Blidingia spp. on vertical littoral fringe soft rock

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

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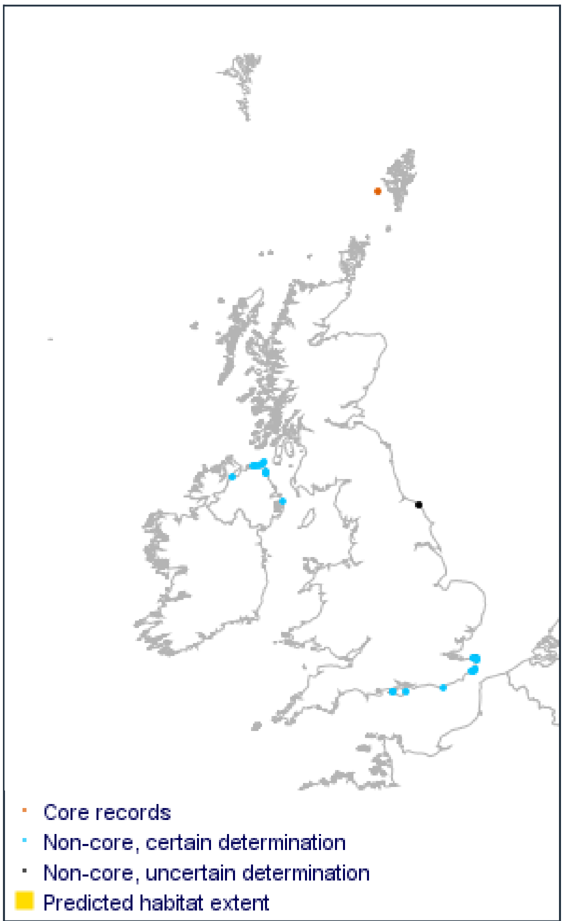

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by Dr Harvey Tyler-Walters **Refereed by** Admin

Summary

UK and Ireland classification

EUNIS 2008	B3.114	*Blidingia* spp. on vertical littoral fringe chalk
JNCC 2015	LR.FLR.Lic.Bli	Blidingia spp. on vertical littoral fringe soft rock
JNCC 2004	LR.FLR.Lic.Bli	*Blidingia* spp. on vertical littoral fringe soft rock
1997 Biotope	LR._.L.Bli	*Blidingia spp.* on vertical littoral fringe soft rock

Description

Vertical soft rock in the littoral fringe may be characterized by a green band of *Blidingia minima*. It is usually found below the *Verrucaria* zone (Ver) and above a band of the similar looking green alga *Ulva* spp. (Eph). Other filamentous green algae, including *Ulothrix* spp. and *Urospora* spp., are found amongst the *Blidingia*. During low tide terrestrial mites, insects and centipedes migrate into this zone. (Information from Connor et al., 1997b, 2004).

Depth range

Upper shore

Additional information

-

Listed By

- none -

Further information sources

Search on:

G G G JNCC

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

This biotope is dominated by *Blidingia* spp. (*Blidingia minima* and *Blidingia marginata*) on steep to vertical bedrock faces. Unbranched filamentous green seaweeds, including *Ulothrix flacca* and *Urospora wormskioldii*, are found amongst the *Blidingia* spp but may also occur as a band above the *Blidingia* band (see Lic.UloUro). *Ulva* spp. occur lower on the shore, while upper littoral fringe is dominated by *Verrucaria* biotopes (Lic.Ver) (Connor *et al*., 2004). Terrestrial mites, centipedes, and spiders probably move across this biotope and throughout the littoral fringe. *Blidingia* spp. is the dominant and only important characteristic species in the biotope, which if lost would result in loss of the biotope. Therefore, the sensitivity of the biotope is based on the sensitivity of *Blidingia* spp. The sensitivity of *Ulothrix flacca* and *Urospora wormskioldii* is discussed under Lic.UloUro.

