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Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment

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

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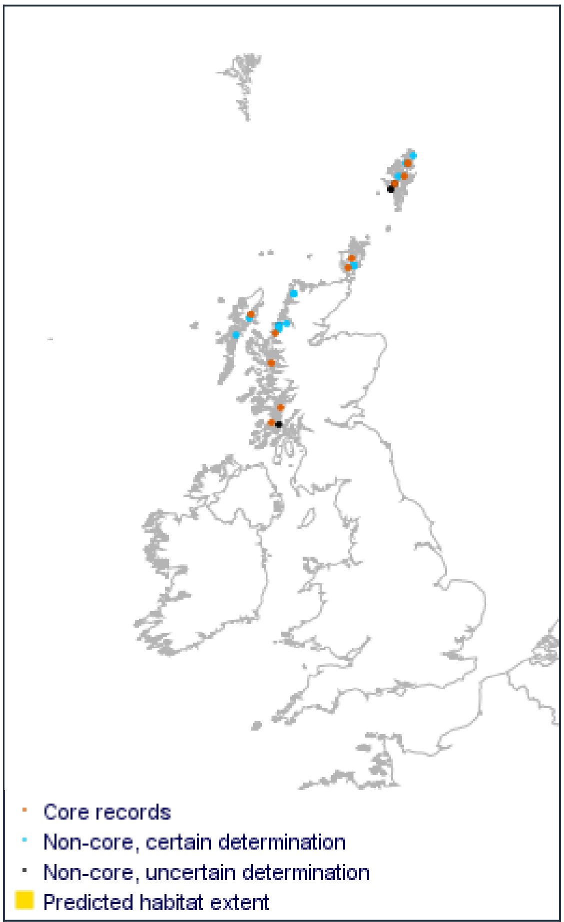

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

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

Summary

UK and Ireland classification

EUNIS 2008	A5.527	Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment
JNCC 2015	SS.SMp.KSwSS.Pcri	Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment
JNCC 2004	SS.SMp.KSwSS.Pcri	Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment
1997 Biotope	SS.IMX.KSwMx.Pcri	Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment

Description

Infralittoral muddy sand and sandy mud, sometimes with some shells or pebbles, and a dense, loose-lying cover of *Phyllophora crispa*. This biotope occurs in very sheltered conditions such as those found in sealochs and voes. SMP.Pcri is similar to other biotopes described with dense, loose-lying algae but has been less frequently recorded, and from the few records available, appears to occur in slightly deeper infralittoral waters primarily between 10 m to 30 m and typically in fully saline waters. The seaweeds in this biotope may be epiphytised by ascidians such as Ascidiella aspera.Kelp such as Saccharina latissima and red seaweeds including *Plocamium cartilagineum* may be present in some areas. The scallops *Pecten maximus* and *Aequipecten opercularis* may also be found occasionally in this biotope and *Trailliella / Bonnemaisonia hamifera* may also be present but not at the levels found in SMP.Tra. (Information from Connor *et al*., 2004).

Depth range

5-10 m, 10-20 m, 20-30 m

Additional information

Little information on the biology of *Phyllophora crispa* was found. In addition, this biotope is unique and occurs in specific habitats, so that even less information on the ecology of the biotope was available. Therefore, the sensitivity assessments are based on the general biology of *Phyllophora* spp., the biotope description and expert judgement, and should be interpreted with caution.

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 (SMp.KSwSS.Pcri) is defined by the abundance of *Phyllophora crispa* in the form of dense loose-lying mats on infralittoral muddy sand and sandy mud in very wave sheltered conditions, typical of sea lochs and voes (Connor *et al*., 2004). The presence of other red algae and kelp varies between records of the biotope. Mobile crabs and urchins probably roam the surrounding area and epifaunal keel worms and hydroids are probably ubiquitous on any stones and pebbles in the surrounding area. The characteristic infauna is not reported except for *Cerianthus lloydii* which is found in many other sedimentary habitats. The remaining epiphytic ascidians and bryozoans are, by definition, dependent on the *Phyllophora* mat for substratum. Therefore, the sensitivity of the biotope is probably dependent on the sensitivity of the *Phyllophora* mat whose loss would result in loss of the biotope as described by the habitat classification.

