



# MarLIN

## Marine Information Network

Information on the species and habitats around the coasts and sea of the British Isles

# *Rhodochorton purpureum* and *Cladophora rupestris* on upper to mid-shore cave walls

MarLIN – Marine Life Information Network  
Marine Evidence-based Sensitivity Assessment (MarESA) Review

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The Marine Life Information Network, Marine Biological Association of the United Kingdom.

**Please note.** This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [<https://www.marlin.ac.uk/habitats/detail/39>]. All terms and the MarESA methodology are outlined on the website (<https://www.marlin.ac.uk>)

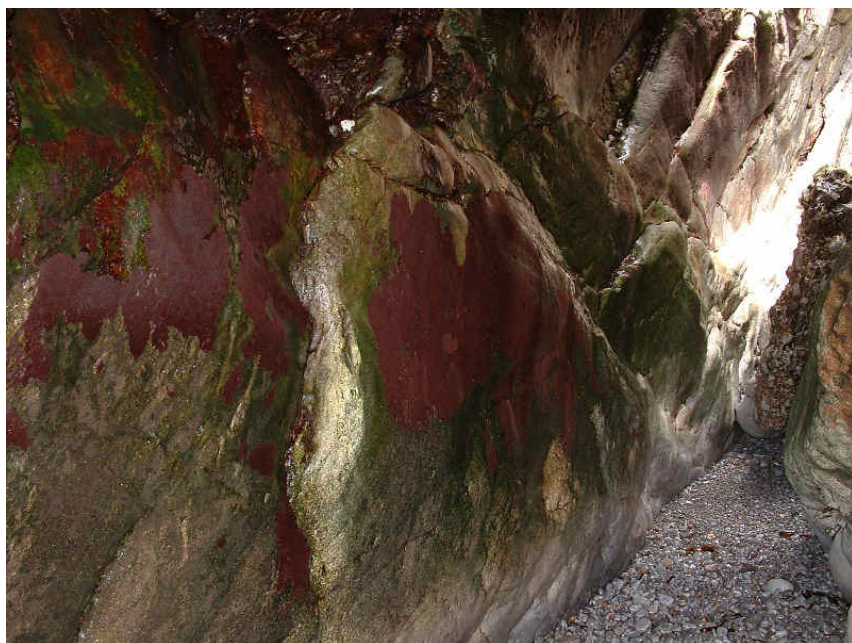
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*Rhodochorton purpureum* in upper littoral fringe soft rock caves.

Photographer: Kathryn Birch

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- Core records
- Non-core, certain determination
- Non-core, uncertain determination
- Predicted habitat extent

17-09-2018

Biotope distribution data provided by  
EMODnet Seabed Habitats  
([www.emodnet-seabedhabitats.eu](http://www.emodnet-seabedhabitats.eu))

Researched by Dr Harvey Tyler-Walters & Karen Riley

Refereed by This information is not refereed.

## Summary

### ☰ UK and Ireland classification

EUNIS 2008	A1.444	<i>Audouinella purpurea</i> and <i>Cladophora rupestris</i> on upper to mid-shore cave walls
JNCC 2015	LR.FLR.CvOv.RhoCla	<i>Rhodochorton purpureum</i> and <i>Cladophora rupestris</i> on upper to mid-shore cave walls
JNCC 2004	LR.FLR.CvOv.AudCla	<i>Audouinella purpurea</i> and <i>Cladophora rupestris</i> on upper to mid-shore cave walls
1997 Biotope	LR.LR.Ov.RhoCv	<i>Rhodothamniella floridula</i> in upper littoral fringe soft rock caves