Resilience and recovery rates of habitat

Blidingia minima and *B. marginata* are both widely distributed around the coasts of Britain and Ireland (Burrows, 1991; Brodie *et al*., 2007). *Blidingia minima* is recorded from Spitzbergen, Svalbard to the Mediterranean and the Adriatic Sea in European coasts, the Atlantic and Pacific coasts of the Americas, South Africa, Japan, and South Island, New Zealand (Burrows, 1991; Tatewaki & Lima, 1984; OBIS 2016). *Blidingia marginata* is recorded from Norway to Portugal and the Mediterranean in the European Atlantic, and along the Atlantic coast of America form the Canadian Arctic to Connecticut and New Jersey, Bermuda, South America, South Africa, Japan and New Zealand (Burrows, 1991; OBIS, 2016).

Sexual reproduction is not recorded in *Blidingia* spp. in the UK (Brodie *et al*., 2007). Reproduction in *Blidingia minima* and *B. marginata* is asexual (by apomixis) and results in numerous quadriflagellate zoospores that settle to form a small disc from which a new plant grows but biflagellate swarmers are formed occasionally (Burrows, 1991; Brodie *et al*., 2007). *Blidingia marginata* reproduces throughout the years with a succession of generations forming only zoospores (Burrows, 1991) and is most abundant in winter and spring (Brodie *et al*., 2007). *Blidingia minima* also reproduces throughout the year but develops best in the spring and summer months (Burrows, 1991). However, Tatewaki & Lima (1984) reported four separate life histories in *Blidingia minima* in Japan; one involving a heteromorphic sexual and asexual phases, another involving sporophyte and sexual gametophyte stages, and two different asexual life histories.

Blidingia marginata is amongst the first species to colonize cleared substrata in the upper littoral (Brodie *et al*., 2007) and the other *Blidingia* spp. are likely to be rapid colonizers. Hruby & Norton (1979) reported that the zoospores of *Blidingia*, *Ulva* (as *Enteromorpha*) and *Ulothrix/Urospora* were the most abundant in the water column between April and February along the rocky shores of the Firth of Clyde. For example, hundreds (between 136 and 675) of *Blidingia minima* plants grew from only 400 ml of water in November at two out of three sites, although there was considerable variation between sites (Hruby & Norton, 1979). *Blidingia minima* was one of four species to show the highest colonization densities on glass slides placed in the littoral for seven days, although there was considerable variation between sites. Survival was dependent on environmental conditions, e.g. temperature, insolation and rainfall and lower colonization densities were found higher on the shore (at 2.89 m rather than at 2.49 m) (Hruby & Norton, 1979).

Resilience assessment. *Blidingia* spp., like most Ulvales, are opportunistic, rapid colonizing species with a high fecundity and short life cycle that grow rapidly on a wide range of substrata. Therefore, even where the species was removed, it could probably recolonize and return to its original abundance within a year. Hence, resilience is assessed as **High** (<2 years).

Hydrological Pressures

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

Blidingia minima and *B. marginata* are both widely distributed around the coasts of Britain and Ireland (Burrows, 1991; Brodie *et al.*, 2007). *Blidingia minima* is recorded from Spitzbergen, Svalbard to the Mediterranean and the Adriatic Sea in European coasts, the Atlantic and Pacific coasts of the Americas, South Africa, Japan, and South Island, New Zealand (Burrows, 1991; Tatewaki & Lima, 1984; OBIS 2016). *Blidingia marginata* is recorded from Norway to Portugal and the Mediterranean in the European Atlantic, and along the Atlantic coast of America from the Canadian Arctic to Connecticut and New Jersey, Bermuda, South America, South Africa, Japan and New Zealand (Burrows, 1991; OBIS, 2016).

Prange (1978) reported that the abundance of *Blidingia minima* var. *subsalsa* in the Squamish River estuary, British Columbia was correlated with brackish waters, high light intensity, high temperatures (20°C), moderate desiccation, and possibly favourable nutrient concentrations. The upper limit of its distribution was determined by either heavy rain or extreme desiccation.