Resilience and recovery rates of habitat

Phyllophora crispa is a perennial species growing from a small discoid holdfast. The growth form varies depending on environmental conditions but it is usually dichotomous branching with membranous or cartilaginous flat bladed fronds up to 10-15 cm in length, sometimes with up to 5-6 proliferations (Dixon & Irvine, 1977; Bunker *et al*., 2012; Guiry & Guiry, 2015). Dixon & Irvine (1977) noted that regeneration occurs in *Phyllophora crispa* after erosion or animal grazing. Molenaar & Breeman (1994) noted that *Phyllophora pseudoceranoides* exhibited annual growth and die back patterns where growth is removed annually by abrasion or water action leading to breakage.

Phyllophora crispa is dioecious but the gametophyte and tetrasporophyte are isomorphic. The male gametophytes release spermatangia in September to October, and female gametophytes develop cystocarps in September to March and release carpospores in January. The tetrasporangia are recorded in August to March and tetraspores are usually released in January (Newroth, 1972; Dixon & Irvine, 1977). Newroth (1972) reported that carposporelings of *Phyllophora pseudoceranoides* transferred from culture into the wild grew to a height of 3 cm in two years. The spores of red algae are non-motile (Norton, 1992) and therefore entirely reliant on the hydrographic regime for dispersal. Norton (1992) reviewed dispersal by macroalgae and concluded that dispersal potential is highly variable, recruitment usually occurs on a local scale, typically within 10 m of the parent plant. Hence, it is expected that the red algal turf would normally rely on recruitment from local individuals and that recovery of populations via spore settlement, where adults are removed, would be protracted.

'Zernov's *Phyllophora* field' in the north-western Black Sea has undergone significant degradation between 1964 and 2004 due to eutrophication, resultant algal blooms and increased turbidity (BSC, 2008; Kostylev *et al*., 2010). The 'field' is composed of several species of *Phyllophora* including *Phyllophora crispa*. The *Phyllophora* field has remained but the abundance of the *Phyllophora*, the range of *Phyllophora* species, their age structure, the extent of the 'field', and the ecosystem of fish and other algae decreased or declined. However, an increase in species richness and extent of the 'field' was reported from 2005 to 2007, so that regeneration had begun (Kostylev *et al*., 2010). BSC (2008) suggest that eutrophication and its effects stabilised in the 1990s and decreased in the 2000s.

Kain (1975) examined recolonization of artificially cleared areas in a Laminaria hyperborea forest in Port Erin, Isle of Man. Cleared concrete blocks were colonized by kelps and un-specified Rhodophyceae at 0.8 m. After about 2.5 years, *Laminaria hyperborea* standing crop, together with an understorey of red algae (Rhodophyceae), was similar to that of virgin forest. Rhodophyceae were present throughout the succession increasing from 0.04 to 1.5 percent of the biomass within the first 4 years. Succession was similar at 4.4 m, and *Laminaria hyperborea* dominated within about 3 years. Blocks cleared in August 1969 at 4.4m were dominated by Rhodophyceae after 41 weeks, e.g. *Delesseria sanguinea* and *Cryptopleura ramosa*. Kain (1975) cleared one group of blocks at two monthly intervals and noted that Phaeophyceae were dominant colonists in spring, Chlorophyceae (solely *Ulva lactuca*) in summer and Rhodophyceae were most important in autumn and winter. However, *Phyllophora crispa* was not reported in her study.

Resilience assessment. No direct evidence of recovery was found. The growth rate of *Phyllophora pseudoceranoides* might suggest that *Phyllophora crispa* would take several years to recover its full length of 10-15 cm, although it is also reported to regenerate (Newroth, 1972; Dixon & Irvine, 1977). Recovery of the extensive field of *Phyllophora* spp. in the Black Sea does not provide a precise timeline but again suggests several years for recovery to begin. Therefore, where a proportion of the population of *Phyllophora* is removed or lost (i.e. resistance in ‘Medium’) then resilience is assumed to be **High**. However, where a significant proportion of the *Phyllophora* mat is lost or removed, resilience is assumed to be **Medium** (2-10 yrs) but with ‘Low’ confidence based on expert judgement and little supporting evidence.

