Caryophyllia (Caryophyllia) smithii and sponges with *Pentapora foliacea*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock

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

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2016-07-06

A report from:
The Marine Life Information Network, Marine Biological Association of the United Kingdom.

This review can be cited as:
Readman, J.A.J., 2016. [Caryophyllia (Caryophyllia) smithii] and sponges with [Pentapora foliacea], [Porella compressa] and crustose communities on 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.
DOI https://dx.doi.org/10.17031/marlinhab.1128.1

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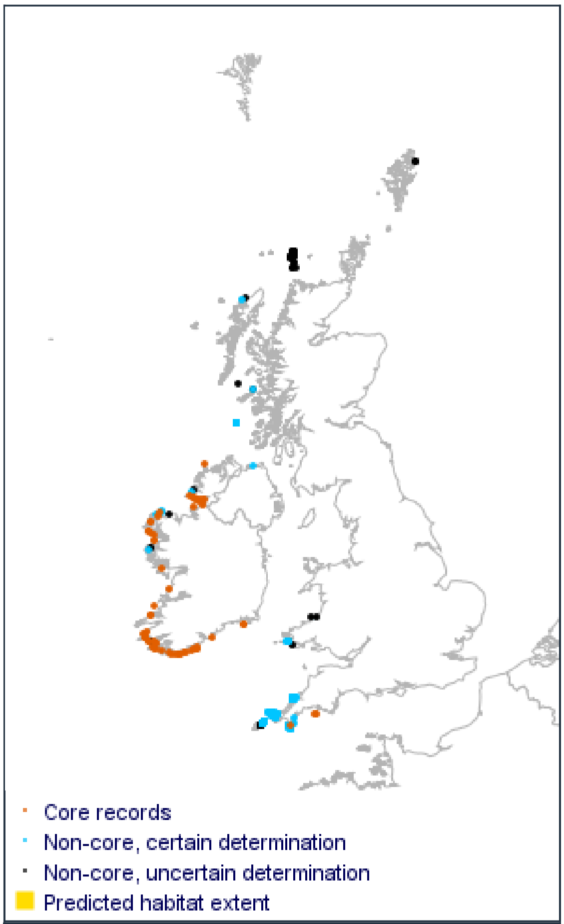

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

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

Summary

UK and Ireland classification

EUNIS 2008	A4.2122	*Caryophyllia smithii* and sponges with *Pentapora foliacea*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock
JNCC 2015	CR.MCR.EcCr.CarSp.PenPcom	*Caryophyllia (Caryophyllia) smithii* and sponges with *Pentapora foliacea*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock
JNCC 2004	CR.MCR.EcCr.CarSp.PenPcom	*Caryophyllia smithii* and sponges with *Pentapora foliacea*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock
1997 Biotope		

Description

This variant is typically found on the upper faces and vertical sides of wave-exposed bedrock or boulders subject to moderately strong to weak tidal streams. The fauna is often sparse with the frequently observed *Echinus esculentus*giving it a grazed appearance, but the community may also be affected by violent storm action working into deep water during winter storms. Despite this spartan appearance, the community is relatively diverse and contains a wide range of sponges, hydroids, bryozoans and echinoderms. This variant is found on open coasts or offshore, and is characterized by the cup-coral *Caryophyllia smithii*, *Alcyonium digitatum*, the sea urchin *Echinus esculentus*, large specimens of the sponge *Cliona celata*, encrusting bryozoans and encrusting red algae. Although this variant tends to occur in deep water (depth range of 20-30m), a high degree of water clarity allows some red algae to grow at these depths. Other species recorded include large specimens of *Haliclona viscosa*, the bryozoans *Parasmittina trispinosa*, *Porella compressa* and*Pentapora foliacea*, the sea cucumbers *Holothuria forskali* and *Aslia lefevrei* and sparse hydroids such as *Abietinaria abietina*, *Nemertesia antennina*, *Nemertesia ramosa* and *Halecium halecinum*. Anemones such as *Corynactis viridis*,*Sagartia elegans* and *Urticina felina* are also frequently seen. Various other species characteristic of wave-exposed rock include the sponges *Pachymatisma johnstonia*, *Stelligera stuposa*, the starfish *Luidia ciliaris*, *Marthasterias glacialis*,*Asterias rubens*, *Henricia oculata*, the crinoid *Antedon bifida*, the barnacle *Balanus crenatus*, the top shell *Calliostoma zizyphinum* and the polychaete *Spirobranchus triqueter*. The majority of the records within this variant originate from the west coast of Ireland.

