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Filamentous red seaweeds, sponges and *Balanus crenatus* on tide-swept variable-salinity infralittoral rock

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

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Please note. This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [https://www.marlin.ac.uk/habitats/detail/218]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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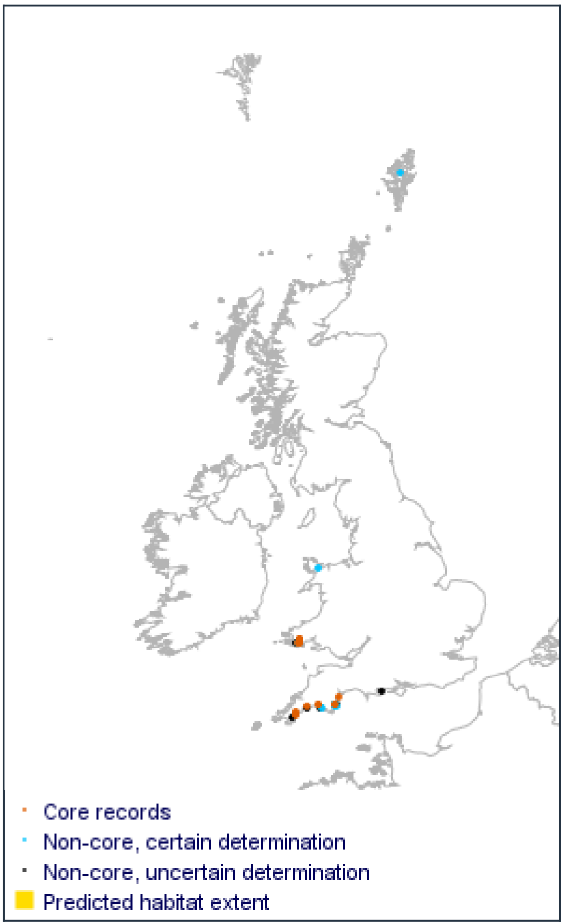

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by Dr Heidi Tillin **Refereed by** Admin

Summary

UK and Ireland classification

EUNIS 2008	A3.225	Filamentous red seaweeds, sponges and *Balanus crenatus* on tide-swept variable-salinity infralittoral rock
JNCC 2015	IR.MIR.KT.FilRVS	Filamentous red seaweeds, sponges and *Balanus crenatus* on tide-swept variable-salinity infralittoral rock
JNCC 2004	IR.MIR.KT.FilRVS	Filamentous red seaweeds, sponges and *Balanus crenatus* on tide-swept variable-salinity infralittoral rock
1997 Biotope	IR.SIR.K.LsacRS.FiR	Sparse *Laminaria saccharina* with dense filamentous red seaweeds, sponges and *Balanus crenatus* on tide-swept variable salinity infralittoral rock

Description

Tide-swept infralittoral rock subject to variable salinity and turbid waters occurs in the mid to upper reaches of the rias of south-west Britain, where riverine freshwater input reduces the salinity. Very shallow rock under these conditions is characterized by a covering of filamentous red seaweed such as *Callithamnion* spp., *Antithamnion* spp., *Ceramium* spp., *Griffithsia devoniensis*, *Pterothamnion plumula* and *Polysiphonia fucoides*, as well as the filamentous green seaweed *Cladophora* spp. Foliose red seaweeds such as *Hypoglossum hypoglossoides*, *Cryptopleura ramosa* and *Erythroglossum laciniatum* commonly occur, as does the foliose green seaweed *Ulva lactuca*. Although *Saccharina latissima* is often present it is usually in very low abundance (Occasional). The fluctuating salinity limits the number of species able to exist in this habitat. The animal community is dominated by the sponges *Halichondria panicea* and *Hymeniacidon perleve* and the barnacle *Balanus crenatus*. The ascidians *Clavelina lepadiformis* and *Dendrodoa grossularia* can be locally abundant at some sites. The crab *Carcinus maenas* is usually present, as is the mussel *Mytilus edulis*. The bryozoan *Crisularia plumosa* is sometimes present. Where vertical rock is present, the seaweeds *Ceramium nodulosum*, *Pterothamnion plumula*, *Cryptopleura ramosa*, *Hypoglossum hypoglossoides* and *Erythroglossum laciniatum* are typically found (JNCC, 2015).

Depth range

0-5 m

Additional information

None

Listed By

- none -

Further information sources

Search on:

G G G JNCC

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

The biotope description and characterizing species are taken from (JNCC, 2015). This biotope occurs on tide-swept infralittoral rock subject to variable salinity and turbid waters. The fluctuating salinity limits the number of species able to exist in this habitat and is considered to be a key factor structuring the biotope. The biological assemblage is characterized by a covering of filamentous red seaweed such as *Callithamnion* spp., *Antithamnion* spp., *Ceramium* spp., *Griffithsia devoniensis*, *Pterothamnion plumula* and *Polysiphonia fucoides*, as well as the filamentous green seaweed *Cladophora* spp. Foliose red seaweeds such as *Hypoglossum hypoglossoides*, *Cryptopleura ramosa* and *Erythroglossum laciniatum* commonly occur, as does the foliose green seaweed *Ulva lactuca*. The red and green algae are considered to characterize this biotope and the sensitivity assessments focus on these species.

The barnacle *Balanus crenatus* is named in the biotope title and is therefore considered a key species defining the biotope and the sensitivity assessments specifically consider this species where information is available. Other animal species present include the sponges *Halichondria panicea* and *Hymeniacidon perleve*, the ascidians *Clavelina lepadiformis* and *Dendrodoa grossularia* the mussel *Mytilus edulis* and the bryozoan *Bugula plumosa*. These species are not considered key to characterizing or defining the biotope but are considered in the sensitivity assessments where the pressures could lead to significant changes in abundance or the species could mitigate pressures.