Sensitivity assessment. This biotope is characteristic of the littoral fringe, where it is rarely inundated, but exposed to direct sunlight for prolonged periods, warm weather in summer and frost and ice in winter. *Blidingia minima* and *B. marginata* are widely distributed to the north and south of the British Isles and are unlikely to be affected by chronic (2°C for a year) increases in temperature. A short-term 5°C increase in air temperature is likely to increase desiccation, especially in summer, and result in increased bleaching and dehydration of the thallus. However, the species probably exhibits adaptation and acclimation to local conditions and is unlikely to be affected adversely by an increase in temperature at the benchmark level. Therefore, a resistance of **High** is suggested so that resilience is also **High** and the biotope is assessed as **Not sensitive** at the benchmark level.

	Resistance	Resilience	Sensitivity
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

Blidingia minima and *B. marginata* are both widely distributed around the coasts of Britain and Ireland (Burrows, 1991; Brodie *et al.*, 2007). *Blidingia minima* is recorded from Spitzbergen, Svalbard to the Mediterranean and the Adriatic Sea in European coasts, the Atlantic and Pacific coasts of the Americas, South Africa, Japan, and South Island, New Zealand (Burrows, 1991; Tatewaki & Lima, 1984; OBIS 2016). *Blidingia marginata* is recorded from Norway to Portugal and the Mediterranean in the European Atlantic, and along the Atlantic coast of America from the Canadian Arctic to Connecticut and New Jersey, Bermuda, South America, South Africa, Japan and New Zealand (Burrows, 1991; OBIS, 2016).

Prange (1978) reported that the abundance of *Blidingia minima* var. *subsalsa* in the Squamish River estuary, British Columbia was correlated with brackish waters, high light intensity, high temperatures (20°C), moderate desiccation, and possibly favourable nutrient concentrations.

Temperature, salinity, and nutrient levels interacted strongly. The lowest photosynthetic rates were recorded at 5°C and 0.25‰ irrespective of N and P concentrations. Therefore, a reduction in temperature is likely to reduce photosynthesis and, hence, growth if salinity and nutrient levels were constant (Prange, 1978). But *Blidingia minima* was reported to persist through the winter months encased in ice in the Arctic Sea and to resume development when the ice melted (Burrows, 1991).

Sensitivity assessment. This biotope is characteristic of the littoral fringe, where it is rarely inundated, but exposed to direct sunlight for prolonged periods, warm weather in summer and frost and ice in winter. *Blidingia minima* and *B. marginata* are widely distributed to the north and south of the British Isles and are unlikely to be affected by chronic (2°C for a year) increases in temperature. A short-term 5°C decrease in air temperature is likely to reduce growth in winter, and the fronds are probably subject to frost in the winter months. However, the species probably exhibits adaptation and acclimation to local conditions and is unlikely to be affected adversely by a decrease in temperature at the benchmark level. Therefore, a resistance of **High** is suggested so that resilience is also **High** and the biotope is assessed as **Not sensitive** at the benchmark level.

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

This biotope (Lic.Bli) is recorded from 'full' and 'variable' salinity (Connor *et al.*, 2004). *Blidingia minima* is recorded from the upper littoral and supralittoral, in harbours on artificial structures and pontoons, and sea walls, in estuaries from brackish water to almost freshwater conditions (Fletcher, 1980b; Tittley & Shaw,1980; Burrows, 1991, Brodie *et al.*, 2007). *Blidingia marginata* is recorded from steep rock faces, stones, artificial surfaces in harbours, on mud and in salt marshes and into estuaries (Burrows, 1991; Brodie *et al.*, 2007). Brodie *et al.* (2007) suggested that *Blidingia marginata* tolerated a wide salinity range.

Prange (1978) suggested that the distribution of *Blidingia minima* var. *subsalsa* in the Squamish River estuary, British Columbia was limited by 'high salinity on the marine side' and the 'absence of seawater on the freshwater side'. Temperature, salinity, and nutrient levels interacted strongly. The highest photosynthetic rates occurred at 20°C, 20‰, and high nutrient levels, which were associated in the Squamish River estuary with low runoff and emersion in summer in areas of nutrient enrichment or tide pools. The lowest photosynthetic rates were recorded at 5°C and 0.25‰ irrespective of N and P concentrations, which were associated with high runoff and rainfall while emersed in winter (Prange, 1978).

