EUROPE / NORTH AMERICA

EVAPORITIC KARST AND CAVES OF NORTHERN APENNINES

ITALY

Evaporitic Karst and Caves of Northern Apennines © IUCN / Gordana Beltram

WORLD HERITAGE NOMINATION – IUCN TECHNICAL EVALUATION

EVAPORITIC KARST AND CAVES OF NORTHERN APENNINES (ITALY) – ID N° 1692

IUCN RECOMMENDATION TO WORLD HERITAGE COMMITTEE: To refer the nomination under natural criterion (viii).

Key paragraphs of Operational Guidelines:
Paragraph 77: Nominated property meets World Heritage criteria.
Paragraph 78: Nominated property partially meets integrity requirements and protection and management requirements.

1. DOCUMENTATION

a) Date nomination received by IUCN: February 2022

b) Additional information officially requested from and provided by the State Party: Following the session of the IUCN World Heritage Panel, an Interim Report and request for supplementary information was sent to the State Party on 26 January 2023. This letter advised on the status of the evaluation process and requested supplementary information on the global comparative analysis, and on the integrity and protection and management requirements. The supplementary information was provided by the State Party on 27 February 2023.

c) Additional literature consulted: IUCN's evaluation consulted a wide array of relevant reference material for the geology, protection and management as well as the comparative values of the nominated property. Comprehensive reference lists were compiled within IUCN's World Heritage Caves and Karst Thematic Report (Williams 2008). Further references included: Aldrovandi, U. (1648). Musaeum metallicum in libros 4 distributum Bartholomaeus Ambrosinus. Bononiae, Marcus Antonius Bernia, Ferronius, 979; Benassi, E., Serventi, C. (eds.) (2010): Le coline di Albinea, Strenna del Pio istituto artigianelli, Pubblicazione semestrale – XIX-1, pp. 83; Broughton, P.L. (2021). Alignment of saline springs with evaporite karst structures in northeast Alberta, western Canada: analogue for Cretaceous hypogene brine seeps to the surface. Acta Carsologica 50, 119-141; D'Angeli, I. M., Serrazanetti, D. I., Montanari, C., Vannini, L., Gardini, F., & De Waele, J. (2017). Geochemistry and microbial diversity of cave waters in the gypsum karst aquifers of Emilia Romagna region, Italy. Science of the Total Environment, 598, 538-552; De Waele, J., et al. (2017). Evaporite karst in Italy: a review. International Journal of Speleology, 46 (2), 137-168; Dogan, U., Yesilyurt, S. (2019). Gypsum karst landscape in the Silvas Basin. In: Kuzucuoglu, C., Ciner, A., Kazanci, N. (eds.) Landscapes and Landforms of Turkey; Dubljansky, V. N. 1979. The gypsum caves of the Ukraine. Cave Geology, 1, 163–183; Forti, P. (1996). Speleothems and cave minerals in gypsum caves. International Journal of Speleology 25, 3: 7; Goldscheider, N., et al. (1977). History of the Mediterranean salinity crisis. Nature 267, 399-403; McKeever, P.J. and Narbonne, G.M. (2021). Geological World Heritage: a revised global framework for the application of criterion (viii) of the World Heritage Convention. Gland, Switzerland: IUCN; Moosdorf, N., Stevanovic, Z. and Veni, G. (2020). Global distribution of carbonate rocks and karst water resources. Hydrogeology Journal, 28, 1661-1677; Raeisi, E., Zare, M. and Aghdam, J.A. (2013). Hydrogeology of gypsum formations in Iran. Journal of Cave and Karst Studies 75, 68-80; Sivelli, M. and Vigna, B. (2017). Evaporite karst in Italy: a review. International Journal of Speleology, 46, 2,137-168; Stafford K., Nance R., Rosales-Lagarde, L. and Boston, P.J. (2008). Epigene and Hypogene Gypsum Karst Manifestations of the Castile Formation: Eddy County, New Mexico and Culberson County, Texas, USA. International Journal of Speleology, 37, 2, 83-98; Williams, P. (2008): World Heritage Caves and Kast. Gland, Switzerland: IUCN. 57pp.

d) Consultations: 12 desk reviews received. The mission was able to meet with scientists, politicians and elected officials (regional, mayors, ministry, and local), administrators, technical experts, non-government organizations, trade unions, and members of the local communities.

e) Field Visit: Gordana Beltram, 21 November – 28 November 2022

f) Date of IUCN approval of this report: April 2023

2. SUMMARY OF NATURAL VALUES

The Evaporitic Karst and Caves of Northern Apennines is a serial property that encompasses 3,680 ha and includes nine nominated component parts. The buffer zones total 8,348 ha. The nominated area is protected by a complex web of national, regional, and local legislation.

