Bryozoan turf and erect sponges on tide-swept circalittoral rock

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

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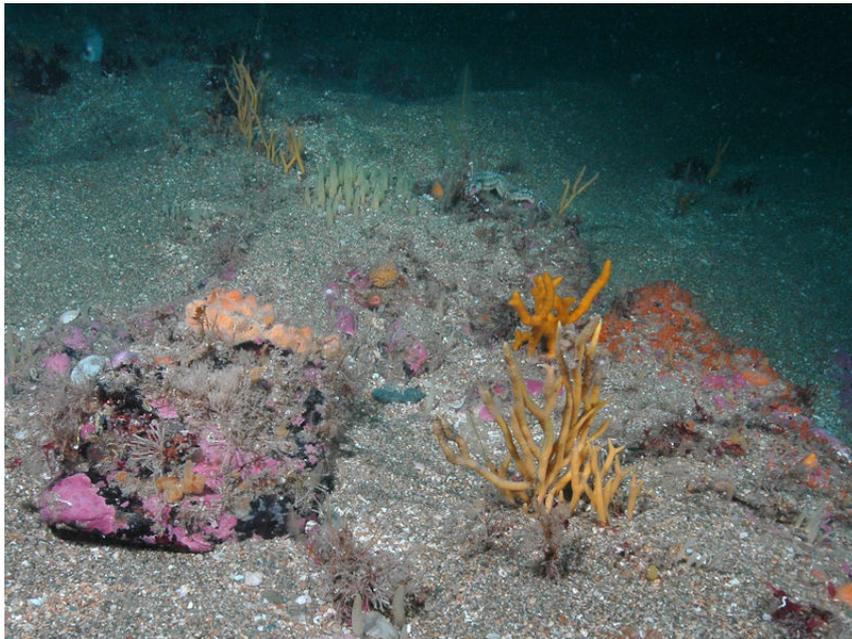
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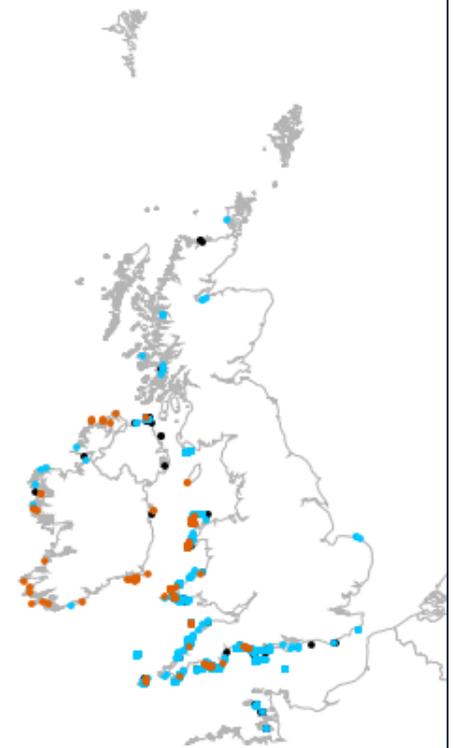DOI https://dx.doi.org/10.17031/marlinhab.9.1

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Bryozoan turf and erect sponges on tide-swept circalittoral rock
Photographer: Keith Hiscock
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- Core records
- Non-core, certain determination
- Non-core, uncertain determination
- Predicted habitat extent

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	A4.131	Bryozoan turf and erect sponges on tide-swept circalittoral rock
JNCC 2015	CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide-swept circalittoral rock
JNCC 2004	CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide-swept circalittoral rock
1997 Biotope	CR.MCR.XFa.ErSPbolSH	Cushion sponges (*Polymastia boletiformis*, Tethya), stalked sponges, *Nemertesia spp.* and *Pentapora foliacea* on moderately exposed circalittoral rock

🏷 Description

This biotope is typically found on wave-exposed circalittoral bedrock or boulders subject to tidal

streams ranging from moderately strong to strong. It often has a thin layer of silt covering the seabed, and is characterized by a bryozoan/hydroid turf with erect sponges. Typical bryozoans to be found include crisiids, *Alcyonidium diaphanum*, *Flustra foliacea*, *Pentapora foliacea*, *Crisularia plumosa* and *Bugulina flabellata*, while typical hydroids include *Nemertesia antennina*, *Nemertesia ramosa* and *Halecium halecinum*. The soft coral *Alcyonium digitatum* is frequently recorded on the tops of boulders and rocky outcrops. Characteristic erect sponges include Raspailia ramosa, Stelligera stuposa andStelligera rigida; other sponges present include *Cliona celata*, *Dysidea fragilis*, *Pachymatisma johnstonia*, *Polymastia boletiformis*, *Hemimycale columella*, *Esperiopsis fucorum*, *Polymastia mamillaris* and *Tethya aurantium*. Other species present include *Caryophyllia smithii*, *Actinothoe sphyrodeta*, *Corynactis viridis*, *Urticina felina*, *Balanus crenatus*, *Asterias rubens*, *Marthasterias glacialis*, *Henricia oculata*, *Echinus esculentus*, *Clavelina lepadiformis*, *Calliostoma zizyphinum* and *Necora puber*. Three variants of this biotope have been described, but all are characterized by a bryozoan turf with erect sponges. ByErSp.Eun is found primarily on circalittoral bedrock and is dominated by the seafan *Eunicella verrucosa*. ByErSp.DysAct is found under slightly stronger tide-swept conditions and is characterized particularly by the sponge *Dysidea fragilis* and the anemone *Actinothoe sphyrodeta*. Finally ByErSp.Sag is characterized by the anemone *Sagartia elegans*. (Information from Connor *et al.*, 2004).

⬇ Depth range

10-20 m, 20-30 m

🏛 Additional information

Please note the molecular taxonomy of the genus *Bugula* (Fehlauer-Ale *et al.*, 2015) identified several clear genera (clades), *Bugula sensu stricto* (30 species), *Bugulina* (24 species), *Crisularia* (23 species) and the monotypic *Virididentulagen*. The following review was derived from information concerning species of *Bugula* prior to their recent revision. The review assumes that, while their taxonomy has changed, the biology of Bugulidae remains similar. Hence, references to *Bugula* spp. in the text refer to *Bugula sensu stricto*, *Bugulina*, and *Crisularia* species.

