C6.1 Underground standing and running waterbody

Summary

This habitat includes running or standing water bodies that develop under the ground surface, in many cases as part of cave systems where impervious bedrocks occurs beneath pervious or between two impervious strata in artesian situations. Specialised invertebrates and vertebrates, many of them endemci, can occur, adapted to the usually cold and dark conditions. Pressures are mainly by direct or indirect pollution of water, touristic use of some parts of the underground systems, abstraction of drinking water and drainage due to construction of infrastructures. If the habitat is damaged its natural capability of recovering is generally very low and restoration takes usually over 50 years.

Synthesis

Less than 20% of the countries in which the habitat occurs provided some quantitative or qualitative data. Although most of these countries stated that the habitat is stable or only slightly declining and/or damaged, any assessment would be based on very poor data. Very little is known on trends in quality, while the water quality may be negatively influenced by drainage of polluted surface water in many sites. For this reason the habitat type is overall assessed as Data Deficient (DD).

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Data Deficient	-	Data Deficient	-

Sub-habitat types that may require further examination

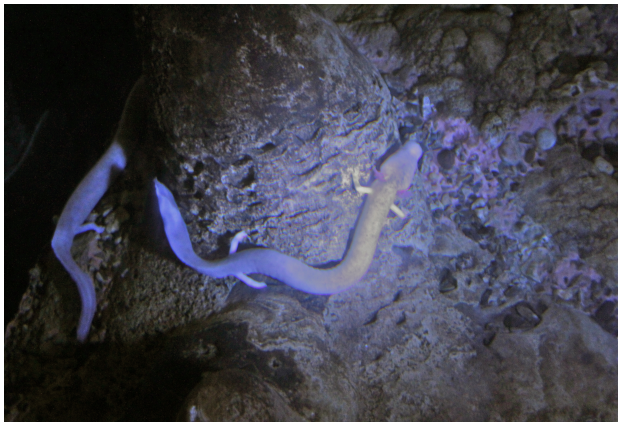
Further investigations are necessary for this habitat type in Europe. Despite the fact that this habitat is likely to be rather frequent and extended in Europe, especially in karst areas, the absence of connections among different underground systems and the very peculiar habitat environmental conditions, make the biotic part of the habitat very characteristic from site to site, with a high rate of specialication, endemism and localized species. Even a small reduction of the habitat in some restricted geographical areas could cause the loss of some unique species.

Habitat Type

Code and name

C6.1 Underground standing and running waterbody

Underground standing waterbodies in the Skakavac cave, Zelengora Mountain, Bosnia and Herzegovina (Photo: Đ. Milanović).



Proteus anguinus in the Postojna caves, Slovenia (Photo: Flavia Landucci).

Habitat description

The habitat includes running or standing water bodies that develop under the ground surface. In many cases these water bodies are part of cave systems. Groundwater systems in soil are not included here. The underground water body is a result of impermeable layers below the body that enables accumulation of water. Water can also be captured between two impermeable layers (artesian water). This habitat most often develops on limestone bedrock. By dissolution of limestone, the water creates underground caves that can be filled with water. Specific animals are adapted to these conditions, such as *Proteus anguinus* the only cave-dwelling chordate species found in Europe. It is an entirely aquatic animal, as it eats, sleeps, and breeds underwater. This animal is most notable for its adaptations to a life of complete darkness: eyes are undeveloped and the animal is blind, while its other senses, particularly smell and hearing, are acutely developed. It has also no pigmentation in its skin. Underground water bodies are an important source for drinking water, and in that sense threatened by pollution. This habitat type can be connected with other habitats developing above the ground surface, like temporary flooded habitats, turloughs, poljes and others karst structures.

Indicators of good quality:

- Unaltered stalactites, stalagmites or other carbonate concretions testifying an active karst phenomenon
- No groundwater capture or canalization
- Presence of invertebrate and vertebrate species typical of this habitat
- No touristic use of the cave

Characteristic species:

This habitat type is characterized by the almost total absence of photosynthetic organisms except for those that grows in the transitional part with the external environment.

