Flustra foliacea on slightly scoured silty circalittoral rock

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

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***Flustra foliacea* on slightly scoured silty circalittoral rock.**
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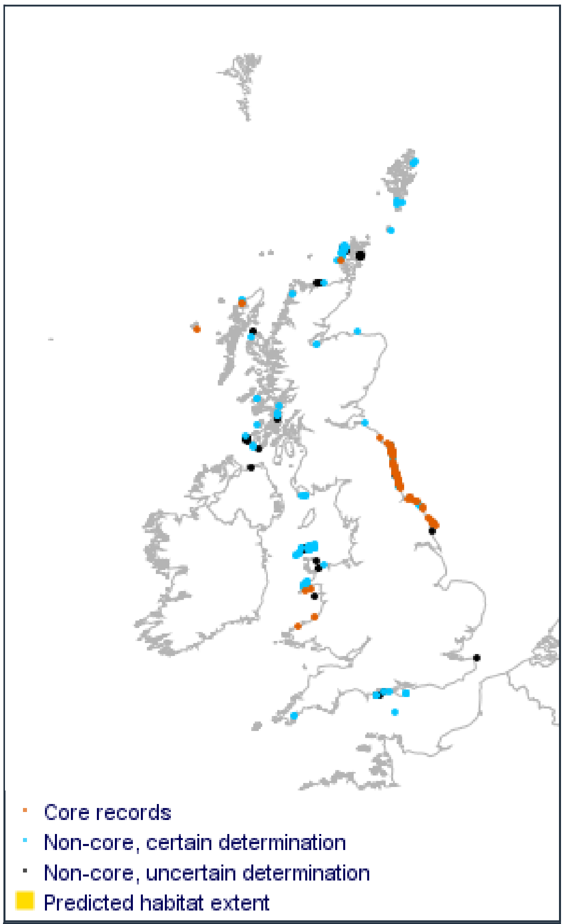

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by John Readman **Refereed by** This information is not refereed.

Summary

UK and Ireland classification

EUNIS 2008	A4.2141	*Flustra foliacea* on slightly scoured silty circalittoral rock
JNCC 2015	CR.MCR.EcCr.FaAlCr.Flu	*Flustra foliacea* on slightly scoured silty circalittoral rock
JNCC 2004	CR.MCR.EcCr.FaAlCr.Flu	*Flustra foliacea* on slightly scoured silty circalittoral rock
1997 Biotope	CR.MCR.ByH.Flu.Flu	*Flustra foliacea* on slightly scoured silty circalittoral rock or mixed substrata

Description

The biotope is characterized by the silt/scour-tolerant species *Flustra foliacea*. It is characteristic of the large bedrock terraces along the Northumberland coast which are generally fairly species-poor compared to similar situations on the west coasts which have more sponges, hydroids and bryozoans. *Thuiaria thuja* is often present, as are patches of *Sabellaria spinulosa* (see also Sspi). With increased turbidity, species-richness is lower, although the abundance of *Flustra foliacea* remains high. Similar assemblages occur on mixed substrata although these tend to be dominated by ephemeral hydroids (see Flu.SerHyd and SNemAdia). Other similar biotope include those dominated by ascidians (As), also characteristic of slight scour and turbidity, although they usually occur in different regions of the country tending to the west/Irish Sea. In increased tides, but more shelter, a similar biotope dominated by *Flustra* and a variety of sponges such as *Haliclona oculata* and *Halichondria panicea* occurs (Flu.Hocu).

Depth range

10-20 m, 20-30 m

Additional information

-

Listed By

- none -

Further information sources

Search on:

JNCC

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

These biotope occur on bedrock or boulders in moderately tide swept, moderately wave exposed conditions and are characteristically dominated by dense beds of *Flustra foliacea* (although other bryozoans may also be present). The CR.HCR.XFa.FluCoAs biotope complex is also characterized by the presence of colonial ascidians, including *Clavelina lepadiformis* and *Polyclinum aurantium*. CR.HCR.XFa.FluCoAs.Paur experiences greater suspended sediment levels and subsequent scour. Sand and silt are periodically re-suspended in the water column, resulting in scour-tolerant species being characteristic of these areas. Together with a dense covering of the scour-resistant bryozoan *Flustra foliacea*, the colonial ascidian *Polyclinum aurantium* commonly covers the rock surface at most locations within this biotope. CR.HCR.XFa.FluCoAs.X occurs on mixed substrata (including boulders, cobbles and pebbles). CR.HCR.XFa.FluCoAs.SmAs experiences lower wave exposure and is more species rich, with greater presence of colonial ascidians (such as *Clavelina lepadiformis*). CR.HCR.XFa.FluHocu occurs in deeper water and has a more impoverished appearance (especially the sponge component).

Therefore, the sensitivity of the biotope is based on *Flustra foliacea*, with *Haliclona oculata* and colonial ascidians (including *Clavelina lepadiformis* and *Polyclinum aurantium*) considered where appropriate. Assessments for the colonial ascidians generally focus on the well-studied *Clavelina lepadiformis*, given the lack of evidence for *Polyclinum aurantium.*

Resilience and recovery rates of habitat

Bryozoans are sessile fauna forming colonies through asexual budding following settlement of sexually produced larvae (Hayward & Ryland, 1995a). Larvae have a short pelagic lifetime of up to about 12 hours (Ryland, 1976). Recruitment is dependent on the supply of suitable, stable, hard substrata (Eggleston, 1972b; Ryland, 1976; Dyrynda, 1994)and the abundance of bryozoans is positively correlated with supply of stable hard substrata and hence with current strength (Eggleston, 1972b; Ryland, 1976). Even in the presence of available substratum, Ryland (1976) noted that significant recruitment in bryozoans only occurred in the proximity of breeding colonies.

Flustra foliacea is a coarse, foliaceous bryozoan that tends to be found on stones and shells, reaches 10 – 20 cm in height (Porter, 2012), is common to all coasts in northwest Europe (Hayward & Ryland, 1995a) and is found across all coasts in the British Isles (NBN, 2015). Stebbing (1971a) noted that *Flustra foliacea* on the Gower peninsular, South Wales had an annual growth season between March and November, with a dormant winter period, when no growth occurred, leading to a line forming across the fronds which can be used to age specimens. In the first year of growth, *Flustra foliacea* forms a flat encrustation on the substrata, from which erect growth begins in the second year (Porter, 2012) and can regularly reach 6 years of age, although 12 year old specimens were reported off the Gower Peninsula (Stebbing, 1971a; Ryland, 1976). Fortunato *et al.* (2013) compared numerous sets of growth data with their own observations and reported that colonies grow faster during the first couple of years (about 1.05 cm/year), with growth subsequently slowing. Colonies appeared to be able to regenerate areas of the frond which had been removed by grazing (Fortunato *et al*., 2013). Stebbing (1971a) reported that growth rates were reasonably consistent between samples, age classes and years. Stebbing (1971a) reported a mean increment in frond height of 16.8 mm/yr, whereas Eggleston (1972b) reported that annual lines were usually between 2-3cm apart in Isle of Man specimens, and Menon (1978) reported that Helgoland specimens reached an average of 21.2 mm in height at 2 years old and an average of 79.3 mm after 8 years. Silén (1981) reported that erect fronds grew in zooid number about 10-20 times that of the encrusting base. Menon (1978) reported that growth rates varied in specimens over 5 years old.

