance of the sun-star *C. papposus*, a large voracious predator occasionally encountered by Gilson in the Westhinder area but not in the remainder of the sampling grid, remains unexplained.

The distribution of densities displays a more even distribution in the historic data-set than in 2005, as was the case for catch probabilities. Thus, the shifts observed based on presence/absence data are confirmed by density data.

**Discussion: long-term trends**

Our results only partly match observations made by Rumohr and Kujawski (2000) based on a historic data-set dating back to the period 1902-1912 and covering the larger southern North Sea. Echinoderm biomass and evenness has increased during the 20$^{th}$ century, probably as a result of increased bottom trawling impacts. However, at a lower taxonomic level, yet contrasted results are obtained, such as a decrease for *O. ophiura*, whereas we observed a much larger increase for this species in our survey area, possibly indicative of an increased sand content in the surveyed pebble and cobble field. The large increase in the abundance of *A. rubens* is obvious in our data-sets; only a slight increase is noted by Rumohr and Kujawski (2000) and Callaway et al (2007) in the whole North Sea. *Ophiothrix fragilis* represents a special case since this echinoderm is a filter-feeder. It has been suggested that this species has been favoured by eutrophication, possibly locally reinforced by bottom trawling through organic enrichment induced by discards (Alizier, 2005). The nearly absence of this species from the whole historic collection of Gilson tends to to support this view. It appeared as decreased in the southern North Sea in data-sets used by Rumohr and Kujawski (2000) and Callaway et al (2007).

We obtain opposite results for some decapod crustaceanss (*Ebalia*), but similar results for others (*Galathea, Pisidia*). The common snail *B. undatum* was recently documented as much declined in the southern North Sea and this trend can be related to high mortality rates in trawled areas as well as to pollution by Tributyl-tin (Lavaleye et al, 2000). Our data again support this view, whereas Rumohr and Kujawski (2000) obtained a reverse trend which Callaway et al (2007) however considered as unclear.

The differences observed between Rumohr and Kujawski (2000) and Callaway et al (2007) and our study are probably due to differences in the scale at which phenomenons are observed and perhaps in considered biotopes, which are controlled in our historic data-set. Callaway et al (2007) evidenced contrasted trends between the southern, central and northern North Sea; at smaller scale, the shifts showed for some aforementioned species (*P. miliaris, O. ophiura* and *A. rubens*) at the few stations of the southern bight thus match our observations. In fact, no other study so far targeted gravel grounds of the very southern bight, and most large-scale surveys on North Sea epibenthos occurred north to 52°N (see section 3.2.1 for relevant references). The area south to this latitude displays increased species richness as compared to the larger southern North Sea owing the the occurrence of gravel patches in French, English and Belgian waters and influence of Channel waters.

When reference is made to the closer adjacent gravels of French waters (e.g.Davoult, 1988; Davoult et al, 1988; Alizier, 2005; Foveau, 2005), the described "pebbles with sessile epifauna" community appears as somehow "hybrid" between Gilson's data-set and ours. Indeed, species as *Flustra foliacea, Pisidia longicornis or Galathea intermedia* as well as branching sponges are documented as most abundant, as in the historic data, whereas abundances of *Ophiothrix fragilis, Asterias rubens or Psammechinus miliaris* are closer to results of the 2005 survey.

Noticeably, none of the researches carried out in this area so far mentioned the European flat oyster *O. edulis*, although we have gathered evidence of its former occurrence off Calais and Dunkerke in the 19$^{th}$ century (see section 4.3, figure 4-27). Results gathered on this species evidences that linking Museum data with information of the historic literature can yield conclusive elements to define a "baseline" for benthos.

Alizier (2005) evidenced a relative stability of this community since the 1970s off Calais, despite a general increase in sand content. However, she showed an increase in the relative abundances of *P. longicornis* and *O. fragilis* in that period. The densities of *P. longicornis* are much larger then we observed in the area of the Westhinder, whereas it was more abundant in Gilson's data than in 2005. Further density-based comparisons will be hampered by the fact that different sampling gears have been used.

An interesting set of observations in our data-sets concern the nudibranch fauna. We observe a virtual disappearance of the nudibranch *Acanthodoris pilosa*, whereas *Dendronotus frondosus*, rare in the historic collection, was frequent in 2005. *A. pilosa* forages on branching bryozoans (*Flustra, Alcyonidium*), whereas *D. frondosus* feeds on hydrozoans, mainly *Tubularia* spp (McDonald and Nybakken, 1996). This observation thus tends to confirm that *Tubularia*, nowadays a dominant species on cobbles, was much less abundant in 1905, whereas *Flustra foliacea* and *Alcyonidium* sp were more represented. *Tubularia* are fast growing colonies, whereas colonies of *Flustra foliacea* can reach an age of of 12 years, perhaps more, and are thus most sensitive to mechanical disturbance of the seafloor (Tyler-Walters and Ballerstedt, 2007). A shift from a bryozoan-dominated to a hydrozoan-dominated branching epilithic cover is thus suggested by our data. This is in line with our observation that the main gully must be entirely trawled in less than 2 years, although other factors cannot be excluded at this stage. Noteworthy, a decrease was also observed in catch probability of *Tritonia hombergi*, another nudibranch exclusively foraging on *Alcyonium digitatum* (McDonald and Nybakken, 1996), for which we observed a reduction in average size likely to be due to trawling activities. To our knowledge this is the first such observation of apparent correlation between abundance of nudibranchs and impact of mechanical disturbance on their preys. The nudibranch fauna thus clearly deserves further investigations to monitor impact of trawling activities on gravel biotopes.

For fish, there is no way to perform any long-term comparison yet since fish data of the Gilson's collection could not be considered in the frame of this project. However, the high abundance of lesser weaver *E. vipera* and sandeel *H. lanceolatus* in sandy areas is striking and should be compared to Gilson's data as soon as possible. No negative or positive trends can be derived from Poll (1947), who has reviewed the fish collections of the RBINS. Indeed, dabs, plaices, soles, gobies, dragonets, lesser weavers or flatfishes are all abundant in the overall Gilson's material. Gilson (1921) himself stated that these species were common. These species were not particularly abundant in our samples, but were regularly observed indeed. We have identified the dragonet *Callionymus reticulatus*, not mentioned by Poll (1947), but specimens of this species were identified in the historic collection during a more recent revision of the marine fishes (G. Rappé, unpublished data).

The discovery of refuge areas between large sand waves is highly interesting since it provides a framework to explain resilience of the marine ecosystem against the destructive and widely spread bottom trawling activity. We expect that similar observations, enabled thanks to the recent development of high-resolution acoustic seafloor mapping, will be made in other large offshore sand banks of the southern bight, such as for instance in the Ruytingen or Sandettié banks in the French zone. Species diversity has remained high in the impacted gravels, and the potential toward a restoration of a healthier biodiversity state seems to exist. This suggests that structural changes induced by bottom trawling are perhaps not permanent.

Further investigations will be necessary, once historic and recent data-sets will be completed, to better analyse the obtained patterns. However, the work carried out so far put forward the high added-value provided by the data-set of Gilson to investigate long-term changes in (epi)benthic biodiversity in the southern bight of the North Sea and the need to obtain more data on this biotope.

# 5 Conclusions

The historical data-set of G. Gilson enabled us to accurately locate a large and species-rich pebble and cobble field, not documented since nearly a century, to the east of the Westhinder bank. The lack of recent information on this biotope within Belgian waters is clearly attributable to undersampling. This area hosted more than 200 species of the taxa considered so far, and the total species richness is expected to be much higher. The species content is comparable with that described in the adjacent French part of the North Sea, confirming a large influence of Channel waters on this area.

The project demonstrated that wild beds of the European flat oyster *Ostrea edulis* used to thrive in this biotope and off the French coast, where they formed "biogenic reefs". As elsewhere, they were destroyed before scientific investigations on the species ecology began. The "baseline" situation at the investigated gravel field can be defined as a strip of oyster beds occurring upon a sandy cobble field and colonized with a rich invertebrate epifauna. This is in full agreement with the description provided by Van Beneden (1883). Epibenthic data of Gilson provide excellent clues to better understand the baseline situation of epibenthos associated to this biotope.

The same area used to form part of the spawning ground of the Downs herring in the southern bight of the North Sea, and our literature review evidenced an increased bottom trawling pressure there since the 1920s. We could not find indications on the current status of herring spawning in the southern bight.

The close match between the historical and newly acquired data demonstrated that Gilson's data are trustworthy. The information brought by this data-set is reliable to track long-term changes in the sediments and benthos of the Belgian marine area on the small-scale, since 1900.

Despite the fact that our data-sets are yet incomplete, we were able to perform some major observations on long-term evolution of the benthic biodiversity of gravels. Firstly, the overall species richness has remained high despite the obvious impact of intensive bottom trawling, probably due to the multi-scale complexity of the biotope. We are yet unable to state whether overall species richness has changed. Secondly, robust and contrasted shifts are observed for abundant and conspicuous species. During the field survey, we could evidence high pressure by bottom trawling, likely to disturb the whole gravel field in less than two years. This pressure affects large branching and long-lived species. We discovered refuge areas for some sensitive species, confirming that bottom trawling is a main driver to local changes in benthic biodiversity.

We propose that the still increasing bottom trawling pressure is a determinant factor to explain the non-reinstallation of wild beds of the European flat oyster since at least 80 years, and such is likely to be the case on the larger scale. This possibility has largely been neglected so far due to a historical focus of on coastal stocks for cultivation purposes. This proposal is likely to question management practices for this species since about 150 years. Our analysis suggest that restoring this species seems feasible but might call for specific protection measures at offshore locations.

Obviously, the structural and functional diversity of benthos is far from understood in Belgian marine waters, and many questions were raised by this project. The long-term effects of mechanical disturbance on gravels are yet poorly documented. There is an urgent need for more research and monitoring to better understand the ecological functions supported by this biotope outside territorial waters, especially in a context of changing climate.

Results gathered so far recently enabled to consider the target-area of this study as the best candidate site for a designation as Marine Protected Area under criteria set by the OSPAR Convention for the Protection of the Northeast Atlantic (Haelters *et al*, 2007).

We can state that the 87-year old suggestion by Gilson (1921) that gravel biotopes should be protected seems more appropriate than ever.

# 6 Recommendations

The research points at various needs in the near future:

1. The investigated biotope is most sensitive to mechanical disturbance and is actually submitted to heavy pressure by bottom trawling. Moreover, it might be threatened by future aggregate extraction activities. It was recently ascertained that pebbles and cobbles are landed by trawlers and sold in gardening centers. In the Dutch waters, targeted gravel extraction has led to the definitive loss of certain gravel grounds. Gravel deposits are a few meters thick at maximum, and this mineral resource can thus be exhausted fast if a targeted exploitation takes place. However, regarding benthic biodiversity, a removal of the very upper layers could be sufficient to trigger a replacement by sands, a phenomenon perhaps already occurring. Such practice might thus rapidly lead to a definitive removal of this unique substratum in Belgian waters as well.

⇒ **There is an urgent need to consider adequate protection measures against mechanical disturbance and seabed removal at gravel grounds. This project demonstrates that such protection measures would be beneficial to a large range of species, including commercially important target species.**

2. Although numbers of trawling vessels have decreased through time, their power and technological equipment has considerably increased and so did the pressure on the marine ecosystem. The micro-scale distribution of trawling activities is still poorly documented, contrary to the well-monitored aggregate extraction activities.

⇒ **There is an urgent need to improve the availability and accessibility of data on the micro-scale distribution of fishing activities to the scientific community, in order to better evaluate the distribution and effects of fishery activities.**

3. Besides it patrimonial value, the Gilson's collection is outstanding to investigate long-terms trends in marine biodiversity; only a part of the whole data-set could be used yet. Budgets are however insufficient to accurately carry out management, digitization and research.

⇒ **There is a need for a better support to the management of the historical patrimony toward acquisition and processing of historical data-sets.**

4. The overall implication of gravel grounds in the southern North Sea ecosystem functioning is yet little studied. On the other hand, research carried out with commonly used "quantitative" benthos samplers such as *Van Veen* or *Hamon* grab will be inappropriate to describe the benthic communities of the pebble and cobble field.

⇒ **We recommend to strengthen research and monitoring on Belgian gravel fields to better understand their contribution to ecosystem functioning and long-term evolution. In particular, there is a need to develop adequate multidisciplinary sampling strategies as much as possible based on non-destructive techniques. Research should preferably be carried out on a transnational scale since a large amount of species disperse through pelagic larvae, which create large-scale inter-connection of gravel patches and hard substrata in general.**

5. Identified refuges are likely to exist on the larger-scale, and these are likely to support some resilience of theeco system against bottom trawling activities. They will probably play a major role in restoration processes under specific protection measures.

⇒ **The distribution, extent, biotope and species content of refuge areas should be further investigated as fast as possible to better define their potential to contribute to a restoration of degraded biodiversity in disturbed areas.**

6. The studied area could be of particular scientific importance to monitor the effects of the global warming on the fauna of the southern North Sea, due to its geographic position at the transition between the English Channel and the North Sea. In particular, it bears a ldue to through undetected species and inaccurate determinations.

⇒ **There is a need to strengthen taxonomic capacity building to accurately describe species-rich areas and to track large-scale shifts in species distribution ranges resulting from ongoing climate change.**

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# Annex 1: Gilson collection: structure and processing strategy

## 1. Original goals and strategies of G. Gilson

It is not our aim to provide the reader with a sound insight on Gilson's career and we forward him to van Loen et al. (2002) for references on this topic.

Most of Gilson's approach is summarized in his first memoir (Gilson, 1900). He established the sampling program designed to provide the Museum of Natural History of Brussels (nowadays "RBINS" – Royal Belgian Institute of Natural Sciences) with samples of the marine fauna of the southern North Sea and started field work in 1899. The way Gilson conducted his sampling program, targeting all compartments of the coastal waters with specific and standardized methods, gives it a special value for studies in the field of ecological history since it provides hundred years old, diversified ecosystem data. Within this project, we focus on benthos and sediment sampling as well as on a part of fish sampling.

## 2. Sampling instruments and methods

Throughout his work, Gilson has used, designed and ameliorated tens of specific sampling instruments: beam trawls, plankton samplers (bottom and surface), fish larvae nets, benthos dredges, sediment samplers, water bottles (see van Loen et al., 2002). We will here focus our attention on three main gears: the dredge (benthos sampler), the ground-collector (sediment sampler), and the beam trawl (nekton sampler).

### 2.1. Gilson's dredges

For the study of benthic invertebrates , Gilson used several models of towed dredges. He used two major models: the "drague à anses" (figure 2) and the "drague à large cadre". Both models are described in detail by Gilson (1900).

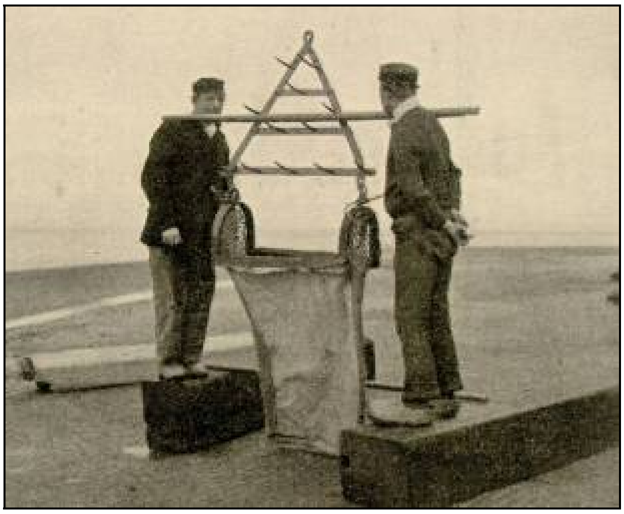


Figure 2: The "drague à anses", here equipped with the frontal rake (source: Gilson, 1900)

Soft bottoms were mostly investigated with the "drague à anses", the frame of which ressembles a small Agassiz trawl. The bottom fauna was collected in a bag made with sailing cloth. The sides of the collecting bag were made of a net (mesh 2.5 centimeter). According to Gilson (1900), the design of this dredge prevented the accumulation of sediment in the collecting bag, although the instrument was towed on a long distance (one nautical mile: 1,852 m). This dredge was furthermore generally equipped with an original frontal rack aiming at collecting further infauna of soft bottoms.

The instrument was maintained on the bottom with lead weights put on the towing cable (figure 3).

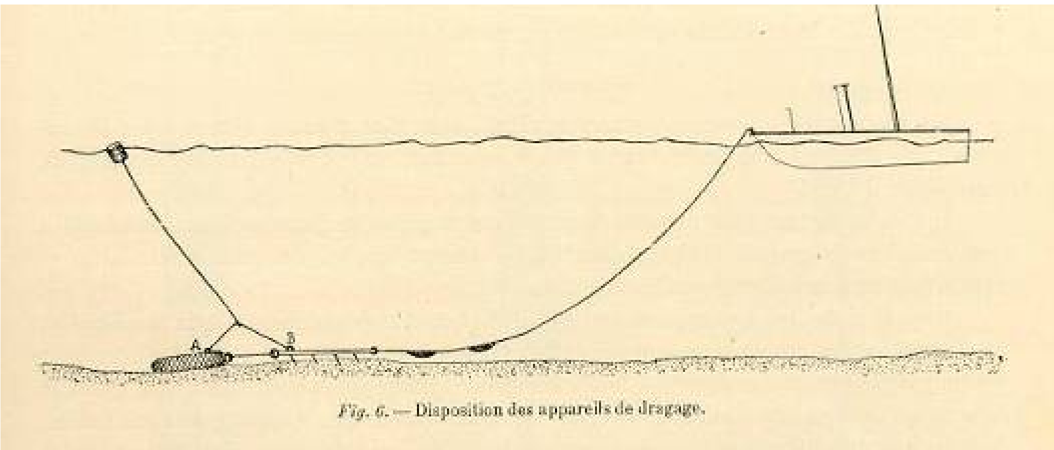



Figure 3 : Operational design for dredging operations (source: Gilson, 1900)

This kind of instrument is basically designed for the collection of epibenthic fauna. However, the additional frontal rack allowed further collection of infauna of the surficial sediment. We believe the presence of the frontal rack also enhanced instrument efficiency by maintaining it close to the bottom in sandy areas, although it can be feared that the vertical spines could crush fragile animals and reduce the amount of specimens amenable to identification. So far, we did not find mention of similar gears in the literature; the real efficiency of the whole instrument is thus hard to evaluate. However, bearing in mind Gilson's perpetual search for innovation and efficiency, we believe it must have been quite efficient on soft bottoms; a high proportion of crushed animals would have led him to find adequate solutions.

A total of 1022 samples are recorded as being collected with different models of dredges (not all are well documented). Of these, the model "n°5", equipped with the frontal rack, was the most widely used (860 samples) and was operated mainly in the exploration of the Belgian marine areas. An additional 51 samples were collected with the model "n°6". According to Gilson's notes, we inferred that the model n°5 with frontal rake was most efficient on sandy bottoms. Model n°6 was mainly used on gravel and bedrock along French and British coasts and in the Hinder bank area, most probably without frontal rack, but we lack appropriate documentation on this model. We record an additional 16 samples with "model n°4", 48 samples with "model n°2" and "model n°1", 2 samples with an "oyster dredge", 21 "triangular dredge" and 24 samples with unspecified dredge model. So far, we found no documentation about all these models.

## 2.2. Gilson's « ground collector »

The cup-shaped "ground collector" ("sondeur-collecteur à coupe") was invented by Gilson (Gilson, 1900, 1901, 1906; Richard, 1907; Carpine, 1996). It consists of a large cup (roughly 20 to 60 cm in diameter depending on models), mounted on a central axis and closed with a mobile lid (figures 4a and 4b). In the very first model (years 1898-1899), the closing lid was a lead weight (see illustrations in Gilson, 1900). Shortly afterwards, the weight was definitely replaced by a forged steel plate. More details on Gilson's ground collectors can be found in van Loen et al. (2002).

Figure 4. Detail of the ground-collector. Source: Carpine, 1996

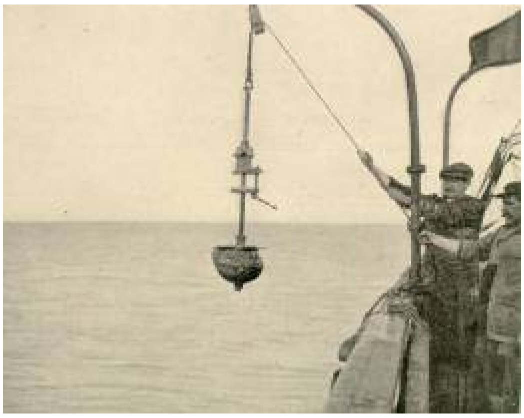


Figure 5 . The ground-collector, over-filled with mud, is hauled onboard (source: Gilson, 1927)

## 2.3. Gilson's Beam trawls

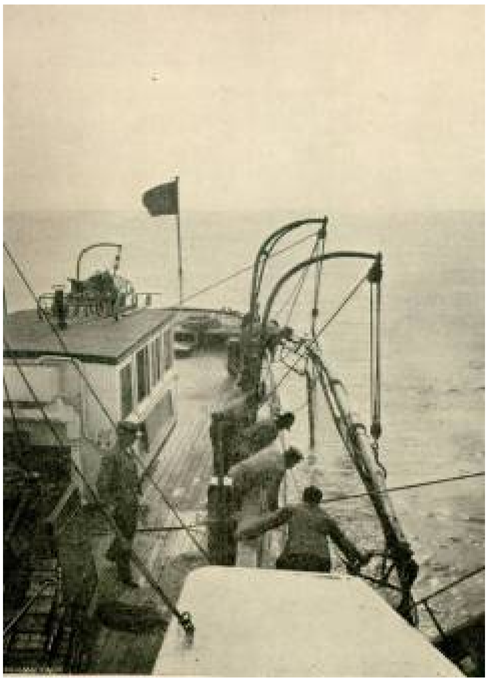


Figure 6. Gilson's beam trawl onboard the steamer "Remorqueur n°1" (source: Gilson, 1927)

Throughout his field work, Gilson used many beam trawls. We do not provide an investigation on this topic at this stage because this question calls for a detailed compilation of available archives. From our investigations in various sources, we concluded that Gilson generally used a 9 or 10 meter trawl equipped with a wooden beam (figure 6). He designed a special model of beam runners ("fers déclinants") to avoid risks of instrument breakage and easier storing onboard fishing vessels (Gilson, 1911).

The use of an otter trawl became the norm of his sampling programmes around 1927 (Gilson, 1928). Trawling was often made on considerable distances (e.g. duration of up to hours, distance of several nautical miles).

## 3. Sampling programmes

As outlined in van Loen et al. (2002), Gilson performed field-work within different sampling programs. In the "Exploration of the sea" in front of the Belgian coasts, Gilson firstly set up a sampling grid based on the minutes of latitude and longitude (figure 7). This "reticular" sampling scheme ("exploration réticulaire") included sediment sampling at each node of the grid and dredge (and plankton ) sampling between the nodes, mostly along the longitude lines (one nautical mile tracks). However, in most cases one or more additional sediment samples were collected in between the nodes, mostly along longitude lines. This "reticular" grid extended toward about ten nautical miles from the shore (the limit of landmarks visibility for ship positioning with a sextant and/or a compass).

On and around the Westhinder bank, Gilson set up a "cross-shaped" sampling scheme ("exploration cruciale") : samples were collected along 4 virtual arms (length : one nautical mile) on 30 crosses. The 30 buoys were probably progressively installed, when sampling was about to take place, and positioned relatively to each other, starting with buoys around the Westhinder lightship. From these buoys, arms were virtually drawn through sampling along 4 lines, 2 oriented toward NNE ½ E and SSW ½ W and 2 orthogonal (Gilson, 1928). Sediment samples were mainly collected at the cross centre and at the middle and extremity of each "arm". Dredge samples were collected along each arm. In addition, a "circular" dredging was performed around the cross centre, the radius of which was about half a nautical mile.

The coastal sampling scheme was completed by a series of transects starting at the Wandelaar lightship, heading north with different azimuts ("exploration radiée"). One of them joins the Westhinder sampling area at the Noordhinder lightship.

Sediment, plankton and benthos were sampled sequentially within these three areas. Many additional samples were collected elsewhere in the southern bight. Re-sampling at the same station also occurred, generally with an interval of a few years. The yearly distribution of sediment sampling effort in the three aforementioned sampling grids is outlined in figure 9.

Furthermore, between 1903 and 1914, Gilson also collected plankton and sediment samples along two transects, between French and Belgian coasts and the UK, every three months (see van Loen et al., 2002). These samples were primarily meant to feed ICES with hydrographic and plankton data, though sediment samples and, on some rare occasions, dredge and beam trawl samples were collected too. For the purposes of the project, we focus our attention on the coastal grids of Gilson since they provide a high and relatively homogeneous and standardized sampling effort. These samples are also generally accurately geo-referenced, which is not always the case for samples collected outside the grids. However, through digitization of the biological collections, we will find interesting stations outside these areas. We will consider their validation based on a case to case examination of species contents (for instance to plot gravel bottoms of French areas and compare their epibenthos content with that of the Westhinder area).

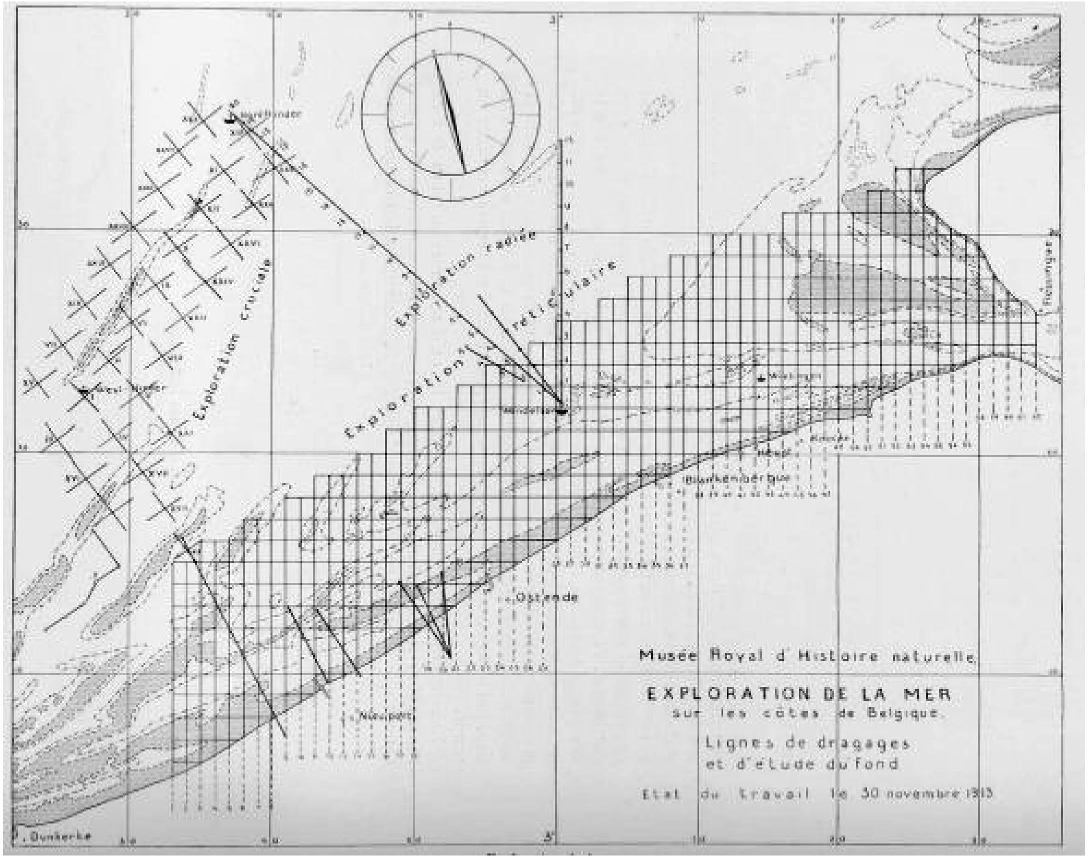



Figure 7: Coastal sampling grids of Gilson in front of the Belgian coast (original map from Gilson, 1914).

## 4. Data processing strategy

The "Gilson's collection" is not a homogenous, readily available dataset. Its age, size, original diversity and history have created a complex puzzle which is difficult to rebuild accurately since its pieces were scattered or lost through time. In addition, information sources are diverse with some level of redundancy (e.g. geographic position can be recorded in field notes, data inventories and sample label). This redundancy is a tool to validate information but is also problematic because discrepancies exist between different (hand-written) data sources.

In 1999, an effort was undertaken to digitize the summarized information of the sampling inventories (see figure 8) but it did not comprise a validation procedure (raw digitization). This process resulted in a databank of more than 14000 entries for sampling information entitled "Explomer", comprising all former errors as well as new ones. Given Gilson' approach to environmental studies throughout his career (notably the search for a standardization of sampling instruments and procedures), we believed this collection could provide a high quality standard for long-term ecological analyses. In an attempt to take as much data as possible into account, and in order to attain a good level of confidence in the final results, we have considered all available sources of information to perform cross-validations. However, this has resulted in a long and tedious step-by-step procedure on data little "managed" (if at all) since about the 1940s.

We therefore tentatively built a schematic diagram of used information sources, which we will refer to in the next methodological explanations (figure 8). This figure only includes data of interest to achieve our goals (i.e. making sediment, benthos and a part of the fish data amenable to ecological analysis).

*A complex puzzle*

Gilson has subdivided his dataset into different subsets ("explorations") very early, depending on different parameters. The original goal was to classify the samples based on instrument and/or sampling area and/or sampling goals (e.g. ICES samples were processed apart). A corresponding sample numbering code (symbols) was assigned. This led to the constitution of a complex system of 17 "explorations" (box 1) and 14 different numbering codes (table 1).

Within this complex puzzle, we have considered the sampling number as the basic source to store Gilson's sampling information and fixed some conventions to overcome the problem of double recordings (e.g. one sample registered in two different "exploration" schemes because the wrong numbering code was originally assigned). The 14 sample numbering codes, some of which used various hand drawn symbols, have been coded to allow easy data digitization respecting original data architecture (box 1). When doubles are eliminated, a total of 13692 "sampling events" is recorded.

*Data sources*

Gilson gave much importance to sampling documentation and took much care to avoid any loss of information. This is particularly marked in his early efforts to prepare accurate log-books to record field data, observations and measurements. Given the aforementioned random distribution of typing errors in summarized data sources, we have considered that field notes of the hand of Gilson were the most secure data source. Unfortunately, much of this information has been lost through time.

Specific log-books were created for all kinds of sampling events: plankton, benthos and sediment samples from the coastal grids, plankton and sediments samples from the ICES scheme, beam trawl samples, etc (figure 8). In order to make sure sampling documentation could not be lost, Gilson further consigned all navigation- related data (sampling time, geographic position, etc) in the ship's navigation log-books (we could however not recover them so far). Gilson generally operated different instruments sequentially : the starting point of a plankton or dredge haul was often sampled for sediments, a plankton haul was often performed in parallel to a dredge sampling, etc. When measured, environmental parameters (temperature, depth, sea conditions, currents, etc) were recorded in sediment, plankton and/or dredge log-books.

This sequential operation of different instruments and the subsequent (theoretical) record of the same information in different log-book constitute the basis of our approach to overcome the problem of missing log-books. As a first step to our validation procedure, we reconstructed the chronological sequence of sampling events of interest to our targets.

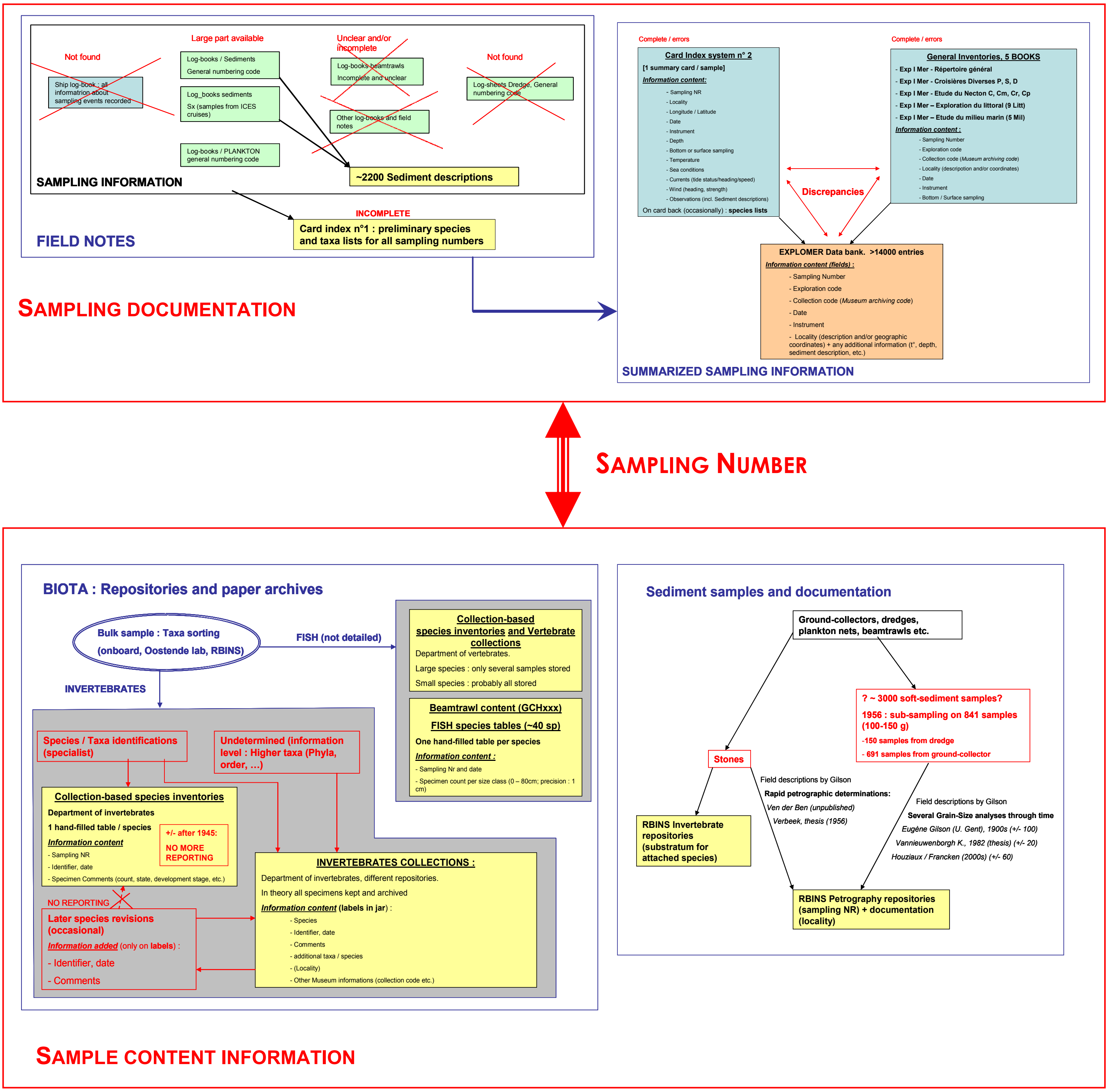



Figure 8: schematic representation of the structure of the collection underpinning strategies aiming at making it accessible to ecological research through digitization and quality control.

**EXP. I MER 1 RET**. 2662 samples (benthos, sediment, fish) collected within the "reticular" sampling grid ("*exploration réticulaire*"). Also samples collected outside the initial coastal grid but using the same sampling number code, the "general" code. Examples: "340" (a sediment sample of the reticular grid ; 6534 (a shrimp beam trawl sample collected in front of Bredene).

**EXP. I MER 2 CR**. 572 samples collected within the "cross-shaped" sampling grid ("*exploration cruciale*") around the Westhinder bank. Sample numbering code identical to 1 RET ("general" code). Benthos, sediments, fish. Example: "3099" (a dredge sample).

**EXP. I MER 3 RAD**. 83 samples collected within the "radiating" sampling grid ("*exploration radiaire*"). Numbering code identical to 1 RET ("general" code). Benthos, sediments.
Example: "5312", a sediment sample collected on the transect from the Wandelaaar lightship

**EXP. I MER 4 CROIS. DIV**. 446 samples with all instruments collected outside the aforementioned sampling grids. Numbering code identical to 1 RET ("general" code).

**EXP. I MER 4 CR DIV (P, S, D)**. 2061 samples: Plankton (P⧗; 1642 samples), Sediment (S⧗; 293 samples) and dredge (D⧗; 26 samples) samples collected at various locations (mostly within ICES transects sampling scheme, but also elsewhere).

Examples: P 3124 S 120 D 8

**EXP. I MER 5 MIL**. 570 samples. Water and plankton samples collected in front of Oostende and at the Westhinder lightship. Numbering code: "general" code.

**EXP. I MER 5 MIL P**. 1557 samples. Plankton samples collected at the Westhinder lightship on monday. Numbering code: P x

**EXP. I MER 5 MIL PR**. 378 samples. Plankton samples collected at the Westhinder lightship on thursday. Numbering code: PR x

**EXP. I MER 6 PL**. 1479 plankton samples mostly from the "reticular" sampling grid. Numbering code identical to 1 RET ("general" code).

**EXP. I MER 7 NECT**. 1467 beam trawl samples collected in various sampling schemes (own samples of Gilson). Numbering codes: "General" code and X

**EXP. I MER 7 NECT. C**. 897 samples collected with shrimp beam trawls (convention with a shrimp fishing boat). Numbering code: Cx

**EXP. I MER 7 NECT. CM**. 382 samples collected with a hand operated shrimp net (convention with a shrimp fisherman). Numbering code: Cmx

**EXP. I MER 7 NECT. CR**. 521 samples collected with "experimental shrimp beam trawls". Numbering code: Crx

**EXP. I MER 7 NECT. LP**. 101 samples collected with a shrimp beam trawl (convention with a shrimp fishing boat from "La Panne"). Numbering code: LPx and CPx

**EXP I MER 9 LITT**. All samples collected in the intertidal zone (groins, beaches, harbour, etc.)
Numbering code: X and M X

Box 1 : Field data classification system within general samples inventories of Gilson. "Numbering codes": see table 1

Most useful information was found in sediment log-books. On a total of about 3000 sediment samples, we could find back field data records for about 2200 samples (which include detailed sediment descriptions). This is the reason why we have concentrated our efforts on sediment data found in the log-books in 2002 – 2004.

| **Original station numbering code** | **Description of associated samples** | **Years / Amount of samples** | **Digitization code** |
|---|---|---|---|
| X [5] | Plankton, benthos, sediments, etc.<br>« General » numbering code. | 1898-1936<br>6660 samples | **G X** |
| P X | Plankton West-Hinder (monday) | 1902 – 1914<br>1529 samples | **GP X** |
| P☞ X | Plankton West-Hinder (Thursday) | 1902 – 1910<br>382 samples | **GPX X** |
| P ▷X | Plankton<br>ICES campaigns southern bight | 1903-1914<br>1642 samples | **GPF X** |
| S ▷X | Sediments<br>ICES campaigns southern bight | 1903-1908<br>293 samples | **GS X** |
| D ▷X | Benthos (dredge)<br>ICES campaigns southern bight | 1904-1913<br>26 samples | **GD X** |
| X (net symbol) | Beam trawl and Petersen’s young fish net | 1902-1914<br>728 samples | **GCH X** |
| C X | Shrimp beam trawl | 1905-1914<br>892 samples | **GC X** |
| Cm X | « Hand shrimp net » | 1905-1914<br>382 samples | **GCM X** |
| Cr X | “Experimental trawl” | 1906-1914<br>521 samples | **GCR X** |
| LP X = CP X | “La Panne shrimp beam trawl” | 1907-1911<br>101 samples | **GCP X** |
| [X] + M [X] | « Littoral catches » (hand-picking on beaches, groins, etc.) | 1900-1914; 1921-1939<br>512 samples | **GL X** |

Table 1. Gilson’s station codes and the assigned corresponding codes for subsequent digitization process. Years and sample counts are based on the databank “Explomer” after deletion of double records. “X” is a figure.

In a first step, we have extracted all sediment data from the “Explomer” data bank. The sample numbers found in the log-books were marked and the available information was confronted with the information of the log-books. When discrepancies appeared, we considered the information from field log-books as most accurate. Through this process, we also discovered that the sediment descriptions of the “Explomer” databank (copied from the “card-index system n° 2, see figure 8) were either summarized or truncated. The original descriptions of the log-books were consequently fully digitized in our files as well. This process has resulted in a first validation of 1786 sampling events and sediment descriptions. These data were entered in the IDOD database (BMDC, MUMM).

5 “X” is a number.

However, data gaps remained in the coastal sampling grids due to the missing log-books. In order to overcome this problem, we have examined the sampling sequences of these samples with plankton and dredge samples (dates and positions). Based on this approach, sampling information of about 500 additional sediment samples (and associated dredge samples) could be accepted. The sediment descriptions of the ~500 newly validated samples being of a lower quality, we further assigned a "sediment description quality" flag to our files (states: "low" / "good"). This flag is intended to allow checks in the dataset if discrepancies are revealed at analysis stage.

The yearly distribution of sediment sampling in front of the Belgian shore is illustrated in figure 9. This map reveals that Gilson focused on a particular region each year, while most of the sampling grid was completed after 7 years (the Hinders grid was completed within 3 years). Sampling was generally carried out between spring and fall.

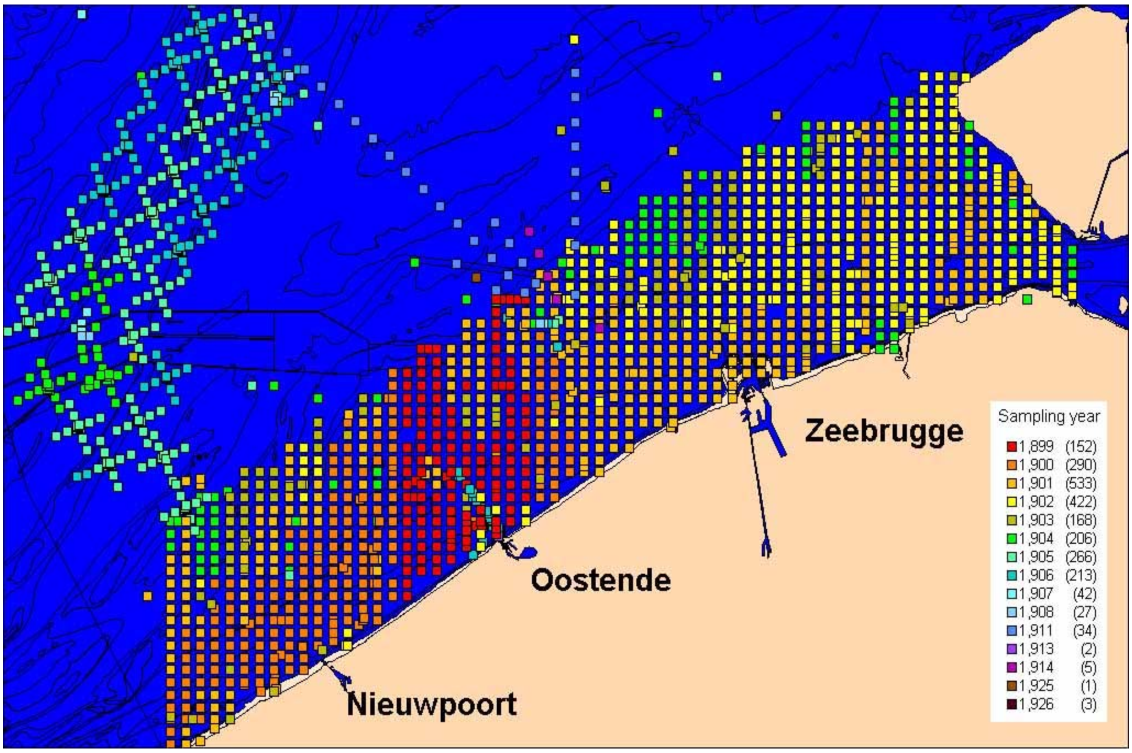



Figure 9 : Yearly distribution of Gilson's sediment samples (which mirrors temporal distribution of benthic dredge samples).

Check and validation of dredge sampling data was performed using their chronological sequence with sediment (and plankton) data. In general, sediment samples were taken at the start, mid and end point of a dredge tow. For these cases, inter-validation was straightforward. However, we faced many cases where sediments were only taken at the start or end point of the dredge, if at all; the missing sediment sample was often collected months or years later at the station, and sampling events are consequently disconnected. We used Gilson's (1900) statement that the dredge is towed on a standard distance of one nautical mile to assign a geographic position to the missing point; where available, plankton sampling information was also used to validate the positions (e.g. parallel sampling with the dredge with indications of start and end positions).

Not all samples can be considered as accurately positioned on the map. The aforementioned procedure led us to realize that geographic precision can vary very much from one sample to one other. In order to identify doubtful data within subsequent grid data analysis (e.g. interpolation maps), we have further considered the question of geographic accuracy.

*Geographic positioning accuracy (ground-collector, dredge)*

When sextant or compass is used for geographic positioning, precision varies from point to point depending on instrument sensitivity, observer skills, distance from sea- or landmarks used, weather conditions, etc. Therefore, in historic samples, the geographic positioning accuracy will generally decrease with distance from the coast (off the coast, landmarks are out of sight and only scattered seamarks like lightships or buoys can be used). We do not always know which instrument was used (geo-referencing using a compass is less accurate than using a sextant), what were the conditions at sea nor which land- or seamark was used. Furthermore, geographic position is not always clearly reported. It is therefore impossible to assign a "standard" value of positioning error to every single sample without tedious case to case examination. We decided to rank samples on a (rough) precision scale detailed hereafter, in order to allow fast selection of samples depending on the target spatial scale. Numbers have been used in the data files as flags to track geographic accuracy and enable meaningful sample selection. Flags are described as follows:

1. *All "normal" points of the coastal "reticular" sampling grid, identified in Gilson's archives by a specific station code made of numbers for longitude lines (from 1 to 62), letter for latitude line (from A (onshore) to J (offshore); see figure 7). Real sampling points are most probably located within 100-200m of the theoretical position but could vary depending on weather conditions, distance from shore and drift strength.*

2. *Position of cross centers in the offshore "cross-shaped" sampling grid. Since these positions condition geographic precision of other points (on cross arms), it is most probable that geographic positioning was made with the highest possible accuracy by Gilson, attaining again an expected precision of 100-200m. The distance to the coast and seamarks justify our expectation that precision will be lower than in coastal waters.*

3. *Positions between nodes of the reticular sampling grid, identified in Gilson's archives by node station codes. Example: "between 3b and 3c". In most cases, one sample was collected approximately at mid-distance between two nodes during a dredge sample. On some occasions, two samples were collected and indication of their closeness to one node was given. The error is thus generally more spread along the axis of the longitudes and might reach 300-400m because we are not always sure that the sample was collected at the average position between the two reference positions.*

*4. Positions located on arms of the crosses in the cross-shaped sampling grid. These points were most probably positioned relatively to the central buoy with a compass indicating azimuth and sextant or even ship speed indicating distance from the central buoy. A good precision is expected due to the short distance to the buoy (maximum one nautical mile) but errors might happen in the azimut.*

*5. Positions given in Gilson's archives in the form of a heading and a distance from a reference point. In the transitional area, we have questions regarding magnetic declination and appropriate position of transect lines. We have calculated positions to fit original Gilson's maps. The precision will here mainly be dependant upon distance from reference points : the shorter the distance, the bigger the precision.*

*6. Positions given by vague indication of proximity to a reference station : "near (station X)", "W of (station X)", "500m of (station X)", "Probably at (station X)", etc.*

*7. Positions located anywhere along a known transect. Some of these transects can be seen on figure 5 within the western coastal grid. Reference is given to a transect name but no indication was found so far on the respective sample positions along the axis. Geographic error is thus restricted to transect axis length, which can be ten to twelve nautical miles long.*

*8. Positions located in the vicinity of reference areas. Example : "Between Oostdijck and Buiten Ratel banks" . Error varying from several to tens of kilometers.*

*9. All larger errors. Examples : "Off Oostende", "in front of Deal".*

The spatial distribution of assigned precision flags is given for sediment samples in figure 10. This map evidences that a serious amount of samples with poor geographic positioning are found within the coastal grids, which can result in bias and misinterpretations when interpolation maps are drawn. We consider that samples with a precision flag of 1 to 4 (1285 samples within the coastal sampling grids) can be considered as accurately positioned relatively to each other. The use of samples with position flag 5 or 6 should be restricted to areas where more accurate positions are not found close by (as is the case along transects of the "transitional area"). For precisions flags of 7 and higher, the amplitude of possible error hampers attempts to use them in such a small-scale grid, but they might be useful to document areas where data gaps exist (e.g. French, Dutch and English parts of the North Sea, English Channel). Geographic coordinates were not assigned for most of these samples due to time constraints, which explains their absence on the figure.

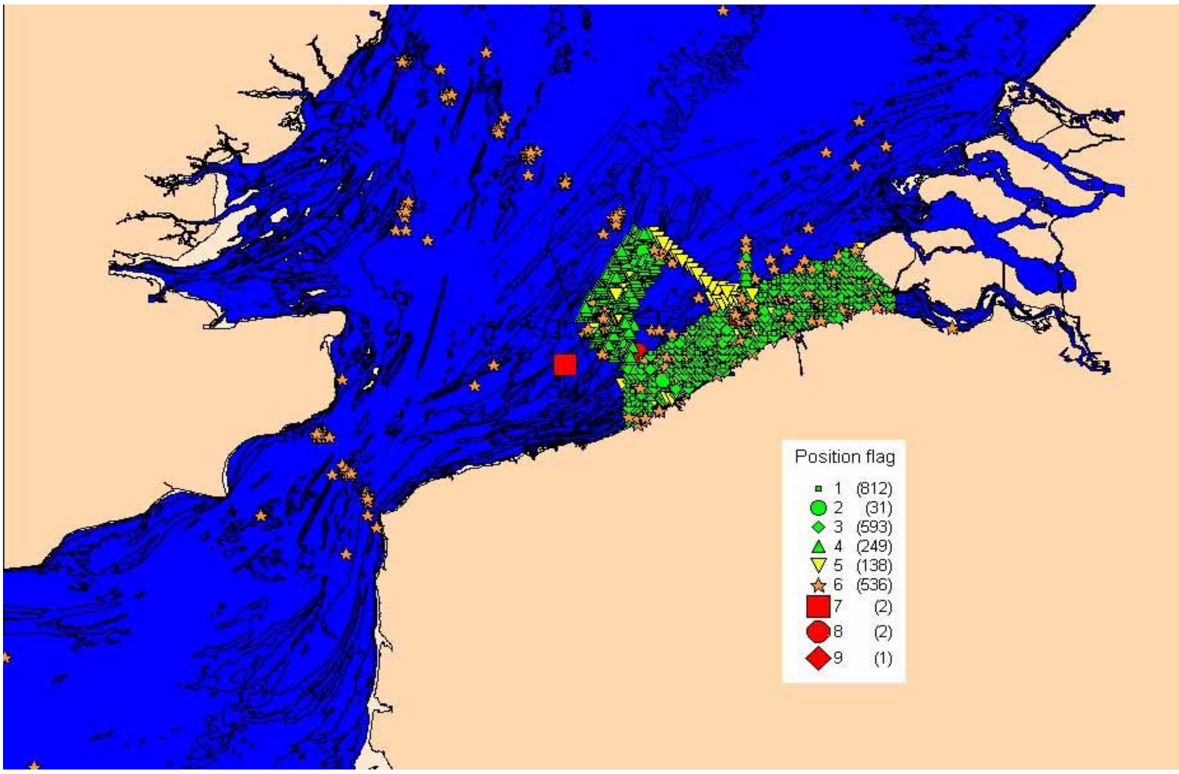



Figure 10 : Distribution of assigned geo-referencing quality flags in the southern bight of the North Sea and eastern English Channel for all sediment samples with available or assigned geographic coordinates.

