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## **SPELEOLOGICAL VIRTUAL LIBRARIES: PRESENT STATE AND PERSPECTIVES**

### **RIASSUNTO**

***Le biblioteche speleologiche virtuali: stato attuale e prospettive future.***

*Le tecnologie digitali per la gestione e la pubblicazione di grandi moli di dati in rete stanno rendendo disponibile un'enorme quantità di informazioni che però è sempre più difficile saper gestire. Per quanto riguarda le applicazioni in ambito speleologico, questo lavoro esamina alcune risorse disponibili, con particolare riguardo al caso italiano. Sono inoltre illustrati due prototipi sviluppati per agevolare la ricerca delle pubblicazioni speleologiche. Il primo è dedicato alla speleologia lombarda e comprende 5247 riferimenti bibliografici, 2500 dei quali liberamente reperibili in rete. Il secondo prototipo organizza 318 riviste speleologiche a livello nazionale, per un totale di 3874 fascicoli, 1522 dei quali reperibili in rete. In conclusione, vengono esaminati alcuni problemi e delineate le possibili linee di evoluzione dei sistemi di analisi e valorizzazione dei dati speleologici provenienti dalle pubblicazioni, mediante l'impiego di tecnologie digitali.*

### **ABSTRACT**

*Digital technologies for managing and publishing a large number of data on the network are making a huge amount of information available which is increasingly difficult to deal with. As regards applications in speleology, this work examines some available resources, with particular consideration to the Italian case. Two prototypes developed to facilitate the research of speleological publications are also illustrated. The first is dedicated to Lombard speleology and includes 5247 references, 2500 of which are freely available on the web. The second prototype organizes 318 speleological nationwide magazines, for a total of 3874 files, 1522 of which are available online. In conclusion, some problems are examined and the possible evolution lines of systems for analyzing and exploiting the speleological data coming from the publications, through the use of digital technologies, are outlined.*

### **INTRODUCTION**

Often in the past, caving research and dedication produced innovative results aimed at relieving part of the hard effort spent in underground exploration and documentation. Achievements in caving techniques and tools deserved application in areas outside of a cave: e.g. single rope technique, rappelling and abseiling devices, specific rescue tools and techniques, LED lighting equipments, ... Even the cave register is an extremely powerful tool, longed for by researchers in other fields.

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However, the digital revolution looks afar from the caving world or, at most, few digital technologies find some customisation in the caving world (e.g. new survey techniques and tools). Data collection and information sharing represent areas in which dramatic improvements and achievements appeared in the recent past, but the caving world looks troubled in coping with such a rapid progress. Recent international and national congresses were entitled to ‘sharing data’, ‘sharing knowledge’, and so on, but actual resources and tools appear underrated and underused. Italy holds the largest caving library in the world, in Bologna, and several caving archives with documents from the 19<sup>th</sup> century on, but such a huge amount of data is still little exploited, so as to provide useful information.

The author, as a long time computer science professional, explored the issue and developed some prototypes intended to establish links among caving data in the Web, as a way to enhance the chance to get information from caving literature.

## A quick look around

A first step toward caving information collection and organization is in the library catalogues. Speleoteca<sup>1</sup> is the catalogue of 17 Italian caving libraries, first of all the Caving Documentation Centre “Franco Anelli” in Bologna. The catalogue collects more than 33,000 cave- and karst-related publications. 918 serials are registered, but most are related to non-exclusively caving publications (e.g. mountain club magazines). More than one thousand bibliographic records are enhanced with the cover scan, and some of them with a link to the digital resource (e.g. Speleologia). However, no query is available to select just the digital resources.

On the other hand, OPAC/SBN<sup>2</sup> is the national collection of library catalogues. It includes also the “Franco Anelli” catalogue. A query with the “grott\*”<sup>3</sup> pattern in the title, meaning all titles with a word beginning with “grott”, provides a list of 8501 references. However, the query fetches also non-cave related references, such as a particle physics journal paper about the Grotthuss mechanism, a proton jumping process<sup>4</sup>. A similar tool, with a world-wide scope, is Worldcat<sup>5</sup>. A “grott\*” query in Worldcat provided a list of 31,360 references, 11,802 of them are books, while 10,202 are journal papers.