✔ Listed By

- none -

🔗 Further information sources

Search on:

G g G JNCC

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

The CR.HCR.XFa.ByErSp of biotope complex is typically found on wave-exposed circalittoral bedrock or boulders subject to tidal streams ranging from moderately strong to strong, often with a thin layer of silt covering the seabed. Three variants of this biotope have been described; all are characterized by a bryozoan turf with erect sponges. Typical bryozoans include *Alcyonidium diaphanum*, *Flustra foliacea*, *Pentapora foliacea*, *Crisularia plumosa* and *Bugulina flabellata*. The biotopes are characterized by a range of erect sponges including *Raspailia ramosa*, *Stelligera stuposa* and *Stelligera rigida*, with others including *Cliona celata*, *Dysidea fragilis*, *Pachymatisma johnstonia*, *Polymastia boletiformis*, *Hemimycale columella*, *Esperiopsis fucorum (syn. Amphilectus fucorum)*, *Polymastia mamillaris* and *Tethya aurantium* also present (Connor *et al*., 2004). Given limited evidence for the sponges, relevant evidence for non-characterizing sponges is presented where applicable.

ByErSp.DysAct is characterized by the dominance of the sponge *Dysidea fragilis* and the anemone *Actinothoe sphyrodeta* and occurs in more tide-swept conditions. ByErSp.Sag is characterized by the additional presence of the anemone *Sagartia elegans*, but occurs in similar conditions to ByErSp.DysAct. There are, however, distinct different geographical distributions. ByErSp.DysAct only tends to be found off Wales and Lundy whereas ByErSp.Sag is usually found off the west coast of Ireland Connor *et al*. (2004). ByErSp.Eun is dominated by the seafan *Eunicella verrucosa* and is considered separately.

Due to the range of bryozoan and sponge species present, most assessments for this biotope are based on the taxonomic group. Other species present in these biotopes are considered transient, mobile or ubiquitous and are, therefore, not considered significant to the assessment of the sensitivity of this biotope. However, information on the sensitivity of other characterizing species is included where appropriate.

Resilience and recovery rates of habitat

The brooded, lecithotrophic coronate larvae of many bryozoans (e.g. *Flustra foliacea*, *Securiflustra securifrons*, and *Bugula* species), have a short pelagic lifetime of several hours to about 12 hours (Ryland, 1976). Recruitment is dependent on the supply of suitable, stable, hard substrata (Eggleston, 1972b; Ryland, 1976; Dyrynda, 1994). However, even in the presence of available substratum Ryland (1976) noted that significant recruitment in bryozoans only occurred in the proximity of breeding colonies. For example, Hatcher (1998) reported colonization of slabs, suspended 1 m above the sediment, by *Bugulina fulva* within 363 days while Castric-Fey (1974) noted that *Bugulina turbinata*, *Crisularia plumosa* and *Bugula calathus* did not recruit to settlement plates after ca two years in the subtidal even though present on the surrounding bedrock. Similarly, Keough & Chernoff (1987) noted that *Bugula neritina* was absent from areas of seagrass bed in Florida even though substantial populations were present <100m away.

Bugula spp. are perennials that tend to form short-lived, large colonies in summer with significant die-back in late autumn and a dormant winter phase (Eggleston 1972; Dyrynda & Ryland, 1982). Reproduction occurs in summer or early autumn with some species such as *Bugulina flabellata* reportedly having two generations of fronds capable of reproduction each year (Dyrynda & Ryland, 1982). Eggleston (1972) reported that newly settled specimens from the first generation in the Isle of Man grew rapidly and contributed to the second generation.

Flustra foliacea is a coarse, foliaceous bryozoan that tends to be found on stones and shells, reaches 10 cm in height, is common to all coasts in north-west Europe (Hayward & Ryland, 1995b) and is found across all coasts in the British Isles (NBN, 2016). 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, leading to a line forming across the fronds which can be used to age specimens. The species can regularly reach 6 years of age, although 12 year old specimens were reported off the Gower Peninsula (Stebbing, 1971; 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) and slowed down afterwards, which could be due to the lateral growth of the fronds. Colonies appeared to be able to regenerate areas of the frond which had been removed by grazing. Silén (1981) found *Flustra foliacea* could repair physical damage to its fronds with 5-10 days, concluding that, as long as the holdfast remains intact, *Flustra foliacea* would survive and grow back. 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* (Hiscock, 1981). *Flustra foliacea* colonies are perennial, and potentially highly fecund with increasing colony size as each zooid produces a single embryo (Tillin & Tyler Walters, 2014; Eggleston (1972) with ca 10,000 larvae released from a specimen of *Flustra foliacea* within 3 hrs (Dalyell, cited in Hincks, 1880). 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 wreck several hundreds of metres from any significant hard substrata, and hence a considerable distance from potentially parent colonies (Hiscock, 1981; Tyler-Walters & Ballerstedt, 2007). *Flustra foliacea* requires stable hard substrata (Eggleston, 1972; 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).

Alcyonidium diaphanum forms an erect colony that can grow up to 50 cm long but more usually 15 cm. It has a small encrusting base, which attaches to a hard substratum. The size, colour and colony form varies widely around the British Isles (Ager, 2007).