Silén (1981) reported that *Flustra foliacea* could repair physical damage (a notch) to its fronds within 5-10 days, and as long as the holdfast remained intact, *Flustra foliacea* would survive and grow back.

Flustra foliacea colonies are perennial, and potentially highly fecund with increasing colony size (Eggleston, 1972b) with ca 10,000 larvae released from a specimen of *Flustra foliacea* within 3 hrs (Dalyell, cited in Hincks, 1880). Once settled, new colonies of *Flustra foliacea* take at least 1 year to develop erect growth and 1-2 years to reach maturity, depending on environmental conditions (Tillin & Tyler Walters, 2014). Four years after sinking off Lundy, the *M.V. Roberts* was found to be colonized by erect bryozoans and hydroids, including occasional *Flustra foliacea*. Whilst Bryozoan larvae are typically very short lived, limiting recruitment to the immediate area surrounding breeding colonies, specimens experiencing strong water movement would improve dispersal potential, and may explain reports of *Flustra foliacea* colonizing a the *MV Roberts* (Hiscock, 1981; Tyler-Walters & Ballerstedt, 2007).

Fariñas-Franco *et al.* (2014) recorded the colonization of an artificial reef constructed of 16 tonnes of king scallop shells (*Pecten maximus*) deployed in Strangford Loch in February 2010. The reef was then seeded with translocated *Modiolus modiolus* in March 2010. Among other species, *Flustra foliacea* had colonized the reef within 6 months of the reef construction. *Flustra foliacea* was also recorded locally prior to construction of the reef, and therefore recruitment may have a local source.

Clavelina lepadiformis is a colonial ascidian that grows up to a height of 2 cm with zooids joined at the base by short stolons (Fish & Fish, 1992). Picton & Morrow (2004c) reported regression of Atlantic colonies in winter with re-growth occurring in spring. De Caralt *et al.* (2002) looked at the differences in *Clavelina lepadiformis* between Mediterranean populations inside and outside of harbours. The inner harbour population underwent rapid growth, reproducing both asexually and sexually throughout the year, resulting in a dense population that carpeted submersed surfaces, with large abundance fluctuations from one month to the next, suggesting multiple generations per year (De Caralt *et al.*, 2002). The outer population exhibited restricted growth but with less fluctuation between observation times.

Clavelina lepadiformis undergoes stolonic asexual budding. At the end of the sexual breeding season, towards the end of the summer, zooids disappear or are resorbed. Over winter the colony survives as 'winter buds' from which new zooids develop in spring (Berrill, 1950; Fish & Fish, 1996). In the winter months, when the zooids undergo de-differentiation, the resulting cylindrical bodies of many species of *Clavelinidae* are often found on rocky shores (Millar, 1970). *Clavelina lepadiformis* is considered an INIS species in the north west Atlantic (Reinhardt *et al.*, 2010). *Clavelina lepadiformis* grows from immature zooids to full size in two months (Riley, 2008).

Polyclinum aurantium colonies consist of irregular globular masses of zooids (10-15 mm thick by 20-50 mm across) irregularly arranged around common cloacal openings (Picton & Morrow, 2004b). Larvae are produced from May to October. The colony regresses into an overwintering phase when it divides and reproduces asexually before beginning to feed again in the spring.

Koopmans & Wijffels (2008) reported that growth of *Haliclona oculata* in the Netherlands was seasonal, with the highest average specific growth rate measured in May. The study noted that growth rate correlated with temperature, algal biomass (measured as chlorophyll a), carbon and nitrogen content in suspended particulate matter. Growth rate negatively correlated with salinity, ammonium, nitrate, nitrite, and phosphate. No correlation was found with dissolved organic carbon, suggesting that *Haliclona oculata* was more dependent on particulate organic carbon.

Koopmans & Wijffels (2008) monitored *Haliclona oculata* off the Dutch coast over a year. Mass mortality was recorded at the end of the summer (2006) with all sponges on and around the monitoring platform perishing. The reason for this death is not known but could be related to the relatively high temperature of the water. Summer 2006 was a warm summer with water temperatures rising to 23°C (normally approximately 20°C. In other years *Haliclona oculata* survived throughout the year (ANEMOON foundation data cited in Koopmans & Wijffels, 2008).

Haliclona oculata is a stalked to branching-erect sponge found in sheltered but fast-moving water or on vertical rock faces in exposed conditions (Ackers *et al*., 1992). It is found from the Arctic (Ackers *et al*., 1992), to the Mediterranean (Mustapha *et al*., 2003). Larvae (parenchymella) are produced in summer and autumn (July to November) (Wapstra & Van Soest, 1987) and *Haliclona oculata* can also reproduce asexually through fragmentation, with primmorphs forming, have a lifespan of 0.6 months (Sipkema *et al*., 2003). The typical lifespan of *Haliclona oculata* is unknown, however, populations in Fishers Island Sound were found to be reproductively active on an annual basis (reproductive structures present from March to June) over a three-year sampling period (Fell, 1974). Van Dolah *et al.* (1987) studied the effects on sponges and corals of one trawl event over a low-relief hard bottom habitat off Georgia, US. *Haliclona oculta* did not appear to be significantly affected and 12 months after trawling the abundance of sponges had increased to pre-trawl densities, or greater.

Resilience assessment

Bryozoans tend to be fast growing fauna that are capable of self-regeneration. Dispersal of the larvae is limited and whist it is likely that *Flustra foliacea* would recover rapidly, within 2 years (resilience of 'High'), from most levels of damage, but if more than 75% of the bryozoan population or habitat is removed (Resistance of 'None'), recovery could take longer, due to the limited dispersal potential of larvae, and a resilience of 'Medium' (2-10 years) is recorded in such cases. The colonial ascidians including *Clavelina lepadiformis* is more ephemeral, with some populations having multiple generations per year (De Caralt *et al*., 2002). When also taking into consideration the classification of *Clavelina lepadiformis* as an INIS species in the north west Atlantic, recovery is likely to be rapid and resilience is likely to be 'High'. *Haliclona oculata* has been shown to recover rapidly from low mortality events (Van Dolah *et al*., 1987), however lifespan and recovery from more significant mortality is unknown. Resilience of 'High' should be recorded in the event of no or low levels of mortality (resistance of 'High' or 'Medium'). A more cautious resilience assessment of 'Medium' should be recorded for lower levels of resistance ('Low' and 'None').

