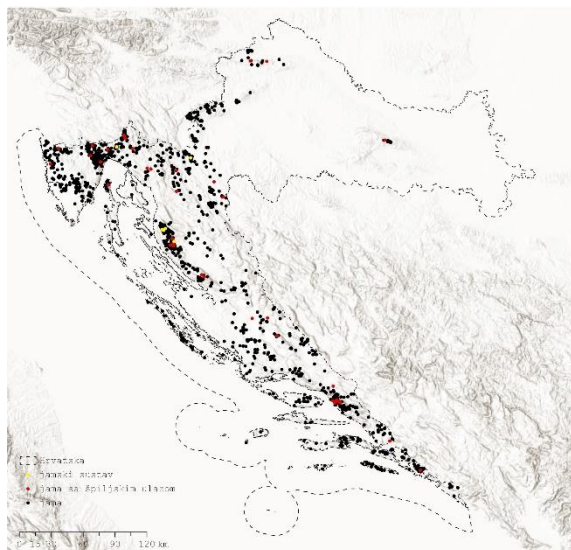


Environmental European Caves Outlook (EECO)

Country: Croatia

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Geodiversity and Caves



Speleological objects of Croatia registered in national Cave Cadaster

Geodiversity of Croatian karst (both surface and underground features) is certainly high, and it covers approximately 52% (29400 km²) of the country's territory. It is formed in limestones and dolomites, and in breccias in which the deepest Croatian caves are formed. Numerous caves are formed in flysch deposits. Due to thick and highly fissured packages of carbonates, and on the other side long cave exploring tradition, there is currently 4979 fully explored and documented caves in Croatian Cave Cadaster. Most of the caves are vertical (39%), but there is a significant number of complex speleological objects, 46 of them listed in national Cave Cadaster.

Cave Protection Status

The Ministry of Environment Protection and Green Transition in conjunction with speleological societies has formed and is continuing to fill in the Croatian Cave Cadaster (<https://crospeleo.mingor.hr/>).

There are no laws specific to cave protection, but all the caves in Croatia are protected under the Nature Protection Law. Under the mentioned law, caves are considered as part of geodiversity. The same law lists categories of nature protection areas. Some of the

caves are part of larger protected areas such as national or nature parks, and some of the are protected under the category natural monument. There are 53 natural monuments in Croatia, and they can be: geomorphological, geological, paleontological, hydrological etc. In total 66 % of the nature monuments in Croatia are caves, and they are mostly listed as geomorphological nature monument. Archaeological excavations in caves are protected as cultural heritage of Croatia. Caves which are categorized as springs, or parts of underground aquifers fall under the Water Law. Caves on maritime property, inland coastal waters and territorial sea and its coast, bottom or underground fall under the Law on maritime property and ports, and Maritime code, which do not recognize caves, therefore, any action must be in accordance with Nature Protection Law. In year 2013, Croatia proclaims Regulation on ecological networks, which forms Natura 2000 network. Numerous caves (540), some of which are not even listed in national Cave Cadaster, are protected by Natura 2000 network. Obvious problem of Natura 2000 protection of the caves is that it is specifically directed to the protection of the species which use the cave as habitat, and thus abiotic components (geodiversity aspect) is completely neglected.

Firstly, overall problem is that all the caves (even the ones which are not documented and surveyed) are protected by Nature Protection Law, but all the regulations in the law are not directed to preservation of the caves, but are directed on establishment of cave use rules, which mainly refer to speleologists, because they are the most common "users".

Secondly numerous caves are protected under different Laws and regulations, and in system like that is hard to manage and react in the case of threat. Also, there is actually no specific system of protection "on the field", but only written words in Laws which no body is implementing. As well, there is very little or no communication in relation amenable ministries – speleologist and scientific community involved in speleology. And indeed, the only protection is carried out by speleologists and the scientific community involved in speleology.

Underground Geological Heritage Status

Despite the legal provisions on the protection of geodiversity, the problems with effective protection actually start from incorrectly defined terms in the Law itself, which shows a fundamental lack of understanding of the concepts of geodiversity and geoheritage. Although the national Cave Cadaster is formed, it is not oriented on geodiversity and its weakest point is actually geodiversity aspect (geological and geomorphological aspects). A pressing problem is the wrong perception of caves as point, and not as 3D areas whose influencing areas are even bigger than just cave passages. Only scientific



community involved in speleology and individual speleologists give knowledge and perspective in terms of cave geodiversity through individual case studies.

Caves which are listed as nature monuments are officially considered as geoheritage, but the criteria for distinguishing those caves are unknown, and the list itself is outdated, considering that the largest number of monuments was declared in the period from 1951 to 1986. In contrast, the largest number of speleological investigations and the intensification of scientific research on issues of geodiversity happened after 1990. and is still taking place.

Some caves are protected geoheritage but the dynamics is not sufficient because of this lack of knowledge and also because priority is often given to the biological heritage.