A further step is represented by the provision of some digital information about the single referenced items. Speleoteca adds cover scans to new entries. Some cave club librarian or caving organization provided cover scans and book or magazine indexes. Some Italian examples follow, with no claim of completeness:

- Bibliografia speleologica ligure<sup>6</sup>: a 2009 web page in which books and magazines published by caving clubs in the Liguria region are listed, together with covers and indexes. No virtual resources are present.
- GEO CAI Bassano<sup>7</sup>: a catalogue of the club library, developed by Mirko Fossa in 2011. 435 magazine issues are listed, with cover scan and index, together with 92 books and proceedings volumes. Each record shows the cover and the index.

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<sup>1</sup> Sivelli & Forti, 2018. <http://www.speleoteca.it/>, link visited on October, 6<sup>th</sup>, 2018.

<sup>2</sup> The Italian Online Public Access Catalog (OPAC), <http://opac.sbn.it/opacsbn/opac/iccu/change.jsp?language=en>, link visited on October, 6<sup>th</sup>, 2018.

<sup>3</sup> Grotta/grotte means cave/caves in Italian.

<sup>4</sup> The late Giovanni Badino would be delighted by this invalid reference.

<sup>5</sup> <https://www.worldcat.org/advancedsearch>, link visited on October, 6<sup>th</sup>, 2018.

<sup>6</sup> <http://www.catastogrotte.net/dsl/vecchiosito/Delegazione%20Speleologica%20Ligure.htm>, link visited on August, 5<sup>th</sup>, 2018.

<sup>7</sup> <http://www.geocaibassano.it/biblioteca-geo-cai>, link visited on August, 5<sup>th</sup>, 2018.

- Speleofantasy<sup>8</sup>: Pasquale Zucca (Gruppo Grotte Milano) scanned covers and indexes of the paper resources in the Gruppo Grotte Milano library. He developed a library portal in which 185 Italian caving magazines are collected, together with 36 non-caving magazines and web links to clubs and associations. Some foreign caving magazines are referenced, too.
- Gestionale speleologico ligure<sup>9</sup>: an up-to-date bibliographic data-base, containing 1282 references, some of them enhanced with the link to the virtual resource.

Further enhancements to the catalogue can go in three directions:

- addition of **analytics** about journal and magazine papers or collective books papers; in this way, further references to single papers are generated and added to the catalogue;
- content **classification** in categories, subjects, references to caves, karst areas, cavers, clubs;
- addition of a **link** to the actual digital resource.

The Speleological abstracts (BBS)<sup>10</sup> is an extremely powerful tool to gain knowledge about specific caving disciplines, areas or keywords at a worldwide level. It is the result of a long-time collective work in analysing caving publications and categorising each single reference. The classification work started in 1969 but the present digital database spans from 1988 to 2014. The huge amount of 111,833 references is collected in the on-line search tool.

A full-fledged virtual library should provide both the links to the digital resources and search tools based on the underlying classification. Possibly, it should provide also full analytics. A couple of cave-related examples follow:

- the Karst Information Portal (KIP)<sup>11</sup>: a US-based open-access digital library, managed by the National Cave & Karst Research Institute, by the South Florida University and the New Mexico libraries, and by the Unione Internationale de Spéléologie. The portal was established in 2006; in the near future, it plans to deploy a georeferenced query interface to the bibliographic data-base. Presently, the portal collects 3962 worldwide caving-related items. However, the Italian resources are limited to 27 issues of the SSI News magazine and to two proceedings of volcano-speleology congresses.
- Commissione Grotte “Eugenio Boegan”, Trieste<sup>12</sup>: an actual virtual library, where all 64 issues of the Progressione magazine are shared, together with several issues of the Atti e Memorie journal and many books and excerpts produced by members of the Club established in 1883.

As a comparison with general-purpose virtual libraries, queries in some of the largest virtual libraries provided the following results:

- Google Books<sup>13</sup>: the search pattern ‘grotta’ in the book titles fetched 667 results, 53 of them in full view; the search pattern ‘grotte’ fetched 3160 results, 74 of them in full view; the same queries in the whole text provided 473,000 results for ‘grotta’ (230 in full view) and 673,000 for ‘grotte’ (195 in full view).
- Archive<sup>14</sup>: a full open-access virtual library, holding more than 18,800,000 books. The query ‘grott\*’ in the titles fetched 618 records, usually related to English or French lan-

<sup>8</sup> <http://www.speleofantasy.it/index.php/biblioteca/>, link visited on August, 4<sup>th</sup>, 2018.