#	Nominated component part	Area (ha)	Buffer zone (ha)	IUCN Protected Area Category
1	*Alta Valle Secchia*	1,596	1,294	*II, IV*
2	*Bassa Collina Reggiana*	274	1,385	*IV, V*
3	*Gessi di Zola Predosa*	57	128	*IV*
4	*Gessi Bolognesi*	237	325	*IV*
5	*Vena del Gesso Romagnola - M.te Penzola*	70	4,775	*IV*
6	*Vena del Gesso Romagnola - M.te del Casino*	281		
7	*Vena del Gesso Romagnola - M.te Mauro*	962		
8	*Evaporiti di San Leo*	119	165	*IV*
9	*Gessi di Onferno*	84	276	*IV*
	TOTAL	**3,680**	**8,348**	

Table 1 : Nominated property and buffer zones

The nominated property encompasses two different geological periods during which evaporitic rocks were deposited: Firstly, the Triassic period (200 million years ago) associated with the breakup of the supercontinent Pangea and formation of the modern continents as well as the formation of the Atlantic and Indian ocean basins, and secondly, the ecological catastrophe known as the Messinian Salinity Crisis phase (6 million years ago), when the Mediterranean Sea largely evaporated. Over the last c.500,000 years the current cave system developed within these formations.

The nominated property is an unusually well-preserved and extensive epigenic gypsum karst terrain. It includes a very high density of caves: over 900 caves in a relatively small area. There are over 100 km of caves in total, including the 11.5 km long Spipola-Aquafredda-Prete Santo cave system and the 7 km long hydrogeological tunnel system. It also includes some of the deepest gypsum caves in the world reaching 265 meters below the surface.

The Evaporitic Karst and Caves of Northern Apennines are the first and the best studied evaporitic karst in the world, with academic work beginning in the 16th century. The features are accessible, well preserved, and readily understandable. These studies have had many iconic contributions to understanding of evaporitic karst, including their record of climate evolution over the last hundred thousand years, and their lessons to support our understanding of climate change in the future. This evaporitic karst and cave terrain has played a key role in the development of geology, speleology, mineralogy and hydrogeology. The site also contributed to the understanding of the use of evaporitic deposits as building materials: almost 2,000 years ago some of the natural caves were used by the Romans for the extraction of stunning transparent crystals to be used in window frameworks instead of glass.

The nominated property contains an unusually large diversity of chemical deposits and minerals associated with gypsum deposits and gypsum caves. Some of these minerals are found nowhere else, and no other area has, as yet, documented the same mineral diversity. The nominated property also contains many noteworthy and unique hydrological features and surface karst forms, including hypogean bends, very large gypsum cone features, salt springs, and speleothems. The paleontological values include gypsum strata with evidence of surface exposure, leading to the development of ancient intra-Messinian karst features containing one of the most important Late Miocene continental faunae in the world.

3. COMPARISONS WITH OTHER AREAS

Evaporitic karst, both salt and gypsum, is identified as a gap on the World Heritage List in the 2008 IUCN World Heritage Caves and Karst Thematic Report and in the 2021 IUCN Geological World Heritage global framework. The proposed Evaporitic Karst and Caves of Northern Apennines serial nomination's nine component parts comprise an exceptionally complete epigenic gypsum karst system worldwide. Most of the phenomena observable in evaporitic gypsum karst are present at the nominated property.

All desk reviewers of the nomination agreed that the nominated property has great scientific importance and reviews suggest the site is distinctive as extensively studied and documented epigenic gypsum karst. However, most reviewers concluded that, while well organized, the Global Comparative Analysis included in the nomination document was not adequate. Specifically, the comparison with other areas provided by the State Party applied an analytical framework that limited the range of scores available and used comparison factors for which the nominated property was strongest. The method appeared to essentially predetermine the outcome in favour of the Evaporitic Karst and Caves of Northern Apennines.

