Ulothrix flacca and *Urospora* spp. on freshwater-influenced vertical littoral fringe soft rock

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

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2016-03-04

A report from:
The Marine Life Information Network, Marine Biological Association of the United Kingdom.

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This review can be cited as:
Tyler-Walters, H., 2016. [Ulothrix flacca] and [Urospora] spp. on freshwater-influenced vertical littoral fringe soft rock. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. DOI https://dx.doi.org/10.17031/marlinhab.235.1

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Ulothrix flacca **and** ***Urospora spp.*** **on freshwater-influenced vertical littoral fringe soft rock**
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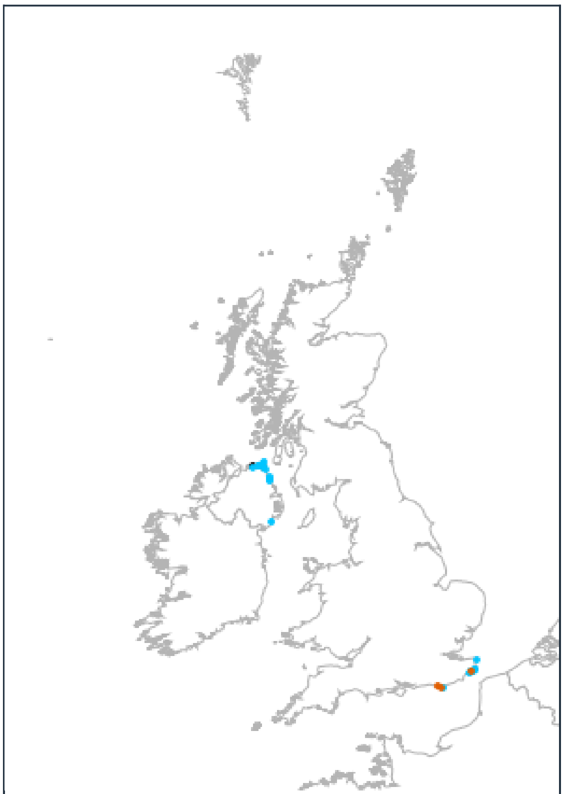

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

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

Summary

UK and Ireland classification

EUNIS 2008	B3.115	*Ulothrix flacca* and *Urospora* spp. on freshwater-influenced vertical littoral fringe soft rock
JNCC 2015	LR.FLR.Lic.UloUro	*Ulothrix flacca* and *Urospora* spp. on freshwater-influenced vertical littoral fringe soft rock
JNCC 2004	LR.FLR.Lic.UloUro	*Ulothrix flacca* and *Urospora spp*. on freshwater-influenced vertical littoral fringe soft rock
1997 Biotope	LR._.L.UloUro	*Ulothrix flacca* and *Urospora spp*. on freshwater-influenced vertical littoral fringe soft rock

Description

An assemblage of the small unbranched filamentous green seaweeds *Ulothrix flacca*, *Urospora penicilliformis* and *Urospora wormskioldii* at High Water Spring Tide level on steep and vertical rock often influenced by freshwater. The community is also present in areas with freshwater seepage. It is visually recognised as a closely adherent, often shiny, green mat of filamentous growth. Associated species include the green seaweeds *Blidingia minima* and *Ulva prolifera*, the barnacle *Semibalanus balanoides* and the limpet *Patella vulgata*, but these species are not common. Although this biotope does occur on rock other than chalk, this description has been derived from chalk coast sites.

On chalk coasts, this community can include *Ulva* spp. and the transition from LR.FLR.Lic.UloUro to LR.FLR.Eph.Ulv is often indistinct and a mixed zone of Lic.UloUro and Eph.Ulv can occur. This biotope is more easily identifiable from autumn to spring as both *Urospora* spp. and *Bangia atropurpurea* may dry out and disappear during the summer. In late winter, the red seaweed *Bangia atropurpurea* may be predominant and the community then appears as shiny blackish mats of filamentous growth.

Depth range

Upper shore

Additional information

Little evidence on the ecology of this biotope or its reaction to anthropomorphic pressures was found. Many of the sensitivity assessments are, therefore, based on expert judgment.

