A catalogue of bird bones: an exercise in semantic web practice

Gudmundur Gudmundsson, Seth D. Brewington,
Thomas H. McGovern, Aevar Petersen

Abstract — The vast databases of natural history collections are increasingly being made accessible through the internet. The challenge is to place this data in a wider context that may reach beyond the interests of scholars only. The North Atlantic Biocultural Organization and Icelandic Institute of Natural History are jointly developing a web based catalogue of bird bones, comprising digital images, and related information from the museum database. Linking the bird bone catalogue with the semantic web developed by STERNA will integrate the bird bone catalogue with diverse information on birds that is directed towards the general public.

Index Terms — bird bones, collections, natural history, semantic web.

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1 INTRODUCTION

Natural history museums have a long tradition of collecting and preserving specimens primarily for scientific study and also for public education and exhibition. Museum research has over time generated vast collections of specimens and related information, which was mostly accessible only to a closed community of researchers. The main reason was that collection information was registered on paper files and index cards. Information retrieval was thus confined to trained personnel only. Present museums almost universally rely on computer databases to register and update information of their vast collections, and almost all institutions are in the process of digitizing information on paper and card files. In addition to this, diverse information that

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G.Gudmundsson is with the Icelandic Institute of Natural History, Hlemmur 3, 125 Reykjavik, Iceland. E-mail: gg@ni.is.
S.Brewington is with the Graduate School and University Canter, CUNY, New York, N.Y. E-mail: SB@colostate.edu.
T. McGovern is with the Graduate School and University Canter, CUNY, New York, N.Y. E-mail: SB@colostate.edu.mail.
A. Petersen Is with the Icelandic Institute of Natural History, Hlemmur 3, 125 Reykjavik, Iceland E-mail: aevar@ni.is.

has resulted from scientific studies on specimens is often integrated to museum databases, like morphological measurements, chemical analyses and digital photos. Many collection databases have thus grown to comprise numerous data tables that share one or more common data fields. For example, a species name is commonly present in data tables that store information on collection locality, morphological measurements, chemical analysis, photos, etc. This conceptual link between data tables creates novel possibilities of filtering out information from diverse datasets, like species diversity at some locality, correlations in species distributions, etc. However, collection databases with clearly defined relations between data sets and standardized data entries can not only be utilized for research, but may also be utilized for educational purposes through the web. [1]

Effective dissemination of information entails making information readily available in such a way that users with different needs have the ability to comprehend it. Information on museum collections should therefore be provided in layers of successively greater depth and detail and in a variety of different contexts. Such a "virtual museum" may be defined as a means to establish access, context, and outreach by using information technology and to establish interactive dialog with users. [2]

2 The STERNA Project: Dissemination of Collection Information

Over the last ten years, ever more cultural and scientific resources have been digitised and made accessible on the internet. However, integrated semantic search and access to these resources that are hosted in many heterogeneous databases is still difficult to achieve. The vision of the STERNA project is to provide cultural and scientific heritage institutions the opportunity to make their digital collections accessible in a light weight fashion. This will be achieved by setting up a distributed digital library that is based on semantic web technologies and standards, such as RDF (Resource Description Framework) and SKOS (Simple Knowledge Organisation System). STERNA is especially designed for small and medium sized institutions with limited budget and technical staff. Thirteen European cultural heritage institutions, multimedia archives, technology providers and research organizations, from ten countries, are participating in the STERNA project.

A network of (semantically) related digital resources is accomplished by connecting data provided by several institutions through a reference structure, which comprises several kinds of "controlled vocabulary", from simple word lists and glossaries to taxonomies, thesauri and ontology. The architecture of STERNA is thus based on distributed data repositories, which are semantically connected into a network that can be searched from different perspectives (faceted search). The network can also be extended by adding new members as well as tools, instruments and guidelines. Individual organisations can thus connect to a wider network of content holding organisations and place their data in a wider and more general context [3].