Resilience and recovery rates of habitat

The abundance, biomass and cover of the characterizing filamentous red algae is likely to vary seasonally and from year to year depending on natural variation in environmental parameters (Sousa-Dias & Melo, 2008). In general red algae life stages may include prostrate creeping bases that function as a holdfast as in *Calliblepharis ciliata* (Guiry & Guiry, 2015) and *Plocamium cartilagineum* whereas in other species present in the biotope such as *Hypoglossum hypoglossoides* the thallus or fronds arise from small discoid holdfasts. 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 much more 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, could be protracted. Seasonality of reproduction varies between the red algal species so that timing of impacts will coincide with different phases of reproduction within species and may alter short-term recovery trajectories with effects on composition. In the Isle of Man, approximately 90% of *Cryptopleura ramosa* plants were fertile in late summer but less than 10% in Spring, although some fertile plants were always present. The filamentous red algae that characterize this biotope are regarded as opportunistic (Krause-Jensen *et al.*, 2007;) and able to rapidly increase in disturbed patches.

The associated epifauna are typically sponges, barnacles, hydroids and ascidians that are opportunistic colonizers of gaps. These species may recruit annually via larvae or asexual reproduction and growth *in-situ*. Some sponges are known to be highly resilience to physical damage with an ability to survive severe damage, regenerate and reorganize to function fully again, however, this recoverability varies between species (Wulff, 2006). *Halichondria panicea* is an opportunistic species, found in wide range of niches on rock or any other hard substrate (Ackers *et* *al*., 1992). Barthel (1986) reported that *Halichondria panicea* in the Kiel Bight went through annual cycles, with growth occurring between March and July. Reproductive activity occurred In August and September with young colonies appearing in early autumn. Adult *Halichondria panicea* degenerated and disintegrated after reproduction. Fish & Fish (1996), however, suggested a lifespan of about 3 years and Vethaak *et al*., (1982) reported that, unlike *Halichondria bowerbanki*, *Halichondria panicea* survives the winter in a normal, active state in the Oosterschelde.

Balanus crenatus produces a single, large brood annually with peak larval supply in April –May (Salman, 1982). Although subsidiary broods may be produced, the first large brood is the most important for larval supply (Salman, 1982; Barnes & Barnes, 1968). *Balanus crenatus* has a lifespan of 18 months (Barnes & Powell, 1953) and grows rapidly (except in winter). *Balanus crenatus* is a typical early colonizer of sublittoral rock surfaces (Kitching, 1937); for example, it heavily colonized a site that was dredged for gravel within 7 months (Kenny & Rees, 1994). *Balanus crenatus* colonized settlement plates or artificial reefs within 1-3 months of deployment in summer, and became abundant on settlement plates shortly afterwards (Brault & Bourget, 1985; Hatcher, 1998). The ship, *HMS Scylla*, was colonized by *Balanus crenatus* 4 weeks after sinking in March. The timing of the sinking in March would have ensured a good larval supply from the spring spawning. The presence of adult *Balanus crenatus* enhances the settlement rate of larvae on artificial panels (Miron *et al*., 1996), so that surviving adults enhance recovery rates.

Resilience assessment. The biotope is likely to undergo annual changes in algal biomass and assemblage structure with the silt tolerant and perennial foliose red algae being the more stable elements. Where resistance is 'High' resilience is assessed as 'High' by default. Where resistance is 'Medium' then recovery is considered to be 'High' based on recolonization from the remaining population of annual and perennial algae. However where resistance is 'Low' or 'None' and the key characterizing species are likely to be removed over a wide area then resilience is assessed as 'Medium'. The associated sponge species, *Balanus crentus* ascidians and bryozoans are opportunistic colonizers of bare rock and are likely to recover rapidly following impacts. Although some changes in species richness, biomass and diversity may occur following an impact, the inherent variability of this biotope means that recovery may be considered to have occurred where foliose red algae, rather than the associated invertebrate species have recolonized.

NB: The resilience and the ability to recover from human induced pressures is a combination of the environmental conditions of the site, the frequency (repeated disturbances versus a one-off event) and the intensity of the disturbance. Recovery of impacted populations will always be mediated by stochastic events and processes acting over different scales including, but not limited to, local habitat conditions, further impacts and processes such as larval-supply and recruitment between populations. Full recovery is defined as the return to the state of the habitat that existed prior to impact. This does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognizable as the initial habitat of interest. It should be noted that the recovery rates are only indicative of the recovery potential.

Hydrological Pressures

	Resistance	Resilience	Sensitivity
Temperature increase (local)	Medium Q: High A: Medium C: High	High Q: High A: Low C: Medium	Low Q: High A: Low C: Medium

The key characterizing red algal species found in this biotope have a range of geographic distributions with some having a 'southern distribution' with their range encompassing warmer waters and others having a 'northern' distribution. Temperature tolerances are therefore likely to vary between species so that long-term changes in temperature have the potential to shift the species composition of this biotope to one more suited to the prevailing thermal regime. This biotope occurs in the subtidal and is therefore protected from exposure to air so that the thermal regime is more stable and desiccation is not a factor. Examples of distribution and thermal tolerances tested in laboratory experiments are provided as evidence to support the sensitivity assessment. Populations can acclimate to prevailing conditions (Davison, 1991; Lohrmann *et al*., 2004) which can alter tolerance thresholds and care should be used when interpreting reported tolerances.

