Flustra foliacea and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment

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

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2016-06-20

This review can be cited as:
Readman, J.A.J., 2016. [Flustra foliacea] and [Hydrallmania falcata] on tide-swept circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. DOI https://dx.doi.org/10.17031/marlinhab.74.1

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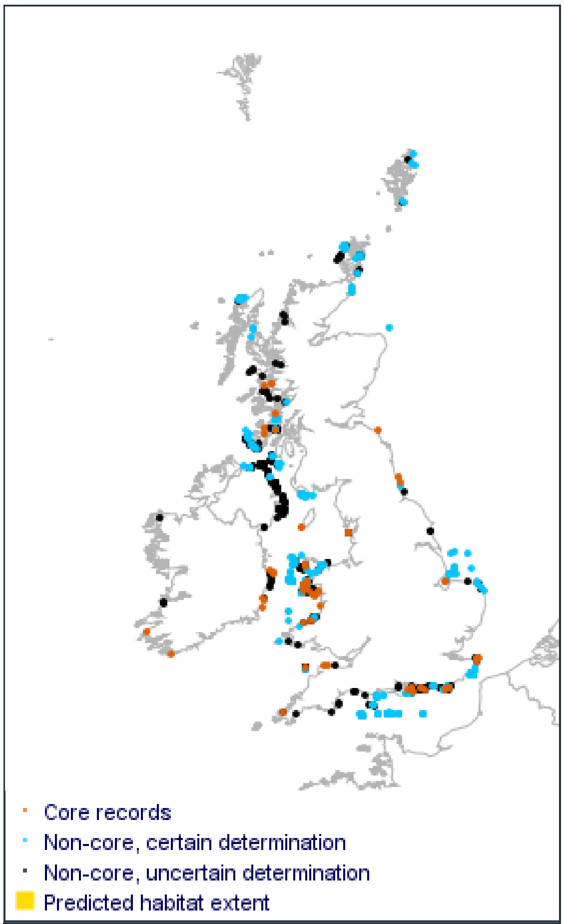

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

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

Summary

UK and Ireland classification

EUNIS 2008	A5.444	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment
JNCC 2015	SS.SMx.CMx.FluHyd	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment
JNCC 2004	SS.SMx.CMx.FluHyd	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment
1997 Biotope	CR.MCR.ByH.Flu.SerHyd	*Sertularia argentea*, *S. cupressina* and *Hydrallmania falcata* on tide-swept circalittoral cobbles and pebbles

Description

This biotope represents part of a transition between sand-scoured circalittoral rock where the epifauna is conspicuous enough to be considered as a biotope and a sediment biotope where an infaunal sample is required to characterise it and is possibly best considered an epibiotic overlay. *Flustra foliacea* and the hydroid *Hydrallmania falcata* characterise this biotope; lesser amounts of other hydroids such as *Sertularia argentea*, *Nemertesia antennina* and occasionally *Nemertesia ramosa*, occur where suitably stable hard substrata is found. The anemone *Urticina felina* and the soft coral *Alcyonium digitatum* may also characterise this biotope. Barnacles *Balanus crenatus* and tube worms *Spirobranchus triqueter* may be present and the robust bryozoans *Alcyonidium diaphanum* and *Vesicularia spinosa* appear amongst the hydroids at a few sites. *Sabella pavonina* and *Lanice conchilega* may be occasionally found in the coarse sediment around the stones. In shallower (i.e. upper circalittoral) examples of this biotope scour-tolerant robust red algae such as *Polysiphonia nigrescens*, *Calliblepharis* spp. and *Gracilaria gracilis* are found. (Information from Connor *et al.*, 2004).

Depth range

5-10 m, 10-20 m, 20-30 m, 30-50 m

Additional information

-

Listed By

- none -

Further information sources

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Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

SS.SSa.IFiSa.ScupHyd and SS.SMx.CMx.FluHyd are also dominated by a bryozoan and hydroid turf, on hard substrata (boulders, stone etc.) subject to scour. CR.HCR.XFa.SpNemAdia is dominated by a dense hydroid and bryozoan turf with sparse sponges and is subject to sand scour. The sand scour is probably responsible for the diversity of opportunistic hydroids and bryozoans. Therefore, their sensitivities are probably similar, so that they were reviewed as a group and the resultant reviews and sensitivity assessments presented separately.

SS.SMx.CMx.FluHyd is characterized by *Flustra foliacea* and the hydroid *Hydrallmania falcata* with other hydroids such as *Sertularia argentea*, *Nemertesia antennina* and *Nemertesia ramosa* occurring on suitable, stable hard substrata. It is similar but experiences less sand scouring than SS.SSa.IFiSa.ScupHyd (Connor *et al*., 2004). SS.SSa.IFiSa.ScupHyd occurs on shallow sands with cobbles and pebbles which are exposed to strong tidal streams. It is characterized by colonies of hydroids, particularly *Hydrallmania falcata* along with *Sertularia cupressina* and *Sertularia argentea*. These hydroids are tolerant to periodic burial and scour by sand (Connor *et al*., 2004).

The sensitivity assessments are based on the sensitivity of the bryozoan and hydroid turf, and the sensitivity of the other species is addressed where relevant.

Resilience and recovery rates of habitat

These biotopes are considered to have a high recovery potential. Sebens (1985, 1986) noted that bryozoans and hydroids covered scraped areas within 4 months in spring, summer and autumn. Hydroids exhibit rapid rates of recovery from disturbance through repair, asexual reproduction and larval colonization. Sparks (1972) reviewed the regeneration abilities and rapid repair of injuries. Fragmentation of the hydroid provides a route for short distance dispersal, for example, each fragmented part of *Sertularia cupressina* can regenerate itself following damage (Berghahn & Offermann, 1999). New colonies of the same genotype may, therefore, arise through damage to existing colonies (Gili & Hughes, 1995). Many hydroid species also produce dormant, resting stages that are very resistant of environmental perturbation (Gili & Hughes 1995). Although colonies may be removed or destroyed, the resting stages may survive attached to the substratum and provide a mechanism for rapid recovery (Cornelius, 1995a; Kosevich & Marfenin, 1986). The life cycle of hydroids typically alternates between an attached solitary or colonial polyp generation and a free-swimming medusa generation. Planulae larvae produced by hydroids typically metamorphose within 24 hours and crawl only a short distance away from the parent plant (Sommer, 1992). Gametes liberated from the medusae (or vestigial sessile medusae) produce gametes that fuse to form zygotes that develop into free-swimming planula larvae (Hayward & Ryland, 1994). Planulae are present in the water column between 2-20 days (Sommer, 1992).

Hydroids are therefore classed as potential fouling organisms, rapidly colonising a range of substrata placed in marine environments and are often the first organisms to colonize available space in settlement experiments (Gili & Hughes, 1995). For example, hydroids were reported to colonize an experimental artificial reef within less than 6 months, becoming abundant in the following year (Jensen *et al*., 1994). In similar studies, *Obelia* species recruited to the bases of reef slabs within three months and the slab surfaces within six months of the slabs being placed in the marine environment (Hatcher, 1998). Cornelius (1992) stated that *Obelia* spp. could form large colonies within a matter of weeks. In a study of the long-term effects of scallop dredging in the

Irish Sea, Bradshaw *et al*., (2002) noted that hydroids increased in abundance, presumably because of their regeneration potential, good local recruitment and ability to colonize newly exposed substratum quickly. Cantero *et al*. (2002) describe fertility of *Obelia dichotoma*, *Kirchenpaureria pinnata*, *Nemertesia ramosa* in the Mediterranean as being year-round, whilst it should be noted that higher temperatures may play a factor in this year round fecundity, Bradshaw *et al.* (2002) observed that reproduction in *Nemertesia antennina* occurred regularly, with three generations per year. It was also observed that presence of adults stimulates larval settlement, therefore if any adults remain, reproduction is likely to result in local recruitment. It has also been suggested that rafting on floating debris as dormant stages or reproductive adults (or on ships hulls or in ship ballast water), together with their potentially long lifespan, may have allowed hydroids to disperse over a wide area in the long-term and explain the near cosmopolitan distributions of many hydroid species (Cornelius, 1992; Boero & Bouillon 1993). For example, *Halecium halecinum* is an erect hydroid growing up to 25 cm and is found on stones and shells in coastal areas. It is widely distributed in the Atlantic and is present from Svalbard to the Mediterranean (Hayward & Ryland, 1994; Palerud *et al*., 2004; Medel *et al*., 1998). *Nemertesia ramosa* grows up to 15 cm and is found inshore to deeper water and is common throughout the British Isles and is distributed from Iceland to north-west Africa (Hayward & Ryland, 1994). *Hydrallmania falcata* grows to 50 cm, grows on rock and shell, particularly in sandy areas and is found from the Arctic to the Mediterranean (Hayward & Ryland, 1994).