Listed By

- none -

Further information sources

Search on:

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Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

This biotope is characterized by a mat of the unbranched and filamentous green algae *Ulothrix flacca*, *Urospora penicilliformis and Urospora wormskioldii*. The biotope occurs in the littoral fringe on hard or soft rock (chalk) substrata (Connor *et al.*, 2004). A similar community occurs on artificial substrata such as the floating pontoons of harbours (Fletcher, 1980b). This biotope can overlap or sit just above other green algal communities dominated by *Ulva* spp. or *Blidingia* spp. *Semibalanus balanoides* or *Patella vulgata* may be present, where the wave exposure and splash keep the biotope wet, or crevices provide them with refuge. However, the important characterizing species are *Ulothrix* sp. and *Uropsora* sp., without which the biotope would not be recognised. Therefore, the sensitivity of this biotope is determined by the *Ulothrix* sp. and *Uropsora* sp.

Resilience and recovery rates of habitat

Ulothrix flacca is a green, filamentous alga that forms woolly masses or mats up to 10 cm long (Brodie *et al.*, 2007). It can grow on a wide variety of substrata that includes bedrock, stones, wood, mollusc shells, and other algae. It is recorded throughout the littoral zone and in rock pools, and often in brackish conditions, including on the stems of saltmarsh plants. It is recorded throughout the British Isles and Europe, North America, temperate Africa, Asia, South America and Antarctica (Brodie *et al.*, 2007).

It is most frequent in summer although spring is its most reproductive season (Burrows, 1991; Brodie *et al.*, 2007). All but the basal cells of each filament can form either asexual zoospores or sexual gametes. Zoospores are motile with four flagella, and settle to form a new filament. Unreleased zoospores can also from aplanopsores (non-flagellate) that also settle and form a new plant. Haploid gametes bear two flagella, and the same size and fuse to form a zygote. The zygote settles and undergoes a resting phase, before dividing to form 4 to 16 motile zoospores or non-motile aplanospores, each of which settles to form a new filament (Lee, 2008).

Uropsora spp. forms green bands or mats composed of filaments or of large club-shaped single cells (the *Codiolum*-phase) or both. *Urospora penicilliformis* is mainly found in the upper littoral and littoral fringe. It develops in spring and winter in the British Isles. It is widespread in the British Isles and recorded from both the Atlantic and Pacific coasts of both the Southern and Northern Hemispheres (Burrows, 1991; Bischoff & Wiencke, 1995; Brodie *et al.*, 2007). *Urospora wormskioldii* occurs as a continuous mat on rocks and artificial substrata but the filamentous form has not been recorded in the British Isles . It is recorded around the coasts of Britain and Northern Ireland (Burrows, 1991; Brodie *et al.*, 2007).

In *Urospora penicilliformis*, the filaments are the gametophyte, and can form asexual quadrflagellate zoospores, non-motile aplanospores and male and female biflagellate gametes of different sizes. The *Codiolum*-phase is a sporophyte that forms quadiflagellate zoospores. In *Urospora wormskioldii*, the filament is dioecious forming gametes and the resultant zygotes form into unicellular *Codiolum*-phase sporophytes that form quadriflagellate zoospores. Zoospores settle to form the filamentous form but occasionally a dwarf filamentous form (Brodie *et al.*, 2007).

Both *Ulothrix* and *Urospora* can produce large numbers of motile and non-motile spores that provide both good local recruitment and ranged dispersal. Like many green algae, they are considered to by fast-growing, opportunistic annuals (Palmer & Sideman, 1988; Fletcher, 1996).

For example, *Ulothrix flacca* colonized cleared areas in both the eulittoral and littoral fringe and reached abundances equal to those of uncleared controls in the littoral fringe within six months (Palmer & Sideman, 1988). In a study of algal colonization of rocky shores in the Firth of Clyde, Hruby & Norton (1979) noted that the propagules of *Ulva* (as *Enteromorpha*) spp., *Blidingia* spp. and *Ulothrix/Urospora* spp. and filamentous brown algae were the most numerous in the water column. *Ulva* (as *Enteromorpha*) spp., *Blidingia* spp. and *Ulothrix/Urospora* spp. had high settlement densities on glass slides left on the shore after seven days. A canopy of *Ulva* (as *Enteromorpha*) spp. was shown to inhibit the settlement of spores of *Ulothrix pseudoflacca*, although the survival of already settled sporelings was increased by the presence of the canopy (Hruby & Norton, 1979).

Resilience assessment. Both *Urospora* spp. and *Ulothrix* spp. are rapid colonizing, opportunistic species, that produce numerous spores, capable of dispersal over wide areas, and widely distributed in the British Isles and Northern Hemisphere. Therefore, recovery is likely to take no more than six months under suitable conditions, and resilience is assessed as **High**, even where the population is removed.

