MAPPING AND DATABASING SUBTERRANEAN BIODIVERSITY – REPORT ON INTERNATIONAL WORKSHOP IN SOUTHERN FRANCE, MARCH 2001

- Arthur Clarke

In the third week of March this year, the small town of Moulis in the Department of Ariege in southern France was "invaded" by almost 60 biospeleologists from seventeen countries around the globe. (A "Department" in France, is a small geographic region, perhaps akin to what we would term as a "Municipality".) Situated in the mid-Pyrenees near the larger town of Saint-Girons, about 90km south of Toulouse, Moulis is renown as a centre for research into karst hydrology and subterranean fauna. The Centre National de Recherche Scientifique (CNRS): the French equivalent to the Australian CSIRO, operates a speleological research base at Moulis: the *Laboratoire Souterrain* (Subterranean Laboratory) with support from two tertiary bodies from Toulouse: the Paul Sabatier University and the National Polytechnic Institute. Founded by Professor Albert Vandel in 1948, the CNRS complex at Moulis is situated near one of two laboratory caves where cave scientists study a range of speleological aspects in different sections of the cave, including the functional and experimental biology of *Proteus* and other salamander species.

The CNRS complex at Moulis (including student accommodation block) provided the base for a recent international workshop titled "Mapping Subterranean Biodiversity" – or if you prefer it in French: "*Cartographie de la biodiversité souterraine*". Organised by the *Societé Internationale de Biospéologie* (SIB) and co-chaired by David Culver, Louis Deharveng and Janine Gibert, most of the participants were SIB members from nine European countries: Belgium, Croatia, England, France, Italy, Netherlands, Romania, Slovenia and Spain. In addition there were a number of cave biologists from USA, plus other attendees from Brazil, Canada, Canary Islands, China, Cuba, Morocco and myself from Australia.

The international workshop included a very intense program scheduled over three days with most presentations given in English, following the opening address in French by Alain Mangin: the Director of *Laboratoire Souterrain*. The purpose of the workshop was to bring together those cave biologists and database specialists from around the world who have been involved in the study, recording, databasing and mapping of subterranean biodiversity. After an initial plenary session, there were a number of thematic sections related to the creation and use of databases with a mix of formal and informal presentations followed by discussion opportunities for participants. Amongst the first topics covered were database construction for subterranean species and the problems associated with creating cave fauna databases, for example: What is included? Just obligate species? Just cave records? Who has access to database? How can it be controlled? How can participation be encouraged as well as credit for work given? Can all cave and other site locations be obtained? Other major topics discussed included web-based databases; construction of maps based on grids or projections, UTM's, hexagons and computer mapping programs such as *Ckmap* and *Worldmap*; spatial statistics incorporating mathematical predictions and gap analysis; conservation planning and the scale of management; and reports on the status level of subterranean biodiversity data, data collection itself and our progress in mapping biodiversity, at both a country level and by taxonomic group.

Several participants presented reports on the knowledge status of subterranean diversity for a defined geographic area (mostly specific provinces, states or countries), an animal group (e.g. fish) or habitat type (e.g. anchialine habitats). Acknowledged highlights were the reports on the use of geo-referenced computer recordings as an instrument for protecting cave-dwelling species in the Tenerife region of the Canary Islands (Isaac Izquierdo); database of Tasmanian cave invertebrate records and the ASF web-based database with IUS fields (Arthur Clarke); a demonstration of linked species location maps for Italian cave fauna records (using Ckmap mapping program) as adopted by the Italian Ministry of Environment (Fabio Stoch); mapping endemic biota in the Pyrenees and Western Europe (Louis Deharveng); development of the biospeleological database in Croatia (Sanja Gottstein-Matocec); the conservation status of subterranean fauna in Morocco (Mohamed Messouli); presentation on mapping with hexagons in USA and the role of Karst Waters Institute (David Culver); an overview of the subterranean biodiversity in the United Kingdom (Graham Proudlove) and the mapping of subterranean biodiversity in Brazilian karst areas (Eleonora Trajano). There were several status reports related to species types and habitats: Graham Proudlove provided a checklist overview of the 85 known hypogean (cave-dwelling) fish species throughout the world; Stephane Blondeau presented detailed maps showing the distribution of the aquatic amphipod (*Niphargus*) in France; in her presentation of the European groundwater project, Janine Gibert provided an outline of the PASCALIS system: Protocols for the Assessment and Conservation of Aquatic Life in the Sub-surface; and Tom Illiffe demonstrated his website, maps and photographic database of the species living in anchialine habitats of the world (see www.cavebiology.com). A number of the European presentations referred to MSS type species, relating to the invertebrate fauna living in the *Meso Superficial Subterranean* habitats in the karst bio-space (*meso-cavern*) voids within the broken rock strata located between the topsoil layers and solid rock

Each session had a chairperson and a "*rapporteur*" (reporter) who was responsible for providing a written overview of the discussion. These overviews will provide the basis for the workshop proceedings, along with summaries of the respective presentations that will include any

relevant Tables of Figures related to cave fauna databases and mapping projects in different parts of the world. The various presentations covered a range of related topics including the recording or mapping methods for various national, regional, karst area and individual species or genera databases and the management of these databases.