Depth range

-

Additional information

-

Listed By

- none -

Further information sources

Search on:

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Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

The biotope occurs on vertical sides of wave exposed bedrock or boulders and is characterized by *Caryophyllia smithii*, *Alcyonium digitatum* and the sponge *Cliona celata*. A heavily grazed faunal crust of various bryozoans such as (*Parasmittina trispinosa*, *Pentapora foliacea and Porella compressa)* and hydroids is also present.

Grazing by the sea urchin *Echinus esculentus* is considered significant in preserving the nature of this biotope and loss of this species is likely to significantly affect the biotope to the extent that reclassification would be necessary. For this sensitivity assessment *Echinus esculentus* , *Caryophyllia smithii* and *Alcyonium digitatum* are the primary focus of research as the important characterizing species defining CR.MCR.EcCr.CarSpA.PenPcom, with species making up the faunal crust (such as the various bryozoans, hydroids and sponges) considered where appropriate. Other species present in these biotopes are considered transient, mobile or ubiquitous and are therefore not considered significant to assessment of the sensitivity of these biotopes.

Resilience and recovery rates of habitat

Caryophyllia smithii is a small (max 3 cm across) solitary coral, common within tide swept sites of the UK (Wood, 2005), and distributed from Greece (Koukouras, 2010) to the Shetland Islands and Orkney (NBN, 2015; Wilson, 1975). It was suggested by Fowler & Laffoley (1993) that *Caryophyllia smithii* was a slow growing species (0.5-1 mm in horizontal dimension of the corallum per year), which in turn suggested that inter-specific spatial competition with colonial faunal or algae species were important factors in determining local abundance of *Caryophyllia smithii* (Bell & Turner, 2000). *Caryophyllia smithii* reproduces between January and March and spawning occurs from March to June (Tranter *et al*., 1982). The pelagic stage of the larvae may last up to 10 weeks, which provides this species with a good dispersal capability (Tranter *et al*., 1982) Asexual reproduction and division is also commonly observed (Hiscock & Howlett, 1976). Bell (2002) reported that juvenile *Caryophyllia smithii* have variable morphology which gives them an advantage in colonizing a wide range of habitats.

Echinus esculentus is a sea urchin found within the north-east Atlantic, recorded from Murmansk Coast, Russia to Portugal (Hansson, 1998). *Echinus esculentus* is estimated to have a lifespan of 8-16 years (Nichols, 1979; Gage, 1992) and reaches sexual maturity within 1-3 years (Tyler-Walters, 2008). Maximum spawning occurs in spring although individuals may spawn over a protracted period throughout the year. Gonad weight is at its maximum in February/March in English Channel (Comely & Ansell, 1988) but decreases during spawning in spring and then increases again through summer and winter until the next spawning season. Spawning occurs just before the seasonal rise in temperature in temperate zones but is probably not triggered by rising temperature (Bishop, 1985). *Echinus esculentus* is a broadcast spawner, with a complex larval life history which includes a blastula, gastrula and a characteristic four armed echinopluteus stage, which forms an important component of the zooplankton. MacBride (1914) observed planktonic larval development could take 45-60 days in captivity.

Recruitment is sporadic or variable depending on locality, for example Millport populations showed annual recruitment, whereas few recruits were found in Plymouth populations during Nichols' studies between 1980-1981 (Nichols, 1984). Bishop & Earll (1984) suggested that the population of *Echinus esculentus* at St Abbs had a high density and recruited regularly whereas the

Skomer population was sparse, ageing and had probably not successfully recruited larvae in the previous six years (Bishop & Earll, 1984). Comely & Ansell (1988) noted that the largest number of *Echinus esculentus* occurred below the kelp forest.