A number of the characterizing red algae species found in the biotope such as *Cryptopleura ramosa*, and *Griffithsia devoniensis are* close to the northern edge of their reported distribution range in the UK (Kain, 1982; Guiry & Guiry, 2015; Hiscock & Maggs, 1984). *Cryptopleura ramosa*, for example, is more common on southern shores of the UK (see MarLIN) and its distribution appears to be southern with worldwide records but none, from Canada, Scandinavia, Russia the Arctic or Antarctic (Guiry & Guiry, 2015) suggesting that it is likely to tolerate increased temperatures more successfully than decreased. Based on the geographic range these species are considered more likely to tolerate chronic and acute increases in temperature at the pressure benchmark and a long-term change exceeding the pressure benchmark may increase habitat suitability. For example *Hypoglossum hypoglossoides* has recently expanded its range to Norway in response to warming temperatures (Husa, 2007). Tolerances within the southern group of red algae may vary, *Cryptopleura ramosa*, for example, is capable of surviving at 27 °C, (Gessner, 1970). (It should be noted that this temperature increase exceeds that of the benchmark level).

The associated *Ulva* spp. are distributed globally and occur in warmer waters than those surrounding the UK suggesting that they can withstand increases in temperature at the pressure benchmark. *Ulva* spp. are characteristic of upper shore rock pools, where water and air temperatures are greatly elevated on hot days. Empirical evidence for thermal tolerance to anthropogenic increases in temperature is provided by the effects of heated effluents on rocky shore communities in Maine, USA. *Ascophyllum* and *Fucus* were eliminated from a rocky shore heated to 27-30 °C by a power station whilst *Ulva intestinalis* (as *Enteromorpha intestinalis*) increased significantly near the outfall (Vadas *et al*., 1976).

Balanus crenatus is a boreal species (Newman & Ross, 1976) it found throughout the northeast Atlantic from the Arctic to the west coast of France as far south as Bordeaux; east and west coasts of North America and Japan. In Queens Dock, Swansea where the water was on average 10°C higher than average due to the effects of a condenser effluent, *Balanus crenatus* was replaced by the subtropical barnacle *Balanus amphitrite*. After the water temperature cooled *Balanus crenatus* returned (Naylor, 1965). The upper temperature limit for this species is about 25°C (Southward, 1955; (Davenport & Davenport, 2005).

Sensitivity assessment. Typical surface water temperatures around the UK coast vary, seasonally from 4-19°C (Huthnance, 2010). The characterizing filamentous and foliose red algae are considered likely to be tolerant of an acute or chronic change at the pressure benchmark, with most species, particularly those with a southern distribution, able to tolerate an acute increase in temperature greater than the pressure benchmark (Gessner, 1970). An acute increase of 5°C in summer would be close to the lethal thermal temperature for *Balanus crenatus* and some losses of this species may occur but these would not alter biotope classification. Biotope resistance is assessed as 'Medium' as there may be some changes in species composition and abundance but the biotope is likely to still be recognisable and the changes within natural fluctuation, resilience is assessed as **'High'**. This biotope is therefore considered to have 'Low' sensitivity at the pressure benchmark.

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

The key characterizing red algal species found in this biotope have a range of geographic distributions with some having a 'southern distribution' with their range encompassing warmer waters and others having a 'northern' distribution. Temperature tolerances are therefore likely to vary between species so that long-term changes in temperature have the potential to shift the species composition of this biotope to one more suited to the prevailing thermal regime. Examples of distribution and thermal tolerances tested in laboratory experiments are provided as evidence to support the sensitivity assessment. Populations can acclimate to prevailing conditions (Davison, 1991; Lohrmann *et al*., 2004) which can alter tolerance thresholds.

A number of the red algal species found in the biotope such as *Cryptopleura ramosa*, and *Griffithsia devoniensis* are close to the northern edge of their reported distribution range in the UK (Kain, 1982, Guiry & Guiry, 2015). *Cryptopleura ramosa*, for example, is more common on southern shores of the UK (see MarLIN) and its distribution appears to be southern with worldwide records but none, from Canada, Scandinavia, Russia the Arctic or Antarctic (Guiry & Guiry, 2015) suggesting that it is likely to tolerate increased temperatures more successfully than decreased. Tolerance of reductions in temperature will vary within this group. In experiments, *Cryptopleura ramosa* were partially or completely killed at 5 °C. Other species had a greater cold tolerance with *Plocamium cartilagineum* surviving at -2 °C (Gessner, 1970).

Species that occur north and south of the UK are considered to be eurythermal and tolerant of a range of temperatures. Laboratory experiments have demonstrated that *Phycodrys rubens* has a greater tolerance of freezing temperatures than species with a southern distribution as mortality occurred only at temperatures of -3°C to -5°C (Gessner, 1970).

Crisp (1964) studied the effects of an unusually cold winter (1962-3) when average temperatures were 5 to 6°C below normal on the marine life in Britain. *Balanus crenatus* were unaffected but *Halichondria panicea* were wholly or partly killed by frost. The tolerance of *Balanus crenatus* collected from the lower intertidal in the winter (and thus acclimated to lower temperatures) to low temperatures was tested in the laboratory. The median lower lethal temperature tolerance was -1.4°C (Davenport & Davenport, 2005).

Sensitivity assessment. The characterizing red algae are considered to be tolerant of an acute or chronic decrease in temperature at the pressure benchmark, with some species, particularly those with a northern distribution, able to tolerate an acute decrease in temperature greater than the pressure benchmark (Gessner, 1970). Changes in temperature may result in some shifts in community structure where thermal tolerances are exceeded and more sensitive species die but these changes are not considered to alter the overall character of the biotope. The filamentous red algae die-off in winter and a decrease in winter temeprature may have little observable effect. Resistance is therefore assessed as 'High' and resilience as 'High' (by default) based on the red algae. This biotope is therefore considered to be 'Not sensitive' at the pressure benchmark.