Bryozoans are sessile fauna forming colonies through asexual budding following settlement of sexually produced larvae (Hayward & Ryland, 1995b). Larvae have a short pelagic lifetime of up to about 12 hours (Ryland, 1976). Recruitment is dependent on the supply of suitable, stable, hard substrata (Eggleston, 1972b; Ryland, 1976; Dyrynda, 1994). Even in the presence of available substratum, Ryland (1976) noted that significant recruitment in bryozoans only occurred in the proximity of breeding colonies, although Hiscock (1981) described *Flustra foliacea* colonizing the wreck of the *MV Roberts*, several hundreds of metres from any significant hard substrata, and hence a considerable distance from potentially parent colonies.

Flustra foliacea is a coarse, foliaceous bryozoan which tends to be found on stones and shells, reaches 10 cm in height. It is common to all coasts in North-West Europe (Hayward & Ryland, 1995b) and is found across all coasts in the British Isles (NBN, 2015). 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 twelve year old specimens were reported off the Gower Peninsula (Stebbing, 1971a; Ryland, 1976). Fortunato *et al.* (2013) compared numerous sets of growth data with their own observations and reported that colonies grow faster during the first couple of years (about 1.05 cm/year), slowing 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 that *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). *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 (1972a) 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). Four years after sinking off Lundy, the *MV Roberts* was found to be colonized by erect bryozoans and hydroids, including occasional *Flustra foliacea* (Hiscock, 1981). *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). *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 1972a; Dyrynda & Ryland, 1982). Reproduction occurs in summer/early autumn with some species such as *Bugula flabellate* reportedly having two generations of fronds capable of reproduction each year (Dyrynda & Ryland, 1982). Eggleston (1972a) reported that newly settled specimens from the first generation in the Isle of Man grew rapidly and contributed to the second generation.

Resilience assessment: Colonization of cleared space from distant populations is probably stochastic, reliant on hydrography and environmental conditions. The hydroids that characterize this biotope are likely to recover from damage very quickly. Based on the available evidence, resilience for the hydroid species is 'High' (recovery within two years) for any level of perturbation. Depending on the season of the impact and level of recovery, recovery could occur within six months. Bryozoans tend to be fast growing fauna that are capable of self-regeneration. Dispersal of the larvae is limited and it is likely that the bryozoan turfs would regenerate rapidly, within 2 years (resilience of 'High') from most levels of damage. *Flustra foliacea* can evidently colonize and reach an abundance of occasional (1-5% cover) within 4 years (Hiscock, 1981). While the biotope may be recognisable in up to five years, *Flustra foliacea* may take at least five years to recover its original dominance. Therefore, if the 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 is assessed as '**High**' (recovery within 2 years). Where habitats are isolated by geography (distance) or hydrography, recovery may take longer.

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

Gili & Hughes (1995) reported that temperature is a critical factor stimulating or preventing reproduction and that most species have an optimal temperature for reproduction. However, limited evidence for thermal thresholds and thermal ranges were available for the characterizing species recorded in this biotope. Berrill (1949) reported that growth in *Obelia commissularis* (syn. *dichotoma*) was temperature dependent but ceased at 27°C. Hydranths did not start to develop unless the temperature was less than 20°C and any hydranths under development would complete their development and rapidly regress at ca 25°C. Berrill (1948) reported that *Obelia* species were absent from a buoy in July and August during excessively high summer temperatures in Booth Bay Harbour, Maine, USA. Berrill (1948) reported that the abundance of

Obelia species and other hydroids fluctuated greatly, disappearing and reappearing as temperatures rose and fell markedly above and below 20°C during this period. The upwelling of cold water (8-10°C colder than surface water) allowed colonies of *Obelia* sp. to form in large numbers. Cantero *et al*. (2002) describe the presence and year-round fertility of *Obelia dichotoma*, *Kirchenpaureria pinnata*, *Nemertesia ramosa* and *Halecium spp.*in the Mediterranean.

Bugula spp. grows and reproduces 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, 2005c). *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, 2015). 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 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 causing mass mortality among a number of species. *Alcyonidium diaphanum* is commonly found across the British Isles and is probably widely distributed across North-West Europe (Fish & Fish, 1996).

Sensitivity assessment. None of the characterizing species are at their southern distribution limit in the British Isles. No evidence for mortality linked to an increase in temperature in the British Isles was found. The biotope is, therefore, assessed as having a resistance of '**High**', a resilience of '**High**' and is assessed as '**Not sensitive**' at the benchmark level.

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

Berrill (1949) reported that for *Obelia*, stolons grew, under optimal nutritive conditions, at less than 1 mm in 24 hrs at 10-12°C, 10 mm in 24 hrs at 16-17°C, and as much as 15-20 mm in 24 hrs at 20°C. All important characterizing bryozoans (*Alcyonidium diaphanum*, *Flustra 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). *Alcyonium digitatum* is recorded from Iceland in the north to Portugal in the south and it is unlikely that this species will be adversely affected by a long-term temperature change in British waters (Budd, 2008). *Alcyonium digitatum* was also reported to be apparently unaffected by the severe winter of 1962-1963 (Crisp, 1964). The hydroids *Obelia dichotoma*, *Halecium Halecinum* and *Nemertesia* sp. were recorded in Svalbard in the Arctic Circle (Orejas *et al*., 2012).

Sensitivity assessment. The majority of characterizing species occur in boreal environments, with none at their northerly distribution limit. Therefore, resistance is likely to be '**High**' with a resilience of **'High'** and the biotope is probably '**Not sensitive'** at the benchmark level.

Salinity increase (local)	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

Studies on hydroids, in general, have found that prey capture rates may be affected by salinity and temperature (Gili & Hughes, 1995) although no evidence was found for species that characterize this biotope. Soule & Soule (1979) cite Hastings (1927) who described the presence of five bryozoans in hypersaline conditions in the Suez Canal. **'No evidence'** for mortality or tolerance of the characterizing bryozoans or hydroids in hypersaline conditions could be found.

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

This biotope is recorded in full salinity habitats (Connor et al., 2004). Little evidence for the characterizing hydroids could be found. Stebbing (1981a) found that, for the hydroid *Campanularia flexuosa*, growth was inhibited in 70% seawater (ca 25‰) and that exposure to below 30% seawater (ca 10‰) was lethal after 3 days. Ryland (1970) stated that, with a few exceptions, the Gymnolaemata bryozoans 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). 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.

Sensitivity assessment. The characterizing bryozoans are likely to be affected by a reduction in salinity, and species diversity is likely to decrease. Resistance is assessed as '**Low**', resilience is assessed as '**High**' and sensitivity is '**Low**'.