Pentapora foliacea (syn *fascialis*) is an erect perennial bryozoan (Eggleston, 1972; Hayward & Ryland, 1995). It recovered in 3.5 years after the almost total loss of a local population (Cocito *et al.*, 1998). *Pentapora foliacea* grows initially as an encrusting sheet, which seems able to regenerate erect growths (P.J. Hayward pers. comm cited in Jackson, 2016). Colonies are typically 20 cm in diameter but can grow up to 2 m in diameter and reach a height of 30 cm in the British Isles (Hayward & Ryland, 1979). Presence or absence of ovicells has been taken to be a reliable indicator of reproductive status and, therefore, of sexual maturity (Cocito *et al.*, 1998). Ovicells were present in colonies in Skomer, Wales in September, indicating a reproduction event in September or late August (Lock et al., 2006). Colonies of *Pentapora fascialis* as small as 2.8 cm were recorded as having ovicells, with reproduction possible from an early stage of colony development (Cocito *et al.*, 1998 cited in Jackson, 2016). Lock *et al.* (2006) describes the growth of *Pentapora foliacea* in Skomer, Wales as highly variable, with some colonies growing 800 cm in a year whilst other large colonies completely disappeared. Recovery to pre-disturbance levels following a severe heat event, which resulted in the decline of 86% in live colony portion of *Pentapora fascialis* in the Mediterranean, took four years (Cocito & Sgorbini, 2014).

Very little information on sponge longevity and resilience exists. Reproduction can be asexual (e.g.

budding) or sexual (Naylor, 2011) and individual sponges are usually hermaphroditic (Hayward & Ryland, 1994). Short-lived ciliated larvae are released via the aquiferous system and metamorphosis follows settlement. Growth and reproduction are generally seasonal (Hayward & Ryland, 1994). Rejuvenation from fragments can also be considered an important form of reproduction (Fish & Fish, 1996). Marine sponges often harbour dense and diverse microbial communities, which can include bacteria, archaea and single-celled eukaryotes (fungi and microalgae) that comprise up to 40% of sponge volume, and which may have a profound impact on host biology (Webster & Taylor, 2012). Many sponges recruit annually, growth can be quite rapid, with a lifespan of one to several years (Ackers, 1992). However, sponge longevity and growth is highly variable depending on the species and conditions (Lancaster, 2014). It is likely that erect sponges are generally longer lived and slower growing given their more complex nature.

Sponges are known to be highly resilient to physical damage with an ability to survive severe damage, regenerate and reorganize to function fully again (Wulff, 2006). However, the ability to resist damage and recover varies between species (Wulff, 2006). Sponge fragments of coral reef species torn from adults during hurricanes have been observed to re-attach and continue growing (Wulff, 2006).Fowler & Lafoley (1993) monitored marine nature reserves in Lundy and the Isles Scilly and found that a number of more common sponges showed great variation in size and cover during the study period. Large colonies appeared and vanished at some locations. Some large encrusting sponges went through periods of both growth and shrinkage, with considerable changes taking place from year to year. For example, *Cliona celata* colonies generally grew extremely rapidly, doubling their size or more each year. In some years an apparent shrinkage in size also took place. In contrast, there were no obvious changes in the cover of certain unidentified thin encrusting sponges. Axinellid sponges have been described as very slow growing and little to no recovery has been observed over long periods of monitoring (Fowler & Lafoley, 1993; Hiscock, 1994; 2003). Picton & Morrow (2015) described *Amphilectus fucorum* as extremely polymorphic and fast growing, changing shape in just a few weeks. It may be encrusting as thin sheets or cushions, massive lobose, or branched. Hiscock (pers. comm.) noted that *Amphilectus fucorum* was found growing on (short-lived) ascidian tests and showed significant seasonal variation in abundance, which suggested this sponge was highly resilient. *Dysidea fragilis* readily colonizes deep water wrecks (Ackers *et al.*, 1992) *Tethya aurantium* produces stalked reproductive buds between July and September (van Soest *et al.*, 2000). *Raspailia ramosa*, a branching sponge, spawns in September (Lévi, 1956, cited from Van Soest, 2000). *Stelligera stuposa* is a branching erect sponge commonly found in Britain's circalittoral (Picton & Morrow, 2015). *Polymastia mamilliaris* is an encrusting sponge present from the Arctic to the Mediterranean (Boury-Esnault, 1987). *Polymastia boletiformis* is a commonly found spherical sponge found across the Western and Eastern Atlantic and is present from the Arctic to the Mediterranean (Boury-Esnault, 1987). *Pachymatisma johnstonia* can be massive-lobose, hemispherical to irregularly rounded and up to 30 cm or more across (Picton & Morrow, 2015). Sebens (1985, 1986) found that the sponge *Halichondria panicea* reached pre-clearance levels of cover after 2 years. A few individuals of *Alcyonium digitatum* and *Metridium senile* colonized within 4 years (Sebens, 1986) and slower growing sponges would probably take longer to reach pre-clearance levels.

Sargatia elegans is found from Scandinavia to the Mediterranean (Picton & Morrow 2016). *Actinothoe sphyrodeta* is distributed from the northern coast of Scotland to Spain (Ramos, 2010; NBN, 2016). However, no information on resilience was found for these species. *Actinothoe sphyrodeta* was described as rapidly maturing (within 1 year) with a low fecundity (Jackson *et al.*, 2008). Anemones are not sessile but are capable of slow movement. For example, Sebens (1981) observed immigration to cleared patches of the long-lived anemone *Anthopleura xanthogrammica* as being the primary driver towards recovery. Sebens (1981) cleared intertidal patches of

Anthopleura xanthogrammica at Mukkaw Bay, WA observing the effects over four years. Even after four years, cleared areas were not back to pre-removal population densities. Chia & Spaulding (1972) studying the anemone *Tealia crassicornis* found no sign of gonad development at 14 months old. Wedi & Dunn (1983) recorded smallest fertile *Urticina lofotensis* at 18 months old.

The recolonization of epifauna on vertical rock walls was investigated by Sebens (1985, 1986). He reported that rapid colonizers such as encrusting corallines, encrusting bryozoans, amphipods and tubeworms recolonized within 1-4 months. Ascidians such as *Dendrodoa carnea*, *Molgula manhattensis* and *Aplidium* spp. achieved significant cover in less than a year, and, together with *Halichondria panicea*, reached pre-clearance levels of cover after 2 years. A few individuals of *Alcyonium digitatum* and *Metridium senile* colonized within 4 years (Sebens, 1986) and would probably take longer to reach pre-clearance levels. Jensen *et al.* (1994) reported the colonization of an artificial reef in Poole Bay, England. They noted that erect bryozoans, including *Bugula plumosa*, began to appear within 6 months, reaching a peak in the following summer, 12 months after the reef was constructed. Similarly, ascidians colonized within a few months e.g. *Aplidium* spp. Sponges were slow to establish with only a few species present within 6-12 months but beginning to increase in number after 2 years, while anemones were very slow to colonize with only isolated specimens present after 2 years (Jensen *et al.*, 1994.). In addition, Hatcher (1998) reported a diverse mobile epifauna after a year's deployment of her settlement panels.

