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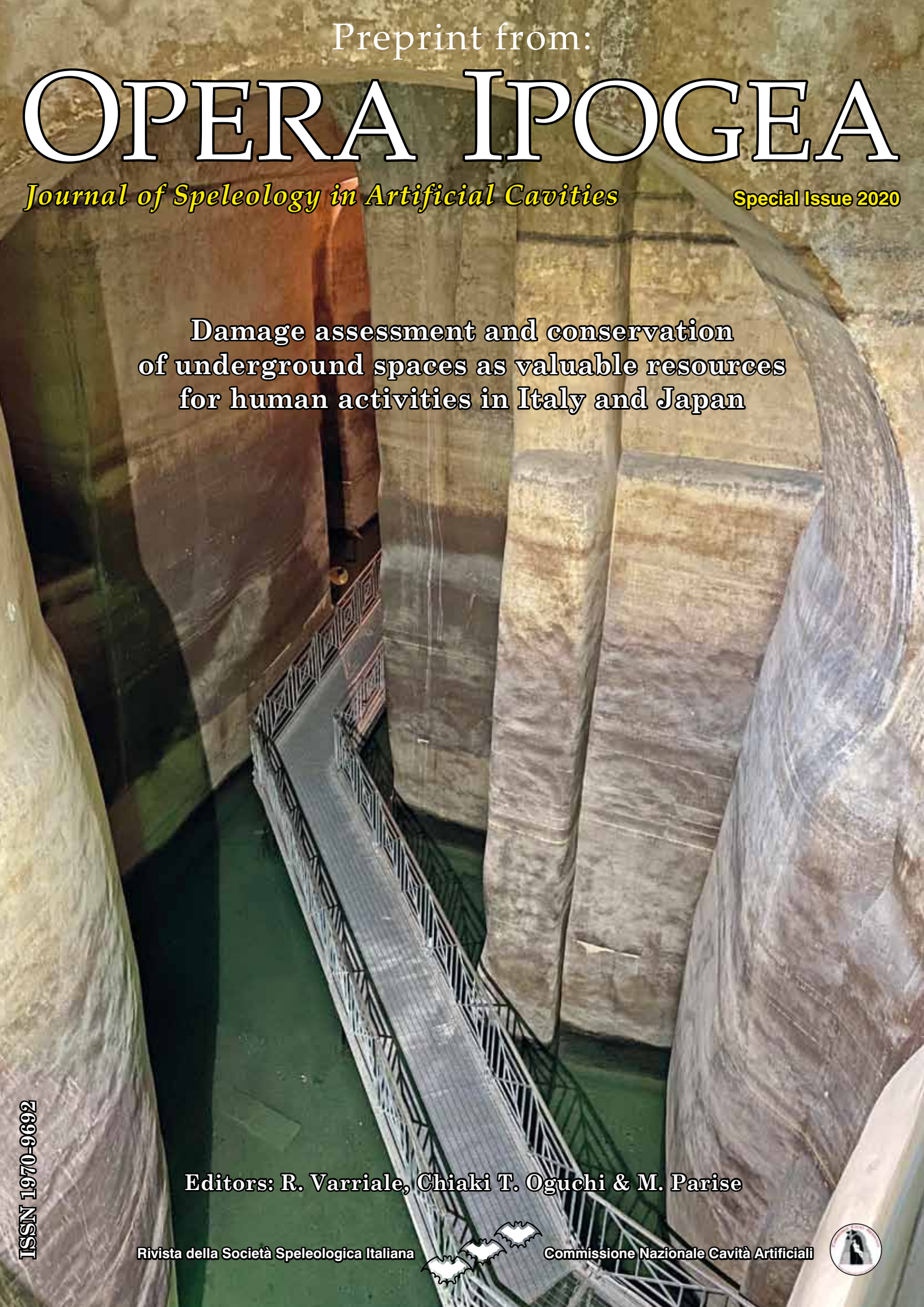

Damage assessment and conservation of underground spaces as valuable resources for human activities in Italy and Japan

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Cisterna il Palombaro Lungo a Matera, Basilicata, Italia (foto: Archivio Antros – Matera)
Palombaro Lungo water tank in Matera, Basilicata, Italy (photo: Antros Archive – Matera)

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Chiesa K4c a Göreme, Cappadocia, Turchia (foto: Archivio Centro Studi Sotterranei – Genova)
K4c church in Göreme, Cappadocia, Turkey (photo: Centre for Underground Study Archive – Genoa)

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Multidisciplinary conservation activities and community development based on the Yokohama City registered historic site “Taya Cave”. Examples report of collaboration with educational institutions

Attività multidisciplinari di conservazione per il sito storico di “Taya Cave”, Yokohama City: esempi di collaborazione con le comunità e le istituzioni educative

Yasuhiko Tamura[1, 7], Chiaki T. Oguchi[1, 2], Yuichi S. Hayakawa[1, 3], Keisuke Ogata[1, 4], Takuro Ogura[1, 3, 5], Masashi Morita[6]

Abstract

Taya Cave (Taya-San-Yoga-do) is an underground cultural property registered as a historic site of Yokohama City in Taya Town, Sakae-ku, Yokohama; it is 570m long and 3 stories high. There are about 300 reliefs inside the cave, that is a relict site such as the three major sacred places in Japan (West Country, Bando, Chichibu), and the Shikoku 88 Site. This cave is currently in need of conservation due to deterioration and weathering, as effect of exposure to the open air and climate change. We have established the Preservation Executive Committee since 2017, and are conducting multi-disciplinary basic surveys based on digital data preservation activities with several university researchers. We are also trying to re-evaluate local town resources in the surrounding area of Taya Cave while coordinating basic research on underground cultural properties with local communities and public educational institutions. In this paper, we clarify the results and issues of practical cooperation between underground cultural property preservation and community development.