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

Hayward & Ryland (1995b) noted that abundant communities of hydroids occur in narrow straits and headlands, which may experience high levels of water flow. Hydroids can bend passively with water flow to reduce drag forces to prevent detachment and enhance feeding (Gili & Hughes, 1995). The hydroid growth form also varies to adapt to prevailing conditions, allowing species to occur in a variety of habitats (Gili & Hughes, 1995). For example, Hiscock (1979b) assessed feeding behaviour of the hydroid *Tubularia indivisa* in response to different flow rates. At flow rates <0.05 m/s, polyps actively moved tentacles. Increasing the flow rate to 0.2 m/s increased capture rates but at higher flow rates from 0.5-0.9 m/s the tentacles were extended down current and pushed together and feeding efficiency was reduced. In general, flow rates are an important factor for feeding in hydroids and prey capture appears to be higher in more turbulent conditions that prevent self-shading by the colony (Gili & Hughes, 1995). The capture rate of zooplankton by hydroids is correlated with prey abundance (Gili & Hughes, 1995), thus prey availability can compensate for sub-optimal flow rates. Water movements are also important to hydroids to prevent siltation, which can cause death (Round *et al*., 1961). Tillin & Tyler-Walters (2014) suggested that the range of flow speeds experienced by biotopes in which hydroids are found indicate that a change (increase or decrease) in the maximum water flow experienced by mid-range populations for the short periods of peak spring tide flow would not have negative effects on this group.

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 the high mass transport of water such as the Menai Strait and tidal rapids generally support large numbers of bryozoan species (Moore, 1977a). Although, active suspension feeders, their feeding currents are probably fairly localized and they are dependent on water flow to bring adequate food supplies within reach (McKinney, 1986). A substantial decrease in water flow will probably result in impaired growth due to a reduction in food availability, and an increased risk of siltation (Tyler-Walters, 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, resulting in the 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 dependant on water currents for food supply. A significant decrease in water flow is likely to result in a decrease in the abundance of bryozoans.

Sensitivity assessment. The biotope experiences moderate tidal streams and substantial increase or decrease would probably result in a decline of the biotope. However, a 0.1 – 0.2 m/s change (the benchmark) is unlikely to significantly impact the characterizing species. Resistance is, therefore, assessed as '**High**', resilience is assessed as '**High**' and the biotope is assessed as '**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/circalittoral conditions-The pressure benchmark is relevant only to littoral and shallow sublittoral fringe biotopes.

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

Jackson (2004) reported that *Nemertesia ramosa* was intolerant of high wave exposure and only found in sheltered areas. Faucci *et al.* (2000) recorded hydroid communities at two sites of different wave exposure and recorded the presence of *Obelia dichotoma* and *Halecium* spp. in both the exposed and sheltered sites, but only found *Kirchenpaueria* sp. in the sheltered site. *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, 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, especially on mobile substrata such as cobbles and pebbles. Cocito *et al.* (1998) described a severe winter storm of 1993 had devastating effects on the same *Flustra foliacea* population, sweeping away most of the colonies down to 11 m.

Sensitivity assessment. A significant increase in wave exposure could affect the characterizing species due to increased scour and movement of mobile substrata. A significant decrease may also affect the biotope. However, a change at the benchmark level would be unlikely to affect the characterizing species. Resistance is, therefore, assessed as '**High**', resilience is assessed as '**High**' and the biotope is assessed as '**Not sensitive**' at the benchmark level.

Chemical Pressures

	Resistance	Resilience	Sensitivity
Transition elements & organo-metal contamination	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Although no information on the effects of heavy metals on the assessed hydroids was found, evidence suggests that hydroids may suffer at least sub-lethal effects and possibly morphological changes and reduced growth due to heavy metal contamination. Various heavy metals have been shown to have sublethal effects on growth in the few hydroids studied experimentally (Bryan, 1984). Stebbing (1981a) reported that Cu, Cd, and tributyl tin fluoride affected growth regulators in *Laomedea* (as *Campanularia*) *flexuosa* resulting in increased growth. Stebbing (1976) reported that 1 µg/l Hg^{2+} was stimulatory, although the effect was transitory, exposure resulting in reduced growth towards the end of his 11-day experiments. Cadmium (Cd) was reported to cause irreversible retraction of 50% of hydranths in *Laomedea loveni* after 7 days exposure at concentrations between 3 µg/l (at 17.5°C and 10 ppt salinity) and 80 µg/l (at 7.5°C and 25 ppt salinity) (Theede *et al.*, 1979). *Laomedea loveni* was more tolerant of Cd exposure at low temperatures and low salinities. Karbe (1972, summary only) examined the effects of heavy metals on the hydroid *Eirene viridula* (Campanulidae). He noted that Cd and Hg caused cumulative effects, and morphological changes. Mercury (Hg) caused irreversible damage at concentrations as low as 0.02 ppm. He reported threshold levels of heavy metals for acute effects in *Eirene viridula* of 1.5-3 ppm Zn, 1-3 ppm Pb, 0.1-0.3 ppm Cd, 0.03-0.06 ppm Cu and 0.001-0.003 ppm Hg. Karbe (1972, summary only) suggested that *Eirene viridula* was a sensitive test organism when compared to other organisms. Although no information on the effects of heavy metals on assessed hydroid species was found, the above evidence suggests that hydroids may suffer at least sub-lethal effects and possibly morphological changes and reduced growth due to heavy metal contamination.

Bryozoans are common members of fouling communities and amongst those organisms most resistant to antifouling measures, such as copper containing anti-fouling paints. Bryozoans were also shown to bioaccumulate heavy metals to a certain extent (Soule & Soule, 1979; Holt *et al.*, 1995).

Nevertheless, this pressure is **Not assessed** but evidence is presented where available.

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

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

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). 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). 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).

Little information on the effects of hydrocarbons on bryozoans was found. Ryland & de Putron (1998) did not detect adverse effects of oil contamination on the bryozoan *Alcyonidium* spp. or other sessile fauna in Milford Haven or St. Catherine's Island, south Pembrokeshire. Houghton *et al.* (1996) reported a reduction in the abundance of intertidal encrusting bryozoa (no species given) at oiled sites after the *Exxon Valdez* oil spill. Soule & Soule (1979) reported that the encrusting bryozoan *Membranipora villosa* was not found in the impacted area for 7 months after the December 1976 *Bunker C* oil spill in Los Angeles Harbour. Additionally, Soule & Soule (1979) reported that *Bugula neritina* was lost from breakwater rocks in the vicinity (in December 1979) of the *Bunker C* oil spill and had not recovered within a year. However, *Bugula neritina* had returned to a nearby area within 5 months (May 1977) even though the area was still affected by sheens of oil. Furthermore, only three of eight recorded species two weeks after the incident were present in April within the affected breakwater area. By June all the species had been replaced by dense growths of the erect bryozoan *Scrupocellaria diegensis*.

Mohammad (1974) reported that *Bugula* spp. and *Membranipora* spp. were excluded from settlement panels near an oil terminal in Kuwait subject to minor but frequent oil spills. Encrusting bryozoans are also probably intolerant of the smothering effects of acute hydrocarbon contamination and pollution, resulting in suffocation of colonies and communities may be lost or damaged. Circalittoral communities are likely to be protected from the direct effects of oil spills by their depth. However, the biotope may be exposed to emulsified oil treated with dispersants, especially in areas of turbulence, or may be exposed to water soluble fractions of oils, PAHs or oil adsorbed onto particulates (Tyler-Walters, 2002).

Little information of the effects of hydrocarbons on hydroids was found although hydroid species adapted to a wide variation in environmental factors and with cosmopolitan distributions tend to be more tolerant of polluted waters (Boero, 1984; Gili & Hughes, 1995).

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

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

The species richness of hydroid communities decreases with increasing pollution but hydroid species adapted to a wide variation in environmental factors and with cosmopolitan distributions tend to be more tolerant of polluted waters (Boero, 1984; Gili & Hughes, 1995). Stebbing (1981a) cited reports of growth stimulation in *Obelia geniculata* caused by methyl cholanthrene and dibenzanthrene. Hoare & Hiscock (1974) suggested that the Bryozoa (as Polyzoa) were amongst the most intolerant species to acidified halogenated effluents in Amlwch Bay, Anglesey, e.g. *Electra* *pilosa* occurred at lower abundance on laminarian holdfasts within the bay, compared to sites outside the affected area.

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

'No evidence' was found.

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

This pressure is **Not assessed**.

De-oxygenation	Medium Q: Low A: NR C: NR	High Q: Medium A: Medium C: Medium	Low Q: Low 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 2mg/l.