### 🔍 Description

Vertical and steeply-sloping upper walls at the entrances and inner reaches of upper to mid-shore caves that are partially sheltered from direct wave action characterized by a turf of the 'velvety'

red seaweed *Rhodochorton purpureum* (syn. *Audouinella purpurea*). Patches of green filamentous seaweed *Cladophora rupestris* can be present. The fauna is generally limited to limpets *Patella* spp., the wrinkle *Littorina saxatilis* and the barnacle *Semibalanus balanoides*, while they usually occur in low abundance. Filamentous or crust forming brown seaweeds may occur mixed with *Rhodochorton purpureum*, often becoming a zone in its own right (RhoPil) above the RhoCla biotope. Other shade-tolerant red seaweed such as *Catenella caespitosa* and *Lomentaria articulata* may occur (but at lower abundance), and where freshwater seepage occurs, *Ulva intestinalis* can form patches. Some variation in the species composition of the individual caves must be expected depending on local conditions. *Rhodochorton purpureum* can be the only seaweed present in caves on the Thanet coast in south-east England. This biotope is known to occur in hard rock caves in north-east England and chalk caves in south-east England. In hard rock caves, this biotope is generally found on the upper walls above the CvOv.ScrFa and CvOv.FaCr biotopes and beneath the biotopes dominated by green and/or brown crusts (CvOv.GCv; CvOv.RhoPil). In chalk caves, CvOv.RhoCla may cover the lower and upper walls while it is usually found below CvOv.GCv and/or CvOv.RhoPil (Information from Connor *et al.*, 2004). **Please note** that *Rhodochorton purpureum* is the accepted name for *Audouinella purpurea* and *Pleurocladia lacustris* is the accepted name for *Pilinia maritima*.

## ↓ Depth range

Upper shore, Mid shore

## 🏛️ Additional information

Both of the *Rhodochorton purpureum* (syn. *Audouinella purpurea*) biotopes LR.FLR.CvOv.RhoCla and CvOv.RhoPle are very similar cave habitats and both are dominated by *Rhodochorton purpurea*. While other macroalgae or algal films may also occur, *Rhodochorton purpureum* is the dominant species. Therefore, the following sensitivity review represents both biotopes. Where relevant, differences in the sensitivity of *Cladophora rupestris* or *Pleurocladia lacustris* (syn. *Pilinia maritima*) are highlighted.

## ✓ Listed By

- none -

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## Sensitivity review

### Sensitivity characteristics of the habitat and relevant characteristic species

The biotopes LR.FLR.CvOv.RhoCla and CvOv.RhoPil are dominated by the velvety growth of *Rhodochorton purpureum* (syn. *Audouinella purpurea*). In CvOv.RhoCla, *Cladophora rupestris* may be present while *Pleurocladia lacustris* (syn *Pilinia maritima*) occurs in CvOV.RhoPil. CvOV.RhoPil usually occurs above CvOV.RhoCla (Connor *et al.*, 2004). Grazers such as *Littorina saxatilis* and *Patella* spp. occur and probably graze the macroalgae and microalgae present in the biotope. The dominance of *Rhodochorton purpureum* probably depends on the correct environmental conditions of the cave or cliff walls, of light, moisture versus desiccation, and hence wave splash or spray, that prevents competition from other macroalgae (e.g. *Ulva*, *Fucus*) and overgrazing. The presence of these biotopes below the green algal film biotope (CvOv.GCv) but above faunal turf biotope (CvOV.ScaFa and CvOV.FaCr) suggests they occur in lower to upper littoral fringe or supralittoral conditions (see also Conway & Knaggs, 1966). Therefore, *Rhodochorton purpureum* is the dominant important characterizing species in both biotopes, and is used to indicate the sensitivity of the biotope in the following review. Where relevant, differences in the sensitivity of *Cladophora rupestris* or *Pleurocladia lacustris* (syn *Pilinia maritima*) are highlighted.

