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The collection Gustave Gilson as a historical reference framework for the Belgian marine fauna: feasibility study

Summary of the research

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SUMMARY

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 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 effort 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.

Gilson has collected marine samples between 1898 and 1939, with particular intensity and systematic scheme between 1899 and 1914. A total of more than 14,000 samples have been collected, distributed as follows: around 3,000 sediment samples (mainly using the "ground-collector"); around 1,500 water samples (various bottles: Richard, Nansen and Petersen); 9,500 fauna samples (using various gears: nets, trawls, dredges, hand-picking, etc.). In most cases, sampling coordinates were determined with a good precision. 841 sediment samples have been 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.

We have focused our attention on some groups for "quality" assessment of samples and sampling data, *e.g.* 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, coordinates, depth, tide status or 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 collected sediment samples, 841 sub-samples are preserved in the RBINS collections and are accompanied with sampling information.

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

1. A total of 920 available samples Neogastropods were recorded in the general collection of the Belgian marine fauna, most of which originated from the Gilson collection. Of 14 species, 12 required a taxonomic revision: 10 were subject to nomenclatural changes, three were incorrectly identified. Seven species were collected alive, while seven were represented by shells only, a part of which are of (sub)-fossil origin. The preservation of specimens is good. Historic distribution maps were drawn for alcohol preserved animals (empty shells were not considered). 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.

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 an alien invasive species (*E. americanus*) in the collections of the RBINS. All species en specimens related information was entered in the SNSSD. 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 collected for museum collections 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. 18S ribosomal DNA extractions and amplifications were performed on old mollusc specimens. While the extractions failed for *Littorina littorea*, the tests were positive for the specimens of *Ensis*. A further attempt on mitochondrial DNA of *L. littorea* was positive. This demonstrates that DNA extractions and amplifications are feasible on Gilson's material. However, case-to-case feasibility investigations will be necessary for specific genetic studies.

4. An evaluation of the utility of Gilson's samples for eco-toxicological applications has been performed. 20 sediment samples were selected for trace metal analysis. The first results in the « total » sediment (< 2 mm fraction) indicate no abnormal result with reference to possible secondary contamination. Cu levels were very low. Pb levels were quite high. Zn and Cd levels were more unclear due to a higher variation pattern. Although incomplete, these analyses showed that the sediment of G. Gilson could provide interesting results for the study of long-term trends in the metal levels of the BMA.

5. A study has been performed on historic "habitat" (sediment nature and depth) for benthic species. Although only 841 sediment 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 translate it into standardized grain-size categories and to establish a detailed reference sedimentologic map. Our investigation on grain-size profiles shows that four main grain-size categories can be established (mud, fine sand, coarse sand, gravels). Sub-categories are further proposed using information on shell remains, gravel and mud presence.. Depth data were investigated as well and seem reliable. This case-study indicates that these historical « habitat » parameters could be used in a long term investigation of the BMA.

In conclusion, the Gilson collection constitutes a historic 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, once incorporated within the database on the quality of the marine environment (IDOD, Integrated Dynamical Oceanographic Data Management) 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 yield comparable data (sampling gear, sampling effort, taxonomic coverage). The establishment of a century-old semi-quantitative "reference point" for the biodiversity of the BMA with the Gilson collection is feasible.