C2.1b Calcareous spring and spring brook

Summary

Calcareous springs, spring brooks and associated tufa cascades occur across Europe in areas with calcareous bedrock and soil where surface discharge is of hard water. They are numerous, but usually small in size and have a distinctive and often rich flora of moss carpets and calcicolous herbs with distinctive invertebrates. Widely threatened away from far northern and high altitude situations, land reclamation, drainage, groundwater abstraction and eutrophication are the main dangers. Restoration demands recovery of the natural hydrology.,

Synthesis

There has been a clear trend of degradation of quality in calcareous springs, spring brooks and tufa cascades in the EU28 during the last 50 years. In quantitative terms the negatively affected part of the area is 50% with a relatively large severity of degradation (58%). This leads to the category Vulnerable (VU) based on trend in quality over the last 50 years (criterion C/D1). The decrease of the area in the recent past is in a range around 23%, qualifying the habitat to the category Near Threatened (NT). The habitat has likely declined up to 70% in area over a longer time period (last centuries), but data exist only from a limited number of countries, leading to a conservative conclusion of Vulnerable. The overall threat category is the same in the EU28+ as most reported occurrences of the habitat are situated in EU28 countries.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Vulnerable	A3, C/D1	Vulnerable	A3, C/D1

Sub-habitat types that may require further examination

Calcareous springs, spring brooks and tufa cascades are defined as a broad habitat type representing a lot of regional and local variation, with many localised fauna species. Alpine springs and spring brooks should be assessed separately from the lowland springs. Spring habitats of karstic areas deserve also an assessment of their own. Of these three subtypes it is likely that lowland springs are more threatened (category Endangered) than the other two subhabitats.

Habitat Type

Code and name

C2.1b Calcareous spring and spring brook

Calcareous spring with seepage area covered by mosses in Tervola, Finland (Photo: Jari Ilmonen).

Extended formation of tufa formed by the cascades at the confluence of the rivers Korana and Slunjčica, Slunj, Croatia (Photo: Flavia Landucci).

Habitat description

Calcareous springs, spring brooks and tufa cascades of karstic rivers differ from base-poor springs (C2.1a) and spring brooks due to their hard water, caused by the high calcium content. Consequently, the pH is clearly alkaline, (pH 6.5-8.5), and the specific conductivity high. This habitat occurs in areas of calcareous bedrock and soils. It is a naturally rare and nowadays declined habitat, particularly in most of the lowland areas in Europe. In montane and alpine areas calcareous springs are more common, and have remained intact to a greater extent. Calcareous springs are usually occurring as small patches. Tufa waterfalls and cascades are characteristics of watercourses in karstic areas of Europe, especially in the Dinaric Alps. The tufa-deposition and later the travertine formation are organogenic processes dependent by the organisms (bacteria, algae, mosses and plants) growing on the substrate. The periphyton produces mucopolysaccharides in which crystals of calcium carbonates ($CaCO3$) are trapped. This phenomenon is pronounced in many karstic areas and is very sensitive to natural or anthropogenic changes in water chemistry. In northern, geologically young springs tufa formations are not well-developed, but calcareous gyttja (organic mud) is common in sediments. Calcareous springs, spring brooks and cascades are species-rich habitats with abundant cover of mosses. Beside species in common with base-poor springs (type C2.1a) there is a number of calcium-demanding mosses and vascular plants. A high dominance of the moss *Cratoneuron commutatum* is often typical. Threats for this habitat type are the same as in base-poor springs; in lowland areas many calcareous springs have been destroyed by forestry and clearing of agricultural land.

Indicators of good quality:

- Natural hydrology and water chemistry in springs and spring brooks,
- Low anthropogenic influence (drainage, water exploitation, forestry, agriculture, eutrophication etc.) in springs, their surroundings and catchment areas,
- Presence of plants and animals adapted to spring conditions, including threatened species,
- High cover of mosses and specialized vascular plants,

- Absence of invasive alien species.