In addition to the analytical framework, reviewers also noted other gypsum karst areas of comparable significance, such as the giant gypsum caves in Podolia (Ukraine), the Sivas gypsum karst (Turkey), the extensive gypsum outcrops of the Gachsaran Formation in the Zagros Mountains (Iran), the gypsum

plain of New Mexico and Texas (United States), the Sorbas gypsum karst (Spain), and the dissolution and subsidence belt associated with the Hith Formation in the Interior Homocline (Saudi Arabia). With respect to salt karst, reviewers noted that the most outstanding salt karst occurs in the salt extrusions of the Zagros Mointains, in the coasts of the Dead Sea, the Delaware Basin (United States) and in the Devonian basins of Canada.

Consequently, the IUCN World Heritage Panel requested supplementary information on the global comparative analysis, which was provided by the State Party on 27 February 2023. The response was comprehensive, and it was provided to reviewers for a supplemental opinion. Although the response improved the Global Comparative Analysis, the view was that the site is probably not sufficiently broad in its values to fully encompass the identified gap on the World Heritage List of Evaporitic Karst, both gypsum and salt. Based on the comparison with other areas, there was substantial debate among desktop reviewers and extensive consideration of the published literature on this karst type. However, notwithstanding some remaining concerns related to the Global Comparative Analysis, all of the reviewers saw a strong case for the global significance of the nominated property.

The view reached by the IUCN World Heritage Panel based on the review input and supplementary information was that the nominated property is globally significant for an epigenic gypsum type of evaporitic karst, but not for a salt karst, and that it would address the remaining gap for Evaporitic gypsum karst on the World Heritage List. The findings of the comparison to other areas concluded that this extremely well-studied area holds cave systems and their evaporitic deposits (speleothems and minerals), some unique in the world, that demonstrate global significance. The area can be considered as the area with the most profusely studied, most accessible, more comprehensively displayed and better protected epigenic gypsum cave systems of the world. The nominated property preserves aspects of two significant effects in earth history: the break-up of the supercontinent Pangea about 200 million years ago, and the Mediterranean Salinity Crisis about 6 million years ago. It contains the greatest diversity of chemical deposits and minerals associated with gypsum caves documented so far worldwide. It is also notable for the high density of caves: 900 caves with the length of over 100 km distributed over a relatively short distance, including the longest epigenetic cave in gypsum (11.5 km long Spipola-Aquafredda-Prete Santo cave system), the second deepest cave in gypsum in the world (265 m), and one of the largest hydrogeological tunnels in gypsum worldwide (over 7 km long). The nominated property also contains an unusually high density of superficial karst forms: caves, minerals, speleothems, and hypogean bends, including salt springs.

In consideration of the comparison to other areas and the advice of expert reviewers, IUCN concludes that the updated comparative analysis supports the conclusion that, whilst the values are somewhat specialised, the nominated property demonstrates global significance under criterion (viii) in the representation of epigenic gypsum karst.

4. INTEGRITY, PROTECTION AND MANAGEMENT

4.1. Protection

The nine component parts of the serial nomination differ considerably in size, ranging from 57 to 1,500 ha. All of the component parts have protection status equivalent to IUCN Category IV, and *Alta Valle Secchia* (nominated component part 1) is also partially protected by a national park (IUCN Category II). Ninety-six percent of the nominated property is protected by the European Union's Natura 2000 network. Seventy percent is protected by a national park and by two regional parks. Most of the remaining areas are nature reserves and protected landscapes, preserved by local law. The buffer zone and the land adjacent to the nominated property is subject to the territorial and landscape planning of the Emilia-Romagna Region that establishes the rules for the management of the territory. The State and the Emilia-Romagna Region have passed and implemented legislation and management that provides adequate legal protection to the gypsum areas in the Northern Apennines. The overall protection system is complex.

