



# MarLIN

## Marine Information Network

Information on the species and habitats around the coasts and sea of the British Isles

# Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept ciraclittoral rock

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

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**Please note.** This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [<https://www.marlin.ac.uk/habitats/detail/1086>]. All terms and the MarESA methodology are outlined on the website (<https://www.marlin.ac.uk>)

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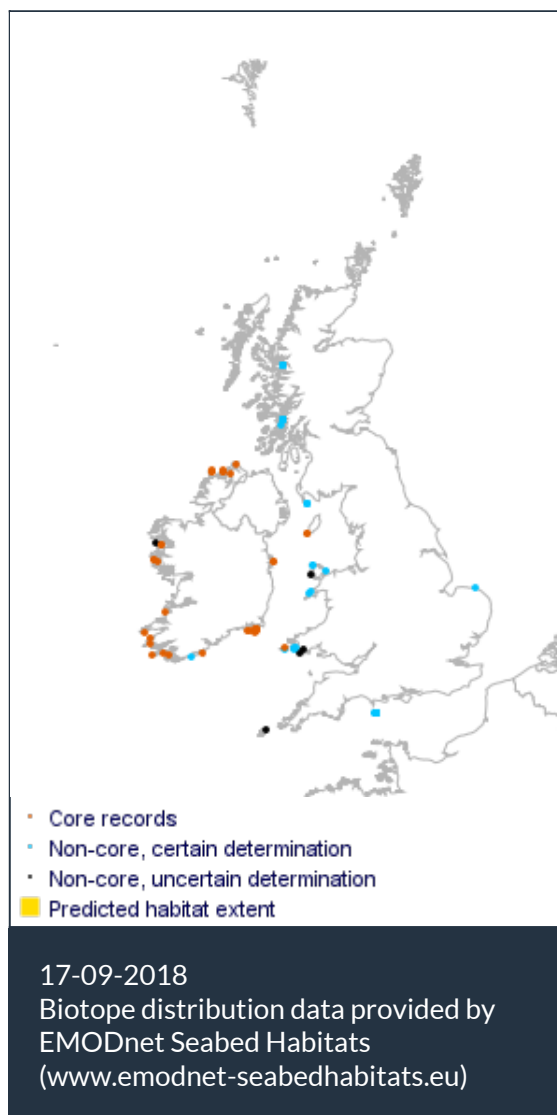


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Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept ciraclittoral rock  
 Photographer: Rohan Holt  
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Researched by John Readman      Refereed by Admin

## Summary

### ☰ UK and Ireland classification

EUNIS 2008	A4.1313	Mixed turf of bryozoans and erect sponges with <i>Sagartia elegans</i> on tide-swept ciraclittoral rock
JNCC 2015	CR.HCR.XFa.ByErSp.Sag	Mixed turf of bryozoans and erect sponges with <i>Sagartia elegans</i> on tide-swept ciraclittoral rock
JNCC 2004	CR.HCR.XFa.ByErSp.Sag	Mixed turf of bryozoans and erect sponges with <i>Sagartia elegans</i> on tide-swept ciraclittoral rock
1997 Biotope		

### 🔍 Description

This variant is typically found on wave-exposed ciraclittoral bedrock and boulders, on steep slopes and upper faces in moderate tidal streams. This species-rich biotope is characterized by a dense sponge, hydroid and bryozoan turf and frequent *Alcyonium digitatum*. There are frequently large

growths of *Cliona celata* and *Pachymatisma johnstonia*. Other species present in this diverse sponge community include *Polymastia boletiformis*, *Haliclona viscosa*, *Polymastia mamillaris*, *Scypha ciliata*, *Hemimycale columella* and *Dysidea fragilis*. Axinellid sponges such as *Stelligera stuposa* and *Raspailia ramosa* may be present in low abundance, and are usually more abundant in deeper water. A dense hydroid turf forms a significant part of this biotope, with tufts of large hydroids such as *Nemertesia antennina* and *Nemertesia ramosa* frequently recorded. Other hydroid turf component species include *Halecium halecinum*, *Aglaophenia tubulifera* and *Abietinaria abietina*. Anemones are also well represented, with species such as *Urticina felina*, *Sagartia elegans* and *Metridium dianthus* recorded. The cup coral *Caryophyllia smithii* and the anemone *Corynactis viridis* are also frequently seen. The bryozoan turf is composed predominantly of *Alcyonidium diaphanum* and *Flustra foliacea*, whilst crustose species such as *Parasmittina trispinosa* contribute to a lesser extent. The delicate *Crisularia plumosa* may also be present. There is a significant echinoderm component in this biotope. Species such as the starfish *Asterias rubens*, *Henricia oculata*, *Marthasterias glacialis* and *Luidia ciliaris*, the sea urchin *Echinus esculentus* and the crinoid *Antedon bifida* are all regularly recorded. Other species which may be observed include the top shell *Calliostoma zizyphinium*, the colonial ascidian *Clavelina lepadiformis* and the barnacle *Balanus crenatus*. The crab *Cancer pagurus* is typically found under boulders. This variant has been recorded from various sites including Pembrokeshire, the Calf of Man and the west coast of Ireland.