<sup>9</sup> <http://www.catastogrotte.net/bibliografia.html>, link visited on August, 5<sup>th</sup>, 2018.

<sup>10</sup> Bulletin bibliographique spéléologique (Deriaz, 2018). <http://www.ssslib.ch/bbs/>, link visited on October, 6<sup>th</sup>, 2018.

<sup>11</sup> <http://digital.lib.usf.edu/karst>, link visited on August, 4<sup>th</sup>, 2018.

<sup>12</sup> Merlak, 2018. <http://www.boegan.it/category/biblioteca/>, link visited on August, 5<sup>th</sup>, 2018.

<sup>13</sup> <https://books.google.com/>, link visited on October, 6<sup>th</sup>, 2018.

<sup>14</sup> <https://archive.org/details/texts>, link visited on October, 6<sup>th</sup>, 2018.

guage resources. A query for 'grotta' in the text contents resulted in 68,134 records, while a search for 'grotte' fetched 170,351 results.

- HathiTrust<sup>15</sup>: holds 16,700,000 digitized books, more of 6 millions of them are in the public domain. A query for 'grott\*' in the resource titles fetched 425 results, 133 of them are open-access. The same query in the text contents resulted in 48,400 records, 12,568 of them are open-access.

The above mentioned data show that a large amount of cave-related books and papers are now freely available in the Web, but the task of searching and finding the relevant information is quite demanding.

### The Lombardy caving virtual distributed library

A specific bibliographic collection is essential to every serious researcher. A detailed caving bibliographic system would require a review of the publications content in order to collect and arrange information about referenced caves and their specific data. In the past, several printed regional catalogues of cave-related publications were produced and updated. Of course, a digital data-base is more powerful: specific queries can be run, to get the list of papers in which a specific cave is referenced, its survey is published, paleontological data are provided, etc.

A prototype virtual library of caving references for the Lombardy region (Northern Italy) was developed (Ferrari 2013a, 2013b). It presently collects 5247 references to books, journal papers, newspapers; 2500 of them are freely available and public domain in the Web. The system proved a useful tool for research and on-field exploration too. It builds on four data layers:

- **Bibliographic references:** plain references from several sources were collected and added to the data-base. Books and magazine papers are considered as sources. Some 428 newspaper articles are inserted too. Web pages are not considered.
- **Cave references:** A list of caves is maintained. Each reviewed title is checked against specific references to caves, divided into categories (e.g. description, paleontological references, presence of a survey, etc.). Each cave reference is represented by a triple: Cave ID – category – paper pages. Presently, collected caves are 4,700. The reference triples are more than 47,700.
- **Web links:** each bibliographic reference which is freely available on the Web is provided with the link (URL – Uniform Resource Locator) to the relevant web resource. Presently, 2500 references are linked to their resource (47 % of the total references).
- **Cave positions:** Finally, public domain cave positions are collected. Unfortunately, they are expressed in several different geographic reference systems and formats. Traspunto, a public domain conversion program, is employed to translate cave positions into a single system and format. Presently, 3,800 caves are provided with position out of 4,700 total.

The whole data-base can be locally consulted and queried by a custom-made application designed on Windows systems. A similar application is employed for data insertion and update. However, cave positions can be used to produce a KML (Keyhole Markup Language) file with a placemark for each cave. The file can be loaded into Google Earth to generate a map with the cave positions (fig. 1). As usual, the user can navigate and zoom in the map. Clicking on a placemark opens a cave specific caption. Its contents are defined in the KML file. In the present version, just the cave name and number are inserted, together with a link to the cave bibliography web page. Clicking on the link opens the cave page in a browser embedded in Google Earth. The cave page includes the list of titles in which the selected cave is referenced

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<sup>15</sup> <https://www.hathitrust.org/>, link visited on October, 6<sup>th</sup>, 2018.