As sediment and dredge samples were generally collected sequentially (figure 11), the length of the dredge tow is determined by the distance between the start and end sediment samples, which is generally of about one nautical mile. However, as mentioned above, sediments were not always collected at start and end of the dredge tows. In these cases, we have considered a standard dredging distance of one nautical mile to assign coordinates to the missing point (start or end), with a precision flag of 6. For some dredge samples without associated sediments, only verbose indications were given for the position. These samples have been positioned using quoted land- or seamarks on old maps and a GIS according to these descriptions, considering a standard track length of one nautical mile. These points have been flagged with value 6 to 9 (dependent upon the level of detail of the locality descriptions). Finally, the "circular" dredge tows of the cross-shaped grid are an exception in that they cannot be accurately represented on a map and their start and end point coincide. We have decided to consider the central buoy as their start and end point.

So far, we have been able to gain acceptable and ranked trust in sampling information of 934 dredge samples and 2364 sediment samples. The remaining samples are too tedious to process at this stage, not recoverable or not relevant (e.g. aborted sampling events, which can only be detected once the total collection content is digitized). Further samples can be considered at a later stage depending on their information content.

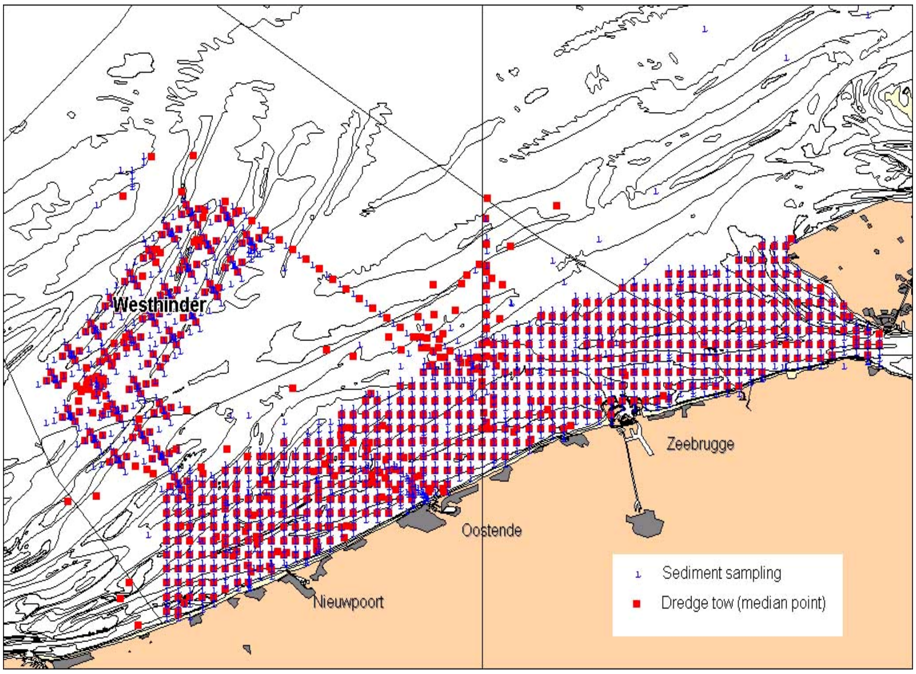



Figure 11. Distribution of validated sediment and dredge samples in front of the Belgian and Dutch coasts

<u>*Beam trawl (fish) samples validation*</u>

Validation of the beam trawl samples has not been done yet. These samples have not been collected in the framework of the aforementioned coastal grid schemes and are therefore treated apart. We focus our attention on 728 beam trawl samples (according to "Explomer" databank), collected between 1902 and 1914, for which the sample number is coded "GCHx" (see table 1), since a series of fish data sheets have been found for these samples (see figure 8, fish information). 66 of these samples were in fact collected with a Petersen "young fish" net, while 5 are seemingly not relevant (probably empty samples, since there is no sampling information attached to the sampling number); these 71 samples are excluded from our dataset. So far, 326 of the considered samples had explicit geographic coordinates in the "Explomer" databank, other localities being in the form of verbose descriptions. 15 samples have no locality so far. The distribution of available positions (start point of the tow) is given in figure 12. (caution: validity not checked and incomplete data). At this stage, highest concentration of samples seems to be located in front of the western Belgian coast, in between – and overlapping with – the "reticular" and "cross-shaped" sampling grids. Linking fish data with sediment and benthos information, which was one of our targets, will probably not be straightforward. These data were therefore finally not considered in the frame of this project as initially planned.

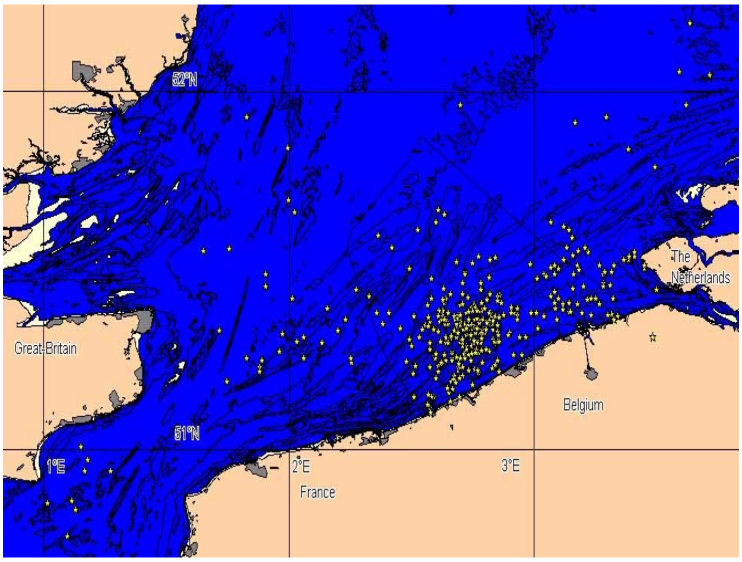



Figure 12 : Provisional map of available beam trawl data
(not validated, incomplete dataset)