Hydrological Pressures

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

Phyllophora crispa is widely distributed on the coasts of the British Isles, except in the east of England. It is widely distributed in the east Atlantic with a northern limit in Iceland and a southern limit in North Africa but is also present in the Mediterranean and Black Sea (Newroth, 1971; Dixon & Irvine, 1977; Guiry & Guiry, 2015; Bunker *et al.*, 2012). OBIS (2016) recorded *Phyllophora crispa* in waters of 8.5 to 14.5°C, although the derivation of the records is unclear. Kooistra *et al.* (1989) noted that it was limited to lower shore tide pools but concluded that temperature and salinity were not the limiting factors but that oxygenation and completion were possible limiting factors. However, Gallon *et al.* (2014) reported that changes in red seaweed assemblages across Brittany were correlated with a 0.7°C increase in coastal water temperature over the prior twenty years. Species varied in their response but the occurrence of several species of red algae, including *Phyllophora crispa*, increased.

Sensitivity assessment. *Phyllophora crispa* is distributed to the north and south of the British Isles and, therefore, is probably tolerant of a long-term 2°C change in temperature for a year. It is also likely to tolerate a 5°C change in the short-term. Therefore, a resistance of **High** is suggested so that resilience is **High** (by default) and the biotope is assessed as **Not sensitive** at the benchmark level. However, confidence in the assessed in Low as it is based on expert judgment and proxies for evidence.

Temperature decrease (local)	High Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Not sensitive Q: Low A: NR C: NR

Phyllophora crispa is widely distributed on the coasts of the British Isles, except in the east of England. It is widely distributed in the east Atlantic with a northern limit in Iceland and a southern limit in North Africa but is also present in the Mediterranean and Black Sea (Newroth, 1971; Dixon & Irvine, 1977; Guiry & Guiry, 2015; Bunker *et al.*, 2012). OBIS (2016) recorded *Phyllophora crispa* in waters of 8.5 to 14.5°C, although the derivation of the records is unclear. Kooistra *et al.* (1989) noted that it was limited to lower shore tide pools but concluded that temperature and salinity were not the limiting factors but that oxygenation and completion were possible limiting factors.

Sensitivity assessment. *Phyllophora crispa* is distributed to the north and south of the British Isles and, therefore, is probably tolerant of a long-term 2°C change in temperature for a year. It is also likely to tolerate a 5°C change in the short-term. Therefore, a resistance of **High** is suggested so that resilience is **High** (by default) and the biotope is assessed as **Not sensitive** at the benchmark level. However, confidence in the assessed in Low as it is based on expert judgment and proxies for evidence.

Salinity increase (local)	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

Phyllophora crispa is recorded from shady places in the lower littoral, lower littoral pools and subtidally to ca 30m (Dixon & Irvine, 1977; Bunker *et al.*, 20102). Kooistra *et al.* (1989) noted that *Phyllophora crispa* was limited to lower shore tide pools but concluded that temperature and salinity were not the limiting factors but that oxygenation and competition were possible limiting factors. Maximova (2013; summary only) reported that 'morphological and biological changes' in *Phyllophora crispa* from the Black Sea changed in experiments where the 'normal' salinity was raised from 18 ppt to 25, 32 and 39, but no further details were available. OBIS (2016) recorded *Phyllophora crispa* in waters of 17.9 to 38 pps, although the derivation of the records is unclear.

Sensitivity assessment. The presence of *Phyllophora crispa* in the lower intertidal suggests that it might be exposed to changes in salinity due to evaporation or rainfall but only for very short periods. This biotope (KSwSS.Pcri) is only recorded from full salinity so that an increase in salinity at the benchmark level would expose the biotope to hypersaline conditions, for example from hypersaline effluents. However, no evidence on which to base and assessment was found.