### Resilience and recovery rates of habitat

*Rhodochorton purpureum* (syn. *Audouinella purpurea*) has a triphasic life cycle that alternates between a gametophyte, tetrasporophyte and carposporophyte stage. The gametophyte and tetrasporophyte phases produce monospores, capable of replacing the parent plant. Gametophytes produce sexual spores (sperm and carpospores) while the tetrasporophyte produced tetraspores that give rise to gametophytes (Conway & Knaggs, 1966; Stegenga, 1978). All spores are typically non-motile. Growth and sporulation were greatest at high light intensities (up to 5000 lux) but lowest at low intensity (150 lux) (West, 1972). Vegetative growth was greatest in long day lengths, yet sporulation was greatest in short day lengths (e.g. winter months) (West, 1972). *Rhodochorton purpureum* spores attach to the substratum via a sticky rhizoid (Pearlmutter & Vadas, 1978). However, *Rhodochorton purpureum* can regenerate from fragmented filaments and vegetative growth (Pearlmutter & Vadas, 1978). In culture, regeneration was detected within 24-48 hrs, and new cells developed with 20 days in 89% of samples. Filaments may also be transported by grazers. Breeman & Hoeksema (1987) noted that grazers fragmented the thallus but more importantly, carried viable filaments through their digestive tracts and deposited them within their faeces, from which filaments could then grow. They also found small tufts of *Rhodochorton purpureum* on bare substratum growing from sticky detritus rich faecal pellets (Breeman & Hoeksema, 1987).

Little information on recruitment or the life history of *Pleurocladia lacustris* (syn *Pilinia maritima*) was found. Wilce (1966) suggested that it was more widespread and common than thought. It is seasonal in the Arctic (Wilce, 1966) present in the Arctic summer suggesting that it can recruit annually. Many species of epifauna, such as *Patella* spp. and *Littorina saxatilis* and polychaetes that may be associated with rock crevices, have long lived pelagic larvae and/or are highly motile as adults.

Information on the ecology of reproduction and propagation of the genus *Cladophora* is limited. Reproduction is achieved by the release of quadriflagellate zoospores and biflagellate isogametes ('swarmers') formed in the terminal cells of fronds. The life history consists of an isomorphic (indistinguishable except for the type of reproductive bodies produced) alternation of

gametophyte and sporophyte generations, the plants are dioecious (Burrows, 1991). Both zoospores and gametes can be found at most times of the year. Archer (1963, cited in Burrows, 1991) was unable to find any correlation between the time of reproduction, the state of tide or environmental conditions. These basal holdfasts may serve as resistant structures from which new growths can arise. Therefore, it is likely that *Cladophora rupestris* will have a considerable capacity for recovery. The species is widespread around the British Isles and Ireland, and may be found in reproductive condition all year round. Numerous motile 'swarmers' (reproductive propagules) are released and in the water column they can be dispersed over considerable distances. In addition to recruitment by swarmers, new growth may arise from the resistant multicellular branching rhizoids (van den Hoek, 1982) that may remain in situ. For instance, after the *Torrey Canyon* tanker oil spill in mid-March 1967, recolonization by sporelings of *Ulva* and *Cladophora* had colonized by the end of April (Smith, 1968).

**Resilience assessment.** Although *Rhodochorton purpureum* spores are non-motile, they are numerous. It can also be transported by fragmentation and by grazers. It is recorded from the eulittoral, the supralittoral and 'almost terrestrial' habitats with maritime influence (Conway & Knaggs, 1966). It is also widely distributed in the North East Atlantic (OBIS, 2016) and recorded from Chile, California, Washington and Alaska (West, 1972). Therefore, its life history and distribution suggests that it could recolonize suitable habitat rapidly, although no information on growth rates was found. Similarly, *Cladophora* spp. are probably an opportunistic species capable of rapid recruitment and growth. Although, no direct evidence on *Pleurocladia lacustris* was found, many Ectocarpales are opportunistic species. Therefore, recovery of the dominant species *Rhodochorton purpureum* is probably rapid, even after significant damage, and resilience has been assessed as **High**.

## Hydrological Pressures

	Resistance	Resilience	Sensitivity
<b>Temperature increase (local)</b>	<b>High</b> Q: Medium A: Medium C: Medium	<b>High</b> Q: High A: High C: High	<b>Not sensitive</b> Q: Medium A: Medium C: Medium

The percentage of plants of *Rhodochorton purpureum* sporulating was greatest at 10°C from Washington and Alaska, but greatest at 15°C in plants from California but plants from Chile sporulated between 10 and 15°C (West, 1972). But sporulation was 'strikingly' inhibited above or below these optima. Gametogenesis was greatest at 15°C but reduced below 10 (West, 1972). Tetrasporophytes survived at 25°C in the laboratory but exhibited aberrant growth (Stegenga, 1978). In the Shetland Isles, Conway & Knaggs (1966) recorded *Rhodochorton purpureum* along the top of cliffs 200 feet high, suggesting that it can tolerate supralittoral conditions, exposed to high summer temperatures and low winter temperatures. It is also widely distributed in the North East Atlantic, and occurs in California, suggesting that it would be resistant of an increase in temperature at the benchmark level within the UK. In addition, the biotopes occur in the darker or shaded areas of caves, protected from strong sunlight and, in the presumably humid or moist areas of caves, protected from desiccation due to the sun and the wind.