One factor adding complexity is that more than half of the area of the nominated component parts is privately owned and not under direct State or Regional responsibility. Private ownership ranges up to 98% in some nominated component parts of the serial nomination. Although the national legislation (Italian Civil Code) specifies that the waters, minerals, crystals, fossils, archaeological finds and antiquities belong to the State, the potential for private landowners to modify the nominated property in ways that may degrade the proposed Outstanding Universal Value is unclear.

In addition, some important areas (see section 4.2) with specifically identified attributes are not covered by any legislative or regulatory protection, including parts of the nominated component part of *Alta Valle Secchia*. Whilst the unprotected areas of *Alta Valle Secchia* are situated within the Appennino Tosco-Emiliano Biosphere Reserve, they are found in the buffer zone or transition zone of the Reserve and are not specifically protected for their geological values. According to supplementary information, the Biosphere Reserve's concern for geological values is mainly centred on educational aspects of geo-conservation rather than protection. The same also applies, to a greater extent, to the buffer zone of the nominated component part of *Alta Valle Secchia*, and to a small extent to the buffer zone of the three nominated component parts of *Vena del Gesso Romagnola.* Therefore, the nominated property and buffer zone would not be protected in their entirety as required by

the *Operational Guidelines*, especially by paragraphs 96-99, 101-102 and 104.

In the view of IUCN, several of the inconsistencies and gaps in protection need to be addressed if inscription is to be considered. For example, protection of geosites is explicitly included for Appennino Tosco-Emiliano National Park, but most of the nominated component parts are not in the National Park. For those nominated component parts not in the National Park, Regional Law 9/2006 specifies that rules for the conservation and enhancement of the geodiversity of Emilia-Romagna aim for the protection, knowledge and prioritization of geosites, caves and karst in the region. However, this law has not been consistently applied to all the nominated component parts in their entirety.

Overall, IUCN notes that adequate protection through different legislative and management programs are covering most of the nominated property. However, there remain gaps in protection within the nominated property and for important attributes of the proposed OUV located outside the nominated property (see section 4.2). The complexity of the system of protection is considerable and would benefit from a single unified protection system for the component parts of the nominated property. IUCN recommends that the State Party demonstrate the legal and relevant protection of the nominated property and the buffer zones match fully the boundaries and attributes of the proposed Outstanding Universal Value. For the northern part of the nominated property that overlaps with the Appennino Tosco-Emiliano Biosphere Reserve, the State Party should ensure strict protection is granted to the entire nominated component part and to all identified attributes of the proposed OUV.

IUCN considers that the protection status of the nominated property does not fully meet the requirements of the *Operational Guidelines*.

4.2 Boundaries

The nine component parts of the nominated serial property include most of the evaporitic rocks of the Northern Apennine range. They represent the whole karst phenomena in gypsum and anhydrite, including the outcropping and underground karst areas, the main karst aquifers, and their recharge areas. They also include epigean and hypogean karst morphologies from the dissolution surfaces in vertically exposed gypsum cliffs to the speleothems in the abysses of the caves. From the environmental integrity point of view, the quality of the karst systems is excellent. The continuity of the karst hydrological system, above and below ground, is well preserved in all the nominated component parts.

However, this is not the case for the nominated component part *Alta Valle Secchia* where a large number of the stated attributes are located outside the nominated property, including in areas that are not formally protected for their geological values. As paragraph 99 of the *Operational Guidelines* requires boundaries to incorporate all the attributes that convey the proposed Outstanding Universal Value and to ensure the integrity of the nominated property, IUCN considers that the boundaries of the nominated component part of *Alta Valle Secchia* would need to be revised to capture the proposed attributes and to ensure their effective protection (see also section 4.1). There is also an underground system (*Tana della volpe*) outside the nominated areas of the *Vena del Gesso Romagnola* component parts.

Specific to the buffer zone for each nominated component part, the primary determinant of the boundary of the buffer zone is to ensure that the watershed is included, and that the legislative and management protection is adequate to protect the nominated property's values. Although there are no settlements on the gypsum outcrops, there are settlements in the surrounding landscapes, which have no legal protection for the geological values, and therefore, the buffer zone in these cases is limited and restricted to non-urban territory. This results for instance in a very narrow strip of buffer along the river to connect the two nominated component parts of *Vena del Gesso Romagnola - M.te Penzola* and *Vena del Gesso Romagnola - M.te del Casino* which are divided by the village of Borgo Tossignano. For most nominated component parts, the buffer zones would be improved by extending them to be more evenly spread on both sides of the gypsum outcrops (nominated component parts of *Alta Valle Secchia, Bassa Collina Reggiana, Gessi Bolognesi, Vena del Gesso Romagnola - M.te Penzola / M.te del Casino / M.te Mauro* and *Evaporiti di San Leo*). The buffer zones would also be improved by surrounding more widely the smaller nominated component parts component parts of *Gessi di Zola Predosa* and *Gessi di Onferno*.