Sensitivity assessment. An increase in salinity at the benchmark level could expose the biotope to hypersaline conditions. No direct evidence of the effects of hyposaline conditions was found. However, the littoral fringe is probably exposed to a wide range of salinities due to the evaporation of seawater from splash and spray, and direct rainfall or freshwater runoff. Therefore, the biotope is likely to be resistant of changes in salinity. The occurrence of the characteristic species in supralittoral pools and salt marshes also suggests they could resist hypersaline conditions. Therefore, a resistance of **High** is suggested so that resilience is also **High** and the biotope is assessed as **Not sensitive** at the benchmark level.

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

This biotope (Lic.Bli) is recorded from 'full' and 'variable' salinity (Connor *et al.*, 2004). *Blidingia minima* is recorded from the upper littoral and supralittoral, in harbours on artificial structures and pontoons, and sea walls, in estuaries from brackish water to almost freshwater conditions (Fletcher, 1980b; Tittley & Shaw,1980; Burrows, 1991, Brodie *et al.*, 2007). *Blidingia marginata* is recorded from steep rock faces, stones, artificial surfaces in harbours, on mud and in salt marshes and into estuaries (Burrows, 1991; Brodie *et al.*, 2007). Brodie *et al.* (2007) suggested that *Blidingia marginata* tolerated a wide salinity range.

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Sensitivity assessment. A decrease in salinity at the benchmark level could expose the biotope to 'reduced (18-30) conditions. The characterizing species are recorded from estuarine, brackish and nearly freshwater conditions so the biotope is likely to be resistant of changes in salinity. The species probably exhibit adaptation and acclimation to local conditions, and local strains that prefer marine conditions may be replaced by strains that prefer reduced salinity, and the relative abundance of *Blidingia minima* and *B. marginata* may change but the biotope remain. Therefore, a resistance of **High** is suggested so that resilience is also **High** and the biotope is assessed as **Not sensitive** at the benchmark level.

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

Mathieson *et al.* (1983) recorded *Blidingia minima* on bridge piers in ca 1.6 - 2 knots (ca 0.8 - 1 m/s) in an estuarine tidal rapid. However, the littoral fringe is unlikely to be affected by changes in water flow as described in the pressure benchmark as it is rarely inundated. Runoff due to heavy rainfall is possible but is outside the scope of the pressure. Therefore, the pressure is **Not relevant.**

Emergence regime changes	Low Q: Medium A: Medium C: Medium	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

Water retention and wetting are probably vital to the survival of this biotope where wave action supplies the water to the littoral fringe in the form of wave splash and spray. The vertical extent of the biotope is probably determined by wave action (via spray and splash) and in turn the emergence regime. Prange (1978) noted that the upper limit of the distribution of *Blidingia minima* was determined by either heavy rain or extreme desiccation and Burrows (1991) noted that *Blidingia marginata* was able to remain dry for long periods under 'unfavourable moisture conditions'. Hruby & Norton (1979) reported that 60-100% of propagules of Blidingia minima survived ca 8 to 12 hours of submersion per tidal cycle after 1-3 weeks in a tidal simulator but only 20-59% survived ca 5.5- 8 hours and 1-19% survived 4.5-5 hours of submersion. Survival was increased if the propagules were cultured for 14 days before being placed in the simulator. For example, after 10 weeks in culture, *Blidingia minima* disappeared from plates submerged for less than 4.7 hr per cycle but sporelings (cultured for 14 days beforehand) grew on plates 2 mm above the level of total emersion (Hruby & Norton, 1979; Figure 2). Therefore, the species resistance to emergence increases with age.