Fortes & Lüning (1980) and Lüning (1984) reported that *Cladophora rupestris* from Helgoland were able to survive at temperatures between 0 -28°C (for a period of a week), so the species is likely to tolerate the benchmark acute increase in temperature, the species is also characteristic of upper shore rock pools, where water and air temperatures are greatly elevated on hot days. The biotope CvOv.AudPil also occurs on the upper littoral level of cliffs, where it could receive heating from

sunlight. However, *Pleurocladia lacustis* is recorded from Devon Island in the Arctic, Greenland, Novaya Zemlya, south to the Baltic and the French Mediterranean (Wilce, 1966).

Overall, the important characterizing species are probably resistant of an increase in temperature at the benchmark level within the UK. Therefore, a resistance of **High** is recorded, so that resilience is also **High** and the biotope is assessed as **Not sensitive**.

### Temperature decrease (local)

**High**

Q: Medium A: Medium C: Medium

**High**

Q: High A: High C: High

**Not sensitive**

Q: Medium A: Medium C: Medium

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Overall, the important characterizing species are probably resistant of a decrease in temperature at the benchmark level within the UK. Therefore, a resistance of **High** is recorded, so that resilience is also **High** and the biotope is assessed as **Not sensitive**.

### Salinity increase (local)

**High**

Q: Medium A: Medium C: Medium

**High**

Q: High A: High C: High

**Not sensitive**

Q: Medium A: Medium C: Medium

*Rhodochorton purpureum* is recorded as an epiphyte on laminarian stipes in the subtidal, and a lithophyte under fucoids in the littoral, in caves in the littoral or littoral fringe, on cliffs and cliff tops in the supralittoral, and in a freshwater waterfall in a shallow cave (Shetland) (Conway & Knaggs, 1966; Connor *et al.*, 2004; Guiry & Guiry, 2015). In experiments, West (1972) noted that clones of *Rhodochorton purpureum* from the upper littoral showed little response to a change in salinity, and were able to sporulate at 10‰, and 20‰ but that clones from the mid-littoral showed the poorest ability to sporulate at the salinities tested (10, 20 and 30‰). Nevertheless, *Rhodochorton purpureum* found on cave walls is probably resistant of a wide range of salinities as it occupies a littoral fringe or supralittoral position on the shore.

*Cladophora rupestris* found in intertidal rock pools can withstand 5-30 psu (Jansson, 1974) and as the species is successful in the high intertidal zone it is likely that the species has a broad salinity tolerance (Dodds & Gudder, 1992). However, Thomas *et al.* (1988) found that, at extreme temperatures, *Cladophora rupestris* had a reduced salinity tolerance range, e.g. the most marked inhibition of photosynthesis occurred in conditions of low salinity (0 psu) and high temperatures (25 - 30°C). *Pleurocladia lacustris* was reported from the upper littoral of limestone shores, exposed to freshwater runoff and rainfall until the breakup of the ice sheet, after which conditions are fully marine (Wilce, 1966).

**Sensitivity assessment.** The important characterizing species are typical of upper littoral and supralittoral habitats. Therefore, they are probably exposed to a wide range of salinities, from running freshwater and rainfall, for fully marine and salt deposited by spray and splash, especially on cliffs. The biotopes are probably resistant of a change in salinity from full to reduced or low. Therefore, resistance is assessed as **High**, so that resilience is **High** and the biotope assessed as **Not sensitive**.

