

THE MAGELLAN-ANTARCTIC CONNECTION: LINKS AND FRONTIERS AT HIGH SOUTHERN LATITUDES.
W.E. ARNTZ, G.A. LOVRICH and S. THATJE (eds.)

Biodiversity of Antarctic echinoids: a comprehensive and interactive database*

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SUMMARY: Eighty-one echinoid species are present south of the Antarctic Convergence, and they represent an important component of the benthic fauna. "Antarctic echinoids" is an interactive database synthesising the results of more than 100 years of Antarctic expeditions, and comprising information about all echinoid species. It includes illustrated keys for determination of the species, and information about their morphology and ecology (text, illustrations and glossary) and their distribution (maps and histograms of bathymetrical distribution); the sources of the information (bibliography, collections and expeditions) are also provided. All these data (taxonomic, morphologic, geographic, bathymetric...) can be interactively queried in two main ways: (1) display of listings that can be browsed, sorted according to various criteria, or printed; and (2) interactive requests crossing the different kinds of data. Many other possibilities are offered, and an on-line help file is also available.

Keywords: sea urchins; Antarctic; biodiversity, database.

RESUMEN: BIODIVERSIDAD DE EQUINOIDEOS: UNA BASE DE DATOS AMPLIA E INTERACTIVA. – Al sur de la Convergencia Antártica existen 81 especies de equinodermos, que representan una componente importante de la fauna bentónica en la zona. "Antarctic echinoids" es una base de datos interactiva que sintetiza los resultados de más de 100 años de expediciones antárticas y contiene informaciones de todas las especies de equinodermos existentes. Incluye claves ilustradas para la determinación de las especies e informaciones sobre su morfología y ecología (texto, ilustraciones y glosario); su distribución (mapas e histogramas de distribución batimétrica); y además presenta fuentes de información (bibliografía, colecciones y expediciones). Todos estos datos (taxonómicos, morfológicos, geográficos, batimétricos...) pueden ser obtenidos interactivamente de dos formas principales: (1) Indicación de listados que ofrecen la posibilidad de ser observados, ordenados según diversos criterios o impresos; (2) Preguntas interactivas combinando los diferentes tipos de datos. Otras posibilidades son ofrecidas, y hay disponibilidad de una sección "on-line" de ayuda.

Palabras clave: equinoideos, antártico, biodiversidad, base de datos.

INTRODUCTION

Although sporadic samplings had been made in the Magellan region previously, Antarctic echinoids were first collected during the British "Challenger" expedition (1873-76), and almost simultaneously by

the German "Gazelle" expedition (1874-76). Subsequently, they were regularly collected by successive expeditions that probed Antarctic and Subantarctic waters. After those pioneering voyages, oceanographic explorations delineated the main geographic areas around Antarctica, and collected abundant new echinoid species. The Antarctic Peninsula and, to a lesser extent, the Weddell Sea were the most

*Received June 7, 2004. Accepted March 10, 2005.

extensively explored areas. On the other side of the continent, the eastern Ross Sea area (Balleny Island and Victoria Land) was also repeatedly investigated. Subantarctic waters were largely explored in the areas where islands are plentiful, that is to say in the Weddell and Enderby quadrants. Since the Second World War, the installation of scientific bases and the appearance of modern oceanographic ships have triggered numerous supplementary explorations. However, the previous imbalance between the principal zones around Antarctica has continued to prevail, though new and deeper zones have also been investigated.

ANTARCTIC ECHINOID BIODIVERSITY

Among the 19 post-Palaeozoic echinoid orders, nine have been reported in the Antarctic, among which four are known only in the fossil record, and two are exclusively recent (Hotchkiss, 1982; McKinney *et al.*, 1988; Pawson, 1994; Néraudeau *et al.*, 2000). These nine orders are on the whole represented by 15 families, with few variations in the number of taxa over time. However, there are rather important changes in the composition of the fauna at the order and family levels. For example, only two orders are present from the Mesozoic to the Recent, while four others, known in the fossil record, survive today only outside Antarctica (David *et al.*, 2005). Recent Antarctic echinoids are widely distributed from onshore environments to the deep sea. Although they are not vastly diversified (there are only 79 species), they represent nine families and seven disparate orders, and display highly diverse morphologies from pencil urchins with smooth, cylindrical, spatulate, or strongly thorned spines to strange, bottle-shaped deep-sea forms and the almost cylindrical *Dermechinus*. In addition, Antarctic sea urchins are distinguished by some of their unusual life-history traits, including the fact that there are more brooding than broadcasting forms (Poulin and Féral, 1996). Adaptations to this reproductive pattern lead to unique features such as the bizarre, internal brooding system of *Antrechinus* (David and Mooi, 1990; Mooi and David, 1993).