Hydroids mainly inhabit environments in which the oxygen concentration exceeds 5 ml/l (Gili & Hughes, 1995). Although no information was found on oxygen consumption for the characterizing hydroids, Sagasti *et al.* (2000) reported that epifaunal species, including several hydroids and bryozoans in the York River, Chesapeake Bay, tolerated summer hypoxic episodes of between 0.5 and 2 mg O_2/l (0.36 and 1.4 ml/l) for 5-7 days at a time, with few changes in abundance or species composition, 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.

Sensitivity assessment. Whilst hydroids and bryozoans have been shown to tolerate short anoxic events (Sagasti *et al.*, 2000) and the sand scoured nature of the biotope would likely result in occasional burial, an event at the benchmark level would likely result in some mortality. Resistance is, therefore, assessed as '**Medium**', resilience as '**High**' and sensitivity as '**Low**'.

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

Witt *et al.* (2004) found that the hydroid *Obelia* spp. was more abundant in a sewage disposal area in the Weser estuary (Germany) which experienced sedimentation of 1 cm for more than 25 days. It should be noted that another hydroid (*Sertularia cupressina)* was reduced in abundance when compared with unimpacted reference areas. As suspension feeders, an increase in organic content at the benchmark is likely to be of benefit to the characterizing hydroids. Hartikainen *et al.* (2009) reported that increased nutrient concentrations resulted in freshwater bryozoans achieving higher biomass. O'Dea & Okamura (2000) found that annual growth of *Flustra foliacea* in western Europe has substantially increased since 1970. They 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).

However, this biotope is considered to be **'Not sensitive'** at the pressure benchmark, that assumes compliance with good status as defined by the WFD.

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

Witt *et al*. (2004) found that the hydroid *Obelia* spp. was more abundant in a sewage disposal area in the Weser estuary (Germany) which experienced sedimentation of 1 cm for more than 25 days. It should be noted that another hydroid (*Sertularia cupressina)* was reduced in abundance when compared with unimpacted reference areas. As suspension feeders, an increase in organic content at the benchmark is likely to be of benefit to the characterizing hydroids. 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). Mayer-Pinto & Junqueira (2003) studies the effects of organic pollution on fouling communities in Brazil and found that some tolerance of polluted/unpolluted artificial reefs varied among bryozoan species. It should be noted that *Bugula* spp. preferred the polluted sites.

Sensitivity assessment. Whilst an increase in organic matter would likely be removed relatively rapidly by water movement in this biotope, such an increase would likely be beneficial to the characterizing species. Resistance is therefore assessed as '**High**', resilience as '**High**' and the biotope is probably '**Not sensitive'** at the benchmark level.

Physical Pressures

	Resistance	Resilience	Sensitivity
Physical loss (to land or freshwater habitat)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

All marine habitats and benthic species are considered to have a resistance of '**None**' to this pressure and to be unable to recover from a permanent loss of habitat (resilience is '**Very low'**). Sensitivity within the direct spatial footprint of this pressure is, therefore '**High**'. Although no specific evidence is described confidence in this assessment is '**High**', due to the incontrovertible nature of this pressure.

Physical change (to another seabed type)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

This biotope is characterized by the hard substratum provided by the pebbles and cobbles to which the key characterizing species can firmly attach to (Connor *et al*., 2004). A change to a mobile gravel or soft sedimentary substratum would significantly alter the character of the biotope. The biotope is considered to have '**No**' resistance to this pressure based on a change to a soft sediment substratum, recovery of the biological assemblage (following habitat restoration) is considered to be '**Medium**'. However, the pressure benchmark is considered to refer to a permanent change and recovery is, therefore '**Very low**'. Sensitivity is, therefore, assessed as '**High**'.

Physical change (to another sediment type)	None Q: High A: High C: High	Very Low Q: High A: High C: High	High Q: High A: High C: High

CR.HCR.XFa.SpNemAdi is characterized by the hard substratum provided by the pebbles and cobbles. SS.SMx.CMx.FluHyd and SS.SSa.IFiSa.ScupHyd are dominated by hard substrata on sediment (Connor *et al*., 2004). A change to a mobile gravel or soft sedimentary substratum would significantly alter the character of the biotope. The biotope is considered to have a resistance of '**None**' to this pressure based on a change to a soft sediment substratum, recovery of the biological assemblage (following habitat restoration) is considered to be 'High'. However, the pressure benchmark is considered to refer to a permanent change and recovery is, therefore '**Very low**'. Sensitivity is, therefore, assessed as '**High**'.

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

The species characterizing these biotopes are epifauna occurring on the cobbles and pebbles that characterize this biotope (Connor *et al*., 2004). Removal of the substratum would remove both the habitat (boulders, cobbles and pebbles) and the characterizing, attached species.

Sensitivity assessment. Biotope resistance is assessed as '**None**' (in the extraction footprint), resilience (following habitat restoration, or where the underlying substratum remains the same) is assessed as '**Medium**'. Sensitivity is, therefore, assessed as '**Medium**'. Recovery will be prolonged (and sensitivity greater) where the entire habitat is removed and restoration (artificial or natural) to the previous state does not occur.

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

The species characterizing this biotope occur on the rock surface and therefore have no protection from surface abrasion. High levels of abrasion from scouring by mobile sands and gravels is an important structuring factor in this biotope (Connor *et al*., 2004) and may prevent succession. Where individuals are attached to mobile pebbles, cobbles and boulders rather than bedrock, surfaces can be displaced and turned over preventing feeding and leading to smothering. 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).

The available evidence indicates that hydroids can be entangled and removed by abrasion. Drop down video surveys of Scottish reefs exposed to trawling showed that visual evidence of damage to bryozoans and hydroids on rock surfaces was generally limited and restricted to scrape scars on boulders (Boulcott & Howell, 2011). The study showed that damage is incremental with damage increasing with the frequency of trawls rather than a blanket effect occurring on the pass of the first trawls. The results indicated that epifaunal species, including the sponge *Pachymatisma johnstoni*, were highly damaged by the experimental trawl. 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 as indicated in their study.

Re-sampling of grounds that were historically studied (from the 1930s) indicates that some species have increased in areas subject to scallop fishing (Bradshaw *et al.*, 2002). This study also found a (unquantified) increase in abundance of tough stemmed hydroids including *Nemertesia* spp.. Its morphology may have prevented excessive damage. Bradshaw *et al.* (2002) suggested that as well as having high resistance to abrasion pressures, *Nemertesia* spp. have benthic larvae that could rapidly colonize disturbed areas with newly exposed substrata close to the adult. Hydroids may also recover rapidly as the surface covering of hydrorhizae may remain largely intact, from which new uprights are likely to grow. In addition, the resultant fragments of colonies may be able to develop into new colonies. Hydroid colonies were still present in the heavily fished area, albeit at lower densities than in the closed area. This may largely be because the Isle of Man scallop fishery is closed from 1st June to 31st October (Andrews *et al.*, 2011), so at the time the samples were taken for the study in question, the seabed had been undredged for at least 3.5 months (Bradshaw *et al.*, 2003). The summer period is also the peak growing/breeding season for many marine species.

Sensitivity assessment. Given the sessile, erect nature of the hydroids 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. Abrasion from scouring by sand, mobile cobbles and pebbles is an important structuring factor in this biotope (Connor *et al.*, 2004) and the persistence of the assemblage may depend on rapid recovery together with scour resistance (e.g. *Flustra*). Therefore, resistance is assessed as '**Low**', resilience as '**Medium**', and sensitivity is assessed as '**Medium**'.

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

This biotope is characterized by mobile pebbles and cobbles, pressures that lead to penetration and disturbance could damage associated species through abrasion and by overturning surfaces could result in the smothering of fauna or reductions in respiration, feeding efficiency or fertilization of gametes in the water column. The biotope is, however, likely to be exposed to at least seasonal movement of substrata and this movement and scour maintains this biotope by preventing species that require more stable habitats from colonizing and developing stable populations (Connor *et al.*, 2004). Evidence presented above for surface abrasion is considered equally relevant to this pressure as abrasion in this biotope is likely to lead to movement and displacement of mobile substrata.