Salinity decrease (local)	Medium Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

Phyllophora crispa is recorded from shady places in the lower littoral, lower littoral pools and subtidally to ca 30m (Dixon & Irvine, 1977; Bunker *et al.*, 20102). Kooistra *et al.* (1989) noted that *Phyllophora crispa* was limited to lower shore tide pools but concluded that temperature and salinity were not the limiting factors but that oxygenation and competition were possible limiting factors. Maximova (2013; summary only) reported that 'morphological and biological changes' in *Phyllophora crispa* from the Black Sea changed in experiments where the 'normal' salinity was raised from 18 ppt to 25, 32 and 39, but no further details were available. OBIS (2016) recorded *Phyllophora crispa* in waters of 17.9 to 38 pps, although the derivation of the records is unclear. A comparative study of salinity tolerances of macroalgae collected from North Zealand and the South Kattegat (Denmark) where salinity is 16 psu showed that species generally had a high tolerance (maintained more than half of photosynthetic capacity in short-term exposures of 4 days) to salinities lower than 3.7 psu. However, tolerances varied between species with *Phyllophora pseudoceranoides* exhibiting greater tolerance than *Phycodrys rubens*, which was the least resistant species tested (Larsen & Sand-Jensen, 2006).

Sensitivity assessment. The presence of *Phyllophora crispa* in the lower intertidal suggests that it might be exposed to changes in salinity due to evaporation or rainfall but only for very short periods. This biotope (KSwSS.Pcri) is only recorded from full salinity so that a decrease in salinity at the benchmark level would expose the biotope to reduced salinity conditions (18-30 psu). The observations from the Black Sea, the South Kattegat and OBIS suggest that *Phyllophora crispa* could survive reduced salinity conditions but the biotope would probably experience a reduction in species richness and less resistant species left or were lost from the biotope. Therefore, a resistance of **Medium** is suggested. Resilience is probably **High** so that sensitivity is assessed as **Low** at the benchmark level. However, confidence in the assessed in Low as it is based on expert judgment and proxies for evidence.

Water flow (tidal current) changes (local)	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Phyllophora crispa was recorded from moderately strong to very weak tidal flow (Connor *et al.*, 2004). It has been recorded to regenerate after erosion (Dixon & Irvine, 1977) while Molenaar & Breeman (1994) noted that *Phyllophora pseudoceranoides* exhibited annual growth and die back patterns where growth was removed annually by abrasion or water action. However, this biotope is unusual because the very weak to weak tidal streams and very wave sheltered conditions allow *Phyllophora crispa* to grow abundantly on fine sediments (muddy sands and sandy muds). It is presumably attached to small stones within the sediment. A significant increase in water flow may winnow away the mud surface or even remove the mud habitat and hence the biotope if prolonged. An increase of 0.2 m/s may begin to erode the mud surface where the site is already subject to flow (e.g. weak flow at the seabed), based on sediment erosion deposition curves (Wright, 2001). Therefore, an increase in water flow could result in the loss of the 'loose-lying' mat of *Phyllophora crispa*. However, an increase of only 0.1-0.2 m/s may only affect example of the biotope already in weak flow, rather than very weak flow and a resistance of **Low** is suggested with Low confidence. Resilience is probably **Medium** so that sensitivity is assessed as **Medium**.

Emergence regime 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

Changes in emergence are '**Not relevant'** to this biotope, which is restricted to fully subtidal habitats. The pressure benchmark is relevant only to littoral and shallow sublittoral fringe biotopes.