Keywords: Taya Cave, Multidisciplinary conservation activities, Collaboration with public primary school and universities, Regional learning.

Riassunto

La Grotta Taya (Taya-San-Yoga-do) è una cavità artificiale di carattere religioso, registrata come sito storico nella città di Yokohama, e ubicata a Taya, Sakae-ku, Yokohama. Essa è lunga 570 metri e si sviluppa in 3 livelli. All’interno della cavità sono presenti circa 300 bassorilievi. La grotta rappresenta un sito di grande interesse religioso, al pari di altri siti sacri in Giappone (West Country, Bando, Chichibu), e del sito Shikoku 88. Essa necessita attualmente di azioni volte alla sua conservazione, a causa dei processi di degrado e di alterazione in atto, connessi all’esposizione all’aria ed ai cambiamenti climatici. Dal 2017 è stato fondato un Comitato Esecutivo per la Conservazione, che sta svolgendo rilievi multi-disciplinari mediante acquisizione di varie tipologie di dati digitali, in collaborazione con diversi ricercatori universitari. Allo stesso tempo, negli ultimi anni sono in corso attività finalizzate alla rivalutazione delle locali risorse e siti di interesse nei dintorni della Grotta Taya, e si stanno coordinando ricerche di base su elementi del patrimonio culturale ipogeo, in collaborazione con la comunità locale e le istituzioni educative pubbliche. Nel presente lavoro, si illustrano i risultati sinora ottenuti e le azioni di cooperazione pratica tra la conservazione e salvaguardia del patrimonio storico-culturale ipogeo e lo sviluppo della comunità locale. Buona parte di tali attività hanno visto il coinvolgimento diretto della comunità locale, sia a partire dalle

[1] Executive Committee for the Preservation of TAYA CAVERN (ECPT), Japan
[2] Institute for Environmental Science and Technology, Graduate School of Science and Engineering, Saitama University, Japan
[3] Faculty of Environmental Earth Science, Hokkaido University, Japan
[4] Tsurumi University, the Department of Cultural Properties, Japan
[5] Graduate School of Frontier Science, The University of Tokyo, Japan
[6] Yokohama National University, Institute of Urban Innovation, Japan
[7] University of Tokyo, Center for Spatial Information Science, Japan

Corresponding author: Yasuhiko Tamura – tytamura2@nifty.com

giovani generazioni (studenti delle scuole elementari, che hanno avuto parte attiva nel progetto, anche con la realizzazione di modelli tridimensionali della grotta) che di anziani, i quali hanno fornito testimonianze orali sulla locale storia, anche in riferimento al sito di studio.

Parole chiave: Grotta Taya, attività multi-disciplinari di conservazione, scuole elementari, apprendimento.

Taya Cave

Taya Cave (fig. 1) is located in the ground of a small *“satoyama”* (17m above sea level terrace) called Mt. Taya (fig. 2) in the precincts of Josenji Temple. This is an artificial tunnel that has been said to exist since the Kamakura period, in the 13th century. Its development is very complicated in both plan and cross section (fig. 4), highlighting the high level of civil engineering technology at the time of construction. Passing through the small cave, it is possible to see the remains of the chisel that have been used by the monks. The cave has undergone extensive renovations in the late 19th century, and various Buddhist reliefs (fig. 3) have been added to its current state.

About Satoyama (Mt. Taya)

“Satoyama” is a Small Mountain which is maintained and controlled by mankind. Typically, a *satoyama* has several land owners, a situation that cannot be ignored when dealing with cultural heritage contained therein. Social issues have therefore to be taken into account. Taya Cave, our case study, is in the underground of a *satoyama*.

From the research we have conducted so far, it has been found that the cave is influenced at several locations within the underground development by the roots of *satoyama* trees, that are present at the ground surface (figs 2 and 5).

Therefore, it is necessary to consider about the conservation of this *satoyama*, as well as about the rural

