INTERNATIONAL CONGRESS on SCIENTIFIC RESEARCH in SHOW CAVES

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The basis of the successful realisation of the first "International Congress on Scientific Research in Show Caves" was the strong commitment and active international cooperation of Grotta Gigante (Italy), Park Škocjanske jame (Slovenia), Karst Research Institute (ZRC-SAZU Institut za raziskovanje krasa -Slovenia) and the University of Trieste (Italy).

The conference was held in Park Skocjanske jame (Slovenia) and the programme allowed participants to visit a number of caves: the Skocjanske jame (Slovenia), the Grotta Gigante (Italy) the Postojnska jama/Postumia Cave (Slovenia).

The Climatological Observatory near the Grotta Gigante

Three show caves of great importance that form a remarkable and easily accessible "karst triangle" as they are situated about an hour's drive one from the other. A remarkable international karst triangle because it includes one of the most fascinating caves of the "UNESCO World Heritage": the Škocjan Cave,then Postojnska jama/ Postumia Cave which is one of the most famous caves in the world and Grotta Gigante which, thanks to the large central room, is considered among the biggest show caves in the world. In short, a triangle that scientists and all those interested in the karst are warmly advised to visit.

The term karst (kras) was adopted to indicate this region on the border between Italy and Slovenia where the first scientific research – the karstology - was made and then developed. Now the scientific tradition continues even though these caves have been converted into show caves.

Thanks to this scientific tradition it was decided to organise international meetings in order to discuss, update and share the scientific research monitored in the show caves. It is important to collect data, but also to communicate results for further research and worldwide diffusion.

The conference (13-15 September 2012) was held in an itinerant method: Škocjanske jama, Grotta Gigante, Postojnska jama/Postumia Cave to encourage direct contact and discussion with all the participants regarding the various tourist-underground environments in the Karst (Italy and Slovenia) and consolidate cooperation in this important triangle of the Classical Karst. The possibility of a copious exchange of experiences, comments and updates has increased thanks to the participation from all over the world: Austria, Brazil, Bosnia and Herzegovina, Croatia, France, Germany, Italy, Poland, Russia, Slovenia, USA. The participants considered the carrying out of scientific research in underground environments and specifically in the caves where the equipment logistics had already been made by the director of each cave; e.g. adequate lighting, easy, comfortable steps and paths according to current standards and many other infrastructures offered to scientists and researchers who have, thus, easier access with subsequent control and monitoring of the scientific instruments.

The conference emphasised the fact that show caves are a consolidated tourist reality with a major financial impact in terms of commerce and employment in areas which, owing to their morphology, are often

The entry to the Visitor centre of the Grotta Gigante

economically disadvantaged. They represent a natural attraction of great importance and make it possible to see the area both from a cultural-scientific and a gastronomical point of view. A special management, an essential consideration for the protection of cave and karst, are basic for all the show caves which not only aim to make a profit but must have a profit in order to develop further, to improve scientific research and the economy of the surrounding karst area.

The importance of the show caves should not be underestimated. Anybody can visit them and appreciate the beauty and significance of the underground world and follow educational events: a large number of pupils enjoy visits to these show caves every year.

Carla Braitenberg explains the work of the pendulums using a micro-model at the Visitor centre of Grotta Gigante

The goals proposed at the conference to present and share different research approaches, to discuss the experiences, the results and the measures needed to improve the management of show caves have been met and will be revised and updated in the next conference, which has been warmly requested by the participants, and is expected to be held every two years.

The meeting was held in the new Promotion and Congress Center Pr Nanetovh in the village Matavun where you can visit the Skocjanske Jame. The official opening of the conference began with a warm welcome from the director of the Park Škocjanske Jame, Gordana Beltram, the director of the Grotta Gigante, Alessio Fabbricatore and the Director of the Karst Research Institute-ZRC-SAZU, Tadej Slabe, as well as the reading of communications from various nations with their best wishes for a productive conference. The best wishes sent from Univ. Prof. Mag. Dr. Hubert Trimmel from Vienna must also be mentioned.

The conference opened with a report by Andrej Kranjc (ZRC-SAZU Karst Research Institute-Slovenia), celebrating an International historical overview of researches carried out in show caves and he reaffirmed that "…scientific research may instigate other activities (education for example), which in turn can give an impulse to new or deepened scientific work".

