

A4.71 Communities of Mediterranean circalittoral caves and overhangs

Summary

Caves and overhangs constitute typical features of the Mediterranean sublittoral rocky bottoms. They are characterised by high morphological complexity, reflected in abiotic gradients and marked biological zonation along the longitudinal cave axis, from the entrance to the inner cave sectors. Light availability and water confinement are acknowledged as the main driving forces shaping this zonation.

Uncontrolled visitation by SCUBA divers, red coral harvesting, water temperature rise, presence of alien species and marine pollution constitute potential threats for the communities of sublittoral caves and overhangs. Increasing water temperature as a result of climate change has also been proposed to cause replacement of the endemic species. Conservation measures include regulation of damaging activities, including within Marine Protected Areas, and managing exploitation of the resources found in marine caves.

Synthesis

Little information exists on the overall trends of this habitat. Localised studies have been conducted at different sites mostly in the western Mediterranean Sea, but the earliest data were only published in 1940-50. The lack of historic quantitative and qualitative data on its community structure from most Mediterranean areas constitutes a major impediment to the identification of potential quantity and quality decline of this habitat type through time. However, it can be assumed that the habitat quality might have decreased as a consequence of uncontrolled visitation by SCUBA divers, water temperature rise, marine pollution and habitat destruction. The habitat is known to be widespread throughout the Mediterranean Sea, with a large EOO and AOO, and therefore it qualifies as Least Concern under Criterion B for both the EU 28 and EU 28+.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Least Concern	-	Least Concern	-

Sub-habitat types that may require further examination

Anchialine caves.

Habitat Type

Code and name

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Semi-dark cave community, Aegean Sea (© V.Gerovasileiou).



Dark cave community, Aegean Sea (© V. Gerovasileiou).

Habitat description

Caves and overhangs constitute typical features of the Mediterranean circalittoral rocky bottoms. They support a great variety of species and host a considerable proportion of the total Mediterranean diversity of certain phyla, such as Brachiopoda, Bryozoa, and Porifera. Several protected and rare species, including recently described species, as well as deep-sea species have been reported. Most of our knowledge comes from caves in the north-west Mediterranean as cave biodiversity is extremely understudied in the southern and eastern basins. They are characterised by high morphological complexity, reflected in abiotic gradients and marked biological zonation along the longitudinal cave axis, from the entrance to the inner cave sectors. Light availability and water confinement are acknowledged as the main driving forces shaping this zonation. Thus, circalittoral caves support a variety of sciaphilic assemblages, usually distributed according to the following scheme: (i) a sciaphilic algae-dominated community at the entrance zone, (ii) a semi-dark zone where sessile filter-feeding invertebrates (mainly sponges and anthozoans) dominate, favored by the disappearance of macroalgae, and (iii) a dark zone which is sparsely colonized by sponges, serpulid polychaetes, bryozoans and brachiopods.

The shift from semi-dark to dark cave communities is evidenced through a sharp decrease in biotic coverage, biomass, three-dimensional biotic complexity, species richness, and the appearance of a black mineral coating of Mn-Fe oxides on the substrate. Additional zones, such as a transitional zone between semi-dark and dark cave communities and an azoic zone at the aphotic cave edge, have been occasionally identified. The limits of these zones might vary among caves with different morphology (e.g. inner zones tend to appear closer to the cave entrance in deeper waters), while in some caves some specific zones might be absent. Semi-dark caves are community is typically dominated by sponges, bryozoans, brachiopods and polychaete species. Serpulid polychaetes (e.g. *Protula* spp.) can form aggregations, which in some cases constitute the basis for the creation of biogenic structures; these 'biostalactites' are constructed by invertebrates (serpulids, sponges, and bryozoans), foraminiferans and carbonate-forming microorganisms. A number of deep-sea species belonging to various taxonomic groups (e.g. sponges, anthozoans and bryozoans) have also been recorded in sublittoral dark caves, regardless of depth

Indicators of quality:

Marine caves are characterised by high levels of individuality and heterogeneity which, coupled to the poor understanding of the ecosystem functioning, make it difficult the assessment of their ecologic quality. However, a number of indicators of quality have been recently suggested for the marine cave ecosystem, such as:

- Presence of invertebrates offering three-dimensional complexity to the substrate, and particularly fragile slow-growing species (e.g. red coral, erect bryozoans)

- High spatial coverage of suspension feeders (i.e. anthozoans) and large filter feeders (e.g. massive sponges)
- Presence of large mysid swarms
- Presence of various omnivorous and carnivorous mobile species (e.g. fish and decapods)