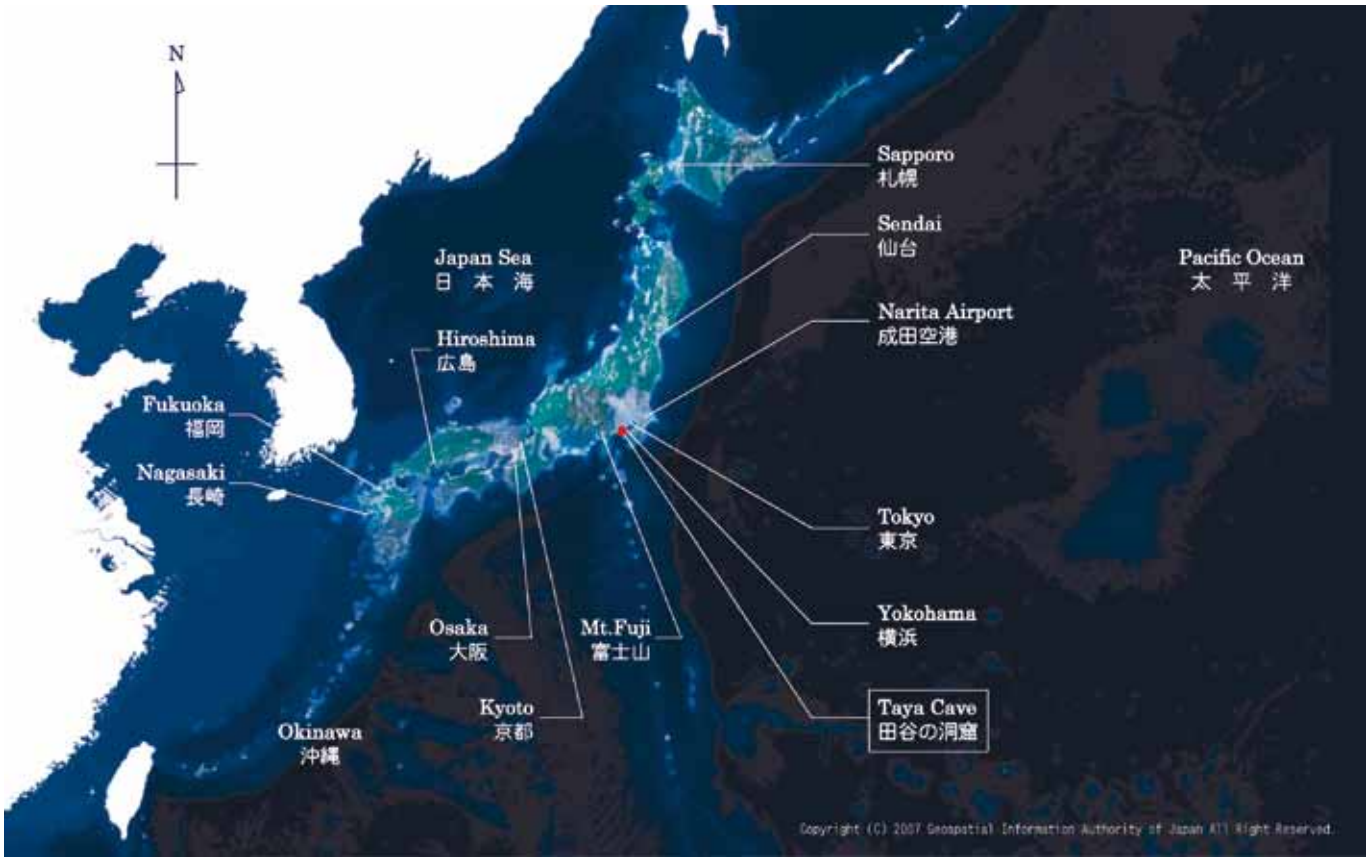

Fig. 1 – Location of Taya Cave in Japan (Geospatial Information Authority of Japan).

Fig. 1 – Ubicazione della Grotta Taya in Giappone (Geospatial Information Authority of Japan).

Fig. 2 – Mt. Taya & Cave Gate (photo: Y.S. Hayakawa).
Fig. 2 – Monte Taya e accesso alla grotta (foto: Y.S. Hayakawa).

Fig. 3 – Dot point 3D model and survey samples (photo: Y.S. Hayakawa).
Fig. 3 – Modello 3D e esempi di rilievi (foto: Y.S. Hayakawa).

regional town planning and design. In other words, the issue of conservation for Taya Cave has to go together with issues of conservation for the *satoyama*, since the two things are strongly linked, being part of a single natural and cultural element. At this aim, actions need to be put in practice to create awareness in the local community, making common efforts toward these conservation activities.

Conservation activities outline

It is necessary to examine the conservation of Taya Cave as soon as possible due to deterioration and weathering caused by exposure to the open air and by climate changes. We are conducting multi-disciplinary basic surveys with many university researchers. Our ultimate goal is to create a 3D digital archive of