Sensitivity assessment. The impact of pressures that disturb and penetrate the mobile substrata will depend on the footprint, duration and magnitude of the pressure. Abrasion from scouring by sand, mobile cobbles and pebbles is an important structuring factor in this biotope (Connor *et al.*, 2004) and the persistence of the assemblage may depend on rapid recovery together with scour resistance (e.g. *Flustra*). Therefore, resistance is assessed as '**Low**', resilience as '**Medium**', and sensitivity is assessed as '**Medium**'.

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

An increase in suspended sediment may have a deleterious effect on the suspension feeding community. It is likely to clog their feeding apparatus to some degree, resulting in a reduced ingestion over the benchmark period and, subsequently, a decrease in growth rate (Jackson, 2004). As the hydroids capture small prey in suspension (Gili & Hughes, 1995), a reduction in feeding efficiency could potentially lead to a reduction in overall biomass. *Nemertesia ramosa* is a passive suspension feeder, extracting seston from the water column. Increased siltation may clog up the feeding apparatus, requiring energetic expenditure to clear. However, recovery is likely to take only a few days (Jackson, 2004).

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 1977a). Also, communities dominated by *Flustra foliacea* were described on tide swept seabed, exposed to high levels of suspended sediment and sediment scour in the English Channel (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).

Sensitivity assessment. Whilst an increase in suspended sediment may result in extra energetic expenditure in cleaning, it is unlikely to increase mortality. Therefore, resistance has been assessed as '**High**', resilience as '**High**' and the biotope is '**Not Sensitive**' at the benchmark level.

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

In general, it appears that hydroids are sensitive to silting (Boero, 1984; Gili & Hughes, 1995) and the decline in beds in the Wadden Sea have been linked to environmental changes including siltation. Round *et al.* (1961) reported that the hydroid *Sertularia* (now *Amphisbetia*) *operculata* died when covered with a layer of silt after being transplanted to sheltered conditions. Boero (1984) suggested that deep water hydroid species develop upright, thin colonies that accumulate little sediment, while species in turbulent water movement were adequately cleaned of silt by water movement.

Hughes (1977) found that maturing hydroids that had been smothered with detritus and silt lost most of the hydrocladia and hydranths. After one month, the hydroids were seen to have recovered, but although neither the growth rate nor the reproductive potential appeared to have been affected, the viability of the planulae may have been affected. *Nemertesia ramosa* is an upright hydroid with a height of up to 15 cm. The colony structure is fairly tough and flexible. Smothering with 5 cm of sediment may cover over some individuals, while others may just have the lower section of the main stem covered (Hayward & Ryland, 1994). *Obelia dichotoma* stems grow to 5 cm, while polysiphonic structures can reach up to 35 cm in height. *Halecium halecinum* can grow up to 25 cm and *Kirchenpaueria pinnata* can grow to ca 10 cm (Hayward & Ryland, 1994). Some of the community is therefore likely to survive smothering by 5 cm.

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, 2005c). However, *Flustra foliacea* dominated communities were subject to sediment transport (mainly sand) and periodic, temporary, burial (ca <5 cm) n a tide-swept region of the central English Channel (Holme & Wilson, 1985).

Sensitivity assessment. Whilst 5 cm of deposition may bury some of the characterizing species, the biotope experiences moderate water flow and sediment is likely to be removed rapidly. The biotope is sand scoured and occasional disposition events are likely to occur. Therefore, resistance is assessed as ‘**High**’, resilience as ‘**High**’ and the biotope is assessed as ‘**Not sensitive**’ at the benchmark level.

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

In general, it appears that hydroids are sensitive to silting (Boero, 1984; Gili & Hughes, 1995) and the decline in beds in the Wadden Sea have been linked to environmental changes including siltation. Round *et al.* (1961) reported that the hydroid *Sertularia* (now *Amphisbetia*) *operculata* died when covered with a layer of silt after being transplanted to sheltered conditions. Boero (1984) suggested that deep water hydroid species develop upright, thin colonies that accumulate little sediment, while species in turbulent water movement were adequately cleaned of silt by water movement.

Hughes (1977) found that maturing hydroids that had been smothered with detritus and silt lost most of the hydrocladia and hydranths. After one month, the hydroids were seen to have recovered, but although neither the growth rate nor the reproductive potential appeared to have been affected, the viability of the planulae may have been affected. *Nemertesia ramosa* is an upright hydroid with a height of up to 15 cm. The colony structure is fairly tough and flexible. Smothering with 5 cm of sediment may cover over some individuals, while others may just have the lower section of the main stem covered (Hayward & Ryland, 1994). *Obelia dichotoma* stems grow to 5 cm, while polysiphonic structures can reach up to 35 cm in height. *Halecium halecinum* can grow up to 25 cm and *Kirchenpaueria pinnata* can grow to ca 10 cm (Hayward & Ryland, 1994). Some of the community is, therefore, likely to survive smothering by 5 cm.

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. A layer of sediment will probably also interfere with larval settlement (Tyler-Walters, 2005c). However, *Flustra foliacea* dominated communities were subject to sediment transport (mainly sand) and periodic, temporary, burial (ca <5 cm) n a tide-swept region of the central English Channel (Holme & Wilson, 1985).

Sensitivity assessment. The biotope occurs in sand scoured areas exposed to moderate water movement and deposited sediment would eventually be removed. However, 30 cm of sediment would bury almost all characterizing species except for those on large boulders and would result in some mortality. Resistance is, therefore, assessed as ‘**Medium**’, resilience as ‘**High**’ and sensitivity as ‘**Low**’.

Litter	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

Not assessed.

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

'No evidence' was found.

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

Stanley *et al.* (2014) studied the effects of vessel noise on fouling communities and found that the bryozoans *Bugula neritina*, *Watersipora arcuate* and *Watersipora subtorquata* responded positively. More than twice as many bryozoans settled and established on surfaces with vessel noise (128 dB in the 30–10,000 Hz range) compared to those in silent conditions. Growth was also significantly higher in bryozoans exposed to noise, with 20% higher growth rate in encrusting and 35% higher growth rate in branching species. No evidence could be found for the effects of noise or vibrations on the characterizing hydroids or sponges could be found. The characterizing species are unlikely to be negatively affected by noise and resistance is, therefore, assessed as '**High**', resilience as '**High**' and sensitivity as '**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

Gili & Hughes (1995) reviewed the effect of light on a number of hydroids and found that there is a general tendency for most hydroids to be less abundant in well-lit situations, potentially due to increased competition with macroalgae. Whilst hydroid larvae can be positively or negatively phototactic, the planulae of *Nemertesia antennina* show no response to light (Hughes, 1977).

Jones *et al.* (2012) compiled a report on the monitoring of sponges around Skomer Island and found that many sponges, particularly encrusting species, preferred vertical or shaded bedrock to open, light surfaces. *Flustra foliacea* larvae are positively phototactic on release, swimming for only short periods (Hayward & Ryland, 1998), however, at the depths *Flustra foliacea* can occur, light may not be important.

Sensitivity assessment: Whilst sponges seem to favour shaded areas in which to settle, it is unlikely that changes at the benchmark pressure would result in mortality. Resistance to this pressure is assessed as '**High**' and resilience as '**High**'. This biotope is, therefore, assessed as **'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

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* spp. has been extended by transportation by shipping (Ryland, 1967). However, no information on transportation of *Bugula turbinata* was found. Therefore, there was **'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

The high levels of scour in this biotope will limit the establishment of all but the most scour resistant invasive non-indigenous species (INIS) from this biotope and no direct evidence was found for effects of INIS on this biotope. 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, there is currently **'No evidence'** on which to assess this pressure.

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

Hydroids exhibit astonishing regeneration and rapid recovery from injury (Sparks, 1972) and the only inflammatory response is active phagocytosis (Tokin & Yaricheva, 1959;1961, as cited in Sparks, 1972). No record of diseases in the characterizing hydroids could be found. 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**' of mass mortality in the important characterizing species.

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

Despite historic harvesting of the hydroid *Sertularia cupressina* in the Wadden Sea (Wagler *et al.*, 2009), no evidence for the harvesting of the characterizing hydroids could be found in the UK and targeted extraction is highly unlikely. 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.