# ANNEX 2. List of taxa digitized, with taxonomic upgrade and summarized classification (ERMS, 2006)

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ANNELIDA (incompletely digitized)** | | | | | | | | | | | | | | | | | | | | | |
| **Annelida** | Annelida | | | | **Annelida** | 6. Phylum | 9 | 9 | 3 | 2 | 0 | 0 | 3 | 1 | 0 | 0 | 8 | OUT | High taxonomic level | | |
| **Polychaeta** | Annelida | Polychaeta | | | **Polychaeta** | 5. Classis | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | Incomplete digitization | | |
| **Aphrodita aculeata** | Annelida | Polychaeta | Phyllodocida | Aphroditidae | **Aphrodita aculeata** | 1. Species | 39 | 39 | 15 | 0 | 21 | 0 | 1 | 1 | 1 | 0 | 39 | | | 15 | 15 |
| **Spirographis sp** | Annelida | Polychaeta | Sabellida | Sabellidae | **Sabella sp** | 2. Genus | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | Incomplete digitization | | |
| **Spirographis spallanzani** | Annelida | Polychaeta | Sabellida | Sabellidae | **Sabella spallanzani** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Serpulidae** | Annelida | Polychaeta | Sabellida | Serpulidae | **Serpulidae** | 3. Family | 105 | 94 | 74 | 7 | 0 | 3 | 3 | 7 | 0 | 0 | 11 | OUT | Incomplete digitization | | |
| **Polydora ciliata** | Annelida | Polychaeta | Spionida | Spionidae | **Polydora ciliata** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |
| **Sabellaria sp** | Annelida | Polychaeta | Terebellida | Sabellariidae | **Sabellaria sp** | 2. Genus | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | OUT | Incomplete digitization | | |
| **Lanice sp** | Annelida | Polychaeta | Terebellida | Terebellidae | **Lanice conchilega** | 1. Species | 6 | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 6 | OUT | Incomplete digitization | | |
| **ARTHROPODA – MALACOSTRACA (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Bodotria arenosa** | Arthropoda | Malacostraca | Cumacea | Bodotriidae | **Bodotria arenosa** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Bodotria scorpioides** | Arthropoda | Malacostraca | Cumacea | Bodotriidae | **Bodotria scorpioides** | 1. Species | 63 | 61 | 0 | 0 | 0 | 9 | 46 | 1 | 1 | 4 | 61 | OUT | No dredge sample | | |
| **Cumopsis goodsiri** | Arthropoda | Malacostraca | Cumacea | Bodotriidae | **Cumopsis goodsiri** | 1. Species | 29 | 29 | 0 | 0 | 0 | 0 | 29 | 0 | 0 | 0 | 29 | OUT | No dredge sample | | |
| **Iphinoe trispinosa** | Arthropoda | Malacostraca | Cumacea | Bodotriidae | **Iphinoe trispinosa** | 1. Species | 33 | 33 | 5 | 0 | 0 | 1 | 26 | 0 | 1 | 0 | 33 | OUT | Species out of scope for dredge | | |
| **Diastylis bradyi** | Arthropoda | Malacostraca | Cumacea | Diastylidae | **Diastylis bradyi** | 1. Species | 172 | 172 | 27 | 1 | 2 | 33 | 101 | 2 | 5 | 1 | 172 | OUT | Species out of scope for dredge | | |
| **Diastylis laevis** | Arthropoda | Malacostraca | Cumacea | Diastylidae | **Diastylis laevis** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Diastylis lucifera** | Arthropoda | Malacostraca | Cumacea | Diastylidae | **Diastylis lucifera** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | OUT | Species out of scope for dredge | | |
| **Diastylis rathkei** | Arthropoda | Malacostraca | Cumacea | Diastylidae | **Diastylis rathkei** | 1. Species | 221 | 221 | 42 | 1 | 0 | 8 | 157 | 7 | 1 | 5 | 221 | OUT | Species out of scope for dredge | | |
| **Diastylis rostrata** | Arthropoda | Malacostraca | Cumacea | Diastylidae | **Diastylis rostrata** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Diastylis rugosa** | Arthropoda | Malacostraca | Cumacea | Diastylidae | **Diastylis rugosa** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Eudorella truncatula** | Arthropoda | Malacostraca | Cumacea | Leuconidae | **Eudorella truncatula** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pseudocuma longicornis** | Arthropoda | Malacostraca | Cumacea | Pseudocumatidae | **Pseudocuma longicornis** | 1. Species | 133 | 132 | 0 | 0 | 0 | 1 | 129 | 0 | 1 | 1 | 132 | OUT | No dredge sample | | |
| **Pseudocuma similis** | Arthropoda | Malacostraca | Cumacea | Pseudocumatidae | **Pseudocuma similis** | 1. Species | 52 | 52 | 0 | 0 | 0 | 4 | 47 | 0 | 1 | 0 | 52 | OUT | No dredge sample | | |
| **Carcinus sp** | Arthropoda | Malacostraca | Decapoda | | **Decapoda** | 4. Order | 8 | 7 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 1 | 7 | OUT | High taxonomic level | | |
| **Alpheus macrocheles** | Arthropoda | Malacostraca | Decapoda | Alpheidae | **Alpheus macrocheles** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Atelecyclus rotundatus** | Arthropoda | Malacostraca | Decapoda | Atelecyclidae | **Atelecyclus rotundatus** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Axius sp** | Arthropoda | Malacostraca | Decapoda | Axiidae | **Axius stirhynchus** | 1. Species | 3 | 3 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 3 | OUT | No dredge sample | | |
| **Callianassa laticauda** | Arthropoda | Malacostraca | Decapoda | Callianassidae | **Callianassa tyrrhena** | 1. Species | 11 | 11 | 7 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 11 | OUT | Species out of scope for dredge | | |
| **Calocaris macandreae** | Arthropoda | Malacostraca | Decapoda | Calocarididae | **Calocaris macandreae** | 1. Species | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | OUT | No dredge sample | | |
| **Cancer pagurus** | Arthropoda | Malacostraca | Decapoda | Cancridae | **Cancer pagurus** | 1. Species | 20 | 18 | 4 | 6 | 0 | 1 | 2 | 0 | 5 | 0 | 18 | | | 4 | 4 |
| **Corystes cassivelaunus** | Arthropoda | Malacostraca | Decapoda | Corystidae | **Corystes cassivelaunus** | 1. Species | 9 | 9 | 1 | 3 | 1 | 0 | 3 | 0 | 0 | 1 | 9 | | | 1 | 1 |
| **Crangon allmanni** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Crangon allmanni** | 1. Species | 121 | 121 | 4 | 25 | 4 | 10 | 73 | 0 | 2 | 3 | 121 | OUT | Species out of scope for dredge | | |
| **Crangon crangon** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Crangon crangon** | 1. Species | 408 | 407 | 18 | 6 | 12 | 40 | 317 | 2 | 10 | 2 | 407 | OUT | Species out of scope for dredge | | |
| **Crangon sp** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Crangon sp** | 2. Genus | 4 | 4 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 4 | OUT | No dredge sample | | |
| **Philocheras trispinosum** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Philocheras trispinosum** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Pontophilus bispinosus** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Pontophilus bispinosus** | 1. Species | 8 | 8 | 0 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 8 | OUT | No dredge sample | | |
| **Pontophilus fasciatus** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Pontophilus fasciatus** | 1. Species | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | OUT | No dredge sample | | |
| **Pontophilus sculptus** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Pontophilus sculptus** | 1. Species | 3 | 3 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 | OUT | Species out of scope for dredge | | |
| **Pontophilus trispinosus** | Arthropoda | Malacostraca | Decapoda | Crangonidae | **Pontophilus trispinosus** | 1. Species | 139 | 139 | 8 | 30 | 2 | 3 | 95 | 0 | 0 | 1 | 139 | OUT | Species out of scope for dredge | | |
| **Diogenes pugilator** | Arthropoda | Malacostraca | Decapoda | Diogenidae | **Diogenes pugilator** | 1. Species | 14 | 14 | 3 | 9 | 1 | 0 | 0 | 0 | 0 | 1 | 14 | | | 3 | 3 |
| **Diogenes sp** | Arthropoda | Malacostraca | Decapoda | Diogenidae | **Diogenes sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Galathea dispersa** | Arthropoda | Malacostraca | Decapoda | Galatheidae | **Galathea dispersa** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Galathea intermedia** | Arthropoda | Malacostraca | Decapoda | Galatheidae | **Galathea intermedia** | 1. Species | 77 | 77 | 60 | 1 | 0 | 0 | 12 | 2 | 2 | 0 | 77 | | | 60 | 60 |
| **Galathea nexa** | Arthropoda | Malacostraca | Decapoda | Galatheidae | **Galathea nexa** | 1. Species | 4 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | | | 1 | 1 |
| **Galathea sp** | Arthropoda | Malacostraca | Decapoda | Galatheidae | **Galathea sp** | 2. Genus | 14 | 14 | 5 | 0 | 0 | 0 | 6 | 0 | 3 | 0 | 14 | | | 5 | 5 |
| **Galathea squamifera** | Arthropoda | Malacostraca | Decapoda | Galatheidae | **Galathea squamifera** | 1. Species | 16 | 16 | 8 | 2 | 0 | 1 | 2 | 2 | 1 | 0 | 16 | | | 8 | 8 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hippolyte varians** | Arthropoda | Malacostraca | Decapoda | Hippolytidae | **Hippolyte varians** | 1. Species | 74 | 74 | 3 | 1 | 0 | 5 | 64 | 0 | 1 | 0 | 74 | OUT | Species out of scope for dredge | | |
| **Spirontocaris cranchi** | Arthropoda | Malacostraca | Decapoda | Hippolytidae | **Spirontocaris cranchi** | 1. Species | 24 | 24 | 6 | 1 | 0 | 2 | 15 | 0 | 0 | 0 | 24 | OUT | Species out of scope for dredge | | |
| **Spirontocaris pusiola** | Arthropoda | Malacostraca | Decapoda | Hippolytidae | **Spirontocaris pusiola** | 1. Species | 72 | 72 | 8 | 0 | 0 | 5 | 55 | 0 | 3 | 1 | 72 | OUT | Species out of scope for dredge | | |
| **Ebalia tuberosa** | Arthropoda | Malacostraca | Decapoda | Leucosiidae | **Ebalia tuberosa** | 1. Species | 53 | 53 | 42 | 0 | 0 | 2 | 6 | 1 | 2 | 0 | 53 | | | 42 | 42 |
| **Ebalia tumefacta** | Arthropoda | Malacostraca | Decapoda | Leucosiidae | **Ebalia tumefacta** | 1. Species | 21 | 21 | 18 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 21 | | | 18 | 18 |
| **Achaeus cranchi** | Arthropoda | Malacostraca | Decapoda | Majidae | **Achaeus cranchii** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | | | 1 | 1 |
| **Eurynome aspera** | Arthropoda | Malacostraca | Decapoda | Majidae | **Eurynome aspera** | 1. Species | 14 | 14 | 13 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 14 | | | 13 | 13 |
| **Hyas araneus** | Arthropoda | Malacostraca | Decapoda | Majidae | **Hyas araneus** | 1. Species | 40 | 35 | 10 | 11 | 7 | 2 | 1 | 0 | 4 | 0 | 35 | | | 10 | 10 |
| **Hyas coarctatus** | Arthropoda | Malacostraca | Decapoda | Majidae | **Hyas coarctatus** | 1. Species | 83 | 82 | 54 | 10 | 0 | 0 | 16 | 1 | 1 | 0 | 82 | | | 54 | 54 |
| **Hyas sp** | Arthropoda | Malacostraca | Decapoda | Majidae | **Hyas sp** | 2. Genus | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Inachus dorsettensis** | Arthropoda | Malacostraca | Decapoda | Majidae | **Inachus dorsettensis** | 1. Species | 55 | 55 | 48 | 3 | 0 | 2 | 0 | 1 | 1 | 0 | 55 | | | 48 | 48 |
| **Inachus leptochirus** | Arthropoda | Malacostraca | Decapoda | Majidae | **Inachus leptochirus** | 1. Species | 3 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 1 | 1 |
| **Inachus dorhynchus** | Arthropoda | Malacostraca | Decapoda | Majidae | **Inachus phalangium** | 1. Species | 7 | 7 | 4 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 7 | | | 4 | 4 |
| **Inachus thoracicus** | Arthropoda | Malacostraca | Decapoda | Majidae | **Inachus thoracicus** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Macropodia longirostris** | Arthropoda | Malacostraca | Decapoda | Majidae | **Macropodia longirostris** | 1. Species | 17 | 17 | 8 | 5 | 0 | 0 | 2 | 0 | 2 | 0 | 17 | | | 8 | 8 |
| **Macropodia rostrata** | Arthropoda | Malacostraca | Decapoda | Majidae | **Macropodia rostrata** | 1. Species | 55 | 55 | 39 | 4 | 1 | 4 | 4 | 2 | 1 | 0 | 55 | | | 39 | 39 |
| **Macropodia sp** | Arthropoda | Malacostraca | Decapoda | Majidae | **Macropodia sp** | 2. Genus | 7 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | | | 7 | 7 |
| **Maja squinado** | Arthropoda | Malacostraca | Decapoda | Majidae | **Maja squinado** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Pisa armata** | Arthropoda | Malacostraca | Decapoda | Majidae | **Pisa armata** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Homarus vulgaris** | Arthropoda | Malacostraca | Decapoda | Nephropidae | **Homarus vulgaris** | 1. Species | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Nephrops norvegicus** | Arthropoda | Malacostraca | Decapoda | Nephropidae | **Nephrops norvegicus** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Anapagurus hyndmanni** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Anapagurus hyndmanni** | 1. Species | 14 | 14 | 11 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 14 | | | 11 | 11 |
| **Anapagurus laevis** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Anapagurus laevis** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Crustacea** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Paguridae** | 3. Family | 18 | 15 | 5 | 0 | 0 | 3 | 6 | 0 | 1 | 0 | 13 | | | 5 | 4 |
| **Eupagurus bernhardus** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Pagurus bernhardus** | 1. Species | 210 | 209 | 135 | 18 | 12 | 6 | 32 | 4 | 1 | 1 | 209 | | | 135 | 135 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Eupagurus cuanensis** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Pagurus cuanensis** | 1. Species | 74 | 73 | 71 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 73 | | | 71 | 71 |
| **Eupagurus prideauxii** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Pagurus prideaux** | 1. Species | 15 | 15 | 7 | 2 | 0 | 2 | 3 | 1 | 0 | 0 | 15 | | | 7 | 7 |
| **Eupagurus sp** | Arthropoda | Malacostraca | Decapoda | Paguridae | **Pagurus sp** | 2. Genus | 5 | 5 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 5 | | | 2 | 2 |
| **Leander longirostris** | Arthropoda | Malacostraca | Decapoda | Palaemonidae | **Leander longirostris** | 1. Species | 42 | 42 | 0 | 1 | 2 | 9 | 18 | 0 | 7 | 5 | 42 | OUT | No dredge sample | | |
| **Leander serratus** | Arthropoda | Malacostraca | Decapoda | Palaemonidae | **Leander serratus** | 1. Species | 19 | 18 | 0 | 5 | 0 | 3 | 4 | 0 | 3 | 3 | 18 | OUT | No dredge sample | | |
| **Leander squilla** | Arthropoda | Malacostraca | Decapoda | Palaemonidae | **Leander squilla** | 1. Species | 3 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | OUT | No dredge sample | | |
| **Palaemonetes varians** | Arthropoda | Malacostraca | Decapoda | Palaemonidae | **Palaemonetes varians** | 1. Species | 13 | 13 | 0 | 0 | 0 | 0 | 1 | 0 | 9 | 3 | 13 | OUT | No dredge sample | | |
| **Pandalina brevirostris** | Arthropoda | Malacostraca | Decapoda | Pandalidae | **Pandalina brevirostris** | 1. Species | 91 | 91 | 13 | 0 | 0 | 5 | 72 | 1 | 0 | 0 | 91 | OUT | Species out of scope for dredge | | |
| **Pandalus montagui** | Arthropoda | Malacostraca | Decapoda | Pandalidae | **Pandalus montagui** | 1. Species | 173 | 172 | 12 | 12 | 12 | 20 | 113 | 1 | 1 | 1 | 172 | OUT | Species out of scope for dredge | | |
| **Pandalus sp** | Arthropoda | Malacostraca | Decapoda | Pandalidae | **Pandalus sp** | 2. Genus | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Pilumnus hirtellus** | Arthropoda | Malacostraca | Decapoda | Pilumnidae | **Pilumnus hirtellus** | 1. Species | 85 | 85 | 54 | 7 | 2 | 5 | 11 | 2 | 4 | 0 | 85 | | | 54 | 54 |
| **Pinnotheres pisum** | Arthropoda | Malacostraca | Decapoda | Pinnotheridae | **Pinnotheres pisum** | 1. Species | 114 | 113 | 62 | 10 | 2 | 6 | 30 | 1 | 0 | 2 | 113 | | | 62 | 62 |
| **Pirimela denticulata** | Arthropoda | Malacostraca | Decapoda | Pirimelidae | **Pirimela denticulata** | 1. Species | 7 | 7 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 7 | | | 5 | 5 |
| **Porcellana longicornis** | Arthropoda | Malacostraca | Decapoda | Porcellanidae | **Pisidia longicornis** | 1. Species | 177 | 176 | 112 | 5 | 1 | 4 | 42 | 5 | 5 | 2 | 176 | | | 112 | 112 |
| **Porcellana platycheles** | Arthropoda | Malacostraca | Decapoda | Porcellanidae | **Porcellana platycheles** | 1. Species | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Porcellana sp** | Arthropoda | Malacostraca | Decapoda | Porcellanidae | **Porcellana sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Carcinus maenas** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Carcinus maenas** | 1. Species | 39 | 38 | 4 | 5 | 6 | 4 | 4 | 0 | 10 | 5 | 38 | | | 4 | 4 |
| **Portunus depurator** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Liocarcinus depurator** | 1. Species | 34 | 34 | 29 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 34 | | | 29 | 29 |
| **Liocarcinus holsatus** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Liocarcinus holsatus** | 1. Species | 183 | 182 | 52 | 11 | 12 | 9 | 66 | 0 | 32 | 0 | 182 | | | 52 | 52 |
| **Liocarcinus marmoreus** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Liocarcinus marmoreus** | 1. Species | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 5 | 5 |
| **Portunus pusillus** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Liocarcinus pusillus** | 1. Species | 37 | 37 | 27 | 2 | 0 | 0 | 8 | 0 | 0 | 0 | 37 | | | 27 | 27 |
| **Portunus sp** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Liocarcinus sp** | 2. Genus | 5 | 5 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | | | 1 | 1 |
| **Portunus puber** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Necora puber** | 1. Species | 26 | 26 | 7 | 12 | 3 | 1 | 2 | 0 | 1 | 0 | 26 | | | 7 | 7 |
| **Portunus arcuatus** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Polybius arcuatus** | 1. Species | 30 | 30 | 24 | 3 | 0 | 2 | 1 | 0 | 0 | 0 | 30 | | | 24 | 24 |
| **Portumnus latipes** | Arthropoda | Malacostraca | Decapoda | Portunidae | **Portumnus latipes** | 1. Species | 55 | 54 | 24 | 14 | 5 | 0 | 0 | 2 | 3 | 6 | 54 | | | 24 | 24 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Processa canaliculata** | Arthropoda | Malacostraca | Decapoda | Processidae | **Processa canaliculata** | 1. Species | 74 | 74 | 10 | 15 | 2 | 8 | 38 | 1 | 0 | 0 | 74 | OUT | Species out of scope for dredge | | |
| **Thia polita** | Arthropoda | Malacostraca | Decapoda | Thiidae | **Thia scutellata** | 1. Species | 20 | 19 | 18 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 19 | | | 18 | 18 |
| **Upogebia deltaura** | Arthropoda | Malacostraca | Decapoda | Upogebiidae | **Upogebia deltaura** | 1. Species | 12 | 11 | 7 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 11 | OUT | Species out of scope for dredge | | |
| **Meganyctiphanes norvegicus** | Arthropoda | Malacostraca | Euphausiacea | Euphausiidae | **Meganyctiphanes norvegicus** | 1. Species | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Nyctiphanes couchi** | Arthropoda | Malacostraca | Euphausiacea | Euphausiidae | **Nyctiphanes couchi** | 1. Species | 83 | 83 | 0 | 0 | 5 | 12 | 63 | 0 | 1 | 2 | 83 | OUT | No dredge sample | | |
| **Thysanoëssa raschi** | Arthropoda | Malacostraca | Euphausiacea | Euphausiidae | **Thysanoessa raschi** | 1. Species | 3 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 3 | OUT | No dredge sample | | |
| **Anthura gracilis** | Arthropoda | Malacostraca | Isopoda | Anthuridae | **Anthura gracilis** | 1. Species | 4 | 4 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | | | 3 | 3 |
| **Cyathura carinata** | Arthropoda | Malacostraca | Isopoda | Anthuridae | **Cyathura carinata** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Arcturella dilatata** | Arthropoda | Malacostraca | Isopoda | Arcturidae | **Arcturella dilatata** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Astacilla longicornis** | Arthropoda | Malacostraca | Isopoda | Arcturidae | **Astacilla longicornis** | 1. Species | 9 | 9 | 0 | 0 | 0 | 2 | 7 | 0 | 0 | 0 | 9 | OUT | No dredge sample | | |
| **Athelges paguri** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Athelges paguri** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Bopyrina giardi** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Bopyrina giardi** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Ione thoracica** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Ione thoracica** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Species out of scope for dredge | | |
| **Phryxus abdominalis** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Phryxus abdominalis** | 1. Species | 7 | 7 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 7 | OUT | No dredge sample | | |
| **Pleurocrypta intermedia** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Pleurocrypta intermedia** | 1. Species | 5 | 5 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 5 | OUT | Species out of scope for dredge | | |
| **Pleurocrypta porcellanae** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Pleurocrypta porcellanae** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Species out of scope for dredge | | |
| **Pseudione proxima** | Arthropoda | Malacostraca | Isopoda | Bopyridae | **Pseudione proxima** | 1. Species | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | Species out of scope for dredge | | |
| **Cirolana borealis** | Arthropoda | Malacostraca | Isopoda | Cirolanidae | **Cirolana borealis** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Conilera cylindracea** | Arthropoda | Malacostraca | Isopoda | Cirolanidae | **Conilera cylindracea** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Eurydice pulchra** | Arthropoda | Malacostraca | Isopoda | Cirolanidae | **Eurydice pulchra** | 1. Species | 57 | 56 | 0 | 0 | 0 | 26 | 22 | 0 | 2 | 6 | 56 | OUT | No dredge sample | | |
| **Eurydice spinigera** | Arthropoda | Malacostraca | Isopoda | Cirolanidae | **Eurydice spinigera** | 1. Species | 20 | 20 | 0 | 0 | 0 | 2 | 18 | 0 | 0 | 0 | 20 | OUT | No dredge sample | | |
| **Eurydice truncata** | Arthropoda | Malacostraca | Isopoda | Cirolanidae | **Eurydice truncata** | 1. Species | 7 | 7 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 1 | 7 | OUT | No dredge sample | | |
| **Prodajus ostendensis** | Arthropoda | Malacostraca | Isopoda | Dajidae | **Prodajus ostendensis** | 1. Species | 46 | 46 | 3 | 0 | 0 | 5 | 36 | 0 | 0 | 2 | 46 | OUT | Species out of scope for dredge | | |
| **Portunion kossmanni** | Arthropoda | Malacostraca | Isopoda | Entoniscidae | **Portunion kossmanni** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Gnathia maxillaris** | Arthropoda | Malacostraca | Isopoda | Gnathiidae | **Gnathia maxillaris** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gnathia oxyurea** | Arthropoda | Malacostraca | Isopoda | Gnathiidae | **Gnathia oxyurea** | 1. Species | 9 | 9 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 9 | OUT | No dredge sample | | |
| **Idotea emarginata** | Arthropoda | Malacostraca | Isopoda | Idoteidae | **Idotea emarginata** | 1. Species | 3 | 3 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | OUT | No dredge sample | | |
| **Idotea granulosa** | Arthropoda | Malacostraca | Isopoda | Idoteidae | **Idotea granulosa** | 1. Species | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | OUT | No dredge sample | | |
| **Idotea linearis** | Arthropoda | Malacostraca | Isopoda | Idoteidae | **Idotea linearis** | 1. Species | 230 | 230 | 5 | 1 | 2 | 36 | 178 | 1 | 1 | 6 | 230 | OUT | Species out of scope for dredge | | |
| **Idotea marina** | Arthropoda | Malacostraca | Isopoda | Idoteidae | **Idotea marina** | 1. Species | 39 | 39 | 5 | 1 | 0 | 13 | 12 | 0 | 5 | 3 | 39 | OUT | Species out of scope for dredge | | |
| **Idotea neglecta** | Arthropoda | Malacostraca | Isopoda | Idoteidae | **Idotea neglecta** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Janira maculosa** | Arthropoda | Malacostraca | Isopoda | Janiridae | **Janira maculosa** | 1. Species | 13 | 13 | 4 | 0 | 0 | 0 | 8 | 0 | 1 | 0 | 13 | | | 4 | 4 |
| **Ligia oceanica** | Arthropoda | Malacostraca | Isopoda | Ligiidae | **Ligia oceanica** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | OUT | No dredge sample | | |
| **Limnoria lignorum** | Arthropoda | Malacostraca | Isopoda | Limnoriidae | **Limnoria lignorum** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Munna fabricii** | Arthropoda | Malacostraca | Isopoda | Munnidae | **Munna fabricii** | 1. Species | 4 | 4 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | OUT | No dredge sample | | |
| **Sphaeroma rugicauda** | Arthropoda | Malacostraca | Isopoda | Sphaeromatidae | **Sphaeroma rugicauda** | 1. Species | 6 | 6 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 1 | 6 | OUT | No dredge sample | | |
| **Sphaeroma serratum** | Arthropoda | Malacostraca | Isopoda | Sphaeromatidae | **Sphaeroma serratum** | 1. Species | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | OUT | No dredge sample | | |
| **Anchialina agilis** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Anchialina agilis** | 1. Species | 54 | 54 | 0 | 0 | 0 | 13 | 39 | 0 | 0 | 2 | 54 | OUT | No dredge sample | | |
| **Gastrosaccus normani** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Gastrosaccus normani** | 1. Species | 7 | 7 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 0 | 7 | OUT | No dredge sample | | |
| **Gastrosaccus sanctus** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Gastrosaccus sanctus** | 1. Species | 8 | 8 | 0 | 0 | 0 | 3 | 5 | 0 | 0 | 0 | 8 | OUT | No dredge sample | | |
| **Gastrosaccus spinifer** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Gastrosaccus spinifer** | 1. Species | 435 | 435 | 20 | 2 | 9 | 52 | 333 | 4 | 8 | 7 | 435 | OUT | Species out of scope for dredge | | |
| **Hemimysis lamornae** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Hemimysis lamornae** | 1. Species | 26 | 26 | 0 | 0 | 0 | 3 | 22 | 0 | 0 | 1 | 26 | OUT | No dredge sample | | |
| **Leptomysis apiops** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Leptomysis apiops** | 1. Species | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Leptomysis liguura** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Leptomysis liguura** | 1. Species | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Leptomysis mediterranea** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Leptomysis mediterranea** | 1. Species | 6 | 6 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 6 | OUT | No dredge sample | | |
| **Mesopodopsis slabberi** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Mesopodopsis slabberi** | 1. Species | 326 | 325 | 1 | 0 | 12 | 53 | 242 | 1 | 8 | 8 | 325 | OUT | Species out of scope for dredge | | |
| **Mysidopsis gibbosa** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Mysidopsis gibbosa** | 1. Species | 56 | 56 | 0 | 1 | 0 | 1 | 54 | 0 | 0 | 0 | 56 | OUT | No dredge sample | | |
| **Neomysis longicornis** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Neomysis longicornis** | 1. Species | 46 | 46 | 0 | 0 | 0 | 7 | 37 | 1 | 0 | 1 | 46 | OUT | No dredge sample | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Neomysis vulgaris** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Neomysis vulgaris** | 1. Species | 24 | 24 | 0 | 0 | 0 | 4 | 16 | 1 | 1 | 2 | 24 | OUT | No dredge sample | | |
| **Paramysis kervillei** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Paramysis kervillei** | 1. Species | 430 | 430 | 2 | 2 | 12 | 41 | 361 | 0 | 8 | 4 | 430 | OUT | Species out of scope for dredge | | |
| **Paramysis ornata** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Paramysis ornata** | 1. Species | 80 | 80 | 0 | 0 | 0 | 12 | 64 | 1 | 1 | 2 | 80 | OUT | No dredge sample | | |
| **Paramysis spiritus** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Paramysis spiritus** | 1. Species | 231 | 231 | 0 | 1 | 7 | 24 | 192 | 0 | 2 | 5 | 231 | OUT | No dredge sample | | |
| **Praunus flexuosus** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Praunus flexuosus** | 1. Species | 152 | 152 | 0 | 0 | 2 | 40 | 100 | 0 | 6 | 4 | 152 | OUT | No dredge sample | | |
| **Siriella armata** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Siriella armata** | 1. Species | 179 | 179 | 1 | 0 | 4 | 34 | 135 | 0 | 1 | 4 | 179 | OUT | Species out of scope for dredge | | |
| **Siriella clausi** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Siriella clausi** | 1. Species | 13 | 13 | 0 | 0 | 0 | 5 | 7 | 0 | 0 | 1 | 13 | OUT | No dredge sample | | |
| **Siriella crassipes** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Siriella crassipes** | 1. Species | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Siriella frontalis** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Siriella frontalis** | 1. Species | 32 | 32 | 0 | 0 | 0 | 3 | 26 | 0 | 0 | 3 | 32 | OUT | No dredge sample | | |
| **Siriella gordonae** | Arthropoda | Malacostraca | Mysidacea | Mysidae | **Siriella gordonae** | 1. Species | 27 | 27 | 0 | 0 | 0 | 11 | 14 | 0 | 0 | 2 | 27 | OUT | No dredge sample | | |
| **ARTHROPODA – MAXILLOPODA (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Lernaea branchialis** | Arthropoda | Maxillopoda | Copepoda | Caligidae | **Lernea branchialis** | 1. Species | 5 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | OUT | No dredge sample | | |
| **Lernacodiscus galatheae** | Arthropoda | Maxillopoda | Rhizocephala | Lernaeodiscidae | **Lernaeodiscus galatheae** | 1. Species | 11 | 11 | 7 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 11 | OUT | Species out of scope for dredge | | |
| **Triangulus galatheae** | Arthropoda | Maxillopoda | Rhizocephala | Lernaeodiscidae | **Triangulus galatheae** | 1. Species | 6 | 6 | 1 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 6 | OUT | Species out of scope for dredge | | |
| **Galatheascus minutus** | Arthropoda | Maxillopoda | Rhizocephala | Peltogastridae | **Galatheascus minutus** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | OUT | No dredge sample | | |
| **Peltogaster paguri** | Arthropoda | Maxillopoda | Rhizocephala | Peltogastridae | **Peltogaster paguri** | 1. Species | 12 | 12 | 4 | 5 | 0 | 1 | 1 | 0 | 0 | 1 | 12 | OUT | Species out of scope for dredge | | |
| **Peltogaster sulcatus** | Arthropoda | Maxillopoda | Rhizocephala | Peltogastridae | **Peltogaster sulcatus** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | Species out of scope for dredge | | |
| **Drepanorchis neglecta** | Arthropoda | Maxillopoda | Rhizocephala | Sacculinidae | **Drepanorchis neglecta** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Sacculina andersoni** | Arthropoda | Maxillopoda | Rhizocephala | Sacculinidae | **Sacculina andersoni** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |
| **Sacculina betencourti** | Arthropoda | Maxillopoda | Rhizocephala | Sacculinidae | **Sacculina betencourti** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Sacculina carcini** | Arthropoda | Maxillopoda | Rhizocephala | Sacculinidae | **Sacculina carcini** | 1. Species | 38 | 38 | 1 | 1 | 0 | 0 | 0 | 0 | 36 | 0 | 38 | OUT | Species out of scope for dredge | | |
| **Cirripedia** | Arthropoda | Maxillopoda | Thoracica | | **Thoracica** | 4. Order | 35 | 22 | 10 | 7 | 0 | 2 | 0 | 0 | 2 | 1 | 22 | OUT | High taxonomic level | | |
| **Semibalanus balanoïdes** | Arthropoda | Maxillopoda | Thoracica | Archaeobalanidae | **Semibalanus balanoides** | 1. Species | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 4 | | | 1 | 1 |
| **Balanus balanus** | Arthropoda | Maxillopoda | Thoracica | Balanidae | **Balanus balanus** | 1. Species | 5 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | | | 2 | 2 |
| **Balanus crenatus** | Arthropoda | Maxillopoda | Thoracica | Balanidae | **Balanus crenatus** | 1. Species | 38 | 37 | 9 | 10 | 5 | 3 | 3 | 0 | 6 | 1 | 37 | | | 9 | 9 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Balanus eparoui** | Arthropoda | Maxillopoda | Thoracica | Balanidae | **Balanus eparoui** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Balanus improvisus** | Arthropoda | Maxillopoda | Thoracica | Balanidae | **Balanus improvisus** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | OUT | Number unknown | | |
| **Balanus porcatus** | Arthropoda | Maxillopoda | Thoracica | Balanidae | **Balanus porcatus** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |
| **Balanus sp** | Arthropoda | Maxillopoda | Thoracica | Balanidae | **Balanus sp** | 2. Genus | 11 | 10 | 3 | 1 | 2 | 0 | 0 | 2 | 2 | 0 | 10 | | | 3 | 3 |
| **Conchoderma auritum** | Arthropoda | Maxillopoda | Thoracica | Lepadidae | **Conchoderma auritum** | 1. Species | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | OUT | No dredge sample | | |
| **Lepas anatifera** | Arthropoda | Maxillopoda | Thoracica | Lepadidae | **Lepas anatifera** | 1. Species | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | OUT | No dredge sample | | |
| **Lepas anserifera** | Arthropoda | Maxillopoda | Thoracica | Lepadidae | **Lepas anserifera** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Lepas fascicularis** | Arthropoda | Maxillopoda | Thoracica | Lepadidae | **Lepas fascicularis** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Lepas hilli** | Arthropoda | Maxillopoda | Thoracica | Lepadidae | **Lepas hilli** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Scalpellum scalpellum** | Arthropoda | Maxillopoda | Thoracica | Scalpellidae | **Scalpellum scalpellum** | 1. Species | 17 | 17 | 11 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 17 | | | 11 | 11 |
| **Verruca stroemia** | Arthropoda | Maxillopoda | Thoracica | Verrucidae | **Verruca stroemia** | 1. Species | 10 | 8 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 8 | | | 7 | 7 |
| **ARTHROPODA – PYCNOGONIDA (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Ammothea echinata** | Arthropoda | Pycnogonida | Pantopoda | Ammotheidae | **Achelia echinata** | 1. Species | 4 | 4 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | | | 2 | 2 |
| **Pallene brevirostris** | Arthropoda | Pycnogonida | Pantopoda | Callipallenidae | **Callipallene brevirostris** | 1. Species | 3 | 3 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 3 | OUT | No dredge sample | | |
| **Endeis charbydaea** | Arthropoda | Pycnogonida | Pantopoda | Endeidae | **Endeis charybdea** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Chilophoxus spinosus** | Arthropoda | Pycnogonida | Pantopoda | Endeidae | **Endeis spinosa** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | | | 1 | 1 |
| **Nymphon brevirostre** | Arthropoda | Pycnogonida | Pantopoda | Nymphonidae | **Nymphon brevirostre** | 1. Species | 10 | 10 | 1 | 0 | 0 | 1 | 8 | 0 | 0 | 0 | 10 | | | 1 | 1 |
| **Nymphon gracile** | Arthropoda | Pycnogonida | Pantopoda | Nymphonidae | **Nymphon gracile** | 1. Species | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | OUT | No dredge sample | | |
| **Chaetonymphon hirtum** | Arthropoda | Pycnogonida | Pantopoda | Nymphonidae | **Nymphon hirtum** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Nymphon rubrum** | Arthropoda | Pycnogonida | Pantopoda | Nymphonidae | **Nymphon rubrum** | 1. Species | 52 | 52 | 9 | 2 | 0 | 2 | 38 | 0 | 1 | 0 | 52 | | | 9 | 9 |
| **Anoplodactylus petiolatus** | Arthropoda | Pycnogonida | Pantopoda | Phoxichilidiidae | **Anoplodactylus petiolatus** | 1. Species | 17 | 17 | 6 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 17 | | | 6 | 6 |
| **Phoxichilidium femoratum** | Arthropoda | Pycnogonida | Pantopoda | Phoxichilidiidae | **Phoxichilidium femoratum** | 1. Species | 8 | 8 | 2 | 0 | 0 | 0 | 5 | 0 | 1 | 0 | 8 | | | 2 | 2 |
| **Pycnogonum littorale** | Arthropoda | Pycnogonida | Pantopoda | Pycnogonidae | **Pycnogonum littorale** | 1. Species | 66 | 66 | 45 | 7 | 0 | 4 | 6 | 3 | 1 | 0 | 66 | | | 45 | 45 |
| **Crustacea** | Arthropoda | | | | **Crustacea** | 6. Phylum | 7 | 5 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 5 | OUT | High taxonomic level | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BRACHIOPODA** | | | | | | | | | | | | | | | | | | | | | |
| **Terebratula sp** | Brachiopoda | Rhynchonellata | Terebratulida | Terebratuloidea | **Terebratula sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **BRYOZOA – GYMNOLAEMATA (revision, H. De Blauwe, scientific collaborator RBINS)** | | | | | | | | | | | | | | | | | | | | | |
| **Membranipora membranacea** | Bryozoa | Gymnolaemata | Cheilostomatida | | **Cheilostomatida** | 4. Order | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | High taxonomic level | | |
| **Reptadeonella violacea** | Bryozoa | Gymnolaemata | Cheilostomatida | Adeonidae | **Reptadeonella violacea** | 1. Species | 25 | 23 | 19 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 23 | | | 19 | 19 |
| **Hippoporina pertusa** | Bryozoa | Gymnolaemata | Cheilostomatida | Bitectiporidae | **Hippoporina pertusa** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 2 | 1 |
| **Pentopora foliacea** | Bryozoa | Gymnolaemata | Cheilostomatida | Bitectiporidae | **Pentapora fascialis** | 1. Species | 13 | 13 | 2 | 6 | 0 | 0 | 4 | 0 | 1 | 0 | 13 | | | 2 | 2 |
| **Schizomavella linearis** | Bryozoa | Gymnolaemata | Cheilostomatida | Bitectiporidae | **Schizomavella linearis** | 1. Species | 20 | 20 | 9 | 5 | 0 | 2 | 2 | 1 | 1 | 0 | 20 | | | 9 | 9 |
| **Schizomavella spec. (not S. linearis)** | Bryozoa | Gymnolaemata | Cheilostomatida | Bitectiporidae | **Schizomavella sp** | 2. Genus | 49 | 45 | 35 | 1 | 0 | 4 | 3 | 2 | 0 | 0 | 45 | | | 35 | 35 |
| **Porella concinna** | Bryozoa | Gymnolaemata | Cheilostomatida | Bryocryptellidae | **Porella concinna** | 1. Species | 21 | 18 | 15 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 18 | | | 15 | 15 |
| **Bicellariella ciliata** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bicellariella ciliata** | 1. Species | 19 | 17 | 4 | 0 | 0 | 0 | 4 | 2 | 7 | 0 | 17 | | | 4 | 4 |
| **Bugula avicularia** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bugula avicularia** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | | | 1 | 1 |
| **Bugula flabellata** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bugula flabellata** | 1. Species | 80 | 80 | 73 | 4 | 0 | 0 | 2 | 1 | 0 | 0 | 80 | | | 73 | 73 |
| **Bugula neritina** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bugula neritina** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Bugula plumosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bugula plumosa** | 1. Species | 16 | 15 | 7 | 2 | 0 | 0 | 6 | 0 | 0 | 0 | 15 | | | 7 | 7 |
| **Bugula sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bugula sp** | 2. Genus | 21 | 21 | 12 | 2 | 0 | 0 | 3 | 2 | 2 | 0 | 21 | | | 12 | 12 |
| **Bugula turbinata** | Bryozoa | Gymnolaemata | Cheilostomatida | Bugulidae | **Bugula turbinata** | 1. Species | 7 | 6 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 6 | | | 2 | 2 |
| **Rosseliana rosselii** | Bryozoa | Gymnolaemata | Cheilostomatida | Calloporidae | **Ammatophora nodulosa** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 1 |
| **Amphiblestrum flemingi** | Bryozoa | Gymnolaemata | Cheilostomatida | Calloporidae | **Amphiblestrum flemingii** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Callopora dumerilii** | Bryozoa | Gymnolaemata | Cheilostomatida | Calloporidae | **Callopora dumerilii** | 1. Species | 5 | 5 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 4 | | | 3 | 2 |
| **Callopora lineata** | Bryozoa | Gymnolaemata | Cheilostomatida | Calloporidae | **Callopora lineata** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | | | 1 | 1 |
| **Callopora spec.** | Bryozoa | Gymnolaemata | Cheilostomatida | Calloporidae | **Callopora sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Cauloramphus spiniferum** | Bryozoa | Gymnolaemata | Cheilostomatida | Calloporidae | **Cauloramphus spiniferum** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Scrupocellaria reptans** | Bryozoa | Gymnolaemata | Cheilostomatida | Candidae | **Scrupocellaria reptans** | 1. Species | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | | | 2 | 2 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Scrupocellaria scruposa** | Bryozoa | Gymnolaemata | Cheilostomatida | Candidae | **Scrupocellaria scruposa** | 1. Species | 50 | 47 | 39 | 2 | 0 | 1 | 1 | 3 | 1 | 0 | 47 | | | 39 | 39 |
| **Scrupocellaria sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Candidae | **Scrupocellaria sp** | 2. Genus | 7 | 6 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 6 | | | 5 | 5 |
| **Cellaria fistulosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Cellariidae | **Cellaria fistulosa** | 1. Species | 30 | 29 | 10 | 8 | 0 | 0 | 4 | 2 | 5 | 0 | 29 | | | 10 | 10 |
| **Cellaria sinuosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Cellariidae | **Cellaria sinuosa** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Bryozoa** | Bryozoa | Gymnolaemata | Cheilostomatida | Cellariidae | **Cellaria sp** | 2. Genus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Membranipora membranacea** | Bryozoa | Gymnolaemata | Cheilostomatida | Celleporidae | **Cellepora pumicosa** | 1. Species | 23 | 23 | 14 | 4 | 0 | 1 | 3 | 0 | 1 | 0 | 23 | | | 14 | 14 |
| **Cellepora sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Celleporidae | **Celleporidae** | 3. Family | 6 | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 4 | 4 |
| **Membranipora membranacea** | Bryozoa | Gymnolaemata | Cheilostomatida | Celleporidae | **Celleporina decipiens** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Cellepora pumicosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Celleporidae | **Omalosecosa ramulosa** | 1. Species | 8 | 8 | 1 | 2 | 0 | 0 | 1 | 3 | 1 | 0 | 8 | | | 1 | 1 |
| **Membranipora membranacea** | Bryozoa | Gymnolaemata | Cheilostomatida | Celleporidae | **Turbicellepora avicularis** | 1. Species | 44 | 43 | 35 | 2 | 0 | 2 | 1 | 3 | 0 | 0 | 43 | | | 35 | 35 |
| **Chorizopora brongniartii** | Bryozoa | Gymnolaemata | Cheilostomatida | Chorizoporidae | **Chorizopora brongniartii** | 1. Species | 15 | 14 | 12 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 14 | | | 12 | 12 |
| **Hippoporidra edax** | Bryozoa | Gymnolaemata | Cheilostomatida | Cleidochasmatidae | **Hippoporidra lusitanica** | 1. Species | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Cribilina radiata** | Bryozoa | Gymnolaemata | Cheilostomatida | Cribrilinidae | **Cribrilina radiata** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Membraniporella nitida** | Bryozoa | Gymnolaemata | Cheilostomatida | Cribrilinidae | **Membraniporella nitida** | 1. Species | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Puellina innominata** | Bryozoa | Gymnolaemata | Cheilostomatida | Cribrilinidae | **Puellina innominata** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Puellina praecox** | Bryozoa | Gymnolaemata | Cheilostomatida | Cribrilinidae | **Puellina praecox** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Puellina praecox or bifida** | Bryozoa | Gymnolaemata | Cheilostomatida | Cribrilinidae | **Puellina sp** | 2. Genus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Bryozoa** | Bryozoa | Gymnolaemata | Cheilostomatida | Cryptosulidae | **Cryptosula pallasiana** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Aspidelectra melolontha** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Aspidelectra melolontha** | 1. Species | 18 | 17 | 15 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 17 | | | 15 | 15 |
| **Conopeum reticulum** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Conopeum reticulum** | 1. Species | 59 | 30 | 25 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 29 | | | 25 | 24 |
| **Bryozoa** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Conopeum seurati** | 1. Species | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Bryozoa** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Conopeum sp** | 2. Genus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Bryozoa** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Electra crustulenta** | 1. Species | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Electra monostachys** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Electra monostachys** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Electra pilosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Electra pilosa** | 1. Species | 186 | 138 | 94 | 10 | 1 | 12 | 11 | 1 | 7 | 2 | 135 | | | 94 | 92 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Membranipora sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Electridae | **Electridae** | 3. Family | 7 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 5 | 5 |
| **Escharina hyndmanni** | Bryozoa | Gymnolaemata | Cheilostomatida | Escharinidae | **Escharina hyndmanni** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Escharina johnstoni** | Bryozoa | Gymnolaemata | Cheilostomatida | Escharinidae | **Escharina johnstoni** | 1. Species | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Gemellaria loricata** | Bryozoa | Gymnolaemata | Cheilostomatida | Eucrateidae | **Eucratea loricata** | 1. Species | 17 | 17 | 13 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 17 | | | 13 | 13 |
| **Chartella papyracea** | Bryozoa | Gymnolaemata | Cheilostomatida | Flustridae | **Chartella papyracea** | 1. Species | 22 | 20 | 7 | 8 | 0 | 0 | 3 | 2 | 0 | 0 | 20 | | | 7 | 7 |
| **Flustra sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Flustridae | **Flustra foliacea** | 1. Species | 255 | 215 | 189 | 8 | 1 | 6 | 6 | 4 | 1 | 0 | 215 | | | 189 | 189 |
| **Securiflustra securifrons** | Bryozoa | Gymnolaemata | Cheilostomatida | Flustridae | **Securiflustra securifrons** | 1. Species | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Haplopoma graniferum** | Bryozoa | Gymnolaemata | Cheilostomatida | Haplopomidae | **Haplopoma graniferum** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Hagiosynodus latus** | Bryozoa | Gymnolaemata | Cheilostomatida | Hippoporidridae | **Hagiosynodos latus** | 1. Species | 28 | 28 | 26 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 28 | | | 26 | 26 |
| **Cellepora sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Hippothoidae | **Celleporella hyalina** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Hippothoa divaricata** | Bryozoa | Gymnolaemata | Cheilostomatida | Hippothoidae | **Hippothoa divaricata** | 1. Species | 16 | 16 | 15 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 15 | | | 15 | 14 |
| **Hippothoa flagellum** | Bryozoa | Gymnolaemata | Cheilostomatida | Hippothoidae | **Hippothoa flagellum** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Hippothoa spec.** | Bryozoa | Gymnolaemata | Cheilostomatida | Hippothoidae | **Hippothoa sp** | 2. Genus | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Membranipora sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Membraniporidae | **Membranipora tenuis** | 1. Species | 16 | 15 | 14 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 15 | | | 14 | 14 |
| **Fenestrulina malusii** | Bryozoa | Gymnolaemata | Cheilostomatida | Microporellidae | **Fenestrulina malusii** | 1. Species | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Microporella ciliata** | Bryozoa | Gymnolaemata | Cheilostomatida | Microporellidae | **Microporella ciliata** | 1. Species | 18 | 18 | 16 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 18 | | | 16 | 16 |
| **Schizotheca fissa** | Bryozoa | Gymnolaemata | Cheilostomatida | Phidoloporidae | **Schizotheca fissa** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Escharella immersa** | Bryozoa | Gymnolaemata | Cheilostomatida | Romancheinidae | **Escharella immersa** | 1. Species | 26 | 23 | 17 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 23 | | | 17 | 17 |
| **Escharella variolosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Romancheinidae | **Escharella variolosa** | 1. Species | 8 | 6 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | | | 5 | 5 |
| **Escharoides coccinea** | Bryozoa | Gymnolaemata | Cheilostomatida | Romancheinidae | **Escharoides coccinea** | 1. Species | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | | | 1 | 1 |
| **Neolagenipora collaris** | Bryozoa | Gymnolaemata | Cheilostomatida | Romancheinidae | **Neolagenipora collaris** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Schizoporella unicornis** | Bryozoa | Gymnolaemata | Cheilostomatida | Schizoporellidae | **Schizoporella sp** | 2. Genus | 6 | 5 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 5 | | | 2 | 2 |
| **Scruparia chelata** | Bryozoa | Gymnolaemata | Cheilostomatida | Scrupariidae | **Scruparia ambigua** | 1. Species | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Scruparia chelata** | Bryozoa | Gymnolaemata | Cheilostomatida | Scrupariidae | **Scruparia chelata** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Scruparia spec.** | Bryozoa | Gymnolaemata | Cheilostomatida | Scrupariidae | **Scruparia sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Parasmittina trispinosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Smittinidae | **Parasmittina trispinosa** | 1. Species | 3 | 3 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 3 | | | 1 | 1 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phylactella labrosa** | Bryozoa | Gymnolaemata | Cheilostomatida | Smittinidae | **Phylactella labrosa** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Flustra sp** | Bryozoa | Gymnolaemata | Cheilostomatida | Smittinidae | **Smittina landsborovii** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Spathipora spec.** | Bryozoa | Gymnolaemata | Cheilostomatida | Spathiporidae | **Spathipora sp** | 2. Genus | 6 | 4 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | | | 3 | 3 |
| **Trypostega venusta** | Bryozoa | Gymnolaemata | Cheilostomatida | Trypostegidae | **Trypostega venusta** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Alcyonidium gelatinosum** | Bryozoa | Gymnolaemata | Ctenostomatida | Alcyonidiidae | **Alcyonidium condylocinereum** | 1. Species | 23 | 18 | 7 | 5 | 2 | 1 | 3 | 0 | 0 | 0 | 18 | | | 7 | 7 |
| **Alcyonidium hirsutum** | Bryozoa | Gymnolaemata | Ctenostomatida | Alcyonidiidae | **Alcyonidium diaphanum** | 1. Species | 63 | 49 | 32 | 4 | 3 | 2 | 5 | 2 | 0 | 1 | 49 | | | 32 | 32 |
| **Bryozoa** | Bryozoa | Gymnolaemata | Ctenostomatida | Alcyonidiidae | **Alcyonidium hydrocoalitum** | 1. Species | 7 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | | | 7 | 7 |
| **Alcyonidium mytili** | Bryozoa | Gymnolaemata | Ctenostomatida | Alcyonidiidae | **Alcyonidium mytili** | 1. Species | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Alcyonidium parasiticum** | Bryozoa | Gymnolaemata | Ctenostomatida | Alcyonidiidae | **Alcyonidium parasiticum** | 1. Species | 59 | 57 | 51 | 0 | 0 | 3 | 2 | 1 | 0 | 0 | 57 | | | 51 | 51 |
| **Alcyonidium gelatinosum** | Bryozoa | Gymnolaemata | Ctenostomatida | Alcyonidiidae | **Alcyonidium sp** | 2. Genus | 213 | 167 | 132 | 11 | 3 | 10 | 3 | 3 | 2 | 3 | 167 | | | 132 | 132 |
| **Arachnidium fibrosum** | Bryozoa | Gymnolaemata | Ctenostomatida | Arachnidiidae | **Arachnidium fibrosum** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Immergentia spec.** | Bryozoa | Gymnolaemata | Ctenostomatida | Immergentiidae | **Immergentia sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Immergentia suecica** | Bryozoa | Gymnolaemata | Ctenostomatida | Immergentiidae | **Immergentia suecica** | 1. Species | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Anguinella palmata** | Bryozoa | Gymnolaemata | Ctenostomatida | Nolellidae | **Anguinella palmata** | 1. Species | 4 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 4 | | | 1 | 1 |
| **Penetrantia concharum** | Bryozoa | Gymnolaemata | Ctenostomatida | Penetrantiidae | **Penetrantia concharum** | 1. Species | 14 | 12 | 9 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 12 | | | 9 | 9 |
| **Penetrantia spec.** | Bryozoa | Gymnolaemata | Ctenostomatida | Penetrantiidae | **Penetrantia sp** | 2. Genus | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Farrella repens** | Bryozoa | Gymnolaemata | Ctenostomatida | Triticellidae | **Farrella repens** | 1. Species | 58 | 51 | 15 | 11 | 5 | 1 | 9 | 0 | 3 | 7 | 50 | | | 15 | 14 |
| **Amathia lendigera** | Bryozoa | Gymnolaemata | Ctenostomatida | Vesiculariidae | **Amathia lendigera** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Amathia sp** | Bryozoa | Gymnolaemata | Ctenostomatida | Vesiculariidae | **Amathia sp** | 2. Genus | 10 | 10 | 0 | 0 | 0 | 6 | 4 | 0 | 0 | 0 | 10 | OUT | No dredge sample | | |
| **Bowerbankia sp** | Bryozoa | Gymnolaemata | Ctenostomatida | Vesiculariidae | **Bowerbankia sp** | 2. Genus | 17 | 16 | 12 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 16 | | | 12 | 12 |
| **Vesicularia spinosa** | Bryozoa | Gymnolaemata | Ctenostomatida | Vesiculariidae | **Vesicularia spinosa** | 1. Species | 67 | 63 | 55 | 2 | 0 | 3 | 1 | 2 | 0 | 0 | 63 | | | 55 | 55 |
| **BRYOZOA – PHYLACTOLAEMATA (revision, H. De Blauwe, scientific collaborator RBINS)** | | | | | | | | | | | | | | | | | | | | | |
| **Cristatella mucedo** | Bryozoa | Phylactolaemata | | | **Cristatella mucedo** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Plumatella fungosa** | Bryozoa | Phylactolaemata | | | **Plumatella fungosa** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Plumatella gaimermassardi** | Bryozoa | Phylactolaemata | | | **Plumatella gaimermassardi** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plumatella repens** | Bryozoa | Phylactolaemata | | | **Plumatella repens** | 1. Species | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Plumatella sp** | Bryozoa | Phylactolaemata | | | **Plumatella sp** | 2. Genus | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **BRYOZOA – STENOLAEMATA (revision, H. De Blauwe, scientific collaborator RBINS)** | | | | | | | | | | | | | | | | | | | | | |
| **Tubulipora sp** | Bryozoa | Stenolaemata | Cyclostomatida | | **Cyclostomatida** | 4. Order | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | OUT | High taxonomic level | | |
| **Crisia denticulata** | Bryozoa | Stenolaemata | Cyclostomatida | Crisiidae | **Crisia denticulata** | 1. Species | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 3 | | | 1 | 1 |
| **Crisia sp** | Bryozoa | Stenolaemata | Cyclostomatida | Crisiidae | **Crisia eburnea** | 1. Species | 6 | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | | | 3 | 3 |
| **Crisia sp** | Bryozoa | Stenolaemata | Cyclostomatida | Crisiidae | **Crisia sp** | 2. Genus | 4 | 4 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 4 | | | 1 | 1 |
| **Crisidia cornuta** | Bryozoa | Stenolaemata | Cyclostomatida | Crisiidae | **Crisidia cornuta** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Diastopora sp** | Bryozoa | Stenolaemata | Cyclostomatida | Diastoporidae | **Diastoporidae** | 3. Family | 3 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | | | 1 | 1 |
| **Diastopora sp** | Bryozoa | Stenolaemata | Cyclostomatida | Diastoporidae | **Eurystrotos compacta** | 1. Species | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | | | 2 | 1 |
| **Plagioecia patina** | Bryozoa | Stenolaemata | Cyclostomatida | Diastoporidae | **Plagioecia patina** | 1. Species | 18 | 17 | 11 | 2 | 0 | 3 | 0 | 0 | 1 | 0 | 17 | | | 11 | 11 |
| **Disporella hispida** | Bryozoa | Stenolaemata | Cyclostomatida | Lichenoporidae | **Disporella hispida** | 1. Species | 36 | 35 | 27 | 1 | 0 | 5 | 1 | 0 | 1 | 0 | 33 | | | 27 | 26 |
| **Stomatoporina incurvata** | Bryozoa | Stenolaemata | Cyclostomatida | Oncousoeciidae | **Stomatoporina incurvata** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Tubulipora liliacea** | Bryozoa | Stenolaemata | Cyclostomatida | Tubuliporidae | **Tubulipora liliacea** | 1. Species | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Tubulipora cf lobifera** | Bryozoa | Stenolaemata | Cyclostomatida | Tubuliporidae | **Tubulipora lobifera** | 1. Species | 6 | 6 | 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 6 | | | 5 | 5 |
| **Tubulipora spec.** | Bryozoa | Stenolaemata | Cyclostomatida | Tubuliporidae | **Tubulipora sp** | 2. Genus | 7 | 7 | 6 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 7 | | | 6 | 6 |
| **Membranipora membranacea** | Bryozoa | | | | **Bryozoa** | 6. Phylum | 205 | 102 | 74 | 5 | 1 | 5 | 7 | 3 | 7 | 0 | 102 | OUT | High taxonomic level | | |
| **ENTOPROCTA (determinations, H. De Blauwe, scientific collaborator RBINS)** | | | | | | | | | | | | | | | | | | | | | |
| **Barentsia elongata** | Entoprocta | | Coloniales | Barentiidae | **Barentsia elongata** | 1. Species | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | OUT | Incomplete digitization | | |
| **Pedicellina sp** | Entoprocta | | Coloniales | Pedicellinidae | **Pedicellina sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |
| **CNIDARIA** | | | | | | | | | | | | | | | | | | | | | |
| **Coelenterata** | Cnidaria | | | | **Cnidaria** | 6. Phylum | 74 | 42 | 37 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 42 | OUT | High taxonomic level | | |
| **CNIDARIA – HEXACORALLIA (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Actiniaria** | Cnidaria | Hexacorallia | | | **Hexacorallia** | 5. Classis | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | High taxonomic level | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Actinia equina** | Cnidaria | Hexacorallia | Actiniaria | Actiniidae | **Actinia equina** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | | | 1 | 1 |
| **Tealia crassicornis** | Cnidaria | Hexacorallia | Actiniaria | Actiniidae | **Urticina sp** | 2. Genus | 7 | 6 | 3 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 6 | | | 3 | 3 |
| **Adamsia palliata** | Cnidaria | Hexacorallia | Actiniaria | Hormathiidae | **Adamsia carciniopados** | 1. Species | 5 | 5 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | | | 3 | 3 |
| **Metridium dianthus** | Cnidaria | Hexacorallia | Actiniaria | Metridiidae | **Metridium senile** | 1. Species | 45 | 39 | 24 | 5 | 0 | 1 | 1 | 2 | 6 | 0 | 39 | | | 24 | 24 |
| **Cereus pedunculatus** | Cnidaria | Hexacorallia | Actiniaria | Sagartiidae | **Cereus pedunculatus** | 1. Species | 17 | 15 | 7 | 0 | 0 | 0 | 2 | 5 | 1 | 0 | 15 | | | 7 | 7 |
| **Cylista undata** | Cnidaria | Hexacorallia | Actiniaria | Sagartiidae | **Sagartiogeton undatus** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | | |
| **Actiniaria** | Cnidaria | Hexacorallia | Actiniaria | | **Actiniaria** | 4. Order | 202 | 44 | 29 | 3 | 1 | 2 | 3 | 4 | 1 | 1 | 44 | OUT | High taxonomic level | | |
| **Antipathes sp** | Cnidaria | Hexacorallia | Antipatharia | Antipathidae | **Antipathes sp** | 2. Genus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Cerianthus lloydii** | Cnidaria | Hexacorallia | Ceriantharia | Cerianthidae | **Cerianthus lloydi** | 1. Species | 65 | 41 | 15 | 0 | 0 | 2 | 11 | 13 | 0 | 0 | 41 | | | 15 | 15 |
| **Polythoa arenacea** | Cnidaria | Hexacorallia | Zoanthiniaria | Sphenopidae | **Palythoa arenacea** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **CNIDARIA – HYDROIDOMEDUSAE (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Coppinia** | Cnidaria | Hydroidomedusae | | | **Hydroidomedusae** | 5. Classis | 39 | 33 | 26 | 3 | 0 | 0 | 4 | 0 | 0 | 0 | 33 | OUT | High taxonomic level | | |
| **Hydra grisea** | Cnidaria | Hydroidomedusae | | | **Hydra attenuata** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Coryne sarsi** | Cnidaria | Hydroidomedusae | Capitata | Corymorphidae | **Corymorpha sarsi** | 1. Species | 4 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | | | 4 | 4 |
| **Coryne eximia** | Cnidaria | Hydroidomedusae | Capitata | Corynidae | **Coryne eximia** | 1. Species | 4 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 4 | OUT | No dredge sample | | |
| **Margelopsis haeckeli** | Cnidaria | Hydroidomedusae | Capitata | Margelopsidae | **Margelopsis haeckeli** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Margelopsis sp** | Cnidaria | Hydroidomedusae | Capitata | Margelopsidae | **Margelopsis sp** | 2. Genus | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Ectopleura dumortieri** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Ectopleura dumortieri** | 1. Species | 30 | 30 | 21 | 0 | 1 | 3 | 5 | 0 | 0 | 0 | 30 | | | 21 | 21 |
| **Ectopleura sp** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Ectopleura sp** | 2. Genus | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 5 | 5 |
| **Hybocodon prolifer** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Hybocodon prolifer** | 1. Species | 15 | 15 | 0 | 0 | 0 | 0 | 14 | 1 | 0 | 0 | 15 | OUT | No dredge sample | | |
| **Hybocodon sp** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Hybocodon sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Tubularia indivisa** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Tubularia indivisa** | 1. Species | 59 | 59 | 46 | 6 | 0 | 0 | 5 | 2 | 0 | 0 | 59 | | | 46 | 46 |
| **Tubularia larynx** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Tubularia larynx** | 1. Species | 54 | 47 | 23 | 5 | 0 | 1 | 4 | 0 | 13 | 1 | 47 | | | 23 | 23 |
| **Tubularia sp** | Cnidaria | Hydroidomedusae | Capitata | Tubulariidae | **Tubularia sp** | 2. Genus | 29 | 28 | 23 | 1 | 0 | 1 | 0 | 0 | 2 | 1 | 28 | | | 23 | 23 |
| **Cladocarpus lignosus** | Cnidaria | Hydroidomedusae | Conica | Aglaopheniidae | **Cladocarpus lignosus** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calycella sp** | Cnidaria | Hydroidomedusae | Conica | Campanulinidae | **Calycella sp** | 2. Genus | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 5 | 5 |
| **Calycella syringa** | Cnidaria | Hydroidomedusae | Conica | Campanulinidae | **Calycella syringa** | 1. Species | 73 | 72 | 55 | 1 | 0 | 3 | 8 | 1 | 3 | 1 | 72 | | | 55 | 55 |
| **Campanulina repens** | Cnidaria | Hydroidomedusae | Conica | Campanulinidae | **Campanulina repens** | 1. Species | 15 | 15 | 12 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 15 | | | 12 | 12 |
| **Cuspidella costata** | Cnidaria | Hydroidomedusae | Conica | Campanulinidae | **Laodicea undulata** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Halecium articulosum** | Cnidaria | Hydroidomedusae | Conica | Haleciidae | **Halecium articulosum** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Halecium beanii** | Cnidaria | Hydroidomedusae | Conica | Haleciidae | **Halecium beanii** | 1. Species | 11 | 11 | 8 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 11 | | | 8 | 8 |
| **Halecium halecium** | Cnidaria | Hydroidomedusae | Conica | Haleciidae | **Halecium halecium** | 1. Species | 55 | 53 | 41 | 6 | 1 | 3 | 2 | 0 | 0 | 0 | 53 | | | 41 | 41 |
| **Halecium sp** | Cnidaria | Hydroidomedusae | Conica | Haleciidae | **Halecium sp** | 2. Genus | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Halecium tenellum** | Cnidaria | Hydroidomedusae | Conica | Haleciidae | **Halecium tenellum** | 1. Species | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | OUT | No dredge sample | | |
| **Halecium undulatum** | Cnidaria | Hydroidomedusae | Conica | Haleciidae | **Halecium undulatum** | 1. Species | 5 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | | | 4 | 4 |
| **Kirchenpaueria pinnata** | Cnidaria | Hydroidomedusae | Conica | Kirchenpaueriidae | **Kirchenpaueria pinnata** | 1. Species | 23 | 23 | 7 | 0 | 0 | 4 | 8 | 1 | 3 | 0 | 23 | | | 7 | 7 |
| **Filellum serpens** | Cnidaria | Hydroidomedusae | Conica | Lafoeidae | **Filellum serpens** | 1. Species | 47 | 47 | 44 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 47 | | | 44 | 44 |
| **Filellum sp** | Cnidaria | Hydroidomedusae | Conica | Lafoeidae | **Filellum sp** | 2. Genus | 3 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Lafoea sp** | Cnidaria | Hydroidomedusae | Conica | Lafoeidae | **Lafoea sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Campanulina hincksi** | Cnidaria | Hydroidomedusae | Conica | Lovenellidae | **Eucheilota maculata** | 1. Species | 14 | 14 | 3 | 2 | 0 | 0 | 9 | 0 | 0 | 0 | 14 | | | 3 | 3 |
| **Halicornaria arcuata** | Cnidaria | Hydroidomedusae | Conica | Plumulariidae | **Halicornaria arcuata** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Antennularia antennina** | Cnidaria | Hydroidomedusae | Conica | Plumulariidae | **Nemertesia antennina** | 1. Species | 50 | 46 | 34 | 10 | 0 | 0 | 0 | 1 | 1 | 0 | 46 | | | 34 | 34 |
| **Nemertesia ramosa** | Cnidaria | Hydroidomedusae | Conica | Plumulariidae | **Nemertesia ramosa** | 1. Species | 73 | 71 | 58 | 4 | 1 | 2 | 2 | 1 | 3 | 0 | 71 | | | 58 | 58 |
| **Nemertesia sp** | Cnidaria | Hydroidomedusae | Conica | Plumulariidae | **Nemertesia sp** | 2. Genus | 18 | 18 | 15 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 18 | | | 15 | 15 |
| **Plumularia setacea** | Cnidaria | Hydroidomedusae | Conica | Plumulariidae | **Plumularia setacea** | 1. Species | 25 | 25 | 18 | 2 | 0 | 1 | 1 | 2 | 1 | 0 | 25 | | | 18 | 18 |
| **Abietinaria abietina** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Abietinaria abietina** | 1. Species | 68 | 66 | 48 | 3 | 1 | 12 | 1 | 1 | 0 | 0 | 66 | | | 48 | 48 |
| **Abietinaria sp** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Abietinaria sp** | 2. Genus | 5 | 5 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 5 | | | 3 | 3 |
| **Sertularia operculata** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Amphisbetia operculata** | 1. Species | 10 | 10 | 3 | 0 | 0 | 6 | 1 | 0 | 0 | 0 | 10 | | | 3 | 3 |
| **Diphasia attenuata** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Diphasia attenuata** | 1. Species | 13 | 13 | 4 | 0 | 0 | 3 | 2 | 0 | 4 | 0 | 13 | | | 4 | 4 |
| **Diphasia rosacea** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Diphasia rosacea** | 1. Species | 40 | 39 | 34 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 39 | | | 34 | 34 |
| **Diphasia sp** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Diphasia sp** | 2. Genus | 5 | 5 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 5 | | | 4 | 4 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dynamena pumila** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Dynamena pumila** | 1. Species | 4 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Hydrallmania falcata** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Hydrallmania falcata** | 1. Species | 136 | 125 | 102 | 5 | 0 | 6 | 11 | 0 | 0 | 1 | 125 | | | 102 | 102 |
| **Sertularella gayi** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularella gayi** | 1. Species | 7 | 7 | 4 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 7 | | | 4 | 4 |
| **Sertularella mediterranea** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularella mediterranea** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Sertularella polyzonias** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularella polyzonias** | 1. Species | 15 | 15 | 8 | 1 | 0 | 1 | 4 | 0 | 1 | 0 | 15 | | | 8 | 8 |
| **Sertularella rugosa** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularella rugosa** | 1. Species | 28 | 28 | 26 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 28 | | | 26 | 26 |
| **Sertularia argentea** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularia argentea** | 1. Species | 42 | 41 | 25 | 0 | 0 | 4 | 8 | 1 | 3 | 0 | 41 | | | 25 | 25 |
| **Sertularia cupressina** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularia cupressina** | 1. Species | 68 | 63 | 50 | 1 | 0 | 2 | 7 | 1 | 1 | 1 | 63 | | | 50 | 50 |
| **Sertularia tenera** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertularia tenera** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |
| **Sertularia sp** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Sertulariidae** | 3. Family | 13 | 13 | 5 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 13 | | | 5 | 5 |
| **Thuiaria thuja** | Cnidaria | Hydroidomedusae | Conica | Sertulariidae | **Thuiaria thuja** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Perigonimus pusillus** | Cnidaria | Hydroidomedusae | Filifera | | **Filifera** | 4. Order | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | High taxonomic level | | |
| **Bimeria vestita** | Cnidaria | Hydroidomedusae | Filifera | Bougainvilliidae | **Bimeria vestita** | 1. Species | 5 | 5 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 5 | | | 3 | 3 |
| **Bougainvillia ramosa** | Cnidaria | Hydroidomedusae | Filifera | Bougainvilliidae | **Bougainvillia muscus** | 1. Species | 106 | 71 | 51 | 1 | 3 | 2 | 9 | 4 | 1 | 0 | 71 | | | 51 | 51 |
| **Bougainvillia sp** | Cnidaria | Hydroidomedusae | Filifera | Bougainvilliidae | **Bougainvillia sp** | 2. Genus | 13 | 13 | 12 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 13 | | | 12 | 12 |
| **Bimeria mutans** | Cnidaria | Hydroidomedusae | Filifera | Bougainvilliidae | **Garveia nutans** | 1. Species | 35 | 35 | 21 | 0 | 0 | 0 | 4 | 9 | 1 | 0 | 35 | | | 21 | 21 |
| **Clava multicornis** | Cnidaria | Hydroidomedusae | Filifera | Clavidae | **Clava multicornis** | 1. Species | 6 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | OUT | No dredge sample | | |
| **Cordylophora caspia** | Cnidaria | Hydroidomedusae | Filifera | Clavidae | **Cordylophora caspia** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Cordylophora lacustris** | Cnidaria | Hydroidomedusae | Filifera | Clavidae | **Cordylophora lacustris** | 1. Species | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | Freshwater - No sample from Gilson | | |
| **Cordylophora sp** | Cnidaria | Hydroidomedusae | Filifera | Clavidae | **Cordylophora sp** | 2. Genus | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Tubiclava lucerna** | Cnidaria | Hydroidomedusae | Filifera | Clavidae | **Tubiclava lucerna** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Eudendrium sp** | Cnidaria | Hydroidomedusae | Filifera | Eudendriidae | **Eudendriidae** | 3. Family | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Eudendrium album** | Cnidaria | Hydroidomedusae | Filifera | Eudendriidae | **Eudendrium album** | 1. Species | 7 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | | | 7 | 7 |
| **Eudendrium capillare** | Cnidaria | Hydroidomedusae | Filifera | Eudendriidae | **Eudendrium capillare** | 1. Species | 15 | 15 | 9 | 0 | 0 | 1 | 2 | 1 | 2 | 0 | 15 | | | 9 | 9 |
| **Eudendrium rameum** | Cnidaria | Hydroidomedusae | Filifera | Eudendriidae | **Eudendrium rameum** | 1. Species | 4 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Eudendrium ramosum** | Cnidaria | Hydroidomedusae | Filifera | Eudendriidae | **Eudendrium ramosum** | 1. Species | 19 | 14 | 13 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 14 | | | 13 | 13 |
| **Podocoryne carnea** | Cnidaria | Hydroidomedusae | Filifera | Hydractiniidae | **Hydractinia carnea** | 1. Species | 3 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Hydractinia echinata** | Cnidaria | Hydroidomedusae | Filifera | Hydractiniidae | **Hydractinia echinata** | 1. Species | 30 | 25 | 14 | 1 | 0 | 7 | 1 | 0 | 2 | 0 | 25 | | | 14 | 14 |
| **Hydractinia sp** | Cnidaria | Hydroidomedusae | Filifera | Hydractiniidae | **Hydractinia sp** | 2. Genus | 7 | 7 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 7 | | | 5 | 5 |
| **Perigonimus serpens** | Cnidaria | Hydroidomedusae | Filifera | Pandeidae | **Amphinema dinema** | 1. Species | 5 | 5 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 5 | | | | |
| **Perigonimus repens** | Cnidaria | Hydroidomedusae | Filifera | Pandeidae | **Leuckartiara octona** | 1. Species | 33 | 33 | 13 | 0 | 18 | 0 | 1 | 0 | 1 | 0 | 33 | | | 13 | 13 |
| **Perigonimus sp** | Cnidaria | Hydroidomedusae | Filifera | Pandeidae | **Pandeidae** | 3. Family | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Clytia inconspicua** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Aglaophenia inconspicua** | 1. Species | 7 | 7 | 6 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 7 | | | 6 | 6 |
| **Campanularia hincksii** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Campanularia hincksii** | 1. Species | 10 | 10 | 3 | 0 | 0 | 0 | 6 | 0 | 1 | 0 | 10 | | | 3 | 3 |
| **Campanularia verticillata** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Campanularia verticillata** | 1. Species | 14 | 14 | 12 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 14 | | | 12 | 12 |
| **Obelia sp** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Campanulariidae** | 3. Family | 22 | 21 | 15 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 21 | | | 15 | 15 |
| **Laomedea gracilis** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Clytia gracilis** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Campanularia johnstoni** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Clytia hemisphaerica** | 1. Species | 209 | 206 | 172 | 4 | 4 | 3 | 13 | 5 | 5 | 0 | 206 | | | 172 | 172 |
| **Gonothyraea loveni** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Gonothyraea loveni** | 1. Species | 51 | 43 | 31 | 3 | 0 | 2 | 5 | 0 | 2 | 0 | 43 | | | 31 | 31 |
| **Laomedea gelatinosa** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Hartlaubella gelatinosa** | 1. Species | 21 | 13 | 4 | 0 | 0 | 0 | 5 | 0 | 4 | 0 | 13 | | | 4 | 4 |
| **Laomedea flexuosa** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Laomedea flexuosa** | 1. Species | 10 | 8 | 7 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 8 | | | 7 | 7 |
| **Laomedea spinulosa** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Obelia bidentata** | 1. Species | 36 | 35 | 23 | 0 | 0 | 3 | 6 | 2 | 0 | 1 | 35 | | | | |
| **Laomedea dichotoma** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Obelia dichotoma** | 1. Species | 80 | 77 | 47 | 4 | 1 | 0 | 14 | 3 | 8 | 0 | 77 | | | 47 | 47 |
| **Laomedea geniculata** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Obelia geniculata** | 1. Species | 59 | 59 | 54 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 59 | | | 54 | 54 |
| **Laomedea longissima** | Cnidaria | Hydroidomedusae | Proboscoida | Campanulariidae | **Obelia longissima** | 1. Species | 66 | 49 | 32 | 6 | 0 | 1 | 4 | 0 | 6 | 0 | 49 | | | 32 | 32 |
| | Cnidaria | Octocorallia | | | | | | | | | | | | | | | | | | | |
| **Alcyonium digitatum** | Cnidaria | Octocorallia | Alcyonacea | Alcyoniidae | **Alcyonium digitatum** | 1. Species | 78 | 56 | 41 | 8 | 0 | 0 | 2 | 5 | 0 | 0 | 56 | | | 41 | 41 |
| | Ctenophora | Nuda | | | | | | | | | | | | | | | | | | | |
| **Beroe sp** | Ctenophora | Nuda | Beroida | Beroidae | **Beroe sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| | Ctenophora | Tentaculata | | | | | | | | | | | | | | | | | | | |
| **Pleurobrachia pileus** | Ctenophora | Tentaculata | Cydippida | Pleurobrachiidae | **Pleurobrachia pileus** | 1. Species | 7 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 3 | OUT | Incomplete digitization | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hormiphora cucumis** | Ctenophora | Tentaculata | Cydippida | Pleurobrachiidae | **Hormiphora cucumis** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **CTENOPHORA (incompletely digitized)** | | | | | | | | | | | | | | | | | | | | | |
| **Ctenophora** | Ctenophora | | | | **Ctenophora** | 6. Phylum | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **ECHINODERMATA – ASTEROIDEA (taxonomic upgrade+ revision, M. Caers)** | | | | | | | | | | | | | | | | | | | | | |
| **Asteroidea** | Echinodermata | Asteroidea | | | **Asteroidea** | 5. Classis | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | High taxonomic level | | |
| **Asterias rubens** | Echinodermata | Asteroidea | Forcipulatida | Asteriidae | **Asterias rubens** | 1. Species | 157 | 88 | 55 | 5 | 4 | 0 | 19 | 1 | 4 | 0 | 88 | | | 55 | 55 |
| **Astropecten irregularis** | Echinodermata | Asteroidea | Paxillosida | Astropectinidae | **Astropecten irregularis** | 1. Species | 13 | 12 | 4 | 6 | 0 | 0 | 0 | 0 | 1 | 1 | 12 | | | 4 | 4 |
| **Henricia sanguinolenta** | Echinodermata | Asteroidea | Spinulosida | Echinasteridae | **Henricia sanguinolenta** | 1. Species | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 1 | 1 |
| **Crossaster papposus** | Echinodermata | Asteroidea | Velatida | Solasteridae | **Crossaster papposus** | 1. Species | 19 | 14 | 10 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 14 | | | 10 | 10 |
| **ECHINODERMATA – ECHINOIDEA (taxonomic upgrade + revision, M. Caers)** | | | | | | | | | | | | | | | | | | | | | |
| **Echinidae** | Echinodermata | Echinoidea | | | **Echinoidea** | 5. Classis | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | High taxonomic level | | |
| **Echinocyamus pusillus** | Echinodermata | Echinoidea | Clypeasteroida | Fibulariidae | **Echinocyamus pusillus** | 1. Species | 121 | 117 | 95 | 1 | 0 | 1 | 17 | 0 | 3 | 0 | ? | | | 95 | 95 |
| **Psammechinus miliaris** | Echinodermata | Echinoidea | Echinoida | Echinidae | **Psammechinus miliaris** | 1. Species | 131 | 96 | 58 | 9 | 7 | 1 | 17 | 1 | 1 | 2 | 96 | | | 58 | 58 |
| **Echinocardium cordatum** | Echinodermata | Echinoidea | Spatangoida | Loveniidae | **Echinocardium cordatum** | 1. Species | 50 | 27 | 15 | 4 | 2 | 0 | 2 | 3 | 0 | 1 | 27 | | | 15 | 15 |
| **Spatangus purpureus** | Echinodermata | Echinoidea | Spatangoida | Spatangidae | **Spatangus purpureus** | 1. Species | 15 | 13 | 9 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 11 | | | 9 | 7 |
| **ECHINODERMATA – HOLOTHUROIDEA (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Ocnus lacteus** | Echinodermata | Holothuroidea | Dendrochirotida | Cucumariidae | **Ocnus lacteus** | 1. Species | 5 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | | | 4 | 4 |
| **Ocnus planci** | Echinodermata | Holothuroidea | Dendrochirotida | Cucumariidae | **Ocnus planci** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Thyone fusus** | Echinodermata | Holothuroidea | Dendrochirotida | Cucumariidae | **Thyone fusus** | 1. Species | 4 | 4 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | | | 3 | 3 |
| **ECHINODERMATA – OPHIUROIDEA (taxonomic upgrade + revision, M. Caers)** | | | | | | | | | | | | | | | | | | | | | |
| **Ophiura albida** | Echinodermata | Ophiuroidea | Chilophiurina | Ophiuridae | **Ophiura albida** | 1. Species | 61 | 58 | 52 | 1 | 0 | 0 | 5 | 0 | 0 | 0 | 58 | | | 52 | 52 |
| **Ophiura ophiura** | Echinodermata | Ophiuroidea | Chilophiurina | Ophiuridae | **Ophiura ophiura** | 1. Species | 78 | 39 | 26 | 1 | 2 | 0 | 8 | 2 | 0 | 0 | 39 | | | 26 | 26 |
| **Ophiura sp** | Echinodermata | Ophiuroidea | Chilophiurina | Ophiuridae | **Ophiura sp** | 2. Genus | 5 | 5 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 5 | | | 3 | 3 |
| **Ophiothrix fragilis** | Echinodermata | Ophiuroidea | Ophiurida | Ophiotrichidae | **Ophiothrix fragilis** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MOLLUSCA** | | | | | | | | | | | | | | | | | | | | | |
| **Mollusca** | Mollusca | | | | **Mollusca** | 6. Phylum | 13 | 9 | 8 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | OUT | High taxonomic level | | |
| **MOLLUSCA – BIVALVIA (incompletely digitized + revision, L. Bruyndoncx [*Ensis* spp] )** | | | | | | | | | | | | | | | | | | | | | |
| **Bivalvia** | Mollusca | Bivalvia | | | **Bivalvia** | 5. Classis | 56 | 36 | 28 | 3 | 0 | 0 | 3 | 2 | 0 | 0 | 11 | OUT | High taxonomic level | | |
| **Arca lactea** | Mollusca | Bivalvia | Arcoida | Arcidae | **Arca lactea** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| **Mya sp** | Mollusca | Bivalvia | Myoida | Myidae | **Mya sp** | 2. Genus | 4 | 4 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | OUT | Incomplete digitization | | |
| **Barnea sp** | Mollusca | Bivalvia | Myoida | Pholadidae | **Barnea sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |
| **Modiola sp** | Mollusca | Bivalvia | Mytiloida | Mytilidae | **Modiolus modiolus** | 1. Species | 4 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | OUT | Incomplete digitization | | |
| **Musculus sp** | Mollusca | Bivalvia | Mytiloida | Mytilidae | **Musculus sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Mytilus or Modiolus sp** | Mollusca | Bivalvia | Mytiloida | Mytilidae | **Mytilidae** | 3. Family | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No dredge sample | | |
| **Mytilus edulis** | Mollusca | Bivalvia | Mytiloida | Mytilidae | **Mytilus edulis / galloprovincialis** | 1. Species | 435 | 238 | 145 | 12 | 1 | 6 | 24 | 0 | 34 | 16 | 123 | | | 123 | 123 |
| **Ostrea edulis** | Mollusca | Bivalvia | Ostreoida | Ostreidae | **Ostrea edulis** | 1. Species | 61 | 45 | 35 | 5 | 0 | 3 | 0 | 0 | 2 | 0 | 29 | | | 17 | 17 |
| **Chlamys opercularis** | Mollusca | Bivalvia | Ostreoida | Pectinidae | **Chlamys opercularis** | 1. Species | 8 | 8 | 4 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | OUT | Incomplete digitization | | |
| **Chlamys sp** | Mollusca | Bivalvia | Ostreoida | Pectinidae | **Chlamys sp** | 2. Genus | 8 | 8 | 4 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 4 | OUT | Incomplete digitization | | |
| **Chlamys varius** | Mollusca | Bivalvia | Ostreoida | Pectinidae | **Chlamys varius** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| **Cardium edule** | Mollusca | Bivalvia | Veneroida | Cardiidae | **Cardium edule** | 1. Species | 6 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | Incomplete digitization | | |
| **Cardium sp** | Mollusca | Bivalvia | Veneroida | Cardiidae | **Cardium sp** | 2. Genus | 5 | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Laevicardium norvegicum** | Mollusca | Bivalvia | Veneroida | Cardiidae | **Laevicardium crassum** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| **Laevicardium sp** | Mollusca | Bivalvia | Veneroida | Cardiidae | **Laevicardium sp** | 2. Genus | 4 | 4 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Cardita sp** | Mollusca | Bivalvia | Veneroida | Carditidae | **Cardita sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Donax sp** | Mollusca | Bivalvia | Veneroida | Donacidae | **Donax sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| **Donax vittatus** | Mollusca | Bivalvia | Veneroida | Donacidae | **Donax vittatus** | 1. Species | 4 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | OUT | Incomplete digitization | | |
| **Dreissena polymorpha** | Mollusca | Bivalvia | Veneroida | Dreissenidae | **Dreissena polymorpha** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Spisula solida** | Mollusca | Bivalvia | Veneroida | Mactridae | **Spisula solida** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Spisula sp** | Mollusca | Bivalvia | Veneroida | Mactridae | **Spisula sp** | 2. Genus | 6 | 6 | 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | OUT | Incomplete digitization | | |
| **Spisula subtruncata** | Mollusca | Bivalvia | Veneroida | Mactridae | **Spisula subtruncata** | 1. Species | 16 | 16 | 11 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 13 | OUT | Incomplete digitization | | |
| **Montacuta bidentata** | Mollusca | Bivalvia | Veneroida | Montacutidae | **Mysella bidentata** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Montacuta** | Mollusca | Bivalvia | Veneroida | Montacutidae | **Mysella sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Ensis americanus** | Mollusca | Bivalvia | Veneroida | Pharidae | **Ensis americanus** | 1. Species | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Ensis arcuatus** | Mollusca | Bivalvia | Veneroida | Pharidae | **Ensis arcuatus** | 1. Species | 107 | 56 | 16 | 0 | 1 | 0 | 4 | 1 | 22 | 12 | 37 | OUT | Incomplete digitization | | |
| **Ensis ensis** | Mollusca | Bivalvia | Veneroida | Pharidae | **Ensis ensis** | 1. Species | 42 | 15 | 10 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 7 | OUT | Incomplete digitization | | |
| **Ensis minor** | Mollusca | Bivalvia | Veneroida | Pharidae | **Ensis minor** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Ensis siliqua** | Mollusca | Bivalvia | Veneroida | Pharidae | **Ensis siliqua** | 1. Species | 56 | 9 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 6 | 9 | OUT | Incomplete digitization | | |
| **Abra sp** | Mollusca | Bivalvia | Veneroida | Semelidae | **Abra sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |
| **Macoma balthica** | Mollusca | Bivalvia | Veneroida | Tellinidae | **Macoma balthica** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| **Tapes sp** | Mollusca | Bivalvia | Veneroida | Veneridae | **Tapes sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Incomplete digitization | | |
| **MOLLUSCA – CEPHALOPODA (taxonomic upgrade)** | | | | | | | | | | | | | | | | | | | | | |
| **Eledone cirrhosa** | Mollusca | Cephalopoda | Octopoda | Octopodidae | **Eledone cirrhosa** | 1. Species | 3 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 3 | OUT | No dredge sample | | |
| **Octopus vulgaris** | Mollusca | Cephalopoda | Octopoda | Octopodidae | **Octopus vulgaris** | 1. Species | 8 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Sepia elegans** | Mollusca | Cephalopoda | Sepiida | Sepiidae | **Sepia elegans** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Sepia officinalis** | Mollusca | Cephalopoda | Sepiida | Sepiidae | **Sepia officinalis** | 1. Species | 113 | 30 | 1 | 12 | 8 | 2 | 0 | 1 | 1 | 5 | 30 | OUT | Species out of scope for dredge | | |
| **Sepiola atlantica** | Mollusca | Cephalopoda | Sepiida | Sepiolidae | **Sepiola atlantica** | 1. Species | 188 | 148 | 3 | 14 | 17 | 20 | 80 | 0 | 7 | 7 | 148 | OUT | Species out of scope for dredge | | |
| **Alloteuthis subulata** | Mollusca | Cephalopoda | Teuthida | Loliginidae | **Alloteuthis subulatus** | 1. Species | 90 | 58 | 2 | 15 | 14 | 15 | 6 | 1 | 2 | 3 | 58 | OUT | Species out of scope for dredge | | |
| **Loligo forbesi** | Mollusca | Cephalopoda | Teuthida | Loliginidae | **Loligo forbesi** | 1. Species | 15 | 6 | 1 | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 6 | OUT | Species out of scope for dredge | | |
| **Taxon name on label** | **Phylum (ERMS)** | **Classis (ERMS)** | **Order (ERMS)** | **Family (ERMS)** | **Taxon - "valid" name** | **Determination level** | **Sample Count - Total** | **Sample Count - Gilson** | **Dredge** | **Beam trawl** | **Shrimp-Beam trawl** | **Petersen net** | **Plankton nets (surface excluded)** | **Ground-collector (Sediment)** | **Unknown** | **Others** | **Gilson: collected alive (all instruments)** | **Status for analysis** | **General selection comment (main )** | **Broad analysis sample count** | **Conservative analysis sample count** |
| **Loligo vulgaris** | Mollusca | Cephalopoda | Teuthida | Loliginidae | **Loligo vulgaris** | 1. Species | 31 | 18 | 3 | 0 | 0 | 0 | 0 | 8 | 5 | 2 | 18 | OUT | Species out of scope for dredge | | |
| **Ommatostrephes sagittatus** | Mollusca | Cephalopoda | Teuthida | Ommastrephidae | **Todarodes sagittatus** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |

## MOLLUSCA – GASTROPODA (taxonomic upgrade + revision, H. van Loen [Neogastropoda] and A. Van Haelen [Opisthobranchia] )