Long-term studies of fixed quadrats in epifaunal communities demonstrated that while seasonal and annual changes occurred, subtidal faunal turf communities were relatively stable, becoming more stable with increasing depth and substratum stability (i.e. bedrock and large boulders rather than small rocks) (Osman, 1977; Hartnoll, 1998). Many of the faunal turf species are long-lived, e.g. 6 -12 years in *Flustra foliacea*, 5-8 years in *Ascidia mentula*, over 20 years in *Alcyonium digitatum*, 8-16 years in *Echinus esculentus* and probably many hydroids (Stebbing, 1971a; Gili & Hughes, 1995; Hartnoll, 1998). However, *Bugula* dominated communities recorded off the west Anglesey in 1996 were reported to be 'silted and ragged' in the same season the following year, suggesting some inter-annual variation may occur (Brazier *et al.*, 1999).

Resilience assessment. The majority of the species within this biotope have short lived pelagic larvae, with limited powers of dispersal, resulting in good local recruitment but poor long distance dispersal. *Bugula* and other bryozoan and hydroid species exhibit multiple generations per year, that involve good local recruitment, rapid growth and reproduction. Bryozoans and hydroids are often opportunistic, fouling species, that colonize and occur space rapidly. For example, hydroids would probably colonize with 1-3 months and return to their original cover rapidly, while *Bugula* species have been reported to colonize new habitats within 6 -12 months (see recruitment). However, *Bugula* has been noted to be absent from available habitat even when large populations are nearby (Castric-Frey, 1974; Keough & Chernoff, 1987), suggesting that recruitment may be more sporadic. Where the population is reduced in extent or abundance but individuals remain, local recruitment, augmented by dormant resistant stages and asexual reproduction, is likely to result in rapid recovery of the dominant bryozoan species, hydroids, probably within 12 months. Colonial ascidians would probably recover their original cover with 2 years, while sponges and anemones may take longer to recover but would probably regain original cover within 5 years. Where the community was destroyed and recovery is dependent on recruitment from other areas, bryozoans, hydroids and ascidians would probably recruit rapidly from other neighbouring areas (see Jensen *et al.*, 1994; Hatcher, 1998). However, sponges and especially Anthozoa may take many years to recruit and develop. Sebens (1985, 1986) found that the sponge *Halichondria panicea* reached pre-clearance levels of cover after 2 years. A few individuals of *Alcyonium digitatum* and *Metridium senile* colonized within 4 years (Sebens, 1986) and slower growing sponges

would probably take longer to reach pre-clearance levels. Some of the faster growing, smaller sponges would colonize new sites relatively quickly, little information regarding the resilience of larger, branching sponges was sparse, and a more cautious resilience assessment is therefore applied. Overall, if community suffers significant mortality from a pressure (resistance of 'None', 'Low') resilience is assessed as '**Medium**' (recovery within 2-10 years). If resistance is assessed as 'Medium' or 'High' then resilience will be assessed as '**High**' (recovery within 2 years). Confidence is assessed as **'Low'**, given the lack of resilience, growth rates or fecundity for characterizing sponges. The anemones are likely to be longer lived and take longer to recover.

🚢 Hydrological Pressures

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

Bugula spp. grow and reproduce in the summer months, however, day length and/or the phytoplankton bloom characteristic of temperate waters are probably more important than temperature (Ryland, 1967; 1970; Tyler-Walters, 2005). *Bugulina turbinata* is a predominantly southern species in British waters (Lewis, 1964; Hayward & Ryland, 1998) but has been recorded as far north as Shetland (NBN, 2016). A long-term increase in temperature may increase its abundance in northern British waters and allow the species to extend its range. It occurs as far south as the Mediterranean (Rosso, 2003) and is likely to tolerate increases in temperature, at the benchmark level. Cocito & Sgorbini (2014) studied spatial and temporal patterns of colonial bryozoans in the Ligurian Sea over 9 years. High temperature events were recorded. The first caused mass mortality among a number of species. The decline in *Pentapora fascialis* colony cover between 11 and 22 m depth followed an unusually warm summer in 1999 (with larger colonies most affected. The temperature at 11 m was 23.87 ± 1.4 °C resulted in mortality of 86% of a colony.   Recovery took place gradually, with deeper communities recovering to pre-disturbance levels within four years. *Pentapora foliacea* is found in warmer waters as far south the north coast of Morocco, with the northernmost limits of its distribution in the Minch off western Scotland (Lombardi *et al.*, 2010). Once established, colonies are most likely able to withstand occasional lower or higher than normal temperatures, but long-term decreases in temperature may cause distribution range to shrink. Although being quite long-lived (10+ years) (Jackson, 2016), *Alcyonidium diaphanum* is commonly found across the British Isles and is probably widely distributed across North-West Europe (Fish & Fish, 1992).

The sponges, *Tethya aurantium*, *Dysidea fragilis* are found from the Arctic to the Mediterranean, *Amphilectus fucorum* from Norway to France, *Polymastia boletiformis* from the Arctic to the Atlantic coasts of Europe, and *Raspailia ramosa* is found across the western British Isles and Northern France (Ackers, 1993). The sea anemone *Sargatia elegans* is found from Scandinavia to the Mediterranean (Picton & Morrow 2016) and *Actinothoe sphyrodeta* is distributed from the northern coast of Scotland to Spain (Ramos, 2010; NBN, 2016).

