

**The collection Gustave Gilson as a historical reference
framework for the Belgian marine fauna :
a feasibility study**



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The Belgian marine areas (BMA) are dramatically and increasingly influenced by human activities. When ecosystem conservation and management practices are to be implemented, it is important to assess human impact on the ecosystem. For that purpose, information on the status of the marine fauna in absence of direct human impact is essential. Such information can be derived from "pristine" areas or from observations on "old" material. Belgium holds a unique historical collection of marine samples thanks to the extensive sampling efforts of Professor Gustave Gilson, a pioneer in marine ecology at the very beginning of the 20th century, a period during which human pressure was considerably lower than today. This collection is held by the Royal Belgian Institute of Natural Sciences (RBINS). Our project aims at examining the feasibility of using this century-old collection as a "reference" for the Belgian marine fauna in order to investigate long term changes and human impacts.

Gilson's sampling scheme and instruments have been studied in detail, focusing on the dredge (benthos samples) and on the "ground-collector" (sediments samples) operated in the BMA. Both instruments seem to have provided reliable samples. Three main surveys are dealt with in the present project :

1. A sampling grid covering the whole Belgian coastal waters (from Dunkerke, France to Walcheren, The Netherlands) up to 10 nautical miles offshore, following minutes of latitude and longitude. Dredging operations (> 600 stations) were performed on a distance of one nautical mile towards the open sea. Sediment sampling (> 2,000 stations) was performed at each node of the grid and in between.
2. In the area of the West, Oost and Noord Hinder (Hinders) Banks, Gilson established 30 crosses on the map. The arms of each cross are parallel to the dominating currents (SW >> NE). The center of the cross, the co-ordinates of which were precisely determined, was marked with a buoy. Biota and bottom samples were collected along the arms of the crosses.
3. Between the two aforementioned areas, Gilson determined a "transition" area in order to study a coast-offshore gradient of benthic species.

Gilson has collected marine samples between 1898 and 1939, with particular intensity and systematic scheme between 1899 and 1914. A total of nearly 13,000 samples have been collected, distributed as follows : around 3,000 sediment samples (mainly using the "ground-collector") ; 9,500-10,000 fauna samples (using various gears : nets, trawls, dredges, hand-picking, etc.). In most cases, sampling co-ordinates were determined with a good precision (the boat positioning method is described in detail by Gilson (1900)). 841 sediment samples are preserved in the RBINS. Marine biota were originally kept in formalin or alcohol, identified when possible and grouped by sampling station. Later on at the RBINS, the specimens were sorted out and classified by species in alcohol jars, often after taxonomic revision. These "sub-samples" were preserved with original sample numbers. In the RBINS, an estimated two third of the Belgian marine fauna samples belong to Gilson's material.

Many archives and unpublished documents have also been preserved together with samples, such as log-books, inventories, letters, information on sampling gears, etc., although some documents could not be recovered yet.

The building up of an exhaustive century-old historic list of species from the BMA as well as a study on species assemblages and their environment at Gilson's sampling stations will

only be feasible when all available information will be transferred into a database. Such a work is time consuming due to the structure of the collection and the need for taxonomic revisions. Consequently, we have focused our attention on some groups for “quality” assessment of samples and sampling data, viz. neogastropods, razor clams and echinoderms. As a first step, a series of taxonomic checks and revisions were performed. All available data were entered in a database created during the project, the “Southern North Sea Species Database” (SNSSD). Most animals are well preserved and are labelled with the original sampling data. Some sampling information, such as date and time, co-ordinates, depth, tide status and bottom description, have been recorded in a systematic manner. These sampling data have been compiled in a separate databank of localities.

The sediment collection was also assessed. Of the original 3,000 sediment samples collected, 841 sub-samples of approximately 150g are preserved at the RBINS in alkanthene flasks with unsealed caps and are accompanied with sampling information. The “quality” of these samples is to be evaluated in function of the research to be conducted (sedimentology, contaminant analysis, ...).

Five case-studies were performed in order to assess possible exploitation of the collection.