Salinity increase (local)	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

The biotope IR.MIR.KT.FilRVS is found in variable salinity (18-35 ppt habitats (JNCC, 2015). An increase at the pressure benchmark refers to an increase in salinity to full salinity (30-35 ppt). Some species that are present such as the red algae *Cryptopleura ramosa* and *Hypoglossum hypoglossoides*, green algae and sponges and barnacles and are tolerant of both variable and full salinity and would be likely to be directly affected by a change in salinity. The variable salinity, in combination with the high turbidity and siltation, is considered to be a key factor structuring this biotope. A change to full salinity would allow species that cannot tolerate lower salinities to colonise and may increase the level of competition for space between macroalgae and may allow grazers to colonize, leading to changes in assemblage character. The high levels of turbidity and siltation would structure this biotope and the low levels of light may prevent extensive colonization by kelps. Where colonists could reach this biotope, it may become more characteristic of a full salinity biotope that experiences high turbidity such as IR.MIR.KR.XFoR. Colonisation by silt tolerant red algae that have perennial holdfasts/bases such as *Calliblepharis ciliata* (Guiry & Guiry, 2015) and *Plocamium cartilagineum*, could lead to reduction in cover or elimination of filamentous red algae due to competition for space..

Sensitivity assessment. No evidence was found to assess the tolerance of the characterizing red algae at the pressure benchmark and the distribution is used to infer sensitivity. Increases in salinity are likely to be tolerated by the characterizing and associated species present. However, increased salinity is likely to lead to an increase in species richness and increased competition between red algae for space and this could lead to biotope classification. Resistance is therefore assessed as 'Low' and recovery as 'High' (following restoration of usual salinity). Sensitivity is therefore assessed as 'Low'.

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

A reduction in salinity at the pressure benchmark refers to a change from variable (18-35) to low (<18 ppt) salinity. In shallower areas where light penetration allows a reduction in salinity at the pressure benchmark may lead to replacement of filamentous red algae by filamentous green algae to a biotope similar to SS.SMp.KSwSS.FilG. The filamentous green algae Ulva spp., *Chaetomorpha linum*, *Cladophora liniformis* or *Rhizoclonium riparium* are very euryhalina and tolerant of low salinity habitats.

Sensitivity assessment. No evidence was found for low salinity tolerances of the filamentous red algae, it is likely that a change at the pressure benchmark would lead to increased dominance by filamentous green algae able to tolerate the changed habitat conditions, although some filamentous red algae may still be present. As the biotope classification is likely to change, biotope resistance is assessed as 'Low' and resilience as 'Medium' following restoration of habitat conditions. Biotope sensitivity is therefore 'Medium'.

Water flow (tidal current) changes (local)	High Q: High A: Medium C: High	High Q: High A: High C: High	Not sensitive Q: High A: Medium C: High

This biotope occurs where tidal streams are moderately strong (0.5-1.5 m/s). As water velocity increases foliose macroalgae can flex and reconfigure to reduce the size of the alga when aligned with the direction of flow, this minimises drag and hence the risk of dislodgement (Boller & Carrington, 2007). These characteristics allow these species to persist in areas that experience a range of flow speeds. Biogenic habitat structures, including the fronds of algae, reduce the effects of water flows on individuals by slowing and disrupting flow. Boller and Carrington (2006) found that the canopy created by a turf of *Chondrus crispus* reduced drag forces on individual plants by 15-65%. Filamentous red algae are likely to offer less water resistance than foliose and to withstand changes in flow.

Turbidity and siltation are key factors structuring this biotope (JNCC, 2015), changes in the flow may increase or decrease sediment transport and alter levels of associated scour and siltation. Reductions in flow in areas where currents are weakest may lead to increased deposition of silts, whereas an increase in water flow at the pressure benchmark may re-suspend and remove particles which are less cohesive than mud particles. The level of impact will depend on site specific hydrodynamic and sediment conditions. Some periodic movement of silts and changes in coverage is likely to be part of the natural temporal variation and the species present are typical of silted habitats (Gorostiaga & Díez, 1996).

The barnacles, sponges and ascidians are suspension feeders relying on water currents to supply food. These taxa thrive in conditions of vigorous water flow e.g. around Orkney and St Abbs, Scotland, where the community may experience tidal currents of 3 and 4 knots (1.5-2 m/s) during spring tides (Kluijver, 1993). *Balanus crenatus* is found in a very wide range of water flows (Tillin & Tyler-Walters, 2014), and can adapt feeding behaviour according to flow rates (Eckman & Duggins, 1993).

Sensitivity assessment. As the biotope can occur in a range of flow speeds from 0.5-1.5 m/s, resistance of the biotope to changes in water flow at the pressure benchmark, is assessed as 'High' although suspension feeders may suffer some reduction in feeding efficiency. Resilience is assessed as 'High' (by default) so that the biotope is assessed as 'Not sensitive'.

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 (group) which is restricted to fully subtidal habitats.

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

This biotope is found in extremely wave sheltered conditions (JNCC, 2015). Key environmental factors structuring this biotope are variable salinity and turbidity and water movement from tidal streams (JNCC, 2015). The characterizing and associated species can be found in biotopes where wave exposure exceeds that experienced by this biotope. A more severe increase in wave action, that exceeds the pressure benchmark, could cause some damage to fronds of filamentous red and green algae resulting in reduced photosynthesis and compromised growth. Furthermore, individuals may be damaged or dislodged by scouring from sediments mobilized by increased wave action (Hiscock, 1983).

The associated suspension feeders such as *Halichondria panicea* occur across a range of wave exposures and are unlikely to be affected by a change in wave exposure at the pressure benchmark. B*alanus crenatus* are firmly attached to the substratum and are unlikely to be dislodged by an increase in wave action at the pressure benchmark. These species are found in biotopes from a range of wave exposures from extremely sheltered to very exposed and were therefore considered 'Not sensitive' to this pressure (at the pressure benchmark, by a previous review (Tillin & Tyler-Walters, 2014).

Sensitivity assessment. This biotope occurs in sheltered areas that are exposed to moderately strong tidal streams and therefore has some tolerance for water movements. An increase or decrease in wave height at the pressure benchmark, will be very small and it is considered unlikely that the biotope will be affected. Therefore, both the resistance and resilience have been assessed as 'High', resulting in a 'Not sensitive' assessment.

