

AGORA-MOLCOL

“Ensuring Belgian Natural History Collections for the 22nd Century: towards a joint tissue and DNA collection”

Institutions involved: Royal Museum for Central Africa (RMCA) and the Royal Belgian Institute of Natural Sciences (RBINS)

Period: December 2012 – April 2015

Both the RMCA and RBINS hold the most important zoological collections housed in Belgium. They belong to the Belgian Federal patrimony and both institutions have in their mission statement the obligation to preserve these collections for future generations and to provide access to them for scientific purposes. A small part, of predominantly recent accessions, is stored in various ways intended for both morphological and molecular research. The latter types of collections often involve tissue samples (like fin clips, or feathers) with or without the corresponding specimen conserved in the traditional way. Natural processes will gradually lower the “quality” of the genetic material if samples are not properly buffered against this decay, resulting in deterioration and destruction of DNA and RNA and thus making specimens unsuitable for molecular research. The current status of the collections does not allow full and optimal future scientific exploitation. Nor are any clear protocols or guidelines in place in both institutions to ensure that all new accessions adhere to rules to ensure suitable conservation. If the RMCA and RBINS, as keepers of these valuable and irreplaceable collections, want to secure future conservation and use for scientific research in the fast developing field of molecular systematics and evolutionary research, they need to invest in the development of appropriate strategies and protocols.

The scientific usefulness of natural history collections is, however, not only subject to the conservation quality of the samples and specimens, but also to the archiving and accessibility of the data and information associated with specimens and samples. Currently, specimen/sample data can be (partly) accessed via a plethora of ways that are not well-structured or standardized. Over time, this might result in loss of essential information. Both RMCA and RBINS have their own data management systems; hence, there is no single data portal from where the holdings of both Institutions can be consulted jointly. Yet, having all information of both institutions available through a similar database (preferably at a joint portal site) would greatly facilitate research activities by both internal and external researchers. Fortunately, there is a growing tendency towards increased collaboration between both institutions. A virtual merging of collections and associated data is, therefore, a positive and feasible evolution. To address these issues, the AGORA-MOLCOL project was launched. The research of this project focused on the existing tissue and DNA collections, though the results from this study will have important implications for the valorisation of both historical collections and new, future accessions. The main objectives were twofold and situated in two different disciplines: Collection Conservation and Bioinformatics.

Molecular systematics - Exploring, testing, and establishing collection conservation protocols for (future) molecular systematic research.

Reasoning: For the majority of the zoological holdings curated by both institutions, conservation methodologies currently in place do not guarantee DNA and RNA preservation over extended periods. For new accessions this shortcoming is partly addressed, but clear and universally accepted protocols are still missing. In order to ensure an optimal future use of these vast zoological collections, there is an urgent need for clear outlines and procedures, especially in view of the application of novel research interests and techniques within the field of molecular systematics such as RNA analyses, screening epigenetic marks (e.g. DNA methylation), next generation sequencing, etc..

Bioinformatics - Developing, testing and improving an institutionally overarching joint collection data management, retrieval and accessibility system.

Reasoning: current database systems at RMCA and RBINS are heterogeneous, not-centralized, and/or ill-adapted for the specific needs related to tissue and DNA collections and molecular systematic research. The availability of a uniform database system and of a joint portal system will greatly enhance the access to the collections in both institutions. It will also allow a more efficient and complementary exploitation of both collections.

Both objectives fit in, and are complementary to, the strategic plan of both institutions with regard to development of molecular systematic research. Over the last years RMCA and RBINS have jointly heavily invested in proposals for developing infrastructure for up to date molecular systematic

research, both regarding specimen repository (National Lottery subsidies for DNA and tissue collection infrastructure) and analysis (e.g. the Joint Experimental Molecular Unit (JEMU); joint BELSPO Action 1 projects). They also embarked on joint intensive collecting efforts to initiate new collections (e.g. 2010 Congo River Expedition). Addressing the storage and management efficiency of these collections is a logical continuation of the previous activities that were developed in close collaboration between both institutions. The project set out the following outcomes and products, with indication of results obtained:

(1) A set of standards and protocols that can be used as guidelines to ensure optimal, cost-effective and readily applicable methodologies for storage and quality maintenance of material for molecular systematic research.

Results: DNA extraction protocols were developed different kind of subsamples (feathers & hair, fluid-preserved, bones & teeth, hides and skins, stools, FTA cards, paraffin-embedded, swabs) in collaboration with JEMU researchers and can be found on the JEMU website : <http://jemu.myspecies.info/node/4601>

A review of recommendations for specimen collecting, labelling and preservation intended for further molecular work will be published in the series 'ABC Taxa' (<http://www.abctaxa.be/>)

(2) A standardized, shared, and jointly managed collection storage infrastructure housed in both institutions.

Results: A common storage system, consisting of unique 2D barcoded tubes and ultra-low temperature freezers has been purchased (through National Lottery grant) and are now operational (see following link: <http://jemu.myspecies.info/state-art-tissue-and-dna-storage-facility-rmca-and-rbins>)

(3) A compilation of protocols and test cases with respect to uses of collection specimens for molecular systematic research that goes beyond the current, standard Sanger methodologies for DNA sequencing.

Results: Different Next generation sequencing techniques were explored, in particular RAD-sequencing (collaboration Edinburgh Genomics), and GBS (collaboration Cornell University, Genomic Diversity Facility).

- Using RAD-Sequencing (Edinburgh Genomics) to resolve the phylogeny of a small species complex (*Ceratitis fasciventris*, *C. anonae* and *C. rosa*, Diptera, Tephritidae) <http://jemu.myspecies.info/node/4611>
- Using GBS (Cornell University, Genomic Diversity Facility) to study the population structure/phylogeny of *Ceratitis capitata* (Diptera, Tephritidae) - <http://jemu.myspecies.info/dna-barcoding-lake-tanganyika-cichlids>
- Using GBS (Cornell University, Genomic Diversity Facility) to study the population structure/phylogeny of the African Buffalo - <http://jemu.myspecies.info/node/4605#>

(4) An internal database management system for the tissue and DNA collections that will ensure safe data storage and retrieval, and provide an adequate and modern loan management system for collection material intended for molecular systematic research.

Results: The existing DaRWIn collection management system (<https://darwin.naturalsciences.be/>), developed by RBINS, was adapted for data management of tissue and DNA collections. ABCD Templates, user manuals and additional tools for taxonomy available for download :

- User manuals : <https://share.naturalsciences.be/d/f5820e3ea1/>
- ABCD templates : <https://share.naturalsciences.be/d/86ab709447/>

(5) A web-based, user-friendly portal where internal and external researchers and interested parties have free access to collection catalogues providing information on samples, specimens and taxa present in RMCA and RBINS, in particular with regard to the tissue and DNA holdings.

Results: While about 350,000 specimens of the RBINS collection are already entered in the DaRWIn database, the program as such is not yet implemented at RMCA. At the latter, only a few collections (Coelentera and Arachnomorpha) have been migrated. In order to facilitate the implementation at RMCA, it is earmarked as one of the five priorities suggested to the Secretary of State (Mrs Sleurs) for 2015-2019 period, and additional funds have been requested for the next three years (2015-2017). Once this transfer and implementation is succeeded, it is planned to further develop a joint portal where collection information of both institutions can be consulted.