Overall, resilience is assessed as '**Medium**' (recovery within 2-10 years) for 'None' or 'Low' resistance and resilience is '**High**' for resistance of 'Medium' or 'High'.

Hydrological Pressures

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

Flustra foliacea is perennial (Stebbing, 1971a) and widespread throughout the British Isles (NBN, 2015). It is distributed across north-west Europe (Fish& Fish, 1996). Stebbing (1974) noted that *Flustra foliacea* on the Gower peninsular, South Wales had an annual growth season between March and November. *Polyclinum aurantium* is distributed across the British Isles and from Norway to the Mediterranean (Picton & Morrow, 2004b).

Reproduction of *Clavelina lepadiformis* is temperature dependant (Berrill, 1975; Millar, 1970). A change in temperature could affect time and duration of spawning, however, the distribution of *Clavelina lepadiformis* extends to the north and south of the British Isles from Norway to the Adriatic (Hayward & Ryland, 1996).

Sensitivity assessment

All characterizing species are not at their southerly limit in the British Isles. Resistance is '**High**', resilience is '**High**' and the biotope is '**Not sensitive**' at the benchmark level.

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

Flustra foliacea is perennial (Stebbing, 1971a) and widespread throughout the British Isles (NBN, 2015). It is distributed across north-west Europe (Fish& Fish, 1996). Stebbing (1974) noted that *Flustra foliacea* on the Gower peninsular, South Wales had an annual growth season between March and November, with a dormant winter period, when no growth occurred. Growth resumed in spring, leading to a line forming across the fronds which can be used to age specimens (Stebbing, 1971a).

Polyclinum aurantium regresses into an overwintering phase when it divides, reproducing asexually before beginning to feed again in the spring and is distributed across the British Isles and from Norway to the Mediterranean (Picton & Morrow, 2004).

Clavelina lepadiformis undergoes stolonic asexual budding. At the end of the sexual breeding season, towards the end of the summer, zooids disappear or are resorbed. Over winter the colony survives as 'winter buds' from which new zooids develop in spring (Berrill, 1950; Fish & Fish, 1996; Picton, 1997). In the winter months, when the zooids undergo de-differentiation, the resulting cylindrical bodies of many species of *Clavelinidae* are often found on rocky shores (Millar, 1970). During the severe winter of 1962-63, although no significant mortality of *Clavelina lepadiformis* was noted, Crisp (1964) found that many compound ascidians were retarded in renewal of the colony after 'winter budding', and some individuals may have been killed.

Sensitivity assessment

Flustra foliacea is not at its northerly limit in the British Isles and growth, which is halted in the winter, resumes in spring (Stebbing, 1971a). The characterizing species have mechanisms in place to cope with cold conditions and no evidence of mortality due to low temperature in the British Isles was found. Sensitivity is therefore assessed as '**High**', Resilience as '**High**' and the biotope is '**Not Sensitive'** at the benchmark level.

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

This biotope occurs in full salinity and an increase in salinity would result in hypersaline conditions. Soule & Soule (1979) cite Hastings (1927) who described the presence of five bryozoans in the Suez Canal at salinities of up to 49‰. No other evidence for bryozoans, including *Flustra foliacea*, in hypersaline conditions was found. Marin *et al.* (1998) describes the presence of *Dysidea fragilis* in a hypersaline coastal lagoon (42-47 g/l) in La Mar Menor, Spain. No other evidence could be found for characterizing sponges.

Sensitivity assessment

CR.HCR.XFa.FluCoAs and associated biotopes occur in the circalittoral and are recorded at full salinity. **No evidence** was found to assess the effects of hypersaline conditions on *Flustra foliacea* or other characterizing species.

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

Ryland (1970) reported that, with a few exceptions, the Gymnolaemata were stenohaline and restricted to full salinity (30-35 ppt), noting that reduced salinities resulted in an impoverished bryozoan fauna. *Flustra foliacea* appears to be restricted to areas with full salinity (Tyler-Walters & Ballerstedt, 2007; Budd, 2008).

Dyrynda (1994) noted that *Flustra foliacea* and *Alcyonidium diaphanum* were probably restricted to the vicinity of Poole Harbour entrance by their intolerance to reduced salinity.

No evidence for the presence of *Haliclona oculata* in lower salinity conditions was found, and the species appears to be limited to open coasts and the outer reaches of estuaries (Hawyard & Ryland, 1995a).

Clavelina lepadiformis can tolerate a relatively broad range of salinities from 14 – 35 psu (Millar, 1971).

Sensitivity assessment

Although protected from extreme changes in salinity due to their subtidal habitat, distribution suggests that hyposaline conditions would probably adversely affect *Flustra foliacea* and *Haliclona oculata*. Resistance is assessed as '**Low**', resilience as '**High**' and sensitivity as '**Low**'.

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

Water flow has been shown to be important for the development of bryozoan communities and the provision of suitable hard substrata for colonization (Eggleston, 1972b; Ryland, 1976). In addition, areas subject to high mass transport of water such as the Menai Strait and tidal rapids generally support large numbers of bryozoan species (Moore, 1977a). Although, active suspension feeders, their feeding currents are probably fairly localized and they are dependent on water flow to bring adequate food supplies within reach (McKinney, 1986). A substantial decrease in water flow will probably result in impaired growth due to a reduction in food availability, and an increased risk of siltation (Tyler-Walters, 2005).

Okamura (1984) reported that an increase in water flow from slow flow (1-2 cm/s) to fast flow (10-12 cm/s) reduced feeding efficiency in small colonies but not in large colonies of *Bugula stolonifera*.

Flustra foliacea colonies are flexible, robust and reach high abundances in areas subject to strong currents and tidal streams (Stebbing, 1971a; Eggleston, 1972b; Knight-Jones & Nelson-Smith, 1977; Hiscock, 1983, 1985b; Holme & Wilson, 1985). Dyrynda (1994) suggested that mature fronded colonies do not occur on unstable substratum due to the drag caused by their fronds, resulting in rafting of colonies on shells or the rolling of pebbles and cobbles and destruction of the colony. Dyrynda (1994) reported that the distribution of *Flustra foliacea* in the current swept entrance to Poole Harbour was restricted to circalittoral boulders, on which it dominated as nearly mono-specific stands. While the pumping activity of the lophophores provide the greatest proportion of the colonies food requirements (Hayward & Ryland, 1998), the current generated is probably localized and the colonies are likely to be dependent on water currents for food supply. *Flustra foliacea* abundance is lower in weak currents (Stebbing, 1971a). A significant decrease in water flow is likely to result in a decrease in the abundance of bryozoans.