Berman *et al*. (2013) monitored sponge communities off Skomer Island, UK over three years with all characterizing sponges for this biotope assessed. seawater temperature, turbidity, photosynthetically active radiation and wind speed were all recorded during the study. It was concluded that, despite changes in species composition, primarily driven by the non-characterizing *Hymeraphia, Stellifera* and *Halicnemia patera*, no significant difference in sponge density was recorded in all sites studied. Morphological changes most strongly correlated with a mixture of

water visibility and temperature. Cebrian *et al.* (2011) conducted four-year surveys of two shallow-water sponge species, *Ircinia fasciculata* and *Sarcotragus spinosulum* in the western Mediterranean Sea. Two severe sponge die-offs (total mortality ranging from 80 to 95% of specimens) occurred in the summers of 2008 and 2009. These events primarily affected *Ircinia fasciculata*, and a significant positive correlation was observed between elevated temperature and injured specimens. It was suggested, following *in vitro* studies of the associated cyanobacteria in increasing temperatures up to those experienced in 'extreme summer' of 27°C, that heat related disappearance of the cyanobacteria in *Ircinia fasciculata* (a bacteriosponge) was important when considering sponge mortality. Research by Webster *et al.*(2008, 2011), Webster & Taylor, (2012), Preston &Burton (2015) suggested that many sponges rely on a holobiont of many synergistic microbes. Webster *et al.*, 2011 describes a much higher thermal tolerance to sponge larval holobiont when compared with adult sponges. Adult *Rhopaloeides odorabile* from the Great Barrier Reef has been shown to have a strict thermal threshold of between 31-33°C (Webster *et al.* 2008) whereas the larvae could tolerate temperatures of up to 36°C with no adverse effects.

Sensitivity assessment. The characterizing species are widely distributed across the British Isles, none being at their southern limit. Morphological changes were observed in UK sponge communities, with the temperature a factor, but the characterizing sponges assessed were not listed as the most highly contributing to these changes (Berman *et al.*, 2013). Resistance has been assessed as '**High**', resilience as '**High**' and sensitivity as '**Not Sensitive**' at the benchmark level.

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

All characterizing bryozoans (*Alcyonidium diaphanum*, *Flustra foliacea*, *Pentapora foliacea*, *Crisularia plumosa* and *Bugulina flabellata*) have been recorded across the British Isles, from the Channel Isles to the northern coast of Scotland (NBN, 2015).

Patzold *et al.* (1987) recorded the formation of a growth band in *Pentapora foliacea* during times of reduced reproduction, which appeared during periods of colder water temperatures. *Pentapora foliacea* is found in warmer waters as far south as the northern coast of Morocco, with the northernmost limits of distribution in the Minch off western Scotland (Lombardi e*t al.*, 2010). The sponges *Tethya aurantium and Dysidea fragalis* are found from the Arctic to the Mediterranean, *Amphilectus fucorum* is found from Norway to France, *Polymastia boletiformis* is found from the Arctic to the Atlantic coasts of Europe, *Raspailia ramosa* found across the western British Isles and Northern France (Ackers, 1993).

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Crisp (1964) reported the effects of an unusually cold winter (1962-3) on the marine life in Britain, including Porifera in North Wales. Whilst difficulty distinguishing between mortality and delayed

development was noted, Crisp (1964) found that *Pachymastia johnstonia* and *Halichondria panicea* were wholly or partly killed by frost, several species appeared to be missing including *Amphilectus fucorum*. Others, including *Hymeniacidon perleve*, were unusually rare and a few species, including *Polymastia boletiformis*, were not seriously affected. It should be noted that Crisp's general comments on all marine life state that damage decreased the deeper the habitat. The anemone *Sargatia elegans* is found from Scandinavia to the Mediterranean (Picton & Morrow 2016), while *Actinothoe sphyrodeta* is distributed from the northern coast of Scotland to Spain (Ramos, 2010; NBN, 2016) and could, therefore, be affected by a reduction in temperature.

Sensitivity assessment There is evidence of sponge mortality at extremely low temperatures in the British Isles. Given this evidence, it is likely that a cooling of 5°C would affect some of the characterizing sponges, and resistance is assessed as '**Medium**'. A resilience of '**High**' is recorded and sensitivity is assessed as '**Low**'.

Salinity increase (local)	No evidence (NEv)	No evidence (NEv)	No evidence (NEv)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

Marin (1997) 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. Soule & Soule (1979) cite Hastings (1927) who described the presence of five bryozoans in hypersaline conditions in the Suez Canal. Both *Sagartia elegans* and *Actinothoe sphyrodeta* occur in the littoral (Picton & Morrow, 2016) and are therefore likely to experience both higher and lower salinities than 'Full' (30-35 ppt) as per the biotope description (Connor et al., 2004).

Sensitivity assessment. The ByErSp biotope complex is a circalittoral biotope that experiences. Whilst there is some evidence of some bryozoan and sponge species existing in hypersaline conditions, '**No evidence**' could be found for the characterizing bryozoans or the majority of sponge species.

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

Ryland (1970) stated that, with a few exceptions, the Gymnolaemata were fairly stenohaline and restricted to full salinity (30-35 ppt), noting that reduced salinities result in an impoverished bryozoan fauna. *Flustra foliacea* appears to be restricted to areas with high salinity (Tyler-Walters & Ballerstedt, 2007; Budd 2008). Dyrynda (1994) noted that *Flustra foliacea* and *Alcyonidium diaphanum* were probably restricted to the vicinity of the Poole Harbour entrance by their intolerance to reduced salinity. Although protected from extreme changes in salinity due to their subtidal habitat, severe hyposaline conditions could adversely affect *Flustra foliacea* colonies.