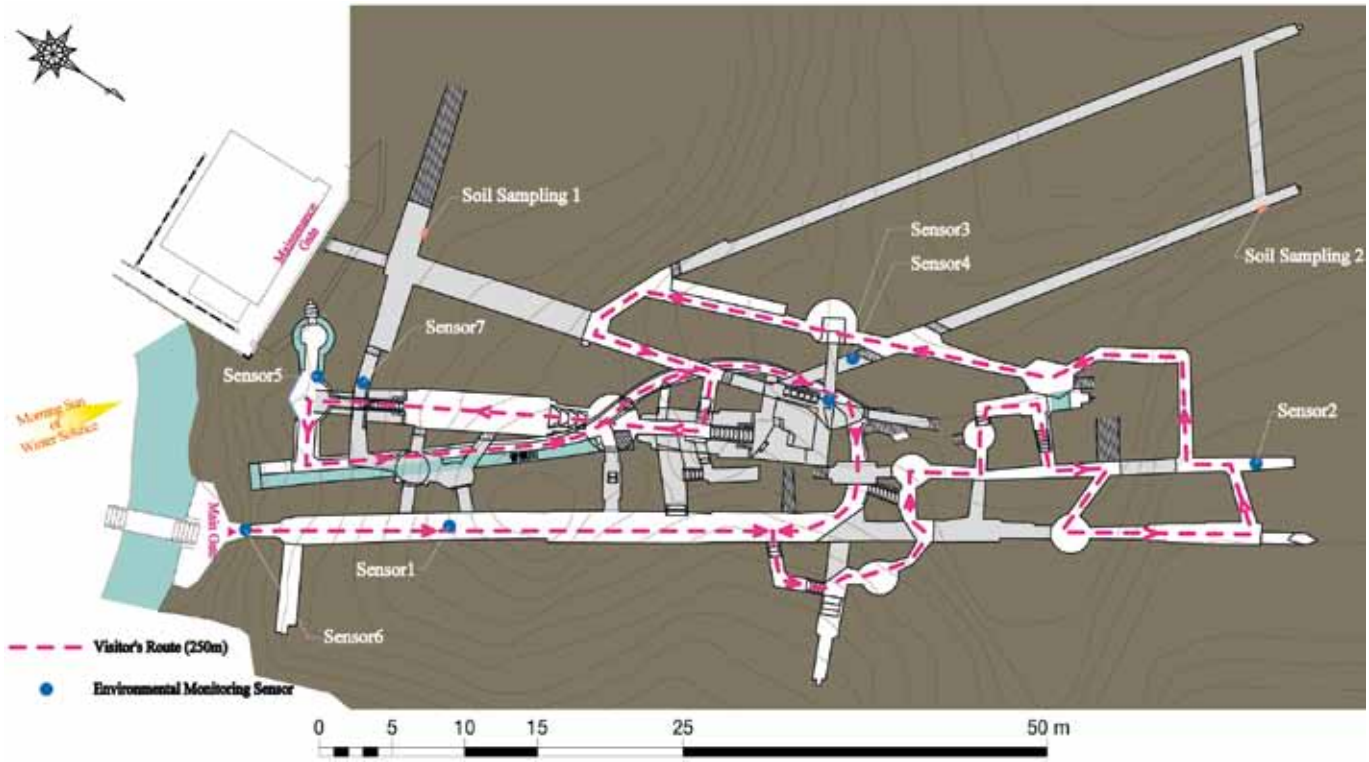

Fig. 4 – Plan of Taya Cave (ECPT © 2016-2019).

Fig. 4 – Planimetria della Grotta Taya (ECPT © 2016-2019).