Invertebrates: many species of invertebrate that populate the underground systems can be also found on the surface water and soil, however they present adaptations to the underground life (often miniaturization, lost of pigments, eyes, morphological simplification). Very common are planarians, oligochaetes (e.g. *Lumbriculida* and *Tubificida*), molluscs (e.g. *Congeria kuscerii* in Bosnia and Herzegovina, Croatia, Slovenia), springtails (e.g. *Bessoniella, Pseudosinella*), diplurans (e.g. family *Campodeidae*), troglobiotic species of beetles, centipedes (e.g. *Lithobius matulicii* from Bosni and Herzegovina), millepedes, troglobiotic spiders and related groups , crustaceans such as copepods (e.g. *Cyclopoida* and *Harpacticoida*), ostracods, malacostracans (e.g. a variant of *Gammarus lacustris* in Norway), cirolanids, asellids. Specific of underground water bodies is the crustacean order *Bathynellacea* and the family *Ingolfiellidae*. Big crustaceans include the genus *Troglocaris* (*Troglocaris anophthalmus* in the Balkans and Italy).

Vertebrates: Also some amphibious species are adapted to this habitat, such as *Proteus anguinus*, cave salamanders (including *Atylodes genei*) and 7 species of the genus *Speleomates* (*S. ambrosii, S. flavus, S. imperialis, S. sarrabusensis, S. italicus, S. strinatii, S. supramuntis*), 6 of those are endemic of restrict areas of the Italian Peninsula.

Classification

This habitat may be equivalent to, or broader than, or narrower than the habitats or ecosystems in the following typologies.

EUNIS:

H1.5. Underground standing water

H1.6 Underground running water

Annex 1:

8310 Caves not open to the public

Emerald:

H1 terrestrial underground caves, cave systems, passages and waterbodies

MAES:

-

IUCN:

5.18 Karst and Other Subterranean Inland Aquatic Systems

15.10 Karst and Other Subterranean Hydrological Systems

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?
No

Justification
The occurrence of this habitat is mainly determined by suitable geological conditions, which occur in different parts of Europe. However the invertebrate and vertebrate communities hosted by this habitat are usually geographically localized.

Geographic occurrence and trends

EU 28	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Austria	Present	Unknown Km^2	Stable	Stable
Belgium	Present	Unknown Km^2	Unknown	Unknown
Bulgaria	Present	Unknown Km^2	Decreasing	Decreasing
Croatia	Present	Unknown Km^2	Stable	Stable
Cyprus	Present	Unknown Km^2	Unknown	Unknown
Czech Republic	Present	0.02 Km^2	Stable	Stable
Denmark	Uncertain	Unknown Km^2	Unknown	Unknown
Estonia	Present	Unknown Km^2	Unknown	Unknown
France	Corsica: Present France mainland: Present	Unknown Km^2	Unknown	Decreasing
Germany	Present	Unknown Km^2	Stable	Stable
Greece	Crete: Present East Aegean: Present Greece (mainland and other islands): Present	Unknown Km^2	Unknown	Unknown
Hungary	Present	Unknown Km^2	Unknown	Unknown
Ireland	Present	Unknown Km^2	Stable	Stable
Italy	Italy mainland: Present Sardinia: Present Sicily: Present	Unknown Km^2	Unknown	Unknown
Latvia	Present	Unknown Km^2	Unknown	Unknown

