

Contribution of German cave and karst research to the UN Sustainable Development Goals (Agenda 2030)



Our contribution and goals

The German Speleological Federation (VdHK) is an organization of speleologists in Germany committed to the research and protection of underground ecosystems, including their geo- and biodiversity. The organization contributes to the objectives, particularly in the areas of landscape protection, subterranean fauna, water protection, tourism and education.



Quick Info Agenda 2030

The United Nations (UN) Agenda 2030 is a global action plan for sustainable development. It addresses the major global challenges and provides a reference framework for the international community to jointly address these challenges and to develop solution strategies. With 17 sustainable development goals, the action plan covers areas of ecological, social and economic progress.

Diversity of underground ecosystems

Underground ecosystems are multifarious and harbour unique habitats and life forms. For example, karst is a type of landscape that results from the solution of rocks and geophysical processes. It is generally characterized by cave systems, fissures, crevices and underground watercourses that emerge in springs. Karst areas are often of spectacular unique beauty, as impressively demonstrated by the fifty UNESCO World Heritage Sites and numerous regional protected areas around the world.

Karst is more widespread than commonly thought, covering 20 % of the Earth's surface and supplying 25 % of the world's population with water. A highly adapted fauna and microbiological life can be found in underground void spaces and as well as within groundwater aquifers. An understanding of karst ecosystems and their complex interrelationships is important for sustainable use and resource protection.

Germany's classic karst landscapes are located in the Swabian Alb, Franconian Switzerland, Sauerland, Harz and the Alps, covering 12 % of the national territory. In the following sections, the contributions of the German cave and karst research to the five UN sustainability goals "quality education" (SDG4), "Clean water and sanitation" (SDG6), "Climate action" (SDG13), "Life on land" (SDG15), and "Partnerships for the goals" (SDG17) are illustrated.





SDG 4: Ensure inclusive and quality education for all and promote lifelong learning



The numerous local caving clubs explain the karst phenomenon to the local public, point out the close connection with biodiversity and water protection and thus contribute to the sustainable protection of the ecosystem. In addition, the VdHK links academia with karst research, which is mostly voluntary.

Show caves have existed for centuries and are firmly established as a tourist attraction in many regions. A visit increases the knowledge about the formation of caves and fascinates the visitor by the diversity of the "cave ecosystem". The karst-related geoparks and UNESCO World Heritage Sites are also a part of it. They inform the population about the underlying geological features. Caves have also been used as prehistoric dwellings, and archaeological excavations as well as cave paintings provide unique insights into former societies and the rituals of our ancestors.

SHOW CAVES

There is a network of over 50 show caves in Germany. They introduce visitors to the fascination of a "cave" in all its diverse aspects. Some of them were initiated and co-conceived by cave associations. The use of the latest LED technology was promoted and applied in the Hessian show cave "Herbstlabyrinth". The lighting possibilities associated with the elimination of the so-called "lampen flora" has set new standards, which were followed by other show caves.



KARST HIKING TRAILS

Karst hiking trails in Germany are developed as landscape-related, with tourist hiking trails and interdisciplinary thematic nature trails with a geoscientific focus. They provide an important regional contribution to public relations and to the general understanding of geo- and biodiversity.

GEOLOGICAL SITES

In 2017, six caves of the Lone and Ach valleys in the Swabian Alb were awarded as a UNESCO World Heritage Site ("Caves and Ice Age Art in the Swabian Jura"). 40,000 years ago, Ice Age artists created mysterious works of art from mammoth ivory, including the Venus of Hohle Fels, known worldwide as the oldest representation of a woman of its kind. It is also the site of some of the oldest music instruments ever found.

SDG 6: Ensure access to water and sanitation for all



Gaspard Magarinos & Andreas Schober / Mordloch

Cave researchers document the underground cave rivers through intensive field studies and work closely with hydrogeologists to show the overall situation of cave and ground waters. Based on this, sustainable exploitation concepts are developed.