THE DATABASE

Gathering and ordering the data about recent Antarctic echinoids led us to build a database and to

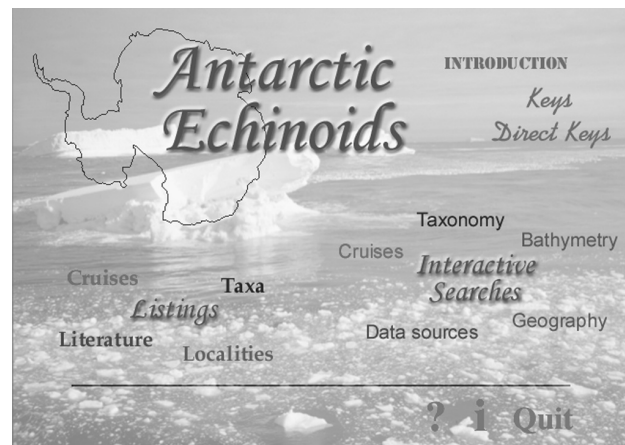


FIG. 1. – Home page of the database

conceive the idea to make this database a powerful tool for extracting and crossing synthetic information about Antarctic echinoid fauna. The main aim of this database is to provide a tool for anyone (ecologists, biogeographers...) interested in Antarctic fauna, but not necessarily for specialists of echinoids.

“Antarctic echinoids” is an interactive database synthesising the results of more than 130 years of Antarctic expeditions. Data from 59 oceanographic cruises, starting in 1872, and from museum and private collections have been revisited, and have led to a systematic revision of the Antarctic echinoid fauna.

The core of the information stored in the database includes: (i) taxonomy, encompassing determination keys, morphological diagnoses, illustrations and a glossary; (ii) geographic and bathymetrical distributions; and (iii) cruises and data sources, including museum collections. The database can be interrogated in two ways that are available from the home page (Fig. 1):

- A static query allowing a simple browsing of the data and displaying listings of taxa, geographic records, cruises, literature and collections, with the possibility of sorting and printing. In this part, a system of illustrated dichotomic keys allows one to advance step by step in the determination of families, genera and species.

- An interactive query allowing connections and combined queries between taxonomy, geography, bathymetry, cruises and data sources. This query makes full use of the relational aspect of the database.

The database comprises information about 81 specific or subspecific taxa gathered into 30 genera, 9 families and 7 orders. For every taxon, the database provides illustrations, diagnosis, a geographic distribution map (Fig. 2) and a histogram of bathy-

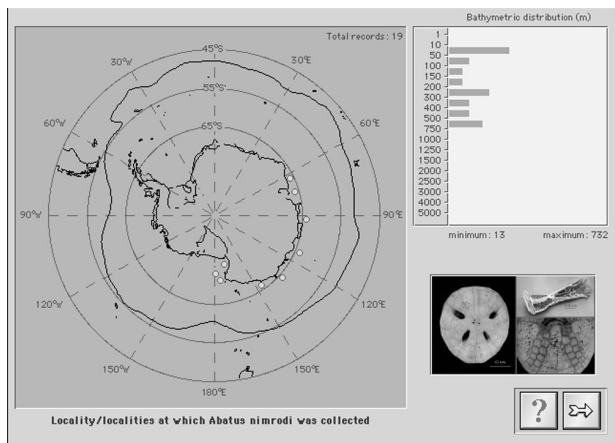


FIG. 2. – Geographic distribution of a selected taxon

metrical distribution. Localities are divided into quadrats of 5° latitude and 10° longitude in conjunction with depth. Only the localities situated south of the Antarctic Convergence were considered. Two maps are available for geographic queries, one with cells corresponding to the quadrats, and one with several sets of larger cells (including the four classical Antarctic quadrants, and rings of latitudinal range). A glossary of echinoid terminology is available to help people who are not familiar with echinoids to read the diagnoses. It includes 139 terms with precise illustrated definitions. In addition, general documents dealing with the history of Antarctic cruises that have searched for echinoids, the Antarctic tectonic and climatic evolution, and an extensive part on the biology of echinoids are provided. For each step, a help screen is available in order to guide the user through the system and give explanations.

CONCLUSIONS

Availability

The database allows one to make numerous types of queries, therefore answering biogeographic as well as ecological questions in a rapid and user-

friendly way. It was built with the 4D™ software but is available in a compiled form which does not require 4D to be installed on the user's computer. It works on Apple Macintosh computers, and is also available for Windows.

If you use the database, please quote this paper.

ACKNOWLEDGEMENTS

We thank H. Schultz (Alfred Wegener Institute, Germany) and C. Madon-Senez (Biogéosciences, Dijon) for their contribution to the data, N. Cominardi for loaning us specimens from the Muséum National d'Histoire Naturelle, Paris (France) and C. Ahearn for her help with Antarctic specimens housed in the Smithsonian Institution, Washington (USA). This work is a contribution of the UMR CNRS 5561 Biogéosciences-Dijon and of the CIBIM (Centre Inter Universitaire de Biologie Marine). Research was supported by an SSTC grant to C. De Ridder, and by the Trans'Tyfpal project.

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