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gastropoda** | Mollusca | Gastropoda | | | **Gastropoda** | 5. Classis | 7 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | OUT | High taxonomic level | | |
| **Catinella arenaria** | Mollusca | Gastropoda | | | **Catinella arenaria** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Limapontia depressa** | Mollusca | Gastropoda | Acochlidioidea | Limapontiidae | **Limapontia depressa** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Acera bullata** | Mollusca | Gastropoda | Anaspidea | Akeridae | **Akera bullata** | 1. Species | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Acmaea virginea** | Mollusca | Gastropoda | Archaeogastropoda | Acmaeidae | **Tectura virginea** | 1. Species | 265 | 252 | 245 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 46 | | | 245 | 45 |
| **Diodora apertura** | Mollusca | Gastropoda | Archaeogastropoda | Fissurellidae | **Diodora graeca** | 1. Species | 118 | 101 | 96 | 0 | 0 | 0 | 1 | 3 | 0 | 1 | 5 | | | 96 | 5 |
| **Emarginula conica** | Mollusca | Gastropoda | Archaeogastropoda | Fissurellidae | **Emarginula rosea** | 1. Species | 38 | 28 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 28 | 3 |
| **Emarginula reticulata** | Mollusca | Gastropoda | Archaeogastropoda | Fissurellidae | **Emarginula sicula** | 1. Species | 6 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 4 | 0 |
| **Puncturella noachina** | Mollusca | Gastropoda | Archaeogastropoda | Fissurellidae | **Puncturella noachina** | 1. Species | 16 | 14 | 13 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | 13 | 0 |
| **Haliotis tuberculata** | Mollusca | Gastropoda | Archaeogastropoda | Haliotidae | **Haliotis tuberculata** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Helcion pellucidus** | Mollusca | Gastropoda | Archaeogastropoda | Patellidae | **Ansates pellucida** | 1. Species | 11 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 4 | 4 |
| **Patella vulgata** | Mollusca | Gastropoda | Archaeogastropoda | Patellidae | **Patella vulgata** | 1. Species | 69 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | | | | |
| **Phasianella pullus** | Mollusca | Gastropoda | Archaeogastropoda | Tricoliidae | **Tricolia pullus** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | OUT | No dredge sample | | |
| **Calliostoma sp** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Calliostoma sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Calliostoma ziziphinum** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Calliostoma zizyphinum** | 1. Species | 152 | 130 | 105 | 3 | 1 | 3 | 13 | 3 | 1 | 1 | 40 | | | 105 | 30 |
| **Gibbula cineraria** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Gibbula cineraria** | 1. Species | 178 | 154 | 138 | 0 | 0 | 1 | 6 | 5 | 1 | 3 | 3 | | | 138 | 3 |
| **Gibbula magus** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Gibbula magus** | 1. Species | 36 | 24 | 21 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 2 | | | 21 | 1 |
| **Gibbula tumida** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Gibbula tumida** | 1. Species | 132 | 119 | 109 | 0 | 0 | 1 | 8 | 0 | 0 | 1 | 19 | | | 109 | 18 |
| **Gibbula umbilicalis** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Gibbula umbilicalis** | 1. Species | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Cantharidus exasperatus** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Jujubinus exasperatus** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Cantharidus montagui** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Jujubinus montagui** | 1. Species | 17 | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 16 | 0 |
| **Cantharidus sp** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Jujubinus sp** | 2. Genus | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Monodonta lineata** | Mollusca | Gastropoda | Archaeogastropoda | Trochidae | **Osilinus lineatus** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Ovatella bidentata** | Mollusca | Gastropoda | Archaeopulmonata | Ellobiidae | **Auriculinella bidentata** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Actaeon tornatilis** | Mollusca | Gastropoda | Cephalaspidea | Acteonidae | **Acteon tornatilis** | 1. Species | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | specimen status: skelettic parts or unknown | | |
| **Cylichna cylindracea** | Mollusca | Gastropoda | Cephalaspidea | Cylichnidae | **Cylichna cylindracea** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Haminea navicula** | Mollusca | Gastropoda | Cephalaspidea | Haminoeidae | **Haminoea navicula** | 1. Species | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Philine aperta** | Mollusca | Gastropoda | Cephalaspidea | Philinidae | **Philine aperta** | 1. Species | 25 | 11 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 11 | 0 |
| **Retusa strigella** | Mollusca | Gastropoda | Cephalaspidea | Retusidae | **Cylichnina umbilicata** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Retusa obtusa** | Mollusca | Gastropoda | Cephalaspidea | Retusidae | **Retusa obtusa** | 1. Species | 67 | 60 | 57 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | | | 57 | 0 |
| **Chrysallida decussata** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Chrysallida decussata** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Chrysallida obtusa** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Chrysallida obtusa** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Chrysallida spiralis** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Chrysallida pellucida** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Eulimella laevis** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Eulimella acicula** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Menestho divisa** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Ondina divisa** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Turbonilla elegantissima** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Turbonilla lactea** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Turbonilla rufa** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Turbonilla rufa** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Turbonilla sp** | Mollusca | Gastropoda | Heterostropha | Pyramidellidae | **Turbonilla sp** | 2. Genus | 8 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 8 | 0 |
| **Aclis minor** | Mollusca | Gastropoda | Mesogastropoda | Aclididae | **Aclis minor** | 1. Species | 4 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | specimen status: skelettic parts or unknown | | |
| **Aporrhais pespelecani** | Mollusca | Gastropoda | Mesogastropoda | Aporrhaiidae | **Aporrhais pespelecani** | 1. Species | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Caecum glabrum** | Mollusca | Gastropoda | Mesogastropoda | Caecidae | **Caecum glabrum** | 1. Species | 4 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 3 | 0 |
| **Calyptraea chinensis** | Mollusca | Gastropoda | Mesogastropoda | Calyptraeidae | **Calyptraea chinensis** | 1. Species | 11 | 11 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 11 | 0 |
| **Crepidula fornicata** | Mollusca | Gastropoda | Mesogastropoda | Calyptraeidae | **Crepidula fornicata** | 1. Species | 35 | 7 | 3 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | | | 3 | 0 |
| **Capulus ungaricus** | Mollusca | Gastropoda | Mesogastropoda | Capulidae | **Capulus ungaricus** | 1. Species | 20 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 9 | 0 |
| **Trichotropis borealis** | Mollusca | Gastropoda | Mesogastropoda | Capulidae | **Trichotropis borealis** | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Bittium reticulatum** | Mollusca | Gastropoda | Mesogastropoda | Cerithiidae | **Bittium reticulatum** | 1. Species | 58 | 53 | 52 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | 52 | 0 |
| **Cerithiopsis clarkii** | Mollusca | Gastropoda | Mesogastropoda | Cerithiopsidae | **Cerithiopsidae** | 3. Family | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Cerithiopsis tubercularis** | Mollusca | Gastropoda | Mesogastropoda | Cerithiopsidae | **Cerithiopsis tubercularis** | 1. Species | 14 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 12 | 0 |
| **Pustularia moneta** | Mollusca | Gastropoda | Mesogastropoda | Cypraeidae | **Monetaria moneta** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Scala clathratula** | Mollusca | Gastropoda | Mesogastropoda | Epitoniidae | **Epitonium clathratulum** | 1. Species | 40 | 26 | 20 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 1 | | | 20 | 0 |
| **Scala clathrus** | Mollusca | Gastropoda | Mesogastropoda | Epitoniidae | **Epitonium clathrus** | 1. Species | 107 | 64 | 39 | 2 | 0 | 1 | 10 | 0 | 1 | 11 | 2 | | | 39 | 1 |
| **Scala sp** | Mollusca | Gastropoda | Mesogastropoda | Epitoniidae | **Scala sp** | 2. Genus | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Strombiformis trifasciata** | Mollusca | Gastropoda | Mesogastropoda | Eulimidae | **Eulima bilineata** | 1. Species | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 5 | 0 |
| **Melanella alba** | Mollusca | Gastropoda | Mesogastropoda | Eulimidae | **Melanella alba** | 1. Species | 13 | 12 | 10 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 3 | | | 10 | 3 |
| **lacuna crassior** | Mollusca | Gastropoda | Mesogastropoda | Lacunidae | **lacuna crassior** | 1. Species | 5 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 3 | 0 |
| **Lamellaria perspicua** | Mollusca | Gastropoda | Mesogastropoda | Lamellariidae | **Lamellaria perspicua** | 1. Species | 3 | 3 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 | | | 1 | 1 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lacuna puteolus | Mollusca | Gastropoda | Mesogastropoda | Littorinidae | Lacuna parva | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| lacuna divaricata | Mollusca | Gastropoda | Mesogastropoda | Littorinidae | Lacuna vincta | 1. Species | 79 | 73 | 68 | 1 | 0 | 1 | 1 | 2 | 0 | 0 | 12 | | | 68 | 12 |
| Littorina obtusata | Mollusca | Gastropoda | Mesogastropoda | Littorinidae | Littorina obtusata | 1. Species | 19 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | | | 4 | 0 |
| Littorina saxatilis | Mollusca | Gastropoda | Mesogastropoda | Littorinidae | Littorina saxatilis | 1. Species | 51 | 17 | 14 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | | | 14 | 0 |
| Acrybia islandica | Mollusca | Gastropoda | Mesogastropoda | Naticidae | Amauropsis islandica | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| Polynices catena | Mollusca | Gastropoda | Mesogastropoda | Naticidae | Polynices catena | 1. Species | 152 | 108 | 70 | 7 | 7 | 7 | 3 | 2 | 2 | 10 | 83 | | | 48 | 53 |
| Polynices poliana | Mollusca | Gastropoda | Mesogastropoda | Naticidae | Polynices poliana | 1. Species | 271 | 238 | 191 | 4 | 1 | 3 | 18 | 8 | 4 | 9 | 142 | | | 183 | 126 |
| Natica sp | Mollusca | Gastropoda | Mesogastropoda | Naticidae | Polynices sp | 2. Genus | 10 | 9 | 7 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 7 | | | 4 | 4 |
| Alvania lactea | Mollusca | Gastropoda | Mesogastropoda | Rissoidae | Alvania lactea | 1. Species | 36 | 31 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 31 | 2 |
| Cingula semicostata | Mollusca | Gastropoda | Mesogastropoda | Rissoidae | Onoba semicostata | 1. Species | 4 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Rissoa membranacea | Mollusca | Gastropoda | Mesogastropoda | Rissoidae | Rissoa membranacea | 1. Species | 5 | 4 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | | | 2 | 0 |
| Rissoa parva | Mollusca | Gastropoda | Mesogastropoda | Rissoidae | Rissoa parva | 1. Species | 25 | 21 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 21 | 1 |
| Cingula semistriata | Mollusca | Gastropoda | Mesogastropoda | Rissoidae | Rissoidae | 3. Family | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | OUT | No dredge sample | | |
| Adeorbis subcarinatus | Mollusca | Gastropoda | Mesogastropoda | Tornidae | Tornus subcarinatus | 1. Species | 44 | 40 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 40 | 0 |
| Triphora perversa | Mollusca | Gastropoda | Mesogastropoda | Triphoridae | Triphoridae | 3. Family | 48 | 45 | 43 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | | | 43 | 0 |
| Trivia arctica | Mollusca | Gastropoda | Mesogastropoda | Triviidae | Trivia arctica | 1. Species | 81 | 64 | 56 | 0 | 0 | 1 | 4 | 1 | 1 | 1 | 2 | | | 56 | 0 |
| Trivia monacha | Mollusca | Gastropoda | Mesogastropoda | Triviidae | Trivia monacha | 1. Species | 28 | 18 | 13 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | | | 13 | 0 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turritella communis | Mollusca | Gastropoda | Mesogastropoda | Turritellidae | Turritella communis | 1. Species | 39 | 34 | 30 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 2 | | | 30 | 2 |
| Velutina velutina | Mollusca | Gastropoda | Mesogastropoda | Velutinidae | Velutina velutina | 1. Species | 12 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 9 | 2 |
| Buccinum undatum | Mollusca | Gastropoda | Neogastropoda | Buccinidae | Buccinum undatum | 1. Species | 336 | 261 | 193 | 17 | 2 | 7 | 16 | 12 | 4 | 10 | 115 | | | 187 | 115 |
| Colus gracilis | Mollusca | Gastropoda | Neogastropoda | Buccinidae | Colus gracilis | 1. Species | 12 | 4 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | | 3 | 0 |
| Colus howsei | Mollusca | Gastropoda | Neogastropoda | Buccinidae | Colus howsei | 1. Species | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| Neptunea antiqua | Mollusca | Gastropoda | Neogastropoda | Buccinidae | Neptunea antiqua | 1. Species | 17 | 6 | 1 | 1 | 0 | 3 | 0 | 0 | 1 | 0 | 3 | | | 1 | 0 |
| Cythara nebula | Mollusca | Gastropoda | Neogastropoda | Conidae | Bela nebula | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| Cythara costata | Mollusca | Gastropoda | Neogastropoda | Conidae | Conidae | 3. Family | 12 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 12 | 0 |
| Bellaspira rufa | Mollusca | Gastropoda | Neogastropoda | Conidae | Oenopota rufa | 1. Species | 84 | 71 | 68 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | | | 34 | 0 |
| Oenopota turricula | Mollusca | Gastropoda | Neogastropoda | Conidae | Oenopota turricula | 1. Species | 193 | 158 | 152 | 0 | 0 | 0 | 2 | 2 | 0 | 2 | 6 | | | 76 | 3 |
| Philbertia linearis | Mollusca | Gastropoda | Neogastropoda | Conidae | Raphitoma linearis | 1. Species | 13 | 11 | 10 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | | 10 | 0 |
| Philbertia purpurea | Mollusca | Gastropoda | Neogastropoda | Conidae | Raphitoma purpurea | 1. Species | 4 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 3 | 0 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Littorina littorea** | Mollusca | Gastropoda | Neogastropoda | Littorinidae | **Littorina littorea** | 1. Species | 137 | 36 | 25 | 0 | 0 | 0 | 1 | 1 | 4 | 5 | 3 | OUT | intertidal species; collected alive on shore only | | |
| **Littorina sp** | Mollusca | Gastropoda | Neogastropoda | Littorinidae | **Littorina sp** | 2. Genus | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | intertidal species, skelettic parts only | | |
| **Boreotrophon clathratus** | Mollusca | Gastropoda | Neogastropoda | Muricidae | **Boreotrophon clathratus** | 1. Species | 9 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 8 | 0 |
| **Boreotrophon clathratus** | Mollusca | Gastropoda | Neogastropoda | Muricidae | **Boreotrophon truncatus** | 1. Species | 59 | 48 | 46 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | | | 46 | 0 |
| **Nucella lapillus** | Mollusca | Gastropoda | Neogastropoda | Muricidae | **Nucella lapillus** | 1. Species | 218 | 107 | 89 | 0 | 2 | 0 | 4 | 0 | 8 | 4 | 10 | | | 57 | 1 |
| **Ocenebra erinacea** | Mollusca | Gastropoda | Neogastropoda | Muricidae | **Ocenebra erinacea** | 1. Species | 214 | 164 | 130 | 4 | 2 | 4 | 12 | 4 | 4 | 4 | 10 | | | 76 | 4 |
| **Trophonopsis muricatus** | Mollusca | Gastropoda | Neogastropoda | Muricidae | **Trophon muricatus** | 1. Species | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 |
| **Nassarius incrassatus** | Mollusca | Gastropoda | Neogastropoda | Nassariidae | **Nassarius incrassatus** | 1. Species | 42 | 33 | 28 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 4 | | | 28 | 1 |
| **Nassarius pygmaeus** | Mollusca | Gastropoda | Neogastropoda | Nassariidae | **Nassarius pygmaeus** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Nassarius reticulatus** | Mollusca | Gastropoda | Neogastropoda | Nassariidae | **Nassarius reticulatus** | 1. Species | 86 | 43 | 23 | 5 | 0 | 0 | 6 | 2 | 0 | 7 | 6 | | | 23 | 1 |
| **Nassa sp** | Mollusca | Gastropoda | Neogastropoda | Nassariidae | **Nassarius sp** | 2. Genus | 3 | 3 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | | | 0 | 0 |
| **Bellaspira septangularis** | Mollusca | Gastropoda | Neogastropoda | Turridae | **Haedropleura septangularis** | 1. Species | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 0 |
| **Aeolidia papillosa** | Mollusca | Gastropoda | Nudibranchia | Aeolidiidae | **Aeolidia papillosa** | 1. Species | 28 | 14 | 3 | 5 | 0 | 0 | 1 | 0 | 5 | 0 | 14 | | | 3 | 3 |
| **Dendronotus frondosus** | Mollusca | Gastropoda | Nudibranchia | Dendronotidae | **Dendronotus frondosus** | 1. Species | 9 | 9 | 6 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 9 | | | 6 | 6 |
| **Doris sp** | Mollusca | Gastropoda | Nudibranchia | Dorididae | **Dorididae** | 3. Family | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Archidoris tuberculata** | Mollusca | Gastropoda | Nudibranchia | Dorididae | **Doris verrucosa** | 1. Species | 17 | 16 | 13 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 16 | | | 13 | 13 |
| **Idulia coronata** | Mollusca | Gastropoda | Nudibranchia | Dotidae | **Doto coronata** | 1. Species | 13 | 12 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | | | 11 | 11 |
| **Idulia fragilis** | Mollusca | Gastropoda | Nudibranchia | Dotidae | **Doto fragilis** | 1. Species | 15 | 15 | 14 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 15 | | | 14 | 14 |
| **Idulia pinnatifida** | Mollusca | Gastropoda | Nudibranchia | Dotidae | **Doto pinnatifida** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Eubranchus exiguus** | Mollusca | Gastropoda | Nudibranchia | Eubranchidae | **Eubranchus exiguus** | 1. Species | 4 | 4 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 4 | | | 1 | 1 |
| **Eubranchus tricolor** | Mollusca | Gastropoda | Nudibranchia | Eubranchidae | **Eubranchus tricolor** | 1. Species | 7 | 7 | 1 | 0 | 0 | 0 | 5 | 0 | 1 | 0 | 7 | | | 1 | 1 |
| **Facelina coronata** | Mollusca | Gastropoda | Nudibranchia | Facelinidae | **Facelina auriculata** | 1. Species | 11 | 11 | 3 | 1 | 0 | 0 | 1 | 0 | 6 | 0 | 11 | | | 3 | 3 |
| **Facelina drummondi** | Mollusca | Gastropoda | Nudibranchia | Facelinidae | **Facelina bostoniensis** | 1. Species | 9 | 9 | 1 | 1 | 0 | 2 | 2 | 0 | 3 | 0 | 9 | | | 1 | 1 |
| **Coryphella lineata** | Mollusca | Gastropoda | Nudibranchia | Flabellinidae | **Coryphella lineata** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Coryphella rufibranchialis** | Mollusca | Gastropoda | Nudibranchia | Flabellinidae | **Flabellina verrucosa** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 1 |
| **Ancula cristata** | Mollusca | Gastropoda | Nudibranchia | Goniodorididae | **Ancula gibbosa** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Jorunna tomentosa** | Mollusca | Gastropoda | Nudibranchia | Kentrodorididae | **Jorunna tomentosa** | 1. Species | 4 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | | | 3 | 3 |
| **Lomanotus marmoratus** | Mollusca | Gastropoda | Nudibranchia | Lomanotidae | **Lomanotus marmoratus** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Acanthodoris pilosa** | Mollusca | Gastropoda | Nudibranchia | Onchidorididae | **Acanthodoris pilosa** | 1. Species | 107 | 103 | 66 | 10 | 3 | 6 | 14 | 1 | 2 | 0 | 103 | | | 66 | 66 |
| **Onchidoris fusca** | Mollusca | Gastropoda | Nudibranchia | Onchidorididae | **Onchidoris fusca** | 1. Species | 24 | 9 | 0 | 3 | 1 | 0 | 2 | 0 | 3 | 0 | 9 | OUT | No dredge sample | | |
| **Euphurus claviger** | Mollusca | Gastropoda | Nudibranchia | Polyceridae | **Limacia clavigera** | 1. Species | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Thecacera pennigera** | Mollusca | Gastropoda | Nudibranchia | Polyceridae | **Thecacera pennigera** | 1. Species | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | OUT | No dredge sample | | |
| **Cratena aurantia** | Mollusca | Gastropoda | Nudibranchia | Tergipedidae | **Cuthona gymnota** | 1. Species | 4 | 4 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 4 | | | 1 | 1 |
| **Embletonia pallida** | Mollusca | Gastropoda | Nudibranchia | Tergipedidae | **Tenellia adspersa** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Tergipes despectus** | Mollusca | Gastropoda | Nudibranchia | Tergipedidae | **Tergipes tergipes** | 1. Species | 14 | 12 | 1 | 0 | 0 | 0 | 7 | 0 | 4 | 0 | 12 | | | | |
| **Duveaucellia hombergi** | Mollusca | Gastropoda | Nudibranchia | Tritoniidae | **Tritonia hombergi** | 1. Species | 48 | 48 | 22 | 14 | 0 | 4 | 0 | 0 | 7 | 1 | 48 | | | 19 | 19 |
| **Duveaucellia plebeia** | Mollusca | Gastropoda | Nudibranchia | Tritoniidae | **Tritonia plebeia** | 1. Species | 45 | 45 | 40 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 45 | | | 20 | 20 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alderia modesta** | Mollusca | Gastropoda | Sacoglossa | Stiligeridae | **Alderia modesta** | 1. Species | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | No dredge sample | | |

## MOLLUSCA – POLYPLACOPHORA (taxonomic upgrade)

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lepidopleurus asellus** | Mollusca | Polyplacophora | Neoloricata | Leptochitonidae | **Leptochiton asellus** | 1. Species | 55 | 51 | 39 | 1 | 0 | 1 | 7 | 2 | 0 | 1 | 0 | | | 39 | 39 |
| **Lepidopleurus cancellatus** | Mollusca | Polyplacophora | Neoloricata | Leptochitonidae | **Leptochiton cancellatus** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 1 |
| **Laculina sp** | Mollusca | Polyplacophora | Neoloricata | | **Laculina sp** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | OUT | Incomplete digitization | | |
| **Dentalium vulgare** | Mollusca | Scaphopoda | Dentaliida | Dentaliidae | **Dentalium vulgare** | 1. Species | 17 | 8 | 7 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | 7 | 0 |

## NEMATODA (incompletely digitized)

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nematoda** | Nematoda | | | | **Nematoda** | 6. Phylum | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Incomplete digitization | | |

## PORIFERA (taxonomic upgrade)

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Porifera** | Porifera | | | | **Porifera** | 6. Phylum | 187 | 46 | 37 | 3 | 1 | 2 | 2 | 1 | 0 | 0 | 46 | OUT | High taxonomic level | | |
| **Eunapius fragilis** | Porifera | | | | **Eunapius fragilis** | 1. Species | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Sycon sp** | Porifera | Calcarea | Leucosolenida | | **Leucosolenida** | 4. Order | 4 | 4 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 4 | OUT | No dredge sample | | |
| **Grantia compressa** | Porifera | Calcarea | Leucosolenida | Grantiidae | **Grantia compressa** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Leucosolenia complicata** | Porifera | Calcarea | Leucosolenida | Leucosoleniidae | **Leucosolenia complicata** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Leucosolenia sp** | Porifera | Calcarea | Leucosolenida | Leucosoleniidae | **Leucosolenia sp** | 2. Genus | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Leucosolenia variabilis** | Porifera | Calcarea | Leucosolenida | Leucosoleniidae | **Leucosolenia variabilis** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Sycon coronatum** | Porifera | Calcarea | Leucosolenida | Sycettidae | **Scypha coronata** | 1. Species | 6 | 6 | 3 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 6 | | | 3 | 3 |
| **Reniera sp** | Porifera | Demospongiae | | | **Demospongiae** | 5. Classis | 5 | 5 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 5 | OUT | High taxonomic level | | |
| **Chondrosia reniformis** | Porifera | Demospongiae | Chondrosida | Chondrillidae | **Chondrosia reniformis** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Spongelia fragilis** | Porifera | Demospongiae | Dendroceratida | Dysideidae | **Dysidea fragilis** | 1. Species | 17 | 17 | 9 | 1 | 0 | 2 | 1 | 3 | 1 | 0 | 17 | | | 9 | 9 |
| **Cliona celata** | Porifera | Demospongiae | Hadromerida | Clionidae | **Cliona celata** | 1. Species | 6 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 3 | 3 |
| **Polymastia robusta** | Porifera | Demospongiae | Hadromerida | Polymastiidae | **Polymastia boletiformis** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Polymastia mammillaris** | Porifera | Demospongiae | Hadromerida | Polymastiidae | **Polymastia mammillaris** | 1. Species | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 5 | 5 |
| **Suberites carnosus** | Porifera | Demospongiae | Hadromerida | Suberitidae | **Suberites carnosus** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |
| **Taxon name on label** | **Phylum (ERMS)** | **Classis (ERMS)** | **Order (ERMS)** | **Family (ERMS)** | **Taxon - "valid" name** | **Determination level** | **Sample Count - Total** | **Sample Count - Gilson** | **Dredge** | **Beam trawl** | **Shrimp-Beam trawl** | **Petersen net** | **Plankton nets (surface excluded)** | **Ground-collector (Sediment)** | **Unknown** | **Others** | **Gilson: collected alive (all instruments)** | **Status for analysis** | **General selection comment (main )** | **Broad analysis sample count** | **Conservative analysis sample count** |
| **Ficulina ficus** | Porifera | Demospongiae | Hadromerida | Suberitidae | **Suberites ficus** | 1. Species | 14 | 10 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | | | 5 | 5 |
| **Tethya auranticum** | Porifera | Demospongiae | Hadromerida | Tethyidae | **Tethya aurantium** | 1. Species | 4 | 4 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | | | 3 | 3 |
| **Ciocalypta penicillus** | Porifera | Demospongiae | Halichondrida | Halichondriidae | **Ciocalypta penicillus** | 1. Species | 24 | 24 | 21 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 24 | | | 21 | 21 |
| **Halichondria coalita** | Porifera | Demospongiae | Halichondrida | Halichondriidae | **Halichondria bowerbanki** | 1. Species | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Halichondria panicea** | Porifera | Demospongiae | Halichondrida | Halichondriidae | **Halichondria panicea** | 1. Species | 39 | 27 | 8 | 15 | 1 | 1 | 0 | 1 | 1 | 0 | 27 | | | 8 | 8 |
| **Halichondria sp** | Porifera | Demospongiae | Halichondrida | Halichondriidae | **Halichondria sp** | 2. Genus | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Hymeniacidon caruncula** | Porifera | Demospongiae | Halichondrida | Halichondriidae | **Hymeniacidon perlevis** | 1. Species | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | 1 | 1 |
| **Halisarca dujardini** | Porifera | Demospongiae | Halisarcida | Halisarcidae | **Halisarca dujardini** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Esperiopsis normani** | Porifera | Demospongiae | Haplosclerida | | **Haplosclerida** | 4. Order | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | High taxonomic level | | |
| **Callyspongia serobiculata** | Porifera | Demospongiae | Haplosclerida | Callyspongiidae | **Callyspongia serobiculata** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Chalina sp** | Porifera | Demospongiae | Haplosclerida | Chalinidae | **Chalinidae** | 3. Family | 34 | 22 | 14 | 6 | 0 | 1 | 0 | 1 | 0 | 0 | 22 | | | 14 | 14 |
| **Reniera indistincta** | Porifera | Demospongiae | Haplosclerida | Chalinidae | **Haliclona indistincta** | 1. Species | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | | 2 | 2 |
| **Chalina oculata** | Porifera | Demospongiae | Haplosclerida | Chalinidae | **Haliclona oculata** | 1. Species | 70 | 60 | 20 | 29 | 1 | 1 | 3 | 4 | 2 | 0 | 60 | | | 20 | 20 |
| **Reniera simulans** | Porifera | Demospongiae | Haplosclerida | Chalinidae | **Haliclona simulans** | 1. Species | 10 | 10 | 8 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 10 | | | 8 | 8 |
| **Reniera viscosa** | Porifera | Demospongiae | Haplosclerida | Chalinidae | **Haliclona viscosa** | 1. Species | 4 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | | | 3 | 3 |
| **Ephydatia fluviatilis** | Porifera | Demospongiae | Haplosclerida | Spongillidae | **Ephydatia fluviatilis** | 1. Species | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Ephydatia mulleri** | Porifera | Demospongiae | Haplosclerida | Spongillidae | **Ephydatia mulleri** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Spongellia sp** | Porifera | Demospongiae | Haplosclerida | Spongillidae | **Spongellia sp** | 2. Genus | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | Freshwater - No sample from Gilson | | |
| **Spongilla lacustris** | Porifera | Demospongiae | Haplosclerida | Spongillidae | **Spongilla lacustris** | 1. Species | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | Freshwater - No sample from Gilson | | |
| **Yvesia fallax** | Porifera | Demospongiae | Poecilosclerida | Crellidae | **Crella fallax** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Hymedesmia irregularis** | Porifera | Demospongiae | Poecilosclerida | Hymedesmiidae | **Hymedesmia irregularis** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | | | 1 | 1 |
| **Myxilla incrustans** | Porifera | Demospongiae | Poecilosclerida | Myxillidae | **Myxilla incrustans** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | OUT | No dredge sample | | |
| **Myxilla rosacea** | Porifera | Demospongiae | Poecilosclerida | Myxillidae | **Myxilla rosacea** | 1. Species | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | | | 1 | 1 |

| Taxon name on label | Phylum (ERMS) | Classis (ERMS) | Order (ERMS) | Family (ERMS) | Taxon - "valid" name | Determination level | Sample Count - Total | Sample Count - Gilson | Dredge | Beam trawl | Shrimp-Beam trawl | Petersen net | Plankton nets (surface excluded) | Ground-collector (Sediment) | Unknown | Others | Gilson: collected alive (all instruments) | Status for analysis | General selection comment (main ) | Broad analysis sample count | Conservative analysis sample count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Raspailia hispida** | Porifera | Demospongiae | Poecilosclerida | Raspailiidae | **Raspailia hispida** | 1. Species | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | | | 2 | 2 |
| **Raspailia ramosa** | Porifera | Demospongiae | Poecilosclerida | Raspailiidae | **Raspailia ramosa** | 1. Species | 24 | 23 | 13 | 6 | 2 | 1 | 0 | 1 | 0 | 0 | 23 | | | 13 | 13 |
| **Raspailia ventilabrum** | Porifera | Demospongiae | Poecilosclerida | Raspailiidae | **Raspailia ventilabrum** | 1. Species | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | OUT | No dredge sample | | |
| **Raspailia virgultosa** | Porifera | Demospongiae | Poecilosclerida | Raspailiidae | **Raspailia virgultosa** | 1. Species | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | | | 5 | 5 |
| **CHORDATA – ASCIDIACEA (incompletely digitized)** | | | | | | | | | | | | | | | | | | | | | |
| **Ascidiidae** | Chordata | Ascidiacea | | | **Ascidiacea** | 5. Classis | 3 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | OUT | Incomplete digitization | | |
| **Ascidiella scabra** | Chordata | Ascidiacea | Phlebobranchia | Ascidiidae | **Ascidiella scabra** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **CHORDATA – ELASMOBRANCHII (incompletely digitized, checked)** | | | | | | | | | | | | | | | | | | | | | |
| **Scyliorhinus canicula** | Chordata | Elasmobranchii | Carcharhiniformes | Scyliorhinidae | **Scyliorhinus canicula** | 1. Species | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | OUT | fish eggs | | |
| **INCERTAE SEDIS** | | | | | | | | | | | | | | | | | | | | | |
| **Fucus museus** | Not checked | | | | **Algae** | | 5 | 4 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | OUT | Out of scope - various records of algae | | |
| **Baria sp** | Not checked | | | | **Baria sp** | 2. Genus | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | OUT | unknown | | |
| **Farrella sp** | Not checked | | | | **Incertae** | | 61 | 49 | 33 | 3 | 0 | 1 | 7 | 1 | 4 | 0 | 47 | OUT | Records unclear | | |
| **Myriazoum truncatum** | Not checked | | | | **Myriazoum truncatum** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Negombo norvegicus** | Not checked | | | | **Negombo norvegicus** | 1. Species | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | OUT | No sample from Gilson | | |
| **Trisicella sp.** | Not checked | | | | **Trisicella sp.** | 2. Genus | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | OUT | Number: undocumented or unknown | | |

# Annex 3. Simper results on species contributions to within - group similarities (cut at 80%) on the full dredge data-set (Belgian waters)

(avg abun = proportion of samples with this species)

*Group Central area / coastal*
Average similarity: 0.70

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| *Mytilus sp* | 0.05 | 0.27 | 0.06 | 38.89 | 38.89 |
| Acanthodoris pilosa | 0.05 | 0.27 | 0.06 | 38.89 | 77.78 |
| A. diaphanum | 0.03 | 0.08 | 0.03 | 11.11 | 88.89 |

*Group Central area / nearshore*
Average similarity: 2.38

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Polynices poliana | 0.13 | 1.86 | 0.14 | 78.29 | 78.29 |
| Mytilus sp | 0.06 | 0.21 | 0.05 | 9.00 | 87.29 |

*Group Central area / farshore*
Average similarity: 6.16

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Polynices poliana | 0.28 | 4.33 | 0.28 | 70.25 | 70.25 |
| Pagurus bernhardus | 0.10 | 0.30 | 0.10 | 4.79 | 75.04 |
| Asterias rubens | 0.09 | 0.29 | 0.08 | 4.78 | 79.82 |
| Pinnotheres pisum | 0.07 | 0.26 | 0.06 | 4.24 | 84.06 |

*Group Central area / offshore*
Average similarity: 7.35

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Buccinum undatum | 0.27 | 1.54 | 0.24 | 20.95 | 20.95 |
| Echinocyamus pusillus | 0.24 | 1.31 | 0.22 | 17.85 | 38.79 |
| Ophiura albida | 0.22 | 1.26 | 0.21 | 17.15 | 55.95 |
| Thia scutellata | 0.13 | 0.85 | 0.11 | 11.52 | 67.46 |
| Pagurus bernhardus | 0.13 | 0.42 | 0.12 | 5.69 | 73.15 |
| Mytilus sp | 0.13 | 0.38 | 0.11 | 5.23 | 78.39 |
| Psammechinus miliaris | 0.16 | 0.34 | 0.15 | 4.60 | 82.98 |

*Group Eastern area*
Average similarity: 6.08

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Polynices poliana | 0.25 | 4.32 | 0.25 | 71.11 | 71.11 |
| Electra pilosa | 0.10 | 0.41 | 0.09 | 6.68 | 77.78 |
| Mytilus sp | 0.09 | 0.33 | 0.09 | 5.45 | 83.23 |

*Group Eastern area / coastal*
Average similarity: 2.67

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Tectura virginea | 0.11 | 1.40 | 0.14 | 52.27 | 52.27 |
| Mytilus sp | 0.11 | 1.11 | 0.14 | 41.41 | 93.69 |

*Group Western area / Coastal*
Average similarity: 4.10

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Polynices poliana | 0.18 | 0.90 | 0.17 | 21.93 | 21.93 |
| Polynices catena | 0.16 | 0.75 | 0.15 | 18.23 | 40.16 |
| Clytia hemisphaerica | 0.16 | 0.55 | 0.15 | 13.42 | 53.58 |
| Flustra foliacea | 0.12 | 0.31 | 0.11 | 7.61 | 61.18 |
| Electra pilosa | 0.09 | 0.20 | 0.08 | 4.76 | 65.95 |
| Mytilus sp | 0.07 | 0.13 | 0.06 | 3.27 | 69.22 |
| Obelia longissima | 0.07 | 0.11 | 0.07 | 2.73 | 71.94 |
| Ectopleura dumortieri | 0.07 | 0.11 | 0.06 | 2.59 | 74.53 |
| Calycella syringa | 0.07 | 0.09 | 0.06 | 2.27 | 76.80 |
| Pinnotheres pisum | 0.05 | 0.09 | 0.05 | 2.24 | 79.04 |
| Acanthodoris pilosa | 0.05 | 0.08 | 0.05 | 2.04 | 81.07 |

*Group Western area / Flemish banks*
Average similarity: 3.53

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Polynices poliana | 0.12 | 0.78 | 0.11 | 22.12 | 22.12 |
| Polynices catena | 0.13 | 0.75 | 0.12 | 21.12 | 43.24 |
| Clytia hemisphaerica | 0.16 | 0.55 | 0.15 | 15.56 | 58.80 |
| Flustra foliacea | 0.11 | 0.26 | 0.09 | 7.45 | 66.25 |
| Hydrallmania falcata | 0.11 | 0.18 | 0.10 | 5.24 | 71.49 |
| Tectura virginea | 0.08 | 0.17 | 0.07 | 4.70 | 76.19 |
| Pagurus bernhardus | 0.07 | 0.10 | 0.06 | 2.70 | 78.89 |
| Gonothyraea loveni | 0.07 | 0.09 | 0.06 | 2.60 | 81.49 |

*Group Western area / Ratel-Dijck*
Average similarity: 11.87

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Clytia hemisphaerica | 0.43 | 1.75 | 0.43 | 14.77 | 14.77 |
| Asterias rubens | 0.40 | 1.34 | 0.39 | 11.29 | 26.07 |
| Pagurus bernhardus | 0.31 | 0.84 | 0.28 | 7.07 | 33.13 |
| Liocarcinus holsatus | 0.26 | 0.83 | 0.22 | 7.01 | 40.15 |
| Flustra foliacea | 0.31 | 0.80 | 0.29 | 6.75 | 46.89 |
| Pisidia longicornis | 0.26 | 0.63 | 0.21 | 5.27 | 52.16 |
| Pinnotheres pisum | 0.23 | 0.62 | 0.20 | 5.22 | 57.38 |
| Abietinaria abietina | 0.23 | 0.48 | 0.22 | 4.05 | 61.43 |
| Pycnogonum littorale | 0.26 | 0.44 | 0.23 | 3.71 | 65.14 |
| Bougainvillia muscus | 0.23 | 0.41 | 0.21 | 3.48 | 68.61 |
| Obelia dichotoma | 0.23 | 0.30 | 0.21 | 2.54 | 71.15 |
| Buccinum undatum | 0.20 | 0.29 | 0.17 | 2.47 | 73.62 |
| Tubularia indivisa | 0.17 | 0.25 | 0.14 | 2.15 | 75.77 |
| Mytilus sp | 0.17 | 0.25 | 0.15 | 2.10 | 77.87 |

| | | | | | |
|---|---|---|---|---|---|
| Galathea intermedia | 0.17 | 0.24 | 0.15 | 2.05 | 79.92 |
| Hydrallmania falcata | 0.20 | 0.22 | 0.18 | 1.85 | 81.77 |

*Group Westhinder/ North*
Average similarity: 8.76

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Echinocyamus pusillus | 0.38 | 2.81 | 0.34 | 32.06 | 32.06 |
| Buccinum undatum | 0.31 | 1.47 | 0.27 | 16.78 | 48.84 |
| Pinnotheres pisum | 0.21 | 0.86 | 0.19 | 9.86 | 58.70 |
| Ophiura albida | 0.23 | 0.83 | 0.18 | 9.44 | 68.13 |
| Pisidia longicornis | 0.28 | 0.69 | 0.25 | 7.90 | 76.03 |
| Inachus dorsettensis | 0.20 | 0.33 | 0.17 | 3.72 | 79.76 |
| Pycnogonum littorale | 0.15 | 0.27 | 0.11 | 3.10 | 82.86 |

*Group Westhinder/ South East*
Average similarity: 11.58

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Pisidia longicornis | 0.48 | 1.40 | 0.43 | 12.13 | 12.13 |
| Flustra foliacea | 0.37 | 0.94 | 0.32 | 8.11 | 20.23 |
| Mytilus sp | 0.34 | 0.67 | 0.31 | 5.79 | 26.02 |
| Hydrallmania falcata | 0.30 | 0.56 | 0.25 | 4.81 | 30.83 |
| Galathea intermedia | 0.32 | 0.45 | 0.30 | 3.90 | 34.73 |
| Echinocyamus pusillus | 0.30 | 0.44 | 0.27 | 3.81 | 38.54 |
| Pagurus cuanensis | 0.31 | 0.44 | 0.29 | 3.78 | 42.32 |
| Clytia hemisphaerica | 0.27 | 0.42 | 0.26 | 3.64 | 45.96 |
| Bugula flabellata | 0.27 | 0.38 | 0.25 | 3.32 | 49.28 |
| Pagurus bernhardus | 0.25 | 0.36 | 0.22 | 3.14 | 52.42 |
| Buccinum undatum | 0.27 | 0.35 | 0.25 | 3.06 | 55.48 |
| Pilumnus hirtellus | 0.26 | 0.28 | 0.26 | 2.45 | 57.93 |
| Leptochiton asellus | 0.24 | 0.24 | 0.23 | 2.11 | 60.03 |
| Calliostoma zizyphinum | 0.24 | 0.23 | 0.23 | 2.00 | 62.04 |
| Acanthodoris pilosa | 0.18 | 0.23 | 0.13 | 1.97 | 64.00 |
| Electra pilosa | 0.22 | 0.22 | 0.20 | 1.91 | 65.91 |
| Hyas coarctatus | 0.23 | 0.21 | 0.22 | 1.81 | 67.73 |
| Scrupocellaria scruposa | 0.20 | 0.18 | 0.19 | 1.56 | 69.29 |
| Inachus dorsettensis | 0.21 | 0.18 | 0.19 | 1.55 | 70.84 |
| Turbicellepora avicularis | 0.19 | 0.18 | 0.17 | 1.55 | 72.39 |
| Ebalia tuberosa | 0.23 | 0.18 | 0.23 | 1.51 | 73.90 |
| Nemertesia ramosa | 0.20 | 0.17 | 0.18 | 1.50 | 75.40 |
| Liocarcinus holsatus | 0.14 | 0.15 | 0.11 | 1.34 | 76.73 |
| Obelia geniculata | 0.15 | 0.15 | 0.12 | 1.31 | 78.04 |
| Vesicularia spinosa | 0.18 | 0.13 | 0.16 | 1.10 | 79.14 |
| Sertularia cupressina | 0.15 | 0.12 | 0.13 | 1.07 | 80.21 |

*Group Westhinder/ South West*
Average similarity: 14.62

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Flustra foliacea | 0.56 | 2.19 | 0.58 | 15.01 | 15.01 |
| Acanthodoris pilosa | 0.44 | 1.53 | 0.43 | 10.44 | 25.45 |
| Bugula flabellata | 0.44 | 1.34 | 0.42 | 9.19 | 34.64 |
| Pisidia longicornis | 0.37 | 0.78 | 0.34 | 5.33 | 39.97 |

| | | | | | |
|---|---|---|---|---|---|
| Tubularia indivisa | 0.37 | 0.69 | 0.35 | 4.73 | 44.70 |
| Tubularia larynx | 0.30 | 0.66 | 0.26 | 4.52 | 49.21 |
| Galathea intermedia | 0.30 | 0.56 | 0.26 | 3.83 | 53.05 |
| Vesicularia spinosa | 0.30 | 0.54 | 0.28 | 3.68 | 56.73 |
| Mytilus sp | 0.33 | 0.46 | 0.32 | 3.15 | 59.87 |
| Nemertesia ramosa | 0.30 | 0.46 | 0.27 | 3.14 | 63.02 |
| Asterias rubens | 0.22 | 0.46 | 0.14 | 3.14 | 66.16 |
| Clytia hemisphaerica | 0.22 | 0.32 | 0.20 | 2.17 | 68.33 |
| Garveia nutans | 0.22 | 0.29 | 0.20 | 2.01 | 70.34 |
| Hydrallmania falcata | 0.26 | 0.26 | 0.24 | 1.75 | 72.09 |
| Alcyonidium parasiticum | 0.22 | 0.25 | 0.21 | 1.74 | 73.83 |
| Obelia geniculata | 0.19 | 0.23 | 0.15 | 1.56 | 75.39 |
| Filellum serpens | 0.22 | 0.21 | 0.20 | 1.46 | 76.85 |
| Bougainvillia muscus | 0.22 | 0.21 | 0.20 | 1.43 | 78.28 |
| Inachus dorsettensis | 0.22 | 0.20 | 0.19 | 1.36 | 79.64 |
| Turbicellepora avicularis | 0.22 | 0.19 | 0.19 | 1.28 | 80.92 |

# Annex 4. Frequency of occurrence of epibenthic species in the three main clusters identified on the offshore stations of Gilson's sampling grid, based on Presence/Absence

Sessile taxa are written in blue; species observed in more than 10% of the stations are written in bold. For the "species-rich" cluster, species under 10 % of occurrences are not presented.

## 1. Frequency of occurrences for valid species

| Valid species | "Impoverished" (78 species) | Valid species | "Intermediate" (133 species) | Valid species | "Rich" (163 species) |
|---|---|---|---|---|---|
| **Echinocyamus pusillus** | **0.19** | **Flustra foliacea** | **0.62** | **Pisidia longicornis** | **0.67** |
| **Buccinum undatum** | **0.14** | **Clytia hemisphaerica** | **0.52** | **Echinocyamus pusillus** | **0.63** |
| **Ophiura albida** | **0.14** | **Pisidia longicornis** | **0.45** | **Buccinum undatum** | **0.57** |
| **Pinnotheres pisum** | **0.14** | **Bugula flabellata** | **0.44** | **Mytilus sp** | **0.54** |
| **Pisidia longicornis** | **0.10** | **Acanthodoris pilosa** | **0.38** | **Galathea intermedia** | **0.51** |
| Mytilus sp | 0.08 | **Hydrallmania falcata** | **0.35** | **Pagurus cuanensis** | **0.49** |
| Pagurus bernhardus | 0.08 | **Bougainvillia muscus** | **0.31** | **Pagurus bernhardus** | **0.48** |
| Liocarcinus holsatus | 0.07 | **Nemertesia ramosa** | **0.30** | **Leptochiton asellus** | **0.48** |
| Thia scutellata | 0.07 | **Vesicularia spinosa** | **0.28** | **Inachus dorsettensis** | **0.44** |
| Tectura virginea | 0.06 | **Abietinaria abietina** | **0.27** | **Pilumnus hirtellus** | **0.44** |
| Acanthodoris pilosa | 0.05 | **Alcyonidium parasiticum** | **0.25** | **Psammechinus miliaris** | **0.43** |
| Galathea intermedia | 0.04 | **Sertularia cupressina** | **0.23** | **Ebalia tuberosa** | **0.43** |
| Asterias rubens | 0.04 | **Obelia geniculata** | **0.23** | **Hyas coarctatus** | **0.41** |
| Inachus dorsettensis | 0.03 | **Buccinum undatum** | **0.21** | **Flustra foliacea** | **0.35** |
| Pycnogonum littorale | 0.03 | **Scrupocellaria scruposa** | **0.21** | **Calliostoma zizyphinum** | **0.35** |
| Sertularia cupressina | 0.03 | **Filellum serpens** | **0.21** | **Ophiura albida** | **0.32** |
| Polynices poliana | 0.03 | **Electra pilosa** | **0.21** | **Liocarcinus pusillus** | **0.30** |
| Hydrallmania falcata | 0.02 | **Mytilus sp** | **0.20** | **Pycnogonum littorale** | **0.29** |
| Tubularia indivisa | 0.02 | **Pycnogonum littorale** | **0.20** | **Liocarcinus depurator** | **0.27** |
| Macropodia rostrata | 0.02 | **Tubularia indivisa** | **0.20** | **Asterias rubens** | **0.25** |

| | | | | | |
|---|---|---|---|---|---|
| Clytia hemisphaerica | 0.02 | **Halecium halecium** | **0.18** | **Alcyonium digitatum** | **0.25** |
| Liocarcinus marmoreus | 0.02 | **Obelia dichotoma** | **0.18** | **Hydrallmania falcata** | **0.24** |
| Polynices catena | 0.02 | **Galathea intermedia** | **0.17** | **Tubularia indivisa** | **0.24** |
| Hydractinia echinata | 0.02 | **Calycella syringa** | **0.17** | **Tritonia plebeia** | **0.24** |
| Pilumnus hirtellus | 0.02 | **Tubularia larynx** | **0.17** | **Bugula flabellata** | **0.24** |
| Psammechinus miliaris | 0.02 | **Nemertesia antennina** | **0.17** | **Nemertesia ramosa** | **0.24** |
| Flustra foliacea | 0.02 | **Sertularella rugosa** | **0.17** | **Tritonia hombergi** | **0.24** |
| Liocarcinus depurator | 0.02 | **Pagurus bernhardus** | **0.14** | **Gibbula tumida** | **0.24** |
| Halecium halecium | 0.02 | **Asterias rubens** | **0.14** | **Liocarcinus holsatus** | **0.22** |
| Metridium senile | 0.02 | **Turbicellepora avicularis** | **0.14** | **Macropodia rostrata** | **0.22** |
| Cerianthus lloydi | 0.02 | **Alcyonidium diaphanum** | **0.14** | **Turbicellepora avicularis** | **0.22** |
| Ebalia tumefacta | 0.02 | **Diphasia rosacea** | **0.14** | **Ostrea edulis** | **0.21** |
| Bougainvillia muscus | 0.02 | **Echinocyamus pusillus** | **0.13** | **Electra pilosa** | **0.21** |
| Scrupocellaria scruposa | 0.02 | **Liocarcinus holsatus** | **0.13** | **Polybius arcuatus** | **0.21** |
| Ciocalypta penicillus | 0.02 | **Macropodia rostrata** | **0.13** | **Clytia hemisphaerica** | **0.17** |
| Membranipora tenuis | 0.02 | **Ciocalypta penicillus** | **0.13** | **Halecium halecium** | **0.17** |
| Chorizopora brongniartii | 0.02 | **Ophiura albida** | **0.11** | **Metridium senile** | **0.17** |
| Astropecten irregularis | 0.02 | **Pinnotheres pisum** | **0.11** | **Cerianthus lloydi** | **0.17** |
| Hyas coarctatus | 0.01 | **Sertularia argentea** | **0.11** | **Ebalia tumefacta** | **0.17** |
| Tritonia plebeian | 0.01 | **Lacuna vincta** | **0.11** | **Eurynome aspera** | **0.17** |
| Ostrea edulis | 0.01 | **Eudendrium capillare** | **0.11** | **Bougainvillia muscus** | **0.16** |
| Calycella syringa | 0.01 | **Tectura virginea** | **0.10** | **Calycella syringa** | **0.16** |
| Doris verrucosa | 0.01 | **Inachus dorsettensis** | **0.10** | **Nemertesia antennina** | **0.16** |
| Anapagurus hyndmanni | 0.01 | **Membranipora tenuis** | **0.10** | **Haliclona oculata** | **0.16** |
| Obelia geniculata | 0.01 | **Alcyonium digitatum** | **0.10** | **Scrupocellaria scruposa** | **0.14** |
| Sertularia argentea | 0.01 | **Garveia nutans** | **0.10** | **Doris verrucosa** | **0.14** |
| Doto fragilis | 0.01 | **Plumularia setacea** | **0.10** | **Vesicularia spinosa** | **0.14** |
| Filellum | 0.01 | Pilumnus | 0.08 | **Hagiosynodos** | **0.14** |

| | | | | | |
|---|---|---|---|---|---|
| serpens | | hirtellus | | **latus** | |
| Obelia dichotoma | 0.01 | Conopeum reticulum | 0.08 | **Pinnotheres pisum** | **0.13** |
| Eudendrium ramosum | 0.01 | Alcyonidium hydrocoalitum | 0.08 | **Acanthodoris pilosa** | **0.13** |
| Conopeum reticulum | 0.01 | Obelia longissima | 0.08 | **Anapagurus hyndmanni** | **0.13** |
| Hippothoa divaricata | 0.01 | Metridium senile | 0.07 | **Alcyonidium parasiticum** | **0.13** |
| Hyas araneus | 0.01 | Hyas coarctatus | 0.07 | **Reptadeonella violacea** | **0.13** |
| Tubularia larynx | 0.01 | Doto fragilis | 0.07 | **Disporella hispida** | **0.13** |
| Cellepora pumicosa | 0.01 | Raspailia ramosa | 0.07 | **Escharella immersa** | **0.13** |
| Necora puber | 0.01 | Psammechinus miliaris | 0.06 | **Sertularia cupressina** | **0.11** |
| Diodora graeca | 0.01 | Cellepora pumicosa | 0.06 | **Obelia geniculata** | **0.11** |
| Macropodia longirostris | 0.01 | Aspidelectra melolontha | 0.06 | **Sertularia argentea** | **0.11** |
| Pagurus prideaux | 0.01 | Gonothyraea loveni | 0.06 | **Doto fragilis** | **0.11** |
| Tubulipora lobifera | 0.01 | Eudendrium album | 0.06 | **Garveia nutans** | **0.11** |
| Aspidelectra melolontha | 0.01 | Pagurus cuanensis | 0.06 | **Dysidea fragilis** | **0.11** |
| Gonothyraea loveni | 0.01 | Leptochiton asellus | 0.06 | **Crossaster papposus** | **0.11** |
| Polymastia mammillaris | 0.01 | Haliclona oculata | 0.06 | **Tectura virginea** | **0.10** |
| Balanus crenatus | 0.01 | Reptadeonella violacea | 0.06 | **Ciocalypta penicillus** | **0.10** |
| Lacuna vincta | 0.01 | Scalpellum scalpellum | 0.06 | **Filellum serpens** | **0.10** |
| Spatangus purpureus | 0.01 | Eucratea loricata | 0.06 | **Obelia dichotoma** | **0.10** |
| Echinocardium cordatum | 0.01 | Suberites ficus | 0.06 | **Eudendrium ramosum** | **0.10** |
| Aeolidia papillosa | 0.01 | Tritonia plebeia | 0.04 | **Plumularia setacea** | **0.10** |
| Fenestrulina malusii | 0.01 | Eudendrium ramosum | 0.04 | **Scalpellum scalpellum** | **0.10** |
| Eudendrium album | 0.01 | Spatangus purpureus | 0.04 | **Plagioecia patina** | **0.10** |