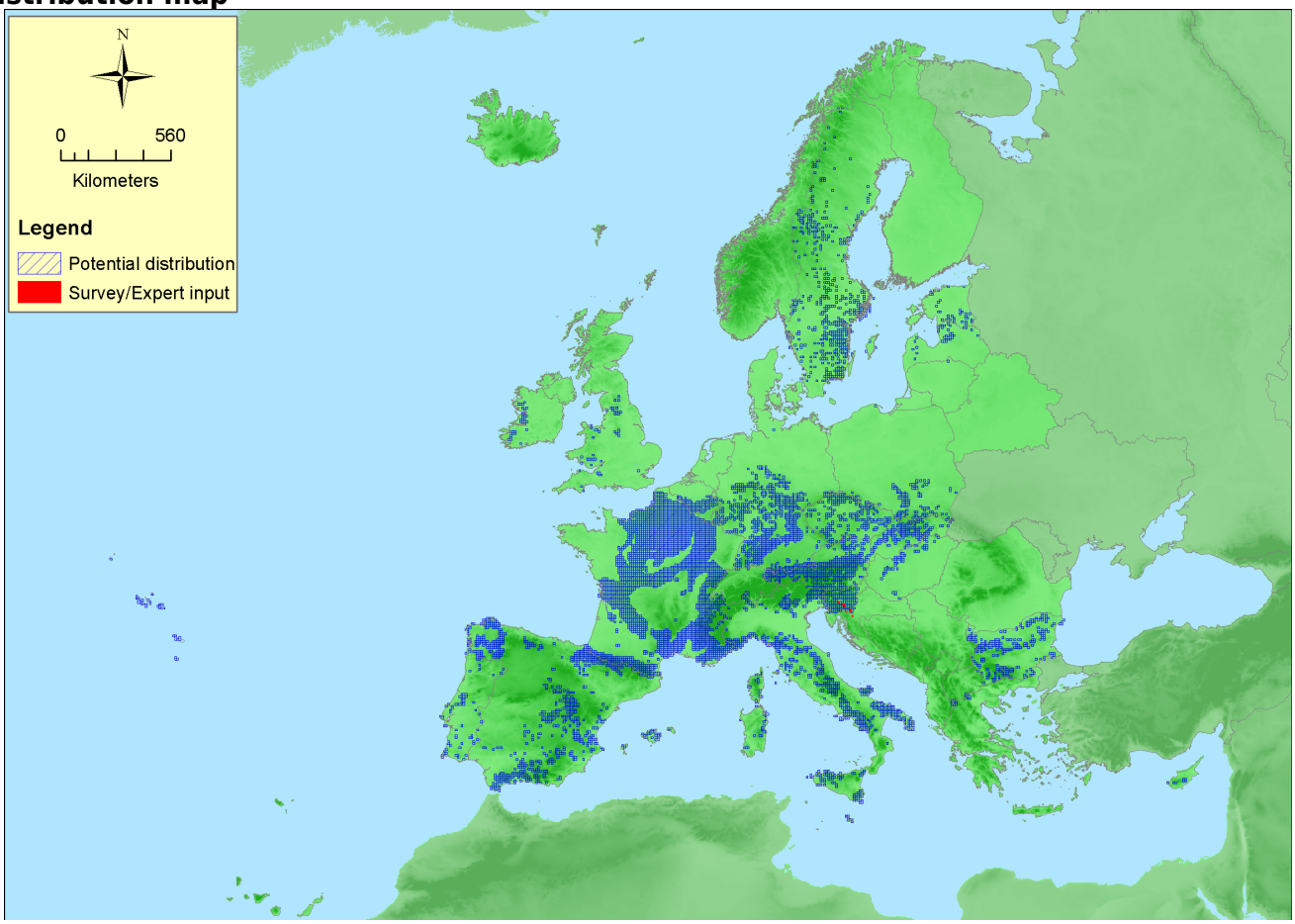
EU 28	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Lithuania	Present	Unknown Km^2	Unknown	Unknown
Luxembourg	Present	Unknown Km^2	Unknown	Unknown
Malta	Uncertain	Unknown Km^2	Unknown	Unknown
Poland	Present	Unknown Km^2	Unknown	Unknown
Portugal	Madeira: Present Portugal Azores: Present Portugal mainland: Present Savage Islands: Present	200 Km^2	Unknown	Unknown
Romania	Present	45 Km^2	Stable	Stable
Slovakia	Present	0.0001 Km^2	Stable	Stable
Slovenia	Present	Unknown Km^2	Stable	Stable
Spain	Balearic Islands: Present Canary Islands: Present Spain mainland: Present	358 Km^2	Decreasing	Unknown
Sweden	Present	Unknown Km^2	Unknown	Unknown
UK	Gibraltar: Uncertain Northern Island: Present United Kingdom: Present	Unknown Km^2	Unknown	Unknown

EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Albania	Present	Unknown Km^2	Unknown	Unknown
Bosnia and Herzegovina	Present	25 Km^2	Stable	Decreasing
Former Yugoslavian Republic of Macedonia (FYROM)	Present	Unknown Km^2	Unknown	Unknown
Kosovo	Present	Unknown Km^2	Unknown	Unknown
Montenegro	Present	Unknown Km^2	Unknown	Unknown
Norway	Jan Mayen: Present Norway Mainland: Present Svalbard: Present	Unknown Km^2	Unknown	Unknown
Serbia	Present	Unknown Km^2	Unknown	Unknown
Switzerland	Present	Unknown Km^2	Unknown	Unknown

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	11555150 Km^2	7190	603 Km^2	AOO and EOO incl. potential distribution
EU 28+	11555150 Km^2	7191	628 Km^2	AOO and EOO incl. potential distribution

Distribution map



The map is very incomplete, based on distribution data from two typical fauna species (GBIF data), and a potential map indicating the distribution of caves in the EU. Data sources: GBIF, ART17.

How much of the current distribution of the habitat type lies within the EU 28?

Probably about 60% of this habitat type in Europe is within EU28 and 40% within EU28+. However these percentages are very rough estimations based on the assumption that most of the habitat is in those areas with extended carbonate formations. For almost all countries there are no data about the extension of this habitat. Underground standing and running waterbodies are very frequent around the world but in most of the cases they host very endemic and localized fauna species, therefore in every country they represent an almost unique habitat for very restricted ranges of species. Therefore, we consider the habitat not to extend far beyong the EU28+.

Trends in quantity

The general trend in quantity is impossible to estimate because there are no sufficient data about the present and past surface of the habitat. However many countries reported, according to expert assessment, that the habitat is stable or slightly decreasing.

- Average current trend in quantity (extent)
  EU 28: Unknown
  EU 28+: Unknown
- Does the habitat type have a small natural range following regression?
  No
  Justification
  Most countries reported unknown, stable or slight declining trend in quantity, while the natural range of the habitat is much higher than 50,000 Km^2
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  The geographical range of the habitat (EOO) is very wide and in most cases the extension is unknown because these underground habitats are still not completely explored. The habitat is assumed to be quite extended in many European countries.

Trends in quality

Not enough quantitative data are available about the present and past surface of the habitat and its abiotic and biotic trends in quality. However many countries reported according to expert assessment that the habitat quality is stable or slightly decreasing.

- Average current trend in quality
  EU 28: Unknown
  EU 28+: Unknown

Pressures and threats

In most countries the exact extent of the habitat as well as the degree of degradation is unknown because often the habitat is unexplored or difficult to access. Despite this, it is possible to say that main pressures for this habitat are represented by pollution and abstraction of groundwater. Human intrusions can cause alteration of the abiotic and biotic conditions of this particular habitat (alteration of temperature, humidity, pH, introduction of microorganisms, etc.). However this kind of pressure is usually restricted to those parts of natural caves accessible to tourists, which represent only a small proportion of the habitat type. Natural geological phenomena such as earthquake and underground collapses can represent local pressures in active seismic areas. Sometimes earthquakes can generate new underground systems even increasing the surface of the habitat.

List of pressures and threats

Human intrusions and disturbances

Sport and leisure structures
Other sport / Leisure complexes
Other human intrusions and disturbances
Trampling, overuse
Vandalism
Disturbance of species

Pollution

Pollution to groundwater (point sources and diffuse sources)

Natural System modifications

Human induced changes in hydraulic conditions
Water abstractions from groundwater

Saltwater intrusion of groundwater

Geological events, natural catastrophes

Earthquake
Undergound collapses

Conservation and management

The measures that should be taken to preserve this habitat type are, consistently with the pressures and threats, those related to human activities that can alter the abiotic and biotic conditions of the habitat: (a) regulating the human access to the habitat for touristic and mining purposes, (b) regulating the water abstraction, (c) regulating the industrial and urban waste management to avoid that underground water systems can be directly or indirectly polluted, (d) improving or restoring the water quality whenever the habitat is already compromised.