Sensitivity assessment. The characterizing species are sessile epifauna and would have no resistance to targeted extraction. Based on the above observations, resistance is assessed as ‘**None**’ and resilience as ‘**Medium**’ with a resultant sensitivity of ‘**Medium**’.

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

This biotope may be removed or damaged by static or mobile gears that are targeting other species. 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. However, incidental 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. Therefore, resistance is recorded as ‘**Low**’, resilience is recorded as **‘Medium’** and sensitivity is assessed as **‘Medium’**.

Bibliography

Ager, O.E.D. 2007. *Alcyonidium diaphanum*, Sea chervil. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/species/detail/1738

Allen, J., Slinn, D., Shummon, T., Hurtnoll, R. & Hawkins, S., 1998. Evidence for eutrophication of the Irish Sea over four decades. *Limnology and Oceanography*, **43** (8), 1970-1974.

Andrews J.W., B.A.R., Holt T.J., 2011. Isle of Man Queen Scallop Trawl and Dredge Fishery. MSC assessment report. pp.

Banks, P.D. & Brown, K.M., 2002. Hydrocarbon effects on fouling assemblages: the importance of taxonomic differences, seasonal, and tidal variation. *Marine Environmental Research*, **53** (3), 311-326.

Bell, J.J. & Barnes, D.K., 2000. The distribution and prevalence of sponges in relation to environmental gradients within a temperate sea lough: inclined cliff surfaces. *Diversity and Distributions*, **6** (6), 305-323.

Berghahn, R. & Offermann, U. 1999. Laboratory investigations on larval development, motility and settlement of white weed (*Sertularia cupressina* L.) - in view of its assumed decrease in the Wadden Sea. *Hydrobiogia*, **392**(2), 233–239.

Berrill, N.J., 1948. A new method of reproduction in *Obelia*. *Biological Bulletin*, **95**, 94-99.

Berrill, N.J., 1949. The polymorphic transformation of *Obelia*. *Quarterly Journal of Microscopical Science*, **90**, 235-264.

Beszczynska-Möller, A., & Dye, S.R., 2013. ICES Report on Ocean Climate 2012. In *ICES Cooperative Research Report*, vol. 321 pp. 73.

Boero, F. & Bouillon, J., 1993. Zoogeography and life cycle patterns of Mediterranean hydromedusae (Cnidaria). *Biological Journal of the Linnean Society*, **48**, 239-266.

Boero, F., 1984. The ecology of marine hydroids and effects of environmental factors: a review. *Marine Ecology*, **5**, 93-118.

Boulcott, P. & Howell, T.R.W., 2011. The impact of scallop dredging on rocky-reef substrata. *Fisheries Research* (Amsterdam), **110** (3), 415-420.

Bradshaw, C., Collins, P. & Brand, A., 2003. To what extent does upright sessile epifauna affect benthic biodiversity and community composition? *Marine Biology*, **143** (4), 783-791.

Bradshaw, C., Veale, L.O., Hill, A.S. & Brand, A.R., 2002. The role of scallop-dredge disturbance in long-term changes in Irish Sea benthic communities: a re-analysis of an historical dataset. *Journal of Sea Research*, **47**, 161-184.

Bryan, G.W. & Gibbs, P.E., 1991. Impact of low concentrations of tributyltin (TBT) on marine organisms: a review. In: *Metal ecotoxicology: concepts and applications* (ed. M.C. Newman & A.W. McIntosh), pp. 323-361. Boston: Lewis Publishers Inc.

Bryan, G.W., 1984. Pollution due to heavy metals and their compounds. In *Marine Ecology: A Comprehensive, Integrated Treatise on Life in the Oceans and Coastal Waters*, vol. 5. *Ocean Management*, part 3, (ed. O. Kinne), pp.1289-1431. New York: John Wiley & Sons.

Budd, G.C. 2008. *Alcyonium digitatum* Dead man's fingers. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/species/detail/1187

Bullimore, B., 1985. An investigation into the effects of scallop dredging within the Skomer Marine Reserve. *Report to the Nature Conservancy Council by the Skomer Marine Reserve Subtidal Monitoring Project, S.M.R.S.M.P. Report*, no 3., Nature Conservancy Council.

Cantero, Á.L.P., Carrascosa, A.M.G. & Vervoort, W., 2002. *The benthic hydroid fauna of the Chafarinas Islands (Alborán Sea, western Mediterranean)*: Nationaal Natuurhistorisch Museum.

Castège, I., Milon, E. & Pautrizel, F., 2014. Response of benthic macrofauna to an oil pollution: Lessons from the “Prestige” oil spill on the rocky shore of Guéthary (south of the Bay of Biscay, France). *Deep Sea Research Part II: Topical Studies in Oceanography*, **106**, 192-197.

Castric-Fey, A. & Chassé, C., 1991. Factorial analysis in the ecology of rocky subtidal areas near Brest (west Brittany, France). *Journal of the Marine Biological Association of the United Kingdom*, **71**, 515-536.

Cocito, S. & Sgorbini, S., 2014. Long-term trend in substratum occupation by a clonal, carbonate bryozoan in a temperate rocky reef in times of thermal anomalies. *Marine Biology*, **161** (1), 17-27.

Cocito, S., Ferdeghini, F., & Sgorbini, S., 1998b. *Pentapora fascialis* (Pallas) [Cheilostomata: Ascophora] colonization of one sublittoral rocky site after sea-storm in the northwest Mediterranean. *Hydrobiologia*, **375/376**, 59-66.

Cole, S., Codling, I.D., Parr, W., Zabel, T., 1999. Guidelines for managing water quality impacts within UK European marine sites [On-line]. *UK Marine SACs Project*. [Cited 26/01/16]. Available from: http://www.ukmarinesac.org.uk/pdfs/water_quality.pdf

Coleman, R.A., Hoskin, M.G., von Carlshausen, E. & Davis, C.M., 2013. Using a no-take zone to assess the impacts of fishing: Sessile epifauna appear insensitive to environmental disturbances from commercial potting. *Journal of Experimental Marine Biology and Ecology*, **440**, 100-107.

Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. & Reker, J.B., 2004. The Marine Habitat Classification for Britain and Ireland. Version 04.05. ISBN 1 861 07561 8. In JNCC (2015), *The Marine Habitat Classification for Britain and Ireland Version 15.03.* [2019-07-24]. Joint Nature Conservation Committee, Peterborough. Available from https://mhc.jncc.gov.uk/

Cook, E.J., Stehlíková, J., Beveridge, C.M., Burrows, M.T., De Blauwe, H. & Faasse, M., 2013b. Distribution of the invasive bryozoan *Tricellaria inopinata* in Scotland and a review of its European expansion. *Aquatic Invasions*, **8** (3), 281-288.

Cornelius, P.F.S., 1992. Medusa loss in leptolid Hydrozoa (Cnidaria), hydroid rafting, and abbreviated life-cycles among their remote island faunae: an interim review.

Cornelius, P.F.S., 1995a. *North-west European thecate hydroids and their medusae. Part 1. Introduction, Laodiceidae to Haleciidae.* Shrewsbury: Field Studies Council. [Synopses of the British Fauna no. 50]

Crisp, D.J. (ed.), 1964. The effects of the severe winter of 1962-63 on marine life in Britain. *Journal of Animal Ecology*, **33**, 165-210.

Diaz, R.J. & Rosenberg, R., 1995. Marine benthic hypoxia: a review of its ecological effects and the behavioural responses of benthic macrofauna. *Oceanography and Marine Biology: an Annual Review*, **33**, 245-303.

Dyrynda, P., Fairall, V., Occhipinti Ambrogi, A. & d'Hondt, J.-L., 2000. The distribution, origins and taxonomy of *Tricellaria inopinata* d'Hondt and Occhipinti Ambrogi, 1985, an invasive bryozoan new to the Atlantic. *Journal of Natural History*, **34** (10), 1993-2006.

Dyrynda, P.E.J. & Ryland, J.S., 1982. Reproductive strategies and life histories in the cheilostome marine bryozoans *Chartella papyracea* and *Bugula flabellata*. *Marine Biology*, **71**, 241-256.