## 2. Frequencies of occurrence aggregated at valid Genus level

| Valid genera | Impoverished (67 genera) | Valid genera | Intermediate (105 genera) | Valid genera | Rich (132 genera) |
|---|---|---|---|---|---|
| **Echinocyamus** | **0.19** | **Flustra** | **0.62** | **Pagurus** | **0.70** |
| **Ophiura** | **0.14** | **Clytia** | **0.52** | **Pisidia** | **0.67** |
| **Pinnotheres** | **0.14** | **Obelia** | **0.49** | **Echinocyamus** | **0.63** |
| **Buccinum** | **0.14** | **Pisidia** | **0.45** | **Buccinum** | **0.57** |
| **Liocarcinus** | **0.11** | **Bugula** | **0.45** | **Mytilus** | **0.54** |
| **Pisidia** | **0.10** | **Acanthodoris** | **0.38** | **Liocarcinus** | **0.54** |
| Pagurus | 0.09 | **Nemertesia** | **0.37** | **Galathea** | **0.51** |
| Mytilus | 0.08 | **Hydrallmania** | **0.35** | **Ebalia** | **0.48** |
| Thia | 0.07 | **Alcyonidium** | **0.34** | **Leptochiton** | **0.48** |
| Polynices | 0.06 | **Sertularia** | **0.32** | **Inachus** | **0.46** |
| Tectura | 0.06 | **Bougainvillia** | **0.31** | **Pilumnus** | **0.44** |
| Acanthodoris | 0.05 | **Tubularia** | **0.28** | **Psammechinus** | **0.43** |
| Asterias | 0.04 | **Vesicularia** | **0.28** | **Hyas** | **0.43** |
| Galathea | 0.04 | **Abietinaria** | **0.27** | **Calliostoma** | **0.35** |
| Macropodia | 0.03 | **Scrupocellaria** | **0.21** | **Flustra** | **0.35** |
| Pycnogonum | 0.03 | **Buccinum** | **0.21** | **Ophiura** | **0.33** |
| Sertularia | 0.03 | **Electra** | **0.21** | **Tritonia** | **0.33** |
| Tubularia | 0.03 | **Filellum** | **0.21** | **Nemertesia** | **0.32** |
| Inachus | 0.03 | **Halecium** | **0.21** | **Pycnogonum** | **0.29** |
| Obelia | 0.02 | **Mytilus** | **0.20** | **Tubularia** | **0.27** |
| Clytia | 0.02 | **Pagurus** | **0.20** | **Alcyonium** | **0.25** |
| Hydractinia | 0.02 | **Pycnogonum** | **0.20** | **Asterias** | **0.25** |
| Hydrallmania | 0.02 | **Sertularella** | **0.20** | **Bugula** | **0.25** |
| Membranipora | 0.02 | **Eudendrium** | **0.20** | **Macropodia** | **0.24** |
| Metridium | 0.02 | **Calycella** | **0.17** | **Gibbula** | **0.24** |
| Pilumnus | 0.02 | **Galathea** | **0.17** | **Hydrallmania** | **0.24** |
| Psammechinus | 0.02 | **Liocarcinus** | **0.15** | **Turbicellepora** | **0.22** |
| Scrupocellaria | 0.02 | **Macropodia** | **0.14** | **Obelia** | **0.21** |
| Astropecten | 0.02 | **Turbicellepora** | **0.14** | **Ostrea** | **0.21** |
| Bougainvillia | 0.02 | **Asterias** | **0.14** | **Polybius** | **0.21** |
| Cerianthus | 0.02 | **Diphasia** | **0.14** | **Electra** | **0.21** |
| Chorizopora | 0.02 | **Ciocalypta** | **0.13** | **Sertularia** | **0.19** |
| Ciocalypta | 0.02 | **Echinocyamus** | **0.13** | **Haliclona** | **0.19** |
| Ebalia | 0.02 | **Ophiura** | **0.11** | **Metridium** | **0.17** |
| Eudendrium | 0.02 | **Pinnotheres** | **0.11** | **Alcyonidium** | **0.17** |
| Flustra | 0.02 | **Lacuna** | **0.11** | **Cerianthus** | **0.17** |
| Halecium | 0.02 | **Membranipora** | **0.10** | **Clytia** | **0.17** |
| Necora | 0.01 | **Plumularia** | **0.10** | **Doto** | **0.17** |
| Oenopota | 0.01 | **Raspailia** | **0.10** | **Eurynome** | **0.17** |
| Ostrea | 0.01 | **Tectura** | **0.10** | **Halecium** | **0.17** |
| Polymastia | 0.01 | **Alcyonium** | **0.10** | **Bougainvillia** | **0.16** |

| | | | | | |
|---|---|---|---|---|---|
| Portumnus | 0.01 | **Doto** | **0.10** | **Calycella** | **0.16** |
| Spatangus | 0.01 | **Garveia** | **0.10** | **Escharella** | **0.16** |
| Tritonia | 0.01 | **Inachus** | **0.10** | **Scrupocellaria** | **0.14** |
| Tubulipora | 0.01 | Pilumnus | 0.08 | **Vesicularia** | **0.14** |
| Aeolidia | 0.01 | Conopeum | 0.08 | **Doris** | **0.14** |
| Ammatophora | 0.01 | Metridium | 0.07 | **Hagiosynodos** | **0.14** |
| Anapagurus | 0.01 | Tritonia | 0.07 | **Pinnotheres** | **0.13** |
| Aphrodita | 0.01 | Hyas | 0.07 | **Reptadeonella** | **0.13** |
| Aspidelectra | 0.01 | Psammechinus | 0.06 | **Acanthodoris** | **0.13** |
| Balanus | 0.01 | Reptadeonella | 0.06 | **Anapagurus** | **0.13** |
| Calycella | 0.01 | Scalpellum | 0.06 | **Disporella** | **0.13** |
| Carcinus | 0.01 | Suberites | 0.06 | **Crossaster** | **0.11** |
| Cellepora | 0.01 | Aspidelectra | 0.06 | **Dysidea** | **0.11** |
| Conopeum | 0.01 | Cellepora | 0.06 | **Garveia** | **0.11** |
| Diodora | 0.01 | Eucratea | 0.06 | **Plagioecia** | **0.10** |
| Doris | 0.01 | Gonothyraea | 0.06 | **Plumularia** | **0.10** |
| Doto | 0.01 | Haliclona | 0.06 | **Scalpellum** | **0.10** |
| Echinocardium | 0.01 | Leptochiton | 0.06 | **Tectura** | **0.10** |
| Fenestrulina | 0.01 | Polybius | 0.04 | **Ciocalypta** | **0.10** |
| Filellum | 0.01 | Spatangus | 0.04 | **Eudendrium** | **0.10** |
| Gibbula | 0.01 | Campanularia | 0.04 | **Filellum** | **0.10** |

# ANNEX 5. Sampling survey 2005: 2m beam trawl data

(Samples 1 to 5: test samples)

| ZONE | Sample NR | Date | UTC time start | lat start WGS84 | lon start WGS84 | UTC time end | lat end WGS84 | Lon End WGS84 | ship speed /end (Knot) | Approx track length (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| H2 | 1 | 9/11/2004 | 15:28 | 51°26.3350 N | 2°26.7326 E | 15:33 | 51°26.383 N | 2°26.895 E | unk | 214 |
| H2 | 2 | 9/11/2004 | 15:51 | 51°26.3360 N | 2°26.5557 E | 16:09 | 51°26.451 N | 2°27.31 E | unk | 791 |
| H2 | 3 | 9/11/2004 | 16:32 | 51°26.6280 N | 2°26.3501 E | 16:48 | 51°26.289 N | 2°27.009 E | unk | 883 |
| H | 4 | 9/11/2004 | 17:16 | 51°27.3280 N | 2°25.9960 E | 17:32 | 51°26.882 N | 2°26.660 E | unk | 659 |
| H | 5 | 9/11/2004 | 17:40 | 51°26.7450 N | 2°26.4806 E | 17:56 | 51°27.160 N | 2°26.318 E | unk | 763 |
| B | 6 | 13/06/2005 | 16:14 | 51°19.711 N | 2°26.282 E | 16:17 | 51°19.656 N | 2°26.223 E | unk | 149 |
| B | 7 | 13/06/2005 | 16:40 | 51°19.7 N | 2°26.18 E | 16:50 | 51°19.349 N | 2°26.136 E | 2.3 | 679 |
| B | 8 | 13/06/2005 | 17:14 | 51°19.104 N | 2°26.609 E | 17:21 | 51°18.809 N | 2°26.563 E | 1.5 | 496 |
| B | 9 | 13/06/2005 | 17:38 | 51°19.11 N | 2°26.568 E | 17:48 | 51°18.827 N | 2°26.553 E | 1.7 | 661 |
| B | 10 | 13/06/2005 | 18:05 | 51°19.386 N | 2°26.474 E | 18:15 | 51°19.123 N | 2°26.281 E | 1.6 | 523 |
| A | 11 | 13/06/2005 | 18:41 | 51°20.477 N | 2°24.685 E | 18:47 | 51°20.283 N | 2°24.979 E | 1.7 | 445 |
| A | 12 | 13/06/2005 | 19:04 | 51°20.247 N | 2°24.907 E | 19:08 | 51°20.083 N | 2°24.828 E | 1.8 | 300 |
| A | 13 | 13/06/2005 | 19:46 | 51°19.946 N | 2°25.245 E | 19:55 | 51°19.659 N | 2°25.078 E | 1.8 | 726 |
| A | 14 | 13/06/2005 | 20:09 | 51°19.707 N | 2°25.339 E | 20:16 | 51°19.448 N | 2°25.216 E | 1.8 | 438 |
| C | 15 | 14/06/2005 | 10:14 | 51°20.522 N | 2°25.027 E | 10:28 | 51°20.646 N | 2°25.496 E | 1.5 | 641 |
| C | 16 | 14/06/2005 | 10:44 | 51°20.803 N | 2°25.931 E | 10:53 | 51°20.851 N | 2°26.26 E | 1.7 | 366 |
| J | 17 | 14/06/2005 | 16:42 | 51°24.356 N | 2°28.143 E | 16:50 | 51°24.07 N | 2°28.168 E | 1.5 | 500 |
| J | 18 | 14/06/2005 | 17:07 | 51°23.93 N | 2°28.348 E | 17:17 | 51°23.727 N | 2°28.526 E | 1.5 | 465 |
| J | 19 | 14/06/2005 | 17:35 | 51°24.1 N | 2°28.191 E | 17:43 | 51°23.952 N | 2°28.162 E | 1.5 | 338 |
| J | 20 | 14/06/2005 | 18:02 | 51°23.983 N | 2°28.279 E | 18:09 | 51°23.8 N | 2°28.349 E | 1.9 | 560 |
| G | 21 | 15/06/2005 | 11:43 | 51°25.896 N | 2°30.643 E | 11:52 | 51°26.012 N | 2°31.042 E | 1.5 | 474 |
| G | 22 | 15/06/2005 | 12:08 | 51°25.96 N | 2°30.699 E | 12:17 | 51°26.082 N | 2°31.019 E | 1.6 | 426 |
| G | 23 | 15/06/2005 | 12:32 | 51°25.839 N | 2°30.088 E | 12:40 | 51°25.936 N | 2°30.562 E | 1.6 | 583 |
| G | 24 | 15/06/2005 | 12:48 | 51°26.049 N | 2°31.115 E | 13:01 | 51°26.129 N | 2°31.47 E | 1.8 | 470 |
| F | 25 | 15/06/2005 | 13:32 | 51°25.004 N | 2°30.226 E | 13:43 | 51°25.376 N | 2°30.403 E | 1.3 | 451 |
| F | 26 | 15/06/2005 | 16:14 | 51°25.304 N | 2°30.477 E | 16:18 | 51°25.135 N | 2°30.524 E | 1.8 | 337 |
| H | 27 | 16/06/2005 | 12:53 | 51°26.587 N | 2°26.496 E | 13:02 | 51°26.872 N | 2°26.683 E | 1.8 | 567 |
| H | 28 | 16/06/2005 | 13:16 | 51°27.076 N | 2°26.286 E | 13:22 | 51°27.235 N | 2°26.487 E | 1.7 | 363 |
| H | 29 | 16/06/2005 | 13:50 | 51°27.287 N | 2°26.127 E | 13:56 | 51°27.469 N | 2°26.214 E | 1.7 | 355 |
| R | 30 | 20/06/2005 | 18:00 | 51°24.685 N | 2°29.012 E | 18:11 | 51°24.889 N | 2°29.341 E | 1.8 | 512 |
| R | 31 | 20/06/2005 | 18:24 | 51°24.445 N | 2°28.19 E | 18:34 | 51°24.641 N | 2°28.51 E | 1.8 | 735 |
| K | 32 | 21/06/2005 | 11:19 | 51°24.332 N | 2°32.101 E | 11:26 | 51°24.251 N | 2°31.817 E | 1.8 | 346 |

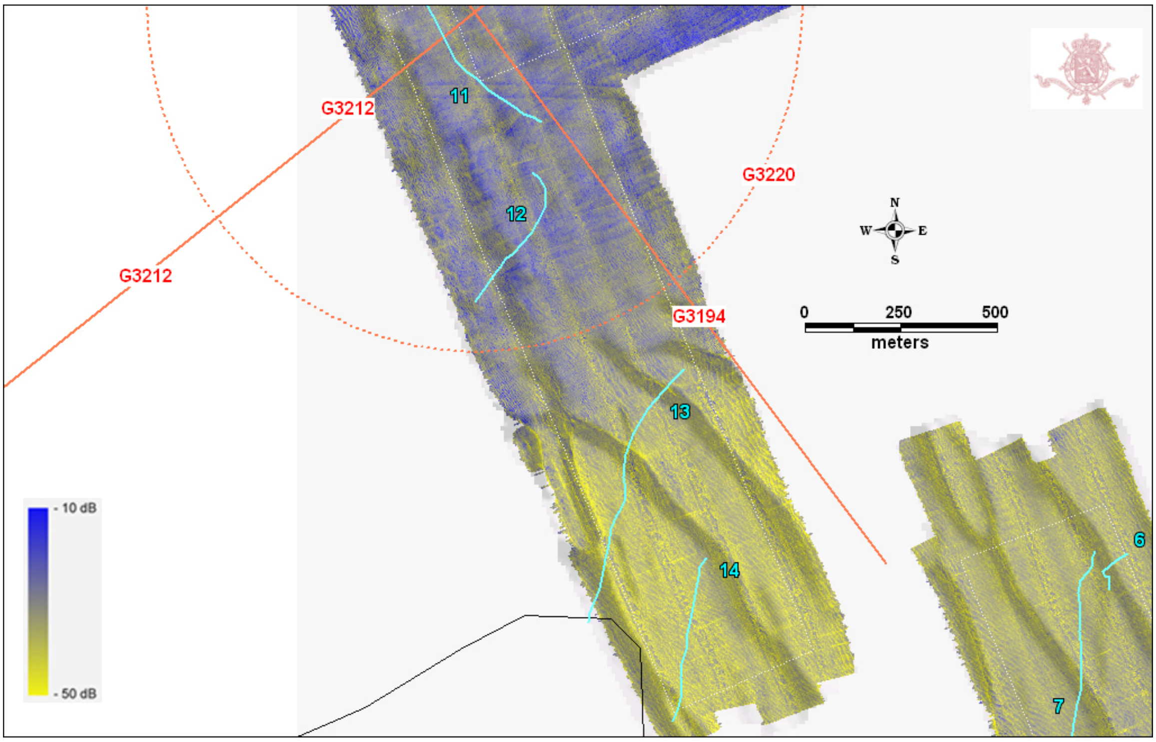
| ZONE | Sample NR | Date | UTC time start | lat start WGS84 | lon start WGS84 | UTC time end | lat end WGS84 | Lon End WGS84 | ship speed /end (Knot) | Approx track length (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| K | 33 | 21/06/2005 | 11:40 | 51°24.179 N | 2°31.364 E | 11:49 | 51°24.093 N | 2°31.131 E | 1.8 | 343 |
| K | 34 | 21/06/2005 | 11:59 | 51°24.137 N | 2°31.771 E | 12:11 | 51°24.094 N | 2°31.305 E | 1.7 | 463 |
| K | 35 | 21/06/2005 | 12:20 | 51°24.03 N | 2°31.524 E | 12:28 | 51°23.92 N | 2°30.945 E | 1.8 | 775 |
| L | 36 | 21/06/2005 | 12:52 | 51°25.035 N | 2°31.687 E | 13:01 | 51°24.849 N | 2°31.573 E | 1.8 | 426 |
| L | 37 | 21/06/2005 | 13:12 | 51°24.956 N | 2°31.748 E | 13:19 | 51°24.71 N | 2°31.643 E | 1.8 | 564 |
| L | 38 | 21/06/2005 | 13:30 | 51°24.932 N | 2°31.731 E | 13:36 | 51°24.721 N | 2°31.74 E | 1.7 | 331 |
| L | 39 | 21/06/2005 | 13:52 | 51°24.646 N | 2°32.091 E | 14:01 | 51°24.428 N | 2°31.965 E | 1.8 | 483 |
| S | 40 | 22/06/2005 | 12:51 | 51°23.479 N | 2°29.876 E | 12:58 | 51°23.274 N | 2°29.834 E | 1.6 | 428 |
| S | 41 | 22/06/2005 | 13:15 | 51°23.19 N | 2°30.076 E | 13:21 | 51°23.074 N | 2°29.997 E | 1.7 | 259 |
| S | 42 | 22/06/2005 | 13:35 | 51°23.208 N | 2°30.022 E | 13:41 | 51°23.011 N | 2°30.13 E | 1.7 | 344 |
| N | 43 | 22/06/2005 | 14:25 | 51°27.304 N | 2°31.735 E | 14:31 | 51°27.243 N | 2°31.623 E | 1.6 | 181 |
| N | 44 | 22/06/2005 | 14:45 | 51°27.333 N | 2°31.875 E | 14:56 | 51°27.149 N | 2°31.509 E | 1.7 | 546 |
| N | 45 | 22/06/2005 | 15:09 | 51°27.119 N | 2°32.002 E | 15:19 | 51°26.993 N | 2°31.696 E | 1.7 | 466 |
| N | 46 | 22/06/2005 | 15:34 | 51°26.755 N | 2°32.106 E | 15:44 | 51°26.476 N | 2°32.175 E | 1.6 | 512 |
| J | 47 | 23/06/2005 | 6:14 | 51°23.853 N | 2°28.431 E | 6:21 | 51°24.192 N | 2°28.081 E | 1.7 | 814 |
| R | 48 | 23/06/2005 | 6:31 | 51°24.542 N | 2°28.567 E | 6:39 | 51°24.755 N | 2°28.728 E | 1.7 | 400 |
| F | 49 | 23/06/2005 | 6:51 | 51°24.876 N | 2°30.372 E | 6:53 | 51°24.994 N | 2°30.489 E | 1.8 | 290 |
| F | 50 | 23/06/2005 | 7:06 | 51°25.698 N | 2°30.022 E | 7:12 | 51°25.546 N | 2°30.33 E | 1.7 | 566 |
| M | 51 | 23/06/2005 | 12:36 | 51°25.995 N | 2°33.263 E | 12:44 | 51°25.818 N | 2°33.068 E | 1.8 | 390 |
| M | 52 | 23/06/2005 | 12:54 | 51°26.015 N | 2°33.015 E | 13:05 | 51°25.726 N | 2°32.699 E | 1.7 | 662 |
| M | 53 | 23/06/2005 | 13:15 | 51°25.824 N | 2°32.591 E | 13:23 | 51°25.602 N | 2°32.424 E | 1.8 | 451 |
| M | 54 | 23/06/2005 | 13:34 | 51°25.662 N | 2°32.153 E | 13:43 | 51°25.458 N | 2°32.034 E | 1.8 | 424 |
| Q | 55 | 23/06/2005 | 14:13 | 51°26.901 N | 2°32.986 E | 14:36 | 51°26.667 N | 2°32.845 E | 0.6 | 452 |
| Q | 56 | 23/06/2005 | 14:46 | 51°26.726 N | 2°33.098 E | 14:53 | 51°26.507 N | 2°32.868 E | unk | 469 |
| Q | 57 | 23/06/2005 | 15:06 | 51°26.468 N | 2°33.238 E | 15:13 | 51°26.243 N | 2°33.141 E | unk | 435 |
| Q | 58 | 23/06/2005 | 15:29 | 51°26.272 N | 2°33.442 E | 15:37 | 51°26.149 N | 2°33.181 E | 1.6 | 362 |

# Annex 6. Field survey, June 2005: detailed data inventory and qualitative analyses

Photographic credits: F. Kerckhof, M. Fettweis, A. Norro (MUMM), J.-S. Houziaux, Y. Loufa, V. Zintzen (RBINS – Invertebrates), J. Mallefet (UCL) and the team of project "BeWreMaBi (BELSPO, EV/42, 2003-2006).

# Zone A

## Area map – acoustic classification and tracks




Sampling data for zone A. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The southern part of the zone encompasse the northern tip of the Bergues bank. When compared to other zones, backscatter strength values suggest that the cobble field is more sandy than more to the North (see zone C). In the gravel ground, numerous trawl marks are clearly visible.

## Historic data: dredge samples (see annex 7)

Gilson's dredge track G3194 started in the sandy area and covered the cobble field. The circular track G3220 covered mainly the cobble field and the transition area.

The historic samples of this zone are typified by the dominance of species typical of gravels, of which *Pisidia longicornis* is the most abundant. Numerous large colonies of the soft coral *Alcyonium digitatum* occurred, whereas 38 specimens of *Galathea intermedia*, 12 of *Inachus dorsettensis* and 10 of *Pilumnus hirtellus* were gathered by Gilson. The common snail *Buccinum undatum* and the crabs *Ebalia* spp were noticeably abundant (respectively 21 and 17 specimens in both samples).

## <u>2m beam trawl samples (see annex 8)</u>

2 samples were collected on the cobble field, 2 on the sand bank. The collected faunas clearly reflect the two different habitats.

### Sample #11 (screened, incompletely sorted)

The cobbles are of various nature (sandstone, granite, flintstone, etc.) and many are perforated (the sponge *Cliona cellata* or boring mussels : one shell fragment of *Barnea parva* found). On the cobbles, a typical assemblage is found. Most tubes of the Polychaete *Pomatoceros triqueter* and nearly all barnacles (*Balanus crenatus*) are damaged but colonized by other sessile species, what indicates that the damages were not caused by our sampling gear.

Two or three species of sea anemones (*Metridium senile, Cerianthus* sp. and *Sagartia elegans*) were found on every cobbles. The hydrozoan fauna is dominated by *Tubularia larynx* and *T. indivisa*. *Electra pilosa* is the dominant branching bryozoan (on *Tubularia* spp), while many encrusting species were observed on the cobbles. Ascidians (*Ciona intestinalis* and another species) colonize some cobbles as well and one small colony of the dead-man finger *A. digitatum* was found.

The mobile fauna is characterized by few young starfish Asterias rubens (max. size 4cm), sea urchins Psammechinus miliaris (small) and Ophiura albida. A specimen of Tritonia hombergi (Nudibranch), one alive mussel (Mytilus edulis) and some small crustaceans (Callianassa sp., Paguridae) and Polychaetes were found as well. One orange colony of the branching bryozoan Alcyonidium diaphanum (determination: H. De Blauwe) was collected.

### Sample #12 (screened)

The sample is similar to #11. Many cobbles are denuded. Living specimens of the boring mussel *B. parva* were found in one cobble, this is the first record for this species within the Belgian waters (see Kerckhof and Houziaux, 2006).

Empty holes bored by *B. parva* and cavities are often colonized with the ascidian *C. intestinalis*.

Tiny colonies of the dead-man finger *A. digitatum* are noticed, also mostly in cavities, with one colony of about 10 cm in height. The Polychaete *Eulalia viridis* is observed associated to *P. triqueter* (under its tubes), whereas *Lepidonotus squamatus* occurs in holes inside the cobbles. Small specimens of the common starfish *A. rubens* and the sea urchin *P. miliari* were collected along with the brittle-star *O. albida*.

Species more typical of sands were observed as well (swimming crabs *Liocarcinus* spp, hermit crabs (*Paguridae*), the gastropod *Nassarius reticulatus*, …), whereas fishes are represented by dragonets (*Callionymus lyra*), gobies (sub-family gobiinae) and one adult plaice (*Pleuronectes platessa)* of 25 cm.

### Sample #13 (screened)

This sample was small and dominated by few species: *A. rubens*, large specimens of *Ophiura ophiura*, *Liocarcinus* sp, the lesser weaver *Echiichtys vipera*, *Pagurus* sp. Many young flatfishes (Soleidae, Scophtalmidae) were collected.

### Sample #14 (screened; no picture)

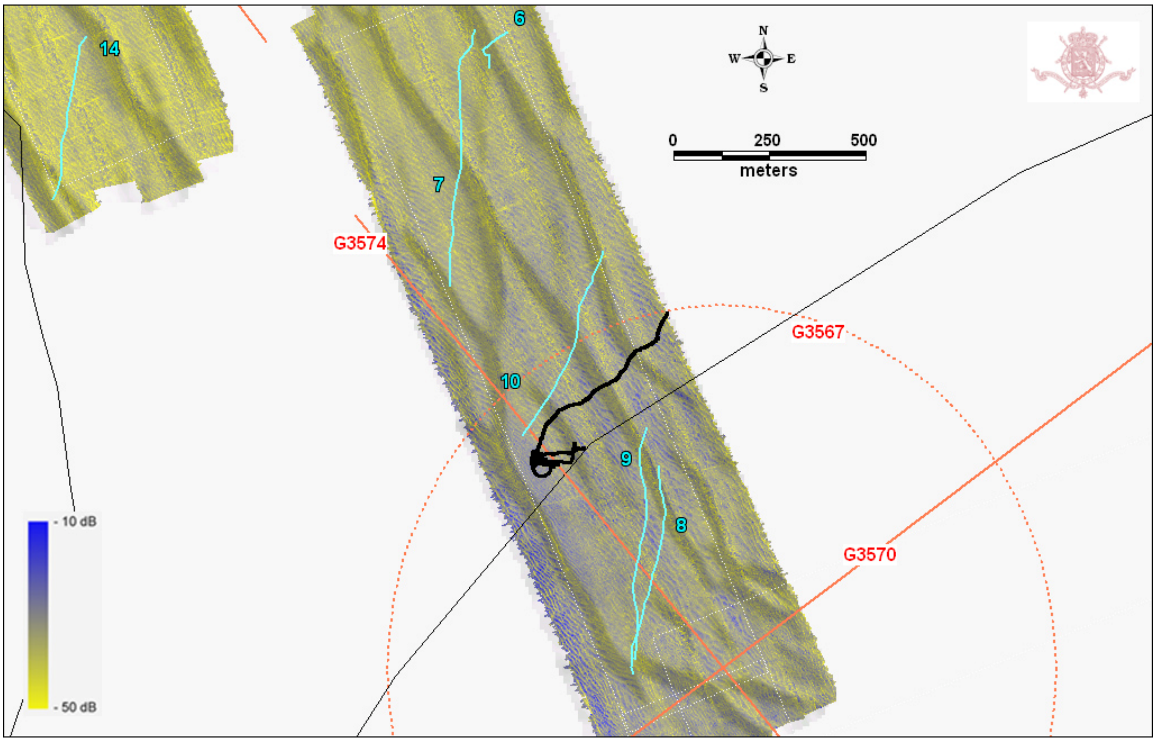
This small sample was very similar to sample 13, without cobble, with one *Pycnogonum litorale*, and dragonnets, gobies, lesser weavers and juvenile soles as in samples 11 and 12. Old shells of *Ostrea edulis* and Pectinidae were gathered in this sample, but no living specimen.

## Comparison with the historical data

In the historic samples, the species composition is typical of a gravel habitat, and species more typical of sands were not represented. Few species were not or poorly collected back in 2005, e.g. the common snail *B. undatum*, *Ebalia*, etc. Only two specimens of *P. miliaris* and no common starfish were collected, although these two species are very abundant in the new samples. In gravels, the brittle star *O. albida* was collected, whereas *O. ophiura* dominate in the sandy part of the area; none of these species were collected by Gilson. The colonies of dead-man fingers collected in 2005 were all tiny, whereas large colonies were collected by Gilson. Last but not least, the quasi-absence of *Tubularia* sp in the historic samples, whereas this species dominates the branching epifauna gathered in 2005, is intriguing. No specimen of flat oyster *O. edulis* was gathered back in this zone. Although only two samples were gathered on the gravel field, we note important changes in the proportions of species represented, with species typical for gravels in the historic collection strongly reduced in samples of 2005.

# Zone B

## Area map – acoustic classification and tracks




Sampling data for zone B. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Black line: geo-referenced track of divers who took video footages of the seafloor. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The area ise dominated by elongated sandwaves, with ripples and patches of higher backscatter values in-between probably due to shell accumulations. Larger patches with high backscatter values are observed in the southern portion of the area, which lays upon the northern tip of the Oostdijck sand bank. No beam trawl mark is apparent.

## Historic data: dredge (see annex 7)

The abundances and species richness are much reduced in samples G3574 and G3567 as compared to zone A, with dominance of the swimming crab *L. holsatus*, typically a species of sandy seafloors, thus indicative of an increased sand content. However, many species typical of hard substrata were collected, noticeably 6 colonies of Dead-man finger *A. digitatum*.

## 2m beam trawl samples (see annex 8)

All samples brought a similar species assemblage typical of a sandy seafloor.

**Sample # 6 (analyzed)**

This sample must be considered as missed. Its small content is similar with that of sample #7

**Sample # 7 (analyzed)**

47 specimens of *A. rubens* were collected of which 36 display one or more arms under regeneration. Very low amounts of small branching species (hydrozoans) indicate reduced presence of hard substrata, whereas sand species dominate this species-poor sample (swimming crabs *L. holsatus*, small *Paguridae* inside shells of the gastropod *N. reticulatus* colonized by the hydrozoan *Hydractinia echinata*).

The brittle-stars *O. albida* and *O. ophiura* are mixed, with the first more abundant. Two dragonets were identified (*Callionymus lyra*,1 adult and *C. reticulates*, 3 juveniles) and 3 lesser weavers *E. vipera*. Few flatfishes were also collected: dab *Limanda limanda* (2 small specimens), 8 juveniles of family Soleidae and 3 juveniles of Pleuronectoideae.

**Sample # 8 (screened)**

This sample is species-poor and bears specimens of the sandeel *Hyperoplus* sp *(probably H. lanceolatus*) with *A. rubens* and the weaver *E. vipera*. A specimen of the fish *Myoxocephalus scorpius* was collected and some sea urchins *P. miliaris*. One Juvenile cod (*G. morhua*) was collected as well.

**Sample # 9(screened)**


Sample similar to #7: sand fauna

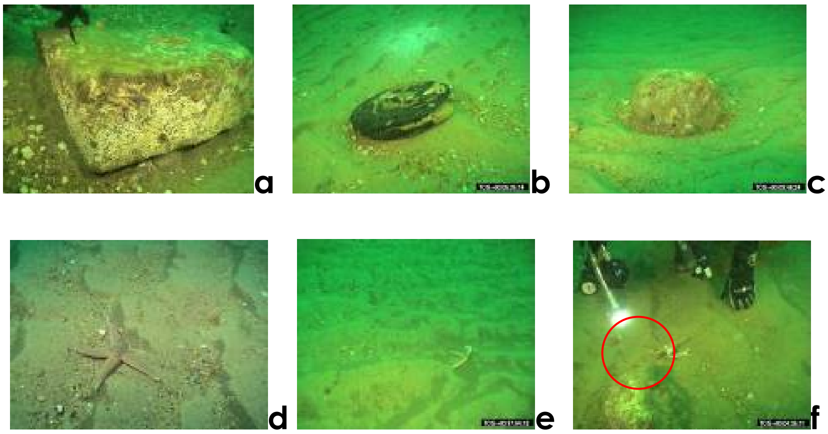
**Sample # 10 (analyzed)**

This sample displays features very similar to sample #7. 11 of the 27 small starfishes collected display arms under regeneration. For fishes, 14 specimens of sandeel *Hyperoplus lanceolatus*, 6 of lesser weaver *E. vipera*, 1 *Agonus cataphractus*, 2 dragonets (*C. lyra* and *C. reticulatus*) and some flatfishes (1 dab *L. limanda*, juveniles of Scophtalmidae and Soleidae) were collected.

## Underwater video footages

Images of the seafloor fully confirm the unexpected sandy nature of the area. The patches of high backscatter values coincide with accumulations of shell debris between sand waves. The thickness of the surficial sand layer is high, as the sampling rod of 50 cm could be fully entered in the sediment. However, isolated cobbles are sometimes encountered, even on top of sand waves, with typical erosion patterns in the surrounding sand. These cobbles thus are allochtonous to the surveyed area and were probably thrown overboard by beam trawlers operating in the area.

In the surrounding sandy area, abundant species of the epibenthos samples are most visible (lesser weaver, common starfishes, swimming crabs), including flatfishes (dab, plaice). Some specimens of *A. rubens* bear missing arms. The area is species-poor.




Extracts of the underwater video footage obtained in zone "B". **a**: an isolated cobble, probably ballast material as indicated by its rectangular shape, entirely covered by the tube-worm P. triqueter; **b**. Probably a trawl bobbin; **c**. an isolated cobble on the sand; **d**. and e. a large starfish *A. rubens* with one missing arm; **f**. Measurement of sand thickness: the graduated rod (50 cm; red circle) entirely penetrates the sediment.

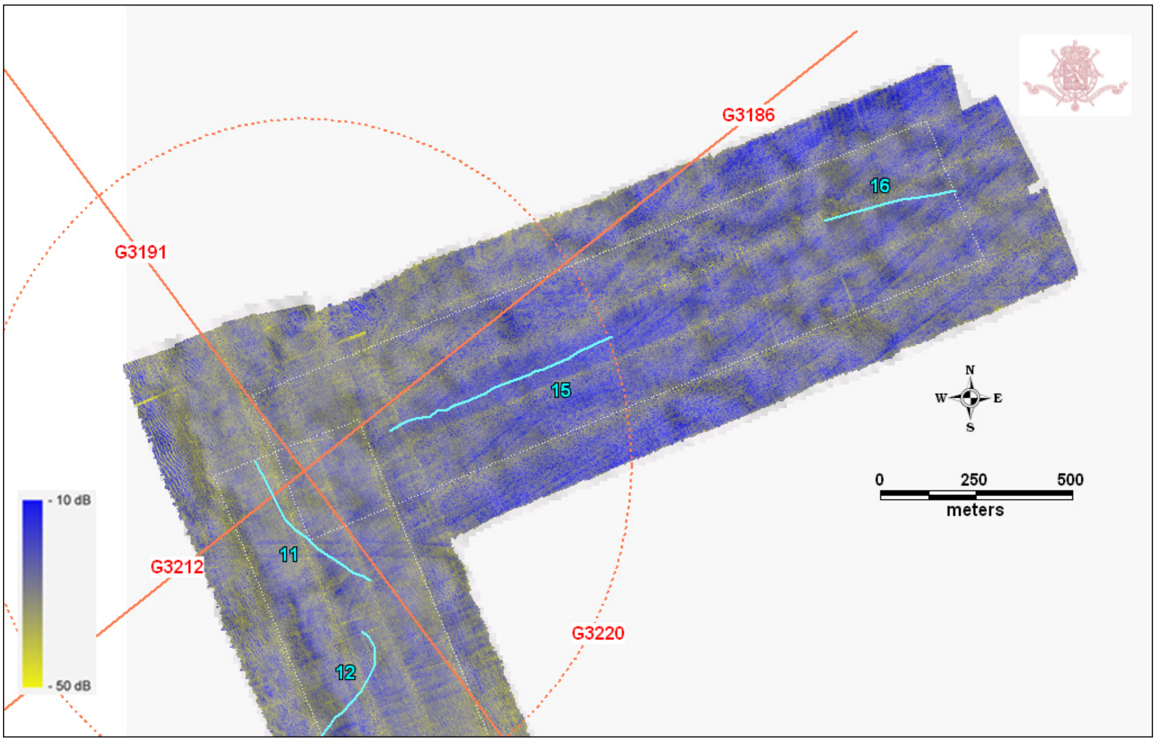
## Comparison with the historical data

Although the historic samples display a trend toward increased representation of sand species, they tend to indicate occurrence of typical gravel species which have not been collected at all in 2005, whereas images of the seafloor show that the area is essentially sandy apart from spare allochtonous cobbles. As in zone A, it seems likely that the sand cover was much higher in 2005 as compared to 1905. No common starfish was collected by Gilson, whereas this species is well represented in 2005. This portion of the survey area, at the tip of the Bergues sand bank, might be relatively variable for what regards its sand cover. A similar change in the amount of sand at the surface of the seafloor of gravel grounds was observed in French waters (Carpentier et al, 2005).

Although no impact from beam trawling was visible on the acoustic seafloor map, significant proportions of starfishes with missing arms under regeneration were observed in the epibenthic samples as well as on underwater videos.

# Zone C

## Area map – acoustic classification and tracks




Sampling data for zone C. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The seafloor map shows on average higher values of backscatter and hillocky morphology in the eastern, part of zone C as compared to the partly overlapping zone A. The sand dunes visible on the northeastern edge of zone A disappear. Abundant trawl marks are well visible throughout the area.

## Historic data: dredge (see annex 7)

The samples G3186 and G3220 display high levels of species richness in the collection of Gilson and are very similar to those obtained in zone A, with a marked dominance of species typical of gravel grounds.

## 2m beam trawl samples (see annex 8)

**Sample # 11 (screened, incompletely sorted)** => See zone A

**Sample # 15 (screened)**

This sample was characterized by collection of a large amount of cobbles colonized by a diverse branching epifauna dominated by hydrozoans (especially *Tubularia indivisa* and *T. larynx*), the bryozoan *Electra pilosa* (small colonies) and the polychaete *Pomatoceros triqueter*, of which tubes are either intact or broken on the cobbles.

Damages caused to these tubes are older than our sampling, as these were found to be colonized with other species like sea anemones. The sand mason *L. conchilega* is also found abundantly attached to the cobbles upon *Pomatoceros*. Many specimens of the ascidian *Ciona intestinalis* were found, as well as a *Molgula* sp, and 10 specimens of the nudibranch *Dendronotus frondosus*. 2 specimens of the brittle-star *Ophiothrix fragilis* were collected at this station. Intact and damaged common starfishes as well as sea urchins *Psammechinus miliaris* were collected.

One blue-velvet swimming crab *Necora puber* was observed. The fish fauna is represented by gobies (Gobiinae), dragonets (*Callionymus lyra*) and lesser weavers (*E. vipera*).

**Sample # 16 (screened)**

This sample was not properly analyzed but bears a similar species content as sample #15. Noticeably, a very large, moderately colonized cobble (>1m long) was collected due to the fact that the chain matrix was wrongly mounted on the trawl. The amphipod *Jassa* sp (probably *J. falcata*) was observed in the abundant shoots of the hydroids *Tubularia indivisa* and *T. larynx*. One *Galathea* sp and three velvet crabs *Necora puber* (of which one large) were gathered.

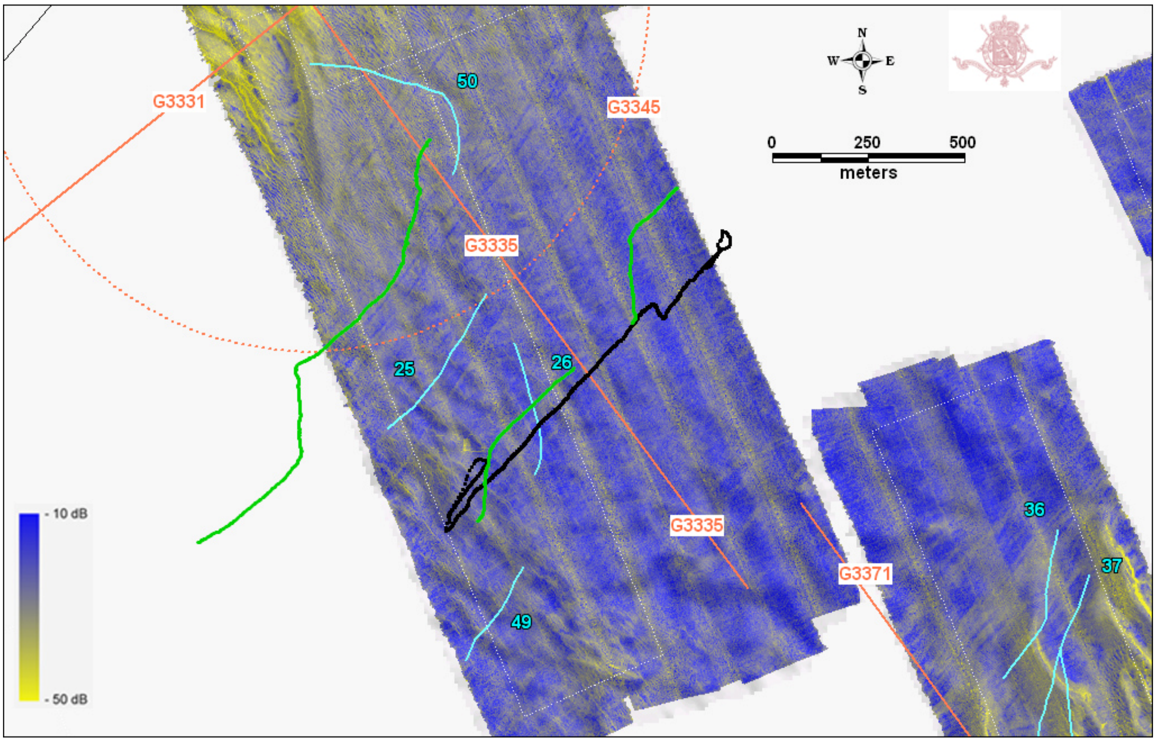
About a hundred specimens of *C. intestinalis* were collected. The polychaete worm *Lepidonotus squamatus* is frequent in holes inside the cobbles. The nudibranch *Dendronotus frondosus* (17 ex.) was also observed at this station, together with another species which could not be identified yest.

## Comparison with the historical data

As in zone A, the abundance of the common starfish *A. rubens* was much lower in the historic samples than in 2005. *C. zyziphinum* was abundant and not collected back at all. Branching bryozoans as *Alcyonidium* sp or *Flustra* sp, collected in the circular drege sample, were not collected back alive (one fragment was found in sample #11), whereas the two species of *Tubularia* are absent from the historic collection but dominate the modern samples. The acoustic Image of the seafloor, together with the high proportions of damaged *Pomatoceros* tubes and starfishes point at a high fishing pressure in the area. In this zone, it clearly appears that trawl marks disappear in the main gravel field.

# Zone F

## Area map – acoustic classification and tracks




Sampling data for zone F. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Black line: track of geo-referenced video footages (14/06/2005). Green lines: additional video transects, September 2005. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The acoustic map of the seafloor clearly shows a transition from the sand bank flank, in the Northwest portion of the zone, to the main gravel field. Patches of high backscatter values are observed between the large dunes of the sand bank.

Abundant trawl marks are visible, especially in the transition area between the sand dunes and the main gravel field. Trawl marks seem to be most visible in this portion where the sand content is higher than on the main gravel field, where they are not visible anymore, probably due to the fact that sand cover is minimal. Trawlers visibly avoid the flank of the sand bank.

## Historic data: dredge (see annex 7)

Samples G3335, G3345 and G3331 bear respectively 51, 31 and 5 species. Surprisingly, the latter sample, which was seemingly located more on the sand bank, only bears attached species: *Electra pilosa, Flustra foliacea, Hydrallmania falcata, Kirchenpaueria pinnata, Obelia geniculata*. One possible explanation for this observation is the possible existence of small cobbles in between dunes, associated with a low fishing efficiency due to the fact that the dredge most probably encountered large sand dunes. This possibility is confirmed by the acoustic image of the seafloor. Sediment descriptions from that portion of the F frame also mention occurrence of pebbles, together with coarse sand and shell debris (not illustrated).

The bryozoan *Flustra foliacea*, which is most abundant in the collection, was seemingly not collected in G3335 but a minimum of 3 colonies were found in G3345, a circular dredging which track is half located on the sand bank and half in the main gravel field. Given its frequent occurrence in adjacent samples, It is likely that this species was fairly abundant on the cobbles of the area. Similarly, the branching bryozoan *Alcyonidium* sp was collected on G3345, with three distinct species identified. 13 specimens of the flat oyster *Ostrea edulis* were collected alive, the highest abundance recorded. Assuming an homogeneous distribution along the whole transect, this suggests an average density of about 1 specimen / 100 square meter.

## <u>2m beam trawl samples (see annex 8)</u>

The samples #25, #26 and #49 are all located more toward the center of the gully, where the sand cover appears as minimal on the acoustic image. The sample #50 is located in a complex in a rippled sand area which marks a transition toward the flank of the sand bank.

### Sample #25 (not analyzed)




This sample was very similar to sample #26 , to which it can be referred to for general considerations on species content. The beam trawl brought a large amount of cobbles, most of which were colonized (dominance of Pomatoceros sp., Tubularia sp and Electra pilosa).

Some of the cobbles bear damaged *Pomatoceros* tubes re-colonized by other species, as illustrated on figure 4 (the orange spot is an encrusting unidentified sponge). This is clearly an evidence of earlier mechanical disturbance. This figure also shows a common pattern of colonization of holes and crevices by small branching species together with *Lanice conchilega* and other species

The tunicate *Ciona intestinalis* is abundant. The mobile fauna is dominated by the Echinoderms *A. rubens* and *P. miliaris*.

**Sample # 26 (screened)**

This sample was very similar to sample #25. A much lower proportion of the *Pomatoceros* tubes is damaged. Some cobbles are entirely covered with *Pomatoceros* tubes, what indicates that they were located above the seafloor, probably on higher portions of cobble accumulations as observed with underwater video.

There is relatively few *A. rubens* and *P. miliaris*. 23 specimens of *C. intestinalis* were counted. The sample analysis revealed presence of the boring mussel *B. parva*. A solitary ascidian could not be identified, about 20 specimens of 2 species of anthozoans, 6-7 species of Polychaetes, one unidentified Nemertina, 2 very small colonies of *A. digitatum*, 2-3 species of nudibranchs, and 2 specimens of Nemertea. The boring mussel *Barnea parva* is again observed. It is estimated that a minimum of 15 species of hydrozoans were collected in this sample

The track crosses the scuba-operated video transect. The seafloor morphology is relatively homogeneous with the typical "hillhocky" morphology throughout the track.

**Sample 49 (screened)**

The fauna of this sample is again very similar to #25 and #26, but less cobbles were collected. In this sample, the association of the polychaete *Eulalia viridis* with the Pomatoceros tubes was confirmed.

2 alive specimens of *Calliostoma zizyphinum* were collected, 3-4 species of ascidians were observed, 3 juvenile specimens of *B. undatum*, few specimens of *Ophiothrix fragilis*. Very few empty shells were gathered.

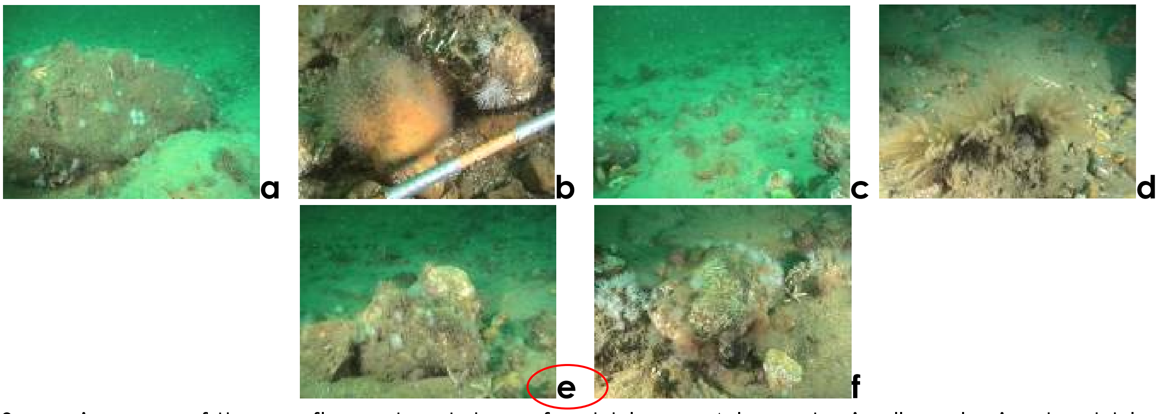
**Sample # 50 (not analyzed)**

In this sample, many cobbles were denuded.

## Underwater video footages.

The scuba-operated video recordings of June 2005 were obtained in excellent visibility conditions (~ 10-20m), This has enabled to visualize the "seascape" with a good accuracy, whereas dives of September 2005 were performed in conditions of much higher turbidity. In addition, scuba-divers measured the thickness of the sand cover using a graduated rod.

The seafloor consists of pebbles and cobbles (0.01 – 1m) covered with a thin layer of surficial sand, generally smaller than 20 cm. The abundance of cobbles emerging from the sandy surface varies very much at a small scale (1-10 meter), and patches of accumulated cobbles are regularly encountered. Large cobbles generally appear as most colonized, with the hydroids *Tubularia larynx* and *Tubularia indivisa* as the dominant species.




Some images of the seafloor at patches of cobbles. a. A large typically colonized cobble, under which a blue-velvet crab (*Necora puber*) was observed; b. A small colony of the dead-man finger *Alcyonium digitatum*; c. general view of the cobble field; d. a shot of the hydroid Nemertesia sp; e. a large and typically colonized coble; note specimens of starfish *A. rubens* displaying arms under regeneration (red circle) and sea urchins (*Psammechinus miliaris*) on the cobble; f. a richly colonized cobble, showing local abundance and diversity of sea anemones (Actiniaria) and other species such as the ascidian *Ciona intestinalis*.

The fauna encountered conforms well with the content of the 2m beam trawl, with a visible dominance of Pomatoceros sp (Polychaeta), *Tubularia* sp (Hydrozoa) and *Metridium senile* (Anthozoa) as sessile species, and large abundance of the starfish *A. rubens*, swimming crabs *Liocarcinus* sp. and hermit crabs (generally *Pagurus bernhardus*). Large starfishes are observed on sand, but small specimens are systematically encountered on the cobbles. The sea urchin *P. miliaris* tends to show a more aggregated distribution, with patches of high abundance; the specimens are generally observed on the cobbles. Flatfishes are regularly encountered (plaice, dab). The common snail *Buccinum undatum* is occasionally encountered. The velvet crab *Necora puber* is occasionally noticed under larger cobbles. Many other large species can be observed (such as dragonets (*Callionymus* spp.), small weaver (*Echiichtys vipera*), flafishes (dab, plaice), shrimps, etc).

