

---

Volume I

# Patrimoine et Écologie / *Heritage & Ecology*

## Table des Matières / *Contents*

---

Avant-propos / *Foreword* 5

### Conférences plénières / *Keynote conferences*

---

Philippe AUDRA  
Caves and Karsts of France / Grottes et karsts de France 13

Laurent BRUXELLES  
Cradle of Humankind Karsts in Southern Africa / Les karsts du berceau de l'Humanité en Afrique australe 15

Pierre-Yves JEANNIN  
From Oaxaca to La Chaux-de-Fonds... 25th anniversary of the Swiss Institute for Speleology and Karst-Studies, SSKA / D'Oaxaca à La Chaux-de-Fonds... Le 25<sup>ème</sup> anniversaire de l'Institut Suisse de Spéléologie et de Karstologie, ISSKA 27

### Symposium 01 : Karst, Patrimoine et ressources / *Karst, heritage and resources*

---

John GUNN, Serge DELABY, Kyung Sik WOO & Fabien HOBLÉA  
Karst, heritage and resources 41

### Special Session 1 : Géopatrimoine et géosites karstiques : de la connaissance à la gestion / *Karst Geoheritage and Geosites: from Knowledge to Management*

---

John GUNN, Fabien HOBLÉA & Kyung Sik WOO  
Karst Geoheritage and Geosites: from Knowledge to Management 45

Joël RODET  
Diversité patrimoniale du karst crayeux en Normandie (France) 47

Bernard CHIROL  
Un géomorphosite karstique remarquable : la Cluse des Hôpitaux (Ain, France) 51

Fabien HOBLÉA, Richard MAIRE, Stéphane JAILLET, Charlotte HONIAT, Arnaud MALARD, Laurent MOREL, Paul DUHART, Catherine HUERTA, Juan-Pablo LACASSIE, David QUIROZ, Dominique LEGOUPIL, Luc-Henri FAGE, Serge CAILLAULT, Florian CHENU, Georges MARBACH, Denis MORALES, Natalia MORATA, José MULOT (†), Jean-François PERNETTE, Jacques SAUTERAU DE CHAFFE (†), Bernard TOURTE, & Ultima Patagonia Team  
The subpolar karst of Madre de Dios (Magallanes, Patagonia, Chile): a masterpiece of the world geoheritage 55

Lyoun KIM, Kyung Sik WOO, Jonghee LEE & Kwang Choon LEE  
Geoheritage assessment and conservation of caves in Republic of Korea 59

Katarina KOSIČ FICCO, William D. ORNDORFF, Thomas E. MALABAD & Michael J. FICCO  
Buried world of Virginian karst: an introduction to karst resources in the compartmentalized and covered karst of Virginia, USA 63

Nathalia UASAPUD, Marion WEBER & Juan Pablo PALACIO-HENAO  
Oriente Antioqueño karst – A tropical stripe karst in Colombia 67

