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NATIONAL DATABASE ON BIODIVERSITY – A TOOL CONTRIBUTING TO A BETTER UNDERSTANDING OF THE FLORA AND FAUNA OF THE MALTESE ISLANDS

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ABSTRACT

The National Database on Biodiversity (NDB) project was initiated in 1991 within the framework of the Biological Diversity and Genetic Resources Network of the Malta Council for Science and Technology (MCST), in partnership with the Department of Biology of the University of Malta. This project is concerned with the collection and cataloguing of information on Maltese biodiversity and with making this information accessible to a wide range of potential users in the form of a computer database. In the pilot and building phases of the project, data on the flora and fauna of the Maltese Islands was structured in an appropriate format and a customised database with data entry, editing, management and querying facilities was created using Corel® Paradox® 8; the database currently holds some 450 species records and can be expanded to cover the entire range of Maltese species. The problems and opportunities in setting up such a database are discussed.

INTRODUCTION

Biological diversity (biodiversity) is an umbrella term for the sum total of the variety and variability among the living organisms of this planet, the ecological role they perform, and the genetic diversity they contain (Wilson, 1988). One of the major concerns today is the rapid loss of biodiversity, which, although it may take many forms, at its most fundamental and irreversible, involves the extinction of species (McNeely *et al.*, 1990).

To counteract this loss, it is imperative to manage biological resources, but management requires stocktaking exercises as well as monitoring and inventorying of species and populations (Busby, 1997). This in itself creates problems since the number of species that occur in a given locality is not precisely known for many groups of organisms and most figures for species diversity and abundance are only rough estimates (Hawksworth & Kalin-Arroyo, 1995; for Malta, see Schembri, 1992 and Schembri *et al.*, 1999). Moreover, the conservation of biological resources requires information not only on basic taxonomy but also on other factors such as human use, geographical distribution, status, trends, ecological relationships, as well as protection status by virtue of international or regional legislation (see for example McNeely *et al.*, 1990 and Heywood, 1997). Until recently, compiling and disseminating such information would have been a prohibitively expensive and time-consuming task, however advances in data management technology now make it possible to compile, update and disseminate such databases efficiently and at moderate cost.

The N.D.B. project: Objectives

The National Database on Biodiversity (NDB) project is concerned with the collection, collation and cataloguing of information regarding Maltese biodiversity, giving special attention to those species and local populations that are of particular scientific, ecological and/or conservation importance, and with providing easy access to this data. Once implemented, the database would effectively provide local scientists, environmentalists, environmental managers and other interested parties with a centralised and accessible repository of accurate and up to date information on the species occurring in the Maltese Islands and their surrounding waters.

The significance of the NDB can be seen when realising that most of the information concerning local biodiversity does not yet have any specific physical location (i.e. a library), and is often in the hands of a few interested persons who have accumulated a collection of literature over the years. Thus, it is self evident that once the NDB is fully functional, it will become a key tool contributing to the understanding of local biodiversity, including its variety, ecology and scientific and economic importance, as well as for the co-ordination of local conservation and management efforts, and for assessing

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potential biotechnological and other applications.

The NDB project, initiated in 1991, took on a new significance following the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil in June 1992. One of the results of this conference was the Convention on Biological Diversity. This convention emphasises the need to improve the collection, management and dissemination of scientific information on biodiversity. Malta has recently (December 2000) ratified this Convention, and therefore the NDB project can now effectively become part of Malta's contribution to the global effort to study and conserve biodiversity.

Apart from providing information on Maltese biodiversity to all who require it, other uses of the NDB are expected to be the preparation of synoptic checklists of Maltese biota; the highlighting of deficiencies in the knowledge of particular groups and thus the identification of possible areas for future research; the identification of organisms of economic, cultural or special scientific importance, as well as the identification of species requiring immediate conservation measures. The NDB should also contribute towards Malta's obligation with respect to the Convention on Biological Diversity to document the nation's biodiversity.

