

CELEBRATION OF EVENTS IN KARSTIC CAVES?

HIGHLIGHTING THE NEED FOR ENVIRONMENTAL STUDIES BEFORE DECIDING

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ABSTRACT

In addition to their conventional tourist use, the caves have also been used as a place for the celebration of a wide range of activities, among which the celebration of musical events with relatively large public attendance of people stands out (Figs. 1 and 2). The development of these events can induced an additional environmental impact to those produced by the tourist visit and thus, they can represent a risk factor for the conservation of the natural and cultural heritage of the caves.

The fragile environmental balance of caves makes necessary to study and control this type of activities, as well as to design and implement specific conservation protocols aimed to prevent or minimize their impact. We present some of the results obtained in Nerja Cave (Malaga, Spain), an important touristic cave (about 450,000 visitors/year) declared Good of Cultural Interest with the category of Archaeological Zone and Global Geosite, where an annual music and dance Festival took place from 1959 to 2019.



Fig. 1. Nerja Cave Festival, Ballet Hall.



Fig. 2. The decrease of the size of the stage (compare figs. 1 and 2) and the reduction of the attending public were two of the measures implemented in the Conservation Protocol.

MAIN IMPACTS OF THE MUSIC AND DANCE FESTIVAL “NERJA CAVE” The environmental monitoring of the Festival for several years has allowed to know and value its impact for the cave conservation and to tests the efficacy of the Conservation Protocol applied. The main impacts were:

(1) damage of the walls and speleothems. We observed accidental incisions, scratches, paintings..., related to their use as direct support of infrastructures for the event (stage, sound systems or artistic lighting, amongst others) (Fig. 2).

(2) significant microclimatic changes in the air cave that added to the daily impact of the tourists. We observed increases in the air and rock temperature and carbon dioxide concentrations, amongst others, which persisted in the cave during several days after the end of the event (Fig. 3). During the shows, the established habitual capacity and the average time of people in the cave was exceeded and the audience (450-800 people) remained in the same place (Ballet Hall) for about two hours. The musical event took place at night, outside the normal tourist opening hours which meant a reduction in the recovery time of the cave.

(3) damage to the institutional image of the Nerja Cave Foundation as heritage element and inconveniences caused to the visitors by the presence of the infrastructures which disturbed the beautiful subterranean landscape.

CONSERVATION PROTOCOL To limit the impact of the Festival, a specific protocol was implemented in 2002. The main work lines consisted of *(a) preventive and corrective measures*: progressive reduction in the number of shows held in the cave and of spectators; physical protection for the most fragile elements; to maximize the cleanliness of the Ballet Hall and of all the objects introduced into it; to prohibit any organic material and of a porous nature; to limit the time allochthonous elements could remain in the cave. The objective of these measures was to prevent damage to the cave itself caused by the installation of the infrastructures, the presence of people and the development of potentially contaminating agents, *(b) environmental control measures*: specific control of the environmental and biological parameters in the air, water and support systems (before, during and after the shows) in order to identify possible alterations related to the Festival and its ongoing impact and *(c) training measures* for spectators and for workers involved in the installation and the dismantling of the infrastructures inside the cave.

CONCLUSIONS The environmental studies performed have allowed to design a specific Conservation Protocol for the Festival “Nerja Cave”, whose progressive application has managed to diminished part of the anthropic impact (Fig. 3) and of the damages linked to their infrastructures. However, despite these improvements, the heritage nature of the place cause that this type of events continues being a significant risk factor for its conservation and, particularly, for its rock art. The presence of public, unexpected behaviors, unpredictable factors or accidents during the insertion of the infrastructures produce irreversible damage to their speleothems and walls and allow for microorganisms development potentially dangerous for the rock art. For all this, in 2019 was celebrated the last show inside the cave (a single performance). Currently, all Festival performances are held outside, in the garden area.