#### Salinity decrease (local)

**High**

Q: Medium A: Medium C: Medium

**High**

Q: High A: High C: High

**Not sensitive**

Q: Medium A: Medium C: Medium

*Rhodochorton purpureum* is recorded as an epiphyte on laminarian stipes in the subtidal, under fucoids in the littoral, in caves in the littoral or littoral fringe, on cliffs and cliff tops in the supralittoral, and in a freshwater waterfall in a shallow cave (Shetland) (Conway & Knaggs, 1966; Connor *et al.*, 2004; Guiry & Guiry, 2015). In experiments, West (1972) noted that clones of *Rhodochorton purpureum* from the upper littoral showed little response to a change in salinity, and were able to sporulate at 10‰, and 20‰ but that clones from the mid-littoral showed the poorest ability to sporulate at the salinities tested (10, 20 and 30‰). Nevertheless, *Rhodochorton purpureum* found on cave walls is probably resistant of a wide range of salinities as it occupies a littoral fringe or supralittoral position on the shore.

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**Sensitivity assessment.** The important characterizing species are typical of upper littoral and supralittoral habitats. Therefore, they are probably exposed to a wide range of salinities, from running freshwater and rainfall, for fully marine and salt deposited by spray and splash, especially on cliffs. The biotopes are probably resistant of a change in salinity from marine to reduced, or reduced to low. Therefore, resistance is assessed as **High**, so that resilience is **High** and the biotope assessed as **Not sensitive**.

#### Water flow (tidal current) changes (local)

**Not relevant (NR)**

Q: NR A: NR C: NR

**Not relevant (NR)**

Q: NR A: NR C: NR

**Not relevant (NR)**

Q: NR A: NR C: NR

Tidal influence in mid-littoral to supralittoral caves is probably is probably limited to the floor and



sides of the caves, and the upper walls and ceilings only receive spray and splash. However, water movement, splash, spray in caves are probably wave mediated rather than due to tidal streams. Therefore, the biotope is unlikely to be affected by water flow as described by the benchmark and the pressure is **Not relevant**.

### Emergence regime changes

**Low**

Q: **Low** A: **NR** C: **NR**

**High**

Q: **Low** A: **NR** C: **NR**

**Low**

Q: **Low** A: **Low** C: **Low**

*Rhodochorton purpureum* (syn. *Audouinella purpurea*) is recorded from s recorded as an epiphyte on laminarian stipes in the subtidal, and a lithophyte under fucoids in the littoral, in caves in the littoral or littoral fringe, on cliffs and cliff tops in the supralittoral, and in a freshwater waterfall in a shallow cave (Shetland) (Conway & Knaggs, 1966; Connor *et al.*, 2004; Guiry & Guiry, 2015). It is, therefore, found in a variety of emergence regimes. *Cladophora rupestris* is also recorded from the sublittoral fringe to the supralittoral (Connor *et al.*, 1997a) while *Pleurocladia lacustris* (syn *Pilinia maritima*) is primarily recorded from upper littoral or littoral fringe habitats (Wilce, 1966). However, the *Rhodochorton purpureum* dominated biotopes only occur in shaded areas of caves, sheltered from wave action, or on cliff faces, presumably moist and shaded enough to support the biotope. Changes in emergence will probably affect the degree of splash and spray, and, hence, moisture, desiccation and salinity experienced by the biotopes. Therefore, a change in wave exposure will probably affect the upper and lower extent of the biotopes, and result in loss of extent. Therefore, a resistance of **Low** is recorded. Resilience is probably **High** (albeit at Low confidence), therefore, a sensitivity of **Low** is recorded.

### Wave exposure changes (local)

**High**

Q: **Low** A: **NR** C: **NR**

**High**

Q: **High** A: **High** C: **High**

**Not sensitive**

Q: **Low** A: **Low** C: **Low**

These biotopes (CvOv.AudCla and CvOv.AudPil) occur on the entrances and inner reaches of upper to mid-shore caves that are partially sheltered from direct wave action, in moderately wave exposed to wave sheltered shores (Connor *et al.*, 2004). Wave surge, splash and spray keep the rock surface moist while the cave habitat maintains the humidity. AudPil can also occur on upper littoral cliffs. Changes in wave action will probably affect the degree of splash and spray, and, hence, moisture, desiccation and salinity experienced by the biotopes. Therefore, a change in wave exposure will probably affect the upper and lower extent of the biotopes, and result in loss of extent. However, a 3-5% change in significant wave height is unlikely to be significant in wave exposed conditions. Therefore, the biotope is probably **Not sensitive** (resistance and resilience are **High**) at the benchmark level.

