

Recreational Impacts on the Microclimate of the Gorilla Limestone Cave in Shoushan National Nature Park of Taiwan

Chun Chen and Lih-Der Ho

Department of Geography, National Kaohsiung Normal University, Kaohsiung, Taiwan (kevin469655@gmail.com)

This study reports a continuous microclimate monitoring carried out in the Gorilla Cave (Kaohsiung, Taiwan) between December 2015 and December 2016. This limestone cave is located in the Mt. Shoushan, which is mainly composed of limestone and mudstone. This study tried to assess the recreational impacts to the microclimate of the cave by monitoring the CO₂, temperature, humidity and barometric pressure. Two monitoring stations were set up respectively at the front part (station A) and the end of the cave (station B). We also set up an auto-operated time-lapse camera at the entrance of the cave to record the numbers of tourists, and their entering time and the durations in cave. As carbon dioxide in the limestone cave may have negative impact to both speleothems and visitors, our presentation focuses on the variations of CO₂ concentration in the Gorilla Cave.

Daily and seasonal fluctuations of CO₂ concentration were observed. The fluctuations are closely related with the temperature outside the cave. In summer, when the temperature outside the cave maintained at ~ 30 [U+3002] C, fluctuations of CO₂ concentration in the cave will become chaotic. The CO₂ concentration would fluctuate around 1000ppm most of the day, but it would be relatively low (~ 500 ppm) during the noon. In winter, when temperature outside the cave maintained below 25 [U+309C] C, the fluctuation of CO₂ concentration in cave presented a steady state (~ 400 -500 ppm). Only at the noon, the temperature outside the cave rose above 25 [U+309C] C, the CO₂ concentration inside the cave would increase.

There were 1,517 tourists entered the cave during the monitoring period. The average number of visitors in a group is 13, and each group averagely stayed for 15 minutes. Over half of the visitors (776 tourists) entered the cave in December, due to lower humidity, drier in the cave and less dripping water in winter. After tourists entered the cave, the CO₂ concentration value of station A rose instantly. However, most tourists stayed at the end of the cave longer, so the CO₂ concentration of station B would be higher due to the CO₂ accumulation. Therefore, it took a long time to return to the background level of CO₂ concentration. In summer, because the CO₂ concentration in the cave was already high, the value fluctuated less when the tourists entered the cave, but it took a longer time to return to the background CO₂ level. On the contrary, the CO₂ concentration increased significantly after tourists entered the cave during the winter time, but the recovery time was shorter.

Based on the monitoring results, we suggest that (1) the buffering time between each visiting group should be longer in summer, but shorter in winter. (2) Consider to the limited space of the cave, each group should not exceed 20 tourists and stays no longer than 30 minutes to avoid the CO₂ concentration exceeding 2400 ppm to discomfort tourists. However, the degradation of speleothems by increasing CO₂ concentration in the Gorilla Cave is still unclear and further research is needed.