Castric & Chassé (1991) conducted a factorial analysis of the subtidal rocky ecology near Brest, France and rated the distribution of species from estuarine to offshore conditions. *Dysidea fragilis* and *Raspailia ramosa* were rated as indifferent to this range. *Cliona celata* and *Pachymatisma johnstonia* had a slight preference for more estuarine conditions while *Polymastia mamillaris* and *Tethya aurantium* had a slight preference for offshore conditions. *Stelligera rigida* and *Polymastia boletiformis* (as *Polymastia robusta*) were intolerant of the more estuarine conditions. Mean salinity difference between the two farthest zones was low (35.1 and 33.8 ‰ respectively) but with a greater range being experienced in the Inner Rade (± 0.1 compared with 2.4‰). It should be noted that the range of salinities identified in this study do not reach the lower benchmark level, and at

least some of the characterizing sponges are likely to be affected at the benchmark level. Some characterizing sponges are present in lower salinity biotopes, such as CR.MCR.CFaVS (Connor *et al.*, 2004) and proportion of the sponge community is likely to survive a low salinity event. Both *Sagartia elegans* and *Actinothoe sphyrodeta* occur in the littoral (Picton & Morrow, 2016) and are therefore likely to experience both higher and lower salinities than 'Full' (30-35 ppt) as per the biotope description (Connor et al., 2004).

Sensitivity assessment. Some of the characterizing bryozoans and sponges are likely to be adversely affected by a reduction in salinity. Resistance is assessed as '**Low**', resilience as '**Medium**' and sensitivity as '**Medium**'.

Water flow (tidal current) changes (local)	High	High	Not sensitive
	Q: Medium A: Medium C: Medium	Q: High A: High C: High	Q: Medium 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, 1977). 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, 2005c). 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, 1985; 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 very localized and the colonies are likely to be dependent on water currents for food supply. A significant decrease in water flow is likely to result in a decrease in the abundance of bryozoans.

Riisgard *et al.* (1993) discussed the low energy cost of filtration for sponges and concluded that passive current-induced filtration may be of insignificant importance for sponges. Pumping and filtering occur in choanocyte cells which generate water currents in sponges using flagella (de Vos *et al.*, 1991).

Sensitivity assessment. The biotope complex CR.HCR.XFa.ByErSp is defined as a moderate to high energy and occurs in areas of moderately strong to strong tidal water flow (1-6 kn). Bryozoan communities rely on movement of water for feeding and a severe reduction in water flow over an extended period of time could cause mortality. Sponges are present in biotopes with both stronger and negligible tidal flow and are therefore unlikely to be affected by a change in water flow. However, at the benchmark level (0.1-0.2 m/s), it is unlikely that an increase or decrease would increase chances of mortality for any of the characterizing species or require a reclassification of

the biotope. Resistance is therefore recorded as '**High**' with resilience as '**High**' and the biotope is '**Not sensitive'** at the benchmark level.

Emergence regime changes	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

Changes in emergence are **not relevant** to this biotope as it is restricted to fully subtidal/circalittoral conditions - the pressure benchmark is relevant only to littoral and shallow sublittoral fringe biotopes.

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

Bugula spp. produce flexible erect tufts, which are likely to move with the oscillatory flow created by wave action. *Bugulina turbinata* has been recorded from very wave exposed to very wave sheltered habitats (Tyler-Walters, 2005c). *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/sec at 20 m (Hiscock, 1983, 1985). *Flustra foliacea* is a common member of the flotsam, having been removed from its substratum by storms. Whilst the biotope is circalittoral, a severe increase in wave exposure (e.g. storms) could affect bryozoans colonies. Cocito *et al*. (1998) described a severe winter storm of 1993 had devastating effects on a *Flustra foliacea* population, sweeping away most of the colonies down to 11 m.

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).

Sensitivity assessment. The ByEuSp complex is found in extreme wave exposure so that a further increase is Not relevant. However, a reduction in wave exposure is likely to result in faunal communities typical of moderate to low energy, and less wave exposed, habitats, e.g. BrAs complex dominated by ascidians and brittlestars, Flustra, or echinoderm grazed faunal turfs. Hence, a significant reduction in wave exposure could result in reclassification and loss of the biotope. However, a 3-5% change in significant wave height (the benchmark) is probably not 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)	Not assessed (NA)	Not assessed (NA)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	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.

Hydrocarbon & PAH contamination	Not Assessed (NA)	Not assessed (NA)	Not assessed (NA)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

ByErSp 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 & 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*.

Tethya lyncurium concentrated BaP (benzo[a]pyrene) to 40 times the external concentration and no significant repair of DNA was observed in the sponges, which, in higher animals, would likely lead to cancers. As sponge cells are not organized into organs the long-term effects are uncertain (Zahn *et al.*, 1981).

Synthetic compound contamination	Not Assessed (NA)	Not assessed (NA)	Not assessed (NA)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

This pressure is **Not assessed** but evidence is presented where available.

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 less than 165 m from the effluent source. The evidence, therefore, suggests that *Securiflustra securifrons* would be sensitive to synthetic compounds.

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

'No evidence'.

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

This pressure is **Not assessed**.

De-oxygenation	Low	Medium	Medium
	Q: Medium A: Low C: Low	Q: Medium A: Medium C: Medium	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 (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 epifauna communities, including dominant species such as the bryozoans, were unaffected by periods of moderate hypoxia (ca 0.35 -1.4 ml/l which corresponds to ca 0.5 - 2 mg/l) and short periods of hypoxia (<0.35 ml/l which corresponds to <0.5 mg/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.

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 (ca <0.5 mg/l) below ca 10 m. No *Tethya aurantia, Kirchenpaueria pinnata, Hymeniacidon pereleve or Polymastia boletiformis* were recorded at depths below 10 - 11 m. Demosponges maintained under laboratory conditions can tolerate hypoxic conditions for brief periods, (Gunda & Janapala, 2009) investigated the effects of variable dissolved oxygen (DO) levels on the survival of the marine sponge, *Haliclona pigmentifera*. Under hypoxic conditions (1.5-2.0 ppm DO which corresponds to ca 1.5-2.0 mg/l), *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 = ca <0.3 mg/l).

Sensitivity assessment. The evidence suggests that the sponge communities would be severely affected by hypoxic conditions. Resistance is therefore recorded as '**Low**', with a resilience of '**Medium**' and sensitivity is classed as '**Medium**' at the benchmark level.