In conclusion, whilst most nominated component parts have boundaries that encompass the attributes of the nominated property, there are important attributes that remain outside the nominated component parts of *Alta Valle Secchia* and the *Vena del Gesso Romagnola* component parts. The size and protection status of serial component parts of the proposed property are mostly sufficient to sustain and safeguard the proposed Outstanding Universal Value. However, important modifications to the boundaries are needed to ensure that all the attributes of each individual nominated component part are fully included. IUCN recommends that the State Party refine the boundaries and consider expanding the buffer zones as indicated above.

IUCN considers that the boundaries of the nominated property and buffer zones do not fully meet the requirements of the *Operational Guidelines*.

4.3 Management

The management system consists of two management bodies. The nominated component part of *Alta Valle Secchia* is managed by the Appennino Tosco-Emiliano National Park. All other nominated component parts are under the control of the Emilia-Romagna Region, which directly supervises the management bodies of the regional protected areas. These management bodies have a management plan, a specific budget and dedicated staff (technical and administrative) to manage and control the respective areas. Key management issues include the protection of the attributes and values of the geological heritage, conservation measures for habitats and species of Community interest, knowledge and communication of the natural environments. In addition, the northern part of the nominated property overlaps with management of the Appennino Tosco-Emiliano Biosphere Reserve.

The region and the responsible ministry provide adequate resources for the management of the nominated area and according to the management strategy and the field mission. Additional staffing and financial resources for the management of the nominated areas is planned. For 2022 and 2023 the Ministry has provided almost 7.9 million USD per year for natural World Heritage projects. For the period 2023 to 2025 an annual budget of approximately 2.5 million USD is foreseen. Staffing for the nominated property is sufficient with 88 rangers and 79 ecological guards. Expertise in geo-conservation is sufficiently covered by staff and complemented by strong cooperation with nearby universities.

A long-term monitoring system has been set up, using ground- and underground-based observations, for improved evaluation of the chemical and ecological state of karst aquifers, seismotectonic movements, and climate cave conditions. Key aspects of the nominated property's flora and fauna are also monitored. A Memorandum of Understanding was signed in 2020 including all the 37 responsible authorities.

The State Party has drafted a structure of governance and management for the nominated property, and an office at the local level to coordinate all the partners included in the serial nomination is to be established as part of the General Directorate for Land Care and Environment. The proposed Overall Management Strategy provides a fair basis for the future structure and shared responsibilities between the regional and the national administration and among the 37 involved stakeholders. The shared vision includes: protection of the environmental balance and safeguarding of the epigean and hypogean ecosystems; protection and conservation of geological values and specific geological landscape of the gypsums; enhancement of the historical, cultural, social, and archaeological aspects of the territories; environmental education of the local people and visitors to the protected and adjacent areas; sustainable development of the territory through best practices and promotion of compatible economic activities.

However, the final Programme Agreement is planned to be signed only 12 months after the potential inscription of the proposed serial property. A site management office for the overall coordination, communication and governance of the nominated property is expected to be put in place 18 months after potential inscription. IUCN recommends that the State Party puts in place the proposed management structure and management office to demonstrate that the serial site management is fully operational at the time of potential inscription. It is also recommended that the zonation of the Appennino Tosco-Emiliano Biosphere Reserve aligns with the management needs for geo-conservation of the nominated component parts.

IUCN considers the management of the nominated property does not fully meet the requirements of the *Operational Guidelines*.

4.4 Community

The Field Evaluation Mission experienced a high degree of support for the nomination. The degree of consultation with the 37 stakeholder groups and their participation in decision-making appeared to be effective. The management structure of the protected area would be complex owing to the different levels of protection, and different management agencies, both national and regional. This complexity will likely make community inclusion challenging.