Databases, and understanding biodiversity

The 1992 Convention on Biological Diversity recognised that the organisation of data relevant to biodiversity is not merely an academic exercise, but is an essential tool as regards environmental management. This Convention provided the impetus to numerous projects aimed towards the collection and analysis of data regarding different aspects of biodiversity, with the result that today a number biodiversity databanks are available. Examples include:

- The Species 2000 Programme [http://www.sp2000.org/]. Originally a joint programme of several scientific unions in association with the Biodiversity Programme of UNEP and with the Clearing House Mechanism of the Convention on Biological Diversity, since 1998 it has been incorporated as a UK company operating as an independent federation with taxonomic database organisations as its members. The aim of Species 2000 is to create a uniform and validated quality index of names of all known species as a practical tool (1) for use in inventorying projects world-wide; (2) as an Internet gateway to species/biodiversity databases world-wide; (3) as a reference system for comparison between different inventories; and (4) as a comprehensive catalogue for checking the status, classification and naming of all species.

- The Global Biodiversity Information Facility (GBIF) [http://www.gbif.org/] is an initiative of the Organisation for Economic Cooperation and Development's Megascience Forum Working Group on Biological Informatics, whose purpose is to coordinate the standardization, digitisation and global dissemination of the world's biodiversity data.

- DIVERSITAS [http://www.icsu.org/DIVERSITAS] is an international programme of biodiversity science sponsored by UNESCO and several members of the International Council of Science (ICSU). The goal of DIVERSITAS is to provide accurate scientific information and predictive models of the status of biodiversity and sustainability of the use of the Earth's biotic resources, and to build a worldwide capacity for biodiversity science. One core programme of DIVERSITAS is systematics inventorying and classification.

- The International Working Group on Taxonomic Databases (TDWG) [http://www.tdwg.org] was started in 1985 as an international working group to explore ideas on standardization and collaboration between major plant taxonomic database projects. However, it has since expanded its scope to include taxonomic database projects from all biological disciplines. TDWG is affiliated with the International Union of Biological Sciences (IUBS) as the Commission on Taxonomic Databases and members include institutions and individuals responsible for biological databases with taxonomic components.

The level of effort and expense diverted to producing databanks such as the above suggests that the current interest in biodiversity databases is not merely a passing fashion, but is a direct response to an increasing demand for readily accessible, accurate and detailed information.

The data most relevant to a biodiversity database can be classified under three main inter-related categories:

1. **Taxonomic data** i.e. data pertinent to the diversity of species. Individual species may be defined according to a wide variety of criteria, but are frequently considered to consist of individuals between whom there is significant genetic exchange (i.e. sharing in a common gene pool), but which do not interact genetically with members of other gene pools. Such organisms consequently have numerous characteristics in common, such as anatomical, physiological or behavioural traits.
2. **Genetic data** i.e. data on the genetic variation that determines the nature and attributes of individual organisms. The genetic variation within species is part of the evolutionary mechanism that allows different generations of individuals to adapt to changing circumstances. A species that is genetically impoverished is less likely to adapt and is consequently more likely to become extinct should environmental conditions change.
3. **Ecological** data i.e. data on the diversity of ecological communities. This is a very important and vulnerable aspect of biodiversity as it permits the existence of the rich variety of taxonomic and genetic biodiversity. Ecological diversity may be described in terms of

interactions: those with the physical environment within which this diversity survives, and those with other organisms that constitute the biological environment of the species.

Taxonomic data form the backbone of any biodiversity database, as this allows biological diversity to be identified and placed within a hierarchy that can be used for data filing and management purposes. Consequently, the NDB project has so far been oriented mainly towards the collection of such taxonomic data. Information resident within the database is organised in a logical manner with species catalogued in terms of their taxonomic rankings.