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

Phyllophora crispa was recorded from wave exposed to very wave sheltered sites (Connor *et al.*, 2004). It has been recorded to regenerate after erosion (Dixon & Irvine, 1977) while Molenaar & Breeman (1994) noted that *Phyllophora pseudoceranoides* exhibited annual growth and die back patterns where growth was removed annually by abrasion or water action. However, this biotope is unusual because the very weak to weak tidal streams and very wave sheltered conditions allow *Phyllophora crispa* to grow abundantly on fine sediments (muddy sands and sandy muds). It is presumably attached to small stones within the sediment. A further decrease in wave exposure is unlikely to affect the biotope. However, an increase in wave exposure is likely to remove the loose-lying mat of *Phyllophora crispa* but a 3-5% change in significant wave height (the benchmark) is unlikely to have a significant effect. 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 was 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	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

Kooistra *et al*. (1989) noted that *Phyllophora crispa* was limited to lower shore tide pools but concluded that temperature and salinity were not the limiting factors but that oxygenation and competition were possible limiting factors. However, no direct evidence was found.

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

'Zernov's *Phyllophora* field' in the north-western Black Sea has undergone significant degradation between 1964 and 2004 due to eutrophication, resultant algal blooms and increased turbidity (BSC, 2008; Kostylev *et al.*, 2010). The 'field' is composed of several species of *Phyllophora* including *Phyllophora crispa*. The *Phyllophora* field has remained but the abundance of the *Phyllophora*, the range of *Phyllophora* species, their age structure, the extent of the 'field', and the ecosystem of fish and other algae decreased or declined. Although the Black Sea is a unique environment, the results suggest that nutrient enrichment could affect the biotope and its associated community adversely. Nevertheless, 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	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

'Zernov's *Phyllophora* field' in the north-western Black Sea has undergone significant degradation between 1964 and 2004 due to eutrophication, resultant algal blooms and increased turbidity (BSC, 2008; Kostylev *et al.*, 2010). The 'field' is composed of several species of *Phyllophora* including *Phyllophora crispa*. The *Phyllophora* field has remained but the abundance of the *Phyllophora*, the range of *Phyllophora* species, their age structure, the extent of the 'field', and the ecosystem of fish and other algae decreased or declined. It is unclear if the eutrophication in the Black Sea resulted from nutrients, organic loading, or both. Therefore, in the absence of clear evidence no assessment has been made.

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

If sedimentary substrata were replaced with rock substrata the biotope would be lost, as it would not longer be a sedimentary habitat.

Sensitivity assessment. Resistance to the pressure is considered '**None**', and resilience '**Very low**' or 'None' (as the pressure represents a permanent change) and the sensitivity of this biotope is assessed as '**High**'.

Physical change (to another sediment type)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

This biotope is recorded from sandy gravelly muds (Connor *et al.*, 2004, sediment matrix).

Phyllophora crispa is found on other substrata, including rock and other seaweeds. The low energy environment of the biotope, i.e. low water flow and wave sheltered conditions, determines the nature of the sediment. The muddy sediment is probably inhospitable to most other macroalgae so that *Phyllophora* can become abundant. A change in sediment from sand muddy gravels to gravel or mud may not affect the biotope adversely. Bunker *et al.* (2012) note that *Phyllophora crispa* thrives on rock subject to shell gravel. Therefore, in the very sheltered condition so of this biotope, the mat of *Phyllophora* would probably survive on gravel or on muds where enough stone for attachment remains. Therefore, the biotope is probably **Not sensitive** (resistance and resilience are High) at the benchmark level.

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

The biotope is an epifloral mat sitting on the surface of the sediment. Extraction of the sediment to any depth would result in removal of the *Phyllophora* mat from the affected area. Therefore, a resistance of **None** is suggested. Resilience is probably **Medium** and sensitivity is assessed as **Medium** but with Low confidence due to the lack of any direct evidence.

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

Dixon & Irvine (1977) noted that *Phyllophora crispa* regenerates after erosion and animal grazing. Bunker *et al.* (2012) noted that it tolerated sediment cover and thrived in areas subject to shell gravel. Both observations suggest that it can either resist or regrow from damage due to sediment scour or animal grazing. However, this biotope (KSwSS.Pcri) is an epifloral mat sitting on the surface of sediment; probably loosely attaché to small stones or shells in the sediment. Any passing bottom gear is liable to remove the mat of *Phyllophora*. Therefore, a resistance of **Low** is suggested. Resilience is probably **Medium** so that the sensitivity is assessed as **Medium** at the benchmark level but with Low confidence due to the lack of any direct evidence.