Characteristic species:

Flora

Vascular plants: *Arabis soyeri, Cardamine* spp., *Carex atrofusca, C. saxatilis, C. flava* aggr., *C. capillaris, C. capitata, C. appropinquata, C. acutiformis, C. paniculata, Cochlearia pyrenaica, Deschampsia argentea, Epilobium davuricum, Epilobium* spp., *Equisetum scirpoides, E. variegatum, Pinguicula vulgaris, Juncus biglumis, J. triglumis, Montia fontana, Oenanthe divaricata, Saxifraga aizoides.*

Bryophytes: *Aneura pinguis, Brachythecium rivulare, Bryum pseudotriquetrum, Catoscopium nigritum, Cinclidium stygium, Cinclidotus fontinaloides, Cratoneuron commutatum, C. falcatum, C. filicinum, C. decipiens, Eucladium verticillatum, Gymnostomum recurviroste, Marcantia* spp., *Meesia* spp., *Oncophorus* spp., *Paludella squarrosa, Pellia* spp., *Philonotis calcarea, Philonotis* spp., *Scorpidium revolvens, S. cossoni, Sphagnum* spp. (*S. wanstorfii, S. subsecundum*), *Tomentypnum nitens, Warnstorfia* spp.

Algae: *Chara* spp. (*C. fragilis, C. aspera*).

Classification

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

EUNIS:

C2.1 Springs, spring brooks and geysers

EuroVegChecklist (alliances)

Cratoneurion commutati Koch 1926

Lycopo europaei-Cratoneurion commutati Hadac 1983

Adiantion Br.-Bl. ex Horvatic 1934

Pinguiculion longifoliae Fernandez Casas 1970

Deschampsion argenteae Capelo et al. 2000 (Madeiran waterfalls and cascades)

Cinclidotium fontinaloidis Philippi 1956

Charion fragilis Krausch 1964

Annex 1:

7220 Petrifying springs with tufa formation (Cratoneurion)

32A0 Tufa cascades of karstic rivers of the Dinaric Alps

Emerald:

C2.12 Hard water springs

C2.19 Lime rich oligotrophic vegetation of spring brooks

MAES-2:

Rivers and lakes

IUCN:

5.9 Freshwater Springs and Oases

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

Justification
The habitat is widespread in calcareous hilly and mountainous regions in Europe.

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	Decreasing	Decreasing
Belgium	Present	0.9 Km^2	Stable	Decreasing
Bulgaria	Present	0.35 Km^2	Decreasing	Decreasing
Croatia	Present	Unknown Km^2	Stable	Stable
Cyprus	Uncertain	Unknown Km^2	Unknown	Unknown
Czech Republic	Present	0.3 Km^2	Decreasing	Decreasing
Denmark	Present	10.6 Km^2	Decreasing	Decreasing
Estonia	Present	Unknown Km^2	Unknown	Unknown
Finland	Aland Islands: Present Finland mainland: Present	0.16 Km^2	Decreasing	Decreasing
France	Corsica: Present France mainland: Present	50 Km^2	Decreasing	Decreasing
Germany	Present	7 Km^2	Decreasing	Decreasing
Greece	Crete: Uncertain East Aegean: Uncertain Greece (mainland and other islands): Present	Unknown Km^2	Unknown	Unknown
Hungary	Present	0.1 Km^2	Decreasing	Unknown
Ireland	Present	0.15 Km^2	Stable	Decreasing
Italy	Italy mainland: Present Sardinia: Present Sicily: Present	43 Km^2	Decreasing	Decreasing
Latvia	Present	Unknown Km^2	Unknown	Unknown
Lithuania	Present	1 Km^2	Decreasing	Decreasing
Luxembourg	Present	Unknown Km^2	Unknown	Unknown
Netherlands	Present	1 Km^2	Decreasing	Unknown
Poland	Present	Unknown Km^2	Unknown	Unknown
Portugal	Portugal mainland: Present	Unknown Km^2	Unknown	Unknown
Romania	Present	2 Km^2	Decreasing	Decreasing
Slovakia	Present	0.35 Km^2	Decreasing	Decreasing
Slovenia	Present	Unknown Km^2	Unknown	Unknown
Spain	Spain mainland: Present	18 Km^2	Decreasing	Decreasing
Sweden	Present	Unknown Km^2	Unknown	Unknown