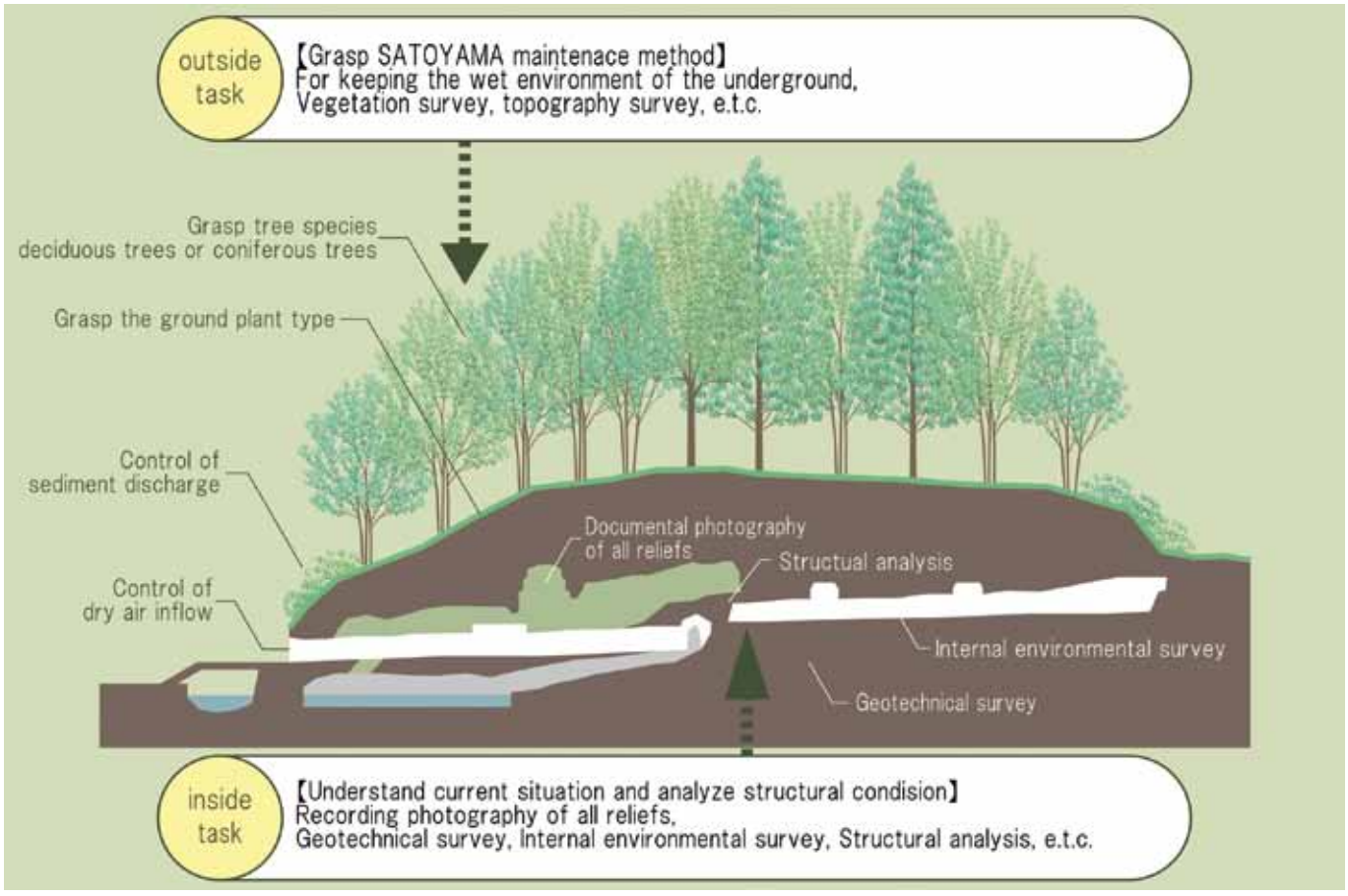

Fig. 5 – Surveys outline (ECPT © 2016-2019).

Fig. 5 – Schema delle attività di rilievo (ECPT © 2016-2019).

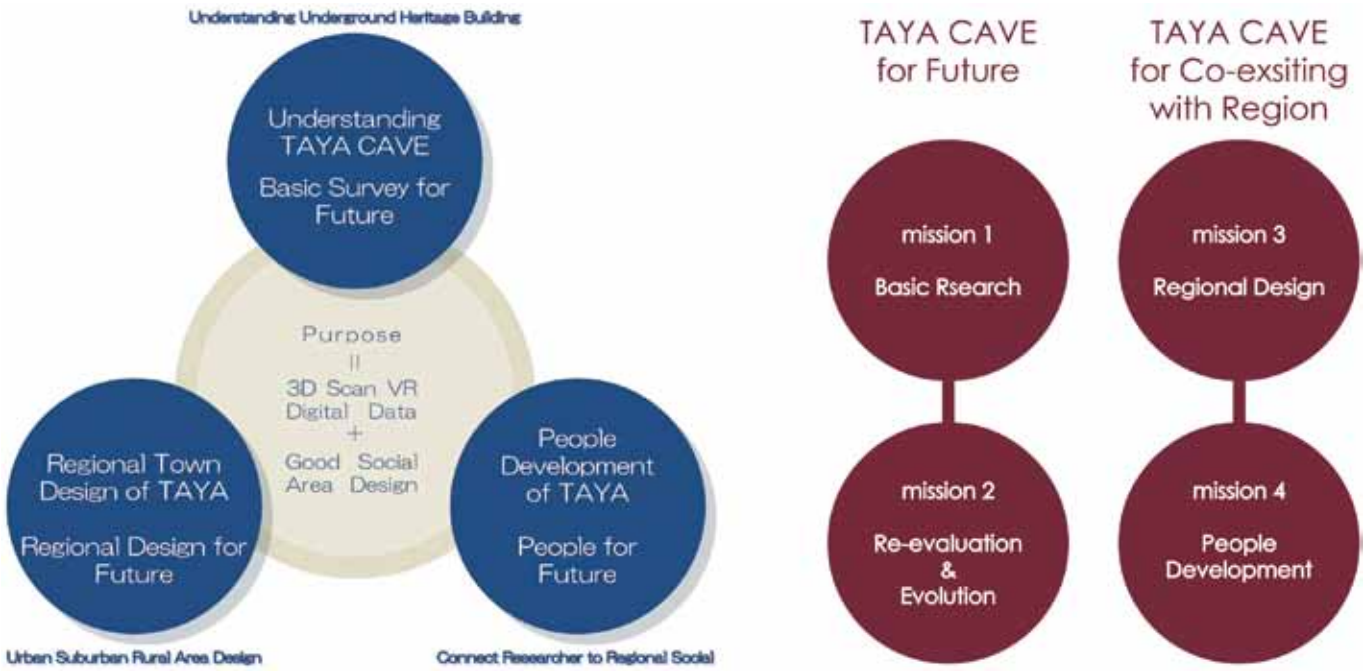

Fig. 6 – 3 axes and 4 missions (ECPT © 2016-2019).
Fig. 6 – 3 assi e 4 missioni (ECPT © 2016-2019).

the cave. Our purpose can be visualized as having 3 axes and 4 missions (fig. 6).

Collaboration with public elementary schools

The underground cultural properties are closely related to local communities, cultures and environments, and to ensure their conservation both the community and human resource development are necessary. For this purpose, we are trying to make local inhabitants feel like having a positive sense of participation. In general, local communities have traditional values and various interests. The complex local history of these sites needs to be unraveled. As it is well known, this work is very difficult, and has necessarily to start through a generational approach and actions. In the autumn of 2017, Yokohama City Senshu Elementary School asked for cooperation for community learning for sixth graders. Since Senshu Elementary School is a counter facility in the local community, we started a project that links this elementary school with the university. We have begun to consider an advanced integrated regional learning program that uses research and survey data from researchers working in many different disciplines, in order to ensure a multidisciplinary approach to the study (fig. 7).

Elementary school and university collaboration project

First, the 6th graders take pre-learning classes taught by various university researchers. Students learn from a high-level perspective the "local community, culture, environment, etc." surrounding underground cultural properties. Lastly, they produce a model of materials that are useful for preserving Taya's cave, which also serves as a graduation project. In the end, students will learn comprehensively about the underground heritage building and the general culture of the area, while directly touching materials and tools through "making things". By outreaching their research activities to elementary school students in an easy-to-understand manner, researchers can participate in local research and survey contributions and receive direct responses from children and teachers. We are currently managing these series of projects, hoping they might represent a chance to develop future local human resources or human resources as researchers (fig. 7).