## ↓ Depth range

-

## 🏛️ 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

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## 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 cirralittoral 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*, *Bugulina 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 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; Dyrinda, 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 *Bugula fulva* within 363 days while Castric-Fey (1974) noted that *Bugula turbinata*, *Bugula 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 which tend to form short lived, large colonies in summer with significant die-back in late autumn and a dormant winter phase (Eggleston 1972; Dyrinda & Ryland, 1982). Reproduction occurs in summer/early autumn with some species such as *Bugula 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 six 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 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 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 early stage of colony development (Cocito *et al.*, 1998 cited in Jackson, 2016). Lock *et al.*, 2006 describes growth of *Pentapora foliacea* in Skomer, Wales as highly variable, with some colonies growing 800 cm<sup>2</sup> in a year whilst other large colonies completely disappeared. Recovery to pre-disturbance levels following a severe heat event, which resulted in decline of 86% in live colony portion of *Pentapora fascialis* in the Mediterranean, took four years Cocito & Sgorbini

(2014).

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 ciraclittoral (Picton & Morrow, 2015). *Polymastia mamillaris* 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 of 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 Q: High A: Medium C: Medium	High Q: High A: High C: High	Not sensitive 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). *Bugula 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 of 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. 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  $23.87 \pm 1.4$  °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 fragalis* 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 *Hymenaphia*, *Stellifera* and *Halicnemis 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 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*, *Bugula plumosa* and *Bugula 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 *et 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).

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 visibility and temperature. Some sponges do exhibit morphological strategies to cope with winter temperatures e.g. *Halichondria bowerbanki* goes into a dormant state below 4°C, characterized by major disintegration and loss of choanocyte chambers with many sponges surviving mild winters in more protected areas from where it can recolonize (Vethaak *et al.*, 1982).

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 *Polymstia 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 *Sagartia 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 extreme 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**'.

<b>Salinity increase (local)</b>	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 ciraclittoral 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.

<b>Salinity decrease (local)</b>	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). Dyrinda (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 ( $\pm 0.1$  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

Q: Medium A: Medium C: Medium

High

Q: High A: High C: High

Not sensitive

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, 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, 1971; Eggleston, 1972b; Knight-Jones & Nelson-Smith, 1977; Hiscock, 1983, 1985; Holme & Wilson, 1985). Dyrinda (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. Dyrinda (1994) reported that the distribution of *Flustra foliacea* in the current swept entrance to

Poole Harbour was restricted to ciraclittoral 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 occurs 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)  
Q: NR A: NR C: NR

Not relevant (NR)  
Q: NR A: NR C: NR

Not relevant (NR)  
Q: NR A: NR C: NR

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

#### Wave exposure changes (local)

High  
Q: Low A: NR C: NR

High  
Q: High A: High C: High

Not sensitive  
Q: Low A: Low C: Low

*Bugula* spp. produce flexible erect tufts, which are likely to move with the oscillatory flow created by wave action. *Bugula turbinata* has been recorded from very wave exposed to very wave sheltered habitats (Tyler-Walters, 2005).

*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 ciraclittoral, 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
<b>Transition elements &amp; organo-metal contamination</b>	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.

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

	Resistance	Resilience	Sensitivity
<b>Hydrocarbon &amp; PAH contamination</b>	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.

ByErSp is a sub-tidal biotopecomplex (Connor *et al.*, 2004). Oil pollution is mainly a surface phenomenon its impact upon ciraclittoral 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 animal, 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)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

Not assessed (NA)

Q: NR A: NR C: NR

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