Sensitivity assessment. This biotope is recorded below the Lic.UloUro and LIc.Ver bands and above the *Ulva* (syn. *Enteromorpha*) band in the littoral fringe. The upper limit of the biotope is probably determined by desiccation and, hence, emergence regime, depending on wave splash and season. A change in emergence will result in a reduction in the upper limit or increased competition at its lower limit. Therefore, a proportion of the biotope will be lost but recover quickly so that biotope moves up or down the shore. Therefore, a resistance of **Low** is recorded. As resilience is probably **High**, sensitivity is assessed as **Low**.

Wave exposure changes (local)	High Q: Medium A: Medium C: Medium	High Q: High A: High C: High	Not sensitive Q: Medium A: Medium C: Medium

Water retention and wetting are probably vital to the survival of this biotope where wave action supplies the water to the littoral fringe in the form of wave splash and spray. The vertical extent of the biotope is probably determined by wave action (via spray and splash), especially on steep or vertical faces. For example, Fletcher (1980b) noted that the vertical height of the green algal band on artificial substrata (pontoons) in Langstone harbour was greater in areas subject to wave exposure when compared to the sheltered inner reaches of the harbour. Therefore, a decrease in wave exposure is likely to reduce the vertical extent of the biotope, while an increase in wave exposure may increase its extent, depending on competition from other green algae. 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	Resilience	Sensitivity
Transition elements & organo-metal 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.

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.

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 found.

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 is rarely inundated and this biotope is probably exposed to the air for the majority of the time. Even if the water lapping over the littoral fringe was deoxygenated, wave action and turbulent flow over the rock surface would probably aerate the water column. Hence, the biotope is unlikely to be exposed to deoxygenated conditions.

Nutrient enrichment	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not sensitive Q: NR A: NR C: NR

Fletcher (1996) listed *Blidingia minima* as a species characteristic of eutrophic waters. Therefore, the biotope might benefit from eutrophication. However, this biotope is considered to be **Not sensitive** at the pressure benchmark that assumes compliance with good status as defined by the WFD.

Organic enrichment	High Q: Medium A: Medium C: Medium	High Q: High A: High C: High	Not sensitive Q: Medium A: Medium C: Medium

Opportunistic green algae are reported to flourish in nutrient enriched conditions (Fletcher, 1996). Organic enrichment will result in the release of nutrients due to bacterial decomposition and, so, may lead to an increase in green algal cover. Organic enrichment may occur on cliffs due to runoff from agricultural land and may benefit the biotope. Therefore, the biotope is considered to be **Not sensitive** (resistance and resilience are **High**).

Physical Pressures

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

Physical change (to another seabed type)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

Blidingia minima and *B. marginata* can occur on saltmarsh plants, on mud and on artificial substrata (Brodie *et al*., 2007). However, this biotope is characteristic of hard rock or soft rock (chalk) 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.

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

Blidingia minima and *B. marginata* can occur on saltmarsh plants, on mud and on artificial substrata (Brodie *et al*., 2007). However, this biotope is characteristic of hard rock or soft rock (chalk) substrata. Therefore, a change in sediment type is **Not relevant**.

Habitat structure changes - removal of substratum (extraction)	None Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

This biotope is characteristic of hard rock or soft rock (chalk) substrata. Removal of the substratum is not relevant where the biotope occurs on hard bedrock. However, chalk habitats can be subject to landslides but also direct extraction as a result of tunnelling or other construction activities. Removal of the substrata would remove the biotope from the affected area. Therefore, a resistance of **None** is recorded. However, where suitable habitat remains (e.g chalk or hard rock surface) or where artificial hard substrata are introduced, the characteristic species could colonize the habitat quickly, and resilience is probably **High**. Therefore, sensitivity is assessed as **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