Dyrynda, P.E.J., 1994. Hydrodynamic gradients and bryozoan distributions within an estuarine basin (Poole Harbour, UK). In *Proceedings of the 9th International Bryozoology conference, Swansea, 1992. Biology and Palaeobiology of Bryozoans* (ed. P.J. Hayward, J.S. Ryland & P.D. Taylor), pp.57-63. Fredensborg: Olsen & Olsen.

Eggleston, D., 1972a. Patterns of reproduction in marine Ectoprocta off the Isle of Man. *Journal of Natural History*, **6**, 31-38.

Eggleston, D., 1972b. Factors influencing the distribution of sub-littoral ectoprocts off the south of the Isle of Man (Irish Sea). *Journal of Natural History*, **6**, 247-260.

Faucci, A. & Boero, F., 2000. Structure of an epiphytic hydroid community on *Cystoseira* at two sites of different wave exposure. *Scientia Marina*, **64** (S1), 255-264.

Fish, J.D. & Fish, S., 1996. *A student's guide to the seashore.* Cambridge: Cambridge University Press.

Fortunato, H., Schäfer, P. & Blaschek, H., 2013. Growth Rates, Age Determination, and Calcification Levels in *Flustra foliacea* (L.) (Bryozoa: Cheilostomata): Preliminary Assessment. In Ernst, A., et al. (eds.). *Bryozoan Studies 2010*, Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 59-74.

Fowler, S. & Laffoley, D., 1993. Stability in Mediterranean-Atlantic sessile epifaunal communities at the northern limits of their range. *Journal of Experimental Marine Biology and Ecology*, **172** (1), 109-127.

Galstoff, P., 1942. Wasting disease causing mortality of sponges in the West Indies and Gulf of Mexico. *Proceedings 8th American Scientific Congress*, pp. 411-421.

Gili, J-M. & Hughes, R.G., 1995. The ecology of marine benthic hydroids. *Oceanography and Marine Biology: an Annual Review*, **33**, 351-426.

Hartikainen, H., Johnes, P., Moncrieff, C. & Okamura, B., 2009. Bryozoan populations reflect nutrient enrichment and productivity gradients in rivers. *Freshwater Biology*, **54** (11), 2320-2334.

Hatcher, A.M., 1998. Epibenthic colonization patterns on slabs of stabilised coal-waste in Poole Bay, UK. *Hydrobiologia*, **367**, 153-162.

Hayward, P.J. & Ryland, J.S. 1979. *British ascophoran bryozoans.* London: Academic Press.

Hayward, P.J. & Ryland, J.S. 1994. *The marine fauna of the British Isles and north-west Europe. Volume 1. Introduction and Protozoans to Arthropods.* Oxford: Clarendon Press.

Hayward, P.J. & Ryland, J.S. 1998. *Cheilostomatous Bryozoa. Part 1. Aeteoidea - Cribrilinoidea*. Shrewsbury: Field Studies Council. [Synopses of the British Fauna, no. 10. (2nd edition)]

Hayward, P.J. & Ryland, J.S. (ed.) 1995b. *Handbook of the marine fauna of North-West Europe.* Oxford: Oxford University Press.

Herreid, C.F., 1980. Hypoxia in invertebrates. *Comparative Biochemistry and Physiology Part A: Physiology*, **67** (3), 311-320.

Hincks, T., 1880. *A history of British marine Polyzoa*, vol. I & II. London: John van Voorst.

Hiscock, K., 1979b. South-west Britain sublittoral survey. Field survey of sublittoral habitats and species along the Gower coast. June 25th to 30th, 1978. *Nature Conservancy Council CSD Report No. 274.*

Hiscock, K., 1981. Marine life on the wreck of the M.V. "*Robert*". *Report of the Lundy Field Society*, **32**, 40-44.

Hiscock, K., 1983. Water movement. In *Sublittoral ecology. The ecology of shallow sublittoral benthos* (ed. R. Earll & D.G. Erwin), pp. 58-96. Oxford: Clarendon Press.

Hiscock, K., 1985. Littoral and sublittoral monitoring in the Isles of Scilly. September 22nd to 29th, 1984. *Nature Conservancy Council, Peterborough*, CSD Report, no. 562., Field Studies Council Oil Pollution Research Unit, Pembroke.

Hoare, R. & Hiscock, K., 1974. An ecological survey of the rocky coast adjacent to the effluent of a bromine extraction plant. *Estuarine and Coastal Marine Science*, **2** (4), 329-348.

Holme, N.A. & Wilson, J.B., 1985. Faunas associated with longitudinal furrows and sand ribbons in a tide-swept area in the English Channel. *Journal of the Marine Biological Association of the United Kingdom*, **65**, 1051-1072.

Holt, T.J., Jones, D.R., Hawkins, S.J. & Hartnoll, R.G., 1995. The sensitivity of marine communities to man induced change - a scoping report. *Countryside Council for Wales, Bangor, Contract Science Report*, no. 65.

Houghton, J.P., Lees, D.C., Driskell, W.B., Lindstrom & Mearns, A.J., 1996. Recovery of Prince William Sound intertidal epibiota from *Exxon Valdez* oiling and shoreline treatments, 1989 through 1992. In *Proceedings of the* Exxon Valdez *Oil Spill Symposium. American Fisheries Society Symposium*, no. 18, *Anchorage, Alaska, USA, 2-5 February 1993*, (ed. S.D. Rice, R.B. Spies, D.A., Wolfe & B.A. Wright), pp.379-411.

Hughes, R.G., 1977. Aspects of the biology and life-history of *Nemertesia antennina* (L.) (Hydrozoa: Plumulariidae). *Journal of the Marine Biological Association of the United Kingdom*, **57**, 641-657.

Jackson, A. 2004. *Nemertesia ramosa*, A hydroid. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews* [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 02/03/16] Available from: http://www.marlin.ac.uk/species/detail/1318

Jennings, S. & Kaiser, M.J., 1998. The effects of fishing on marine ecosystems. *Advances in Marine Biology*, **34**, 201-352.

Jensen, A.C., Collins, K.J., Lockwood, A.P.M., Mallinson, J.J. & Turnpenny, W.H., 1994. Colonization and fishery potential of a coal-ash artificial reef, Poole Bay, United Kingdom. *Bulletin of Marine Science*, **55**, 1263-1276.

JNCC, 2015. The Marine Habitat Classification for Britain and Ireland Version 15.03. (20/05/2015). Available from https://mhc.jncc.gov.uk/

Jones, J., Bunker, F., Newman, P., Burton, M., Lock, K., 2012. Sponge Diversity of Skomer Marine Nature Reserve. *CCW Regional Report*, CCW/WW/12/3.

Karbe, L., 1972. Marine Hydroiden als testorganismen zur prüfung der toxizität von abwasserstoffen. Die wirkung von schwermetallen auf kolonien von *Eirene viridula* (summary only). *Marine Biology*, **12**, 316-328.

Knight-Jones, E.W. & Nelson-Smith, A., 1977. Sublittoral transects in the Menai Straits and Milford Haven. In *Biology of benthic organisms* (ed. B.F. Keegan, P. O Ceidigh & P.J.S. Broaden), pp. 379-390. Oxford: Pergamon Press.

Kosevich, I.A. & Marfenin, N.N., 1986. Colonial morphology of the hydroid *Obelia longissima* (Pallas, 1766) (Campanulariidae). *Vestnik Moskovskogo Universiteta Seriya Biologiya*, **3**, 44-52.

Mayer-Pinto, M. & Junqueira, A., 2003. Effects of organic pollution on the initial development of fouling communities in a tropical bay, Brazil. *Marine Pollution Bulletin*, **46** (11), 1495-1503.

McKinney, F.K., 1986. Evolution of erect marine bryozoan faunas: repeated success of unilaminate species *The American Naturalist*, **128**, 795-809.

Medel, M., García, F. & Vervoort, W., 1998. The family Haleciidae (Cnidaria: Hydrozoa) from the Strait of Gibraltar and nearby areas. *Zoologische Mededeelingen*, **72**, 29-50.