Increased competition and sedimentation could also affect the community. Riisgard *et al.* (1993) discussed the low energy cost of filtration for sponges and concluded that passive current-induced filtration may be insignificant for sponges. Pumping and filtering occurs in choanocyte cells that generate water currents in sponges using flagella (De Vos *et al.*, 1991).

Clavelina lepadiformis thrives in areas where there is little water movement (Hiscock & Hoare, 1975; De Caralt *et al*., 2002). Naranjo *et al.* (1996) found that the species was dominant in a low rate of water renewal, excess silting and high suspended solid concentrations. High water flow rates may be detrimental to feeding ability and posture but are unlikely to cause detachment.

Sensitivity assessment

The CR.HCR.XFa.FluCoAs biotope complex occurs in a range of water flow conditions, from weak (>1kn) to strong (3-6kn) (Connor *et al*., 2004). *Flustra foliacea* has been reported in areas subject to high water flow, with greater abundance in stronger water flow (Stebbing , 1971a). Significant decrease in water flow would likely result in a reduction in the abundance of *Flustra foliacea*. But a change in flow benchmark level (0.1-0.2 m/s) are unlikely to result in mortality. Resistance is therefore assessed as '**High**', resilience as '**High**' and the biotope is '**Not sensitive'** at the benchmark level.

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

Water flow has been shown to be important for the development of bryozoan communities and the provision of suitable hard substrata for colonization (Eggleston, 1972b; Ryland, 1976). In addition, areas subject to high mass transport of water such as the Menai Strait and tidal rapids generally support large numbers of bryozoan species (Moore, 1977a). Although, active suspension feeders, their feeding currents are probably fairly localized and they are dependent on water flow to bring adequate food supplies within reach (McKinney, 1986). A substantial decrease in water flow will probably result in impaired growth due to a reduction in food availability, and an increased risk of siltation (Tyler-Walters, 2005).

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The CR.HCR.XFa.FluCoAs biotope complex occurs in a range of water flow conditions, from weak (>1kn) to strong (3-6kn) (Connor *et al.*, 2004). *Flustra foliacea* has been reported in areas subject to high water flow, with greater abundance in stronger water flow (Stebbing , 1971a). Significant decrease in water flow would likely result in a reduction in the abundance of *Flustra foliacea*, but changes at the benchmark level are unlikely to result in mortality. Resistance is therefore assessed as '**High**', resilience as '**High**' and the biotope is '**Not sensitive'** at the benchmark level.

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

Flustra foliacea occurs from very wave exposed to sheltered waters, although probably limited to deeper waters in very wave exposed conditions (Tyler-Walters & Ballerstedt, 2007). The oscillatory water flow generated by wave action may be more damaging than constant strong currents, e.g. strong wave action may generate an oscillatory flow of 2 m/s at 20 m (Hiscock, 1983, 1985). Dead colonies of *Flustra foliacea* are commonly found washed up, having been removed from its substratum by storms (Hayward & Ryland, 1995a). Whilst the biotope is circalittoral, a severe increase in wave exposure (e.g. storms) could affect bryozoans colonies.

Roberts *et al.* (2006) studied deep sponge reef communities (18-20 m) in sheltered and exposed locations in Australia. They reported greater diversity and cover (>40% cover) of sponges in wave-sheltered areas compared with a sparser and more temporal cover in exposed sites (25% cover). Erect sponges dominated the sheltered sites, while encrusting sponges dominated in exposed locations (Roberts *et al.*, 2006). Erect or massive sponge forms possess a relatively small basal area relative to volume and do poorly in high energy environments (Wulff, 1995; Bell & Barnes, 2000). *Haliclona oculata* is found in biotopes up to moderately exposed (Connor *et al.*, 2004)

Clavelina lepadiformis is tolerant of a wide range of exposure, but is most abundant in moderately exposed sites (Picton, 1997).

Sensitivity assessment:

The CR.HCR.XFa.FluCoAs biotope complex is exposed or moderately exposed to wave action (Connor *et al.*, 2004). Whilst there is evidence that storm damage has significantly affected *Flustra foliacea* populations (Cocito *et al.*, 1998b), changes in wave action at the benchmark level (a 3-5% change in significant wave height) are unlikely to be significant. Resistance is therefore recorded as '**High**', with resilience as '**High**' and the biotope is '**Not sensitive'** 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

Bryozoans are common members of the fouling community, and amongst those organisms most resistant to antifouling measures, such as copper containing anti-fouling paints (Soule & Soule, 1979; Holt *et al.*, 1995). Bryan & Gibbs (1991) reported that there was little evidence regarding TBT toxicity in bryozoa with the exception of the encrusting *Schizoporella errata*, which suffered 50% mortality when exposed for 63 days to 100ng/l TBT. Rees *et al.* (2001) reported that the abundance of epifauna (including bryozoans) had increased in the Crouch estuary in the 5 years since TBT was banned from use on small vessels. This last report suggests that bryozoans may be at least inhibited by the presence of TBT. Bryozoans were shown to bioaccumulate heavy metals to a certain extent (Holt *et al.*, 1995). For example, *Bowerbankia gracialis* and *Nolella pusilla* accumulated Cd, exhibiting sublethal effects (reduced sexual reproduction and inhibited resting spore formation) between 10-100 µg Cd /l and fatality above 500 µg Cd/l (Kayser, 1990).

De Caralt *et al.* (2002) reported that *Clavelina lepadiformis* accumulated copper, lead and vanadium (vanadium is used in ascidian metabolism). A harbour population contained significantly more copper and lead than an open littoral population despite its abundance being an order of magnitude higher in the harbour (De Caralt *et al.*, 2002). Neither reproduction nor growth were affected in this harbour population compared with a population outside of the harbour.

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.

CR.HCR.XFa.FluCoAs is a sub-tidal biotope complex (Connor *et al*., 2004). Oil pollution is mainly a surface phenomenon its impact upon circalittoral turf communities is likely to be limited. However, as in the case of the *Prestige* oil spill off the coast of France, high swell and winds can cause oil pollutants to mix with the seawater and potentially negatively affect sub-littoral habitats (Castège *et al*., 2014).

Filter feeders are highly sensitive to oil pollution, particularly those inhabiting the tidal zones which experience high exposure and show correspondingly high mortality, as are bottom dwelling organisms in areas where oil components are deposited by sedimentation (Zahn *et al*., 1981). There is little information on the effects of hydrocarbons on bryozoans. Ryland & De Putron (1998) did not detect adverse effects of oil contamination on the bryozoan *Alcyonidium* spp. in Milford Haven or St. Catherine's Island, south Pembrokeshire although it did alter the breeding period. Banks & Brown (2002) found that exposure to crude oil significantly impacted recruitment in the bryozoan *Membranipora savartii*.

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.