Varoujan SISSAKIAN & Aqeel Abbas AL-ZUBAIDI The influence of karst features on the biodiversity and cultural heritage near Al-Salman Depression, Iraqi Southern Desert	71
Angel ACOSTA-COLON A unique karstic ecosystem and historical site in Puerto Rico: Las Cabachuelas Nature Reserve Cave System	75
Afkar HADI Biodiversity of Caves and Fractures in Safin Mountain, Kurdistan, North of Iraq	79
José Maria CALAFORRA, Paolo FORTI, Fernando GAZQUEZ, Francesco SAURO, Tommaso SANTAGATA & Marco VATTANO Giant gypsum crystal caves: different fates due to their peculiar socio-economic situation	83
Samvel M. SHAHYNIAN, Smbat R. DAVTYAN, Artavazd E. JANNOYAN & Andranik Kh. BUNATYAN Makar Cave: discovery of a new heritage site of the Azat River Basin (Armenia)	87
Issam BOU JAOUDE, Rena KARANOUH & Wakel KARANOUH The History of Lebanon exposed through the darkness of Jeita Cave	91
Angelo NASEDDU, Paolo FORTI, Martino PIRAS, Fiorenzo CASTI, Maria Roberta CADONI & Jo DE WAELE San Giovanni Cave (Domusnovas, Southern Sardinia): history, exploration and valorization of the longest cave traversable by car	95
Angel JR. GARCIA Constructing cultural consensus models about cave and cave processes to characterize ethnogeology knowledge	99
Mounia KHOUKHOUCI, Khalid EL BEKKAYE La culture, ressort de la diffusion géotouristique du Karst ? Approche comparative des Grottes d'El Khenzira et d'El Kaf (Maroc)	103
Stefan ZAENKER, Christian ZAENKER, Bärbel VOGEL, Andreas WOLF & Friedhart KNOLLE CaveLife App - Applications and Results	107
Raphaël TORQUEBIAU, Benoit PASCAULT, Marie-Clélia LANKESTER, Corentin GUINAULT, Lucas GLEIZE & Fabien HOBLÉA EVALCAV : Vers une méthodologie standard d'évaluation patrimoniale des cavités	111
Vincent FISTER & Jean-François FROGER Le Pôle Karst : un outil au service des milieux et rivières karstiques de Bourgogne Franche-Comté	115
Oier GOROSABEL El papel de los espeleólogos en la gestión del patrimonio subterráneo: ¿miembros activos del equipo de gestión, o simples peones?	119

---

## Special Session 2 : Spéléologues et scientifiques ensemble pour mieux respecter et protéger les grottes et l'environnement karstique / *Cavers and scientists together to better respect and protect caves and karst environments*

---

Jean-Pierre BARTHOLEYNS Cavers and scientists together to better respect and protect caves and karst environments	125
John GUNN & David GILLIESON The UIS-UICN Guidelines for Cave and Karst Protection	127
Bärbel VOGEL, Jörg DREYBRODT, John GUNN, Andreas WOLF & Friedhart KNOLLE Engagement in international institutions for cave and karst protection	129
Jure TIČAR Cave pollution-can we predict and solve it? Experience gained by the big data approach from Slovenia	133

Maria-Laura TÎRLĂ, Bogdan BĂDESCU & Georgeta ȚÎȚAN Cave restoration and depollution: Towards a favorable conservation status of the 8310 habitat (ROSCI0031, SW Romania)	137
Leda ZOGBI, Allan S. CALUX, Annie GUIRAUD, Philippe CROCHET & Kevin DOWNEY Lights in the Darkness: caving-photographic expeditions to highlight the heritage values of the caves in Brazil	141
Patricia E. SEISER What will Cave Wilderness Mean for Resource Protection and Management Concerns?	145
Joerg DREYBRODT, Urs ETTER, Nyi Nyi AUNG, Naw Yuzana WIN & Fleur LOVERIDGE Karst and Cave Conservation in Myanmar	149
Fadi Henri NADER & Johnny TAWK The outstanding karstic features of Lebanon: a call for protection	153
Claude MOURET The karst of Sagada in the Philippines: will of conservation vs general degradation	157
Issam BOU JAOUDE & Rena KARANOUH El Kassarat Cave: From Destruction to Protection	161
Adriana NERI "Cave Museum": a new virtual platform for the conservation and dissemination of the karst heritage	165

---

### Special Session 3 : Grottes et karst dans les aires protégées labellisées UNESCO / *Caves and Karst in UNESCO Protected Areas*