## Chemical Pressures

**Resistance**

**Not Assessed (NA)**

Q: **NR** A: **NR** C: **NR**

**Resilience**

**Not assessed (NA)**

Q: **NR** A: **NR** C: **NR**

**Sensitivity**

**Not assessed (NA)**

Q: **NR** A: **NR** C: **NR**

### Transition elements & organo-metal contamination

This pressure is **Not assessed** but evidence is presented where available.

**Hydrocarbon & PAH contamination**

Not Assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

**Synthetic compound contamination**

Not Assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

Smith (1968) reported *Cladophora rupestris* to be amongst algae of unhealthy appearance following exposure to oil dispersants. O'Brien & Dixon (1976) suggested that red algae were the most sensitive group of algae to oil or dispersant contamination. Laboratory studies of the effects of oil and dispersants on several red algal species concluded that they were all sensitive to oil/dispersant mixtures, with little difference between adults, sporelings, diploid or haploid stages (Grandy, 1984, cited in Holt *et al.*, 1995). In addition, Cole *et al.* (1999) suggested that the herbicides Atrazine, Simazine, Diuron, Linuron and the insecticide Dimethoate were probably very toxic to algae.

**Radionuclide contamination**

No evidence (NEv)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence

**Introduction of other substances**

Not Assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

This pressure is **Not assessed**.

**De-oxygenation**

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

The littoral fringe and supralittoral and cave ceilings are rarely inundated and are, therefore, permanently exposed to the air. The biotope is unlikely to be exposed to deoxygenated conditions.

**Nutrient enrichment**

No evidence (NEv)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

Maritime cliff plant and algae communities are probably nutrient poor, i.e. lack nutrients. An increase in nutrients in the form of runoff from adjacent agricultural land may benefit the communities. The opportunistic filamentous algae such as *Ulothrix* sp. and *Urospora* sp. may overgrow these biotopes. However, no evidence concerning the effects of nutrient enrichment on these communities was found.

**Organic enrichment**

No evidence (NEv)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

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## A Physical Pressures

	Resistance	Resilience	Sensitivity
Physical loss (to land or freshwater habitat)	<b>None</b> Q: High A: High C: High	<b>Very Low</b> Q: High A: High C: High	<b>High</b> Q: High A: High C: High

All marine habitats and benthic species are considered to have a resistance of '**None**' to this pressure and to be unable to recover from a permanent loss of habitat (resilience is '**Very Low**'). Sensitivity within the direct spatial footprint of this pressure is, therefore '**High**'. Although no specific evidence is described confidence in this assessment is '**High**', due to the incontrovertible nature of this pressure.

	Resistance	Resilience	Sensitivity
Physical change (to another seabed type)	<b>None</b> Q: High A: High C: High	<b>Very Low</b> Q: High A: High C: High	<b>High</b> Q: High A: High C: High

These biotopes require hard or soft rock substrata. A change to a sedimentary substratum, however unlikely, would result in the permanent loss of the biotope. Therefore, the biotope has a resistance of **None**, with a **Very low** resilience (as the effect is permanent) and, therefore, a sensitivity of **High**. Although no specific evidence is described confidence in this assessment is '**High**', due to the incontrovertible nature of this pressure.

	Resistance	Resilience	Sensitivity
Physical change (to another sediment type)	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

**Not Relevant** on hard rock biotopes. Where present, it is unlikely that chalk would be replaced by sediment in the littoral fringe or supralittoral. Therefore, this pressure is **Not relevant**. However, change in substratum type is address above.