Bryozoans are common members of the fouling community, and amongst those organisms most resistant to antifouling measures, such as copper containing anti-fouling paints (Soule & Soule, 1979; Holt *et al*., 1995). Bryan & Gibbs (1991) reported that there was little evidence regarding TBT toxicity in bryozoa with the exception of the encrusting *Schizoporella errata*, which suffered 50% mortality when exposed for 63 days to 100ng/l TBT. Rees *et al.* (2001) reported that the abundance of epifauna (including bryozoans) had increased in the Crouch estuary in the 5 years since TBT was banned from use on small vessels. This last report suggests that bryozoans may be at least inhibited by the presence of TBT. Hoare & Hiscock (1974) suggested that polyzoa (bryozoa) were amongst the most intolerant species to acidified halogenated effluents in Amlwch Bay, Anglesey and reported that *Flustra foliacea* did not occur within 165m of the effluent source.

Radionuclide contamination	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence

Introduction of other substances	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

This pressure is **Not assessed**.

De-oxygenation	Medium Q: Medium A: Low C: Low	High Q: Medium A: Medium C: Medium	Low Q: Medium A: Low C: Low

In general, respiration in most marine invertebrates does not appear to be significantly affected until extremely low concentrations are reached. For many benthic invertebrates this concentration is about 2 ml/l (ca 2.66 mg/l) (Herreid, 1980; Rosenberg *et al.*, 1991; Diaz & Rosenberg, 1995). Cole *et al.* (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l.

Little information on the effects of oxygenation on bryozoans was found. Sagasti *et al.* (2000) reported that epifaunal communities, including dominant species such as bryozoans (*Membranipora tenuis* and *Conopeum tenuissimum*)**,** were unaffected by periods of moderate hypoxia (ca 0.35 -1.4 ml/l) and short periods of anoxia (<0.35 ml/l) in the York River, Chesapeake Bay, although bryozoans were more abundant in the area with generally higher oxygen. However, estuarine species are likely to be better adapted to periodic changes in oxygenation. An anoxic event in the northern Adriatic (1989–1990) exterminated the *Pentapora fascialis* population (McKinney & Jaklin, 2000; Hayward and McKinney, 2002). Colonies of *Pentapora fascialis* established after that anoxic event exceeded 15 cm in diameter by the summer of 1998 (Hayward & McKinney, 2002).

Demosponges maintained under laboratory conditions can tolerate hypoxic conditions for brief periods. Gunda & Janapala (2009) investigated the effects of variable DO levels on the survival of the marine sponge, *Haliclona pigmentifera*. Under hypoxic conditions (1.5-2.0 ppm DO), *Haliclona pigmentifera* with intact ectodermal layers and subtle oscula survived for 42 ± 3 days. Sponges with prominent oscula, foreign material, and damaged pinacoderm exhibited poor survival (of 1-9 days) under similar conditions. Complete mortality of the sponges occurred within 2 days under anoxic conditions (<0.3 ppm DO). Stefaniak *et al.* (2014) reported that the sponge population at Stratford Shoal persisted despite multiple hypoxic events, however, the length and magnitude of these events was uncertain. Hiscock & Hoare (1975) reported an oxycline forming in the summer months (Jun-Sep) in a quarry lake (Abereiddy, Pembrokeshire) from close to full oxygen saturation at the surface to <5% saturation below ca 10 m. No sponges or ascidians were recorded at depths below 10 - 11 m.

Sensitivity assessment

There is evidence that bryozoans and sponges may tolerate short periods of hypoxia, although moderate to long-term events or anoxia is likely to cause significant mortality. Resistance at the benchmark level is likely to be '**Medium**', resilience is '**High**' and sensitivity is '**Low**'.

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

Hartikainen *et al.* (2009) reported that increased nutrient concentrations resulted in freshwater bryozoans achieving higher biomass. O'Dea & Okamura (2000) found that annual growth of *Flustra foliacea* in western Europe has substantially increased since 1970. They suggested that this could be due to eutrophication in coastal regions due to organic pollution, leading to increased phytoplankton biomass (see Allen *et al.*, 1998). Rose & Risk, 1985 described increase in abundance of *Cliona delitrix* in organically polluted section of Grand Cayman fringing reef affected by the discharge of untreated faecal sewage. Ward-Paige *et al.* (2005) described greatest size and biomass of Clionids corresponding with highest nitrogen and ammonia and ^{15}N levels. Gochfeld *et al.* (2012) studied the effect of nutrient enrichment (≤0.05 to 0.07 M for nitrate and ≤0.5 M for phosphate) as a potential stressor in *Aplysina cauliformis* and its bacterial symbionts and found that nutrient enrichment had no effects on sponge or symbiont physiology when compared to control conditions. This study does contradict with findings in Gochfeld *et al.* (2007) in which *Aplysina* spp. sponges were virtually absent from a site of anthropogenic stress in Bocas del Toro, Panama, which experienced high rainfall and terrestrial runoff. The author suggested that whilst this site did include elevated nutrient concentrations, other pressures and stresses could be contributing.

Koopmans & Wijffels (2008) reported that concentrations of nitrate, nitrite, ammonium and phosphate correlated negatively with growth rate of *Haliclona oculata*.

Clavelina lepadiformis was found to dominate Spanish harbours and nearby zones with highly transformed substrata, low rate of water renewal and excess silting and suspended matter and was described as biofouling and opportunist (Naranjo *et al.*, 1996).

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

O'Dea & Okamura (2000) found that annual growth of *Flustra foliacea* in western Europe has substantially increased since 1970. They suggested that this could be due to eutrophication in coastal regions due to organic pollution, leading to increased phytoplankton biomass (see Allen *et al.*, 1998).

Koopmans & Wijffels (2008) found no correlation between growth rate of *Halilcona oculata* and dissolved organic carbon, suggesting that *Haliclona oculata* is more dependent on particulate organic carbon. Rose & Risk (1985) described an increase in abundance of the sponge *Cliona delitrix* in an organically polluted section of Grand Cayman fringing reef affected by the discharge of untreated faecal sewage. De Goeij *et al.* (2008) used ^{13}C to trace the fate of dissolved organic matter in the coral reef sponge *Halisarca caerulea.* Biomarkers revealed that the sponge incorporated dissolved organic matter through both bacteria mediated and direct pathways, suggesting that it feeds, directly and indirectly, on dissolved organic matter. Koopmans & Wiffjels (2008) reported that there was no correlation of *Haliclona oculata* growth rate and dissolved organic carbon concentration, suggesting that *Haliclona oculata* is more dependent on particulate organic carbon.

Clavelina lepadiformis was found to dominate Spanish harbours and nearby zones with highly transformed substrata, low rate of water renewal, excess silting and suspended matter. The species was described as biofouling and opportunist (Naranjo *et al.*, 1996).

Sensitivity assessment

Therefore, the important characteristic species could probably resist organic enrichment at the benchmark level. Resistance to this pressure is assessed as '**High**', but with Low confidence, and resilience as '**High**'. This biotope is therefore considered to be '**Not sensitive**'.