Characteristic species:

Communities of semi-dark caves and overhangs:

Sponges: *Agelas oroides*, *Petrosia ficiformis*, *Spirastrella cunctatrix*, *Chondrosia reniformis*, *Phorbastenaciator*, *Axinella damicornis*, *Aplysina cavernicola*, *Oscarella* spp. and *Plakina* spp. Anthozoans: (scleractinian species) *Leptopsammia pruvoti*, *Madracis pharensis*, *Hoplangia durotrix*, *Polycyathus muelleriae*, *Caryophyllia inornata* and *Astroides calycularis*. Facies of *Corallium rubrum* and *Parazoanthus axinellae*. Bryozoans: e.g. *Adeonella* spp. and *Reteporella* spp.

Communities of dark caves:

Sponges: *Petrosia ficiformis*, *Petrobiona massiliana*, *Chondrosia reniformis*, *Diplastrella bistellata*, *Penares euastrum*, *P. helleri*, *Jaspis johnstoni*, and *Haliclona mucosa*. Serpulid polychaetes, e.g. *Protula* spp. Encrusting bryozoans e.g. *Onychocella marioni* and brachiopods *Joania cordata*, *Argyrotheca cuneata*, and *Novocrania anomala*. Other species include mysids *Hemimysis margalefi* and *H. spelunca*, the decapods *Stenopus spinosus*, *Palinurus elephas*, and *Plesionika narval*, the boring bivalve *Lithophaga lithophaga* and fish species such as *Apogon imberbis* and *Grammonus ater*.

Classification

EUNIS (v1405):

Level 4: A sub-habitat of 'Mediterranean circalittoral rock' (A4.7)

Annex 1:

8330 Submerged or partially submerged sea caves

MAES:

Marine - Coastal

MSFD:

Shallow sublittoral rock and biogenic reef

EUSeaMap:

Shallow photic rock or biogenic reef

Shallow aphotic rock or biogenic reef

IUCN:

9.2 Subtidal Rock and Rocky Reefs

Barcelona Convention:

V. 3. 2. Caves and ducts in total darkness (in enclave in the upper stages)

IV.3. 2. Semi-dark caves (also in enclave in upper stages)

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?

Yes

Regions

Mediterranean

Justification

The Mediterranean communities present in this habitat vary considerably depending on the biogeographical region, internal cave morphology, extent and abiotic features of the cave system. They also host a considerable proportion of the total Mediterranean diversity for certain phyla as well as several protected and endemic species.