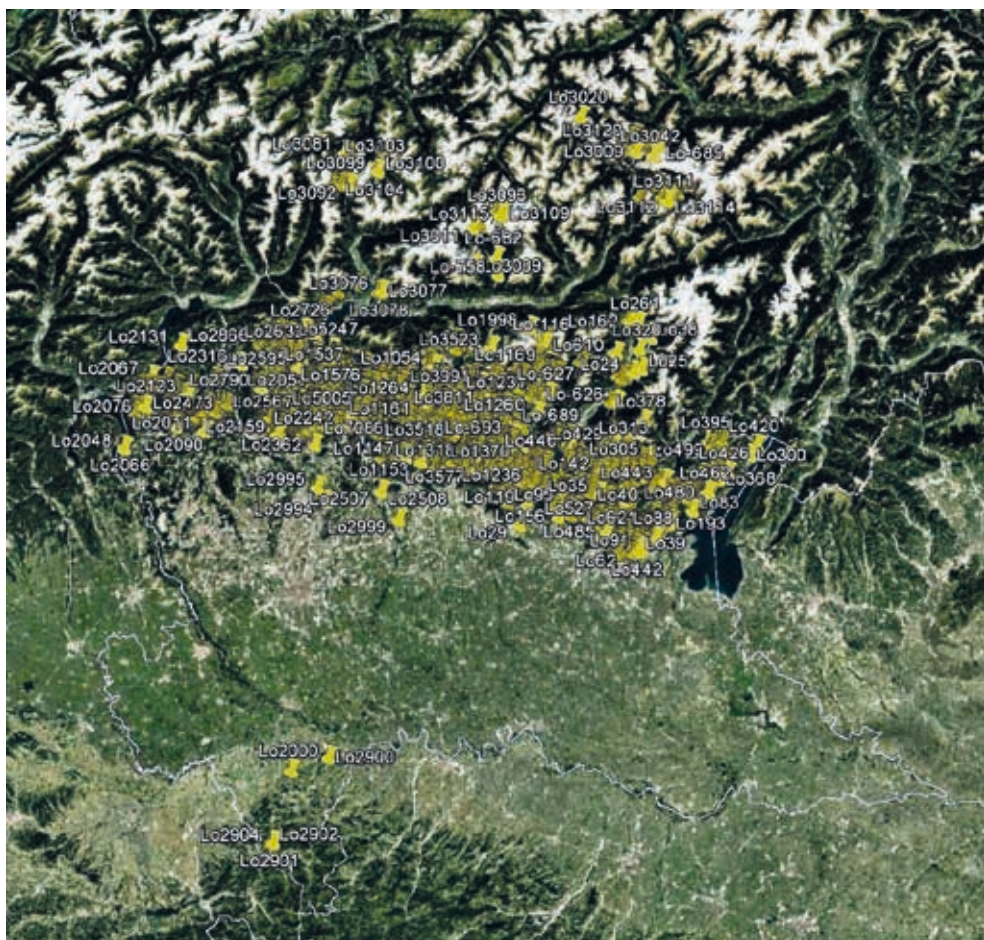


Fig. 1 - The 3800 cave placemarks over Lombardy in Google Earth®.

(fig. 2). Titles are arranged by reference category. Each title entry in a cave bibliography page contains a link to the title web page. This one contains the full bibliographic reference of the publication and the list of referenced caves (fig. 3). If the publication is freely available on the Web, its link is inserted in the page, so the user can directly jump to the content (fig. 4).

The system proved quite useful in research and generation of specific bibliographic reviews and in exploration too. The review process of some 19<sup>th</sup> century books revealed mentions of a long-forgotten iron mine on Lake Como shores (Lombardy, Northern Italy), unknown to cavers and researchers. The mine was identified and explored; its present development is more than 1600 m long (Ferrari *et al.* 2019).

### Cave-O-Zines, the Italian caving magazines virtual library

As mentioned above, presently researchers and explorers can find a huge amount of magazines in the World Wide Web. Older, public domain publication were scanned and freely pro-



# Lo 2210 Buco della Volpe

(Pertus de La Vulp, Pertugio della Volpe, Pertugio di Rovenna)

## Bibliografia Ragionata

Buzio A., Gandini F., 1986. Grotte e abissi di Lombardia: guida speleologica. Pubblicato in proprio: pp. 178. C.It.D.St.Id: 73-74; R.Ft: Ft.

### Catasto

Badini, 1971a: 48-49.  
Bini, 2002a.  
Chiesa, 1933a: [69].  
Dellera Banti et al., 1983.  
Dell'Oca, 1962b: 77.  
Focarile, 1950c: 42.  
Gruppo Grotte Milano C.A.I. S.E.M., 1972.