The underwater videos clearly point at a high degree of aggregation for the fauna, with large cobbles and patches of cobbles concentrating highest biomasses. The habitat is extremely heterogeneous and thus offers a large variety of micro-habitats, which most certainly explains the high levels of species richness and taxonomic breadth observed. The structures formed by the branching species offer a micro-habitat for small crustaceans observed in the 2m beam trawl samples such as Amphipods (*Jassa*, Caprellidae ...) or mysids.

### Comparison with the historical data

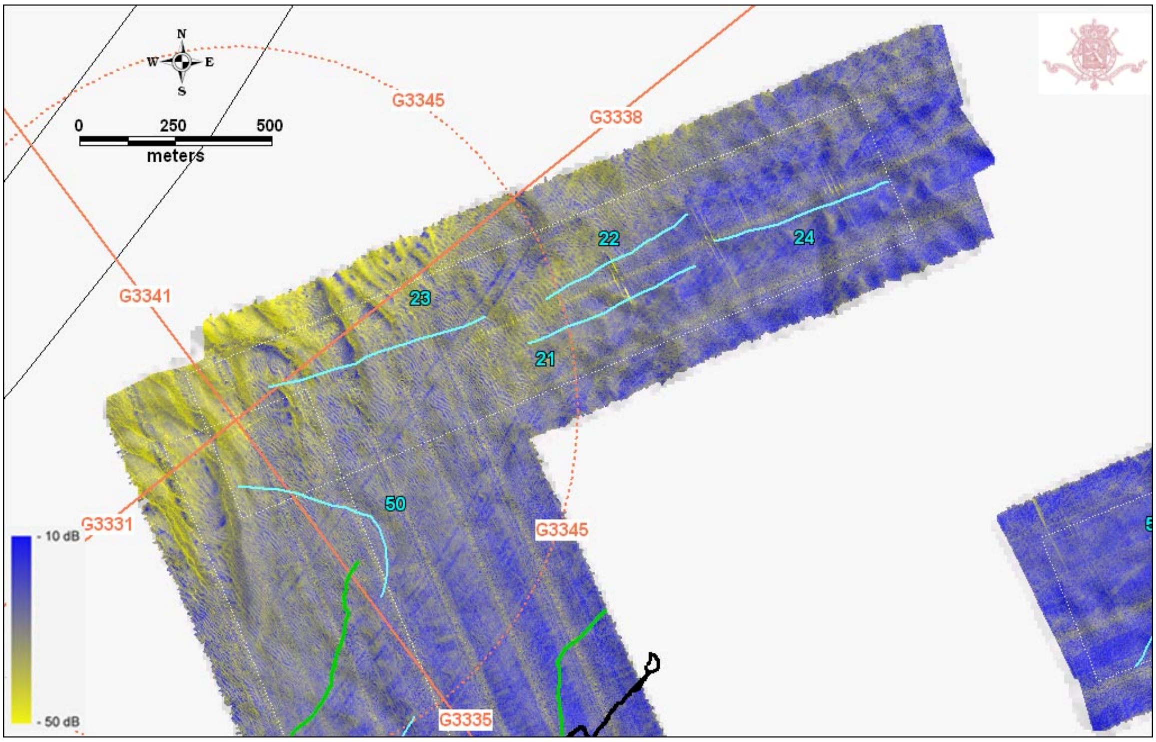
The acoustic image of the seafloor shows that the dredge ample G3335 was mostly collected on a gravelly seafloor with minimal sand thickness. The largest portion of the circular dredging G3345 was carried out on the sand bank itself, with only a small portion covering the more gravelly seafloor. The close sample G3331 was entirely carried out on the flank of the sand bank, where the acoustic image shows occurrence of small coarser patches.

A striking difference between Gilson's samples and new samples is the complete absence of starfish A. rubens and the urchin P. miliaris, two most abundant species both in beam trawl samples and on the video recordings. Similarly, the hydroids Tubularia spp, visibly most abundant in epibenthos samples and on the underwater video tracks, are by far under-represented in the historic collection. On the contrary, 13 specimens of living oysters (some large), 6 living specimens of *B. undatum* and 31 *Calliostoma zyzyphinum* were collected. *Ophiura albida* is abundant both in historical and modern samples.

The observed scarcity of *Buccinum undatum* in modern samples contrasts with its historical abundance. On the contrary, it is highly improbable that the echinoderms *P. miliaris* and *A. rubens* would be absent from Gilson's dredge tow at the currently observed abundances. We thus observe contrasted and significant differences in the collected faunas, although overall species richness has remained comparable.

# Zone G

## Area map – acoustic classification and tracks




Sampling data for zone G. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Black line: track of geo-referenced video footage (14/06/2005). Green lines: additional video transects, September 2005. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

Zone G is contiguous to zone F and shows the typical hillocky morphology closer to the sand bank. The abundance of trawl marks evidenced in F is confirmed, but these are hardly visible in the main gravel field.

## Historic data: dredge (see annex 7)

In the sample G3338, *Flustra foliacea* is the most represented branching species in terms of number of jars. Typical species of gravels are encountered in this sample and G3345. *Asterias rubens* and *Psammechinus miliaris* were not collected at all. According to our seafloor map, this sample seems to have been collected along the edge of the sand bank

## 2m beam trawl samples (see annex 8)

None of the samples of this zone could be properly analyzed, but a screening was carried out on sample #21, which appears as very similar to the three others, although species content of sample #24 visually appeared as richer and bearing larger proportions of intact tubes of *Pomatoceros triqueter* which overgrows the cobbles. All sample brought few tens of cobbles. These two samples are located in the main gravel field, whereas samples #22 and #23 seem more sandy since gravels were on average more denuded, an observation consistent with the acoustic image of the seafloor.

**Sample # 21 (not analyzed)**

A large portion of the cobbles is poorly colonized. Association between *Pomatoceros triqueter* (lots of them damaged), *Tubularia* spp, *Electra pilosa* and the sand-mason *Lanice conchilega* appear to dominate the sessile fauna, which are also colonized by some species of sponges (e.g. *C. cellata*); of these, a characteristic but unidentified yellow species displaying typical protuberances was observed for the first time and was further collected in subsequent samples (see picture).

Lots of small undetermined sea anemones were collected. Three fragments of colonies of *Flustra foliacea* with alive zooids were collected, but it is uncertain whether these were attached or floating. One specimen of *Anomia ephippium* is recorded. Traces of barnacles are again observed, but not the living animal.

**Sample # 22 (not analyzed)**

Collected cobbles are generally denuded apart from *Pomatoceros*, encrusting species and small hydroids.

**Sample # 23 (not analyzed)**

This sample is similar to #22. A bobbin of a beam trawl was collected, confirming occurrence of bottom trawling pressure in this area.

**Sample # 24 (not analyzed)**

This sample is characterized by larger proportions of intact tubes of *P. triqueter*, which sometimes completely covers the cobbles, but is relatively similar to samples #21.

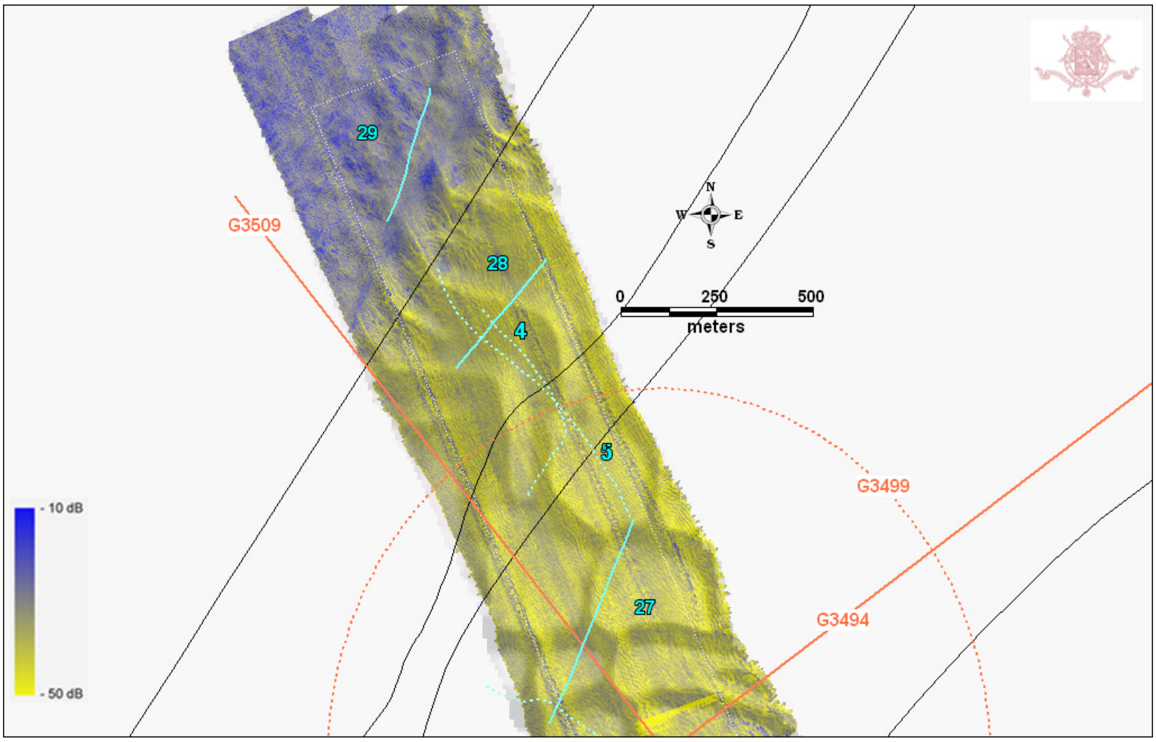
Few relatively extended encrusting sponges (yellow, orange or brown crusts) as well as sea anemones were further observed in this sample, overgrowing damaged an intact tubes of *P. triqueter*, but could not be identified yet.

## Comparison with the historical data

As in previous zones, a remarkable difference between historic and modern samples is the absence of large branching bryozoans and dominance of the hydrozoans *Tubularia indivisa* and *T. larynx* in the later. In sample #20, the nudibranch *Dendronotus frondosus* is again relatively abundant whereas it is absent from historic samples. Further sample processing is necessary prior to conclusions.

# Zone H

## Area map – acoustic classification and tracks




Sampling data for zone H. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file); samples #4 and #5: test-samples, November 2004. Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

Most of this zone and its corresponding historic sample (G3509) is located on the sand bank itself, with only the northern portion located in gravel field, of which limit coincides with the 30m isoline.

## Historic data: dredge (see annex 7)

Sample G3509 is the richest of all Gilson's dredge samples. This sample is typified by the very large abundance of medium to large colonies of dead-man finger *A. digitatum*, which must have filled the dredge. Many colonies were found on valves of *Ostrea edulis*, of which 7 alive specimens were collected, together with the tube worm *Pomatoceros triqueter*. It seems likely that a community typical of oyster beds was here encountered by Gilson.

24 specimens of the swimming crab *L. holsatus* were collected, which is consistent with the fact that a large part of the tow occurred on the sand bank. *A. rubens* and *P. miliaris* were here visibly abundant.

## 2m beam trawl samples (see annex 8)

Two samples were collected in 2004 to test the 2-meter beam trawl. 3 further samples were collected in 2005, of which one in the gravel field.

### Sample # 4 (not analyzed)


The occurrence of cobbles is in disagreement with position of the sample on the sand bank as evidenced by the acoustic seafloor map. As this is one of the test samples, it is not unlikely that an error occurred in the exact start and end time records, which could explain the curve of the track.

This sample bears a mixed fauna and cobbles are poorly colonized.

### Sample # 5 (not analyzed)

A typical sand fauna was collected

### Sample # 27 (not analyzed)

A typical sand fauna was collected, with one cobble.

### Sample # 28 (not analyzed)

A typical sand fauna was collected, with a noticeably high abundance of the lesser weaver *E. vipera*.

### Sample #29 (screened)


Abundance of hydroids, noticeably *Tubularia* spp, and their associated species (*E. pilosa*, *L. conchilega*) and tubes of amphipods. Species typical of gravels as the crabs *Macropodia* sp or *Ebalia tumefacta* were collected. Colonies of the bryozoan *Cellepora*

sp, the nudibranch *Dendronotus frondosus*.

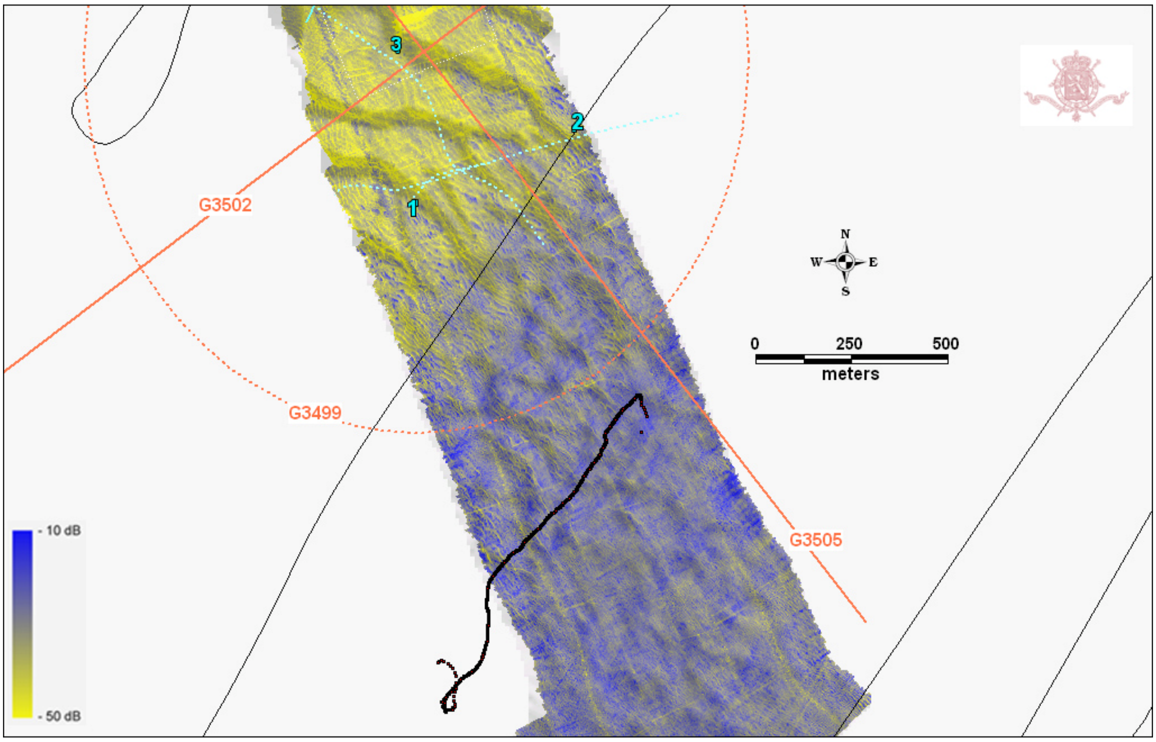
The swimming crabs Liocarcinus spp (*Liocarcinus depurator* was identified onboard, and *L. holsatus* is likely to be present), the shrimp Crangon and the lesser weaver E. vipera were collected as well, which is indicative of a mixed fauna of gravels and sands.

## Comparison with the historical data

Given the fact that samples were not properly analyzed, a comparison of sample contents is hard. However, the characteristic features of the historic samples, i.e. abundance of flat oysters (alive and valves) and large colonies of *A. digitatum*, were not found back in sample #29. Large branching species, such as sponges of the family Chalinidae or bryozoans, were not collected back at all. In this case, *Tubularia* spp are present in the historic samples. Again, the absence of *A. rubens* and *P. miliaris* in the historic samples is striking.

# Zone H2

## Area map – acoustic classification and tracks




Sampling data for zone H2. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Black line: track of geo-referenced video footage (16/06/2005). Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

This zone was sampled with the two-meter beam trawl only in November 2004 (preliminary tests), and samples were collected on the sand bank. The main gravel fields was thus not sampled, but underwater video recording could be carried out to provide information on the seafloor and epifauna. The acoustic map again points at high trawling pressure in the main gravel field.

## Historic data: dredge (see annex 7)

Apart from the absence of flat oysters, G3505 is very similar to G3509 (zone H) and characterized by a high species richness which includes many species typical for gravel fields. *Flustra foliacea* seems to be abundant as 4 lots of this species are recorded in the collection at this station.

## 2m beam trawl samples (see annex 8)

### Sample 1 (not analyzed)

This first test-sample was missed.

### Sample 2 (not analyzed; no picture)

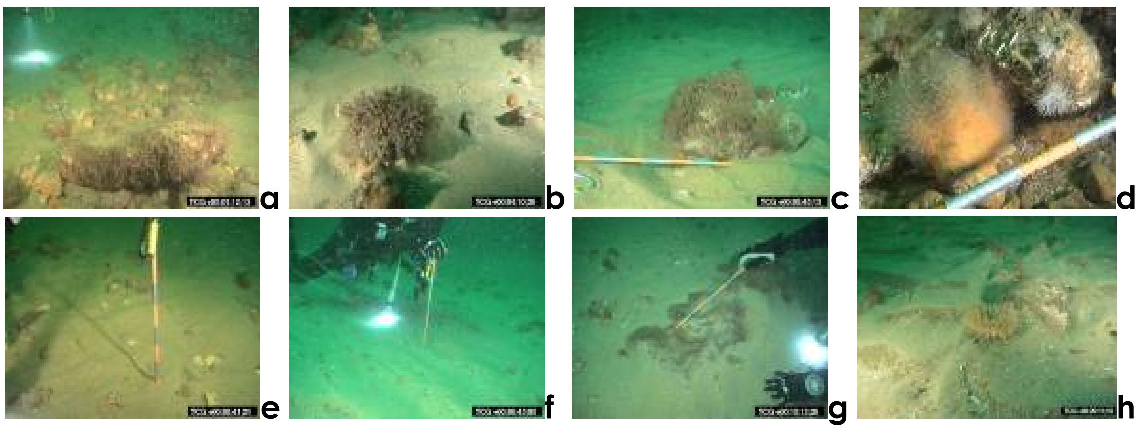
This sample is relatively poor as compared to other samples collected on gravels, and bear species typical of sandy areas. It characterizes the transition area between the sand bank and the main gravel field. Fragments of the branching bryozoan *Flustra foliacea* were collected.

### Sample 3 (not analyzed, no picture)

No image available, sample similar to sample #2

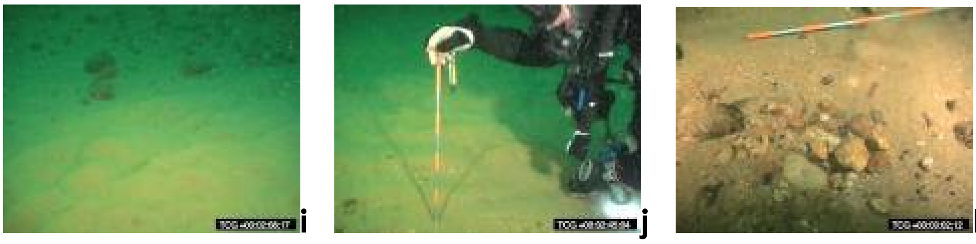
## Underwater video footage

The transect was carried out in the main gravel field. Images show that the seafloor and epibenthic cover are very similar to zone F, with a heterogeneous distribution of cobbles mainly covered with *Tubularia* spp and their associated species (e.g. *Lanice conchilega*). An increased abundance of medium-sized (5-10 cm length) colonies of Deadman fingers *A. digitatum* and one large sea anemone of the genus Tealia (probably *T. felina*) were noticeably observed.




Extracts of the video footage. **a**, **b** and **c**. General views of the seafloor. **d**. A small colony of dead-man fingers *A. digitatum*. **e** and **f**. Measuring sand layer thickness. **g**. A large cobble covered by sand. **h**. A sea-anemone *Tealia felina*.

Dune-like structures were encountered. These are of small height (~ 1 meter) and breadth (~ 5-10 meter). Cobbles are rare at their surface, but the sand cover never exceeds 10 cm; underneath, a cobble substratum is found (figures ). These dune-like structures probably correspond to accumulations of cobbles recognized as "hillocks" on the acoustic image.



i j k

A "hillock". Left: view from top, showing abundance of emergent cobbles at its basis. Center: measuring the sand thickness on top of the hillock (5-10 cm). Right: cobbles found underneath the thin sand layer at the same place.

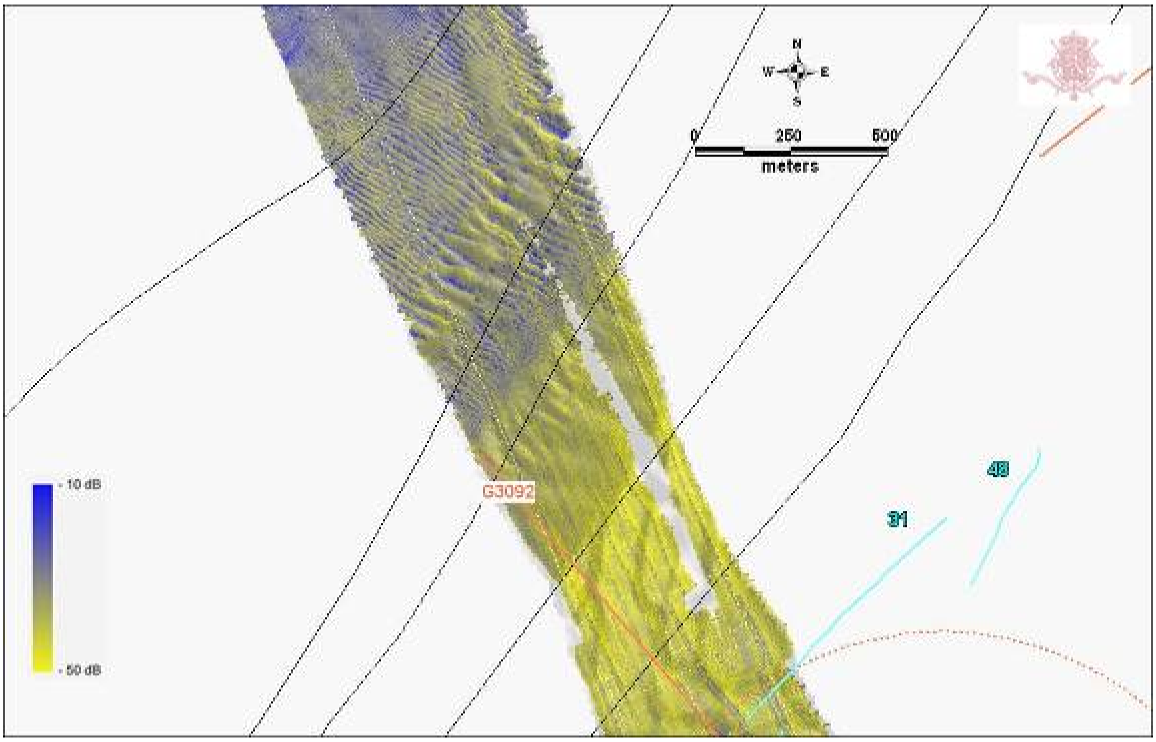
**Comparison with the historical data**

A comparison between historic and modern data is difficult since no sample was collected in the main gravel field in 2005. The underwater videos however evidence strong similitude with the zone F both in terms of seafloor morphology and epifauna; this zone can thus be considered as a basic model of expected species content.

However, despite relatively frequent encounters with colonies of *A. digitatum,* it is much unlikely that its observed density would lead to the amount collected by Gilson. Such is likely to be the case for other conspicuous species such as the hornwrack *F. foliacea*, the bryozoan *Alcyonidium* sp or the sponge *Haliclona oculata*, which were regularly encountered in Gilson's dredge and trawl samples in these surroundings.

# Zone I

## Area map – acoustic classification and tracks




Sampling data for zone I. Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks). Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

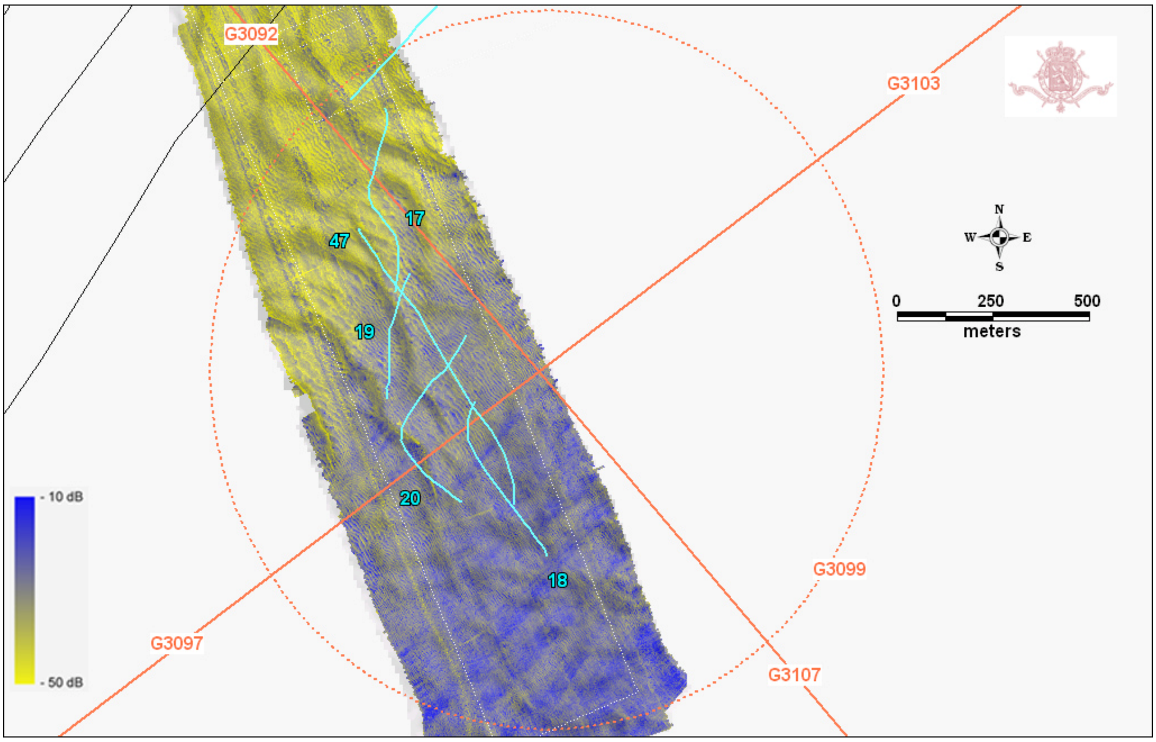
Zone "I" was initially drawn around dredge sample G3092, of which position was however wrong when sampling at sea occurred. As a result, this zone cannot be compared to historic samples.

No beam trawl sample was collected and no underwater video transect was carried out.

On the acoustic map of the zone, no trawl mark is visible in the large sand dune area observed between the sand bank and the main gravel field, where some are observed. In the area adjacent to the main sand bank, where some level of sand dune accretion seem to occur, patches with high backscatter values are observed, which could coincide with isolated cobble and shingle patches.

# Zone J

## Area map – acoustic classification and tracks




Sampling data for zone J. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The acoustic map show that half of the zone lays in the gravel field, where the typical hillocky morphology is observed. Trawl marks are again abundant. Noticeably, a mark of a twin beam trawl clearly stops against a sand dune, after which it is masked by sand ripples. This evidences the fact that beam trawls enter such sand dune before literally jumping over it, whereas their marks are quickly covered with sand ripples except where the trawl entered the seafloor more deeply. This is agreement with our own observations of high rises of tension in the cable when passing over such dunes, even at our lower speed (1-2 knots, whereas commercial vessels trawl at more than 6 knots). This is likely to explain why trawlers tend to avoid the sand bank itself to focus on the main gravel field and the transitional area.

## Historic data: dredge (see annex 7)

*Flustra foliacea* seems abundant in the three samples relevant for long-term analysis, i.e. G3092, G3107 and G3099. G3092 is however much impoverished in mobile species, which might be explained by its position more on the sand bank itself. The two other samples display the typical gravel epifauna observed in other dredge samples.

## 2m beam trawl samples (see annex 8)

### Sample 17 (no picture; not analysed)

Despite some cobbles were collected in this sample, these were denuded, whereas a typical sand epifauna was collected in this small sample, together with one specimen of the masked crab *Corystes cassivelaunus*.

### Sample 18 (no picture; screened)

The sample was not properly analyzed but consisted of cobbles with a typical fauna associated to gravels in other samples. One plaice *P. platessa* (28 cm) was collected. *Tubularia indivisa* and *T. larynx*, with their associated species, are particularly abundant. One colony of *Alcyonidium* cf. *diaphanum*, 3-4 species of ascidians, about ten specimens of crab of family Inachinae, the cephalopod *Sepiola atlantica*, weaver, gobies, dragonets, juvenile flatfishes (Scophtalmidae), one encrusting sponge, and probably a fragment of tube of the polychaete *Chaetopterus variopedatus*, inside which Cyclostoma were identified by H. De Blauwe.

### Sample 19 (no picture; not analyzed)

This tow crossed numerous sand dunes, which obviously triggered the high increase felt in cable tension, leading to precocious ending of the track. The sample content it was very similar to sample #18, with few cobbles. Colonies of the bryozoan family Celleporidae (*Cellepora pumicosa* and / or *Turbicellepora avicularis*) were abundant, as in many other samples.

### Sample 20 (no picture; screened)

This sample also contained small cobbles with typical sessile and mobile species and many shells, as well as representative of sand bottom fauna. The exact position of this track might have been wrongly determined, as indicated by its curve, and is yet to correct (the northern part of the track is the right one).

### Sample 47 (screened)

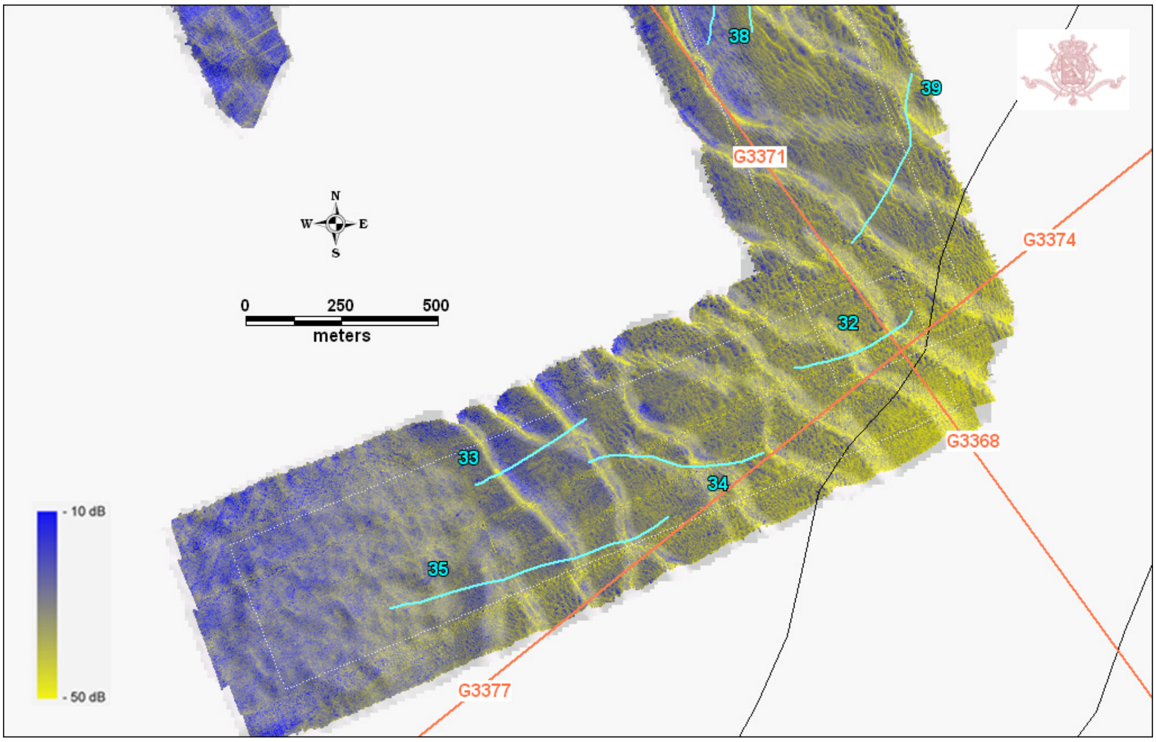
Despite its length and position in the gravel field, this sample did not provide very colonized cobbles and its content is a mix between gravel and sand epifaunas similar to other samples of this zone.

## Comparison with the historical data

*A. digitatum* (medium to large colonies), *Flustra foliacea* and the crustacean *Galathea intermedia* were visibly historically abundant in the zone, whereas they were not observed in 2005.

# Zone K

## Area map – acoustic classification and tracks




Sampling data for zone K. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The acoustic map shows a complex of large sand dunes which separate the main gravel field (hillocks, high backscatter values) from the main sand bank. The area seems to be mainly sandy, with however patches of high backscatter values between large sand waves. Only two parallel trawl marks, corresponding to a twin beam trawl of 8 meter wide, are visible in the south-western corner of the zone. Either the zone is avoided by trawlers, either trawl marks are faster masked by transported sand.

## Historic data: dredge (see annex 7)

The sample G3377 is typified by a large abundance of the gastropods *B. undatum* (45 specimens) and *Calliostoma zyziphynum* (13), flat oysters and species most typical of gravels, despite the fact that sampling efficiency an be expected to be very low when considering the transversal dunes evidenced on the acoustic seafloor map (the tow started on the sand bank and ended in the main gravel field). Species more typical of sandy seafloors were not collected by Gilson.

## 2m beam trawl samples (see annex 8)

### Sample 32 (analyzed)

A mixed species-poor assemblage was gathered together with a relatively large amount of large debris (shells of *Ostrea edulis*, *Spisula* sp, Pectinidae, sea urchins (*Echinocardium cordatum*) tests) and coal pebbles.

### Sample 33 (screened)

This sample was not analyzed in detail. Small cobbles were collected, mostly denuded apart from the very abundant sea anemone *Metridium senile*.

A large amount of the brittle-star *Ophiothrix fragilis* dominate the sample with an estimate of 4000 specimens collected.

### Sample 34 (screened)

This sample is dominated by species typical of sandy gravels, whereas few *O. fragilis* and *M. senile* were collected, showing affinities with sample #33.

4 green sea urchins (*Echinocardium cordatum*) were collected in this sample. A relatively large amount of shells of few species, including *Ostrea edulis*, were gathered.

**Sample 35 (screened)**

The sample composition is very similar to sample #34, with the noticeable presence of the green sea urchin *E. cordatum*, and low abundances of *O. fragilis* and *M. senile*.

The amount of shell debris, including many of *O. edulis*, is much larger. Some bivalve species typical for gravels are represented in this sample, which lays at the limit of the main gravel field.

On average, this zone seems to harbour a specific fauna of shingle not encountered in other zones so far. It bears similitude with sample #39 of the close zone "L" (one km to the NE) and share presence of *Ophiothrix* with the more distant zone "S", which is however of more gravelly nature. Pieces of coal, which are probably relicts of steamers of the early 20$^{th}$ century, are seemingly abundant in these three zones as compared to the rest of the survey area.

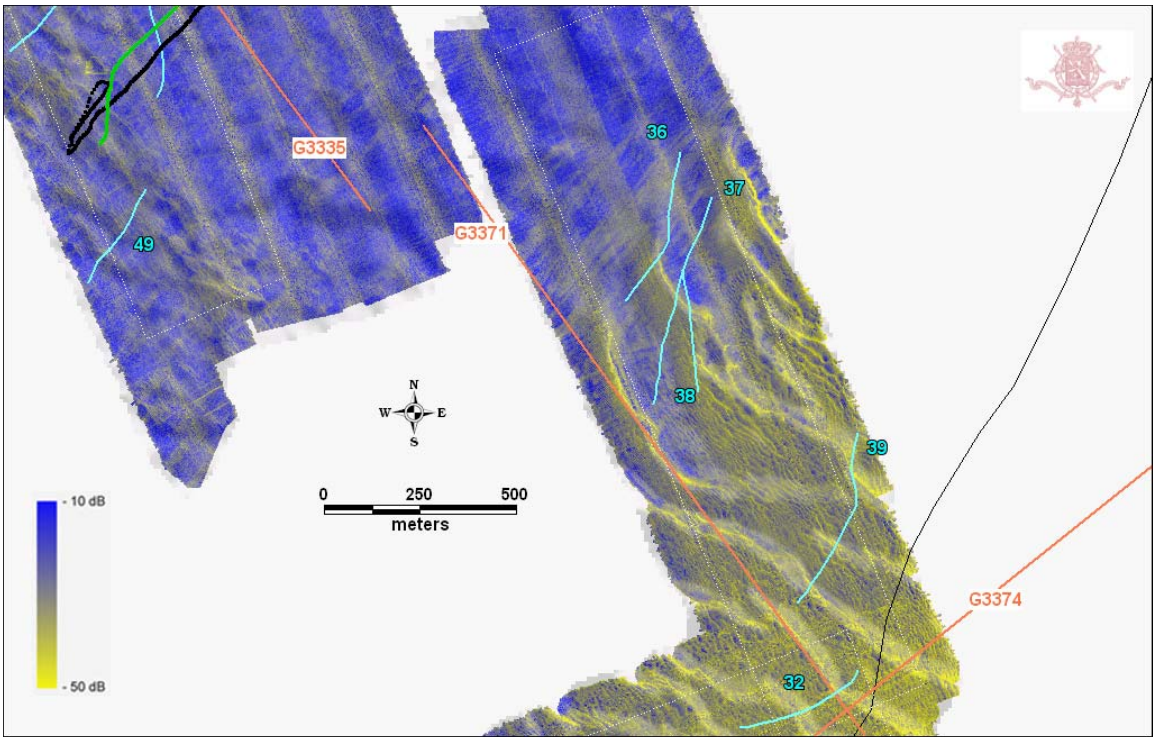
The unexpected occurrence of the endobenthic sea urchin *E. cordatum* in our tows suggests the species displays a particular abundance in this zone. Given the high sensitivity of this species to trawling and the fact that the area lays out of the main trawling lane, it is not unlikely that it constitutes a natural refuge for this species, which was however absent from Gilson's dredge tows.

**Comparison with the historical data**

Provided the tow of Gilson was accurately positioned, it seems that the area is much more sandy than expected. *Ophiothrix fragilis* was not collected at all by Gilson in this zone. Given the amounts of valves collected in 2005, it seems however much likely that a bed of *Ostrea edulis* used to exist in the central part of the zone, which tends to be confirmed by the abundance of oysters gathered by Gilson. No living specimen was collected in 2005, which indicates that the bed has ceased to exist as such, although this observation doesn't eliminate the possibility that spare specimens could occur in the area. Indeed, fresh shells of recently settled spat were observed in two other zones (#42, zone "S" and #52, zone "M").

# Zone L

## Area map – acoustic classification and tracks




Sampling data for zone L. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The acoustic map shows that this area bears large sand waves in the transition area from the sand bank to the main gravel field, with patches of high backscatter values in-between them. Abundance of trawl marks is high on the border of the gravel field, whereas they considerably rarefy in the dune area, suggesting some level of avoidance by trawlers. As in zone "J", deeper trawl marks are observed on the foot of the sandwaves, which are likely to indicate blockage of the gear by the dune, as we experienced with the 2-meter beam trawl. Given the speed at which commercial trawlers operate (6-8 knots, perhaps more), it is thus much likely that such dunes represent dangerous obstacles to the trawl, which could explain a trend to avoid them and a resulting lower amount of marks on the seafloor. This seems to be confirmed in zones F and G in particular, where one loose mark is observed closer to the sand bank whereas numerous marks are visible closer to the main gravel field.

## Historic data: dredge (see annex 7)

Sample G3371 is one of the richest dredge samples of Gilson much similar to other species-rich gravel samples. Flat oysters were noticeably not collected alive in this zone.

## 2m beam trawl samples (see annex 8)

### Sample 36 (not analyzed)


This sample is located at the border of the main gravel field and the acoustic map shows a somewhat higher proportion of sand at the surface of the sediment (lower backscatter values). The track passed over the northern end of a large sand wave.

This sample brought a rather small species content in which *Asterias rubens* and *Psammechinus miliaris* are dominant aside pagurids and the brittle star *Ophiura ophiura*. The cobbles display a reduced epibenthic cover, which tends to confirm the more sandy nature of the seafloor. Two large plaices (*P. platessa*) and two large soles (*Solea sp*) were collected.

### Sample 37 (not analyzed)


Despite its position close to sample #36 but more toward the sand bank, this sample surprisingly brought a large amount of richly colonized cobbles, together with a large mass of neritic coarse sand probably gathered on encounter with the transversal sand dunes. Its composition was similar to that of sample #38, which was analyzed in detail.

The occurrence of large colonies of deadman fingers, the richness of large sessile fauna on cobbles and the quasi absence of damaged tubes of *P. triqueter* strikingly contrast with the rest of the overall survey area.

**Sample 38 (analyzed)**

This sample is very similar to its close neighbour, sample #37, with a large amount of richly colonized cobbles and neritic sand. The sand is likely to originate from the sand wave crossed by both samples. Noticeably, sample #38 mostly occurred on this sand dune, whereas only it final portion was shared with #37 in a small gravel patch (dimensions: 210*80 m) between two large sand waves.

Large specimens of the sponge *Suberites ficus* and of the dead-man fingers *A. digitatum* were noticeably collected along with a species-rich epifauna typical of gravels (> 70 species collected). The mobile fauna is heavily dominated by *A. rubens* and *P. miliaris*, but also by the nudibranch *D. frondosus* which displays its highest abundance at this station, aside two other nudibranch species.

Obviously, this sample and sample #37 bear a fauna that is not encountered in the rest of the sampling survey, apart from sample #51 in zone M, which was collected in a similar configuration (gravel patch between large sand waves outside the main "trawling lane"). There is little doubt that a refuge area was here identified for species sensitive to bottom trawling.

**Sample 39 (analyzed)**

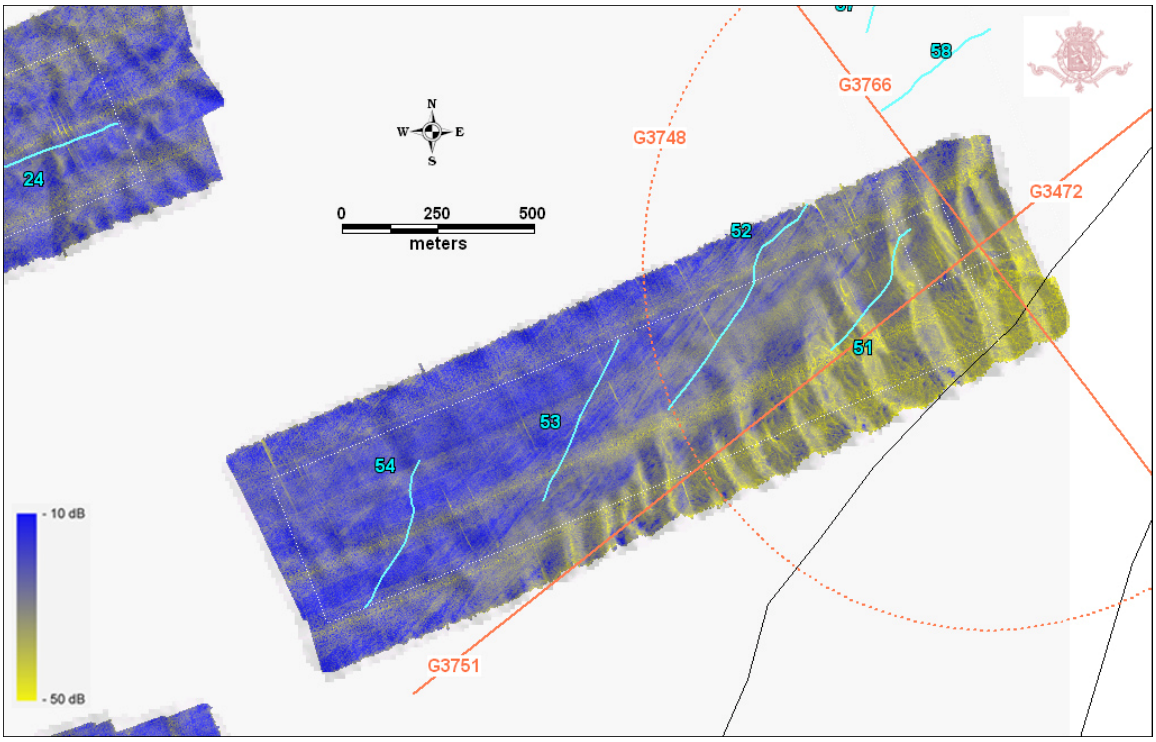
This sample brought mainly species typical of sands, although gravel species are represented as well. A quarter of the old shells collected are of *Ostrea edulis*, the rest being represented by *Cerastoderma* sp, Mactridae, *Mya truncata*, fragments of *Mytilus* sp and *Ensis* sp, one *Calliostoma zizyphinum*; none of these species were collected alive. As in zone K, many colonies of Celleporidae were gathered. Tests of *Echinocyamus pusillus* were observed as well.

## Comparison with the historical data

Old oyster shells collected at sample #39 indicate that the old oyster bed identified in zone K probably extended up to this zone and was located alongside the sand bank. As in other samples, the density of the snail *B. undatum* seems to have decreased. However, many dominant species of Gilson were collected back in samples 37 and 38. A large increase is again observed for *A. rubens* (absent from Gilson's sample) and *P. miliaris* (Gilson: 1 specimen).

# Zone M

## Area map – acoustic classification and tracks




Sampling data for zone M. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

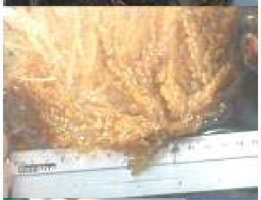
The seafloor morphology observed at this zone much resembles that of zone "L", with a succession of large sand waves marking the transition between the sand bank and the main gravel field. The image reveals an even higher abundance of trawl marks on the seafloor located between the sand waves and the main gravel field, where they are much less visible.

## Historic data: dredge (see annex 7)

Few *A. rubens* and *P. miliaris* were here collected in this area along with a series of typical species of gravels, and *B. undatum* is abundantly represented. Alive flat oysters were collected as well in Gilson's dredge tow.

## 2m beam trawl samples (see annex 8)

### Sample 51 (analyzed)


This sample is the second richest sample of the survey and is very similar to samples 37 and 38. A very large colony of the bryozoan *Alcyonidium diaphanum* was noticeably gathered, together with large colonies of the dead-man finger *A. digitatum* and the hydrozoans *Nemertesia antennina* and *N. ramosa*. Tubes of *Pomatoceros* are intact, whereas the barnacle *B. crenatus* was observed alive, in contrast with many samples gathered in the survey area (noticeably zone "C" where many damaged barnacles and *Pomatoceros* tubes were encountered).

Strikingly, as sample #38, this tow mainly occurred across large sand dunes, and such a rich epibenthic cover would not have been a priori expected from examination of the acoustic map of the seafloor. Based on the latter, only one gravel patch of approximately 30*50 meter can be observed throughout the track. The collected gravel fauna thus mainly originates from this small patch, similarly to samples 37 and 38 in zone "L". This is thus the second observation of a "refuge area" for large branching epifauna. The acoustic map of the seafloor provides indications on where other similar refuge areas can be expected to occur.

### Sample 52 (screened)



This sample was screened, and an increased identification effort has been paid to Hydroidomedusae. It carried a mixed epifauna dominated by species typical of gravels very similar to that observed in other samples located in the transitional area between the sand banks and the main gravel field. The large colonial species were however not encountered as in sample #51. Tubes of the tubeworm Pomatoceros appeared to be mostly intact, whether large damaged starfishes were collected (proportions yet undetermined).

A very recent shell of a juvenile flat oyster (1 year-old) was collected. Three specimens of the sponge *S. ficus* were gathered

### Sample 53 (not analyzed)


This sample was not analyzed. *A. rubens* and *P. miliaris* clearly dominate the mobile fauna. A large plaice was collected.

**Sample 54 (analyzed)**


This sample was much similar to other samples collected in the main gravel field, with a typical sessile and mobile species assemblage and a large plaice.

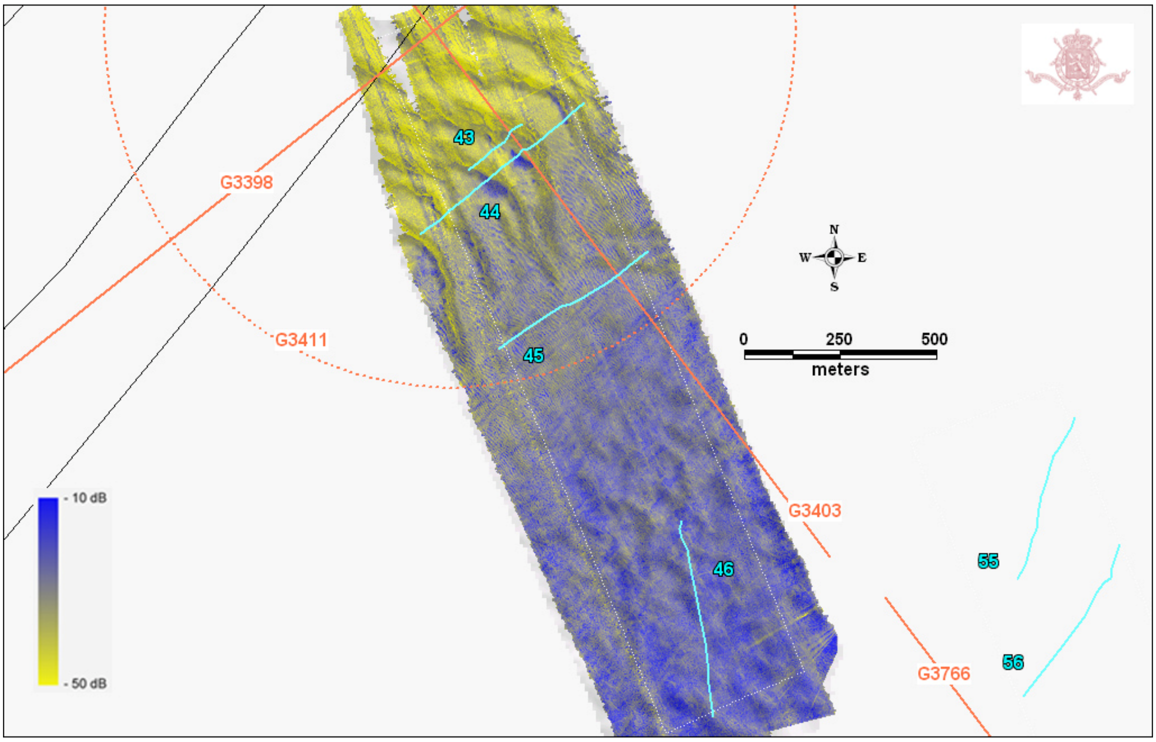
The data gathered so far for this area evidence that sample #51 is exceptional for what regards species richness and large branching species, even compared to close samples from the main gravel field in the same area. However, we note that the level of damage to *Pomatoceros* tubes seems lower in this zone than e.g. in zone C, suggesting a somewhat lower pressure by beam trawlers. Further researches are needed to compare "refuges" with the main gravel field both for seafloor morphology and size spectra of sensitive branching species.