Pre-learning

First, we conduct a pre-learning class on the meaning and outline of the cavern preservation activities in Taya. Students learn about the beauty of Taya cave and the local culture. We then conduct classes to promote interest in community learning in Taya Town, with students learning professionally from basic research collaborators. Researchers conduct a pre-learning class on research conducted in the preservation activities of the Taya Caves. Specialized classes are the following: "Geotechnical Engineering Basic Survey", applied to Taya's ground and topography, "Geography, Topography and Spatial Basic Survey" to Photogrammetry / Environment, "Regional Design Basic Survey" to Architectural Cultural Heritage, and

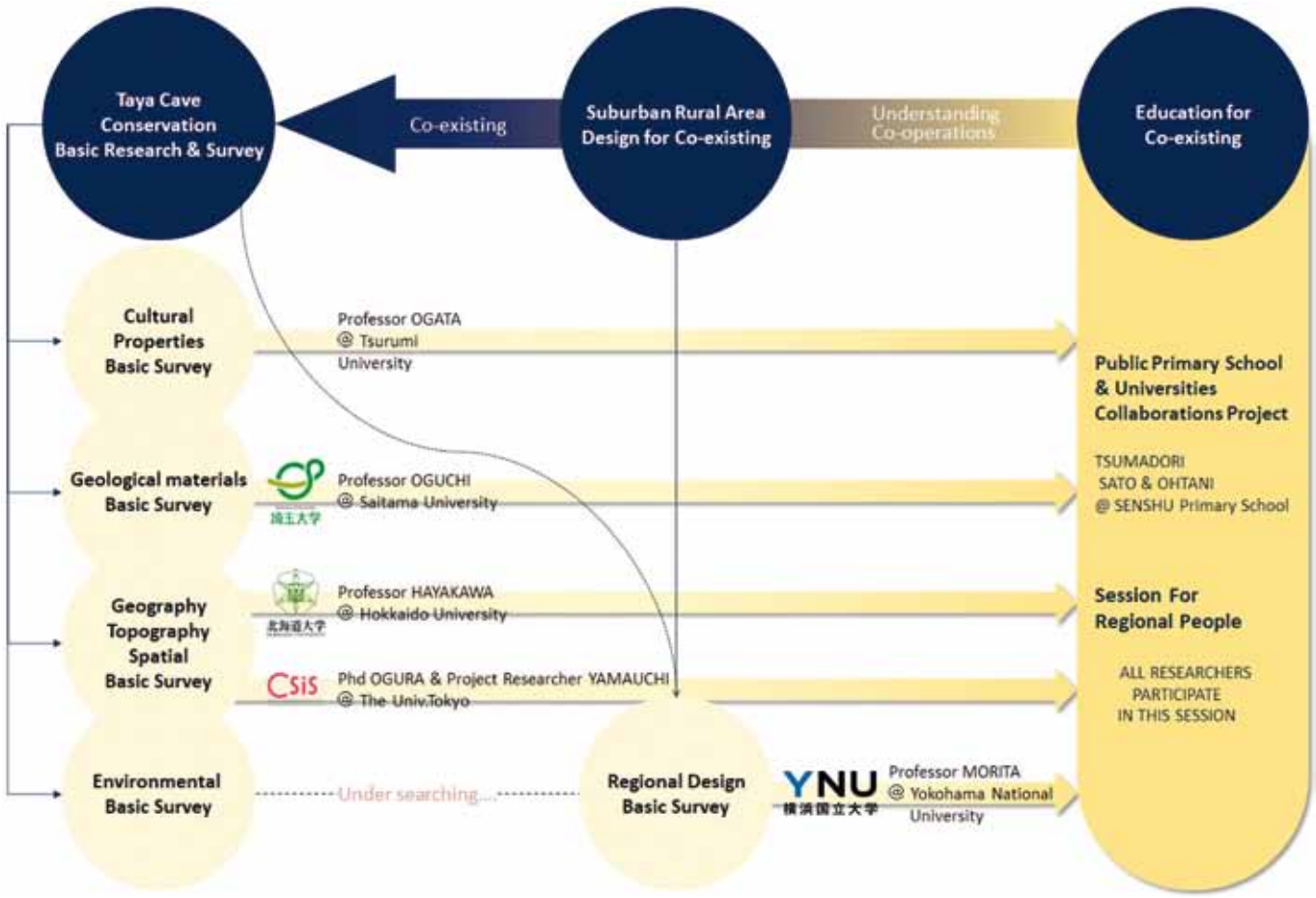

Fig. 7 – Outline of elementary school and university collaboration project (ECPT © 2016-2019).

Fig. 7 – Schema del progetto di collaborazione tra scuole elementari e università (ECPT © 2016-2019).

“Cultural Property Basic Survey” to Japanese Cultural Property (fig. 8).

Modeling class

In the modeling class, students create models that are useful for preserving Taya Cave using the basic survey materials and digital data acquired so far. Model production is carried out by Prof. Morita and student volunteers from the Faculty of Architecture at Yokohama National University, directly teaching students how to use the materials and tools. The students learned the environment surrounding the underground cultural property intuitively by touching the model, and by directly making the model.