Andrej Kranic and Chris Groves were the moderators of the first day and Chris Groves, (Western Kentucky University-USA) presented an extensive report on Karst hydrology research in show caves. In the area that includes the Mammoth Cave System (UNESCO world heritage Site) there are many public and privately managed show caves, providing excellent sites for quarries related hydrologic, biological, and resource management research activities. "…Mammoth Cave projects have studied hydrology, geochemistry and water quality. Epikarst hydrology and impacts of agriculture have been the focus at Crumps Cave (Cave Spring Caverns), and we are now developing a reference site at Lost River Cave for a global monitoring network to study landscape / atmosphere CO_2 interactions."

From these experiences in North America one passed to Brazil, in South America, to the Cave of Santana, where Heros Lobo (Universidadae Federal São Carlos UFSCAR -Brazil) took into account human impact and environmental sustainability by comparing the monitoring that is carried out to verify the impact of human activity on the natural environment, stating that: "… The investigation of the variation of temperature, in the present study, showed that the interval of time spent at a specific point in the cave is more critical than the absolute variation of the temperature which is an important contribution in the process of definition of the tourist carrying capacity of a cave, mainly in the days with more tourists (weekends and holidays)."

Regarding the topic of the impact of visitors, but now in Europe, another paper was presented by Rosana Cerkvenik (Park Škocjanske Jame-Slovenia), stating that

R.Colucci (first right) explain the use of the Climatological Observatory near Grotta Gigante

"... the most significant impacts are off-trail footprints - trodden fine sediments, destroyed gours and cave pearls, graffiti and broken formations."

The participation of two Russian scholars (Mining Institute of Ural branch of Russian Academy of Science-Russia) made the illustration of tourism, the studies of the characteristic rocks and their transformation at karstification in Kungur Ice Cave, possible.

Christophe Gauchon (Université de Savoie-France) presented an overview of scientific research in show caves in France and Stephan Jaillet (Université de Savoie, CNRS-France), reported on 3D laserscanning and geomorphological studies in Orgnac cave conferming that "...the implementation of this new technological approach in tourist cave also offers an additional opportunity: the scientific mediation to the public, eager for this type of 3D production with many possibilities of representation."

Experimental station of limestone lowering near Visitor Centre of Grotta Gigante

The keynote speakers of the second day were Franci Gabrovšek (Karst Research Institute ZRC SAZU - Slovenia) and Franco Coren (O.G.S.-Italy), who presented their reports. Franci Gabrovšek reported on the results of the metereological monitoring carried out at the Postumia caves: wind, humidity, CO_2. Although tourists are a potential additional source of CO_2, their presence is most unlikely to influence natural precipitation and dissolution processes. CO_2 in cave atmosphere is now measured by non-dispersive infrared CO_2 sensors, which measure the absorption of infrared light by CO_2.

Another keynote speaker was Franco Coren, (O.G.S. National Institute of Oceanography and Experimental Geophysics of Trieste-Italy), who presented the results of a series of remote sensing and geophysical campaigns. This project was developed with a strong integration between the Grotta Gigante, and the O.G.S. The cave is accessible to the public by means of an artificially-lit path, consisting of numerous steps. The underground environment and the type of path make it difficult for people with walking difficulties to visit the cave. "... The need for the cave to become easily accessible to everyone has led the manager of the Grotta Gigante, Alessio Fabbricatore, to promote a wide-ranging project involving both the administration spheres, which have always been attentive to the needs of the disabled, and the scientific spheres, which have always worked in the cave area. The project immediately proved to be ambitious: as well as traditional photo and video shooting, a high-resolution 3D topographic survey was carried out, by means of aerial LIDAR surveying for the outside part of the cave and of terrestrial laser scanning, total station and GPS for the georeferencing and topographic reconstruction of the underground part of the tourist site. Thanks to these surveys it was possible to create a geomorphometric database of the entire site, which enabled to update the planimetry and sections, acquire details of the most impressive stalagmites and carry out videos and 3D models of the underground environment, in order to promote tourism and allow visitors unable to have direct access the cave to enjoy a virtual tour of it." The processing of the collected data will be the basis for future studies, such as studies on environmental monitoring, the eco-friendly development of the Grotta Gigante, geophysical, geological and gravimetric studies, thereby demonstrating that the important combination of tourism and scientific research make it possible for the Grotta Gigante to be constantly monitored in order to ensure eco-compatibility between the flow of tourists and the delicate underground environment of the cave.

Miris Castello (University of Trieste-Italy) also selected the Grotta Gigante as the place of research for the monitoring of lamp flora, which grow near artificial light sources. The various types of organisms were specified and "... small, scattered individuals of 4 moss species and *Asplenium trichomanes* were observed growing around some LED lamps recently installed along the cave pathways, precisely in 2009." Janez Mulec (ZRC-SAZU Karst Research Institute-Slovenia), in his interesting report, stated that "... different microbial indicators were used to evaluate human impact and some possible approaches were tested in order to remediate affected sites in the Postojna and Škocjan Caves (Slovenia), since the opening to the public often brings reversible and/or irreversible effects on the cave environment and cave-dwelling organisms."