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

Dixon & Irvine (1977) noted that *Phyllophora crispa* regenerates after erosion and animal grazing. Bunker *et al.* (2012) noted that it tolerated sediment cover and thrived in areas subject to shell gravel. Both observations suggest that it can either resist or regrow from damage due to sediment scour or animal grazing. However, this biotope (KSwSS.Pcri) is an epifloral mat sitting on the surface of sediment; probably loosely attaché to small stones or shells in the sediment. Any passing bottom gear is liable to remove the mat of *Phyllophora*. Therefore, a resistance of **Low** is suggested. Resilience is probably **Medium** so that the sensitivity is assessed as **Medium** at the benchmark level but with Low confidence due to the lack of any direct evidence.

Changes in suspended solids (water clarity)	Low Q: High A: Medium C: Medium	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Red algae are shade tolerant macroalgae. *Phyllophora crispa* is particularly shade tolerant and is recorded a greater depths than many other red algae. For example, Smith & Jones (1970) reported that *Phyllophora crispa* grew at a greater depth (25 m) than other red algae examined on the west coast of Anglesey and Norton (1968) reported it at 33 m at St Mary's Isles of Scilly. Norton *et al.* (1971) noted that *Phyllophora crispa* penetrated up to 15 m in a sea cave (Bullock Island Cave, near Lough Ine), although its growth was stunted at its limit into the cave. The degradation of 'Zernov's *Phyllophora* field' in the north-western Black Sea was attributed to eutrophication, algal blooms and turbidity. All three species of *Phyllophora* present survived but their biomass was reduced by an order to magnitude (Kostylev *et al.*, 2010). Therefore, it is likely that an increase in turbidity due to suspended solids could result in a loss of a proportion of the population of *Phyllophora crispa*, especially in the deeper examples of the biotope and a resistance of **Low** is suggested. Resilience is probably **Medium** so that sensitivity is assessed as **Medium**.

Smothering and siltation rate changes (light)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Airoldi (2003) identified a number of morphological, physiological and life history traits that conferred high levels of tolerance to sedimentation. For example, regeneration of upright fronds from a perennial basal crust resistant to burial and scour, calcified thalli, apical meristems, large reproductive outputs, lateral vegetative growth and slow growth rates (Airoldi, 2003). Algae with tough thalli are more resistant to sedimentation and scour (Pedersén & Snoeijs, 2001). *Phyllophora crispa* was reported to regenerate after erosion and animal grazing (Dixon & Irvine, 1977) and Bunker *et al.* (2012) noted that it tolerated sediment cover and thrived in areas subject to shell gravel. Both observations suggest that it can either resist or regrow from damage due to sediment scour. However, in the wave sheltered, low energy conditions that typify this biotope any deposit of sediment is likely to remain and smother the biotope.

Sensitivity assessment. *Phyllophora crispa* grows up to 15 cm in length, and could probably either protrude through 5 cm of deposited sediment or grow up through it. Therefore, a resistance of **High** is suggested. Resilience is, therefore, **High** and the biotope is probably **Not sensitive** at the benchmark level.

Smothering and siltation rate changes (heavy)	None Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Airoldi (2003) identified a number of morphological, physiological and life history traits that conferred high levels of tolerance to sedimentation. For example, regeneration of upright fronds from a perennial basal crust resistant to burial and scour, calcified thalli, apical meristems, large reproductive outputs, lateral vegetative growth and slow growth rates (Airoldi, 2003). Algae with tough thalli are more resistant to sedimentation and scour (Pedersén & Snoeijs, 2001). *Phyllophora crispa* was reported to regenerate after erosion and animal grazing (Dixon & Irvine, 1977) and Bunker *et al.* (2012) noted that it tolerated sediment cover and thrived in areas subject to shell gravel. Both observations suggest that it can either resist or regrow from damage due to sediment scour. However, in the wave sheltered, low energy conditions that typify this biotope any deposit of sediment is likely to remain and smother the biotope.