Some farmers, including a local farmers association, spoke out about a lack of engagement, and expressed concern regarding the effect of a World Heritage inscription on their current activities. A trade union representing workers from the Monte Tondo quarry and gypsum panel factory in Riolo Terme were concerned about limits on their activity as well. The group considers that coexistence of the quarry and the protected area would be possible, and in fact would like the quarry to be enlarged a further ten metres into the mountainous area near the nominated component part of Vena del Gesso Romagnola - M.te Mauro.

4.5 Threats

Overall the threats to the nominated property are low. There are few settlements in the wider area, but the nominated component parts of the serial nomination are distributed in the hilly area of the Northern Apennines in the vicinity of the large towns of Parma, Reggio Emilia, Modena, Bologna and Rimini. There are no major industrial developments in the proposed property or in their buffer zones with the exception of the Monte Tondo quarry and the factory for gypsum panels in Riolo Terme. Potential threats to the nominated property are linked to three main activities: quarrying, agriculture and tourism.

The primary threat to the nominated property is continued quarrying of gypsum. This activity has been

ongoing since the Roman Empire. Most of the quarries in the region have been closed down and quarrying is now prohibited by law with the exception of the Monte Tondo quarry, which is located in the buffer zone of the proposed nomination, but may affect the cave system, in particular the Re Tiberio cave. The quarry currently operates under the permit issued by the regional administration. The region financed a study in 2021 which showed that further extension of the site should be phased out and the quarry closed in less than 10 years. Following the results of the study the Region intends to require the operator to prepare an environmental restoration plan including social restructuring and halt further quarrying activity. Currently, the company would like to renew the permit that has expired.

The agricultural activity is relatively limited, and management of the forestry resources is focused on expanding areas dedicated to wilderness. A few caves (six caves) are open to the public and, as evidenced during the field mission, are well taken care off, without alterations of the natural cavities and their habitats. There are no settlement pressures in the proposed nomination. The nominated property is close to large towns and is popular for local weekend visitation. If inscribed, it is anticipated that the level of tourism would increase, which could constitute a threat to the nominated property if not effectively managed through a visitor management plan with an identified carrying capacity.

In conclusion, IUCN recommends that the State Party confirm that it will not extend the permit in 2024 to the gypsum mining operation, and commence restoration activity as soon as practical. It is also recommended that the State Party prepare a visitor management plan that identifies areas of expected high levels of visitation, and identifies a carrying capacity for these areas.

In summary, IUCN considers that the integrity requirements and protection and management requirements of the *Operational Guidelines* are partially met.

5. ADDITIONAL COMMENTS

The proposed serial nomination is based on criterion (viii), but there are several cultural values of nominated component parts that provide additional value to the area. Most of these are directly or indirectly linked to gypsum use, karst and caves research, and archaeological sites preserving spiritual and burial grounds. Biodiversity is also an important value; for example, bat colonies in caves, species and habitat diversity of importance at national and European level, with some endemic and rare species. The Northern part of the proposed area (nominated component parts of *Alta Valle Secchia* and *Bassa Collina Reggiana*) is also part of the Appennino Tosco-Emiliano Biosphere Reserve which could also be extended to include the larger area of the nine component parts of the nominated property.

5.1 Consideration in relation to serial properties

a) What is the justification for the serial approach?

The gypsum outcrops and the nominated component parts of the Evaporitic Karst and Caves of Northern Apennines are located within a larger landscape with settlement, land use developments, and cities. The numerous settlements and varied infrastructure developments in the area do not provide the integrity and legal protection that would allow inclusion in a World Heritage property, and thus a contiguous property is not feasible. The nine nominated component parts are all required to protect the different types of karst and cave attributes that together convey the proposed Outstanding Universal Value of the nominated property.

b) Are the separate component parts of the nominated property functionally linked in relation to the requirements of the *Operational Guidelines*?

The nine component parts of the proposed nomination are complementary in demonstrating attributes linked to criterion (viii) together representing a relatively small, yet comprehensive and complete evaporitic karst system, including different surface phenomena ranging from dolinas, blind valleys, wallkarren, to karst springs, and caves, speleothems and cave minerals as well as different stages of geological history, processes and climate conditions. The parts are functionally linked in that they include a comprehensive evaporitic gypsum karst system.

c) Is there an effective overall management framework for all the component parts of the nominated property?