The conference was also enriched by interesting reports and posters on the current methods of protection and monitoring of radon (Italy and Slovenia), fauna monitoring (Slovenia), micro-erosion measurements (Italy and Slovenia), ground penetrating radar survey (Giuseppe Camero-Italy) and tests (M. Kržič, Društvo ljubiteljev Križne jame, Slovenia) on protective materials to minimise damage to the most vulnerable sections of the rimstone dams in the Krizna Jama.

Not to mention those works presented by means of posters which contributed to enrich the conference with explanations, discussions, updates on various topics including studies (Tadej Slabe & others, ZRC-SAZU Karst Research Institute, Slovenia) on the transformation of the Heaven cave, (Phong Nha-Ke Bang National Park,

UNESCO World Heritage site -Vietnam) into a show cave with the aim of maintaining the cave in its natural equilibrium.

The poster which was carried out following a speleogenesis study (EDYTEM, CNRS, University of Savoy-France) on the scientific enhancing of the Jeita Cave (Lebanon), showed us how they decided to implement "…the paths with educational boards in order to respond to the scientific curiosity of tourists." In fact, they confirm that "…our duty as cavers and karst scientists is not only to gather data on caves (by means of photos, maps, descriptions, etc.) and publish them in our bulletins, but also to inform and educate the public on the scientific value of our underground natural heritage. Communicating science can be one of the best means to preserve natural sites, such as the Jeita Cave."

The charming underground flow of the Reka river, which sinks in the Skocjanske Jame and reappears in the springs in Italy, was presented by da Borut Peric (Park Škocjanske Jame -Slovenia). The aim of his project was to prove a connection between some of the caves reached by the Reka river and the dynamics of water transport between the ponor and the springs, using uranine as a tracing experiment: three caves in Slovenia (Kačna Jama Cave, Brezno 3G abyss system Jama 1 v Kanjaducah Cave and Brezno v Stršinkni dolini abyss) and two in Italy (Labodnica/Grotta di Trebiciano and Čudovita Jama Lazarja Jerka/Grotta meravigliosa di Lazzaro Jerko). Two of them, the Škocjan Caves and Labodnica, are also show caves.

Fulvio Forti, guide of Grotta Gigante explaining the limestone lowering at the experimental station of Grotta Gigante

As previously stated, all the people taking part in the conference visited the three show caves, always accompanied by specialised staff giving specific scientific information. For example, a tour of the Grotta Gigante and the Museo dell'uomo e delle grotte was made, accompanied by expert guides, researchers and scientific research specialists who showed us all the study and monitoring stations present on the Grotta Gigante site. Among these specialists it is worth mentioning: Carla Braitenberg (University of Trieste-Italy), who explained the horizontal pendulums; Renato Roberto Colucci (University of Trieste, CNR- Italy), who presented the Karst Meteo-Climatological Observatory; Fulvio Forti (Grotta Gigante guide-Italy), who explained limestone lowering and its measurement at the station near the Visitor Reception Centre of the Grotta Gigante, and Massimo Sbarbaro (University of Trieste-Italy), who talked about wireless internet connection: on certain types of mobile phones, it is possible to make videocalls from inside the cave and show the spectacular view you are admiring in real time. The above-mentioned studies also take into consideration the other scientific stations of the Grotta Gigante, such as the Seismographic Station, two clinometers, the biology station with the monitoring of lamp flora, the radon monitoring station, the archaeological and palaeontological studies, speleothem growth monitoring and the Epigean station for the measurement of karstic dissolution.

At the end of the tour of the Grotta Gigante, the new English/German version of the guide to the cave was presented and given out to all participants.

The new edition of the guidebook, which is different from the previous ones, is divided in sections, one for each scientific section covered in the Grotta Gigante site, without forgetting the analysis of the karst processes which lead to the formation of the cave and an in-depth geo-morphological explanation of the territory in which the cave is located.

The guidebook offers the reader not only the chance to appreciate the beauty of the Grotta, but also to understand the multiplicity of scientific studies that have already been carried out and may be carried out in the future in the cave, as well as showing the importance of the use of the most advanced technology in order to solve certain scientific problems and to provide clear evidence of the natural processes that take place in caves.

The variety of studies is presented in a very convincing way by a great number of researchers who, in this brochure, reveal their specific fields of study and research.

The guidebook covers a wide range of topics and could therefore be a very useful tool for pupils.

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