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

The southern-most distribution of *Urospora penicilliformis* in the northern Hemisphere is limited by the 26°S and 16°W isotherm (Bischoff & Wiencke, 1995). Samples of *Urospora penicilliformis* were grown in the laboratory for two weeks at a range of temperatures. Cold temperate samples in the Northern Hemisphere grew between 0-20°C and survived up to 25-26°C. Arctic strains survive up to 23-24°C while Antarctic strains survive up to 19°C (Bischoff & Wiencke, 1995).

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. *Urospora* sp. are most abundant in winter to spring and sometimes summer, while *Ulothrix* is most abundant in summer so that increases in temperature may change to the relative abundance of the species within the biotope. However, the temperature will also affect water retention and desiccation, so that the effect of temperature change will also vary depending on the wave exposure, splash, and spray, humidity and cloud cover. Nevertheless, the wide distribution of both species in the North Hemisphere suggests that the biotope is resistant of temperature change at the benchmark level. Therefore, resistance is probably **High**, resilience is **High** (by default) and the biotope is assessed as **Not sensitive** as 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

The southern-most distribution of *Urospora penicilliformis* in the northern Hemisphere is limited by the 26°S and 16°W isotherm (Bischoff & Wiencke, 1995). Samples of *Urospora penicilliformis* were grown in the laboratory for two weeks at a range of temperatures. Cold temperate samples in the Northern Hemisphere grew between 0-20°C and survived up to 25-26°C. Arctic strains survive up to 23-24°C while Antarctic strains survive up to 19°C (Bischoff & Wiencke, 1995).

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. *Urospora* sp. are most abundant in winter to spring and sometimes summer, while *Ulothrix* is most abundant in summer so that increases in temperature may change to the relative abundance of the species within the biotope. However, the temperature will also affect water retention and desiccation, so that the effect of temperature change will also vary depending on the wave exposure, splash, and spray, humidity and cloud cover. Nevertheless, the wide distribution of both species in the North Hemisphere suggests that the biotope is resistant of temperature change at the benchmark level. Therefore, resistance is probably **High**, resilience is **High** (by default) and the biotope is assessed as **Not sensitive** as the benchmark level.

Salinity increase (local)	High Q: Medium A: Low C: Medium	High Q: High A: High C: High	Not sensitive Q: Medium A: Low C: Medium

The marine *Ulothrix* species in the British Isles are recorded as tufts and mats on mud, artificial and other hard substrata, in saltmarshes, from the mid-littoral to littoral fringe and supralittoral pools. They flourish in areas of extreme salinity variation and occur close to the mouth of freshwater streams or rocks in freshwater seeps (Brodie *et al*., 2007). The brackish-water *Ulothrix flacca* is only rarely recorded in freshwater (Brodie *et al*., 2007). Hanic (1965 cited in Burrows. 1991) noted that the dwarf form of *Urospora wormskioldii* predominated at high (50‰) and low (10‰) salinities while the filamentous predominated at 20-30‰.

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 also suggests they could resist hypersaline conditions. Therefore, a resistance of **High** is suggested. Hence, resilience is **High**, so that the biotope is probably **Not sensitive**.

Salinity decrease (local)	High Q: Medium A: Low C: Medium	High Q: High A: High C: High	Not sensitive Q: Medium A: Low C: Medium

The marine *Ulothrix* species in the British Isles are recorded as tufts and mats on mud, artificial and other hard substrata, in saltmarshes, from the mid-littoral to littoral fringe and supralittoral pools. They flourish in areas of extreme salinity variation and occur close to the mouth of freshwater streams or rocks in freshwater seeps (Brodie *et al*., 2007). The brackish-water *Ulothrix flacca* is only rarely recorded in freshwater (Brodie *et al*., 2007). Hanic (1965 cited in Burrows. 1991) noted that the dwarf form of *Urospora wormskioldii* predominated at high (50‰) and low (10‰) salinities while the filamentous predominated at 20-30‰.

