

"HISTORIC HABITATS" MAPPING IN THE SOUTHERN NORTH SEA

A PRELIMINARY INVESTIGATION



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Introduction

Habitats and biodiversity evolution are heavily influenced by human activities. Historic environmental data and studies are therefore important to assess anthropogenic sources of changes and their effects in the long term. Such data are scarce.

Professor G. Gilson, a pioneer in marine ecology, has collected thousands of samples of sediments, benthos, plankton and fish, mainly in the period 1899 – 1914, within an impressive systematic survey the Belgian area of the southern North Sea. Most samples were preserved in the RBINS collections together with detailed sample documentation.

Our research project aims at determining whether Gilson's data and samples, collected after the first industrial developments, could provide a "reference" data set for habitats and benthic biodiversity in the considered area. Our ongoing investigation on a sub-sample of sediment data aims at studying the feasibility of computing nearly 2000 sediment descriptions and depth measurements within a GIS map of "historic habitats". As a first step, we investigate the translation of Gilson's sediment descriptions into well defined grain-size categories.



Figure 1 : The "ground-collector" filled with mud.

Methods

A total of more than 2500 sediment samples were taken with the "ground-collector" designed by Gilson (fig. 1). Gilson recorded (among others): co-ordinates, time, tide status, qualitative description of the sediment, depth.

We here consider the 691 samples taken with the "ground collector" between 1899 and 1908 that were preserved in the RBINS collections (fig. 2). 440 of these samples are accompanied with adequate co-ordinates and comments and are used here. However, a part of the remaining data should be recoverable.

On the basis of all available qualitative descriptions, we propose sediment categories (table 1) that are controlled by two series of analyses :

1. A series of original grain-size analyses were performed in 1907, on sediments not preserved in the RBINS. Data on homogenous material (33 data on 77) were processed to check the accuracy of assigned categories to grain-size distributions, using multivariate analysis (entropy theory).
2. New grain-size analyses were performed on 12 samples, focusing on categories under-represented in the aforementioned series of analyses. Samples were treated for organic content (H_2O_2).

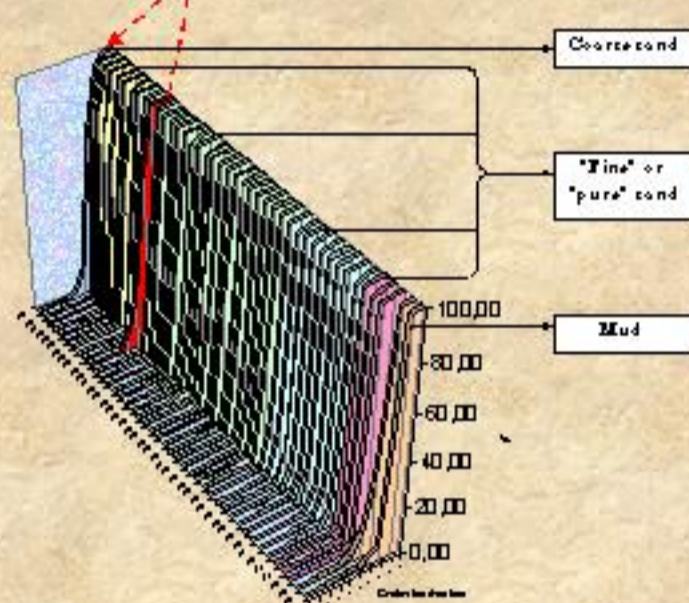
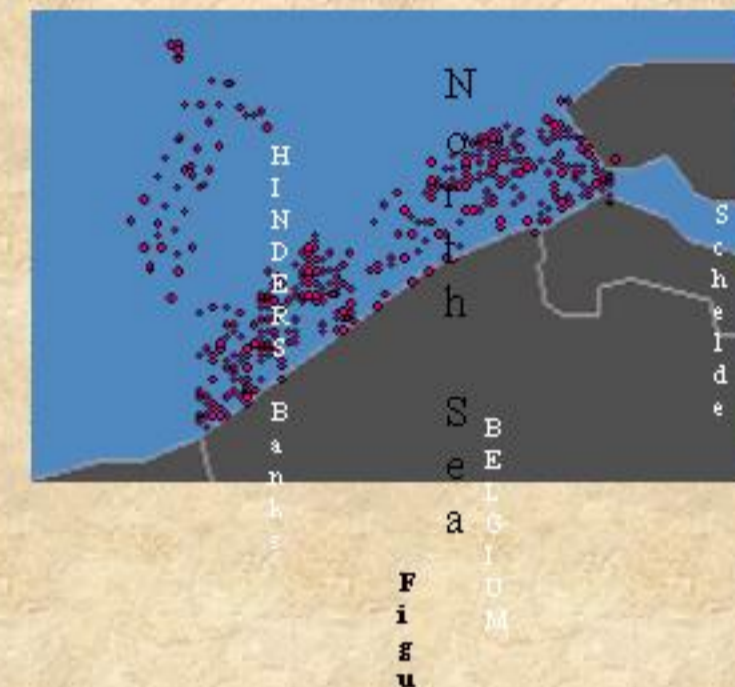