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

Gochfeld *et al.* (2012) studied the effect of nutrient enrichment (≤0.05 to 0.07 ꙮM for nitrate and ≤0.5 ꙮM for phosphate) as a potential stressor in *Aplysina caulifornis* and its bacterial symbionts

and found that nutrient enrichment had no effects on sponge or symbiont physiology when compared to control. This study does contradict 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.

Rose & Risk (1985) described an increase in abundance of *Cliona delitrix* in an organically polluted section of Grand fringing reef affected by the discharge of untreated faecal sewage. Ward-Paige *et al.* (2005) described the greatest size and biomass of clionids corresponded with highest nitrogen, ammonia and $\delta^{15}N$ levels.

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	High	Not sensitive
	Q: Medium A: Medium C: Medium	Q: High A: High C: High	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 suggest 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 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. Mayer-Pinto & Junqueira (2003) studied the effects of organic pollution on fouling communities in Brazil and found that tolerance of polluted/unpolluted artificial reefs varied among bryozoan species. It should be noted that *Bugula* spp. preferred the polluted sites.

Sensitivity assessment. The evidence suggests that organic enrichment may allow some species in the biotope to increase in abundance. Therefore, resistance to this pressure is assessed as '**High**' 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	Very Low	High
	Q: High A: High C: High	Q: High A: High C: 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	Very Low	High
	Q: High A: High C: High	Q: High A: High C: 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**'.

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

'**Not relevant**' to biotopes occurring on bedrock.

Habitat structure changes - removal of substratum (extraction)	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: 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	Medium	Medium
	Q: Medium A: Medium C: Low	Q: Medium A: Medium C: Medium	Q: Medium A: Medium C: Low

Physical disturbance by fishing gear has been shown to adversely affect emergent epifaunal communities with hydroid and 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).

Picton & Morrow (2015) describe *Amphilectus fucorum* as extremely polymorphic and fast growing, changing shape in just a few weeks. It may be encrusting as thin sheets or cushions, massive lobose, with or without tassels, or branched. It has a soft texture and open surface and is, therefore, likely to be damaged through abrasion pressures. Picton & Morrow (2015) noted that whilst *Raspailia ramosa* is firm and elastic, the soft layer is easily rubbed from the strong axial core.

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 oculata* and *Ircina campana* were not significantly affected. Twelve months after trawling, the abundance of sponges had increased to pre-trawl densities, or greater. Tilnant (1979) found that, following a shrimp trawl in Florida, the US, over 50% of sponges, including *Neopetrosia, Spheciospongia, Spongia* and *Hippiospongia*, were torn loose from the bottom. Highest damage incidence occurred to the finger sponge *Neopetrosia longleyi*. Size did not appear to be important in determining whether a sponge was affected by the trawl. Recovery was ongoing, but not complete 11 months after the trawl, although no specific data was provided.

Freese *et al.* (1999) studied the effects of trawling on seafloor habitats and associated invertebrates in the Gulf of Alaska. They found that a transect following a single trawling event showed significantly reduced 'vase' sponges (67% expressed damage), 'morel' sponges (total damage could not be quantified as their brittle nature meant that these sponges were completely torn apart and scattered).   The 'finger' sponges, the smallest and least damaged of the sponges assessed, were damaged by being knocked over (14%). Freese (2001) studied deep cold-water sponges in Alaska a year after a trawl event; 46.8% of sponges exhibited damage with 32.1% having been torn loose. None of the damaged sponges displayed signs of regrowth or recovery. This was in stark contrast to early work by Freese (1999) on warm shallow sponge communities. Impacts of trawling activity in Alaska study were more persistent due to the slower growth/regeneration rates of deep, cold-water sponges. Given the slow growth rates and long lifespans of the rich, diverse fauna, it was considered likely to take many years for deep sponge communities to recover if adversely affected by physical damage Freese (2001).

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 vulnerable epifauna, including the sponge *Pachymatisma johnstoni*, were highly damaged by the experimental trawl. It should be noted that other epifaunal turfs on uneven rock substrata were more resistant to damage than populations on sediment. Coleman *et al.*, 2013 described a four year study on the differences between a commercially potted area in Lundy with a no-take zone. No significant difference in *Axinellid* populations was observed. The authors concluded that lighter abrasion pressures, such as potting, were far less damaging than heavier gears, such as trawls. Whilst capable of movement, the anemones are not rapid and are likely to be as exposed to abrasion events as the sessile epifauna. Anemones are also soft bodied and are likely to be intolerant of abrasion events.

Sensitivity assessment. Given the sessile, emerged nature of the sponges and bryozoans, damage and mortality following a physical disturbance effect are likely to be significant, however, some studies have brought into question the extent of damage to the faunal turf. The physiology of the bryozoans affords some protection in the event of abrasion events and recovery is likely to be rapid if stolons remain undamaged. However, based on the damage to sponges, resistance has been assessed as '**Low**', resilience as '**Medium**' and sensitivity has been assessed as '**Medium**'. Please note, Boulcott & Howell (2011) did not mention the abrasion caused by fully loaded collection bags on the Newhaven dredges. A fully loaded Newhaven dredge may cause higher damage to the community than indicated in their study.

Penetration or disturbance of the substratum subsurface	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: 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)	Low	Medium	Medium
	Q: Low A: NR C: NR	Q: Medium A: Medium C: Medium	Q: Low A: Low C: Low

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 increased 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 a tide-swept seabed, exposed to high levels of suspended sediment and sediment scour in the English Channel (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 to survive in highly sedimented conditions, and many species prefer such habitats (Bell & Barnes 2001; Bell & Smith 2004). Castric & 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). *Cliona celata* and *Stelligera rigida* were classed as indifferent to turbidity, *Tethya aurantium*, *Pachymatisma johnstonia* and *Polymastia boletiformis* (as *Polymastia robusta*) had a slight preference for clearer water, while *Dysidea fragilis*, *Polymastia mamillaris*, and *Raspailia ramosa* 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. *Raspailia ramosa* and *Stelligera stuposa* have a reduced maximum size in areas of high sedimentation (Bell et al, 2002).