The understanding of hydrogeological relationships is an essential basis for the protection and exploitation of underground water resources. They are threatened by construction projects, quarries, dams, uncontrolled disposal of pollutants from factories or households, agricultural waste and over-fertilization. Karst aquifers store large quantities of water, but have so far received little attention as a groundwater resource and habitat. In neighboring Switzerland, the contribution of water

from karst is around 40 % with area coverage of just 20 %. A systematic use of karst aquifers is complicated by the difficulty of making quantitative detections due to insufficient hydrogeological models. Often, drainage of karst waters happens over long distances underground, with inflows spread out unnoticed over these distances causing contamination of the drinking water. At the same time, groundwater is piped, filtered and ecologically improved. Bio-filtration by microorganisms living in the tiny cavities also substantially contributes to the degradation of pollutants. These two natural processes reduce the subsequent costs for drinking water treatment. Finally, groundwater must not be solely seen as a resource, but represents a large number of complex habitat types.

SDG 13: Take urgent action to combat climate change and its impacts



Arge Blautopf, Rainer Straub / Blautopfhöhle

Cavers work closely with research institutions to collect sediment and related metadata such as air temperature and humidity. The systematic recording of these local "climate reservoirs" contributes to the improvement of current climate models and forms the basis for predictions on future climate development.

Stalactites store climate information over millions of years and their time-resolved analysis helps to understand past climatic conditions. Sediments and their deposition sequences form another possibility to look back into the past.

GERMAN ARCHIVE FOR SINTER CHRONOLOGY

The Höhlengruppe Nord has archived stalactites and sinter information for more than 40 years and makes them accessible to international researchers. The collection was crucial for the development of stalactite dating methods, which today are standard measures.

GERMAN CAVE CLIMATE REGISTER

Caves have a very stable climate. The temperature in the cave corresponds to the annual average at the surface. This makes it easy to investigate long-term changes. This project of the VdHK aims to consolidate existing data into a cave climate register and to establish a comprehensive monitoring system.

SDG 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss



The biospeleological research of the VdHK records the biodiversity of underground habitats at the levels of ecosystems, species diversity and genetic diversity. It contributes to the conservation of biodiversity through appropriate protection measures, regular monitorings and the formal descriptions of new species.

The underground fauna is specially adapted to the lightless environment, which is generally difficult to explore due to the inaccessibility of caves and groundwater. This is one of the reasons why many new species are still being discovered today. Cave and groundwater organisms are usually relatively small and belong to the invertebrates (e.g. arachnids, crustaceans and insects).

BIOSPELEOLOGICAL INVENTORY

The VdHK records species diversity in a biospeleological inventory. In cooperation with the relevant nature conservation authorities, concepts are being developed for particularly endangered habitats in order to preserve protected or endangered

animal species. The “Alpine Fauna” project investigated the fauna in Bavarian caves for over a year in 2016. 20,000 individuals and almost 200 species were identified. Some species were detected for the first time in the Alps or rediscovered after decades. Since 2012 the project group "SubFauna" records the genetic diversity of German cave and groundwater organisms.

BAT MONITORING

The monitoring and protection of bat colonies is one of the classic traditional tasks of speleologists. Access to caves is prohibited in Germany in winter to ensure undisturbed hibernation. In addition, numerous caves in Germany are regularly checked to record the numbers and species of bats, to assess the population and species diversity and the data reported to the federal authorities in order to detect unnatural changes in the population at an early stage.

Klaus Bogen / Großes Mausohr



Klaus Bogen / Großes Mausohr



Klaus Bogen / Höhlenflohkrebs Niphargus

SDG 17: Revitalize the global partnership for sustainable development



Interdisciplinary speleology contributes facts and knowledge, and hence can promote solution processes. It initiates and encourages multidisciplinary research projects and the political dialogue for a deeper understanding of all karst phenomena.

Cave and karst protection requires the cooperation of various interest groups. Cooperation between industry, the population, nature conservation associations and government representatives is indispensable, particularly with regard to groundwater use, construction projects in karst areas and the mining of lime, dolomite, gypsum and anhydrite. It is important to balance interests and achieve sustainable protection plans.