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.

Contamination at levels greater than the pressure benchmark may adversely impact the biotope. No information was found concerning the effects of heavy metals on turf forming and encrusting coralline algae. Bryan (1984) suggested that the general order for heavy metal toxicity in seaweeds is: organic Hg> inorganic Hg > Cu > Ag > Zn> Cd>Pb. Contamination at levels greater than the pressure benchmark may adversely impact the biotope. Cole *et al*. (1999) reported that Hg was very toxic to macrophytes. The sub-lethal effects of Hg (organic and inorganic) on the sporelings of an intertidal red algae, *Plumaria elegans*, were reported by Boney (1971). 100% growth inhibition was caused by 1 ppm Hg.

Uptake of heavy metals from solution by seaweed is influenced by factors such as light, algal nitrogen content, frond age, length of emersion, temperature, salinity, season of the year and presence of other pollutants in the surrounding water (see Lobban & Harrison, 1997) and consequently seaweeds may not accurately reflect metal concentrations in the surrounding water. The order of metal toxicity to algae varies with the algal species and the experimental conditions, but, generally, the order is Hg>Cu>Cd>Ag>Pb>Zn (Rice *et al*., 1973; Rai *et al*., 1981).

Whilst some sponges, such as *Cliona* spp. have been used to monitor heavy metals by looking at the associated bacterial community (Marques *et al*., 2007; Bauvais *et al*., 2015), no literature on the effects of transition element or organo-metal pollutants on the characterizing sponges could be found.

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.

O'Brien & Dixon (1976) concluded that red algae were the most sensitive group of algae to hydrocarbon or dispersant contamination, possibly attributable to the susceptibility of the photosynthetic pigment phycoerythrin to chemical damage. Following a series of laboratory and field experiments Grandy (1984) reported *Delesseria sanguinea*, *Cryptopleura ramosa*, *Phycodrys rubens* and *Plocamium cartilagineum* to be sensitive to oil/dispersant mixtures; *Cryptopleura ramosa* and *Plocamium cartilagineum* were the most sensitive and *Phycodrys rubens* the least sensitive. In toxicity experiments, Smith (1968) found *Delesseria sanguinea* to be particularly intolerant of the oil dispersant BP 1002; 10 ppm of BP 1002 was lethal to the species. Heavy mortality of *Delesseria sanguinea* was also observed down to a depth of 12 m after the *Torrey Canyon* oil spill (Drew *et al*., 1967). However, experience during the *Torrey Canyon* oil spill seems to be exceptional. As after the *Esso Bernicia* spill in 1978 in the Sullom Voe and heavy use of dispersants on significant quantities of oil, practically no damage to shallow (< 5 m) red algae could be found in Martins Haven (K. Hiscock, pers. comm.).

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.

Contamination at levels greater than the pressure benchmark may adversely impact the biotope. Cole *et al*. (1999) suggested that herbicides were (not surprisingly) very toxic to algae and macrophytes. Hoare & Hiscock (1974) noted that with the exception of Phyllophora species, all red algae including encrusting coralline forms, were excluded from the vicinity of an acidified halogenated effluent discharge in Amlwch Bay, Anglesey. Chamberlain (1996) observed that although *Lithophyllum incrustans* was quickly affected by oil during the Sea Empress spill, recovery occurred within about a year. The oil was found to have destroyed about one third of the thallus thickness but regeneration occurred from thallus filaments below the damaged area.

O'Brien & Dixon (1976) report that red algae are effective indicators of detergent damage since they undergo colour changes when exposed to relatively low concentrations. Smith (1968) reported that 10 ppm of the oil dispersive detergent BP 1002 killed the majority of specimens in 24hrs in toxicity tests. However, the effects take several days to manifest; when killed the algae turn bright orange.

Radionuclide contamination	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

Some algal species are known to be able to acquire large concentrations of substances from surrounding water. In the vicinity of the Sellafield nuclear plant, England, *Ulva* (as *Enteromorpha*) sp. accumulated zirconium, niobium, cerium and plutonium-239, however, the species appeared to be unaffected by the radionuclides (Clark, 1997). No evidence was found to assess the key characterizing filamentous red algae and this pressure is not assessed.

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	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

The effects of reduced oxygenation on the red algae within the biotope are not well studied. Lack of oxygen may impair both respiration and photosynthesis (Vidaver, 1972). This pressure is not assessed due to the lack of evidence.

	Resistance	Resilience	Sensitivity
Nutrient enrichment	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

This pressure relates to increased levels of nitrogen, phosphorus and silicon in the marine environment compared to background concentrations. The pressure benchmark is set at compliance with Water Framework Directive (WFD) criteria for good status, based on nitrogen concentration (UKTAG, 2014).

Sensitivity assessment. If nutrient levels were to increase (exceeding the pressure benchmark) enhanced growth of the filamentous red algae and *Cladophora* and *Ulva* spp. would be expected in response and this is not considered to significantly alter the character of the biotope. The characterizing red algae may decline in response to reductions in nutrient levels in habitats where other species more typical of undisturbed species are able to recolonize. However, as this biotope is structured by low salinity and high levels of turbidity and siltation, other species are not considered to establish following decreases in nutrient levels. The biotope is therefore considered to have 'High' resistance to this pressure and 'High' resilience, (by default) and is assessed as 'Not sensitive'.