Sensitivity assessment. *Phyllophora crispa* grows up to 15 cm in length and would be completely smothered by 30 cm of deposited sediment. The sediment is likely to remain, and the plants will be removed from light and probably succumb to localise anoxia under the sediment. Therefore, a resistance of **None** is suggested. Resilience is probably **Medium** and the sensitivity is assessed as **Medium** benchmark level.

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

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

Red algae are shade tolerant macroalgae. *Phyllophora crispa* is particularly shade tolerant and is recorded a greater depths than many other red algae. For example, Smith & Jones (1970) reported that *Phyllophora crispa* grew at a greater depth (25 m) than other red algae examined on the west coast of Anglesey and Norton (1968) reported it at 33 m at St Mary's Isles of Scilly. Norton *et al.* (1971) noted that *Phyllophora crispa* penetrated up to 15 m in a sea cave (Bullock Island Cave, near Lough Ine), although its growth was stunted at its limit into the cave. The degradation of 'Zernov's *Phyllophora* field' in the north western Black Sea was attributed to eutrophication, algal blooms and turbidity. All three species of *Phyllophora* present survived but their biomass was reduced by an order to magnitude (Kostylev *et al*., 2010). Therefore, shading by an artificial structure may reduce photosynthesis (depending on intensity and duration), and may reduce the abundance of algae, although *Phyllophora* will probably survive. Therefore, a resistance of **Medium** is suggested, with a resilience of **High** and a sensitivity of **Low**. However, permanent shading may reduce the depth to which the biotope can grow, resulting in loss of deeper example of the biotope. The biotope occurs below 5 m so that artificial lighting is unlikely to penetrate the water column enough to affect photosynthesis.

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

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 seabed biotopes 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

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 was found of the translocation, breeding or species hybridization of the important characterizing species.

Introduction or spread of invasive non-indigenous species	Medium Q: Low A: NR C: NR	High Q: Low A: NR C: NR	Low Q: Low A: Low C: Low

Bonnemaisonia hamifera (and the *Trailliella*-phase) is a non-native species introduced to the British Isles from Japan and first recorded in 1890 (Dixon & Irvine, 1977; Maggs & Stegenga, 1998; Gollasch, 2006). It is thought to have been introduced by shipping or with shellfish and to have dispersed by drifting on water currents (Gollasch, 2006). *Bonnemaisonia hamifera* (and the *Trailliella*-phase) has spread around the British Isles and Europe, into the Mediterranean and the Canary Isles and north to the Orkneys and the Norwegian coast (Lüning, 1990, Maggs & Stegenga, 1998; Gollasch, 2006). It grows rapidly, reproduces vegetatively, and can spread by fragmentation and drifting (Maggs & Stegenga, 1998).

Bonnemaisonia hamifera (and the *Trailliella*-phase) occurs in this biotope with *Phyllophora crispa* but at a lower abundance than its characteristic biotope (KSwSS.Tra). KSwSS.Tra occurs in shallower waters but otherwise similar conditions. Therefore, if the abundance of Phyllophora crispa was reduced by an external factor then the *Trailliella* might be about to take over the available space, especially in the shallow examples of the biotope (KSwSS.Pcri). However, there is no evidence that this has happened to date. Therefore, a precautionary resistance of **Medium** is suggested but with a 'Low' confidence. Resilience is probably **High** so that sensitivity is assessed as **Low**.

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 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

Phyllophora crispa is unlikely to be targetted by any commercial or recreational fishery or harvest.

Removal of non-target species	None Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Accidental physical disturbance due to access (e.g. trampling), grounding, or passing fishing gear is examined under abrasion above. However, the accidental removal of the *Phyllophora* mat would result in a significant change in the biological character of, and loss of, the biotope. Therefore, a resistance of **None** is suggested. Resilience is probably **Medium** so that sensitivity is assessed as **Medium** but with 'Low' confidence.

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