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 on freshwater seeps and in brackish conditions also suggests they could resist hyposaline conditions. Therefore, a resistance of **High** is suggested. Hence, resilience is **High**, so that the biotope is probably **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

The littoral fringe is unlikely to be affected by changes in water flow as described in the pressure benchmark. 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: Low A: NR C: NR	High Q: High A: High C: High	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. A decrease in emergence regime is likely to result in competition from macroalgae resulting in loss of extent, especially in no other suitable substratum is available. Conversely, an increase in emergence will probably result in the biotope moving further 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: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive 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). 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 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 *Urospora penicilliformis* 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: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

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

Ulothrix and *Urospora* species 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

Ulothrix and *Urospora* species 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: High A: High C: High	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: High A: High C: High	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 untrampled 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, *Ulothrix* sp. and *Urospora* sp. 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: High A: High C: High	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. 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 as a result 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 by impermeable materials or by other hard construction materials, however, would result in loss of the biotope (see physical loss above).

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 as a result of rainwater runoff of silt and soil from the tops of the cliffs. However, where the biotope occured 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 by impermeable materials or by other hard construction materials, however, would result in loss of the biotope (see physical loss above).

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: High A: High C: High	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. Roleda *et al.* (2009a&b) reported that *Urospora penicilliformis* was insensitive to the effects of natural and artificial ultraviolet light (UV) and could cope with the high UV found in cold-temperate waters of both hemispheres and increases in UV due to a reduction in the ozone layer in polar regions. No evidence on the effects of shading was found. However, its presence in 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 evidence was found.

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.

Bibliography

Bischoff, B. & Wiencke, C., 1995. Temperature adaptation in strains of the amphi-equatorial green alga *Urospora penicilliformis* (Acrosiphoniales): Biogeographical implications. *Marine biology. Berlin, Heidelberg*, **122** (4), 681-688.

Brodie, J., Maggs, C.A. & John, D.M., 2007. *Green Seaweeds of Britain and Ireland*. British Phycology Society

Burrows, E.M., 1991. *Seaweeds of the British Isles. Volume 2. Chlorophyta.* London: British Museum (Natural History).

Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. & Reker, J.B., 2004. The Marine Habitat Classification for Britain and Ireland. Version 04.05. ISBN 1 861 07561 8. In JNCC (2015), *The Marine Habitat Classification for Britain and Ireland Version 15.03.* [2019-07-24]. Joint Nature Conservation Committee, Peterborough. Available from https://mhc.jncc.gov.uk/

Fletcher, H. & Frid, C.L.J., 1996b. The response of an inter-tidal algal community to persistent trampling and the implications for rocky shore management. In Jones, P.S., Healy, M.G. & Williams, A.T. (ed.) Studies in European coastal management., Cardigan, Wales: Samara Publishing

Fletcher, H. & Frid, C.L.J., 1996a. Impact and management of visitor pressure on rocky intertidal algal communities. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **6**, 287-297.

Fletcher, R.L., 1980b. The algal communities of floating structures in Portsmouth and Langstone Harbours (South Coast of England. In *The Shore Environment*, vol. 2: *Ecosystems* (ed. J.H. Price, D.E.G. Irvine & W.F. Farnham), pp. 789-842. London: Academic Press. [Systematics Association Special Volume no. 17(b)].

Fletcher, R.L., 1996. The occurrence of 'green tides' - a review. In *Marine Benthic Vegetation. Recent changes and the Effects of Eutrophication* (ed. W. Schramm & P.H. Nienhuis). Berlin Heidelberg: Springer-Verlag. [Ecological Studies, vol. 123].

Hruby, T. & Norton, T.A., 1979. Algal colonization on rocky shores in the Firth of Clyde. *Journal of Ecology*, **67**, 65-77.

JNCC, 2015. The Marine Habitat Classification for Britain and Ireland Version 15.03. (20/05/2015). Available from https://mhc.jncc.gov.uk/

Lee, R.E., 2008. *Phycology*. Cambridge: Cambridge University Press.

Palmer, B.L. & Sideman, E.J., 1988. A field investigation into the effects of interspecific competition on the distribution and cover of *Ulothrix flacca*. *Hydrobiologia*, **157** (2), 97-104.

Roleda, M.Y., Campana, G.L., Wiencke, C., Hanelt, D., Quartino, M.L. & Wulff, A., 2009a. Sensitivity of Antarctic *Urospora penicilliformis* (Ulotrichales, Chlorophyta) to Ultraviolet Radiation is Life-Stage Dependent. *Journal of Phycology*, **45** (3), 600-609.

Roleda, M.Y., Lütz-Meindl, U., Wiencke, C. & Lütz, C., 2009b. Physiological, biochemical, and ultrastructural responses of the green macroalga *Urospora penicilliformis* from Arctic Spitsbergen to UV radiation. *Protoplasma*, **243** (1), 105-116.