	Resistance	Resilience	Sensitivity
Organic enrichment	High Q: High A: High C: NR	High Q: High A: High C: High	Not sensitive Q: High A: High C: Low

The red and green algae are unlikely to be directly affected by high levels of organic pollution. In an area polluted by industrial and domestic sewage with high levels of total suspended solids and metal;s red algae including *Calithamnion neglectum*, and *Ceramium diaphanum* were important cover species (Gorostiaga & Díez, 1996). The suspension feeding animals found within the biotope may be able to utilise the input of organic matter as food, or are likely to be tolerant of inputs at the benchmark level. In a recent review, assigning species to groups based on tolerances to organic pollution, the sponge *Halichondria panicea* were assigned to AMBI Group II described as 'species indifferent to enrichment, always present in low densities with non-significant variations with time, from initial state, to slight unbalance' (Gittenberger & van Loon, 2011). *Ascidia mentula* has been reported in Iberian bays subject to both nutrient-rich upwelling events and anthropogenic pollution (Aneiros *et al*., 2015). There is some suggestion that there are possible benefits to ascidians from increased organic content of water; ascidian 'richness' in Algeciras Bay was found to increase in higher concentrations of suspended organic matter (Naranjo *et al.* 1996).

Sensitivity assessment. Based on resistance to sedimentation, exposure to wave action, and the dominance of red algal turfs in areas subject to sewage inputs, resistance is assessed as 'High' and resilience as 'High' (by default). The biotope is therefore considered to be 'Not sensitive' to this pressure at the benchmark.

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

The loss of hard substratum would alter the habitat and sediments would be unsuitable for the red algae that characterize this biotope. Other associated species such as sponges would also be lost as these are associated with rock habitats. Artificial hard substratum may also differ in character from natural hard substratum, so that replacement of natural surfaces with artificial may lead to changes in the biotope through changes in species composition, richness and diversity (Green *et al*., 2012; Firth *et al*., 2013) or the presence of non-native species (Bulleri & Airoldi, 2005). Many species have specific preferences for substratum type.

Sensitivity assessment. Based on the loss of suitable habitat, resistance is assessed as 'None' recovery is assessed as 'Very Low' as the change at the pressure benchmark is permanent. Sensitivity is therefore 'High'.

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

Not relevant to biotopes occurring on bedrock.

Habitat structure changes - removal of substratum (extraction)	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 species characterizing this biotope are epifauna or epiflora occurring on rock and would be sensitive to the removal of the habitat. However, extraction of rock substratum is considered unlikely and this pressure is considered to be 'Not relevant' to hard substratum habitats.

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

No direct evidence for the sensitivity of filamentous and foliose red algae was found to support assessment of this pressure. The species characterizing this biotope occur on the rock and therefore have no protection from abrasion at the surface. In a recent review, assigning species to groups based on tolerances to bottom disturbance from fisheries, the sponge *Halichondria panicea* were assigned to AMBI Fisheries Group II, described as 'species sensitive to fisheries in which the bottom is disturbed, but their populations recover relatively quickly' (Gittenberger & van Loon, 2011).Whilst a large proportion of the sponge community is likely to be affected by abrasion events, there is some debate as it the level of effects depending on the size of the sponge and the type of abrasion effect (see Freese *et al*., 1999 and Coleman *et al*., 2013). The majority of the literature agrees that damage would fall within the 'Low' bracket of 25-75% reduction.

Sensitivity assessment. The impact of surface abrasion will depend on the footprint, duration and magnitude of the pressure. In response to a single event of abrasion a proportion of the populations of the characterizing and associated species may be removed, but damaged algal individuals, *in-situ* would be capable of growth and reproduction. Resistance of the biotope, to a single abrasion event is assessed as 'Low' and recovery as 'High', so that sensitivity is assessed as 'Low'.

Penetration or disturbance of the substratum subsurface	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 species characterizing this biotope are epifauna or epiflora occurring on rock and would be sensitive to the removal of the habitat. However, extraction of rock substratum is considered unlikely and this pressure is considered to be 'Not relevant' to hard substratum habitats.

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

This biotope occurs in habitats exposed to high levels of turbidity and siltation (JNCC, 2015) and it is likely that the biotope is exposed to chronic or intermittent episodes of high-levels of suspended solids as local sediments are re-mobilised and transported. A significant increase in suspended solids may result in smothering (see siltation pressures) where these are deposited. This biotope is considered, based on the JNCC (2015) description, to experience medium turbidity (100-300 mg/l) based on the UK TAG (2014) categories. An increase at the pressure benchmark refers to a change from medium turbidity (100-300 mg/l) to very turbid (>300 mg/l) and a decrease is assessed as a change to intermediate turbidity (10-100 mg/l) based on UK TAG (2014). The filamentous red algae present in this biotope are characteristic of areas with high turbidity and siltation that are unsuitable for other species. In an area polluted by industrial and domestic sewage with high levels of total suspended solids and 'very heavy silt levels) the only algae present were filamentous red algae including *Pterothamnion plumula*, that characterizes the assessed biotope (Gorostiaga & Díez, 1996). Following improvements in water quality this site was colonized by foliose red algae resistant to high levels of sedimentation, (that are also recorded in the assessed biotope), *Hypoglossum hypoglossoides* and *Erythroglossum laciniatum* (Gorostiaga & Díez, 1996).

In general, this biotope is considered to be relatively tolerant of high levels of suspended solids as increases in the cover of sediment trapping, turf forming red algae at the expense of canopy forming species has been observed worldwide, in temperate systems, linked to increased suspended solids resulting from human activities (Airoldi, 2003). An accumulation of sediment within the turf may attract more sediment dwelling interstitial invertebrates such as nematodes, harpacticoids and polychaetes, although in more wave exposed locations accumulation of sediment is likely to be minimal as wave action removes sediments. Increased suspended sediments may result in increased scour, which may adversely affect foliose red algae, and interfere with settling spores and recruitment of the factor is coincident with their major reproductive period. Tolhurst *et al*. (2007) found that *Ulva intestinalis* germlings kept in tanks and exposed to 100 mg/l of suspended sediment showed reduced growth. Similarly, Hyslop & Davies (1998) found that the green alga *Ulva lactuca* lost weight when kept in flasks with 1 g/l of colliery waste that was shaken for 1 hour every day for 8 days. The experimental solids level, however, exceeds the pressure benchmark and Ulva are very thin species and are probably more susceptible to scour damage than the red algae.