	Resistance	Resilience	Sensitivity
Habitat structure changes - removal of substratum (extraction)	<b>None</b> Q: High A: High C: High	<b>High</b> Q: Low A: NR C: NR	<b>Medium</b> Q: Low A: Low C: Low

Extraction of sediment, as described under this pressure, is **not relevant** in hard rock habitats. However, soft rocks could suffer extraction due to tunnelling, mining or construction. Therefore, removal of chalk from the cliff or caves would remove the surface resulting in loss of the biotope. Resistance would, therefore, be **None** where it occurs on chalk or other soft rocks. But if the existing substratum (chalk) remains in the same habitat (upper littoral fringe to supralittoral) then the biotope would recover rapidly and resilience is probably **High**, therefore, sensitivity to extraction is probably **Medium**.

**Abrasion/disturbance of the surface of the substratum or seabed****Low**Q: **Low** A: **NR** C: **NR****High**Q: **Low** A: **NR** C: **NR****Low**Q: **Low** A: **Low** C: **Low**

The characterizing species are filamentous, lithophytes, and probably fairly soft and fragile. These algal communities are likely to be removed as a result of any abrasion, e.g. from vessel grounding, the abrasion from chains or cables, or recreational access and trampling, especially where the friable (e.g. chalk) rock surface is removed. Therefore, resistance is probably **Low** (depending on the scale of the impact). However, recovery is likely to be rapid if suitable substratum remains so that resilience is probably **High** and sensitivity is probably **Low**.

**Penetration or disturbance of the substratum subsurface****Low**Q: **Low** A: **NR** C: **NR****High**Q: **Low** A: **NR** C: **NR****Low**Q: **Low** A: **Low** C: **Low**

Penetration by mobile fishing gear is unlikely to occur in caves or on vertical chalk cliffs. However, soft rock, by definition, can be damaged by other penetrative activities, for example during construction. Therefore, where these biotopes occur on chalk (e.g. CvOv.AudPil) resistance is probably **Low** (depending on the scale of the impact). However, recovery is likely to be rapid if suitable substratum remains so that resilience is probably **High** and sensitivity is probably **Low**.

**Changes in suspended solids (water clarity)****Not relevant (NR)**Q: **NR** A: **NR** C: **NR****Not relevant (NR)**Q: **NR** A: **NR** C: **NR****Not relevant (NR)**Q: **NR** A: **NR** C: **NR**

This biotope occurs in mid to upper littoral and littoral fringe and reaches upper walls of caves, probably only exposed to wave splash and rarely inundated. Therefore, an increase in turbidity due to suspended solids (at the benchmark) is unlikely to adversely affect the biotope and **Not relevant** is recorded.

**Smothering and siltation rate changes (light)****Medium**Q: **Low** A: **NR** C: **NR****High**Q: **Low** A: **NR** C: **NR****Low**Q: **Low** A: **Low** C: **Low**

The upper, vertical walls of caves are unlikely to be subject to smothering, but the inner reaches of caves with shallow slopes or horizontal ledges may be. In the wave exposed conditions experienced by this biotope, 5 cm of sediment may be removed quickly from the entrance but may persist in the inner reaches of the cave, depending on the shape of the cave. The fine 'velvety' mat of *Rhodochorton purpureum*, filaments of *Cladophora rupestris* or *Pleurocladia lacustris* may trap sediment and result in localised anoxia near the base of the plant. This may cause death, where the slope of the rock is sufficient for sediment to be deposited and the wave action so limited that sediment is not removed quickly. It is possible, therefore, that a proportion of the biotope (on shallow sloping or horizontal surfaces) could be lost and a resistance of **Medium** is recorded. Resilience is probably **High**, so that a sensitivity of **Low** is suggested, albeit at **Low** confidence.