Other descriptors used in the NDB include categories concerning ecological, scientific, social and economical significance. This includes details such as Red Data Book status, as well as an estimate of the degree of exploitation and any conservation measures. The information also includes a bibliography, which may be used as a launching point for further in-depth research on the various taxonomic groups catalogued.

The NDB project – pilot and building phases

The NDB was initiated in 1991 within the framework of the Biological Diversity and Genetic Resources Network of the Malta Council for Science and Technology (MCST), in partnership with the Department of Biology of the University of Malta. The MCST has sponsored two Fellowships (each of 2 years duration), and a number of part-time workers with the aim of rendering this database functional.

The development of the NDB was planned to occur in three phases:

1. A **pilot phase** during which the system is designed and tested using data from a few groups of organisms;
2. A **building phase** during which the system is implemented and more data on various groups is entered into the database; and
3. A **consolidation phase** during which the database will be expanded to cover as much as possible of the known biota of the Maltese Islands and the data made available to different users.

The first NDB Fellow was appointed in 1991. The primary task was to produce a prototype database in order to demonstrate the viability of such a project. Sample data entries from four widely separated groups (Orchidaceae - orchids, Orobanchaceae – broomrapes, Cerambycidae - long-horn beetles, and Scombridae - tuna and mackerel) were produced and circulated amongst a wide range of potential users that included NGOs, policy-makers, museum curators, the Government's Environment and Agriculture departments, health workers, industrial firms concerned with biodiversity related subjects such as pest control, and local and foreign experts in the different fields of concern to the database. The feedback received determined the basic format that was to be adopted by the NDB (Mallia & Schembri, 1991). Commercial database software was adapted to the needs of a local biodiversity database. Specimen data were collected and organised into an appropriate format. When the term of the first Fellowship ended, part-time workers continued further input of data. However, it was realised that in order to assure the success of the NDB project, full time staff were required.

As a consequence of the above, a second Fellowship was awarded in 1996. Owing to rapid developments in the field of information technology (and its potential with respect to biodiversity databases), this second Fellowship was primarily concerned with assessing the best way of updating the software and hardware components of the NDB. The design of a new biodiversity database required an in-depth analysis of database systems, particularly those in use by other projects of a similar nature elsewhere, and their potential with respect to the requirements of the NDB project.

The data resident within the NDB had to be reviewed, given that the project had been dormant for three years. It was noted that the employment of part-timers resulted in the inputted data being inconsistent due to the lack of co-ordination between different input procedures. A new database management system was created using Corel® Paradox® 8. This involved customising the software such that it provided the required querying facilities, together with user-friendly interfaces. The dataset contained within the database was standardised, and a list of keywords (essential for efficient querying facilities) was generated. The final task carried out by the second Fellow was the compilation of a manual regarding the maintenance of the NDB database: *A biodiversity database designed using Corel® Paradox® 8: Guide and manual* (Sant, 1998).

The NDB project – present status and future prospects

At the time that funding for the second Fellowship ran out at the end of 1998, the NDB project had reached the stage of being a fully operational system with some 450 full species records that had been validated and another 300 or so that still required inputting and validation. An example of a typical record is shown in the Appendix. The customised database software was fully functional and allowed data entry, editing, management and querying. The next step is to continue adding records and to make the database accessible to all potential users, possibly by placing it on the Internet. No funds for the third phase have been secured to date and the NDB, which is presently housed at the Malta Council for Science and Technology, is currently dormant.

Nonetheless, work on the cataloguing of local biodiversity that will be complimentary to the NDB project, should this be re-activated, is still being carried out. An example of this is the recently completed database on the Archaeogastropoda (a group of marine molluscs) from Maltese coastal waters produced by Sant (2001). The production of this database involved the pooling of data collected from different sources and from museum specimens. This data was then used to analyse the biogeographic affinities of the local suite of archaeogastropods, and to produce a computerised multiple

entry key that could be used by non-specialists in the group for the identification of specimens.