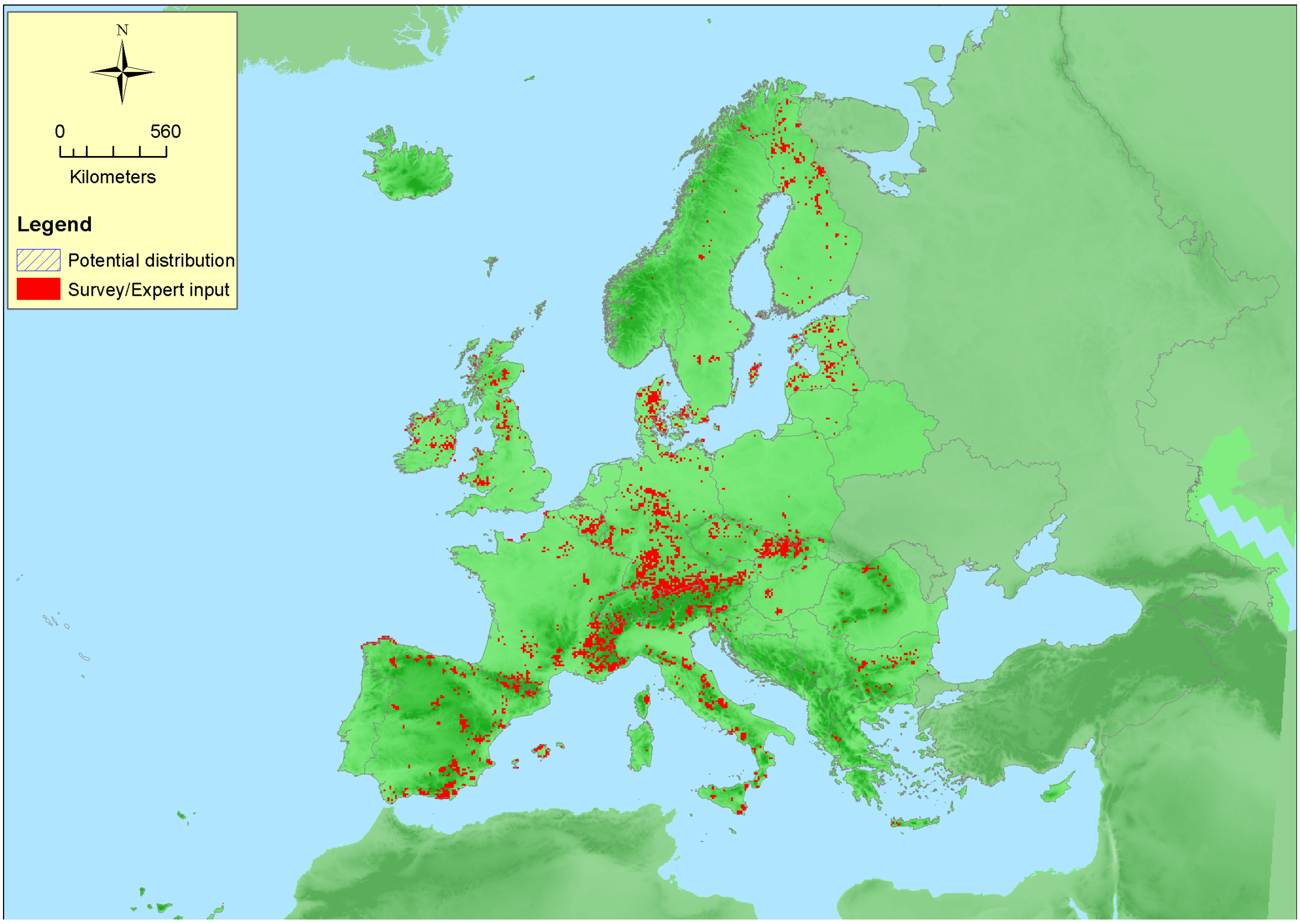
EU 28	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
UK	Northern Island: Present United Kingdom: Present	2 Km^2	Stable	Stable