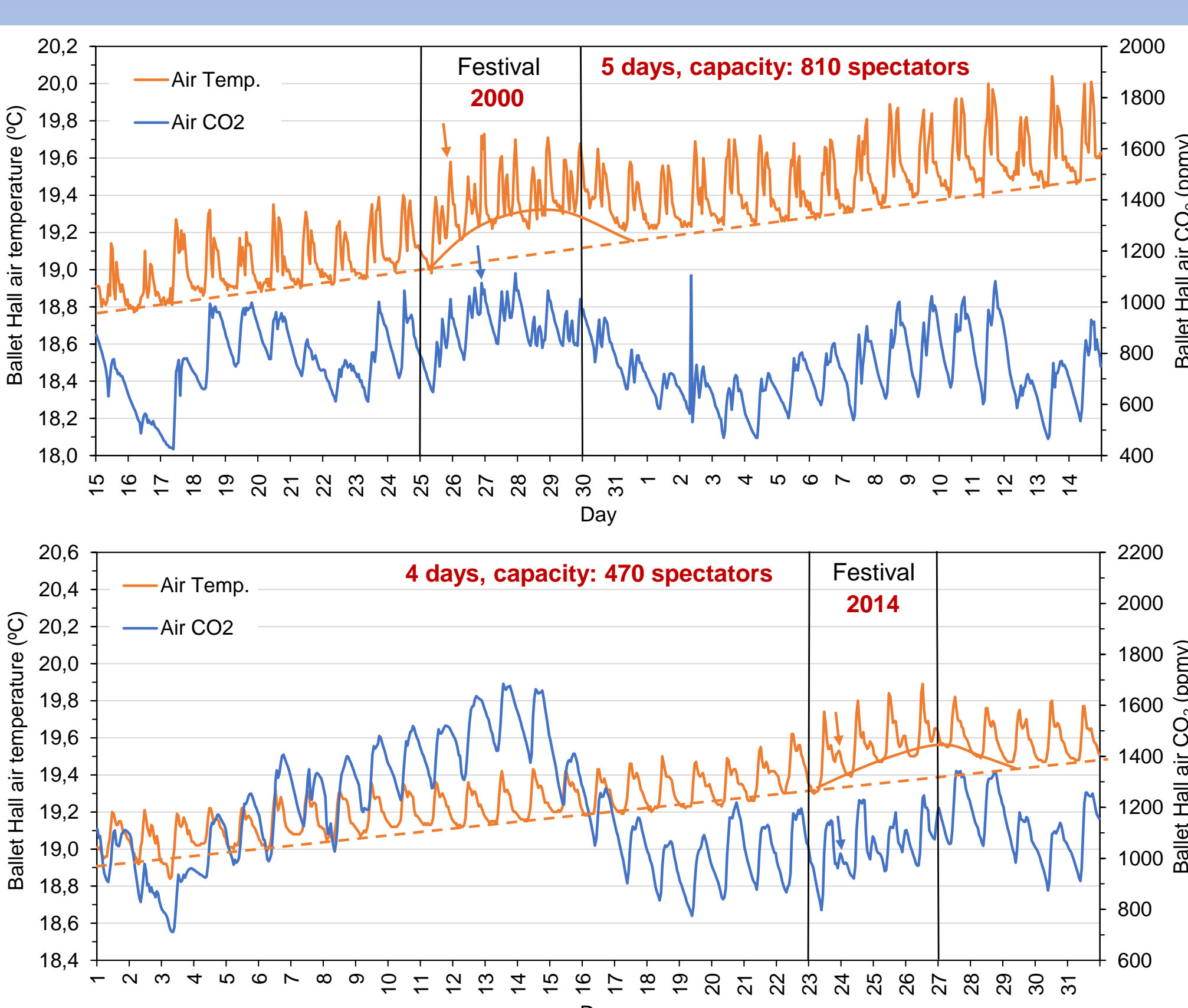


Fig. 3. Temporal evolution of air CO₂ and temperature (Ballet Hall, years 2000 and 2014). The reduction of the capacity and of the number of shows diminished the air CO₂ and temperature increases linked to the presence of the public and to the special lighting used for the Festival.