### Itinerario

Chiesa, 1933a: [70].  
Olivieri, 1939: 47.

### Descrizione

Anonimo, 1898a: 486-487.  
Badini, 1971a: 48-49.  
Binda & Pozzi, 1958.  
Bini, 1977: 165-169.  
C.A.I. Sezione di Milano, 1921: 141.  
Capparoni, 1941: 57-59.  
Chiesa, 1933a: [70-71].  
Cornalia, 1850: 21-23.  
Cornalia, 1852a: 14-16.  
Cornalia, 1852b: 85-87.  
Curti, 1872: 67-68.  
Focarile, 1950c: 42.  
Lavizzari, 1859: 67.  
Mariani, 1897: 190.  
Monti, 1902: 209-210.  
Olivieri, 1939: 47.

Fig. 2 - Part of a single cave analytic bibliography web page.

vided by caving associations and virtual or real libraries. As an example, several digital issues (1932-1944) of *Le Grotte d'Italia* were published by the National Central Library in Rome<sup>16</sup>. On the other hand, many scientific and caving club magazines are presently published on-line, mainly in order to spare money. This means that a fair percentage of references can be perused directly on-line. The large number of open access caving magazines dictates the need for a tool which links the resources catalogue with the relevant web-based resources.

<sup>16</sup> <http://digitale.bnc.roma.sbn.it/tecadigitale/>, link visited on October, 6<sup>th</sup>, 2018.

## Mariani, 1897

[Visualizza il lavoro](#)

Mariani E., 1897. Su alcune grotte lombarde. Atti della Società Italiana di Scienze Naturali, Milano, 36 (3-4): 187-197.

### COMMENTI

1 Tavola.

Errata: p. 197: cita un Buco del Nasone che probabilmente coincide con la Lo 2226 (Bûs del Campanell) e cita un Buco del Campanello che invece probabilmente è andato perduto (pozzo con apertura circolare del diametro di circa 1 metro, tenuta chiusa da un masso).

### GROTTE CITATE

Lo 2034 (Grotta della Fonte Pliniana): Id: 190, 193, 195.

Lo 2204 (Bûs de la Niccolina): Id: 190, 193, 195.

Lo 2207 (Buco dell'Orso): 194.

Lo 2208 (Buco del Piombo): 197.

Lo 2210 (Buco della Volpe): 187; D: 190; Id: 190, 193, 195; R: Tav. ft.

Lo 2211 (La Rotella): D.Cit: 197.

Lo 2212 (Zocca d'Ass): 187, 193; D.E: 189; Id: 189, 190, 193, 195.

Lo 2213 (La Masera): Id: 190, 193, 195.

Lo 2214 (Bûs del Pertûs): 187; D: 196.

Lo 2215 (La Caldirola): 197.

Lo 2220 (Boeuce del Suriv): 187; Id: 189, 190, 193, 195; D: 194.

Lo 2222 (Bucone 1° di Griante): D.Cit: 197.

Lo 2224 (Boeuce de la Scudela): D: 197.

Lo 2226 (Bûs del Campanell): 187; D: 197.

Lo 2231 (Bûs de la Purina): D: 197.

Fig. 3 - A single paper web page.

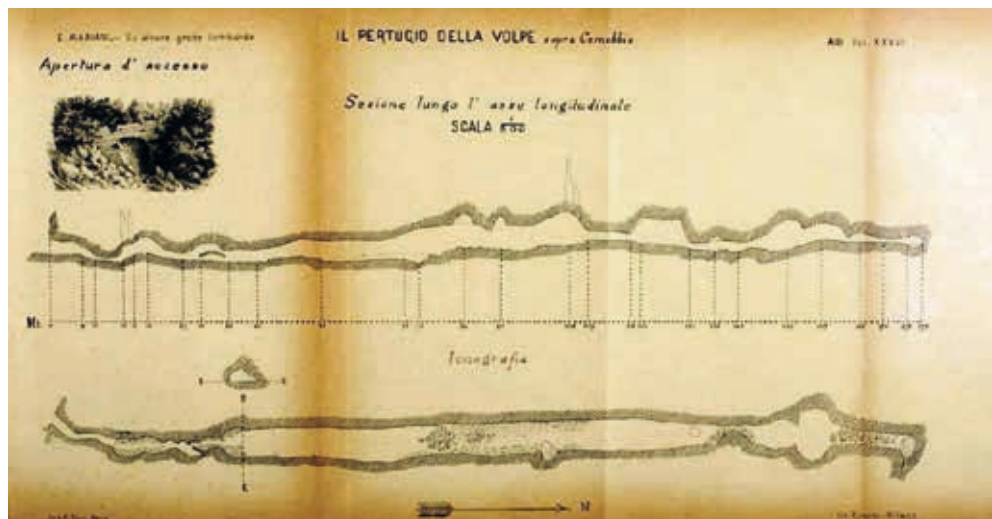


Fig. 4 - A 1897 survey in the original paper digital resource.