CONTRACT OF USE FOR CAVES WITH QUARRIES

Caves are often found in active quarries or during ongoing mining work. This can lead to a conflict of interest between cave protection and commercial goals. In the case of the well-known caves of the Herbstlabyrinth (Hesse) or the Riesenbergröhre (Lower Saxony), an agreement was reached with the quarry operators through the allocation of compensation areas by the local authorities in cooperation with cave explorers. In both areas, public show caves have been created to provide

information about cave protection and to increase eco-tourism.

WORKING GROUP KARST PROTECTION

Numerous sub-associations are locally involved in karst protection and work closely with the authorities. The VdHK is a member of the European Speleological Federation (FSE), International Union of Speleology (UIS), the German Nature Conservation (DNR) and the European Environmental Bureau (EEB), contributing with its expertise in karst and working in expert groups within the International Union for Conservation of Nature (IUCN) to set karst protection standards.



Bärbel I Vogel / Südharz

EXAMPLES



K. Bögon / Höhlenpilzmücke

SDG 15: CAMPAIGN CAVE ANIMAL OF THE YEAR

Since 2009, a "cave animal of the year" is named. It draws attention to the diversity of animal species living in underground habitats. This campaign was awarded the International France Habe Prize of the UiS World Cave Protection Commission in 2014.

SDG 17: BIOSPHERE KARST RESERVE „SÜDHARZ“

Local speleologists' associations have been working for over 20 years to protect this unique gypsum landscape. Gypsum karstification is very quick and provides a high morphological diversity and thus valuable unique habitats. The association supported protection zones and a limitation of the mining of gypsum. This was the trigger for the cooperation of local stakeholders in a working group, and in 2009 promoted the establishment of the biosphere reserve "Karstlandschaft Südharz" involving the communities and responsible institutions.



H Wenzel / Hörniger Sattelköpfe

Goals of the Cave and Karst research

German cave and Karst research is active and contributes through

- 1.** Exploration and documentation of caves, karst, karst phenomena, groundwater and karst springs
- 2.** Characterization, recording and description of cave and groundwater fauna
- 3.** Inventory development and management of databases for further research
- 4.** Implementation of interdisciplinary projects with the German Karst Institute and academia and the organization of conferences, workshops and excursions
- 5.** Cooperation with regional, national and international institutions and associations
- 6.** local activities with authorities and the transfer of knowledge to protect karst phenomena in all their forms





REFERENCES

- Williams, Paul, 2008: A Global Review of Karst World Heritage Properties: Present situation, future prospects and management requirements. IUCN
- Forti, Paoli, 2015: The scientific and socio-economic importance of karst and caves and their vulnerability.
- Overview of showcaves in Germany:
<http://www.vdhk.de/ueber-hoehlen/schauhoehlen.html>
- UNESCO Worldwater Development Report 2016,
<http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2016-water-and-jobs/>
- Malard, A, 2016: A novel approach for estimating karst groundwater recharge in mountainous regions. Hydrological Processes 30(13):2153–2166 · June 2016
- Climate inventory <http://www.vdhk.de/klimakataster.html>
- Biospeleology: <https://hoehlenkataster-hessen.de/biospelaeologie/lebensraum-untertage/>
- Campaign "Höhlentier des Jahres": <https://hoehlentier.de>
- Position paper Biodiversity:
http://www.vdhk.de/fileadmin/pdf/Biodiversitaet_in_subterranean_Oekosystemen.pdf
- Subterranean Fauna-Project: www.SubFauna.de
- Example of Karst hiking trails:
<https://www.karstwanderweg.de>
<http://www.sah-breitscheid.de/Page/Karstpfad.php>
<https://www.muehlbachquellhoehle.de/der-wanderweg/>
<http://www.tiefenhoehle.de/> -> Umgebung -> Karstkundlicher Wanderweg
- Biosphärenreservat Südharz::
<http://www.bioreskarstsuedharz.de/>
- Example for showcaves in quarries:
www.schauhoehle-breitscheid.de
www.schillathoehle.de
- Karstspezialistengruppe des Naturschutz-Weltverbandes IUCN: www.iucn.org/content/world-heritage-caves-and-karst-thematic-study

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