This biotope is probably overlooked and included under 'green algae', therefore, little direct evidence on the effect of abrasion was found. The characteristic species are probably a component of the 'green algae' regularly cleaned from jetties, pontoons, and slipways. In experimental trampling studies, Fletcher & Frid (1996a&b) noted that the abundance of *Ulva* spp. (as *Enteromorpha*) was routinely greater in trampled rather than un-trampled areas. This suggested that opportunistic algae were able to colonize the bare space created by trampling, and benefited from the reduced abundance of other macroalgae. Overall, *Blidingia minima* and *B. marginata* are not physically robust and are probably removed easily from the rock surface, except in cracks and fissures protected from abrasion, so the resistance is probably **Low**. Vertical surfaces are probably protected from trampling except in areas subject to climbing. However, resilience is probably **High** and sensitivity is assessed as **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 of hard rock (as described by the pressure definition) is 'Not relevant'. However, soft rock may be tunnelled into or removed by construction activities. Removal of the rock surface would result in loss of the biotope from the affected area (as above). Therefore, resistance is assessed as **Low**. As resilience is likely to be **High** sensitivity is assessed as **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

The littoral fringe or supralittoral are rarely inundated. It is, therefore, unlikely to be exposed to changes in water clarity due to changes in suspended sediment.

Smothering and siltation rate changes (light)	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

Smothering could occur because of rainwater runoff of silt and soil from the tops of the cliffs. However, where the biotope occurs on vertical or steep cliffs the slope would preclude the build-up of significant deposits (except on crevices and pits) sufficient to block the algal communities access to sunlight. Therefore, the factor is probably **Not relevant** at the level of the benchmark.

Smothering and siltation rate changes (heavy)	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

Smothering could occur because of rainwater runoff of silt and soil from the tops of the cliffs. However, where the biotope occurs on vertical or steep cliffs the slope would preclude the build-up of significant deposits (except on crevices and pits) sufficient to block the algal communities access to sunlight. Therefore, the factor is probably **Not relevant** at the level of the benchmark.

Litter	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

Not assessed.

Electromagnetic changes	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 was found.

Underwater noise changes	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. The biotope is rarely underwater and macroalgae are not known to respond to noise.

Introduction of light or shading	Medium Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

The littoral fringe is rarely submerged. Therefore, the species that characterize this biotope are probably adapted to prolonged exposure to sunlight, and unlikely to be affected by introduced artificial light. Prange (1979) suggested that the lower limit of *Blidingia minima* was determined by low light intensities. However, its lower limit is probably also determined by grazing pressure from littorinids (Lein, 1980). Prolonged or permanent shading (e.g. from an artificial structure) is undoubtedly detrimental to macroalgal growth, and may result in the replacement of the biotope by a cave biotope. Norton *et al.* (1971) noted that *Ulva* sp. penetrated ca 5 m into a sea cave near Lough Ine. Anand (1937b) noted that his *Enteromorhpa* belt (that may have included *Blidingia minima*) penetrated into chalk sea caves but stopped abruptly at 8 m from the entrance. Anand (1937c) reported that *Ulva* (as *Enteromorpha*) in caves required about 5-6% of the external illumination. Therefore, only prolonged shading may be detrimental but the presence of Lic.Bli on exposed cliff faces suggests that it may be out-competed in shaded areas. Therefore, a resistance of **Medium** is suggested, with **Low** confidence. Resilience is likely to be **High** so that sensitivity is assessed a **Low**.

Barrier to species movement	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. This pressure is considered applicable to mobile species, e.g. fish and marine mammals rather than seabed habitats. Physical and hydrographic barriers may limit the dispersal of spores. But spore dispersal is not considered under the pressure definition and benchmark.

Death or injury by collision	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 pressure definition is not directly applicable to the littoral fringe 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.

Visual disturbance	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. Macroalgae respond to light intensity but are unlikely to respond to 'visual' cues.

Biological Pressures

	Resistance	Resilience	Sensitivity
Genetic modification & translocation of indigenous species	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 of the translocation, breeding or species hybridization was found.

Introduction or spread of invasive non-indigenous species	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 direct evidence on the effect of non-native species on this biotope was found. However, this assessment should be revisited in the light of new evidence.

Introduction of microbial pathogens	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 on disease or pathogens mediated mortality was found.

Removal of 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

The algal community characteristic of this biotope is unlikely to be targetted 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 of the algal mat would probably remove the entire belt rather than specific characteristic species. Where present, mobile invertebrate fauna are probably not entirely dependent on the 'belt' for food or habitat and would forage elsewhere. However, this algal community is 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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