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.

	Resistance	Resilience	Sensitivity
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 rock were replaced with sediment, this would represent a fundamental change to the physical character of the biotope and the species would be unlikely to recover. The biotope would be lost.

Sensitivity assessment. Resistance to the pressure is considered '**None**', and resilience '**Very low'**. Sensitivity has been assessed as '**High**'.

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

'Not relevant' to biotopes occurring on bedrock.

	Resistance	Resilience	Sensitivity
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.

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

Flustra foliacea is tolerant of sediment abrasion (Stebbing, 1971a; Knight-Jones & Nelson-Smith, 1977), but physical disturbance by fishing gear has been shown to adversely affect emergent epifaunal communities with bryozoan matrices reported to be greatly reduced in fished areas (Jennings & Kaiser, 1998). Heavy mobile gears could also result in movement of boulders (Bullimore, 1985; Jennings & Kaiser, 1998). Although *Flustra foliacea* is flexible, physical disturbance by a passing scallop dredge is likely to damage fronds and remove some colonies. Colonies on hard substrata are probably less vulnerable to fishing activity but would probably be damaged or partially removed. Colonies of *Flustra foliacea* are capable of regenerating areas of the frond which have been removed by grazing, which can result in new branches (Stebbing, 1971a). Silén (1981) reported that *Flustra foliacea* could repair physical damage (a notch) to its fronds within 5-10 days, and regenerated at ca 4-5 zooid lengths per month. As long as the holdfast remains intact, *Flustra foliacea* would survive and grow back.

Haliclona oculata is a branching erect sponge which is soft and elastic near the branch tips, becoming firmer near the base (Ackers *et al*., 1992). Van Dolah *et al.* (1987) studied the effects on sponges and corals of one trawl event over a low-relief hard bottom habitat off Georgia, US. The densities of individuals taller than 10 cm of three species of sponges in the trawl path and in adjacent control area were assessed by divers, and were compared before, immediately after and 12 months after trawling. Of the total number of sponges remaining in in the trawled area, 32% were damaged. Most of the affected sponges were the barrel sponges *Cliona* spp., whereas *Haliclona oculta* (and *Ircina campana)* were not significantly affected. Twelve months after trawling, the abundance of sponges had increased to pre-trawl densities, or greater. Freese (2001) studied deep cold-water sponges in Alaska a year after a trawl event and found that 46.8% of sponges exhibited damage and 32.1% were torn loose. None of the damaged sponges displayed signs of regrowth or recovery. This was in stark contrast to early work by Freese *et al.* (1999) on warm shallow sponge communities. Impacts of trawling activity in Alaska study being much more persistent due to the slower growth/regeneration rates of deep, cold-water sponges. Boulcott & Howell (2011) conducted experimental Newhaven scallop dredging over a circalittoral rock habitat in the sound of Jura, Scotland and recorded the damage to the resident community. The results indicated that epifaunal species, including the sponge *Pachymatisma johnstoni*, were highly damaged by the experimental trawl.

Clavelina lepadiformis is permanently attached to the substratum and is unable to move out of the way from abrasive objects. The body of the species is soft and delicate, so abrasion is likely to cause physical damage and possibly death.

Sensitivity assessment

Whilst disturbance would damage the sessile *Flustra foliacea*, the flexibility and ability to regenerate damaged fronds (as long as the holdfast is undamaged) would result in a significant proportion of the colonies to survive disturbance. Therefore, resistance is assessed as '**Medium**', resilience is '**High**' and sensitivity 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 group are epifauna or epiflora occurring on rock which is resistant to subsurface penetration. The assessment for abrasion at the surface only is therefore considered to equally represent sensitivity to this pressure. This pressure is thought '**Not relevant'** to hard rock biotopes.

Changes in suspended solids (water clarity)	High Q: Medium A: Medium C: Medium	High Q: High A: High C: High	Not sensitive Q: Medium A: Medium C: Medium

Bryozoans are suspension feeders that may be adversely affected by increases in suspended sediment, due to clogging of their feeding apparatus. However, Tyler-Walters & Ballerstedt (2007) reported *Flustra foliacea* as tolerant to suspended sediment based on its occurrence in areas of high suspended sediment e.g. abundant in turbid, fast flowing waters of the Menai Straits (Moore

1977). Communities dominated by *Flustra foliacea* were described on tide swept seabed, exposed to high levels of suspended sediment and sediment scour in the English Channel subject to sediment transport (mainly sand) and periodic, temporary, submergence by thin layers of sand (ca <5 cm) (Holme & Wilson 1985). *Flustra foliacea* is also characteristic of sediment-scoured, silty rock communities CR.HCR.XFa.FluCoAs and CR.MCR.EcCr.UrtScr (Connor *et al*., 2004).

Despite sediment being generally 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 many species prefer such habitats (Bell & Barnes 2001; Bell & Smith 2004). 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. *Raspailia ramosa* and *Stelligera stuposa* have a reduced maximum size in areas of high sedimentation (Bell *et al*, 2002). Tjensvoll *et al.* (2013) found that *Geodia barretti* physiologically shuts down when exposed to sediment concentrations of 100 mg /l (86% reduction). Rapid recovery to initial respiration levels directly after the exposure indicated that *Geodia barretti* can cope with a single short exposure to elevated sediment concentrations. Schönberg (2015) reviewed and observed the interactions between sediments and marine sponges and described the lack of research on Porifera, with most studies grouping them together when looking at sediment effects. Her findings were that, whilst many sponges are disadvantaged by sedimentation, many examples exist of sponges adapting to sediment presence, including through sediment incorporation, sediment encrusting, soft sediment anchoring using spicules and living, at least partially, embedded within the sediment. Schönberg (2015) found that *Polymastiida* interacted with sediment in 18.9% of observations (primarily through spicules), *Clionaida* had a highly variable interaction with sediment, with 5.7±11.4 %, *Tethyida* interacted in 13.1±21.1%. However no Haliclonids were considered as part of the study. De Kluijver & Leewis (1994) monitored the marine species before and two years after construction of a storm barrier in the Oosterschelde Estuary. The barrier resulted in lower tidal flow, higher sedimentation and increased *Haliclona oculata* abundance.

Increased siltation can cause clogging of ascidians respiratory organs (Bakus, 1968). *Clavelina lepadiformis* has relatively wide apertures that help prevent clogging from particles (Naranjo *et al.*, 1996). The simplistic structure of its branchial sac (Fiala-Medioni, 1978) may be less efficient in expelling particles, and more likely to suffer from clogging of feeding apparatus than other forms of sea squirts, such as *Ciona intestinalis*. *Clavelina lepadiformis* was found to dominate Spanish harbours and nearby zones with low rate of water renewal, excess silting and suspended matter and the species was described as biofouling and opportunist (Naranjo *et al.*, 1996).