1. The neogastropod specimens of the RBINS have been studied. A total of 922 available samples were recorded in the general collection of the Belgian marine fauna, most of which originated from the Gilson collection. On 14 species, 12 required a taxonomic revision : 10 were subject to nomenclatural changes, two were incorrectly identified. Seven species were collected alive, while seven were represented by shells only, part of which are fossil or sub-fossil.
Historic distribution maps were drawn for alcohol preserved animals (empty shells were considered not relevant for species distribution maps). The common whelk, *Buccinum undatum*, was best represented. This species was surprisingly most abundant in the Hinders region, despite a more intense sampling effort in the coastal area. The same work was carried out on echinoderms. A total of 656 samples from 13 species belonging to four classes (Asteroidea, Ophiuroidea, Echinoidea, Holothuroidea) was recorded in the RBINS collections, mainly from the Gilson collection. Data are entered into the SNSSD and are to be processed soon.
2. The genus *Ensis* (Mollusca, Bivalvia) has been taxonomically investigated. Indeed, the taxonomy of some species of the genus is controversial. Morphometric measurements were performed on the specimens of five “species” from the southern North Sea (*E. ensis*, *E. arcuatus*, *E. phaxoides*, *E. siliqua*, *E. minor*) and on an invasive species (*E. americanus*). All specimen related information was entered in the SNSSD. A further study on holotypes and paratypes was performed in the Museum of Leiden (The Netherlands). The distinctions between *E. ensis* and *E. phaxoides* and between *E. siliqua* and *E. minor* are not straightforward. A more profound systematic investigation should be performed on these taxa before they can be properly identified.
3. A feasibility study on genetic applications of the Gilson collection was performed. Until recently, animals preserved in Museums were usually first fixed in formalin before preservation in alcohol (ethanol). Unfortunately, formalin damages and degrades DNA. Therefore, our aim was to determine whether genetic studies could still be performed on this historic material. DNA extractions and amplifications were performed on old specimens of *Littorina* (1904, 1911), *Ensis arcuatus* (1913) and *Ensis siliqua* (1938). While the extractions failed for *L. littorea*, the tests were successful for specimens of *Ensis*. This demonstrates that DNA extractions and amplifications on old alcohol

material are feasible. However, case-to-case feasibility investigations will be necessary for specific genetic studies.

4. An evaluation of the utility of samples for eco-toxicological applications has been performed. Contaminant analysis in alcohol preserved animals was considered not reliable. Indeed, aside from expected sample contamination during preservation (solvents of low purity, flasks, tags, manipulations, etc.), acidification during formalin fixation followed by several alcohol rinses probably resulted in leaching of contaminants. However, analysis in calcified parts (for example : dry mollusc shell, echinoderm endoskeleton) can be considered, provided that they have not been altered during their preservation. Sediment analysis was considered more relevant, although contamination problems are also possible. Twenty of the 841 remaining samples were selected, in which preliminary trace metal analysis is ongoing at the Department of Sea Fisheries (DvZ, Oostende) and at CODA laboratory (Tervuren). Organic contaminant analyses will be more difficult to interpret after a hundred years of storage in unsealed jars (varying degrees of volatility in contaminants, ageing of the matrix, ...).
5. A study has been performed on sediment grain-size as a parameter defining "habitat" for benthic species. Although only 841 samples remain in the collection, many of the original 3,000 samples were qualitatively described by Gilson. Our aim was to determine whether this information is reliable, in order to establish a map of historic grain-size data, using the sub-set of the 841 remaining samples. For that purpose, we have used the original results of 77 sedimentological analyses realised in 1907. We have also performed new grain-size analyses on 12 preserved samples. It can be concluded that the original qualitative descriptions are reliable with some restrictions. At least four main grain-size categories can be established (mud, fine sand, coarse sand, gravels). Mapping of medium grain-sized sands will require new analyses on preserved samples. Our aim being to consider habitats for biota rather than sedimentologic profiles, sub-categories are further proposed using information on shell remains, gravel and mud presence. When further considering the available geographic information provided with these samples, an estimated 1,000 to 1,500 descriptions should be usable for a mapping of sediment "grain-sizes" (including shells remains) in the BMA in the period 1899-1914.

In conclusion, the Gilson collection constitutes a material of high scientific value. A short investigation on historic zoological collections in neighbouring countries of the North Sea shows that Gilson's survey was quite unique in its design and, consequently, in the resulting collections. Sampling information is detailed, and many parameters have been recorded. A large part of the biological material has been identified by previous researchers although further taxonomic revisions are necessary for future research. The SNSSD database will be a valuable tool for long term research in the BMA and even at larger scale. The Gilson collection is particularly attractive for assessing long term changes in habitats and fauna in the BMA, provided that current marine research and monitoring programmes give comparable data (sampling gear, sampling effort, taxonomic coverage). The establishment of a century-old semi-quantitative "reference point" for biodiversity of the BMA with the Gilson collection is feasible.

Reference :

Gilson, G., 1900 : Exploration de la Mer sur les côtes de la Belgique en 1899. *Mém. Mus. Roy. Hist. Nat. Belg., Première série, 2* : 1-81.