Figure 3 : Cumulated relative frequencies of grain-size fractions (1.5mm, 5mm, 2.5mm, 1.5mm, 1mm, 0.5mm; additional fine fractions according to a decantation procedure) of 33 samples in old analyses. Colours : multivariate analysis classification (6 groups). Text boxes : original description ; red : wrong category.

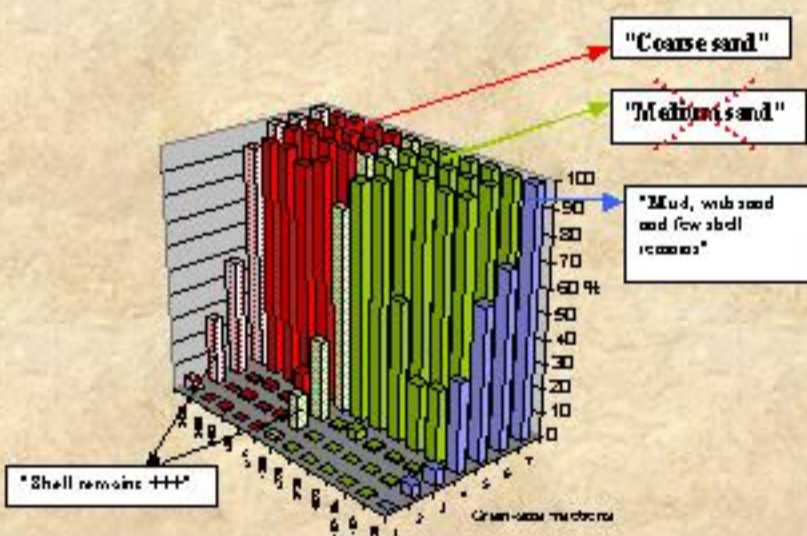


Figure 4 : Cumulative histogram of grain-size relative frequencies in new analyses. Fractions 1 to 7 : 2000, 1000, 500, 250, 125, 63 and $63\mu m$.