Sensitivity assessment

Sediment scour within CR.HCR.XFa.FluCoAs and associated biotopes is an important factor in the dominance of the scour tolerant *Flustra foliacea* (Connor *et al*., 2004). Whilst an increase is unlikely to have an effect, a reduction in suspended sediment could reduce scour and allow other species to colonize the biotope. On return to the original sediment levels, it is probable that *Flustra foliacea* would again dominate the biotope.

Resistance is assessed as '**High**', resilience as '**High**' and the biotope is '**Not Sensitive**' at the benchmark level.

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

Smothering by 5 cm of sediment is likely to prevent feeding, and hence growth and reproduction, as well as respiration in the bryozoans. In addition, associated sediment abrasion may remove the bryozoan colonies. A layer of sediment will probably also interfere with larval settlement (Tyler-Walters, 2005). Communities dominated by *Flustra foliacea* were described on tide swept seabed, exposed to high levels of suspended sediment and sediment scour in the English Channel subject to sediment transport (mainly sand) and periodic, temporary, submergence by thin layers of sand (ca <5 cm) (Holme & Wilson 1985).

Despite sediment being generally considered to have a negative impact on suspension feeders (Gerrodette & Flechsig 1979), many encrusting sponges appear to be able to survive in highly sedimented conditions, and in fact many species prefer such habitats (Bell & Barnes 2001; Bell & Smith 2004). However, Wulff (2006) described mortality in three sponge groups following four weeks of burial under sediment. 16% of *Amphimedon* biomass died compared with 40% and 47% in *Iotrochota* and *Aplysina* respectively. The complete disappearance of the sea squirt *Ascidiella aspera* and associated sponges in the Black Sea near the Kerch Strait was attributed to siltation (Terent'ev, 2008 cited in Tillin & Tyler-Walters, 2014). Some sponges are likely to be buried in 5cm of sediment deposition. *Haliclona oculata* grows to ca 30 cm in height (Hayward & Ryland, 1995a) and smothering by 5 cm depth of sediment would bury only the smallest individuals.

Clavelina lepadiformis reaches up to 2 cm in height and often colonizes vertical surfaces and overhangs (Fish & Fish, 1992). Smothering by 5 cm depth of sediment would completely cover the majority of the population, with only those colonizing overhangs and vertical surfaces protected.

Sensitivity assessment

A deposit of 5 cm of fine sediment could smother and damage many of the smaller individulas of the faunal community. For example, *Flustra foliacea* is probably resistant while *Clavelina lepadiformis* is probably not resistant. However, in the high energy environment that the biotope occurs, deposited sediment would probably be removed quickly. Therefore, resistance is '**Medium**', resilience is '**High**' and the sensitivity is '**Low**'.

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

Smothering by 30 cm of sediment is likely to prevent feeding, hence growth and reproduction, as well as respiration in the bryozoans. In addition, associated sediment abrasion may remove the bryozoan colonies. Sediment will probably also interfere with larval settlement (Tyler-Walters, 2005).

Holme & Wilson (1985) examined the bottom fauna in a tide-swept region of the central English Channel. *Flustra foliacea* dominated communities were reported to form in areas subject to sediment transport (mainly sand) and periodic, temporary, submergence by thin layers of sand (ca <5 cm). If inundated by 30cm of sediment respiration and larval settlement are likely to be blocked until the deposited sediment is removed. *Haliclona oculata* grows to ca 300 mm in height (Hayward & Ryland, 1995a) and smothering by 30 cm of sediment would cover the majority of the population.

Clavelina lepadiformis reaches up to 20 mm in height and often colonizes vertical surfaces and overhangs (Fish & Fish, 1992). Smothering by 30 cm of sediment would completely cover the majority of the population, with only those colonizing overhangs and vertical surfaces protected.

Sensitivity assessment

A deposit of 30 cm of fine sediment would smother and damage the majority of the faunal community. In the high energy environment that the biotope occurs, deposited sediment would probably be removed fairly quickly.

Resistance is therefore assessed as '**Low**', resilience as '**Medium**' and sensitivity as '**Medium**'.

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

No evidence was returned on the impact of litter on characterizing species for this biotope, although studies show impacts from ingestion of micro plastics by sub surface deposit feeding worms (*Arenicola marina)* and toxicants present in cigarette butts have been shown to impact the burrowing times and cause DNA damage in ragworms *Hediste diversicolor*.

Litter, in the form of cigarette butts has been shown to have an impact on Ragworms. *Hediste diversicolor* showed increased burrowing times, 30% weight loss and a >2 fold increase in DNA damage when exposed to water with toxicants (present in cigarette butts) in quantities 60 fold lower than reported from urban run-off (Wright *et al.*, 2015).Studies are limited on impacts of litter on infauna and this UK study suggests health of infauna populations are negatively impacted by this pressure.

Studies of sediment dwelling, sub surface deposit feeding worms, a trait shared by species abundant in this biotope, showed negative impacts from ingestion of micro plastics. For instance, *Arenicola marina* ingests micro-plastics that are present within the sediment it feeds within. Wright *et al.* (2013) carried out a lab study that displayed presence of micro-plastics (5% UPVC) significantly reduced feeding activity when compared to concentrations of 1% UPVC and controls. As a result, *Arenicola marina* showed significantly decreased energy reserves (by 50%), took longer to digest food, and as a result decreased bioturbation levels which would be likely to impact colonisation of sediment by other species, reducing diversity in the biotopes the species occurs within.Wright *et al.* (2013) also present a case study based on their results, that in the intertidal regions of the Wadden Sea, where *Arenicola marina* is an important ecosystem engineer, *Arenicola marina* could ingest 33m□ of micro-plastics a year.

Sensitivtiy assessment. 'No evidence' was returned to complete a sensitivity assessment, however, both microplastics and the toxicants present in cigarette butts are likely to have negative impacts on the characterizing species.

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

Underwater noise changes	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Stanley *et al.* (2014) studied the effects of vessel noise on fouling communities and found that the bryozoans *Bugula neritina*, *Watersipora arcuate* and *Watersipora subtorquata* responded positively.

More than twice as many bryozoans settled and established on surfaces with vessel noise (128 dB in the 30–10,000 Hz range) compared to those in silent conditions. Growth was also significantly higher in bryozoans exposed to noise, with 20% higher growth rate in encrusting and 35% higher growth rate in branching species. No evidence could be found for the effects of noise on sponges but they are unlikely to be sensitive.

Sensitivity assessment. Resistance to this pressure is assessed as '**High**' and resilience as '**High**'. This biotope is therefore considered to be '**Not sensitive**' at the benchmark level.

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

Flustra foliacea larvae are positively phototactic on release, swimming for only short periods (Hayward & Ryland, 1998) however, at the depths *Flustra foliacea* can occur, light may not be important.