In the time to come, close cooperation of amenable Ministry, scientific institutions and professional associations on correct definition of fundamental terms is needed, and in order to lay the foundations to comprehensive inventory and evaluation of geodiversity and geoheritage at the national level.

Over Visitation Concerns

Lack of monitoring of speleological objects before granting the concession for show caves. Such research can determine carrying capacity, and further recommendations for cave visitation and management.

Archaeological Heritage Status

A significant number of caves in Croatia have been visited in the past, as testified by archaeological remains from various periods of prehistory and history. Earliest visits date to Early Pleistocene. Neandertals were frequent visitors to Caves. Their biological and cultural heritage from the Vindija cave yielded the first complete genome of these ancient humans, the work that resulted in Nobel prize for Physiology or Medicine (2022). Caves continued to be visited for various reasons (e.g. symbolic, as testified by the Palaeolithic art in Romuald's cave, or by numerous burials from various prehistoric and later times) leaving valuable scientific data and cultural remains that are a part of the world heritage. Under Croatian laws, these sites are protected as both natural and cultural heritage sites, and their protection and preservation is essential. In addition, numerous sites can be presented for public and become an important touristic asset.

Biodiversity Conservation Status

Croatian karst is part of a global subterranean biodiversity hotspot and caves are home to a large and diverse number of species. To date, over 520 new taxa for science have been described, from more than 331 cave type localities.

At the national level, all bats, troglobitic and stygobitic species are strictly protected under the Nature Protection Law. For their research a permit from the ministry responsible for nature protection is required. By Natura 2000 network all anchialine caves are protected as habitat type 8330 Submerged or partially submerged caves, while other Natura 2000 caves are habitat type 8310 Caves not open to the public. Four Natura 2000 target species live in Croatia: *Congerja jalcici*, *C. kusceri*, *Leptodirus hochenwartii* and *Proteus anguinus*.

Mineral Resources Management Status

Karst areas and caves offer considerable mineral resources, in Croatia mainly in the form of building stone. Such activities are regulated through environmental impact assessments, which are mostly biologically oriented, and very often are neglecting any geological or geomorphological features of certain area, and thus neglecting the impact assessment on the caves.

Water Status

The estimated amount of water in the underground karst aquifers amounts to about 78% of the total renewable underground water supplies of the Republic of Croatia, i.e., 7,132.4 106 m³/year (Water Management Strategy, 2009). On the other hand National Cadaster of Polluted Caves led by speleological initiative "Čisto podzemlje" (eng. *Clean Underground*) (<https://cistopodzemlje.info/en/map/?=&lng=16&lat=44.9999999999999&zoom=8>) shows that 73 polluted speleological objects can be found within the area of national strategic groundwater supplies.

Environmental Contaminants Status

"Clean Underground" is a Croatian program dedicated to protecting caves from illegal waste disposal. With a thousand polluted sites identified through our program posing a threat to the unique underground ecosystem and vital karst aquifers storing two thirds of Croatian drinking water, we focus on preserving these critical resources.



Monitoring and Research Status

Individual initiatives, studies and scientific projects are existent, but without national inventory and strategy based on collected knowledge from speleological community and scientists involved in speleology there is no positive effect, except in individual cases.

Public Awareness and Education Status

In total we have data on 140 cleaned locations in Croatia. We have organized or funded cleanups at 82 locations and donated substantial funds directly to caving clubs, significantly advancing basic cave exploration. Additionally, we have actively and successfully influenced karst protection in Croatia by integrating this issue for the first time in the National Waste Management Plan. Our most recent major achievement is our successful advocacy for the government to take on the responsibility of organizing and funding cave cleanups, securing the long-term financial sustainability of this work. With this foundation in place, we have broadened our efforts to education.

Cave pollution continues to be a pressing ecological issue in Croatia. In response, in 2023 we launched our spin-off “Clean Underground Ambassadors”, an educational campaign which focuses on elementary school children. Till the end of 2024, around 280 schools and approximately 13,000 children have participated in the project, raising awareness among their families and helping to prevent further cave damage. This approach not only fosters long-term conservation habits but is also rapidly becoming the primary strategy for halting new karst pollution in Croatia.

Basic Data

- Total Number of Caves: 4979 registered in national Cave Cadaster
- Karst Area Coverage: approximately 52% of total land area
- Troglotic and stygotic species: more than 500
- Endemism: almost 70% of subterranean species are Croatian endemics
- Main Zoological Orders: Coleoptera, Crustacea, Gastropoda, Pseudoscorpiones, Araneae, Diplopoda
- Number of Speleologists: around 800
- Number of Speleological Groups and Organizations: 41
- National Caving Organization: Speleological Committee of the Croatian Mountaineering Association / Croatian Speleological Federation
- Main Speleological Publications: [Speleolog](#), [Subterranea Croatica](#)

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