---

Serge DELABY, Christophe LANSIGU & Fabien HOBLÉA Caves and karst in UNESCO protected areas	171
John GUNN A global overview of UNESCO protected areas that contain carbonate or evaporite caves and karst	173
Kasimir MICULINIĆ, Andrijana BROZINČEVIĆ, Željko RENDULIĆ & Dino GROZIĆ Disclosing the underground secrets of The Plitvice Lakes National Park: new approach to cave exploration for the management of the natural heritage	175
Joško BOŽANIĆ, Jelena KURTOVIĆ MRČELIĆ & Paola BOŽANIĆ The Azure Sun in the UNESCO Geopark Vis Archipelago, Adriatic Sea, Croatia	179
Serge DELABY & Sophie VERHEYDEN Le karst du Géoparc mondial UNESCO Famenne-Ardenne	183
Christophe LANSIGU & Fabien HOBLÉA Karst heritage: a sustainable resource of the Bauges Massif Regional Nature Park and Geopark	187
Thierry PÉLISSIE, Guy BARIVIERA & Vincent BIOT Les spéléologues, promoteurs de la valorisation des phosphatières au sein du Géoparc mondial UNESCO Causses du Quercy	191
Vincent BIOT, Delphine JACONELLI, Benjamin WEBER & Thierry PÉLISSIE Le développement des sentiers karstiques : l'exemple de l'Occitanie et des Causses du Quercy	195

## Symposium 07 : Biologie, Vie souterraine / *Biology, Subterranean Life*

---

Florian MALARD & Louis DEHARVENG Subterranean life: What are we speaking about?	201
Paolo AGNELLI, Antonio DE VIVO, Paolo FORTI, Leonardo PICCINI & Stefano VANNI Fauna and conservation in a show cave, Puerto Princesa Underground River Park, Palawan, Philippines	205
Leonardo de ASSIS, Diego M. Von SCHIMONSKY & Maria Elina BICHUETTE Pseudoscorpions (Arachnida) from two semi-arid karst areas in Brazil: a high phylogenetic diversity that requires urgent protection	209
Bella G. BABAYAN, Samvel M. SHAHINYAN & Aram R. MIKAELYAN Cave Microbiome in karsts of Armenia	213
Myrtille BÉRENGER & Rémi FONTERS Étude des chauves-souris à la grotte du Bournillon, Châtelus, Vercors, France	217
Myrtille BÉRENGER & Céline LE BARZ & Quentin CHABANNE Étude du regroupement automnal des Chiroptères sur le gouffre Berger et ses environs, Vercors, France	221
Maria Elina BICHUETTE Ecology and Conservation of Brazilian subterranean Fishes, an Update	225
Anna BIRÓ, Gergely BALÁZS, Žiga FIŠER & Gábor HERCZEG Gender inequality in the dark: are adaptations to the cave environment sex-specific?	229
Berta CABALLERO-LÓPEZ, Neus BRAÑAS, Jorge MEDEROS, Sergi GAGO, Miguel PRIETO, Floren FADRIQUE, Lluís DOMINGO, Daniel PONS & Glòria MASÓ Invertebrate cave fauna in three protected areas in Catalonia: an excellent team-building exercise	233
Omar CALVA & Reyna A. CASTILLO-GÁMEZ Mammals and birds cave use in the Sonoran desert, Mexico	237
Oana Mirela CHACHULA, Adrian SOPINCEAN & Ioan COROIU Seven decades of study of the biggest hibernacula of <i>Pipistrellus pipistrellus</i> and <i>Miniopterus schreibersii</i> in South East Europe	241
Jacques CHAUVIN Données complémentaires sur la biodiversité cavernicole du Pays basque	245
Carlos CONDE-COSTAS Nitrogen Dynamics in a Tropical Karst Cave Stream	249
Carlos CONDE-COSTAS Stygobites of Puerto Rico: Natural History and Relationship with Caribbean Species	253
Marcel Santos DE ARAÚJO, Marcus V.S. Agua DUARTE & Maria Elina BICHUETTE Some records of Brazilian cave mites (Acari)	257
Louis DEHARVENG, Guy BARIVIERA, Anne BEDOS, Patricia FABRIZI, Sunbin HUANG, Nadir LASSON, Jérôme LIPPART, Guillaume LORETTE, Marko LUKIĆ, Thierry PÉLISSIÉ & Philippe TYSSANDIER Subterranean invertebrates of Quercy (France)	261
Marina FERRAND & Christophe HERVE Les araignées cavernicoles des "Catacombes de Paris" et des carrières souterraines franciliennes : mise à jour de l'inventaire	265
Jéssica Scaglione GALLO & Maria Elina BICHUETTE Historic of taxonomic studies on Brazilian cave myriapods (Arthropoda)	269