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	2 Km^2	Decreasing	Decreasing
Former Yugoslavian Republic of Macedonia (FYROM)	Present	Unknown Km^2	Unknown	Unknown
Iceland	Present	Unknown Km^2	Unknown	Unknown
Kosovo	Present	Unknown Km^2	Unknown	Unknown
Montenegro	Present	Unknown Km^2	Unknown	Unknown
Norway	Norway Mainland: Present Svalbard: Uncertain	Unknown Km^2	Unknown	Unknown
Serbia	Present	Unknown Km^2	Unknown	Unknown
Switzerland	Present	14 Km^2	Decreasing	Decreasing

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	8320300 Km^2	3202	Unknown Km^2	Habitat occurs in numerous sites, which are usually very small in size
EU 28+	9935700 Km^2	3244	Unknown Km^2	Habitat occurs in numerous sites, which are usually very small in size

Distribution map



Map is rather complete, but data gaps exist in the Balkan and probably in Norway. Data sources: EVA, Art17.

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

5-10%. Calcareous springs and spring brooks are cosmopolitan habitats occurring in areas with suitable bedrock and soils. As large parts of other continents are dry, the proportion of these habitats in Europe may be higher than Europe´s share of all terrestrial areas.

Trends in quantity

Many calcareous springs and spring brooks are destroyed in historical times due to land reclamation, drainage, ground water abstraction, and pollution. This trend has continued during the recent past (last 50-60 years). In many countries, decline has been 20 to 40 % over that period. In future the total area of calcareous spring habitats may further decrease, but likely more slowly compared to the past trend. The total area of the habitat is difficult to estimate, partly because different methods have been used in countries in estimating the habitat area. It may be 150 - 250 km^2 in EU28.

- Average current trend in quantity (extent)
  EU 28: Decreasing
  EU 28+: Decreasing
- Does the habitat type have a small natural range following regression?
  No
  Justification
  Calcareous springs, spring brooks and tufa cascades have undergone severe losses in quantity in many countries historically and also in the recent past, but they still have a very large distribution range.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  Yes

Justification
Total area of calcareous spring habitats is small in most countries, and most occurrences are very small in size, often only some tens of square meters. They occur only in areas with calcium rich bedrock (limestone, dolomite) and soils. The tufa cascades are larger but very rare and mostly restricted to karstic areas. The fauna and flora of calcareous spring habitats vary largely between different regions.

Trends in quality

The quality of calcareous spring habitats declined in historical periods in many countries, as well as over the 50 last years. The severity of degradation has been estimated to be moderate to severe in most countries. This degradation may continue in the future.

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

Pressures and threats

Calcareous springs and spring brooks are small scale habitats occurring as patches in a wider landscape. Depending on regional and local circumstances (relief, ground water) they are subjected to different natural and human-caused pressures. Since historical times these habitats have been influenced by groundwater abstraction, land reclamation, drainage and other changes in hydrology, and many kinds of pollution. These pressures caused a decline in the quantity of springs, as well as deterioration of their quality. Relatively early many calcareous springs with their surroundings were lost in many lowland areas. The same trend has continued the last 50 years as well. Nutrient loading, particularly nitrogen, has increased, largely by diffuse loading of nutrients from agriculture and forestry, or airborne nutrient input. Both hydrological changes and increasing nutrient load result in succesion (replacement of spring vegetation by more productive plant communities). The climate change may enhance this in future. Mining and sand or soil excavation can be locally important threats. In general, these pressures have been much stronger in spring habitats in lowland areas than in mountains. In north European and in alpine areas many calcareous spring habitats are still in a good state.