The critical depth for the growth of kelp plants is at about 1% of surface illumination, and for foliose red algae about 0.1% (Luning & Dring, 1979). An increase in light penetration due to reduced turbidity could either allow kelps to establish while a decrease in light penetration could reduce habitat suitability for the characterizing red algae leading to the development of an animal dominated (circalittoral) assemblage type. Some changes in the height at which this biotope is found at could, therefore, occur in response to changes in light levels.

Increases in suspended sediments may impact filter feeders such as *Halichondria panicea* within the biotope by reducing feeding efficiency, however, an increase in organic solids would supply more food. *Halichondria panicea* is found in highly turbid areas associated with biotopes such as CR.MCR.SfR.Pol (Connor *et al*., 2004) and are therefore considered to be unaffected by an increase in turbidity at the benchmark. Many encrusting sponges appear to be able survive in highly sedimented conditions (Schönberg, 2015; Bell & Barnes 2000; Bell & Smith 2004). Castric-Fey & Chassé (1991) conducted a factorial analysis of the subtidal rocky ecology near Brest, France and rated the distribution of species in varying turbidity (corroborated by the depth at which laminarians disappeared); *Dysidea fragilis*, had a strong preference for turbid water. Storr (1976) observed the sponge *Sphecispongia vesparium* back washing to eject sediment and noted that other sponges (such as *Condrilla nucula*) use secretions to remove settled material.

Sensitivity assessment. Overall biotope resistance is assessed as 'Medium' to an increase in suspended solids, as increased scour may reduce the biomass of red algae and may remove some individuals or species that are more sensitive. However, the encrusting corallines and some red algae are considered likely to survive. Resilience is categorised as 'High' as some adults are likely to remain *in situ* from which recruitment can occur. The biotope is considered to be 'Not sensitive' to decreased suspended solids where scour and abrasion are unaffected. A reduction in turbidity and scour may allow less scour tolerant species and those adapted to higher light levels, such as kelps, to colonize the biotope. Resistance to a decrease in suspended solids, accompanied by a significant reduction in scour is assessed as 'Medium' as space pre-emption by foliose red algae is likely to limit colonization. Resilience (following a return to previous habitat conditions) is assessed as 'High' as adjacent populations in deeper waters may support recolonisation. Sensitivity is therefore assessed as 'Low'.

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

This biotope occurs on silted areas where high levels of turbidity and siltation (JNCC, 2015) and the red algae and other associated species are tolerant of low-levels of siltation. Increased abundance of red algal turfs worldwide has been linked to sediment perturbations although not all the pathways and mechanisms of these effects are clear (see review by Airoldi, 2003). However, even tolerant organisms would eventually suffer from inhibition and mortality following smothering although the thresholds for these effects has not been identified (Airoldi, 2003).

The filamentous red algae present in this biotope are characteristic of areas with high turbidity and siltation that are unsuitable for other species. In an area polluted by industrial and domestic sewage with high levels of total suspended solids and 'very heavy silt levels) the only algae present were filamentous red algae including *Pterothamnion plumula*, that characterizes the assessed biotope (Gorostiaga & Díez, 1996). Following improvements in water quality this site was colonized by foliose red algae resistant to high levels of sedimentation, (that are also recorded in the assessed biotope), *Hypoglossum hypoglossoides* and *Erythroglossum laciniatum* (Gorostiaga & Díez, 1996).

In an experimental study, Balata *et al*. (2007) enhanced sedimentation on experimental plots in the Mediterranean (close to Tuscany) by adding 400 g of fine sediment every 45 days on plots of 400 cm^2 for 1 year. Nearby sites with higher and lower levels of sedimentation were assessed as control plots. Some clear trends were observed. Foliose algae, in general, were present in much greater abundances in areas with low sedimentation (mean cover of approximately 13% and 19%) and much reduced at experimental sites and those with high natural sedimentation (mean cover of approximately 2-3 %). Some species of filamentous algae increased where sediment loads were naturally high or experimentally enhanced (Balata *et al*., 2007). The experiment relates to chronic low levels of sedimentation rather than a single acute event, as in the pressure benchmark, however the trends observed are considered to have some relevance to the pressure assessment.

As small, sessile species attached to the substratum, siltation at the pressure benchmark would bury *Balanus crenatus* . Holme and Wilson (1985) described a *Pomatoceros-Balanus* assemblage on 'hard surfaces subjected to periodic sever scour and 'deep submergence by sand or gravel' in the English Channel. They inferred that the *Pomatoceros-Balanus* assemblage was restricted to fast-growing settlers able to establish themselves in short periods of stability during summer months (Holme and Wilson, 1985), as all fauna were removed in the winter months. Barnacles may stop filtration after silt layers of a few millimetres have been discharged as the feeding apparatus is very close to the sediment surface (Witt *et al*., 2004). In dredge disposal areas in the Weser estuary, Germany, where the modelled exposure to sedimentation was 10mm for 25 days, with the centre of the disposal ground exposed to 65 mm for several hours before dispersal, *Balanus crenatus* declined in abundance compared to reference areas. (Witt *et al*., 2004). However, separating the effect of sedimentation from increased suspended solids and changes in sediment from sediment dumping was problematic (Witt *et al*., 2004).

Despite sediment being considered to have a negative impact on suspension feeders (Gerrodette & Flechsig 1979), many encrusting sponges appear to be able survive in highly sedimented conditions, and, in fact, many species prefer such habitats (Schönberg, 2015; Bell & Barnes 2000; Bell & Smith 2004).

