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A biobanking platform for fish-borne zoonotic parasites: a traceable system to preserve samples, data and money

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ABSTRACT

A biobank is a non-profit service that hosts a collection of biological samples organized as a technical unit with defined quality criteria, order and destination, to ensure full traceability of the sample and, above all, is a valuable underpinning for medical and biological research. We present the first biobank for marine biological samples, stemming mainly from the activity developed on zoonotic parasites. The creation of the biobank had three objectives: (a) improve the quality and traceability of the collection of zoonotic parasite samples; (b) serve as a supplier of marine field samples for scientific, industrial and clinical studies and (c) create a solution with high added value for marine samples derived from monitoring, both in its self-studies and derivatives. Web-based technology allows for an easier, faster and less disruptive implementation. Data from 15,855 fish specimens, which included morphometric and meristic data, as well as the description, quantification and location of the zoonotic parasites found on any single host, and genetic, antigen and protein data, were introduced into the database of the biobank. These data were introduced into the Biobank software, for which the only requirement is an Internet connection, and are now stored under a traceable basis and following regulations herein described. The software has restricted access by codes and passwords. Our biobank stores more than 278,000 zoonotic anisakids, as well as their associated information, from 19 fish species and 13 fishing areas. These samples include whole animals, DNA and proteins. Furthermore, we estimated the cost for the basic functioning of the Technical Unit of Biobank to maintain its infrastructure. The constitution of this biobank and the development of the programmed action will yield several global benefits that otherwise would not be achievable in a local/regional framework in three ways: economic, ecological and transfer to stakeholders.

1. Introduction

Curators of natural history museums have been responsible for the collection, storage and exploitation of samples from marine ecosystems, among others, during the centuries. The usual purpose of such collections, oriented to a wide audience as well as to provide reference material for taxonomic classification and cataloging of biodiversity, limited the potential use of this material for scientific purposes. This valuable work on natural history was the origin of sampling programs carried out for many decades, from early 20th century until the 1960s, when the industrial perspective gained more relevance and the need to explore, assess and monitor the use of marine ecosystems was wider more widely developed. Nowadays, biological samples collected from the marine environment are valuable for a wide variety of purposes such as long-term studies of climate change or the supply of compounds of pharmaceutical and cosmetic interest (Christiansen et al., 2014; Galli et al., 2015).

During the last few decades, research projects and networks for managing marine samples and sampling programs have been diverse and sometimes controversial. Efforts have been directed toward collecting components of the marine ecosystems during field sampling programs with no general attempts to implement internal management platforms or self-monitoring analysis and reporting technology for samples and associated information. Despite the operational limitations associated with sample processing, researchers made efforts toward improving the processing and use of the samples. Thus, there are some examples,

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such as the BIOTA cluster (https://wiki.ceh.ac.uk) and CORONA network (http://sites.biology.duke.edu) that fostered this search for excellence using links between researchers to optimize the use of samples under a multidisciplinary approach. More recently, MarBEF, an EU-funded project (http://www.marbef.org), was a platform to integrate and disseminate knowledge and expertise on marine biodiversity, with links to researchers, industry, stakeholders and the general public, undertaking a socio-economic approach in the field of marine biodiversity under a relatively fragmented nature. Other networks, such as Marnet (http://whitakerinstitute.ie/project/marnet/), an EU-funded transnational cooperation project, aimed at creating a marine socio economic network to develop a methodology to create, collate and use comparable marine socio-economic data across the Atlantic regions. The baseline of these networks is set from the utilization of "marine repositories". It is important to remark that processing of repositories does not imply complete traceability, in contrast to the clinical protocols for "biobanking". Therefore, banking and repositories are two terms that have to be understood in a different way. The main differences relate to the control process: while repositories could have relative uniformity in the way they store samples and their linked information, in sample banking, software guarantees the complete traceability and quality of the entire process, its linked information and the donor–cession system. Sample banks provide a complete traceability in the exploitation of these resources, improving the scientific excellence and also adding value to the outcomes of the present and future research projects. The cession–donation scheme of marine sample banks, the monitoring of traceable samples and interoperability of the data, will optimize trans-disciplinary studies to be undertaken in the future.