List of pressures and threats

Urbanisation, residential and commercial development

Urbanised areas, human habitation

Pollution

Pollution to groundwater (point sources and diffuse sources)
Air pollution, air-borne pollutants

Natural System modifications

Human induced changes in hydraulic conditions

Natural biotic and abiotic processes (without catastrophes)

Biocenotic evolution, succession

Climate change

Changes in abiotic conditions

Conservation and management

Maintaining natural hydrology and control of eutrophication and other pollution are crucial for conservation of calcareous springs, spring brooks and tufa cascades. Water protection measures are needed in catchment areas of these groundwater habitats. Calcareous springs are small-scale habitats (often only a few to some tens of square meters), therefore their specialized flora and fauna are sensitive to various changes, including stochastic ones. As the catchments of springs in some lowlands may be very large, conservation measures for restoring or maintaining water quality and quantity may be needed in a large area. Most representative sites should be legally protected, and they should be taken into account in agriculture, forestry and other land use in the area.

List of conservation and management needs

Measures related to forests and wooded habitats

Adapt forest management

Measures related to wetland, freshwater and coastal habitats

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

Measures related to spatial planning

Establish protected areas/sites
Legal protection of habitats and species

Measures related to hunting, taking and fishing and species management

Specific single species or species group management measures

Conservation status

Annex 1:

7220: ALP U1, ATL U2, BLS U1, BOR U1, CON U1, MED U2, PAN U1.

32AO (Tufa cascades) is missing from the reporting tables.

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

Calcareous spring habitats have some capacity to recover, but in most cases interventions related to restoration of hydrology, control of nutrient loads and other pollution are required, particularly if there is intensive land use in the surrounding areas. Fauna and flora of calcareous spring habitats require specific management and restoration measures. Restrictions in land use (including recreational activities) in surroundings of these habitats are often needed.

Effort required

10 years
Through intervention

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	-23 %	unknown %	unknown %	-70 %
EU 28+	unknown %	unknown %	unknown %	unknown %

The quantitative analyses in the last 50 years is based on 12 EU28 countries leads to an average decline of 23%. However, for several countries some data is lacking, some countries report large decline ranges (for example Austria 25-55%, Germany 50-70%), and besides provided data on the area is very uncertain. Therefore the trend is seen as indicative, and an uncertainty range around it would include the 25-30% threshold range for the category Near Threatened. Data from only two additional EU28+ country (Bosnia & Herzegovina) suggests a lower trend on the Balkan, but large declines (-80%) in Switzerland. As most area is found in the EU28, we conclude "Near Threatened" for EU28+ as well. The loss during last centuries has been severe (Criterion A3) with a least 7 countries reporting trends between 50 and 90 percent. An average trend of -70% would qualify for the category Endangered (EN). As these data are derived from a limited number of countries the trend is indicative, and the more conservative conclusion for A3 is Vulnerable.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	> 50000 Km^2	Yes	No	No	> 50	Yes	No	No	No
EU 28+	> 50000 Km^2	Yes	No	No	> 50	Yes	No	No	No

The range (EOO), distribution (AOO) and number of locations of this habitat are all much larger than the thresholds, and therefore evaluation of B-criteria leads to the conclusion Least Concern.

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	50 %	58 %	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%

Qualitative data of current degraded area were derived from 15 countries (13 in the EU28), the severity of degradation from 17 countries (15 in the EU28). Data for quantitative analysis combining extent and severity of degradation were available from only 7 countries in the EU28. Data from two countries outside the EU 28 is too limited to make a proper additional analysis for the EU28+. Although the resulting trend has some uncertainty as well (especially due to the area estimates), we conclude a Vulnerable (VU) status for both EU28 and EU28+.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

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

No quantitative analysis to evaluate risk of habitat collapse has been made.

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	NT	DD	DD	VU	LC	LC	LC	VU	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	NT	DD	DD	VU	LC	LC	LC	VU	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
Vulnerable	A3, C/D1	Vulnerable	A3, C/D1

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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