Topographical model in 2017

A huge topographical model about 2km square was created around Senshu Elementary School and Taya Cave, the scale module is 1/1000. Students made a model with an interest in the environment of their living sphere. As for the production class, 10 classes were held for a total of 5 days, and the students seemed to be interested in “the terrain that gradually builds up”. Through this action, we have actually appreciated the results of regional environmental education.

Taya Cave Sectional 3D Model in 2018

The 6th graders in 2018 made a 1/50 cave section model. One hundred and twenty-six (126) cross-sections of sliced cave every 60cm were extracted from 3D digital data of the cave, obtained by TLS (Terrestrial Laser Scanner). The students carefully cut out sliced shapes of the inside of the cave from these cross-sections, and layered 126 serial cross-sections, thus creating a complete cross-section model that represented the whole inside of the cave. Looking into this model, one can appreciate the development of the cave. The students continued the simple task of cutting out the partial cross sections, and initially they could not imagine the finished form. However, when all the sections were arranged in order, they shouted that the interior of the Taya Cave had been restored and looked into the model to confirm the underground space. Everyone could check the wall and floor thickness of the underground space by using a ruler on the 1/50 cross-section model.

Fig. 8 – Pre-learning (photo: ECPT © 2016-2019).
Fig. 8 – Pre-insegnamento (foto: ECPT © 2016-2019).

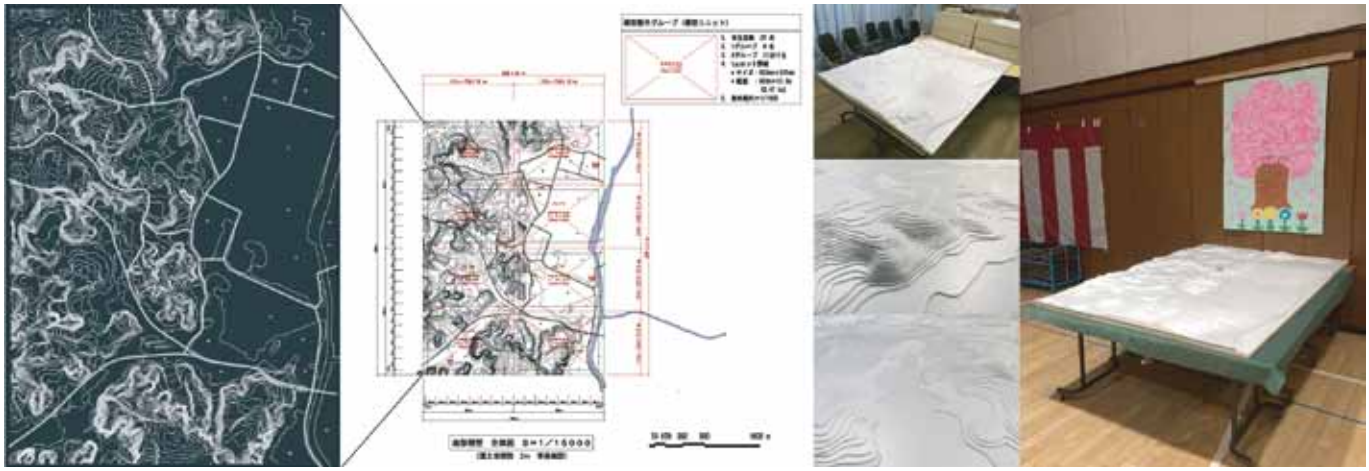

Fig. 9 – Topographical modeling Class (ECPT © 2016-2019).
Fig. 9 – Classe di modellazione topografica (ECPT © 2016-2019).

Practical model use for regional design by architecture and urban design

University students in architecture and urban planning grasp the local environment in three dimensions by using these models made by elementary school students and conduct a basic survey of the regional qualities around the underground cultural properties. Architectural students plot pins of local charm place found by their fieldwork on a topographical model and create a layer on the model. It is possible to conduct a regional survey in relation to the topography in visual. We have been continuing to survey around Taya Cave using these models (fig. 11). The students use the basic data from the Taya Cave Preservation Activities and the topographic models produced by the elementary school and university collaboration project to propose local designs for sustainable local communities, cultures and environments.
Furthermore, by using this topographical model in interview surveys with local residents, the elderly people can also share the geographic information of the local space intuitively. The elderly people can start to discuss about the old times in town, thus providing