The future development of the NDB should include the following tasks (not necessarily in the order presented):

1. The continuation of the process of data collection;

2. The validation of the data resident within the database by experts in the field, with a view towards the dissemination of these data;

3. A review of the choice of software to be used for integration of the datasets collected above with other datasets (particularly those forming part of international initiatives);

4. The storage, evaluation and study of distribution data and other spatial information using Geographic Information Systems, as described by Froese & Pauly (1994) and Light (1998).

The linkage of 'traditional' biological data with information on other environmental aspects, such as edaphic, climatic, and socio-cultural data will definitely produce results that would be invaluable to all organisations and agencies interested in environmental management or the implementation of the concept of sustainable development. It is self evident that those individuals and agencies that need this tool should promote its continuation and contribute towards its maintenance.

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APPENDIX

Sample National Database on Biodiversity entry for the Maltese freshwater crab *Potamon fluviatile lanfrancoi* to illustrate the structure of the database records. Images are also available as part of the record but are not included here.

SPECIES ID.	***Potamon fluviatile***
KINGDOM	Animalia
PHYLUM	ARTHROPODA
SUBPHYLUM	Crustacea
CLASS	Malacostraca
SUBCLASS	Eumalacostraca
ORDER	DECAPODA
SUBORDER	Reptantia
SUPERFAMILY	Potamoidea
FAMILY	Potamidae
SUBFAMILY	
GENUS	*Potamon*
SUBGENUS	
SPECIFIC NAME	*fluviatile*
AUTHOR (of SPECIES)	(Herbst, 1785)
SUBSPECIES	*lanfrancoi*
MALTESE NAME	qabru, qobru, granc ta' l-ilma helu, granc ta' l-art
ENGLISH NAME	Maltese freshwater crab
SYNONYMS	*Thelphusa fluviatilis* Latreille *Potamon edulis* (Latreille 1818)
LOCAL DISTRIBUTION	Malta: Wied il-Gnejna, Wied il-Bahrija, Il-Wied ta' l-Imtahleb/Wied Markozz, San Martin (near Wardija), Il-Wied ta' Gordajna Gozo: Wied il-Lunzjata
GLOBAL DISTRIBUTION	Endemic to the Maltese Islands (Malta, Gozo)
LOCAL ABUNDANCE	Rare (localised populations)
IUCN RDB STATUS	NOT LISTED
MALTA RDB STATUS	Endemic; Endangered; Restricted distribution in the Maltese Islands
HABITAT	TERRESTRIAL/FRESHWATER
	Microhabitat: burrows; in crevices Community type: watercourses (slow moving water), agricultural areas
PICTURE	(available)

NOTES

Taxonomy: Authors of subspecies: Capolongo & Cilia (1990). Only species of freshwater crab in the Maltese Islands.
Biogeography: Local populations have been described as a distinct and endemic subspecies. The Maltese population may be a relict of the Plio-Pleistocene between Sicily and Malta.
Conservation: Legally protected (Legal Notice 49 of 1993). Species threatened due to dearth of habitat type in the Maltese Islands and by casual pointless collection.
Behaviour: Generally occupies the banks of streams with thick reed beds and digs burrows up to one metre in depth; burrows may have more than one opening. Small individuals generally keep under stones and in crevices under dense vegetation.
Cultural Importance: named after Guido G. Lanfranco (Capolongo & Cilia, 1990). It used to be consumed by people during periods of fasting. This species appears on the Maltese five-cent coin.

The Bahrija population is the most abundant on Malta, occupying a watercourse of about 350m at its fullest extent. It also used to occur at Marsa and Bingemma, but these populations have now been lost. The only known Gozo population, at Wied il-Lunzjata, used to be more abundant as was the amount of water flowing from the source, but this population has declined in recent years. The species is endangered because of its restricted distribution and the slow reduction or total destruction of the perennial freshwater streams in which it lives. It is also affected by pesticides, urbanization, and indiscriminate collecting.

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