Jones *et al.* (2012) compiled a report on the monitoring of sponges around Skomer Island and found that many sponges, particularly encrusting species, were more abundant on vertical or shaded bedrock to open, light surfaces, probably due to reduced competition with algae.

Sensitivity assessment

The biotope occurs in the ciraclittoral and, whilst increase in light could result in competition with algae, it is unlikely that an increase at the benchmark level would be significant. Resistance to this pressure is assessed as '**High**' and resilience as '**High**'. This biotope is therefore considered to be '**Not sensitive**' at the benchmark level.

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

Barriers and changes in tidal excursion are '**Not relevant'** to biotopes restricted to open waters.

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	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

There is currently **'No evidence'** on which to assess this pressure.

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

This biotope is classified as circalittoral and therefore no algal species have been considered. *Didemnum vexillum* is an invasive colonial sea squirt native to Asia which was first recorded in the UK in Darthaven Marina, Dartmouth in 2005. *Didemnum vexillum* can form extensive mats over the substrata it colonizes, binding boulders, cobbles and altering the host habitat (Griffith *et al*., 2009). *Didemnum vexillum* can also grow over and smother the resident biological community. Recent surveys within Holyhead Marina, North Wales have found *Didemnum vexillum* growing on and smothering native tunicate communities, including *Ciona intestinalis* (Griffith *et al*., 2009). Due to the rapid-re-colonization of *Didemnum vexillum* eradication attempts have to date failed.

Presently *Didemnum vexillum* is isolated to several sheltered locations in the UK (NBN, 2015), however *Didemnum vexillum* successfully colonized offshore in Georges Bank, USA (Lengyel *et al*., 2009), which is more exposed than the locations that *Didemnum vexillum* has colonized in the UK. It is therefore possible that *Didemnum vexillum* could pose a threat to these biotopes.

A number of invasive bryozoans are of concern including *Schizoporella japonica* (Ryland *et al*., 2014) and *Tricellaria inopinata* (Dyrynda *et al*., 2000; Cook *et al*., 2013). *Tricellaria inopinata* has been reported to colonize the byssal threads of the mussel *Mytilus galloprovincialis*, *Hymeniacidon perleve* and the ascidian *Styela plicata* (Dyrynda *et al*., 2000). *Tricellaria inopinata* dominated the fouling community in the Lagoon of Venice, within 7 years of being introduced (Ambrogi, 2000).

There is '**No evidence'** at present that this biotope has been affected by INIS species. Due to the constant risk of new invasive species, the literature for this pressure should be revisited.

Introduction of microbial pathogens	Medium Q: Low A: NR C: NR	Medium Q: Medium A: Medium C: Medium	Medium Q: Low A: Low C: Low

Pukall *et al.* (2001) studied the microbial community associated with *Flustra foliacea* and reported colonization of surfaces by bacteria typical of the marine environment and which may have been transferred into this environment from terrestrial sites. No information on diseases was found. Stebbing (1971a) reported that encrusting epizoites reduced the growth rate of *Flustra foliacea* by ca 50%. The bryozoan *Bugula flabellata* produces stolons that grow in and through the zooids of *Flustra foliacea*, causing "irreversible degeneration of the enclosed polypide" (Stebbing, 1971b).

Gochfeld *et al.* (2012) found that diseased sponges hosted significantly different bacterial assemblages compared to healthy sponges, with diseased sponges also exhibiting significant decline in sponge mass and protein content. Sponge disease epidemics can have serious long-term effects on sponge populations, especially in long-lived, slow-growing species (Webster, 2007). Numerous sponge populations have been brought to the brink of extinction including cases in the Caribbean with 70-95% disappearance of sponge specimens (Galstoff, 1942) and the

Mediterranean (Vacelet,1994; Gaino *et al.*,1992). Decaying patches and white bacterial film were reported in *Haliclona oculata* and *Halichondria panicea* in North Wales, 1988-89 (Webster, 2007). Specimens of *Cliona* spp. exhibited blackened damage since 2013 in Skomer. Preliminary results have shown that clean, fouled and blackened *Cliona* all have very different bacterial communities. The blackened *Cliona* were effectively dead and had a bacterial community similar to marine sediments. The fouled *Cliona* had a very distinct bacterial community that may suggest a specific pathogen caused the effect (Burton, pers comm; Preston & Burton, 2015).

There appears to be little research into ascidian diseases particularly in the Atlantic. The parasite *Lankesteria ascidiae* targets the digestive tubes and can cause 'long faeces syndrome' in *Ciona intestinalis* (although it has also been recorded in other species). Mortality occurs in severely affected individuals within about a week following first symptoms. (Mita *et al.*, 2012). Ooishi (2010) reported the copepod *Enterocola hessei* parasitizing *Clavelina lepadiformis*, however no evidence for microbial infection was found.

Sensitivity assessment

Current research on disease indicates that *Flustra foliacea* and some sponges are susceptible to disease, although the extent and long term implications are still being researched. There is no evidence to suggest mortality of sponges in the British Isles, although mass mortality and even extinction have been reported further afield. Resistance has been assessed as '**Medium'** with a resilience of '**Medium**' and sensitivity is therefore '**Medium**'.

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

Flustra foliacea is not presently known to be subject to extraction. However, many bryozoans have been recently found to contain pharmacologically active substances (Hayward & Ryland, 1998; Lysek *et al.*, 2002; Peters *et al.*, 2003). *Spongia officinalis* (a Mediterranean species) has been targeted as a commercial species for use as bath sponges, although this species does not occur in the British Isles and no record of commercial exploitation of sponges in the British Isles could be found. Many different bioactive compounds have been found in the *Haliclona* order, such as lectins, peptides, ketosteroids, and sterol esters (Pajic *et al.* 2002; Aoki *et al.* 2003; Santalova *et al.* 2003; Koopmans & Wijffels, 2008), and it is possible that these sponges may be subject to future harvesting.

Sensitivity assessment

Whilst not presently harvested, it is possible that *Flustra foliacea* and Haliclonids may be subject to harvesting in the future. *Flustra foliacea* and the sponges are sessile epifauna and would therefore have no defence against targeted extraction. Therefore a precautionary resistance of '**None**' is suggested with Low confidence. Resilience is '**Medium**' and overall sensitivity is therefore '**Medium**'.

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

The characteristic species probably compete for space within the biotope, so that loss of one species would probably have little if any effect on the other members of the community. However, removal of the characteristic epifauna due to by -catch is likely to remove a proportion of the biotope and change the biological character of the biotope.

Whilst disturbance would damage the sessile *Flustra foliacea*, the flexibility and ability to regenerate damaged fronds (as long as the holdfast is undamaged) would result in survival of a significant proportion of the colonies. Resistance is therefore '**Medium**', resilience is '**High**' and sensitivity is '**Low**'.

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