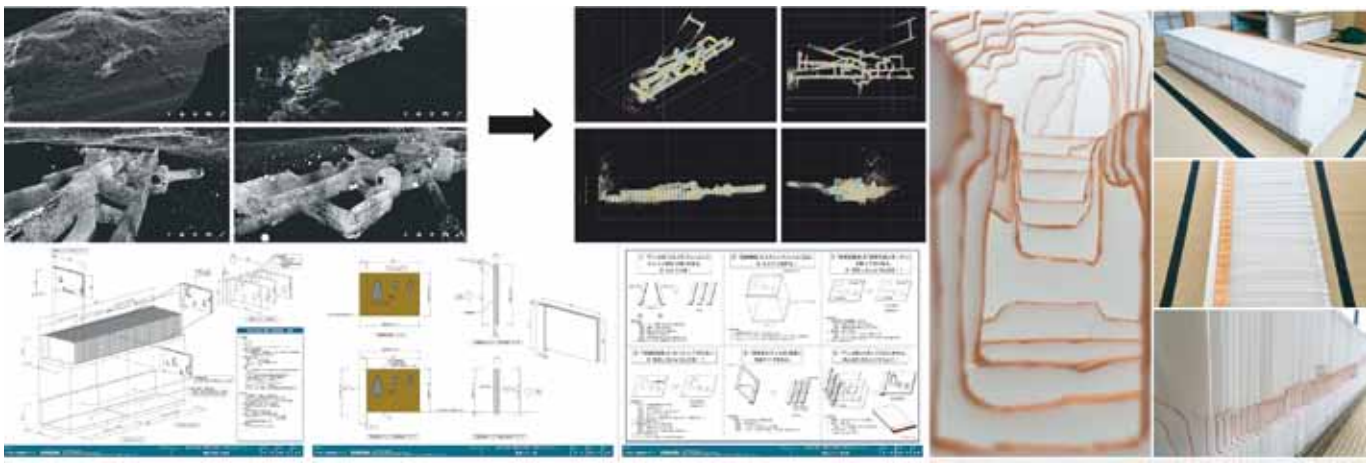

Fig. 10 – Section model class (ECPT © 2016-2019).
Fig. 10 – Classe di modello delle sezioni (ECPT © 2016-2019).

Fig. 11 – Practical model use for regional basic survey (photo: ECPT © 2016-2019).
Fig. 11 – Modello pratico di uso per rilievo di base regionale (foto: ECPT © 2016-2019).

valuable historical information for the regional basic survey. We can get unknown oral information, that were never written in any kind of books and documents. This model became a communication tool for local residents and architectural students, and it became possible to discuss local history going back in time (fig. 13).

Feedback to elementary school students and local residents

So far we have described that elementary school students have been conducting comprehensive regional learning from Taya Cave (underground cultural property), elementary school students have created models, and architectural students have been studying regional designs using these models. The results of these activities have been also presented to elementary school students and local residents. Elementary school students can find out how their learning outcomes are being used for regional basic surveys of architectural students. Local residents can see how the basic research of Taya Cave is linked to the future of the region, through the joint work by elementary and university students. Different sectors of the community, from elementary school students to elderly people, have been highly interested in listening to our progress reports, that were presented with the architectural students (fig. 14). As a result, local residents have begun to be interested

Fig. 12 – Architecture & design class in university (photo: ECPT © 2016-2019).
Fig. 12 – Classe di architettura e progettazione all'università (foto: ECPT © 2016-2019).

Fig. 13 – Hearing survey for neighbours with models (photo: ECPT © 2016-2019).
Fig. 13 – Riunioni di ascolto con modelli (foto: ECPT © 2016-2019).

in Taya Cave (underground cultural property), and it has been recognized that this is an important cultural property of this region.

Outcome and social evaluations

In this project, we state that "Taya cave (underground cultural property) is one of the concerns that are around us for local people, especially elementary school students". The main aim of this project is to get people interested in the essential values of"local environment" and "local culture" through this underground cultural property. Thus, we launched this project in collaboration with public elementary school and a variety of university researchers and students. This collaborative project gained the interest of many adults, and as a result, gained high interest in underground cultural properties. This collaborative effort with public elementary schools and universities has a high social reputation, that has been featured in many media. The initiative was honored by the Japanese Minister of Land, Infrastructure, Transport and Tourism in October 2019 for "Overall View of Geographic Education". In addition, it raised the interest of several elementary school students who want to go on a career path such as preserving cultural assets or getting a job in town development. From this report, "future human resource development", which is another purpose of our company, has been achieved too.

Fig. 14 – Feedback lecture (photo: ECPT © 2016-2019).
Fig. 14 – Lezione di feedback (foto: ECPT © 2016-2019).

Conclusion

The Japanese society is going to enter an unprecedented low birthrate super-aging society, that no one has ever experienced in the world. Population decline requires various social changes, and it may be difficult to maintain the local communities. Furthermore, the impact of climate change cannot be denied, and there is an urgent need to renovate the human activity space that is resilient to natural disasters. It can be imagined that the preservation of the Taya Cave (underground cultural property) in the local community will be very difficult. It is important to learn that the natural environment is the basis of all the things related to human society, but this is a very difficult theme in the field of education in Japan. Given the underground cultural property content of Taya Cave, it is considered that providing a comprehensive learning opportunity for elementary schools in cooperation with universities in various fields has a definite value.
On the other hand, IT technology is evolving day by day and has become an indispensable technology for human daily life. This technology is also effective as a learning tool in elementary school, and in the future society all people are expected to be users of this technology. However, even in this respect, it has not been used much in Japanese education so far. It can be said that there are few opportunities for children to learn about its effectiveness, practicality, and versatility about IT technology. In this activity, multidisciplinary educational development using digital technology has been implemented. By collaborating with universities, it is possible to provide students with comprehensive learning across multiple subjects such as elementary school society, science, morality, etc., and further learning of local communities, cultures, and environments. We could make students memories of underground cultural property remain.

Acknowledgement

We have been able to implement this article and collaborative projects between elementary schools and universities with the cooperation by many people, especially: Prof. Oguchi, Saitama University, Prof. Hayakawa, Hokkaido University, Prof. Morita, Yokohama National University, Prof. Ogata, Tsurumi University, Mr. Ogura, Tokyo University, and every teacher of Yokohama City Senshu Public elementary school. We appreciate very much the cooperation of all these people.

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