Fig. 5 - The Cave-O-Zines map into Google Maps®.

Cave-O-Zines means Caving Open-access magaZines. The Cave-O-Zines project aims at developing a collection of all the periodic caving resources (journals, magazines and newsletters) ever published in Italy, both in paper or just in digital format. Covers and index pages are provided where available. Links to the whole single resource are provided where available.

A query in Speleoteca provided the list of nearly all Italian caving serials. Very few additional entries came from direct search on the web or in actual libraries.

The Cave-O-Zines prototype is: **virtual**, that is the system is fully digital and web-based; **distributed**: the library resources are provided by several kinds of publishers, usually caving clubs or associations. The single resource is hosted in the provider web site.

Data about each magazine were collected and organized, together with links to the Speleoteca record, the OPAC/SBN record and the ACNP<sup>17</sup> record. A geographic positioning of the magazine is inferred from the address of the publishing organization (cave club, federation,...).

<sup>17</sup> The Italian Catalogue of periodicals, <https://acnpsearch.unibo.it/lang/eng>, link visited on October, 6<sup>th</sup>, 2018.



A second level of information is relevant to issues. For each publication, the list of published issues is collected, usually from Speleoteca. Where available, a link to the digital resource is added to each issue record.

Data are organized in an Excel® file; geospatial information is used to generate a KML (Keyhole Markup Language) file, with a placemark to show the localization of each publication. The KML file can be loaded into Google Earth® to generate a map with the publication positions. A marker with a hanging bat is related to a no longer active publication, while a marker with a flying bat positions an active one. The same KML file was loaded into Google Maps®; an even more user-friendly map resulted (fig. 5). A click on a placemark opens a box with essential data about the publication and a link to the publication web page. HTML code is programmatically generated in the excel file, so as to generate a web page for each publication. The web page is divided into two sections (fig. 6). A heading shows data about the publication (title, complement of title, publisher, link to publisher web site, starting and ending date, links to related publications, links to related records in other catalogues; link to publication web page). A body section lists all known issues. Each issue is represented by its cover image, together with the relevant data (issue data, link to index page). A light green background means the relevant open access resource is available. A click on the cover opens the resource as a link to the content provider.

The whole Cave-O-Zines system can be navigated from the Google Earth / Google Maps interface or directly through regional and national index web pages. Specific web pages for national magazines, national congress proceedings and cave rescue journals have been added to the system. Where available, regional index pages show links to regional congress proceedings (fig. 7).

The prototypical system was developed and deployed on a private web server, so as to be demonstrated as need arises. Cave-O-Zines collects 318 Italian cave-related journals, magazines and newsletters, summing up 3874 issues, from 1899 on. New publications add an estimated 30 issues per year. 1522 issues are available as open access resources, which is 39 % of the whole issues ever published in Italy. This builds up a fairly large library, which is available to every interested researcher or explorer. As a comparison, given a 0.5 cm mean thickness of the single paper magazine issue, the open access issues would need 7.6 m of shelf space in a real library. The KML file can be loaded on a tablet or smartphone with Google Earth or Google Maps installed. This means that, provided a mobile internet connection is present, the Cave-O-Zines virtual library can be navigated just in front of a cave entrance.

A hint of a virtual library potential came from the late Giovanni Badino bibliography. Paolo Forti produced the bibliography, thanks to a huge effort in perusing the Bologna Library books and magazines (Forti, 2017). The caving-related papers summed up to 587 references. The author enhanced the bibliography with links to open-access papers: 399 references are available in the Web, which is 68 % of the total, mostly represented by papers on magazines<sup>18</sup>.