**Comparison with the historical data**

Starfishes and brittle-star (*Ophiura*) were apparently abundant in this area in 1905. However, we observe reverse trens in some species, such as *Tubularia* spp and *Dendronotus frondosus*(absent from historic collection), or *Calliostoma* (absent from recent samples). Thus, the species richness has remained high but the relative species dominance pattern is changed.

# Zone N

## Area map – acoustic classification and tracks




Sampling data for zone N. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The area is located to the north of zones F and G and displays a similar morphology. As in the former zones, trawl marks are well visible and they are probably in continuity. Noticeably, sample #44 crossed two gravel patches between large sand waves, whereas the short duration of sample #43 is due to encounters with the large transverse dunes which led to high rise in cable tension during the tow.

## Historic data: dredge (see annex 7)

About two-third of Gilson's tow G3403 occurred in the cobble field, whereas the circular tow G3411 occurred mainly upon the sand bank. Sample G3403 bears a typical species-rich gravel epifauna, typified by numerical dominance by the nudibranch *A. pilosa* (along with three other nudibranch species). The gastropod *L. vincta* is abundant, which makes a difference with other samples of the area. On the contrary, the circular sample G3411 bears a low species richness with a mix of gravel and sand species, which matches the fact that this tow mainly occurred on the sand bank. Noticeably, 8 colonies or fragments of colonies of *Flustra foliacea* were collected. No flat oyster was collected in this area.

## 2m beam trawl samples (see annex 8)

### Sample 43 (analyzed)

This sample was extremely poor, which can be explained by its small length and the fact that it occurred mainly on sand dunes, which is reflected by its typical species content.

### Sample 44 (not analyzed)


Noticeably, the tow crossed two gravel patches but didn't bring a similar fauna as samples #37, #38 and #51. On the contrary, most cobbles were denuded. The total lengths of the encountered patches are respectively 20 and 22 meter long only along the tow and located to the north of each patch.

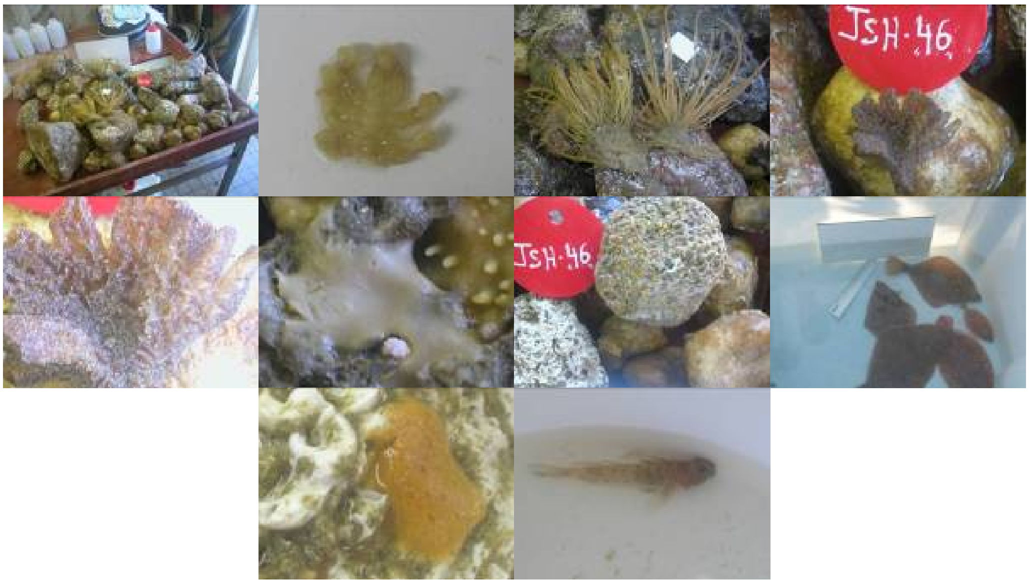
### Sample 45 (not analyzed)



This sample visibly occurred on a "gravelly sand" area, which is in agreement with the acoustic map of the seafloor (transition area).

A species-poor mixed fauna was collected which matches the close neighbour samples #21, #22 and #23 of zone G. This observation confirms the more sandy nature of the seafloor of the transition area along the eastern flank of the Westhinder sand bank.

**Sample 46 (not analyzed)**



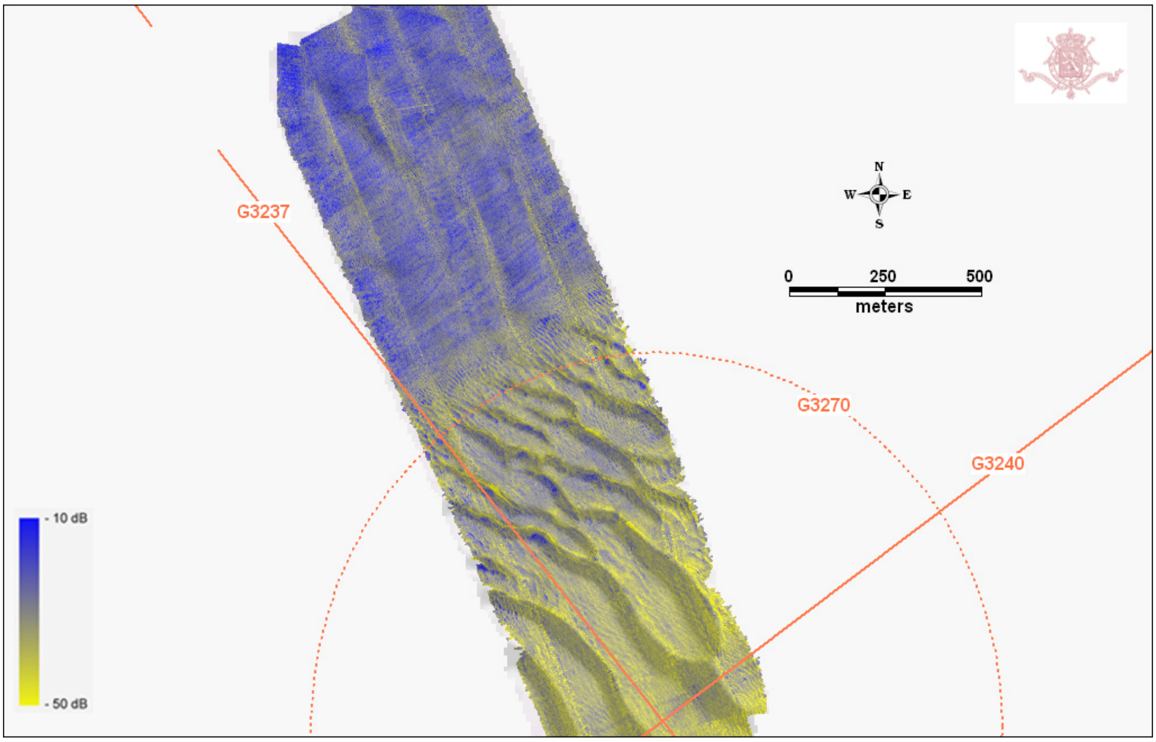

This rich sample brought a species-rich epifauna typical of gravels, with an abundant cover by sessile species. Many cobbles are entirely covered with intact tubes of the tubeworm P. triqueter, and the sample hosts a higher diversity in sponge species (>= 5 species, including a small unidentified branching species), some of which were observed elsewhere but could not be determined. Large flatfishes were again collected as well.

## Comparison with the historical data

The hornwrack *F. foliacea* was abundant whereas it was not collected back, and so does the bryozoan eater nudibranch A. pilosa. T. indivisa was present in the historical sample, whereas changes similar to other zones are observed, with historical absence of *A. rubens*, *P. miliaris* and *Ophiura* p, abundant in the 2m beamtrawl samples.

# Zone O

## Area map – acoustic classification and tracks




Sampling data for zone O. Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

The northern half of the zone covers the main gravel field, whereas its southern portion is typified by abundance of sand dunes, with significant amount of patches with high backscatter values in between. A large amount of trawl marks is visible in the gravel field but none appears in the more sandy area.

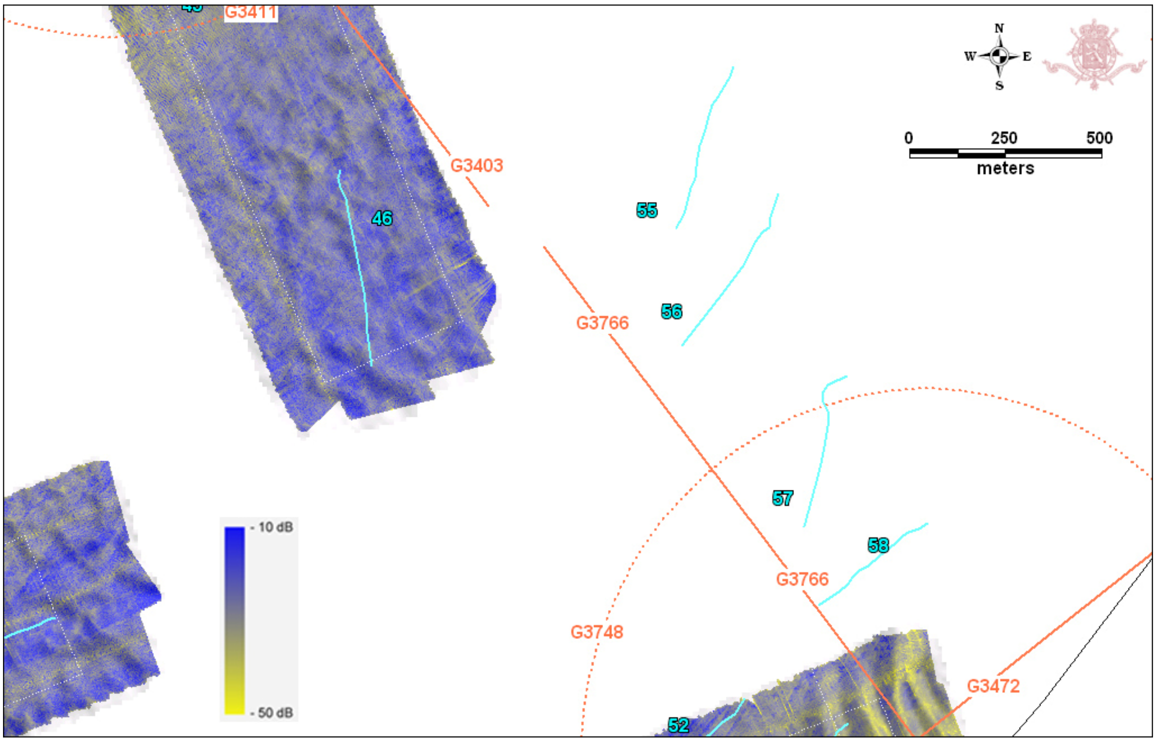
Unfortunately, no benthos sample could be gathered in this zone.

## Historic data: dredge (see annex 7)

The species content of both tows of interest (G3237 and G3270) is interesting since it indicates a typical species-rich gravel epifauna, especially in the circular dredge sample G3237 which seemingly occurred mainly in a sandy area according to the acoustic seafloor map. Although it is difficult to draw conclusions at this stage, this observation is fully consistent with those made at the neighbour zones A and B, thus suggesting an increase in the sand content of this area in the long run.

# Zone Q

## Area map – acoustic classification and tracks




Sampling data for zone Q. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum).

Unfortunately, no coverage could be obtained with the multibeam echosounder for this area. However, examination of the neighbour zones M and N show that the zone is essentially located in the gravel field, with benthos samples #57 and #58 in the "transitional" (more sandy) area and samples #55 and #56 in the main gravel field.

## Historic data: dredge (see annex 7)

The sample G3766 is numerically dominated by the britle star *O. albida* and other mobile species, with abundance of the swimming crab *L. holsatus*. Many rare species typical of gravels were collected. On the contrary, sample G3748, seemingly largely occurring on the sand bank, collected a typical gravel species-rich epifauna. Flat oysters were collected in both samples.

## 2m beam trawl samples (see annex 8)

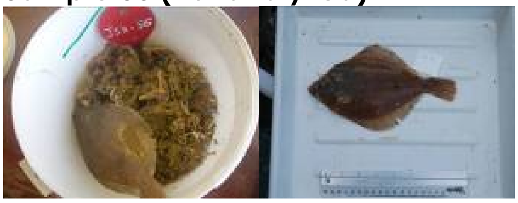
None of the sample could be properly analyzed in the timeframe of the project.

**Sample 55 (not analyzed)**

A limited amount of fauna was collected aside cobbles, which were covered with intacts as well as damaged *Pomatoceros* tubes and typical species encountered in other gravel samples (e.g. *Tubularia* spp, *C. intestinalis*, *A. rubens*).

Two large flatfishes were collected (*Microstomus kitt* and *Solea solea*). This sample thus seems very similar to others, but its species content is small.

**Sample 56 (not analyzed)**



The large abundance of hydroids (*Tubularia* spp mainly) along with typical mobile species (*A. rubens*, Paguridae) indicate the gravel nature of the seafloor, although little amount of cobbles were gathered.

**Sample 57 (not analyzed)**

This sample seems very similar to sample #55 and bears a typical gravel epifauna. An interesting observation was made with co-occurrence of a mussel (*M. edulis*) and a large specimen of the polychaete *Lepidonotus squamata* in a hole of a cobble. As in many other samples, the soft coral *A. digitatum* is represented by tiny colonies.

A ling (*Molva molva*) was surprisingly collected; this species is not expected to occur on the BCS due to its depth range, but juveniles are sometimes encountered in the southern bight (Poll, 1947) and alongshore in Belgian waters according to Gilson (1921).

### Sample 58 (not analyzed)


The cobbles were here more modestly covered with *Pomatoceros* tubes, matching the suggestion of increased sand content inferred from the acoustic map of the seafloor.

Flatfishes (plaice, sole, lemon-sole) were collected as well as a mussel *M. edulis* alongside the now typical species assemblage dominated by *Tubularia* spp.

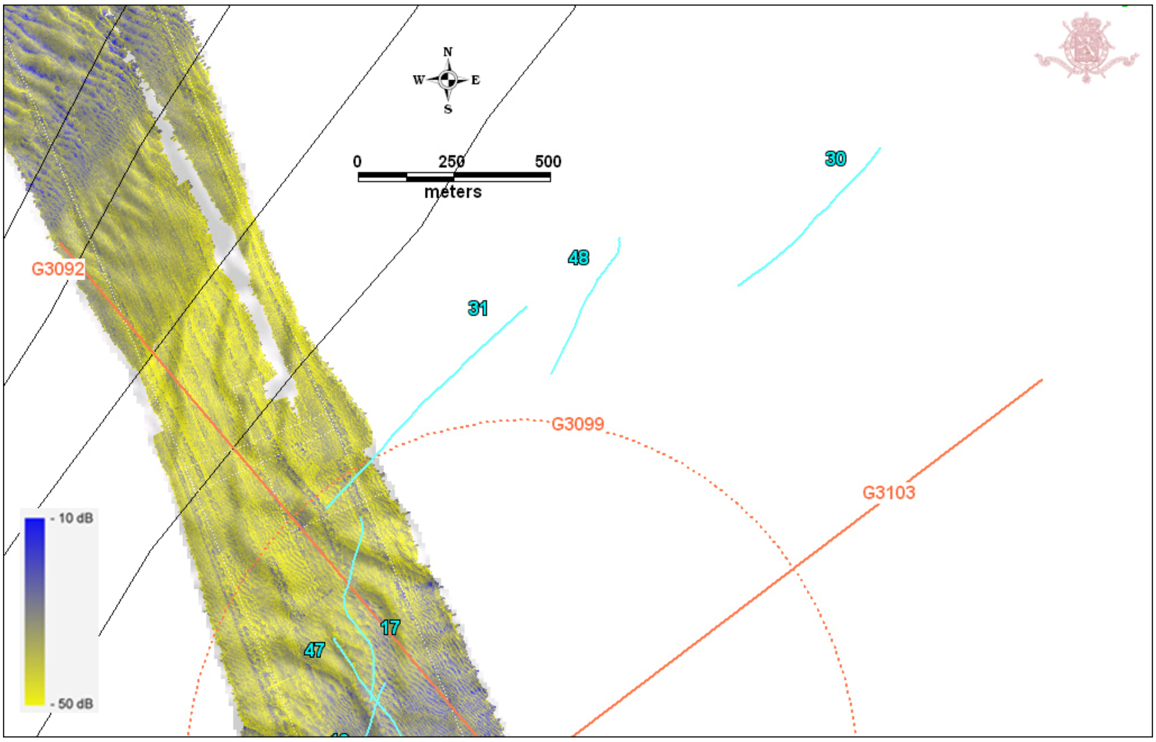
Despite lack of analysis, a common trait between the four samples is the higher abundance of large flatfishes as compared to other zones and increased representation of the common mussel *M. edulis*.

### Comparison with the historical data

*A. rubens* and *Ophiura* spp. used to be abundant in the area in the historical samples. Shifts in relative abundances of other species are obervsed as in other zones (e.g. historical absence of *Tubularia* spp).

# Zone R

## Area map – acoustic classification and tracks




Sampling data for zone R. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling code. Orange dotted circle: theoretic position of historic dredge tow (circular tracks), with sampling code. Background: acoustic classification of seafloor based on signal backscatter strength, from low (yellow: soft sediment) to high (blue: hard substratum) – no coverage obtained on zone R.

No coverage could be obtained for this zone. Coverage on zones I, J and F indicate that samples #31 and #48 were gathered on sandy area and crossed large sand waves, whereas sample #30 is located more closer to he main gravel field and could be similar to the non-analyzed samples #17 and #19 and the analyzed sample #20.

## Historic data: dredge (see annex 7)

This area was drawn on position of dredge samples that were erroneous, and consequently no dredge sample accurately matches it for small-scale long-term comparisons purposes. G3103 brought a typical gravel species content which matches its position more toward the gravel field. G3099 is one of the richest samples and is typified by  a gravel species-content; G3092 is much less rich but also brought typical species of gravels. Thus, all three samples brought faunas more typical of the main gravel field and are difficult to compare to the new benthos samples.

## 2m beam trawl samples (see annex 8)

The species content of the samples is in agreement with expectations based on the acoustic map of the seafloor.

### Sample 30 (screened)

This sample much resembles other sandy gravel samples dominated by gravel epifauna (e.g. *Tubularia* spp – associated community and few swimming crabs), with however an apparent smaller content in mobile species

It is typified by more abundant colonies of *Vesicularia spinosa*, some remarkably large bryozoan crusts (*C. reticulum*), and capture of a seahorse *Hippocampus hippocampus*, a species rarely mentioned in Belgian waters (Poll, 1947).

The seahorse depends on branching organisms, generally algae. Given the relatively low amounts of documented sampling efforts in his area, it can be questioned whether the local branching fauna enables a local population to thrive in the abence of algae. Gilson (1921) noted that the species was sometimes caught by shrimp trawlers "on polyp-rich grounds" off Belgian waters, what tends to support this assumption. This species is listed in the IUCN red list of endangered species but considered "data deficient" to implement accurate management measures.

### Sample 31 (not analyzed)

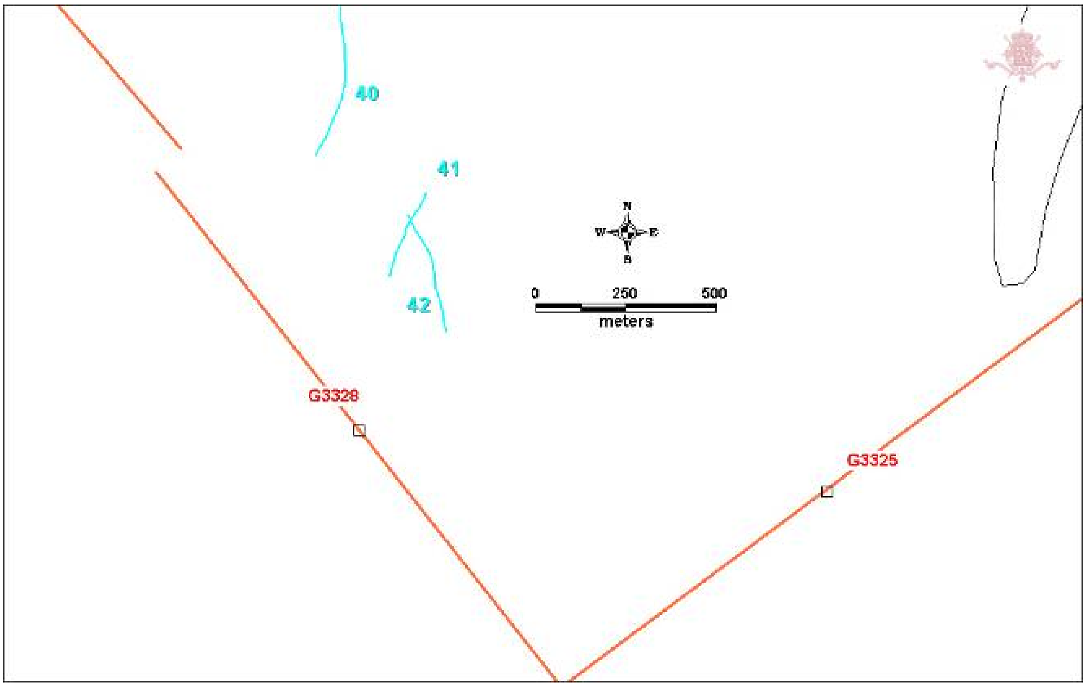
This very small sample reveals the typical species-poor fauna of sand banks (*O. ophiura*, *E. vipera*, juvenile flatfishes, *A. rubens*), with some medium-sized flatfishes (plaice and sole).

### Sample 48 (analyzed)

This small sample displayed a mixed gravel-sand epifauna. A fragment of *Flustra foliacea* was noticeably collected.

# Zone S

## Area map – acoustic classification and tracks




Sampling data for zone S. Pale solid blue lines: beam trawl tracks (ODAS/Belgica data file). Orange solid lines: theoretic position of the historic dredge tows (linear tracks) with sampling codes.

No coverage could be obtained with the multibeam echosounder in this zone, nor in its direct surroundings. Seafloor composition is difficult to infer from the general map of the surveyed area, but can be expected to be sandy gravels. In particular, at the position of the new samples, a similar seafloor as in the south-Western portion of zone K can be expected. These samples are somewhat shifted from the position of the historic sample G3328, which was the reference tow for this zone, but it is unlikely that the seafloor and hydrodynamics would change much at such a small distance. We thus consider that a long-term comparison can be made.

## Historic data: dredge (see annex 7)

A typical gravel ground epifauna was collected in the species-rich tow G3328, dominated by a large abundance of *B. undatum*. Note the occurrence of the sun-starfish *Crossaster popposus*, which also occurred in three other samples (zones S, L, A-C and M-Q; thus along the eastern border of our survey area) and was not collected at all in 2005.

## 2m beam trawl samples (see annex 8)

This zone was dominated by huge amounts of the brittle-star *Ophiothrix fragilis*, absent from the historic data-set.

### Sample 40 (screened)

Large cobbles were collected in this sample, with a moderate cover by Pomatoceros tubes and the sponge *C. celata*, as observed elsewhere; however, the mobile fauna is heavily dominated by the brittle-star *O. fragilis* that were not enumerated. Provided a volume of one liter contains about a hundred specimens, the collected volume (approximately one cubic meter) would contain $10^6$ specimens. Given a sampled surface of 856 square meters, an average density of 1168 specimens / square-meter is obtained.

Next to this species, a fauna typical of gravels is encountered but the abundance of mobile species is much reduced. One specimen of the edible crab *Cancer pagurus* was collected, with a carapax breadth of about 12 cm, along with a large plaice, a large lemon sole and a large sole, three species commonly encountered in other samples in the survey area. A rectangular cobble of coal, probably ballast material from the period of steamers, was also collected. Noticeably, one small specimen of the slipper-limpet Crepidula fornicata was collected.

### Sample 41 (not analyzed)

Slightly less *Ophiothrix fragilis* were collected along this tow, which is shorter than the prevous. Densities on the seafloor must thus be relatively similar, perhaps slightly higher in this sample. Few poorly colonized cobbles were collected, and other mobile species seem even more reduced than in sample #40 (very small content).

**Sample 42 (not analyzed)**

In this sample, a doubling of the quantity of brittle-star *O. fragilis* is noted, whereas its length is shorter than sample #40. We can thus assume a similar doubling of densities on the seafloor, thus amounting at 2000-2500 specimens / square meter. Many cobbles are poorly colonized, some of them displaying the typical *Tubularia*-associated epifauna; the mobile fauna is reduced as well.

We note a second occurrence (first: sample #52, zone "M") of a very recent valve of spat of *Ostrea edulis*, which indicates that larvae still settle down in the surveyed area.

Despite lack of appropriate sample analysis, the data gathered so far indicate that these stations overcrowded with *O. fragilis* display a much reduced abundance of mobile fauna of the gravel.

**Comparison with the historical data**

The main differences resides in the absence of *O. fragilis* in the historic samples and the reduced amounts of specimens of typical species of gravels, and this observation is discussed in the main text. The area seems to have been much richer during Gilson's survey. The observation of the slipper-limpet, an introduced species causing much damage elsewhere, is the only one in our survey. The species, although present, thus visibly doesn't thrive so far in the sandy gravels of the Westhinder, an observation in agreement with low densities gathered in French gravels (Alizier, 2005). This species seems thus unlikely to occupy the ecological niche of the European flat oyster *O. edulis*, as observed in many (coastal) locations elsewhere, e.g. in France and UK.

# Annex 7. Species content of Gilson's samples in the survey area (south-Eastern flank of the Westhinder bank; 1905)

Values represent the numbers of specimens in the collections. For colonial organisms, values represent the number of different samples archived in the repositories (sum of occurrences). Frequencies of occurrence are calculated on the basis of presence/absence data. Gilson's station codes are provided together with the zones to which they correspond. Species are ranked by decreasing frequency of occurrence in the area. Determination levels were adapted where necessary to enable preliminary long-term comparisons. Polychaeta, Tunicata, bulk of Bivalvia and Pisces are excluded.

| Taxon | Total specimen count | Frequency of occurrence | G3194 /A | G3220 /A-C | G3574 /B | G3567 /B | G3186 /C | G3335 /F | G3345 /F-G | G3338 /G | G3509 /H | G3499 /H-H2 | G3505 /H2 | G3092 /J (R) | G3097 /J | G3099 /J (R) | G3107 /J-S | G3377 /K | G3371 /L | G3751 /M | G3403 /N | G3411 /N | G3328 /S | G3748 /M-Q | G3766 /Q | G3103 / (R) | G3237 /O | G3270 /O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pisidia longicornis** | **238** | **0.85** | 52 | 5 | 5 | 4 | 13 | 50 | 5 | 13 | 5 | | 7 | | | 5 | 9 | 5 | 5 | 5 | 5 | | 5 | 5 | 5 | 3 | 11 | 16 |
| **Flustra foliacea** | **58** | **0.77** | | 1 | 1 | 3 | | | 3 | 6 | 3 | 1 | 4 | 3 | 4 | 6 | 1 | 1 | 3 | | 3 | 5 | 3 | | 2 | 4 | | 1 |
| **Galathea sp (intermedia)** | **102** | **0.77** | 42 | 3 | 2 | 4 | 3 | 6 | | 1 | 2 | | 1 | | | 14 | 1 | 1 | 1 | 1 | 3 | | 4 | 3 | 6 | | 1 | 3 |
| **Bugula sp** | **39** | **0.69** | | 1 | | 3 | | | 1 | 4 | 2 | | 1 | 1 | 1 | 3 | 2 | 1 | 2 | | 4 | 1 | 2 | | | 1 | 3 | 6 |
| **Paguridae** | **73** | **0.65** | 3 | | 3 | | 9 | 8 | 1 | 1 | 7 | | 3 | | | 2 | 1 | 3 | 4 | 7 | 4 | | 6 | 8 | 3 | | | |
| **Ebalia sp (sum)** | **118** | **0.62** | 5 | 12 | | | 7 | 7 | | 3 | 5 | | 6 | | | 1 | 1 | 5 | 24 | 4 | 7 | | 6 | 13 | 12 | | | |
| **Ebalia tuberosa** | **109** | **0.62** | 5 | 11 | | | 7 | 5 | | 1 | 5 | | 6 | | | 1 | 1 | 5 | 24 | 4 | 7 | | 5 | 10 | 12 | | | |
| **Portunidae** | **82** | **0.62** | 4 | | 11 | | 5 | 4 | | 1 | 25 | | 2 | | | 1 | | | 3 | 6 | 3 | 1 | 1 | 2 | 12 | 1 | | |
| **Hydrallmania falcata** | **20** | **0.58** | | | | | 1 | 1 | 2 | 3 | 1 | 1 | 1 | | | 1 | 2 | 1 | 1 | | | 1 | 1 | | | 2 | | 1 |
| **Leptochiton asellus** | **44** | **0.58** | 1 | 3 | 1 | | | | | 1 | 4 | | 4 | | | | 3 | 7 | 5 | 3 | 1 | | 2 | 4 | 2 | | 3 | |
| **Buccinum undatum** | **138** | **0.54** | 5 | 16 | 1 | | 5 | 6 | | | 7 | | | | | 1 | 6 | 42 | 12 | 3 | | | 24 | 9 | 1 | | | |
| **Hyas sp** | **37** | **0.54** | 4 | 2 | | | | 2 | 3 | 3 | 2 | | 1 | | | 4 | | 2 | 2 | | | 2 | 2 | 2 | 6 | | | |
| **Pilumnus hirtellus** | **66** | **0.54** | 10 | 3 | | | 8 | 12 | | | 6 | | 2 | | | 1 | 1 | 10 | 2 | 4 | 3 | | | 2 | | | 2 | |
| **Calliostoma zizyphinum** | **104** | **0.50** | | | | | 9 | 31 | | 1 | 7 | | | | | 1 | 3 | 13 | 2 | 7 | | | 12 | 12 | 2 | | 4 | |
| **Clytia hemisphaerica** | **25** | **0.50** | | | 2 | 3 | 1 | | 3 | 4 | | | | 1 | | | | 2 | 1 | | 1 | 1 | | | 1 | 1 | | 4 |
| **Echinocyamus pusillus** | **224** | **0.50** | | | 5 | | 1 | 11 | | 31 | 14 | | 50 | | | | 1 | 45 | 13 | 5 | 4 | | | 39 | 5 | | | |
| **Electra pilosa** | **28** | **0.50** | | 1 | | 1 | | | 6 | 5 | | 2 | | 1 | | 5 | | | 1 | | 2 | | 1 | | | 1 | 1 | 1 |
| **Inachus dorsettensis** | **57** | **0.50** | 12 | 1 | | | 4 | 6 | | | 3 | | 2 | | | | 2 | 1 | 3 | 2 | 1 | | 6 | 14 | | | | |
| **Mytilus sp** | **29** | **0.50** | | 5 | | | 1 | 2 | | | 2 | | 2 | | | 1 | 2 | 1 | | 4 | | | | 3 | 2 | 3 | 1 | |
| **Nemertesia sp** | **32** | **0.50** | | | | 2 | | 2 | 3 | 7 | 2 | 3 | | | | 2 | 2 | | 2 | | 3 | | 2 | | | 1 | 1 | |
| **Alcyonidium sp** | **30** | **0.46** | | 1 | | 1 | | | 4 | 5 | | 3 | 1 | | | 1 | | 1 | 3 | | 2 | | | | | 2 | | 6 |
| **Scrupocellaria scruposa** | **16** | **0.46** | | | | 1 | | | 1 | 1 | 1 | | | 1 | | 4 | | | 1 | | 1 | 1 | | | | 2 | 1 | 1 |
| **Turbicellepora avicularis** | **11** | **0.38** | | 1 | | | | | | | 1 | | 1 | 1 | | 1 | 2 | | 1 | 1 | 1 | | | | | | | 1 |

| Taxon | Total specimen count | Frequency of occurrence | G3194 /A | G3220 /A-C | G3574 /B | G3567 /B | G3186 /C | G3335 /F | G3345 /F-G | G3338 /G | G3509 /H | G3499 /H-H2 | G3505 /H2 | G3092 /J (R) | G3097 /J | G3099 /J (R) | G3107 /J-S | G3377 /K | G3371 /L | G3751 /M | G3403 /N | G3411 /N | G3328 /S | G3748 /M-Q | G3766 /Q | G3103 / (R) | G3237 /O | G3270 /O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Eurynome aspera** | **12** | **0.35** | | | | | 1 | 2 | | | 1 | | 1 | | | 1 | | 1 | | | 2 | | 2 | | 1 | | | |
| **Ophiura sp SUM** | **81** | **0.35** | | | 6 | | | 20 | | | 1 | | 6 | | | | | 3 | 15 | 5 | | | | 6 | 19 | | | |
| **Ostrea edulis** | **41** | **0.35** | | 3 | | | 3 | 13 | | | 7 | | | | | | | 7 | | 2 | | | | 4 | 1 | | 1 | |
| **Tritonia plebeia** | **41** | **0.35** | 10 | | 5 | | | | | | 5 | | | | | | | | 1 | 3 | 5 | | 8 | 1 | 3 | | | |
| **Acanthodoris pilosa** | **87** | **0.31** | | | | 1 | | | 1 | | 7 | 10 | | | | 2 | 1 | | | | 32 | | | | | | | 33 |
| **Ophiura albida** | **75** | **0.31** | | | 6 | | | 20 | | | 1 | | | | | | | 3 | 15 | 5 | | | | 6 | 19 | | | |
| **Tritonia hombergi** | **13** | **0.31** | 4 | | | | | | | | 2 | | 1 | | | | | 1 | 1 | | 1 | | | 1 | 2 | | | |
| **Vesicularia spinosa** | **17** | **0.31** | | | | | | 1 | 4 | 1 | | | | | | 1 | | 2 | 3 | | 2 | | | | | | | 3 |
| **Abietinaria abietina** | **7** | **0.27** | | | | | | | 1 | 1 | | | | | 1 | 1 | | | | | | 1 | 1 | | | 1 | | |
| **Calycella syringa** | **8** | **0.27** | | | | | | 1 | 1 | 2 | | 1 | | | | 1 | | | 1 | | 1 | | | | | | | |
| **Cerianthus lloydi** | **18** | **0.27** | 4 | 4 | 2 | | 4 | 1 | | | 1 | | | | | | | | 2 | | | | | | | | | |
| **Gibbula tumida** | **26** | **0.27** | | 1 | | | 6 | 12 | | | | | | | | | | 2 | 1 | 3 | | | | | | | 1 | |
| **Halecium halecium** | **10** | **0.27** | | | | | | | | 3 | | | | | | 1 | | | 1 | | 2 | | 1 | | | 1 | | 1 |
| **Macropodia sp** | **10** | **0.27** | 1 | 1 | | | | | 3 | | 1 | | | | | 1 | | | | | 2 | | | | | | | 1 |
| **Obelia geniculata** | **10** | **0.27** | | | | | | | | 4 | 1 | | | 1 | 1 | | | | | | 1 | | 1 | | 1 | | | |
| **Psammechinus miliaris** | **22** | **0.27** | | 2 | | | 3 | | | | 6 | | 6 | | | | | | 1 | 3 | | | 1 | | | | | |
| **Pycnogonum littorale** | **8** | **0.27** | 1 | | | | | | | 1 | 1 | | 1 | | | | | | | | 1 | | | | 1 | | | 2 |
| **Sertularella rugosa** | **7** | **0.27** | | | 1 | 1 | | | | | 1 | | | | 1 | | | | | | | 1 | 1 | | | 1 | | |
| **Asterias rubens** | **144** | **0.23** | | | | | 13 | | | | 8 | 100 | 5 | | | | | | | 13 | | | | 5 | | | | |
| **Chalinidae** | **6** | **0.23** | 1 | | 1 | | | | | | 1 | | | | | | | 1 | 1 | | | | 1 | | | | | |
| **Doris verrucosa** | **11** | **0.23** | 1 | 1 | 3 | | 4 | 1 | | | 1 | | | | | | | | | | | | | | | | | |
| **Hagiosynodos latus** | **14** | **0.23** | | | | | 6 | 4 | | | | | | | | | | | 1 | 1 | | | 1 | | | | 1 | |
| **Scalpellum scalpellum** | **7** | **0.23** | | 1 | | | | | | 2 | | | 1 | | | 1 | | | | | | | | | | 1 | | 1 |
| **Sertularia cupressina** | **7** | **0.23** | | | | | | | 2 | 1 | | | | | | | | 1 | 1 | | | | 1 | | | 1 | | |
| **Alcyonium digitatum** | **334** | **0.19** | 39 | | | 6 | | | | | 249 | | 32 | | | 8 | | | | | | | | | | | | |
| **Bougainvillia muscus** | **5** | **0.19** | | 1 | | 1 | | | | | 1 | | | | | | | | | | | | | | | | 1 | 1 |
| **Diphasia rosacea** | **6** | **0.19** | | | | | | 1 | 1 | 1 | | | | | | | | | 1 | | | | | | | | | 2 |
| **Ebalia tumefacta** | **9** | **0.19** | | 1 | | | | 2 | | 2 | | | | | | | | | | | | | 1 | 3 | | | | |
| **Membranipora tenuis** | **6** | **0.19** | | | 1 | | | | | | | 2 | | 1 | | | 1 | | | | | | | | | 1 | | |
| **Reptadeonella violacea** | **7** | **0.19** | | | | | 1 | 3 | | | | 1 | | | | | 1 | | | 1 | | | | | | | | |
| **Tectura virginea** | **37** | **0.19** | | | | | | | | 4 | 18 | | | | | 4 | | | 8 | | | | | | | 3 | | |
| **Tubularia indivisa** | **7** | **0.19** | | | | | | | | 1 | 1 | | 2 | | | | | | | | 1 | | 2 | | | | | |
| **Tubularia sp** | **5** | **0.19** | | | | 1 | | | | | | | 1 | | | 1 | | | | | | | | | | 1 | | 1 |
| **Anapagurus hyndmanni** | **10** | **0.15** | | | | | | 4 | | | 1 | | | | | | | | | | 1 | | 4 | | | | | |
| **Ciocalypta penicillus** | **4** | **0.15** | | | | | | | | 1 | | | | | | 1 | | | | | | | 1 | | | 1 | | |
| **Crossaster papposus** | **4** | **0.15** | | 1 | | | | | | | | | | | | | | | 1 | | | | 1 | 1 | | | | |
| **Disporella hispida** | **8** | **0.15** | | | | | 1 | 5 | | | | | | | | | | | | 1 | | | 1 | | | | | |
| **Doto fragilis** | **18** | **0.15** | | | | | | 2 | | 5 | | | | | | | | | | | 1 | | 10 | | | | | |
| **Dysidea fragilis** | **4** | **0.15** | | | | | | 1 | | | | | 1 | | | | | 1 | | | | | | | | | 1 | |

| Taxon | Total specimen count | Frequency of occurrence | G3194 /A | G3220 /A-C | G3574 /B | G3567 /B | G3186 /C | G3335 /F | G3345 /F-G | G3338 /G | G3509 /H | G3499 /H-H2 | G3505 /H2 | G3092 /J (R) | G3097 /J | G3099 /J (R) | G3107 /J-S | G3377 /K | G3371 /L | G3751 /M | G3403 /N | G3411 /N | G3328 /S | G3748 /M-Q | G3766 /Q | G3103 / (R) | G3237 /O | G3270 /O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Escharella immersa | 6 | 0.15 | | | | | 3 | 1 | | | | | | | | 1 | | | | 1 | | | | | | | | |
| Haliclona oculata | 4 | 0.15 | | | | 1 | | | | | | | 1 | | | | | 1 | | | | | | | | | 1 | |
| Plumularia setacea | 6 | 0.15 | | | | | | | | 2 | 1 | | | | | | | | | | 2 | 1 | | | | | | |
| Schizomavella sp | 13 | 0.15 | 2 | | | | 7 | 3 | | | | | | | | | 1 | | | | | | | | | | | |
| Sertularia argentea | 4 | 0.15 | | | | | | | | 1 | 1 | | | | | 1 | 1 | | | | | | | | | | | |
| Anthura gracilis | 7 | 0.12 | | | | | | | | | | | | | | | | | | 4 | | | | 2 | 1 | | | |
| Aspidelectra melolontha | 5 | 0.12 | | | 3 | | | | | | | 1 | | 1 | | | | | | | | | | | | | | |
| Cellepora pumicosa | 3 | 0.12 | | | | | | | | | 1 | | | | | | | | 1 | | | | | | | | 1 | |
| Celleporidae | 3 | 0.12 | | 1 | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | |
| Conopeum reticulum | 4 | 0.12 | 2 | | | | | | | | | | | 1 | | 1 | | | | | | | | | | | | |
| Diodora graeca | 3 | 0.12 | 1 | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | | |
| Doto coronata | 17 | 0.12 | | | | | | | 4 | | 12 | | | | | | | | | | | | 1 | | | | | |
| Eucratea loricata | 5 | 0.12 | | | | | | | 2 | | | | | | | | | 1 | | | 2 | | | | | | | |
| Haliclona simulans | 3 | 0.12 | | | | | | | | | | | 1 | | | | | 1 | | | | | 1 | | | | | |
| Jorunna tomentosa | 3 | 0.12 | | | | | | | | | | | | | | | | | | 1 | | | | 1 | 1 | | | |
| Kirchenpaueria pinnata | 4 | 0.12 | | | | | | | | | 2 | | | | | | | 1 | | | | | 1 | | | | | |
| Melanella alba | 4 | 0.12 | | | | | | 2 | | | | | 1 | | | | | | | | | | | | 1 | | | |
| Microporella ciliata | 10 | 0.12 | | | | | 3 | 5 | | | | | | | | | 2 | | | | | | | | | | | |
| Obelia dichotoma | 5 | 0.12 | | | | | | 1 | | 1 | | | | | | | | | | | | | | | | | | 3 |
| Penetrantia concharum | 5 | 0.12 | | | | | | 3 | | | | | | | | | 1 | | | | | | 1 | | | | | |
| Pinnotheres pisum | 5 | 0.12 | | | | | | 2 | | | 2 | | | | | | | 1 | | | | | | | | | | |
| Plagioecia patina | 3 | 0.12 | 1 | | | | | 1 | | | | | | | | | | | | 1 | | | | | | | | |
| Porella concinna | 6 | 0.12 | | | | | 4 | | | | | | | | | | 1 | | 1 | | | | | | | | | |
| Verruca stroemia | 3 | 0.12 | | | | | | 1 | | | 1 | | | | | | 1 | | | | | | | | | | | |
| Balanus sp | 3 | 0.08 | | | | | | | | | 2 | 1 | | | | | | | | | | | | | | | | |
| Callopora dumerilii | 2 | 0.08 | | | | | 1 | | | | | | | | | | 1 | | | | | | | | | | | |
| Chorizopora brongniartii | 3 | 0.08 | | | | | 2 | 1 | | | | | | | | | | | | | | | | | | | | |
| Cliona celata | 2 | 0.08 | | | | | | | | | | | 1 | | | | 1 | | | | | | | | | | | |
| Doto pinnatifida | 8 | 0.08 | | | | | | | | | | | | | | | | | 2 | | | | | | | | 6 | |
| Emarginula rosea | 2 | 0.08 | | 1 | | | | | | | | | | | | | | | | | 1 | | | | | | | |
| Escharella variolosa | 2 | 0.08 | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| Eudendrium capillare | 2 | 0.08 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 |
| Eudendrium ramosum | 2 | 0.08 | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 | |
| Filellum serpens | 3 | 0.08 | | | | | | | | 2 | | | 1 | | | | | | | | | | | | | | | |
| Garveia nutans | 3 | 0.08 | | | | | | | | | | | | | | 2 | | 1 | | | | | | | | | | |
| Hippothoa divaricata | 7 | 0.08 | | | | | 4 | 3 | | | | | | | | | | | | | | | | | | | | |
| Janira maculosa | 10 | 0.08 | | | | | | | | | | | | | | | | | | | | 1 | 9 | | | | | |
| Lacuna vincta | 34 | 0.08 | | | | | | | 8 | | | | | | | | | | | | 26 | | | | | | | |
| Limacia clavigera | 2 | 0.08 | | | | | 1 | | | | | | | | | | | | | | | | 1 | | | | | |

| Taxon | Total specimen count | Frequency of occurrence | G3194 /A | G3220 /A-C | G3574 /B | G3567 /B | G3186 /C | G3335 /F | G3345 /F-G | G3338 /G | G3509 /H | G3499 /H-H2 | G3505 /H2 | G3092 / J (R) | G3097 /J | G3099 / J (R) | G3107 /J-S | G3377 /K | G3371 /L | G3751 /M | G3403 /N | G3411 /N | G3328 /S | G3748 /M-Q | G3766 /Q | G3103 / (R) | G3237 /O | G3270 /O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lomanotus marmoratus | 2 | 0.08 | | | | | | | | | | | | | | | | | | | 1 | | 1 | | | | | |
| Metridium senile | 3 | 0.08 | | | | | | | | | 1 | | | | | | | | 2 | | | | | | | | | |
| Nymphon rubrum | 5 | 0.08 | | | | | | | 3 | | | | | | | | | | | | 2 | | | | | | | |
| Raspailia ramosa | 2 | 0.08 | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | |
| Tubularia larynx | 2 | 0.08 | | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | |
| Tubulipora lobifera | 2 | 0.08 | | | | | | 1 | | | | | | | | | | | | 1 | | | | | | | | |
| Adamsia carciniopados | 1 | 0.04 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| Aeolidia papillosa | 1 | 0.04 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | |
| Alvania lactea | 3 | 0.04 | | | | | | | | | | | | | | | | | | | | | 3 | | | | | |
| Anoplodactylus petiolatus | 6 | 0.04 | | | | | | | 6 | | | | | | | | | | | | | | | | | | | |
| Bimeria vestita | 2 | 0.04 | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| Bougainvillia sp | 1 | 0.04 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Callopora sp | 1 | 0.04 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | |
| Campanularia verticillata | 2 | 0.04 | | | | | | | | 2 | | | | | | | | | | | | | | | | | | |
| Campanulina repens | 1 | 0.04 | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| Cereus pedunculatus | 6 | 0.04 | | | | | | | | | | | | | | | | | | | | | | 6 | | | | |
| Crisia denticulata | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Crisia eburnea | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Crisia sp | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Crisidia cornuta | 1 | 0.04 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Ectopleura sp | 1 | 0.04 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| Eudendrium album | 1 | 0.04 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | |
| Eurystrotos compacta | 2 | 0.04 | | | | | | 2 | | | | | | | | | | | | | | | | | | | | |
| Fenestrulina malusii | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Halecium beanii | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Halichondria panicea | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Haliclona indistincta | 1 | 0.04 | | | | | | | | | | | | | | | | 1 | | | | | | | | | | |
| Haliclona viscosa | 1 | 0.04 | | | | | | | | | | | | | | | | 1 | | | | | | | | | | |
| Hippoporidra lusitanica | 1 | 0.04 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Hippoporina pertusa | 1 | 0.04 | | | | | | | | | | | | 1 | | | | | | | | | | | | | | |
| Hippothoa sp | 1 | 0.04 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | |
| Immergentia sp | 1 | 0.04 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | |
| Lafoea sp | 1 | 0.04 | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| Leuckartiara octona | 1 | 0.04 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Leucosolenia variabilis | 1 | 0.04 | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| Necora puber | 1 | 0.04 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | |
| Obelia longissima | 1 | 0.04 | | | | | | | 1 | | | | | | | | | | | | | | | | | | | |
| Ophiura ophiura | 6 | 0.04 | | | | | | | | | | | 6 | | | | | | | | | | | | | | | |
| Penetrantia sp | 1 | 0.04 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | |

| Taxon | Total specimen count | Frequency of occurrence | G3194 /A | G3220 /A-C | G3574 /B | G3567 /B | G3186 /C | G3335 /F | G3345 /F-G | G3338 /G | G3509 /H | G3499 /H-H2 | G3505 /H2 | G3092 / J (R) | G3097 /J | G3099 /J (R) | G3107 /J-S | G3377 /K | G3371 /L | G3751 /M | G3403 /N | G3411 /N | G3328 /S | G3748 /M-Q | G3766 /Q | G3103 / (R) | G3237 /O | G3270 /O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polymastia boletiformis** | **1** | **0.04** | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| **Polymastia mammillaris** | **1** | **0.04** | | | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| **Raspailia virgultosa** | **1** | **0.04** | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| **Schizomavella linearis** | **1** | **0.04** | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| **Scrupocellaria sp** | **1** | **0.04** | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| **Scypha coronata** | **1** | **0.04** | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| **Sertularella polyzonias** | **1** | **0.04** | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| **Suberites ficus** | **1** | **0.04** | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| **Tethya aurantium** | **1** | **0.04** | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| **Thyone fusus** | **1** | **0.04** | | | | | | | | | | | | | | | | | | | 1 | | | | | | | |
| **Tubulipora sp** | **3** | **0.04** | | | | | | 3 | | | | | | | | | | | | | | | | | | | | |
| **Velutina velutina** | **1** | **0.04** | | | | | 1 | | | | | | | | | | | | | | | | | | | | | |

# Annex 8. Species content of samples collected in 2005, South-Eastern flank of the Westhinder bank (analyzed and screened samples, provisional data)

Amounts of specimens collected are provided for every sample. When specimens were not counted, occurrence of the species is marked by a "X". Species are ranked by decreasing frequency of occurrence (calculated on the basis of presence/absence). Taxonomy of certain taxa was adapted to enable preliminary long-term comparisons.