The STERNA project is partly funded the European Commission's

*e*Content*plus* programme. It started in June 2008 and will end in May 2011, and the participating institutions are:

1. Salzburg Research, Austria (Coordination)
2. Archipelagos, Greece
3. DOPPS BirdLife Slovenia
4. Heritage Malta
5. 5.Hungarian Natural History Museum
6. Icelandic Institute of Natural History
7. Nat. History Museum of the Municipality of Amaroussion Greece
8. Natural History Museum of Luxembourg
9. Naturalis, Natural History Museum of the Netherlands
10. Netherlands Institute of Sound and Vision
11. Royal Museum for Central Africa, Belgium
12. Teylers Museum, Netherlands
13. Wildscreen/ARKive, UK
14. Trezorix, NL

The data sources are of different types and sizes, from natural history museums, audiovisual archives, research institutions and nature conservation agencies. The vision is to create a dispersed network of information nodes, where each is supported and sustained by a member institution. For practical reasons (limited funds and staff) the STERNA project is focused on data access on birds, although the general objective is to extend the network to serve worldwide audience with more general interest in nature and wildlife. The aims are to:

1. Offer substantial amount of data by the combined effort of several institutions.
2. Linking the data in semantic context.
3. Providing advanced site functionalities, such as faceted search.
4. Offering possibilities for users to contribute additional data.

3 THE BIRD BONE CATALOGUE

Bird bones are a constant source of interest both to nature observers and professionals. Excavation of archaeological sites often yields rich assemblages of zoological remains. Zooarchaeological studies in Iceland have indicated that early settlement relied to a greater extent on hunting, than in later periods. Prior to the eleventh century the faunal remains include a large number of fish and wild birds in addition to domesticated animals, while in later periods the presence of wild fauna drops dramatically [4], [5], [6], [7].

Accurate identification of bird bones often requires consultation of reference specimens in natural history collections. However, this usually requires visit to the museums, which can be time consuming and expensive. Internet access to photos of zoological bone specimens and associated information facilitates proper identification. If these bone data are linked to a wider source of information on birds, it may be of use to a much larger audience than a closed research community. It is on these grounds that The Icelandic Institute of Natural History and NABO, in association with STERNA, decided to develop internet access to

a catalogue of bird bones with conceptual relations to diverse bird information of cultural significance.

NABO (North Atlantic Biocultural Organization) was founded over 20 years ago in an attempt to cross-cut national and disciplinary boundaries of researchers in several fields of studies, like archaeology, biology, geology, and anthropology. NABO has worked to aid in improving basic data comparability, in assisting practical fieldwork and interdisciplinary ventures, in promoting student training, and in dissemination of knowledge to other scholars, funding agencies, and the general public. [8]

The objective of the bone catalogue is to provide basic information on the internet to aid identification of bird bones. Photos and associated information are registered and maintained in a relational database, which comprises three primary data sets:
1. Taxonomical classification of birds, including scientific and vernacular names in many languages
2. Photographs and descriptions of the major bones in 54 species that have a long tradition of being utilized by humans and are of cultural relevance.
3. Specific descriptions of individual bones of a particular species – along with a simple general directory of the major bones in birds: e.g. the skull, bones of the wings and legs, keel (sternum), pelvic girdle, furcula and coracoid.

Associated with these primary data sets are two secondary (supportive) data tables:
1. Inventory of available reference specimens of a particular species at the IINH
2. Exhaustive registry of literature references on Icelandic bird fauna.

The bone catalogue will open on the web by the end of 2010. It is not intended as a conventional identification key, as it does not provide stepwise guidance to reach a final identification. Instead, it provides two search options when looking for images of bird bones: 1) taxon name (species, genus or family) and 2) type of bone. These can be used separately or in combination. A search that is limited to, say, one type of bone and a single genus will filter and display all images of skulls of that genus. The associated (secondary) data tables provide an optional inventory of available specimens at the IINH and a fairly complete list of literature with relevance to Icelandic populations of birds.

Information on bird bones in museum collections, literature and inventory of museum specimens are not likely to interest others than archeologists and ornithologists, with focused reasearch interest on that subject. The intention with the cooperation between STERNA, NABO and IIHN is to enrich the bone catalogue by making it a part of a diverse semantic network. Images of bird bones would then be accessible in a conceptual context to bird enthusiast, ordinary nature observers, as well as outreach and educational programmes.

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