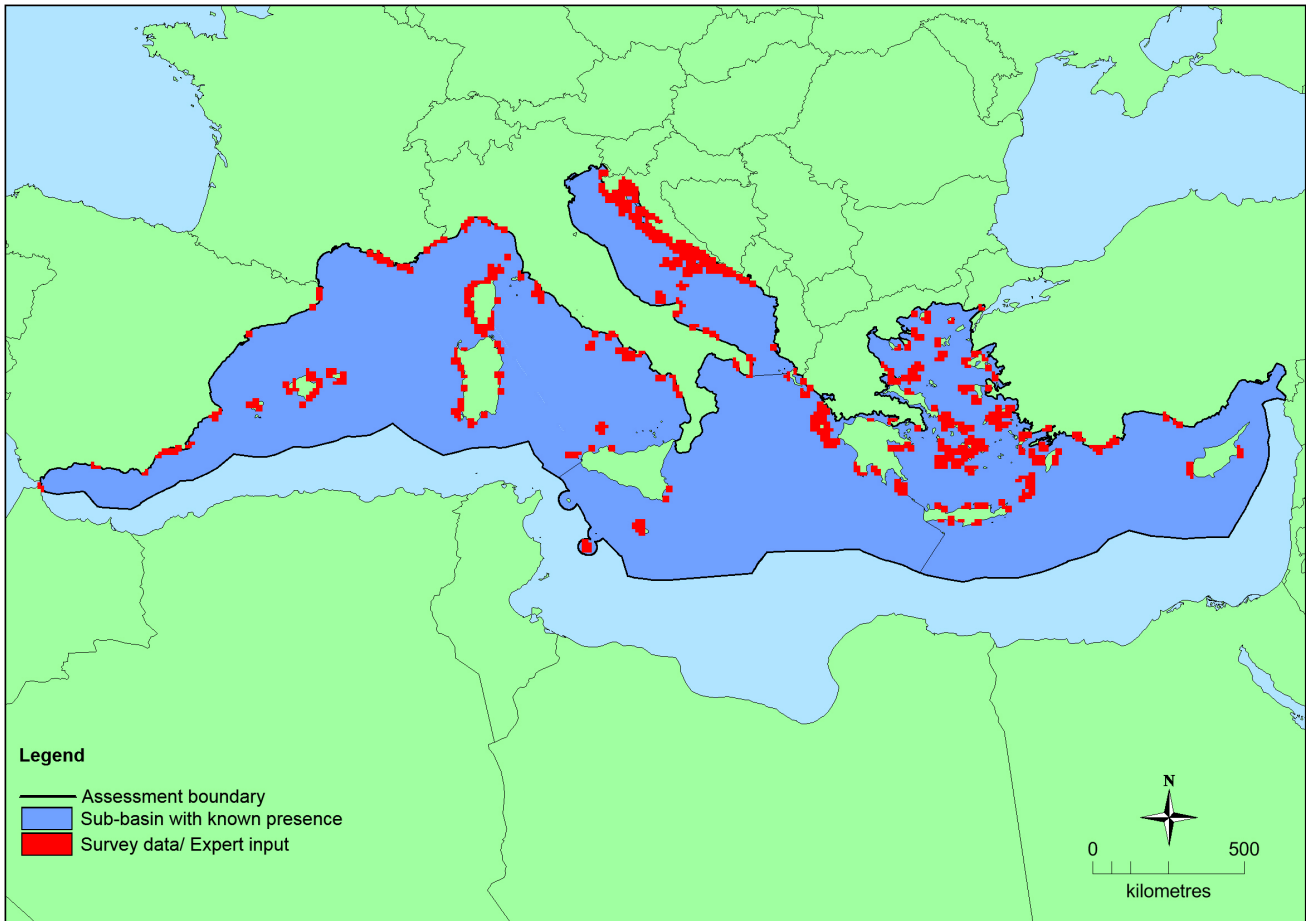
Geographic occurrence and trends

Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
<i>Mediterranean Sea</i>	Adriatic Sea: Present Aegian-Levantine Sea: Present Ionian Sea and the Central Mediterranean Sea: Present Western Mediterranean Sea: Present	76,721 Km ²	Unknown	Decreasing

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
<i>EU 28</i>	2,208,454 Km ²	1,063	75,436 Km ²	EOO and AOO have been calculated on the available data. Although this data set is known to be incomplete the figures exceed the thresholds for threatened status.
<i>EU 28+</i>	2,676,887 Km ²	1,094	76,721 Km ²	EOO and AOO have been calculated on the available data. Although this data set is known to be incomplete the figures exceed the thresholds for threatened status.

Distribution map



This map has been generated using data based on Giakoumi S. *et al.* (2013) and V. Gerovasileiou.. EOO and AOO have been calculated on the available data presented in this map however these should be treated with caution as expert opinion is that this may not indicate the full distribution of the habitat.

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

The vast majority of recorded marine caves are located in the northern Mediterranean basin, with 2,543 caves (89% of the known Mediterranean caves) present within the EU 28.

Trends in quantity

The advances in technology in the last decades have allowed to start exploring marine caves in the Mediterranean. Most of the recent work has focused on the description of faunal assemblages and there seems to be no information on the trends in quantity of the habitat.

- 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

The habitat is present along the whole Mediterranean basin and the EOO largely exceeds 50,000 km². Therefore this habitat does not have a small natural range.

- Does the habitat have a small natural range by reason of its intrinsically restricted area?

No

Justification

This habitat has a large natural range in the Mediterranean extending from the Alboran Sea in the west to the Levantine Sea in the eastern basin.

Trends in quality

Mediterranean marine caves had remained almost totally unexplored until the middle of the twentieth century. Earliest data regarding marine cave communities of the western Mediterranean were published in 1940-50. Changes in habitat quality have been recently evaluated only for a small number of caves in the western Mediterranean Sea, while there is no information from the Adriatic Sea, the Ionian Sea and the central Mediterranean Sea. A recent study in the shallow cave of Bergeggi in the Ligurian Sea (Italy), which was affected by two regional heat waves in 1999 and 2003, revealed a notable reduction of sessile invertebrates which offered three-dimensional complexity to the cave ecosystem (comparison of data collected in 1986 and 2009). Sessile invertebrates with erect growth forms have been also found to be more abundant and evenly distributed in protected caves of Sardinia (Italy), where no diving activities take place in comparison to caves which are frequently visited by SCUBA divers. The absence of data depicting the past ecological state of this habitat in the Aegean-Levantine Sea, where several non-indigenous species have been recorded in caves, makes it difficult to evaluate recent general changes of quality. However, it can be assumed that the habitat quality might have decreased.