## Problems

Dealing with virtual distributed libraries raises several issues which need specific attention:

- Persistence: links to web librarian resources could break when resources are moved or removed. Furthermore, resources are available only with an internet connection.
- Copyright: all data in the systems could be considered in the public domain, and actual resources are simply linked from the owner's web-sites. Anyway, authorization from the copyright owner is recommended in order to freely manage resource data.

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<sup>18</sup> <http://gwferrari.it/RivisteSpeleo/BiblioBadino.html>, link visited on October, 6<sup>th</sup>, 2018.

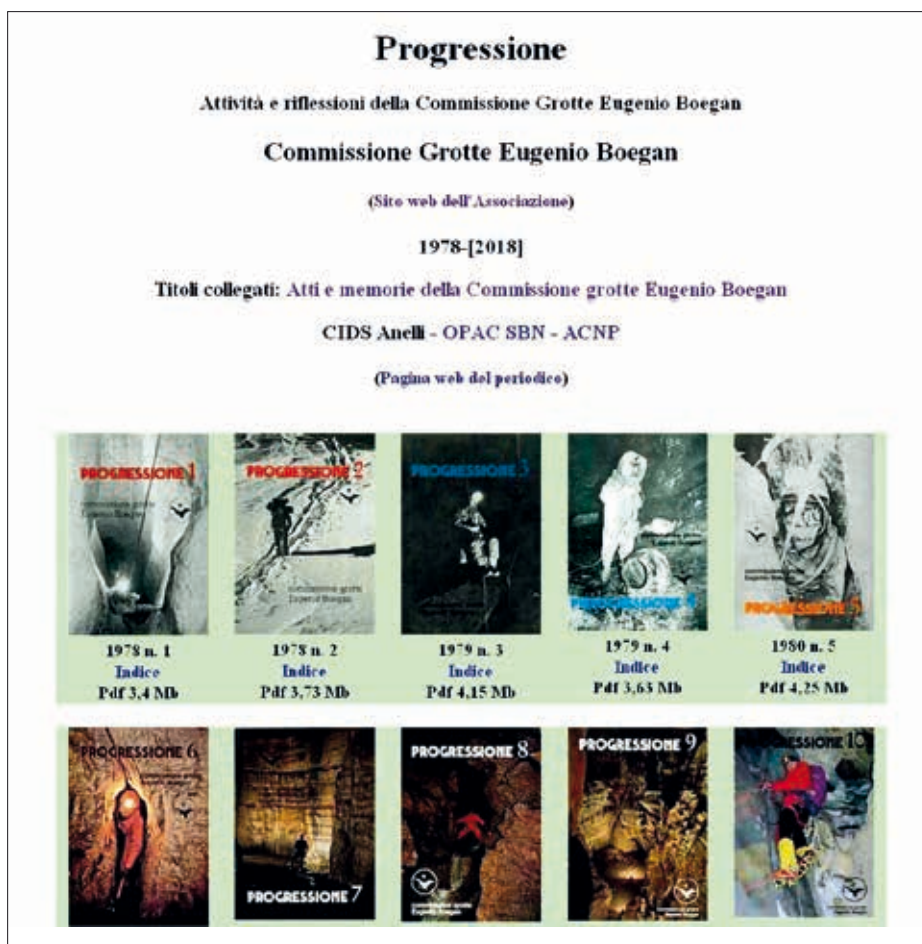


Fig. 6 - Part of the Progressione web page.

- Resource formats: most resources are in the PDF format, but few files are corrupt or unreachable. Several other resources come in other formats, mainly HTML.
- Index formats: most indexes are plain scan images. Search for a specific paper is awkward. Some indexes are actually web pages, in HTML format.

## Conclusions

Both the mentioned caving virtual library prototypes proved to be very useful in search, in new papers development and in exploration too. However many enhancements are needed to improve the systems and the underlying data. The Google Earth / Google Maps interface enables people, who are not confident with full-featured Geographic Information Systems, to get a dramatic insight into geographic information. Georeferentiation applied to bibliographic information could be employed in many other geographic-related fields.