| Taxon | Total specimen count (incomplete) Total surveyed area= | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Asterias rubens** | 1537 | 1.00 | 150 | X | X | X | X | X | 4 | X | 217 | 20 | 20 | 15 | 20 | 150 | 80 | 200 | 333 | 22 | 107 | X | 7 | 47 | X | 20 | 27 | 60 | X | 7 | 9 | 20 | 2 |
| **Ophiura sp (SUM)** | 1053 | 0.97 | X | X | X | X | 16 | | 30 | 20 | 59 | 16 | 24 | 8 | 30 | 40 | 106 | 100 | 39 | 106 | 28 | 206 | 13 | 71 | X | 50 | 57 | X | X | 16 | 6 | 10 | 2 |
| **Paguridae** | 334 | 0.90 | 15 | X | | 2 | 6 | | | 4 | 6 | 21 | 10 | 20 | 15 | 10 | 40 | 50 | 14 | 16 | 11 | X | 1 | 10 | X | 30 | 16 | 10 | 1 | 2 | 9 | 11 | 4 |
| **Portunidae** | 200 | 0.84 | | x | x | x | | | 1 | 5 | 1 | 7 | 5 | 10 | 5 | 20 | 15 | 7 | 6 | 2 | | | x | 27 | x | 50 | 12 | 10 | x | 3 | 5 | 6 | 3 |
| **Ophiura albida** | 685 | 0.77 | 20 | | X | X | 15 | | 30 | | | 11 | 20 | 7 | | 40 | 100 | 100 | 8 | 91 | 2 | 108 | 12 | 60 | X | 30 | | 15 | X | 7 | 3 | 6 | |
| **Pomatoceros triqueter** | 0 | 0.77 | X | X | X | X | X | +++ | X | +++ | X | X | X | X | X | X | X | X | X | X | ++ | X | | X | | | | X | | | X | X | |
| **Tubularia indivisa** | 11 | 0.77 | X | X | X | X | X | X | X | X | X | | X | X | X | X | | X | X | X | +++ | X | | | | X | X | X | | 10 | 1 | X | |
| **Crangon sp (SUM)** | 174 | 0.71 | 10 | | | | | | 2 | 10 | 3 | | 10 | 10 | 5 | 5 | 7 | 6 | 2 | 20 | | | 3 | 10 | | 30 | 17 | 8 | | 3 | 5 | 6 | 2 |
| **Echiichtys vipera** | 161 | 0.71 | 1 | | | | 2 | | | | | 8 | 5 | 10 | 3 | | 15 | 25 | 2 | 8 | 18 | 5 | | 3 | X | 10 | 6 | X | X | 17 | 10 | 12 | 1 |
| **Ophiura ophiura** | 288 | 0.68 | | | X | | 1 | | | ++ | | 5 | 4 | 1 | | | 6 | | 31 | 15 | 20 | 98 | 1 | 11 | X | 20 | 57 | X | | 9 | 3 | 4 | 2 |
| **Tubularia larynx** | 0 | 0.65 | X | X | X | X | X | X | | X | X | | X | X | X | X | | | X | X | +++ | X | | | | | X | X | | X | | X | |
| **Psammechinus miliaris** | 708 | 0.61 | 30 | X | X | | 10 | X | 2 | ++ | 231 | 11 | 4 | 4 | 1 | | 2 | | 406 | 2 | 3 | X | | | X | | | | | | | 2 | |

| Taxon | Total specimen count (incomplete) | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electra pilosa | 0 | 0.58 | X | | X | X | X | X | | X | X | | X | X | X | | | | X | X | ++ | X | | X | | | X | | | X | | X | |
| Scophtalmidae : JUVENILES | 56 | 0.58 | 2 | | | | 1 | | | 1 | | | 1 | | 3 | | 10 | 2 | 1 | 1 | | 1 | | 3 | | 10 | 2 | 15 | X | 1 | | 1 | 1 |
| Gobiinae | 64 | 0.52 | 3 | 1 | X | X | 2 | X | 2 | 6 | 7 | 19 | | | | 1 | | 1 | 7 | 1 | | 13 | | | | 1 | | | | | | | |
| Lanice conchilega | 20 | 0.52 | X | | X | X | X | | X | X | 20 | | X | X | X | | X | | X | X | X | | | | | | | | | X | | X | |
| Actiniaria | 109 | 0.48 | X | X | X | ++ | X | 20 | | 15 | 5 | | | 4 | | | X | | 30 | 8 | X | 26 | | | | | | | | 1 | | | |
| Amphipoda | 32 | 0.45 | X | | | | X | 30 | | | X | | X | X | | | X | X | X | | 1 | | | 1 | | | | X | | X | | X | |
| Callionymus sp | 21 | 0.45 | 4 | 1 | X | | 1 | | | | | | | | | 4 | 1 | 4 | | | 1 | 2 | | | X | 1 | | 1 | X | 1 | | | |
| Ophiothrix fragilis | $10^6$ | 0.42 | 5 | | 15 | 2 | | | $10^6$ | 8 | 74 | | 1 | | | 4000 | 30 | 300 | 21 | | | | | | | 1 | | | | | | | 50 |
| Macropodia sp | 56 | 0.32 | 5 | | | | 10 | | | X | 3 | 2 | 3 | 1 | | | | 1 | 30 | | | | | | | | | 1 | | | | | |
| Alcyonium digitatum | 51 | 0.29 | X | X | | | | 1 | | 18 | 1 | | | | | | | | 20 | | 9 | 1 | | | | | | 1 | | | | | |
| Pleuronectes platessa | 13 | 0.29 | 2 | 1 | | | | | | | 1 | | | 1 | | 1 | | 2 | | | 2 | | | | | | | 2 | | 1 | | | |
| Ascidiacea | 6 | 0.26 | | | | | X | 1 | 1 | X | | | | 1 | | | | | X | | 2 | | | 1 | | | | | | | | | |
| Ciona intestinalis | 130 | 0.26 | X | 3 | X | 100 | X | 23 | | | 3 | | | | | | | | 1 | | | | | | | | | | | | | | |
| Hyperoplus lanceolatus | 52 | 0.26 | | | | | | | | | | 1 | | | | | | | 1 | | 3 | | | | X | 30 | 14 | | | 2 | | 1 | |
| Limanda limanda | 12 | 0.26 | | | | 1 | | | | 1 | 3 | | | | | | | | 1 | | | | | 2 | | | 1 | | | 1 | | 2 | |
| Metridium senile | 210 | 0.26 | X | | | | | | | | | | | | | 200 | 4 | 2 | X | | X | | | | | | | | | | 2 | 2 | |
| Sepiola atlantica | 13 | 0.26 | | | | | 2 | | | | | 4 | | | 1 | | | 1 | | | | 1 | | | | | 2 | 1 | | | | | 1 |
| Soleidae | 26 | 0.26 | | | | | | | | | | | | 1 | | 1 | | 1 | | | | | | 9 | | X | 9 | 5 | X | | | | |
| Agonus cataphractus | 11 | 0.23 | | | | | | 1 | | | | | | | 2 | | | 1 | | | 2 | 2 | | | | 2 | 1 | | | | | | |
| Alcyonidium sp | 1 | 0.23 | x | 1 | X | | X | | | | | | | | | | | | | | X | | | | | | X | | | | X | | |
| Crangon crangon | 52 | 0.23 | | | | | | | | | | | | | | | | | 2 | 20 | | | | 2 | | | 17 | | | 2 | 5 | 4 | |
| Crustacea | 2 | 0.23 | X | | | X | X | | | X | X | | | | | | | | 2 | | | | X | | | | | | | | | | |

| Taxon | Total specimen count (incomplete) | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dendronotus frondosus** | 294 | 0.23 | 10 | | | 10 | 6 | | | | | | 3 | 7 | | | | | 222 | | 36 | | | | | | | | | | | | |
| **Echinocyamus pusillus** | 121 | 0.23 | | | | | X | | | | | | 7 | | | 5 | | 70 | 30 | | | | 1 | 8 | | | | | | | | | |
| **Nassarius reticulatus** | 25 | 0.23 | | X | | | | | | | | | | | | | | | | | | | 2 | 3 | | 11 | 8 | X | 1 | | | | |
| **Pisidia longicornis** | 52 | 0.23 | 10 | | | 5 | X | | | X | 8 | | | | | | | | 27 | | 2 | | | | | | | | | | | | |
| **Conopeum reticulum** | 0 | 0.19 | X | | | x | | | | | | | | | | | | | X | | X | | | | | | | | | | X | X | |
| **Ensis arcuatus** | 6 | 0.19 | | | | | | | | | 1 | | | | | | | | 1 | | 3 | | | | | X | X | | | | | 1 | |
| **Necora puber** | 13 | 0.19 | | | 1 | 3 | | | 1 | | | | | 2 | | | | | 4 | | 2 | | | | | | | | | | | | |
| **Vesicularia spinosa** | 7 | 0.19 | | | | | X | | | X | | | | | X | | | | | | 7 | X | | | | | | | | | X | | |
| **Buccinum undatum** | 6 | 0.16 | | | | | | | | | | 2 | | 1 | | | | | 2 | | 1 | X | | | | | | | | | | | |
| **Callionymus lyra** | 6 | 0.16 | | | | | | | | | | 2 | | | | | | | 1 | | | 1 | | 1 | | | 1 | | | | | | |
| **Chaetopterus variopedatus** | 4 | 0.16 | 1 | | | | X | | | | | | | | | 1 | | | 1 | | | | | | | | | 1 | | | | | |
| **Hydractinia echinata** | 10 | 0.16 | | | | | | | | | | | | | | | | | X | | 10 | | | X | | | X | | | | X | | |
| **Nudibranchia** | 10 | 0.16 | | | | | 5 | | | 1 | 3 | | | | | | | | X | | 1 | | | | | | | | | | | | |
| **Barnea parva** | 0 | 0.13 | X | X | X | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Campanulariidae** | 0 | 0.13 | | | | | | | | | X | | | | | | | | X | | X | | | X | | | | | | | | | |
| **Flustra foliacea** | 12 | 0.13 | 1 | | | | | | | | | 10 | | 1 | | | | | | | | | | | | | | | | X | | | |
| **Nemertina** | 7 | 0.13 | | | | | 1 | 2 | | | | | 1 | | | | | | 3 | | | | | | | | | | | | | | |
| **Philocheras trispinosum** | 33 | 0.13 | | | | | | | | | | | | | | | 7 | | 10 | | | | | 7 | | | 9 | | | | | | |
| **Pleuronectoidea** | 6 | 0.13 | | | | | | | | | | | | | | | | | | | 3 | | | 3 | X | X | | | | | | | |
| **Polynoinae** | 13 | 0.13 | | X | | 10 | | | | X | 3 | | | | | | | | | | | | | | | | | | | | | | |
| **Pycnogonum littorale** | 6 | 0.13 | | | | | | X | | | | | | | | | | | 3 | | 3 | | | | | | | | X | | | | |
| **Spisula sp** | 6 | 0.13 | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | 1 | | | | | 3 |
| **Callionymus reticulatus** | 7 | 0.10 | | | | | | | | | | | | | | | | | | | 1 | | | 3 | | | 3 | | | | | | |

| Taxon | Total specimen count (incomplete) | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calycella syringa | 0 | 0.10 | | | | | | | | | | | | | | | | | | | X | X | | X | | | | | | | | | |
| Celleporidae | 50 | 0.10 | | | | | | | | | | | X | 30 | | | | | | | | | | | | | | 20 | | | | | |
| Didemnidae | 1 | 0.10 | | | | | X | | | | | | | X | | | | | 1 | | | | | | | | | | | | | | |
| Echinocardium cordatum | 14 | 0.10 | | | | | | | | | | | | | | | 4 | 1 | | | | | | 9 | | | | | | | | | |
| Gastrosaccus spinifer | 6 | 0.10 | | | | | | | | | | | | | | | 2 | | | | | | | 1 | | | 3 | | | | | | |
| Hydrallmania falcata | 0 | 0.10 | | | | | | | | | X | X | | | | | | | | | | X | | | | | | | | | | | |
| Myoxocephalus scorpius | 2 | 0.10 | | | | | | | | | | | | | | | | | 1 | | 1 | | | | X | | | | | | | | |
| Sertularia cupressina | 0 | 0.10 | | | | | | | | | | | | | | | | | | | | X | | X | | | X | | | | | | |
| Nemertesia sp | | 0.08 | | | | | | X | | | | | | X | | | | | X | | X | X | | | | | | | | | | X | |
| Arachnidium fibrosum | 0 | 0.06 | | | | | | | | | | | | | | X | | | | | | X | | | | | | | | | | | |
| Balanus crenatus | 0 | 0.06 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | X | | |
| Calliostoma zizyphinum | 3 | 0.06 | | | | | | | | 2 | | | | | | | | | 1 | | | | | | | | | | | | | | |
| Caprellidae | 1 | 0.06 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | 1 | | | |
| Cliona celata | 0 | 0.06 | | X | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clytia hemisphaerica | 0 | 0.06 | | | | | | | | | | | | | | | | | X | | | X | | | | | | | | | | | |
| Ctenostomata | 0 | 0.06 | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | |
| Escharella immersa | 0 | 0.06 | | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | |
| Hyas sp | 2 | 0.06 | 2 | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| Jassa herdmani | 0 | 0.06 | | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | |
| Membranipora tenuis | 0 | 0.06 | | | | | | | | | | | | | | | X | | | | X | | | | | | | | | | | | |
| Mysidacea | 3 | 0.06 | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 2 | | | |
| Mytilus sp | 7 | 0.06 | | | | | | | | | | | | | | | | | 4 | | 3 | | | | | | | | | | | | |
| Nudibranchia EGGS | 0 | 0.06 | | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | |
| Nudibranchia sp1 | 4 | 0.06 | | | | | | | | 1 | | | | | | | | | 3 | | | | | | | | | | | | | | |

| Taxon | Total specimen count (incomplete) | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nudibranchia sp2 | 2 | 0.06 | | | | | | | | 1 | | | | | | | | | 1 | | | | | | | | | | | | | | |
| Reptadeonella violacea | 0 | 0.06 | | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | |
| Schizomavella linearis | 0 | 0.06 | | | | | | | | | | | | | | | X | | | | X | | | | | | | | | | | | |
| Schizomavella sp | 0 | 0.06 | | | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | |
| Solea vulgaris | 3 | 0.06 | 2 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spisula solida | 3 | 0.06 | | | | | | | | | | | | | | | | | | | 2 | | | | | | 1 | | | | | | |
| Suberites ficus | 5 | 0.06 | | | | | | | | | | | | | | | | | 2 | | | 3 | | | | | | | | | | | |
| Thoracica | 0 | 0.06 | X | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Undet eggs | 1 | 0.06 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | 1 | | | |
| Abietinaria abietina | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Alloteuthis subulata | 1 | 0.03 | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | |
| Ammodytidae | 1 | 0.03 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | |
| Amphipholis squamata | 1 | 0.03 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Aphroditidae | 1 | 0.03 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Aspidelectra melolontha | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Bicellariella ciliata | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Bougainvillia sp | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Bougainvilliidae | 1 | 0.03 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| Buccinum undatum EGGS | 1 | 0.03 | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Callopora dumerilii | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Cancer pagurus | 1 | 0.03 | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Caprella linearis | 10 | 0.03 | | | | | | | | | | | | | | | | | | | 10 | | | | | | | | | | | | |
| Cellepora pumicosa | 62 | 0.03 | | | | | | | | | | | | | | | 62 | | | | | | | | | | | | | | | | |
| Corophium sp | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |

| Taxon | Total specimen count (incomplete) | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crangon allmanni | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | |
| Cyclostomatida | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Escharella variolosa | 1 | 0.03 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| Eulalia viridis | 1 | 0.03 | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gadidae | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| Gadus morhua | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | |
| Galathea sp | 1 | 0.03 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Halecium halecinum | 1 | 0.03 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| Halecium sp | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Hippocampus hippocampus | 1 | 0.03 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| Hippolyte longirostris | 1 | 0.03 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Hippolyte varians | 2 | 0.03 | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | |
| Hippolytidae | 1 | 0.03 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | |
| Hypophorella expansa | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Immergentia suecica | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Inachus dorsettensis | 1 | 0.03 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Jassa falcata | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |
| Kirchenpaueria sp | 1 | 0.03 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| Lepidonotus sp | 1 | 0.03 | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lepidonotus squamosus | 3 | 0.03 | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | |
| Lovenelloidea | 1 | 0.03 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| Mactra stultorum | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| Melita palmata | 1 | 0.03 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Microporella ciliata | 1 | 0.03 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |

| Taxon | Total specimen count (incomplete) | Frequency of occurrence | # 11 | # 12 | # 15 | # 16 | # 18 | # 26 | # 40 | # 49 | # 54 | # 2 | # 20 | # 29 | # 30 | # 33 | # 34 | # 35 | # 38 | # 47 | # 51 | # 52 | # 6 | # 7 | # 8 | # 9 | # 10 | # 13 | # 14 | # 48 | # 32 | # 39 | # 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Molgula sp | 3 | 0.03 | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | |
| Nassarius reticulatus EGGS | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Obelia bidentata | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Obelia longissima | 1 | 0.03 | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | |
| Pandalina brevirostris | 1 | 0.03 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Pandalus brevirostris | 1 | 0.03 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Peracarida | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | |
| Pilumnus hirtellus | 4 | 0.03 | | | | | | | | | | | | | | | | | 4 | | | | | | | | | | | | | | |
| Puellina innominata | 1 | 0.03 | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| Sabella sp | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Sacculina sp | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| Sarsia tubulosa | 1 | 0.03 | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Schizomavella auriculata | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Schizomavella theresae | 1 | 0.03 | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| Teleost | 1 | 0.03 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| Thia scutellata | 2 | 0.03 | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | |
| Tritonia hombergi | 1 | 0.03 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Turbicellepora avicularis | 13 | 0.03 | | | | | | | | | | | | | | | 13 | | | | | | | | | | | | | | | | |

# Annex 9. Results of clustering procedure on 29 conspicuous or abundant taxa in surveys of 1905 and 2005: main contributors.

The list of considered taxa is displayed on figure 4-45. Records of *Ophiura ophiura* and *O. albida* were removed and only *Ophiura* sp was considered for multivariate analyses. The genera *Liocarcinus* and *Polybius* were aggregated under family Portunidae, whereas *Necora puber* was considered separately. Analysis was carried out with the Primer-E statistical suite. Statistically different groups were determined using the SIMPROF permutation tests and SIMPER procedure was applied to identify main contributors to similarities.

## SIMPER

### 1. Similarity Percentages - species contributions

One-Way Analysis

```
Data type: Presence/Absence
Sample selection: All
Variable selection: All
```

*Parameters*

```
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%
```

**Group a**
Average similarity: 59.74

| **Species** | **Av.Abund** | **Av.Sim** | **Sim/SD** | **Contrib%** | **Cum.%** |
|---|---|---|---|---|---|
| Galathea sp | 1 | 7.79 | 6.09 | 13.04 | 13.04 |
| Paguridae | 0.88 | 5.79 | 1.76 | 9.69 | 22.73 |
| Pilumnus hirtellus | 0.82 | 5.1 | 1.36 | 8.54 | 31.26 |
| Calliostoma zizyphinum | 0.76 | 4.49 | 1.12 | 7.52 | 38.78 |
| Buccinum undatum | 0.76 | 4.32 | 1.13 | 7.23 | 46.01 |
| Portunidae | 0.76 | 4.25 | 1.13 | 7.12 | 53.13 |
| Inachus dorsettensis | 0.76 | 4.24 | 1.13 | 7.1 | 60.23 |
| Mytilus sp | 0.71 | 3.77 | 0.94 | 6.31 | 66.54 |
| Hyas sp | 0.71 | 3.51 | 0.95 | 5.88 | 72.41 |
| Flustra foliacea | 0.65 | 2.89 | 0.81 | 4.83 | 77.25 |
| Ostrea edulis | 0.53 | 2.12 | 0.59 | 3.55 | 80.79 |
| Nemertesia sp | 0.53 | 2.01 | 0.58 | 3.36 | 84.15 |
| Tritonia hombergi | 0.47 | 1.44 | 0.5 | 2.41 | 86.56 |
| Ophiura sp | 0.47 | 1.42 | 0.5 | 2.38 | 88.94 |
| Electra pilosa | 0.41 | 1.22 | 0.42 | 2.04 | 90.98 |

**Group b**
Less than 2 samples in group

**Group c**
Average similarity: 71.43

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Buccinum undatum | 1 | 14.29 | ####### | 20 | 20 |
| Flustra foliacea | 1 | 14.29 | ####### | 20 | 40 |
| Portunidae | 1 | 14.29 | ####### | 20 | 60 |
| Ophiura sp | 1 | 14.29 | ####### | 20 | 80 |
| Paguridae | 1 | 14.29 | ####### | 20 | 100 |

**Group d**
Average similarity: 78.73

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Asterias rubens | 1 | 18.19 | 7.17 | 23.1 | 23.1 |
| Portunidae | 1 | 18.19 | 7.17 | 23.1 | 46.2 |
| Ophiura sp | 1 | 18.19 | 7.17 | 23.1 | 69.3 |
| Paguridae | 1 | 18.19 | 7.17 | 23.1 | 92.4 |

**Group e**
Average similarity: 69.00

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Asterias rubens | 1 | 9.36 | 5.45 | 13.56 | 13.56 |
| Ophiura sp | 1 | 9.36 | 5.45 | 13.56 | 27.12 |
| Tubularia indivisa | 1 | 9.36 | 5.45 | 13.56 | 40.68 |
| Tubularia larynx | 0.95 | 8.18 | 2.56 | 11.85 | 52.53 |
| Paguridae | 0.89 | 7.23 | 1.83 | 10.48 | 63.01 |
| Electra pilosa | 0.84 | 6.25 | 1.46 | 9.06 | 72.07 |
| Portunidae | 0.79 | 6.07 | 1.21 | 8.8 | 80.87 |
| Psammechinus miliaris | 0.79 | 5.39 | 1.21 | 7.82 | 88.68 |
| Ophiothrix fragilis | 0.42 | 1.38 | 0.43 | 2 | 90.68 |

**Group f**
Average similarity: 44.63

| Species | Av.Abund | Av.Sim | Sim/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|
| Flustra foliacea | 1 | 22.18 | 1.82 | 49.71 | 49.71 |
| Electra pilosa | 0.75 | 8.75 | 0.99 | 19.62 | 69.33 |
| Alcyonidium sp | 0.63 | 4.89 | 0.73 | 10.95 | 80.28 |
| Nemertesia sp | 0.5 | 2.9 | 0.51 | 6.49 | 86.77 |
| Acanthodoris pilosa | 0.5 | 2.79 | 0.51 | 6.25 | 93.02 |

## 2. Contribution of species to dissimilarities (pairwise group comparison)

**Groups a & b**
Average dissimilarity = 78.84

| Species | Group a Av.Abund | Group b Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Galathea sp | 1 | 0 | 4.82 | 6.65 | 6.12 | 6.12 |
| Tubularia larynx | 0 | 1 | 4.82 | 6.65 | 6.12 | 12.23 |
| Cliona celata | 0.12 | 1 | 4.27 | 2.44 | 5.41 | 17.64 |
| Paguridae | 0.88 | 0 | 4.15 | 2.51 | 5.26 | 22.91 |
| Pilumnus hirtellus | 0.82 | 0 | 3.92 | 1.96 | 4.98 | 27.88 |
| Alcyonium digitatum | 0.24 | 1 | 3.8 | 1.7 | 4.82 | 32.71 |
| Calliostoma zizyphinum | 0.76 | 0 | 3.7 | 1.67 | 4.7 | 37.4 |
| Buccinum undatum | 0.76 | 0 | 3.61 | 1.7 | 4.58 | 41.98 |
| Portunidae | 0.76 | 0 | 3.57 | 1.69 | 4.53 | 46.51 |
| Inachus dorsettensis | 0.76 | 0 | 3.57 | 1.7 | 4.52 | 51.03 |
| Tubularia indivisa | 0.29 | 1 | 3.52 | 1.46 | 4.46 | 55.49 |
| Asterias rubens | 0.29 | 1 | 3.5 | 1.46 | 4.44 | 59.94 |
| Mytilus sp | 0.71 | 0 | 3.4 | 1.44 | 4.32 | 64.25 |
| Hyas sp | 0.71 | 0 | 3.25 | 1.46 | 4.12 | 68.38 |
| Psammechinus miliaris | 0.41 | 1 | 2.98 | 1.13 | 3.77 | 72.15 |
| Flustra foliacea | 0.65 | 0 | 2.95 | 1.29 | 3.74 | 75.89 |
| Electra pilosa | 0.41 | 1 | 2.81 | 1.14 | 3.57 | 79.46 |
| Ostrea edulis | 0.53 | 0 | 2.6 | 1 | 3.3 | 82.76 |
| Nemertesia sp | 0.53 | 1 | 2.3 | 0.91 | 2.92 | 85.68 |
| Tritonia hombergi | 0.47 | 0 | 2.12 | 0.9 | 2.69 | 88.37 |
| Ophiura sp | 0.47 | 0 | 2.1 | 0.9 | 2.67 | 91.04 |

**Groups a & c**
Average dissimilarity = 55.68

| Species | Group a Av.Abund | Group c Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Pilumnus hirtellus | 0.82 | 0 | 4.14 | 1.96 | 7.43 | 7.43 |
| Calliostoma zizyphinum | 0.76 | 0 | 3.91 | 1.67 | 7.02 | 14.44 |
| Inachus dorsettensis | 0.76 | 0 | 3.75 | 1.71 | 6.74 | 21.18 |
| Mytilus sp | 0.71 | 0 | 3.59 | 1.45 | 6.45 | 27.63 |
| Hyas sp | 0.71 | 0 | 3.42 | 1.48 | 6.14 | 33.77 |
| Ophiura sp | 0.47 | 1 | 2.88 | 1.02 | 5.17 | 38.94 |
| Ostrea edulis | 0.53 | 0 | 2.75 | 1.01 | 4.94 | 43.88 |
| Nemertesia sp | 0.53 | 0 | 2.66 | 1 | 4.78 | 48.66 |
| Psammechinus miliaris | 0.41 | 0.5 | 2.5 | 0.97 | 4.5 | 53.15 |
| Macropodia sp | 0.29 | 0.5 | 2.48 | 0.97 | 4.45 | 57.6 |
| Asterias rubens | 0.29 | 0.5 | 2.48 | 0.97 | 4.45 | 62.05 |
| Galathea sp | 1 | 0.5 | 2.41 | 0.96 | 4.33 | 66.38 |
| Tritonia hombergi | 0.47 | 0 | 2.23 | 0.91 | 4 | 70.39 |
| Electra pilosa | 0.41 | 0 | 2.12 | 0.8 | 3.81 | 74.2 |
| Flustra foliacea | 0.65 | 1 | 1.98 | 0.71 | 3.56 | 77.76 |
| Alcyonidium sp | 0.41 | 0 | 1.94 | 0.82 | 3.49 | 81.25 |
| Vesicularia spinosa | 0.35 | 0 | 1.69 | 0.72 | 3.03 | 84.28 |
| Tubularia indivisa | 0.29 | 0 | 1.37 | 0.63 | 2.46 | 86.74 |
| Portunidae | 0.76 | 1 | 1.33 | 0.54 | 2.38 | 89.12 |
| Buccinum undatum | 0.76 | 1 | 1.29 | 0.53 | 2.31 | 91.43 |

**Groups b & c**
Average dissimilarity = 87.50

| Species | Group b Av.Abund | Group c Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Alcyonium digitatum | 1 | 0 | 6.7 | 10.61 | 7.65 | 7.65 |
| Buccinum undatum | 0 | 1 | 6.7 | 10.61 | 7.65 | 15.31 |
| Cliona celata | 1 | 0 | 6.7 | 10.61 | 7.65 | 22.96 |
| Electra pilosa | 1 | 0 | 6.7 | 10.61 | 7.65 | 30.61 |
| Flustra foliacea | 0 | 1 | 6.7 | 10.61 | 7.65 | 38.27 |
| Portunidae | 0 | 1 | 6.7 | 10.61 | 7.65 | 45.92 |
| Nemertesia sp | 1 | 0 | 6.7 | 10.61 | 7.65 | 53.57 |
| Ophiura sp | 0 | 1 | 6.7 | 10.61 | 7.65 | 61.22 |
| Paguridae | 0 | 1 | 6.7 | 10.61 | 7.65 | 68.88 |
| Tubularia indivisa | 1 | 0 | 6.7 | 10.61 | 7.65 | 76.53 |
| Tubularia larynx | 1 | 0 | 6.7 | 10.61 | 7.65 | 84.18 |
| Asterias rubens | 1 | 0.5 | 3.57 | 0.71 | 4.08 | 88.27 |
| Galathea sp | 0 | 0.5 | 3.57 | 0.71 | 4.08 | 92.35 |

**Groups a & d**
Average dissimilarity = 71.37

| Species | Group a Av.Abund | Group d Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Galathea sp | 1 | 0 | 5.49 | 5.52 | 7.7 | 7.7 |
| Pilumnus hirtellus | 0.82 | 0 | 4.46 | 1.95 | 6.25 | 13.95 |
| Calliostoma zizyphinum | 0.76 | 0 | 4.22 | 1.67 | 5.92 | 19.87 |
| Buccinum undatum | 0.76 | 0 | 4.09 | 1.72 | 5.73 | 25.6 |
| Inachus dorsettensis | 0.76 | 0 | 4.04 | 1.72 | 5.66 | 31.26 |
| Asterias rubens | 0.29 | 1 | 4.01 | 1.47 | 5.61 | 36.87 |
| Mytilus sp | 0.71 | 0 | 3.88 | 1.45 | 5.43 | 42.31 |
| Hyas sp | 0.71 | 0 | 3.67 | 1.49 | 5.15 | 47.45 |
| Flustra foliacea | 0.65 | 0 | 3.33 | 1.31 | 4.67 | 52.12 |
| Ophiura sp | 0.47 | 1 | 3.13 | 1.03 | 4.38 | 56.51 |
| Ostrea edulis | 0.53 | 0 | 2.98 | 1.01 | 4.17 | 60.68 |
| Nemertesia sp | 0.53 | 0 | 2.87 | 1.01 | 4.03 | 64.7 |
| Ophiothrix fragilis | 0 | 0.5 | 2.65 | 0.97 | 3.71 | 68.42 |
| Tubularia indivisa | 0.29 | 0.4 | 2.42 | 0.9 | 3.39 | 71.81 |
| Tritonia hombergi | 0.47 | 0 | 2.39 | 0.92 | 3.35 | 75.16 |
| Electra pilosa | 0.41 | 0.1 | 2.39 | 0.84 | 3.35 | 78.51 |
| Psammechinus miliaris | 0.41 | 0.2 | 2.35 | 0.87 | 3.29 | 81.8 |
| Alcyonidium sp | 0.41 | 0.1 | 2.2 | 0.85 | 3.09 | 84.88 |
| Vesicularia spinosa | 0.35 | 0.1 | 1.98 | 0.77 | 2.77 | 87.66 |
| Macropodia sp | 0.29 | 0.1 | 1.72 | 0.69 | 2.41 | 90.07 |

**Groups b & d**
Average dissimilarity = 73.93

| Species | Group b Av.Abund | Group d Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Alcyonium digitatum | 1 | 0 | 7.4 | 11.48 | 10.01 | 10.01 |
| Cliona celata | 1 | 0 | 7.4 | 11.48 | 10.01 | 20.03 |
| Portunidae | 0 | 1 | 7.4 | 11.48 | 10.01 | 30.04 |
| Nemertesia sp | 1 | 0 | 7.4 | 11.48 | 10.01 | 40.06 |
| Ophiura sp | 0 | 1 | 7.4 | 11.48 | 10.01 | 50.07 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Paguridae | 0 | 1 | 7.4 | 11.48 | 10.01 | 60.08 |
| Tubularia larynx | 1 | 0.1 | 6.74 | 2.76 | 9.11 | 69.2 |
| Electra pilosa | 1 | 0.1 | 6.63 | 2.75 | 8.97 | 78.17 |
| Psammechinus miliaris | 1 | 0.2 | 5.92 | 1.86 | 8.01 | 86.18 |
| Tubularia indivisa | 1 | 0.4 | 4.69 | 1.16 | 6.34 | 92.52 |

**Groups c & d**
Average dissimilarity = 42.13

| Species | Group c Av.Abund | Group d Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Buccinum undatum | 1 | 0 | 8.05 | 7.98 | 19.11 | 19.11 |
| Flustra foliacea | 1 | 0 | 8.05 | 7.98 | 19.11 | 38.22 |
| Asterias rubens | 0.5 | 1 | 4.35 | 0.97 | 10.33 | 48.55 |
| Galathea sp | 0.5 | 0 | 4.35 | 0.97 | 10.33 | 58.88 |
| Psammechinus miliaris | 0.5 | 0.2 | 3.83 | 0.96 | 9.09 | 67.97 |
| Ophiothrix fragilis | 0 | 0.5 | 3.82 | 0.97 | 9.07 | 77.04 |
| Macropodia sp | 0.5 | 0.1 | 3.75 | 0.97 | 8.91 | 85.95 |
| Tubularia indivisa | 0 | 0.4 | 2.93 | 0.79 | 6.95 | 92.9 |

**Groups a & e**
Average dissimilarity = 65.02

| Species | Group a Av.Abund | Group e Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Galathea sp | 1 | 0.05 | 4.05 | 3.33 | 6.24 | 6.24 |
| Tubularia larynx | 0 | 0.95 | 3.99 | 3.37 | 6.14 | 12.37 |
| Pilumnus hirtellus | 0.82 | 0.05 | 3.36 | 1.8 | 5.17 | 17.54 |
| Tubularia indivisa | 0.29 | 1 | 3.1 | 1.47 | 4.76 | 22.3 |
| Asterias rubens | 0.29 | 1 | 3.08 | 1.47 | 4.74 | 27.05 |
| Calliostoma zizyphinum | 0.76 | 0.11 | 3.07 | 1.48 | 4.73 | 31.77 |
| Inachus dorsettensis | 0.76 | 0.05 | 3.06 | 1.6 | 4.71 | 36.48 |
| Mytilus sp | 0.71 | 0.11 | 2.86 | 1.34 | 4.39 | 40.88 |
| Buccinum undatum | 0.76 | 0.21 | 2.81 | 1.33 | 4.32 | 45.19 |
| Hyas sp | 0.71 | 0.11 | 2.74 | 1.35 | 4.22 | 49.41 |
| Flustra foliacea | 0.65 | 0.16 | 2.47 | 1.19 | 3.8 | 53.22 |
| Ophiura sp | 0.47 | 1 | 2.39 | 1.03 | 3.67 | 56.89 |
| Psammechinus miliaris | 0.41 | 0.79 | 2.38 | 1.07 | 3.67 | 60.55 |
| Electra pilosa | 0.41 | 0.84 | 2.36 | 1.09 | 3.63 | 64.19 |
| Ostrea edulis | 0.53 | 0.05 | 2.28 | 1.01 | 3.5 | 67.69 |
| Nemertesia sp | 0.53 | 0.26 | 2.18 | 0.99 | 3.35 | 71.04 |
| Alcyonidium sp | 0.41 | 0.32 | 1.94 | 0.91 | 2.99 | 74.03 |
| Macropodia sp | 0.29 | 0.42 | 1.91 | 0.91 | 2.94 | 76.97 |
| Tritonia hombergi | 0.47 | 0.05 | 1.91 | 0.92 | 2.93 | 79.9 |
| Alcyonium digitatum | 0.24 | 0.42 | 1.85 | 0.9 | 2.84 | 82.74 |
| Vesicularia spinosa | 0.35 | 0.26 | 1.77 | 0.85 | 2.73 | 85.47 |
| Ophiothrix fragilis | 0 | 0.42 | 1.71 | 0.83 | 2.63 | 88.1 |
| Portunidae | 0.76 | 0.79 | 1.49 | 0.7 | 2.29 | 90.39 |

**Groups b & e**
Average dissimilarity = 44.37

| Species | Group b Av.Abund | Group e Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Ophiura sp | 0 | 1 | 5.37 | 6.66 | 12.1 | 12.1 |
| Cliona celata | 1 | 0.05 | 5.08 | 3.45 | 11.44 | 23.54 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Paguridae | 0 | 0.89 | 4.73 | 2.59 | 10.65 | 34.2 |
| Portunidae | 0 | 0.79 | 4.37 | 1.8 | 9.85 | 44.05 |
| Nemertesia sp | 1 | 0.26 | 4.13 | 1.58 | 9.3 | 53.35 |
| Alcyonium digitatum | 1 | 0.42 | 3.33 | 1.13 | 7.52 | 60.86 |
| Ophiothrix fragilis | 0 | 0.42 | 2.13 | 0.81 | 4.81 | 65.67 |
| Macropodia sp | 0 | 0.42 | 2.04 | 0.82 | 4.61 | 70.28 |
| Dendronotus frondosus | 0 | 0.37 | 1.75 | 0.73 | 3.93 | 74.21 |
| Alcyonidium sp | 0 | 0.32 | 1.65 | 0.65 | 3.72 | 77.93 |
| Necora puber | 0 | 0.32 | 1.61 | 0.65 | 3.62 | 81.55 |
| Vesicularia spinosa | 0 | 0.26 | 1.32 | 0.58 | 2.97 | 84.52 |
| Psammechinus miliaris | 1 | 0.79 | 1.28 | 0.5 | 2.88 | 87.4 |
| Electra pilosa | 1 | 0.84 | 0.97 | 0.42 | 2.19 | 89.59 |
| Buccinum undatum | 0 | 0.21 | 0.93 | 0.5 | 2.1 | 91.7 |

**Groups c & e**
Average dissimilarity = 53.85

| **Species** | **Group c Av.Abund** | **Group e Av.Abund** | **Av.Diss** | **Diss/SD** | **Contrib%** | **Cum.%** |
|---|---|---|---|---|---|---|
| Tubularia indivisa | 0 | 1 | 5.7 | 5.93 | 10.59 | 10.59 |
| Tubularia larynx | 0 | 0.95 | 5.32 | 3.43 | 9.89 | 20.47 |
| Flustra foliacea | 1 | 0.16 | 4.86 | 2.11 | 9.02 | 29.5 |
| Buccinum undatum | 1 | 0.21 | 4.72 | 1.83 | 8.77 | 38.26 |
| Electra pilosa | 0 | 0.84 | 4.66 | 2.11 | 8.65 | 46.92 |
| Asterias rubens | 0.5 | 1 | 3.02 | 0.96 | 5.6 | 52.52 |
| Galathea sp | 0.5 | 0.05 | 3 | 0.96 | 5.58 | 58.1 |
| Psammechinus miliaris | 0.5 | 0.79 | 2.93 | 0.97 | 5.44 | 63.53 |
| Macropodia sp | 0.5 | 0.42 | 2.8 | 0.97 | 5.19 | 68.73 |
| Ophiothrix fragilis | 0 | 0.42 | 2.26 | 0.82 | 4.19 | 72.92 |
| Alcyonium digitatum | 0 | 0.42 | 2.15 | 0.82 | 3.99 | 76.91 |
| Dendronotus frondosus | 0 | 0.37 | 1.84 | 0.74 | 3.41 | 80.32 |
| Alcyonidium sp | 0 | 0.32 | 1.75 | 0.66 | 3.24 | 83.57 |
| Necora puber | 0 | 0.32 | 1.7 | 0.65 | 3.16 | 86.73 |
| Vesicularia spinosa | 0 | 0.26 | 1.39 | 0.58 | 2.59 | 89.31 |
| Nemertesia sp | 0 | 0.26 | 1.31 | 0.58 | 2.43 | 91.74 |

**Groups d & e**
Average dissimilarity = 42.01

| **Species** | **Group d Av.Abund** | **Group e Av.Abund** | **Av.Diss** | **Diss/SD** | **Contrib%** | **Cum.%** |
|---|---|---|---|---|---|---|
| Tubularia larynx | 0.1 | 0.95 | 5.3 | 2.22 | 12.63 | 12.63 |
| Electra pilosa | 0.1 | 0.84 | 4.66 | 1.72 | 11.1 | 23.73 |
| Psammechinus miliaris | 0.2 | 0.79 | 4.07 | 1.36 | 9.68 | 33.41 |
| Tubularia indivisa | 0.4 | 1 | 3.91 | 1.17 | 9.31 | 42.72 |
| Ophiothrix fragilis | 0.5 | 0.42 | 3.08 | 0.97 | 7.33 | 50.05 |
| Macropodia sp | 0.1 | 0.42 | 2.47 | 0.86 | 5.87 | 55.92 |
| Alcyonium digitatum | 0 | 0.42 | 2.32 | 0.83 | 5.52 | 61.44 |
| Alcyonidium sp | 0.1 | 0.32 | 2.12 | 0.72 | 5.04 | 66.48 |
| Dendronotus frondosus | 0 | 0.37 | 1.98 | 0.75 | 4.72 | 71.2 |
| Necora puber | 0 | 0.32 | 1.85 | 0.65 | 4.4 | 75.6 |
| Vesicularia spinosa | 0.1 | 0.26 | 1.8 | 0.66 | 4.28 | 79.88 |
| Nemertesia sp | 0 | 0.26 | 1.41 | 0.58 | 3.36 | 83.24 |
| Portunidae | 1 | 0.79 | 1.13 | 0.51 | 2.69 | 85.93 |
| Buccinum undatum | 0 | 0.21 | 1.05 | 0.51 | 2.5 | 88.43 |
| Flustra foliacea | 0 | 0.16 | 0.92 | 0.42 | 2.18 | 90.61 |

**Groups a & f**
Average dissimilarity = 73.31

| Species | Group a Av.Abund | Group f Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Pilumnus hirtellus | 0.82 | 0 | 4.64 | 1.81 | 6.32 | 6.32 |
| Paguridae | 0.88 | 0.13 | 4.47 | 1.74 | 6.1 | 12.43 |
| Galathea sp | 1 | 0.25 | 4.44 | 1.52 | 6.05 | 18.48 |
| Calliostoma zizyphinum | 0.76 | 0 | 4.39 | 1.57 | 5.99 | 24.47 |
| Buccinum undatum | 0.76 | 0 | 4.24 | 1.63 | 5.78 | 30.25 |
| Inachus dorsettensis | 0.76 | 0 | 4.18 | 1.64 | 5.7 | 35.95 |
| Mytilus sp | 0.71 | 0.13 | 3.76 | 1.24 | 5.12 | 41.07 |
| Portunidae | 0.76 | 0.25 | 3.5 | 1.21 | 4.78 | 45.85 |
| Hyas sp | 0.71 | 0.25 | 3.35 | 1.15 | 4.56 | 50.41 |
| Ostrea edulis | 0.53 | 0 | 3.1 | 0.98 | 4.23 | 54.64 |
| Electra pilosa | 0.41 | 0.75 | 3.04 | 1.02 | 4.15 | 58.79 |
| Alcyonidium sp | 0.41 | 0.63 | 2.88 | 1.01 | 3.93 | 62.73 |
| Nemertesia sp | 0.53 | 0.5 | 2.87 | 0.93 | 3.92 | 66.64 |
| Acanthodoris pilosa | 0.24 | 0.5 | 2.6 | 0.97 | 3.55 | 70.19 |
| Tritonia hombergi | 0.47 | 0 | 2.47 | 0.89 | 3.37 | 73.56 |
| Ophiura sp | 0.47 | 0 | 2.44 | 0.9 | 3.33 | 76.9 |
| Vesicularia spinosa | 0.35 | 0.25 | 2.26 | 0.83 | 3.09 | 79.98 |
| Flustra foliacea | 0.65 | 1 | 2.26 | 0.7 | 3.08 | 83.07 |
| Psammechinus miliaris | 0.41 | 0 | 2.15 | 0.8 | 2.93 | 86 |
| Macropodia sp | 0.29 | 0.25 | 2.08 | 0.78 | 2.83 | 88.83 |
| Asterias rubens | 0.29 | 0.13 | 1.82 | 0.7 | 2.49 | 91.32 |

**Groups b & f**
Average dissimilarity = 76.43

| Species | Group b Av.Abund | Group f Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Cliona celata | 1 | 0 | 7.86 | 4.02 | 10.29 | 10.29 |
| Flustra foliacea | 0 | 1 | 7.86 | 4.02 | 10.29 | 20.57 |
| Psammechinus miliaris | 1 | 0 | 7.86 | 4.02 | 10.29 | 30.86 |
| Tubularia indivisa | 1 | 0 | 7.86 | 4.02 | 10.29 | 41.15 |
| Alcyonium digitatum | 1 | 0.13 | 7.03 | 2.06 | 9.2 | 50.35 |
| Asterias rubens | 1 | 0.13 | 7.03 | 2.06 | 9.2 | 59.54 |
| Tubularia larynx | 1 | 0.25 | 6.33 | 1.5 | 8.29 | 67.83 |
| Nemertesia sp | 1 | 0.5 | 4.61 | 0.91 | 6.03 | 73.86 |
| Alcyonidium sp | 0 | 0.63 | 4.09 | 1.2 | 5.35 | 79.21 |
| Acanthodoris pilosa | 0 | 0.5 | 3.19 | 0.93 | 4.18 | 83.39 |
| Electra pilosa | 1 | 0.75 | 2.53 | 0.54 | 3.3 | 86.69 |
| Portunidae | 0 | 0.25 | 2.03 | 0.53 | 2.66 | 89.35 |
| Hyas sp | 0 | 0.25 | 1.83 | 0.52 | 2.4 | 91.74 |

**Groups c & f**
Average dissimilarity = 72.47

| Species | Group c Av.Abund | Group f Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Buccinum undatum | 1 | 0 | 8.65 | 3.48 | 11.94 | 11.94 |
| Ophiura sp | 1 | 0 | 8.65 | 3.48 | 11.94 | 23.88 |
| Paguridae | 1 | 0.13 | 7.92 | 2.07 | 10.92 | 34.8 |
| Portunidae | 1 | 0.25 | 6.42 | 1.43 | 8.86 | 43.67 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Electra pilosa | 0 | 0.75 | 5.8 | 1.52 | 8.01 | 51.67 |
| Galathea sp | 0.5 | 0.25 | 4.59 | 0.89 | 6.34 | 58.01 |
| Alcyonidium sp | 0 | 0.63 | 4.4 | 1.23 | 6.07 | 64.08 |
| Macropodia sp | 0.5 | 0.25 | 4.04 | 0.93 | 5.57 | 69.65 |
| Asterias rubens | 0.5 | 0.13 | 4 | 0.92 | 5.51 | 75.17 |
| Psammechinus miliaris | 0.5 | 0 | 3.93 | 0.92 | 5.42 | 80.59 |
| Nemertesia sp | 0 | 0.5 | 3.5 | 0.95 | 4.83 | 85.42 |
| Acanthodoris pilosa | 0 | 0.5 | 3.43 | 0.96 | 4.73 | 90.15 |

**Groups d & f**
Average dissimilarity = 88.03

| Species | Group d Av.Abund | Group f Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Flustra foliacea | 0 | 1 | 10 | 2.97 | 11.36 | 11.36 |
| Ophiura sp | 1 | 0 | 10 | 2.97 | 11.36 | 22.73 |
| Paguridae | 1 | 0.13 | 9.2 | 1.97 | 10.45 | 33.18 |
| Asterias rubens | 1 | 0.13 | 9 | 1.9 | 10.23 | 43.41 |
| Portunidae | 1 | 0.25 | 7.44 | 1.38 | 8.45 | 51.86 |
| Electra pilosa | 0.1 | 0.75 | 6.25 | 1.33 | 7.1 | 58.96 |
| Alcyonidium sp | 0.1 | 0.63 | 4.88 | 1.18 | 5.54 | 64.5 |
| Ophiothrix fragilis | 0.5 | 0 | 4.66 | 0.92 | 5.29 | 69.79 |
| Nemertesia sp | 0 | 0.5 | 3.89 | 0.98 | 4.42 | 74.21 |
| Acanthodoris pilosa | 0 | 0.5 | 3.81 | 0.98 | 4.32 | 78.53 |
| Tubularia indivisa | 0.4 | 0 | 3.52 | 0.77 | 4 | 82.53 |
| Macropodia sp | 0.1 | 0.25 | 2.34 | 0.63 | 2.66 | 85.18 |
| Vesicularia spinosa | 0.1 | 0.25 | 2.34 | 0.63 | 2.66 | 87.84 |
| Tubularia larynx | 0.1 | 0.25 | 2.34 | 0.63 | 2.66 | 90.49 |

**Groups e & f**
Average dissimilarity = 76.94

| Species | Group e Av.Abund | Group f Av.Abund | Av.Diss | Diss/SD | Contrib% | Cum.% |
|---|---|---|---|---|---|---|
| Ophiura sp | 1 | 0 | 6.52 | 3.59 | 8.47 | 8.47 |
| Tubularia indivisa | 1 | 0 | 6.52 | 3.59 | 8.47 | 16.95 |
| Asterias rubens | 1 | 0.13 | 5.81 | 2.06 | 7.55 | 24.5 |
| Flustra foliacea | 0.16 | 1 | 5.56 | 1.9 | 7.23 | 31.73 |
| Paguridae | 0.89 | 0.13 | 5.25 | 1.71 | 6.82 | 38.55 |
| Tubularia larynx | 0.95 | 0.25 | 4.92 | 1.45 | 6.4 | 44.95 |
| Psammechinus miliaris | 0.79 | 0 | 4.92 | 1.66 | 6.4 | 51.35 |
| Portunidae | 0.79 | 0.25 | 4.27 | 1.2 | 5.55 | 56.9 |
| Alcyonidium sp | 0.32 | 0.63 | 3.33 | 1.03 | 4.33 | 61.23 |
| Nemertesia sp | 0.26 | 0.5 | 2.96 | 0.96 | 3.85 | 65.08 |
| Acanthodoris pilosa | 0 | 0.5 | 2.74 | 0.97 | 3.56 | 68.64 |
| Macropodia sp | 0.42 | 0.25 | 2.73 | 0.88 | 3.55 | 72.19 |
| Alcyonium digitatum | 0.42 | 0.13 | 2.58 | 0.84 | 3.36 | 75.55 |
| Ophiothrix fragilis | 0.42 | 0 | 2.56 | 0.8 | 3.33 | 78.87 |
| Electra pilosa | 0.84 | 0.75 | 2.46 | 0.67 | 3.2 | 82.07 |
| Vesicularia spinosa | 0.26 | 0.25 | 2.24 | 0.76 | 2.91 | 84.98 |
| Dendronotus frondosus | 0.37 | 0 | 2.05 | 0.73 | 2.67 | 87.65 |
| Necora puber | 0.32 | 0 | 1.93 | 0.63 | 2.51 | 90.16 |