The overall aim of this workshop was to agree upon a standard minimum format for data on subterranean biodiversity, including geographic scale and a coordinating structure for data collection, entry, and mapping. Considering the diverse array of different techniques with varying numbers of database fields and relational tables (e.g., in Croatia, cave biologists use a single database table with over 70 fields), it was quite extraordinary to find that we could agree by consensus to a limited number of essential fields that would form the basis for an international database to record subterranean biodiversity. Despite my suggestion that we should tie our international biospeleology database fields into the existing established international speleology (IUS) fields, it was unanimously decided by the Moulis workshop attendees that they did not want to be constrained by the field structures of any other national or international speleology database. The fields proposed were meant to be the minimum fields, i.e., - the bare minimum required for international purposes.

The fields agreed to at Moulis for the international biodiversity database are:
(1) Species name (including Genus) and relevant species authority;
(2) Higher taxonomic classification (hierarchical): Family / Order / Class / Phylum, - or reverse order;
(3) Habitat classification (coded);
(4) Latitude and longitude (degrees, minutes, seconds);
(5) Datum (coded);
(6) Precision level of data/datum;
(7) Site name (hierarchical): country, state (or province), county, municipality (or department) and cave site name (possibly including cave number, if any);
(8) Species/ specimen collection year;
(9) Contact person (database source);
(10) Notes and comments.

Despite the fact that many countries have now upgraded to grid reference map systems, it was agreed to use Latitude and Longitude as location co-ordinates in order to maintain the historical perspective where most, if not all-previous or early location records are defined in terms of Latitude and Longitude.

A small group of workshop participants was appointed to finalise structure of the international database of biospeleology and establish the protocol for a universally accepted ecological and habitat classification. As the only international organisation for subterranean biology, the *Societé Internationale de Biospéologie* will coordinate the work of this group and work out a proposal for coordination of the work and decide where the database will be based. It was assumed - or hoped - that this minimum ten-field set would be considerably expanded in the linked national (country) level based databases, with possible/ probable further expansion (more fields) at a local regional Provincial (State), County, Municipality or karst area level.

The workshop programme included a visit to the nearby *Moulis* laboratory cave where attendees inspected the various aquariums of salamanders and *Proteus* on different passage levels amidst speleothem deposits and an array of scientific measuring and recording equipment. Despite being in a dark cave environment, many of the aquariums (and their contents) mounted to the semi-permanent benches were hidden from view: shielded by black polythene plastic sheeting. Following the workshop, there were two days devoted to cave fauna field trips. The first day's visit to the *Grottes des Laspugues* ("Cave of the Cave") near Saint Girons had a novel beginning as we kitted up in a local church graveyard! The European cavers all used carbide and I soon discovered that the constant presence of acetylene fumes had a detrimental effect on the quality of most of the digital camera images taken in the cave. A relatively muddy cave, it was rich in cave fauna including numerous troglobitic (terrestrial) invertebrates, such as the opilionid (harvestman): *Ischyropsalis* sp. and the protected carabid beetle: *Aphaenops cerberus*. After checking river water levels, the second day's caving entailed a detour to the Bureau des Sports D'Aventures in St. Girons to borrow wet suits, clean dry suits and gumboots for a visit to a stream swallet cave *Grotte de la Touasse* near the village of Gajan. Cave fauna included large centipedes, *Niphargus* amphipods, minute springtails and two different species of yellow-spotted or striped lizard-like salamanders: *Salamander salamandus*.

A side benefit of our modern electronic age will permit all the biodiversity workshop attendees to stay in touch and follow up with further discussion of the international database. Virtually all participants have email addresses and our names have been added to a specially structured List Server - managed by Graham Proudlove in England – with subscriber "membership" limited to those who attended the Moulis workshop. The small working group of participants who will finalise the framework of our future international database is composed five to six people – Convenor: David Culver (USA), Louis Deharveng (France), Sanja Gottstein-Matocec (Croatia), Isaac Izquierdo (Canary Islands) and Fabio Stoch (Italy), with additional assistance from Arthur Clarke (Australia). It is anticipated that the working group will provide a feedback report to the next official scientific meeting of the *Societé Internationale de Biospéologie* during its XVth (15th) International Symposium of Biospeleology being held during the second week of July 2001 at the Intervales State Park – 270km from Sao Paulo - in southeastern Brazil. This SIB symposium at Intervales is quite separate and un-related to the three-day Symposium of Biospeleology being held in Brasilia from 17 – 19 July as the (S3) Session part of "Speleobrazil": the 13th IUS International Congress of Speleology meeting from 15 – 22 July 2001.