All nominated component parts are included in the overall management strategy that has been drafted. The strategy takes into account all the relevant stakeholders, including the regional administration of Emilia-Romagna and the national park administration. The strategy elaborates on the management structure that is based on the existing institutions and instruments. However, the structure is not in place yet and the nomination states would only become operational 18 months after a potential inscription. Management of visitors is critical and needs to be well established to avoid overcrowding at most attractive spots.

6. APPLICATION OF CRITERIA

The **Evaporitic Karst and Caves of Northern Apennines (Italy)** has been nominated under natural criterion (viii).

Criterion (viii): Earth's history and geological features

The values of the nominated property relate to evaporitic rocks deposited in two distinct geological periods: during the Triassic period (c.200 million years ago) associated with the breakup of the supercontinent Pangea and formation of the modern continents and the formation of the Atlantic and Indian ocean basins; and during the ecological catastrophe known as the Messinian Salinity Crisis (c.6 million years ago), when the present Mediterranean Sea largely evaporated. Over the last 500,000 years the current cave system developed within these two formations.

The area has been extremely well-studied since the 16th century. The cave systems and their evaporitic deposits (speleothems and minerals) have outstanding global significance. The area can be considered as the area with the most profusely studied, most accessible, more comprehensively displayed and better protected epigenic gypsum cave systems in the world. The nominated property contains an exceptional diversity of well-documented chemical deposits and minerals associated with gypsum caves. It has a very high density of caves: 900 caves with the length of over 100 km distributed over a relatively short distance, including the longest epigenetic cave in gypsum (11.5 km long Spipola-Aquafredda-Prete Santo cave system), the second deepest cave in gypsum in the world (265 m), and one of the largest hydrogeological tunnel in gypsum worldwide (over 7 km long). The nominated property contains an unusually high density of superficial karst forms, such as the largest gypsum cones described (2 m in diameter and 2 m high), and including caves, salt springs, minerals, speleothems, and hypogean bends.

The nine component parts of the nominated serial property seek to include most of the entire evaporitic rocks of the Northern Apennine range. They represent the whole karst phenomena in gypsum and anhydrite, including the outcropping and underground karst areas, the main karst aquifers, and their recharge areas. They also include a complete collection of epigean and hypogean karst morphologies from the dissolution surfaces in vertically exposed gypsum cliffs to the speleothems in the abysses of the caves. From the environmental integrity point of view, the quality of the karst systems is excellent. The continuity of the karst hydrological system, above and below ground, is well preserved in all the nominated component parts. The educational value of this exceptionally well-studied system is well illustrated in the several caves that are open to the public.

IUCN considers that the nominated property meets this criterion, noting that the related conditions of integrity, protection and management are not fully met at present.

7. RECOMMENDATIONS

IUCN recommends that the World Heritage Committee adopts the following draft decision:

The World Heritage Committee,

1. Having examined Documents WHC/23/45.COM/8B and WHC/23/45.COM/INF.8B2;

2. Refers the nomination of the **Evaporitic Karst and Caves of Northern Apennines** to allow the State Party to:

a) Modify the boundaries of the nominated property to ensure that the proposed attributes of potential Outstanding Universal Value are fully included,
b) Fully align the legal protection of the nominated property to the boundaries of the nominated property ensuring there are no gaps in legal protection within the boundaries of the nominated property,
c) Fully align the legal protection of the nominated property's buffer zones to ensure there are no gaps in legal protection within any of the buffer zones,
d) Confirm that the permit for quarrying in the Monte Tondo quarry will not be extended, and commence restoration activity as soon as practical;

3. Recommends the State Party to fully establish the planned management structure for the serial nominated property, and to consider:

a) developing a single unified protection system for the nominated component parts of the serial nominated property,
b) ensuring that the zonation of the Appennino Tosco-Emiliano Biosphere Reserve aligns with the protection and management regime needed for the nominated property,
c) preparing a visitor management plan that identifies areas of expected high levels of visitation, and the carrying capacity of the nominated property.

Map 1: Nominated property and buffer zone.