Sensitivity assessment. Based on the biotope exposure to water flow which will remobilise sediments and remove these, the growth form of the characterizing filamentous red algae and the presence of these algae and sponges in biotopes subject to sedimentation and scour (including the assessed biotope), biotope resistance to this pressure, at the benchmark, is assessed as 'High', resilience is assessed as 'High' (by default) and the biotope is considered to be 'Not sensitive'. The assessment considers that sediments are rapidly removed from the biotope and that the scour tolerance of the red algae and other species would prevent significant mortalities although some damage and abrasion may occur. However, if the deposit remained in place; i.e. due to the scale of the pressure or where biotopes were sheltered, or only seasonally subject to water movements or where water flows and wave action were reduced e.g. by the presence of tidal barrages, then resistance would be lower and sensitivity would be greater

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

The available evidence for siltation pressures is outlined for the 'light' deposition pressure. At the pressure benchmark 'heavy deposition' represents a considerable thickness of deposit. Complete burial of algal turf and associated animals would occur. Removal of the sediments by tidal currents would result in considerable scour. The effect of this pressure will be mediated by the length of exposure to the deposit.

Sensitivity assessment. Resistance is assessed as 'Low' as the impact on the characterizing and associated filamentous and foliose algal species and epifauna could be significant but may be mitigated by rapid removal. Resilience is assessed as 'High' based on vegetative re-growth and recolonisation from adjacent habitats. Biotope sensitivity is, therefore, assessed as 'Low'.

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	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence.

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	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The red algae are generally flexible in terms of light requirements and can acclimate to different levels of light intensity and quality. Red algae are shade tolerant, often occurring under a macroalgal canopy that reduces light penetration or subtidally where light penetration is limited by turbidity or depth. In areas of higher light levels, the fronds and bases may be lighter in colour due to bleaching (Colhart & Johansen, 1973). Other red algae in the biotope are flexible with regard to light levels and can also acclimate to different light levels

The critical depth for the growth of kelp plants is at about 1% of surface illumination, and for foliose red algae about 0.1% (Luning & Dring, 1979). An increase in light penetration could either allow kelps to establish or a decrease would reduce habitat suitability for the characterizing red algae leading to the development of an animal dominated (circalittoral) assemblage type.

Sensitivity assessment. As the key structuring and characterizing red algae species colonize a broad range of light environments, from intertidal to deeper sub tidal and shaded understorey habitats, the biotope is considered to have 'High' resistance and, by default, 'High' resilience and therefore is 'Not sensitive' to this pressure.

Barrier to species movement	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Barriers that reduce the degree of tidal excursion may alter larval supply to suitable habitats from source populations. Conversely the presence of barriers may enhance local population supply by preventing the loss of larvae from enclosed habitats. Barriers and changes in tidal excursion are not considered relevant to the characterizing red algae as species dispersal is limited by the rapid rate of settlement and vegetative growth from bases rather than reliance on recruitment from outside of populations. Resistance to this pressure is assessed as 'High' and resilience as 'High' by default. This biotope is therefore considered to be 'Not sensitive'.

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

Not relevant' to seabed habitats. NB. Collision by grounding vessels is addressed under 'surface abrasion.

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	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

Key characterizing species within this biotope are not cultivated or translocated. This pressure is therefore considered 'Not relevant' to this biotope group. The green algae associated with this biotope, *Cladophora* and *Ulva* spp. may be cultivated for use as biofilters to mitigate pollution, as biomass for biofuel generation or for pharmaceuticals and food. No information was found on current production in the UK and no evidence was found for the effects of gene flow between cultivated species and wild populations. As wild populations are widely distributed and water flow may aid dispersal of swarmers, populations are not considered to be genetically isolated.

Introduction or spread of invasive non-indigenous species	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The non-native hydroid, *Cordylophora caspia*, may compete directly with native species for food and space and is found in estuaries and brackish water (from 2-17psu), this biotope may therefore provide suitable habitat (Sweet, 2011i).

In Canada green sea fingers *Codium fragile fragile*, formerly *Codium fragile* subsp *tormentosoides*) has displaced native seaweed species and become the dominant canopy species in some areas, consequently altering community structure and composition, where conditions permit. Most significant impacts have occurred where algal diversity in the invaded area is low. In the UK algal diversity is high and green sea fingers has not yet occurred in nuisance densities (Sweet, 2011j). Generally this species occurs on more sheltered shores and in estuaries and the habitats in which this biotope occurs, where algal diversity is low, may potentially be colonized.

Sensitivity assessment. The low salinity habitat coupled with with high turbidity and siltation mean this biotope may not provide suitable habitat for many INIS. Based on the current lack of information on invasion by INIS resistance is assessed as 'High and resilience as 'High' by default so that the biotope is assessed as 'Not sensitive'. This assessment may require updating in the future as more information becomes available or as distribution patterns of INIS change.

Introduction of microbial pathogens	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence.

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 characterizing or associated species could theoretically be directly removed or damaged by static or mobile gears that are targeting other species. Direct, physical impacts are assessed through the abrasion pressure while the sensitivity assessment for this pressure considers any biological or ecological effects resulting from the removal of target species on this biotope. The species that characterize this biotope are not targeted commercially and there is no evidence to indicate that the biotope and characterizing and associated species have any dependencies on targeted species. This pressure is therefore considered to be 'Not relevant'.

Removal of non-target species	Low Q: Low A: NR C: NR	High Q: High A: Low C: High	Low Q: Low A: Low C: Low

Incidental removal of the key characterizing species and associated species would alter the character of the biotope. The biotope is characterized by filamentous and foliose red and green seaweeds and epifauna such as sponges and barnacles. The loss of the algae due to incidental removal as by-catch would alter the character of the habitat and result in the loss of species richness. The ecological services such as primary and secondary production and the habitat provided by these species would also be lost.

Sensitivity assessment. Removal of a large percentage of the characterising species resulting in bare rock would alter the character of the biotope, species richness and ecosystem function. Resistance is therefore assessed as 'Low' and recovery as 'High', so that sensitivity is assessed as 'Low'.

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