List of conservation and management needs

No measures

Measures needed, but not implemented

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality
Restoring/Improving the hydrological regime
Managing water abstraction

Measures related to urban areas, industry, energy and transport

Urban and industrial waste management

Conservation status

Annex 1 types:

8310: ALP U1, ATL U1, BLS U1, BOR FV, CON U1, MAC FV, MED U1, PAN U1, STE U1

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

The capacity of this habitat to recover naturally or through intervention depends on the kind and severity of the damage that the habitat has undergone, by the geological substrate, the connection of the system with the surface and the time of groundwater renewal. The time for renewal of groundwater can naturally take thousands of years. Therefore, in case of water pollution, which is the most frequent cause of damage, after removal of the causes of pollution it may take decades or centuries to recover the habitat.

Effort required

50+ years	200+ years
Through intervention	Through intervention

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	unknown %	unknown %	unknown %	unknown %

Criterion A	A1	A2a	A2b	A3
EU 28+	unknown %	unknown %	unknown %	unknown %

Despite the habitat occurring in 26 countries within EU28 and 9 within EU28+, most of the countries were not able to estimate past and current area of the habitat. Only 6 countries reported values of the current area and stated that the habitat remained stable in the last 50 years. The values of the current area for Romania and Portugal should be verified, because they seem unrealistically high (maybe they are in hectares). Two countries reported declines in area. The overall conclusion is that data is too limited to assess the reduction in area over the last 50 years, leading to the conclusion Data Deficient (DD).

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	> 50000 Km^2	Unknown	Unknown	unknown	> 50	Unknown	Unknown	unknown	unknown
EU 28+	> 50000 Km^2	Unknown	Unknown	unknown	> 50	Unknown	Unknown	unknown	unknown

The EOO and AOO of this habitat are much higher respectively than 50,000 km^2 and 50 km^2 and the number of locations is very large. There are not sufficient data available about decline of spatial extent, and changes in abiotic or biotic quality. The conclusion for criterion B is Least Concern (LC).

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%
EU 28+	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%

Very few countries provided quantitative data. Four countries reported no significant degradation of the habitat, while 6 countries reported slight to moderate degradation. However the degraded area is in most cases unknown, and therefore it is impossible to calculate the average extent of degradation in Europe.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	unknown
EU 28+	unknown

There is no quantitative analysis available that estimates the probability of collapse of this habitat type.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	DD	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	DD	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Data Deficient	-	Data Deficient	-

Confidence in the assessment
Low (mainly based on uncertain or indirect information, inferred and suspected data values, and/or limited expert knowledge)

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References

Belles, X., 1987. Fauna cavernicola i intersticial de la Peninsula Iberica i les iles Balears. Consell Superior d'Investigacions Cientifiques. Madrid.

Bole, J., Drovenik, B., Mrsic, N., Sket, B., 1993. Endemic animals in hypogean habitats in Slovenia. Nase Jame 35: 43-56.

Culver, D.C., Sket, B., 2000. Hotspots of Subterranean Biodiversity in Caves and Wells. Journal of Cave and Karst Studies 62(1): 11-17.

Culver, D.C, Pipan, T., 2009. The Biology of Caves and Other Subterranean Habitats Oxford University Press, Oxford. 256 pp.

Lanza, B., Pastorelli, C., Laghi, P., Cimmaruta, R., 2005. A review of systematics, taxonomy, genetics,

biogeography and natural history of the genus *Speleomantes* Dubois 1984 Amphibia Caudata Plethodontidae. Atti del Museo Civico di Storia Naturale di Trieste 52 (Suppl.): 5-135.

Østby, E., Lauritzen, S-E., 2013. A checklist of invertebrates from Norwegian caves and mines. Fauna Norvegica 33: 35-51.