Tjensvoll (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. However, it should be noted that a laboratory study on the impact of elevated sedimentation rates on deep water sponges found that sediment load of 30 mg sed./l resulted in significantly higher sponge mortality compared with sponges exposed to 5 and 10 mg sed./l, although no additional information was provided (Hoffman & Tore Rapp, pers com cited in Lancaster *et al.*, 2014). 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. Whilst many sponges are disadvantaged by sedimentation (as would be expected, being sessile filter feeders), 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. Among the characterizing species, 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%.

Sensitivity assessment. The CR.HCR.XFa.ByErSp complex tends to occur in areas of high energy, therefore an increase in suspended sediment will result in an increase in scour. While some sponges and *Flustra* are probably resistant of scour, other fragile sponges, and bryozoans will be removed. The biotope will probably come to resemble Flustra dominated or grazed faunal turf communities in the short-term, and the biotope will be lost. Therefore, a resistance of **'Low'** is suggested, with a resilience of **'Medium'** and sensitivity of **'Medium'**.

Smothering and siltation rate changes (light)	High	High	Not sensitive
	Q: Medium A: Medium C: Low	Q: High A: High C: High	Q: Medium A: Medium 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). However, *Flustra foliacea* dominated communities subject to sediment transport (mainly sand) and periodic, temporary, burial (ca <5 cm) a tide-swept region of the central English Channel (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* biocoenosis and associated sponges in the Black Sea near the Kerch Strait was attributed to siltation (Terent'ev, 2008 cited in Tillin & Tyler-Walters, 2014).

Sensitivity assessment. Smothering by 5 cm of sediment is likely to cause limited mortality amongst some of characterizing species of this biotope (particularly the smaller sponges). This biotope tends to occur in areas with moderate to strong water movement and removal of the sediment is likely to be rapid. Therefore, resistance has been assessed as '**High**'. Resilience has been assessed as **'High'** and sensitivity has been assessed as **'Not sensitive'** at the benchmark level.

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

Smothering by 30 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. Sediment will probably also interfere with larval settlement (Tyler-Walters, 2005). 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* biocoenosis and associated sponges in the Black Sea near the Kerch Strait was attributed to siltation (Terent'ev 2008 cited in Tillin & Tyler-Walters, 2014).

Sensitivity assessment. The majority of the characterizing species are likely to be buried in 30cm of sediment deposition. Smothering by 30 cm of sediment could cause mortality amongst the majority of characterizing species of this biotope if it remained. However, this biotope occurs in areas with moderate to strong water movement and the deposited sediment will be removed quickly. Vertical surfaces may also afford protection so that the effects will depend on the topography of the substratum. Resistance at the benchmark has been assessed as '**Medium**'. Resilience has been assessed as **'High',** assuming sediment removal. Sensitivity has been assessed as '**Low**'.

Litter	Not Assessed (NA)	Not assessed (NA)	Not assessed (NA)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	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	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. Whilst no evidence could be found for the effect of noise or vibrations on the characterizing sponges, it is unlikely that these species would be adversely affected by noise.

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

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

Jones *et al*. (2012) found that many sponges, around Skomer Island, particularly encrusting species, preferred vertical or shaded bedrock to open, light surfaces, presumably due to lack of competition from algae.

Sensitivity assessment. Whilst sponges seem to favour shaded areas in which to settle, it is unlikely that changes at the benchmark level of pressure would result in mortality. Resistance to this pressure is assessed as '**High**' and resilience as '**High**'. This biotope is therefore considered to be '**Not sensitive**'.

Barrier to species movement	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

'**Not relevant**' as 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	No evidence (NEv) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

Bugula spp. are classed as fouling bryozoans, and may be found in the intake pipes of ships or power stations, and on ships hulls. The geographic distribution of *Bugula* species has been extended by transportation by shipping (Ryland, 1967). However, no information on translocation of *Bugula* species was found. In addition, no evidence of genetic modification or hybridization was found. Therefore, 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	No evidence (NEv) 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* has successfully colonized the offshore location of the Georges Bank, USA (Lengyel *et al.*, 2009) which is more exposed than the locations which *Didemnum vexillum* have colonized in the UK. It is, therefore, possible that *Didemnum vexillum* could colonize more exposed locations within the UK and could, therefore, 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.*, 2013b), however evidence of potential effects is sparse.

There is '**No evidence'** regarding known invasive species posing a threat to this biotope. Due to the constant risk of new invasive species, the literature for this pressure should be revisited.

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

Gochfeld *et al.* (2012) found that diseased sponges hosted significantly different bacterial assemblages compared to healthy sponges, with diseased sponges also exhibiting a 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 in the Mediterranean (Vacelet,1994 cited in Cebrian *et al.*, 2011; 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. have 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 which may suggest a specific pathogen caused the effect (Burton, pers. comm..; Preston & Burton, 2015). No evidence for disease in the characterizing bryozoans could be found.

Sensitivity assessment Sponge diseases have caused limited mortality in some species in the British Isles, although mass mortality and even extinction have been reported further afield. Whilst research is on-going into sponge disease in the UK, there is '**No evidence'** to support an assessment of mortality due to diseasing in the characterizing species of this biotope.

Removal of target species	Not relevant (NR)	Not relevant (NR)	Not relevant (NR)
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

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. No evidence for commercial exploitation of bryozoans could be found. Should removal of target species occur, the sessile, epifaunal nature of the characterizing species would result in little resistance to this pressure.

This pressure is '**Not relevant'** as none of the characterizing species are targeted.

Removal of non-target species	Low	Medium	Medium
	Q: Low A: NR C: NR	Q: Medium A: Medium C: Medium	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. These direct, physical impacts are assessed through the abrasion and penetration of the seabed pressures. The sensitivity assessment for this pressure considers any biological/ecological effects resulting from the removal of non-target species on this biotope. 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).

Sensitivity assessment. The incidental removal of a proportion of the sponge and bryozoans populations could result in a change in the character of the biotope. Therefore, resistance is recorded as '**Low**', resilience is recorded as '**Medium**' and sensitivity is '**Medium**'.

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