**Smothering and siltation rate changes (heavy)****Medium**Q: **Low** A: **NR** C: **NR****High**Q: **Low** A: **NR** C: **NR****Low**Q: **Low** A: **Low** C: **Low**

The upper, vertical walls of caves are unlikely to be subject to smothering, but the inner reaches of

caves with shallow slopes or horizontal ledges may be. In the wave exposed conditions experienced by this biotope, sediment may be removed quickly from the entrance but may persist in the inner reaches of the cave, depending on the shape of the cave. The fine 'velvety' mat of *Rhodochorton purpureum*, filaments of *Cladophora rupestris* or *Pleurocladia lacustris* may trap sediment and result in localised anoxia near the base of the plant. This may cause death, where the slope of the rock is sufficient for sediment to be deposited and the wave action so limited that sediment is not removed quickly. It is possible, therefore, that a proportion of the biotope (on shallow sloping or horizontal surfaces) could be lost and a resistance of **Medium** is recorded. Resilience is probably **High**, so that a sensitivity of **Low** is suggested, albeit at **Low** confidence.

<b>Litter</b>	<b>Not Assessed (NA)</b>	<b>Not assessed (NA)</b>	<b>Not assessed (NA)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**Not assessed.** Caves, especially high on the shore, may accumulate litter blown into the cave by the wind. Large pieces of marine debris blown around by wind or wave action may cause abrasion of the cave wall communities (see above). However, **No evidence** on the effects of litter was found.

<b>Electromagnetic changes</b>	<b>No evidence (NEv)</b>	<b>Not relevant (NR)</b>	<b>No evidence (NEv)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**No evidence** was found.

<b>Underwater noise changes</b>	<b>Not relevant (NR)</b>	<b>Not relevant (NR)</b>	<b>Not relevant (NR)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

No relevant

<b>Introduction of light or shading</b>	<b>Medium</b>	<b>High</b>	<b>Low</b>
	Q: Low A: NR C: NR	Q: Low A: NR C: NR	Q: Low A: Low C: Low

Red algae are more shade tolerant than their green or brown equivalents. West (1972) noted that vegetative growth and gametogenesis of *Rhodochorton purpureum* was greatest in long day lengths (summer months), that sporulation and growth were greatest at highest light intensity tested (5000 lux), yet spermatangia and carpogonia production was greatest in short days (winter months), but concluded that the observations were not true photoperiodism. It may be that long summer days promote growth and asexual reproduction while short days and winter months promote sexual reproduction. No evidence on the effects of light on the other characteristic species was found.

These biotopes are characteristic of shaded or dark, moist caves, presumably because green algae would out-compete the dominant species at higher light levels. If artificial lighting was introduced to a cave where this biotope occurred, then it might adversely affect the biotopes by promoting green algal growth. Increased shaded might allow the biotope to increase in extent, or reduce light levels below those needed for the algae to survive. Therefore, a resistance of **Medium** is suggested at **Low** confidence. However, resilience is probably **High**, so that sensitivity is **Low**.

<b>Barrier to species movement</b>	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

Not relevant

<b>Death or injury by collision</b>	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

The pressure definition is not directly applicable to caves, so **Not relevant** has been recorded. Collision via ship groundings or terrestrial vehicles is possible but the effects are probably similar to those of abrasion above.

<b>Visual disturbance</b>	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**Not relevant** has been recorded.

## Biological Pressures

### Resistance

### Resilience

### Sensitivity

<b>Genetic modification &amp; translocation of indigenous species</b>	No evidence (NEv)	Not relevant (NR)	No evidence (NEv)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**No evidence** was found to suggest that the macroalgae that characterize these biotopes were subject to translocation, nor that they were subject to genetic modification or hybridization with other similar species.

<b>Introduction or spread of invasive non-indigenous species</b>	No evidence (NEv)	Not relevant (NR)	No evidence (NEv)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**No evidence** was found

<b>Introduction of microbial pathogens</b>	No evidence (NEv)	Not relevant (NR)	No evidence (NEv)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**No evidence** was found.

<b>Removal of target species</b>	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

The algal communities characteristic of these biotopes are unlikely to be targeted by any commercial or recreational fishery or harvest.

**Removal of non-target species**

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Incidental removal the dominant characteristic species would result in loss of the entire biotope. Where present, mobile invertebrate or gastropod fauna are probably not entirely dependent on the biotope for food or habitat and would forage elsewhere. However, soft rock and hard rock cave communities are unlikely to be targetted by any commercial or recreational fishery or harvest. Accidental physical disturbance due to access (e.g. trampling) or grounding is examined under abrasion above.

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