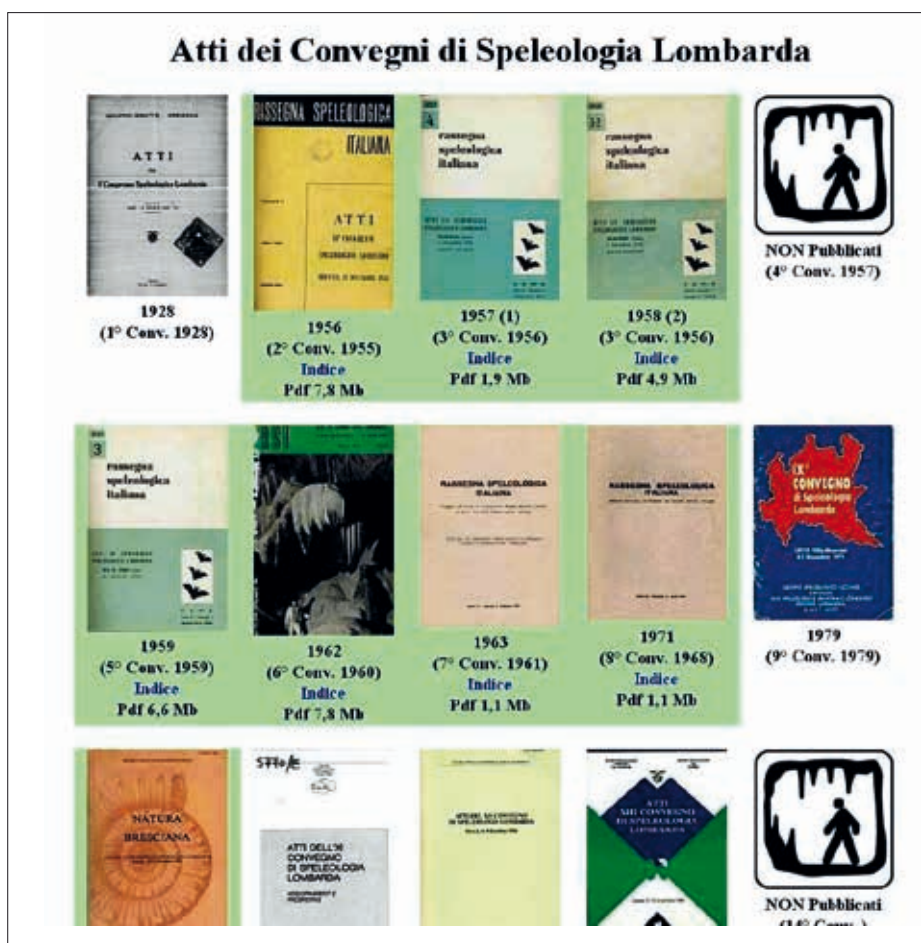


Fig. 7 - Part of the Lombardy congress proceedings web page.

However, several improvement areas are left. The Cave-O-Zines system could be integrated with Speleoteca, so as to extend the catalogue of caving libraries to a comprehensive real/virtual library and a repository of paper and digital books and magazines.

A powerful improvement in the Cave-O-Zines system documentation and information power is in the development of a data-base of single papers. A full-fledged bibliographic reference system should at least be based on data about authors, titles and links to open access resources. It could be enhanced with information about caving clubs, caves and karst areas mentioned in the single paper. In this way, powerful searches could be run. Some journals and magazines published comprehensive indexes of the whole publication. The paper data-base could be established collecting and organizing these indexes.

A dramatic enhancement at world- or nation-wide level could foresee the following steps:

- the collective definition of a shared standard data model to manage caving bibliography data;
- the collection and digitalization of the published bibliographic catalogues; for instance,

the several analytic bibliographic indexes published as supplements of *Atti e Memorie* would build up a comprehensive data-base about caving publications in Friuli and Venezia Giulia. They could be merged with similar efforts about Piedmont, Lombardy, Veneto, Liguria, etc.

- The integration with the powerful BBS data-base.

Over all, the underlying challenges are: how to manage such a huge amount of information? How to profit from digital technologies so as to encourage cavers to read and write? A partial technological solution can come from the Linked data - Semantic web technologies (Fagnoni 2018) which allow to process large amounts of open data in order to get the required information.

## ACKNOWLEDGMENTS

Most issues are shared by their publishers, usually caving clubs or associations. Many of the remaining covers and indexes are linked from Speleofantasy. Alberto Buzio allowed access to his caving library, in order to scan cover and index pages. Daniela Pani provided invaluable assistance in the coordinate conversion process together with several useful suggestions. Arrigo A. Cigna encouraged the Cave-O-Zines prototype development and acted as beta-tester.

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