Daniele GHEZZI, Andrea FIRRINCIELI, Paolo Emidio COSTANTINI, Luca SALVI, Zeinab KHALIL, Robert CAPON, Jo DE WAELE, Francesco SAURO & Martina CAPPELLETTI Bioprospecting and genome mining of culturable bacteria from a quartzite cave	273
Daniele GHEZZI, Stefano FEDI, Francesco SAURO, Alessio ROMEO & Martina CAPPELLETTI Microbial diversity characterizing different depth zones inside the ice cave Cenote Abyss	277
Angel GINÉS, Alberto SENDRA, Joan J. FORNÓS, José M. CALAFORRA, Joaquín GINÉS, Oana A. DUMITRU & Ángel FERNÁNDEZ-CORTÉS Terrestrial cave-fauna enduring extreme CO <sub>2</sub> seasonal changes in the vadose environment: lessons from Dragonera Islet, Balearic Islands	281
Sunbin HUANG, Mingyi TIAN & Arnaud FAILLE A summary of our knowledge of the cavernicolous trechine beetles from mainland China (Insecta: Coleoptera: Carabidae)	285
François LEFEBVRE, Michel CAILLON, Claude BOU, Florian MALARD & Christophe J. DOUADY Distribution, ecology, and diversity of the genus Gallasellus (Isopoda, Asellidae)	289
Josiane LIPS & Christian DODELIN (†) Étude de la faune cavernicole du massif de Chartreuse (France)	293
Eter MAGHRADZE, Arnaud FAILLE & Shalva BARJADZE Cave dwelling Invertebrates of Georgia (Caucasus)	297
Florian MALARD, Philippe GRISON, Louis DUCHEMIN, Maud FERRER, Julian LEWIS, Lara KONECNY-DUPRÉ, Tristan LEFÉBURE & Christophe J. DOUADY An introduction to the World Asellidae Database	301
Stefano MAMMOLA & Pedro CARDOSO Caves as simplified settings for testing ecological theory	305
Ana Zélia MILLER, José Luis GONZALEZ-PIMENTEL, Ana Teresa CALDEIRA, Nicasio T. JIMÉNEZ-MORILLO, Leonila LAIZ, José M. DE LA ROSA, António CANDEIAS, Christine MOISSEL-EICHINGER & Jo DE WAELE Search of life in a Mars analogue site - microbes and associated biosignatures in the deep and completely dark salt caves of the Atacama Desert	309
Soumia MOUTAOUAKIL, Mohamed GHAMIZI & Mohamed BOULANOUAR Contribution to the knowledge of cavernicolous Isopoda from Moroccan Occidental High Atlas and Anti Atlas	313
Helaleh NATEGHEH & Zahra MALEKPOUR-FARD Biodiversity and conservation status of Divrash cave, Guilan province, Iran	317
Caio César Pires de PAULA, Carla Andréa LEITE, Maria Elina BICHUETTE & Mirna Helena Regali SELEGHIM Taxonomic and metabolic profiles show different structures and energetic metabolism into the microbial communities in a tropical cave (Brazil)	321
Christine PERRIN & Olivier GUILLAUME The Moulis Cave (Ariège, South France): from the CNRS Subterranean Laboratory to a Karst-&-Cave scientific platform	325
Elena PIANO & Marco ISAIA Ecological drivers of lampenflora growth in Italian show caves	329
Gabriela C. RABELLO & Maria E. BICHUETTE Filters for the ichthyofauna of Serra da Canastra caves, Minas Gerais state, Southeast Brazil	333
Adora THABAH & Oana Mirela CHACHULA The relevance of cave features in roost selection of Otomops wroughtoni in Meghalaya, North East India	337