Mohammad, M-B.M., 1974. Effect of chronic oil pollution on a polychaete. *Marine Pollution Bulletin*, **5**, 21-24.

Moore, P.G., 1977a. Inorganic particulate suspensions in the sea and their effects on marine animals. *Oceanography and Marine Biology: An Annual Review*, **15**, 225-363.

Mustapha, K.B., Afli, A., Hattour, A. & El Abed, A., 2004. Sessile megabenthic species from Tunisian littoral sites. *MedSudMed Technical Documents*, **2**, 1-16.

Naylor. P., 2011. *Great British Marine Animals, 3rd Edition.* Plymouth. Sound Diving Publications.

NBN, 2015. National Biodiversity Network 2015(20/05/2015). https://data.nbn.org.uk/

O'Dea, A. & Okamura, B., 2000. Life history and environmental inference through retrospective morphometric analysis of bryozoans: a preliminary study. *Journal of the Marine Biological Association of the United Kingdom*, **80**, 1127-1128.

Okamura, B., 1984. The effects of ambient flow velocity, colony size and upstream colonies on the feeding success of Bryozoa, *Bugula stolonifera* Ryland, an arborescent species. *Journal of the Experimental Marine Biology and Ecology*, **83**, 179-193.

Orejas, C., Rossi, S., Peralba, À., García, E., Gili, J.M. & Lippert, H., 2012. Feeding ecology and trophic impact of the hydroid *Obelia dichotoma* in the Kongsfjorden (Spitsbergen, Arctic). *Polar biology*, **36** (1), 61-72.

Palerud, R., Gulliksen, B., Brattegard, T., Sneli, J.-A. & Vader, W., 2004. The marine macro-organisms in Svalbard waters. A catalogue of the terrestrial and marine animals of Svalbard. *Norsk Polarinstitutt Skrifter*, **201**, 5-56.

Preston J. & Burton, M., 2015. Marine microbial assemblages associated with diseased Porifera in Skomer Marine Nature Reserve (SMNR), Wales. Aquatic Biodiversity and Ecosystems, 30th August – 4th September, Liverpool., pp. p110.

Rees, H.L., Waldock, R., Matthiessen, P. & Pendle, M.A., 2001. Improvements in the epifauna of the Crouch estuary (United Kingdom) following a decline in TBT concentrations. *Marine Pollution Bulletin*, **42**, 137-144.

Rosenberg, R., Hellman, B. & Johansson, B., 1991. Hypoxic tolerance of marine benthic fauna. *Marine Ecology Progress Series*, **79**, 127-131.

Rosso, A., 2003. Bryozoan diversity in the Mediterranean Sea. *Biogeographia*, **24**, 227-250.

Round, F.E., Sloane, J.F., Ebling, F.J. & Kitching, J.A., 1961. The ecology of Lough Ine. X. The hydroid *Sertularia operculata* (L.) and its associated flora and fauna: effects of transference to sheltered water. *Journal of Ecology*, **49**, 617-629.

Ryland, J.S. & De Putron, S., 1998. An appraisal of the effects of the *Sea Empress* oil spillage on sensitive invertebrate communities. *Countryside Council for Wales Sea Empress Contract Report*, no. 285, 97pp.

Ryland, J.S., 1967. Polyzoa. *Oceanography and Marine Biology: an Annual Review*, **5**, 343-369.

Ryland, J.S., 1970. *Bryozoans.* London: Hutchinson University Library.

Ryland, J.S., 1976. Physiology and ecology of marine bryozoans. *Advances in Marine Biology*, **14**, 285-443.

Ryland, J.S., Holt, R., Loxton, J., Spencer Jones, M. & Porter, J.S., 2014. First occurrence of the non-native bryozoan *Schizoporella japonica* Ortmann (1890) in Western Europe. *Zootaxa*, **3780** (3), 481-502.

Sagasti, A., Schaffner, L.C. & Duffy, J.E., 2000. Epifaunal communities thrive in an estuary with hypoxic episodes. *Estuaries*, **23**, 474-487.

Sebens, K.P., 1985. Community ecology of vertical rock walls in the Gulf of Maine: small-scale processes and alternative community states. In *The Ecology of Rocky Coasts: essays presented to J.R. Lewis, D.Sc.* (ed. P.G. Moore & R. Seed), pp. 346-371. London: Hodder & Stoughton Ltd.

Sebens, K.P., 1986. Spatial relationships among encrusting marine organisms in the New England subtidal zone. *Ecological Monographs*, **56**, 73-96.

Silén, L., 1981. Colony structure in *Flustra foliacea* (Linnaeus) (Bryozoa, Cheilostomata). *Acta Zoologica (Stockholm.)*, **62**, 219-232.

Sommer, C., 1992. Larval biology and dispersal of *Eudendrium racemosum* (Hydrozoa, Eudendriidae). *Scientia Marina*, **56**, 205-211. [*Proceedings of 2nd International Workshop of the Hydrozoan Society, Spain, September 1991. Aspects of hydrozoan biology* (ed. J. Bouillon, F. Cicognia, J.M. Gili & R.G. Hughes).]

Soule, D.F. & Soule, J.D., 1979. Bryozoa (Ectoprocta). In *Pollution ecology of estuarine invertebrates* (ed. C.W. Hart & S.L.H. Fuller), pp. 35-76.

Sparks, A., 1972. *Invertebrate Pathology Noncommunicable diseases*: Elsevier.

Stanley, J.A., Wilkens, S.L. & Jeffs, A.G., 2014. Fouling in your own nest: vessel noise increases biofouling. *Biofouling*, **30** (7), 837-844.

Stebbing, A.R.D., 1971a. Growth of *Flustra foliacea* (Bryozoa). *Marine Biology*, **9**, 267-273.

Stebbing, A.R.D., 1976. The effects of low metal levels on a clonal hydroid. *Journal of the Marine Biological Association of the United Kingdom*, **56**, 977-994.

Stebbing, A.R.D., 1981a. Hormesis - stimulation of colony growth in *Campanularia flexuosa* (Hydrozoa) by copper, cadmium and other toxicants. *Aquatic Toxicology*, **1**, 227-238.

Storr, J.F. 1976. Ecological factors controlling sponge distribution in the Gulf of Mexico and the resulting zonation. In *Aspects of Sponge Biology* (ed. F.W. Harrison & R.R. Cowden), pp. 261-276. New York: Academic Press.

Theede, H., Scholz, N. & Fischer, H., 1979. Temperature and salinity effects on the acute toxicity of Cadmium to *Laomedea loveni* (Hydrozoa). *Marine Ecology Progress Series*, **1**, 13-19.

Tillin, H. & Tyler-Walters, H., 2014. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 2 Report – Literature review and sensitivity assessments for ecological groups for circalittoral and offshore Level 5 biotopes. *JNCC Report* No. 512B, 260 pp. Available from: www.marlin.ac.uk/publications

Tyler-Walters, H., 2002. Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/habitat/detail/337

Tyler-Walters, H., 2005c. *Bugula turbinata* an erect bryozoan. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 30.03.16] Available from: http://www.marlin.ac.uk/species/detail/1715

Tyler-Walters, H. & Ballerstedt, S., 2007. *Flustra foliacea* Hornwrack. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/species/detail/1609

Wagler, H., Berghahn, R. & Vorberg, R., 2009. The fishery for whiteweed, *Sertularia cupressina* (Cnidaria, Hydrozoa), in the Wadden Sea, Germany: history and anthropogenic effects. *ICES Journal of Marine Science: Journal du Conseil*, fsp201.

Witt, J., Schroeder, A., Knust, R. & Arntz, W.E., 2004. The impact of harbour sludge disposal on benthic macrofauna communities in the Weser estuary. *Helgoland Marine Research*, **58** (2), 117-128.

Zahn, R., Zahn, G., Müller, W., Kurelec, B., Rijavec, M., Batel, R. & Given, R., 1981. Assessing consequences of marine pollution by hydrocarbons using sponges as model organisms. *Science of The Total Environment*, **20** (2), 147-169.