- Average current trend in quality

EU 28: Decreasing

EU 28+: Decreasing

Pressures and threats

Uncontrolled visitation by SCUBA divers, red coral harvesting, water temperature rise, presence of alien species and marine pollution constitute potential threats for the communities of sublittoral caves and overhangs. Mechanical damage to fragile and slow-growing invertebrates due to uncontrolled diving activities (evidenced by the elimination of erect bryozoans and the presence of broken individuals on the cave bed) is probably the most severe human-induced impact on these communities. Increasing water temperature as a result of climate change has also been proposed to cause replacement of the endemic crustacean *Hemimysis speluncola* with its thermotolerant congener *H. margalefi*, and invasive species are becoming a new threat to this habitat type mostly in the southeastern Mediterranean Sea. Coastal infrastructure and development, natural biotic and abiotic processes (e.g. erosion) and geological events (e.g. earthquakes) could also result in a decrease of habitat quantity and quality.

List of pressures and threats

Urbanisation, residential and commercial development

Urbanised areas, human habitation

Discharges

Human intrusions and disturbances

Speleology

Recreational cave visits

Scubadiving, snorkelling

Pollution

Marine macro-pollution (i.e. plastic bags, styrofoam)

Invasive, other problematic species and genes

Invasive non-native species

Climate change

Temperature changes (e.g. rise of temperature & extremes)

Conservation and management

Marine cave habitats are a protected feature under EU Habitats Directive (92/43/EEC). Semi-dark and dark cave communities have been included in two Action Plans by UNEP-MAP-RAC/SPA (2008 and 2015 respectively), adopted by Contracting Parties of the Barcelona Convention specifically aiming at their conservation. A recent evaluation has shown that around 56% of the Mediterranean Marine Protected Areas (MPAs) include marine caves although the precise number of marine caves within designated MPAs remains unknown.

The clear biogeographic patterns exhibited by the Mediterranean marine cave assemblages from different regions suggest the need for protecting marine caves (e.g. management of visitation and other activities) in different regions in order to safeguard representativeness of the habitat type at the Mediterranean scale. Finally, the notable presence of several alien species in southeastern Mediterranean caves (though mostly in semi-submerged and shallow semi-dark caves and tunnels) should be monitored.

List of conservation and management needs

Measures related to marine habitats

Other marine-related measures

Measures related to spatial planning

Other spatial measures

Establish protected areas/sites

Legal protection of habitats and species

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

Measures related to special resource use

Regulating/Managing exploitation of natural resources on sea

Conservation status

Annex 1:

8330: MMED U1

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

Unknown. Marine caves structures undergo natural cycles through the process of erosion. The associated species are likely to show different restoration capabilities.

Effort required

Red List Assessment

Criterion A: Reduction in quantity

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

There is no information available on the historic, present or future reductions in quantity of marine caves

in the Mediterranean, and only recent surveys have produced the first inventories per country and at the basin scale of this habitat type. This habitat has therefore been assessed as Data Deficient under criterion A.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50,000 Km ²	Yes	Yes	No	>50	Yes	Yes	No	No
EU 28+	>50,000 Km ²	Yes	Yes	No	>50	Yes	Yes	No	No

This habitat is widespread in the east and western Mediterranean, and the EOO and AOO values exceed the thresholds for a threatened category. A slight continuing decline in abiotic and biotic quality has been assumed, and there are threats that might cause the decrease in quality of this habitat type in the next 20 years (e.g. water temperature rise). This habitat has therefore been assessed as Least Concern under criterion B for both the EU 28 and EU 28+.

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 %	Slight %	Unknown %	Unknown %	Unknown %	Unknown %
EU 28+	Unknown %	Slight %	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%

It is difficult to assess trends in abiotic and/or biotic quality due to the lack of information available on the past conditions of marine cave habitats for most of the Mediterranean areas. However, marine cave habitats are considered poorly resilient ecosystems, vulnerable to the threats mentioned above, and therefore a slight decline in abiotic and biotic quality has been assumed over the past 50 years, and it is also expected to continue in the future, considering the 50-year period of 1986-2036; although the extent affected remains unknown. Therefore, the habitat type is assessed as Data Deficient under Criteria C/D1.

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 to estimate the probability of collapse of this habitat type.

Therefore, this habitat type is assessed as Data Deficient.

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
Least Concern	-	Least Concern	-

Confidence in the assessment

Medium (evenly split between quantitative data/literature and uncertain data sources and assured expert knowledge)

Assessors

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Reviewers

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Date of assessment

14/10/2015

Date of review

09/03/2016

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