Dayana TORRES & Maria Elina BICHUETTE The importance of registering bat bone remains in cave: analysis of the collection of the Laboratório de Estudos Subterrâneos in Brazil	341
Marco VATTANO, Antonio FULCO, Pietro VALENTI, Giuliana MADONIA & Mario LO VALVO Low-cost temperature monitoring system in the Salnitro Cave: a bat roost cave in Southern Sicily	345
George VENI & Michael JONES GIS Modeling of the Ranges of Endangered Troglodites	349
Quentin WACKENHEIM, Marina FERRAND & Yann BUSSIÈRE Can an artificial cave be a hotspot for mollusc diversity? Overview of land snail biodiversity underneath Paris and surrounding area	353
Dieter WEBER, Lee R. F. D. KNIGHT & Alice SALUSSOLIA Microniphargus, first results of phylogenetic analysis	357
Maja ZAGMAJSTER, Špela BORKO, Teo DELIĆ, Christophe DOUADY, David EME, Florian MALARD, Peter TRONTELJ & Cene FIŠER Availability of DNA barcodes in subterranean amphipods of Europe	361
Maja ZAGMAJSTER, Špela BORKO, Gregor BRAČKO, Teo DELIĆ, Cene FIŠER, Ester PREMATE, Monika ŠAFHAUZER, Peter TRONTELJ, Valerija ZAKŠEK & Jasminko MULAOMEROVIĆ SubBIOCODE - Developing new tools for rapid assessment of subterranean biodiversity in Bosnia and Herzegovina	365
Alexandre ZAPPELLI, Matthieu EGELS, Laura CORE, Jimmy MARTIN & Raphaël COLOMBO Cave of the Adaouste (France, Provence): a major regional roosting for the populations of Mediterranean bats. Study for a concerted management of the site	369
Maria Elina BICHUETTE, Lilia SENNA-HORTA, Frank AZORSA, Diana DAVILA & Jonas GALLÃO Biodiversity of Cuevas de Alto Mayo (San Martin, Peru), a remarkable fauna to be protected	373
Martina CAPPELLETTI, Daniele GHEZZI, Andrea FIRRINCIELI, Andrea COLUMBU, Jo DE WAELE, Cristina CARBONE, Peiyang HONG, Freddy VERGARA & Francesco SAURO Geomicrobiology of amorphous silica speleothems	374
L. Yusnaviel GARCÍA-PADRÓN & John FIORONI Reproductive ecology of the Cuban Giant Frog ( <i>Eleutherodactylus Zeus</i> ) (Anura:Eleutherodactylidae) from Cuba	375
Josiane LIPS & Marcel MEYSSONNIER Le GEB : Groupe d'Etude de Biospéléologie	376
Jéssica SCAGLIONE GALLO & Maria Elina BICHUETTE Historic of taxonomic studies on Brazilian cave myriapods (Arthropoda)	377

## Symposium 20 : Année internationale des grottes et du karst / *International Year of Caves and Karst*

---

Vincent BIOT, Fabien HOBLÉA, Fadi Henri NADER & Nadja ZUPAN HAJNA International Year of Caves and Karst: Actions and Results	381
George VENI The International Year of Caves and Karst: History, Purpose, Plans, and Predictions	389
Philipp HÄUSELMANN Speleogenesis: the other view	393

Nadja ZUPAN HAJNA Karst, Caves and People	395
Ferdinando DIDONNA, Francesco MAURANO & Victor FERRER #SPELEOMEDIT: Mediterranean speleology at glance	399
Francesco MAURANO, Ferdinando DIDONNA & Ivana GUIDONE International Speleology Meeting "Speleo Kamaraton 2021"	403
Bärbel VOGEL, Stefan ZAENKER, Hannes KÖBLE, Andreas WOLF & Friedhart KNOLLE First International Cave Animal of the Year	407
Stéphane JAILLET, Christophe GAUCHON, Fabien HOBLEA, Christophe LANSIGU & Emmanuel MALET Le projet « Cave Time Capsule 2091 ». Choix techniques et mise en œuvre	411