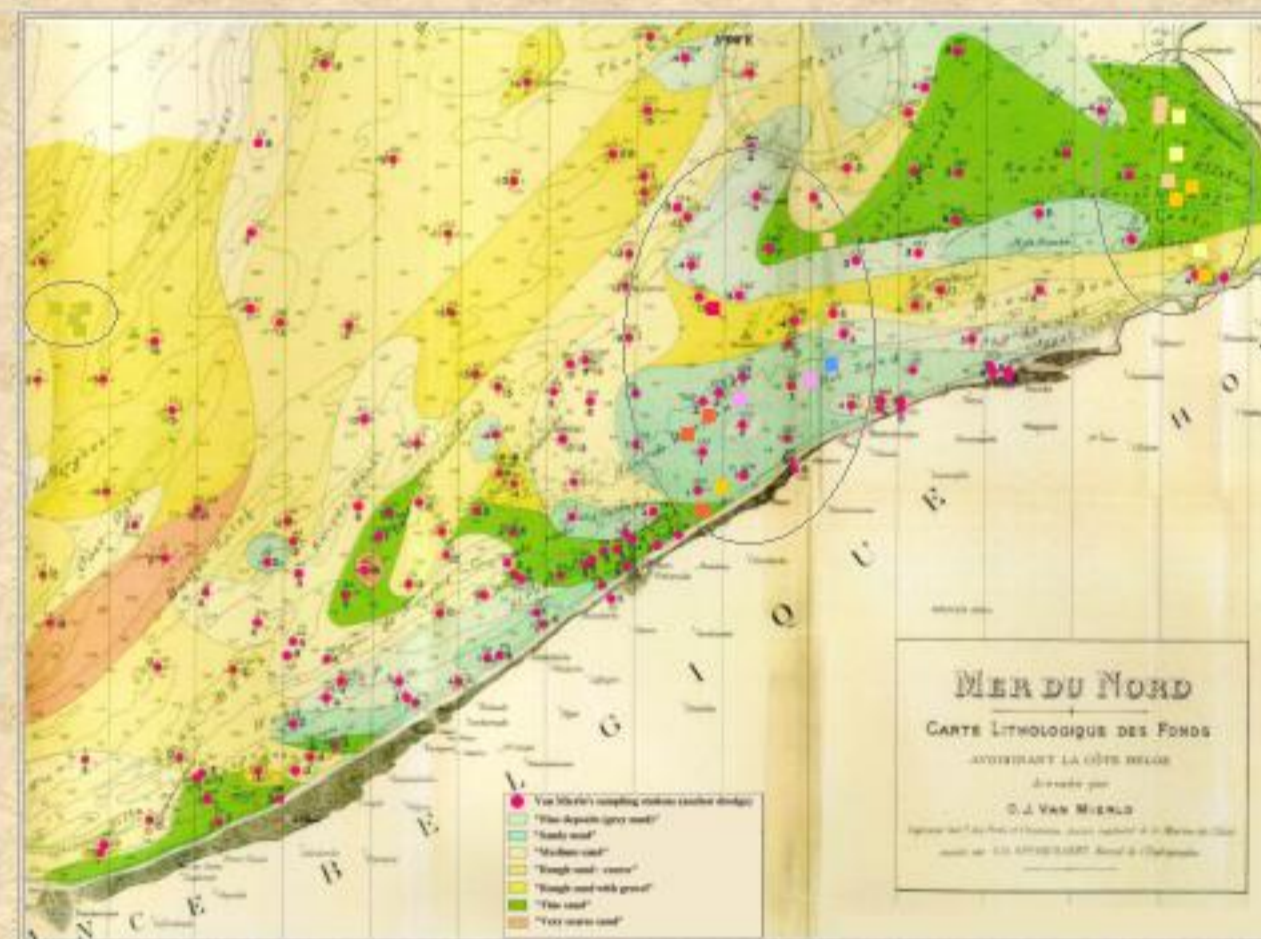


Figure 5 : Modified historical sediment map of Van Mierlo (1899) at Belgian coast, with some superimposed Gilson's observations (colours referring to categories from Table 1).

Category	Grain-size range
Mud (pure)	$63\mu m$
Mud with sand	
Mud with sand and shell remains	
Mud with sand, shell remains and gravel	
"Fine" sand (pure)	$63-75\mu m < FS < 125\mu m$
Fire sand with mud	
Fire sand with mud and shell remains	
Fire sand with shell remains	
Fire sand with mud, shell remains and gravel	
"Medium" sand (pure)	$125\mu m < MS < 250\mu m$
Medium sand with mud	
Medium sand with mud and shell remains	
Medium sand with shell remains	
Medium sand with mud, shell remains and gravel	
"Coarse" sand (pure)	$250\mu m < CS < 500\mu m$
Coarse sand with mud	
Coarse sand with mud and shell remains	
Coarse sand with shell remains	
Coarse sand with mud, shell remains and gravel	
Gravel (pure)	> $2mm$
Fire gravel	
Coarse gravel	

Table 1 : Proposed sediment categories. Colours : fig. 5. "medium sand" to be further investigated.

Preliminary results and discussion

Original grain-size profiles (fig. 3) reveal that "mud", "fine sand" and "coarse sand" descriptions correspond to a physical reality. The term "pure sand", rarely used by Gilson, was correctly interpreted as fine to medium grain-sizes, except in one sample of coarse sand. When having a look at samples described as containing shell remains and/or mud (not illustrated), grain-size profiles clearly confirm the description. When considering sediments as habitats for benthic species, such variation in bottom interstitial surface is important and should be considered, as proposed in Table 1.

New grain size analyses (fig. 4) without carbonate removal give good results for mud and shell remains presence. "Coarse sand" corresponds to a grain-size range currently recognized as "medium sand", probably due to the lack of sand > 500 μm in sampled areas. However, "medium" and "coarse" sands could not be distinguished by Gilson in the few samples analysed.

These preliminary results tend to demonstrate that the descriptions of sediments provided by Gilson a century ago are adequate for habitat mapping with some limits: at least four major grain-size categories are readily usable : mud, fine sand, coarse sand, gravel (fine and coarse). Furthermore, each class can be subdivided in function of mud, shell and gravel content (table 1). Considering "medium sand" representing nearly 16 % of the 440 samples considered, it is anticipated that at least 1500 can be processed.

When plotted on the original Van Mierlo (1899) map of sediments (fig. 5), a few data from Gilson tend to indicate that local heterogeneity of sediments (e.g. banks and deeper areas) can be taken into account. It should be noticed that the original map was drawn on basis of qualitative descriptions by Van Mierlo. Since depth measurements were performed at sampling points, our study indicates that "historic habitats" (depth and sediment nature) of the Belgian marine areas can be mapped and will constitute an important tool in the study of long term changes in the benthic biodiversity of the region.

To be continued...

- Check and recalculations (co-ordinates) of sampling locations; selection of usable data among the 2500 potential entries of sediments. Further grain-size analyses.
- Recalculations of depth measurements with old tide tables and mean LLW level.
- Data computing with GIS-software.

Acknowledgements

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