A decade ago, the cover of Time magazine stated that biobanks were one of the 10 ideas changing the world. They may constitute one of the next years' research infrastructures, which facilitate exchanges of samples and information under a best value for money approach. A biobank is a product that collects, stores and distributes biological material and their associated data. The OCDE in 2001 defined biobanks as Biological Resource Centers. They are an essential part of the infrastructures that sustain the life sciences and biotechnology. They consist of service providers and depots of living cells, genomes of different organisms and information concerning the inheritance and functionality of biological systems. Biorepositors must meet the highest standards of quality and experience required by the international scientific community as well as the industry for the distribution of biological material and information. They must therefore provide access to biological sources on which they depend on research and development in life sciences and the advancement of biotechnology. By biological material is meant: living organisms, cells, genes and relative information.

Currently, a major trend in environmental research implies addressing global phenomena around the study of large series of samples organized with well-defined and detailed criteria, with the specific information required in each case. The availability of traceable samples and associated information of high quality have been a plea that has been at the root of many of the most important advances in marine science. Typically, the collection of significant numbers of marine samples and quality information involves a major effort in planning, construction and finally operation; it is very time- and resource-consuming constraining the accurate development of the marine research. Therefore, the promotion and implementation of biobanks facilitate the access to quality samples (and associated data) by researchers who present a project with the appropriate scientific organization and with the proper ethical and legal safeguards. This represents an essential milestone in shortening the time that normally elapses between research and the application of its results, improving also the effectiveness of research. To enhance this effort and the desired impact, constant coordination and collaboration between biobanks and conceptually related initiatives is required, and within each of them among the different professionals involved in processing the samples and their associated information: identification of the extractions (samples), sampling itself, processing, storage, distribution, transfer, use of samples and associated information and overall management of these proceedings. The main distinguishing feature of biobanks, as currently understood, with respect to the classical concept of a collection of samples and associated data (collection of a research group, institutional collection or private collection), is its commitment to transferring samples and associated information to research groups in an open, transparent, and partnering way for the benefit and improvement of high-quality science. This distinguishing feature is unambiguously reflected in the current definition of a biobank drawn up by the OECD as a Biological Resource Centre.

Costing is a particularly labor-intensive issue for all sectors, but it becomes more complex in the public domain because it does not have as much disaggregated information as private firms. It is a proven fact that the valuation of inventories and the calculation of costs have become more important in the public sector (Pérez-Morote, 2000, Robleda, 2010). In addition, highlighting the advantages and possibilities offered has been a great step forward in recognizing the usefulness of its calculation.

One of the main objectives of the PARASITE project was the creation of the first biobank on marine biological samples, stemming mainly from the activity developed on zoonotic parasites. We understand the biobank as a non-profit service that will host a collection of biological samples resulting from this project and organized as a technical unit with defined quality criteria, order and destination, to ensure full traceability of the sample. Specific software operated remotely served as the base for the functioning of the biobank platform. The creation of the biobank had three objectives: a) improve the quality and traceability of the collection of zoonotic parasite samples obtained during the study of the main commercialized fresh fish species; b) serve as a supplier of marine field samples for scientific, industrial and clinical studies, thus establishing bonds of connection between the marina and biomedical research in the European R+D space and c) the creation of a solution with high added value of marine samples derived from monitoring, both in its self-studies and derivatives. The main idea is that the biobank serves to control and regulate the storage of biological samples and associated data, meaning any biological sample or biological material capable of conservation and that can hold information about the project objectives. This will allow us to ensure the availability of biological material quality, well sorted, processed and preserved to meet the demands of research. Given the boom that is taking the research in the field covered by this tool and the consequent need for biological samples within the scope of the biological material stored in the biobank will be available to the scientific community. Thus, the biobank work as a promoter of scientific research as researchers upon request, obtain such biological material for use in research, present and future, whose purpose here is the diagnosis of marine zoonotic parasites in fishery products. Derived from the main objective, we aimed also to present a model of cost analysis applicable to the Technical Unit of Biobank, held at IIM-CSIC, in order to provide a tool to obtain information on the costs incurred to meet the demand for samples.

2. Material and methods

2.1. Biobank implementation

The functioning of the biobank is based on the traceability of the samples and their associated data. For this purpose, it was used a computer system based on BioeBank (Navarro-Mateu et al., 2013;

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