Echinus esculentus is a mobile species and could therefore migrate and re-populate an area quickly if removed. For example, Lewis & Nichols (1979a) found that adults were able to colonize an artificial reef in small numbers within three months and the population steadily grew over the following year. If completely removed from a site and local populations are naturally sparse, then recruitment may be dependent on larval supply, which can be highly variable. As suggested by Bishop & Earll (1984), the Skomer, Wales *Echinus esculentus* population had most likely not successfully recruited for six years, which would suggest the mature population would be highly sensitive to removal and may not return for several years. The *Prestige* oil tanker spilled 63 000t of fuel 130 nautical miles off Galicia, Spain in November 2002. High wave action and strong weather systems increased mixing of the oil to “some” depth within the water column, causing sensitive faunal communities to be effected. The biological community of Guéthary, France was monitored preceding and for nine years following the oil spill. Following the oil spill, taxonomic richness decreased significantly from 57 recorded species to 41, which included the loss of *Echinus esculentus* from the site. Two to three years after the oil spill, taxonomic richness had increased to pre-spill levels and *Echinus esculentus* had returned (Castège *et al*., 2014).

Alcyonium digitatum is a colonial species of soft coral with a wide distribution in the North Atlantic, recorded from Portugal (41°N) to Northern Norway (70°N) as well as on the east coast of North America (Hartnoll, 1975; Budd, 2008). Colonies consist of stout “finger like” projections (Hartnoll, 1975), which can reach up to 20 cm tall (Budd, 2008) and can dominate circalittoral rock habitats (as in CR.HCR.FaT.CTub.Adig; Connor *et al*., 2004). *Alcyonium digitatum* colonies are likely to have a lifespan that exceeds 20 years as colonies have been followed for 28 years in marked plots (Lundälv, pers. comm., in Hartnoll, 1998). Colonies that were 10-15 cm in height were aged at between 5 and 10 years old (Hartnoll, unpublished). Most colonies are unisexual, with the majority of individuals being female. Sexual maturity is predicted to occur, at its earliest, when the colony reaches its second year of growth. However, the majority of colonies are not predicted to reach maturity until their third year (Hartnoll, 1975). *Alcyonium digitatum* spawns from December and January. Gametes are released into the water where fertilization occurs. The embryos are neutrally buoyant and float freely for seven days, when they give rise to actively swimming lecithotrophic planulae that may have an extended pelagic life before they eventually settle (usually within 1 or 2 further days) and metamorphose to polyps (Matthews, 1917; Hartnoll, 1975; Budd, 2008). In laboratory experiments, several larvae of *Alcyonium digitatum* failed to settle within 10 days, presumably finding the conditions unsuitable. These larvae were able to survive for 35 weeks as non-feeding planulae. After 14 weeks some were still swimming and after 24 weeks the surface cilia were still active although they rested on the bottom of the tanks. By the end of the experiment, at 35 weeks, the larvae had shrunk to a diameter of 0.3 mm. The ability to survive for long periods in the plankton may favour the dispersal and eventual discovery of a site suitable for settlement (Hartnoll, 1975). The combination of spawning in winter and the long pelagic lifespan may allow a considerable length of time for the planulae to disperse, settle and metamorphose ahead of the spring plankton bloom. Young *Alcyonium digitatum* will consequently be able to take advantage of an abundant food resource in spring and be well developed before the appearance of other organisms that may otherwise compete for the same substrata. In addition, because the planulae do not feed whilst in the pelagic zone they do not suffer by being released at the time of minimum plankton density. They may also benefit by the scarcity of predatory zooplankton which would otherwise feed upon them (Hartnoll, 1975). *Alcyonium digitatum* was first observed one year after the sinking of the *HMS Scylla* and took one year to grow to nearly full size. By early 2009 (5 years after the sinking of the *HMS Scylla*) , *Alcyonium digitatum* had become a visually dominant part of the reef community (Hiscock *et al*., 2010).

Cliona celata colonies generally grows extremely rapidly, doubling their size or more each year, but in some years an apparent shrinkage in size also took place (Fowler & Lafoley, 1993). *Cliona celata* occurs on rock and begins as boring sponge, but can become massive and lobose with rounded ridges up to 40 cm across (Ackers *et al*., 1992). Van Dolah *et al.* (1987) reported that, following an experimental trawl, 32% of sponges suffered damage, with *Cliona* spp. The most affected. However the abundance of sponges had increased to pre-trawl densities, or greater 12 months after trawling.

Coralline crusts, bryozoans and sponges are also important within the CR.MCR.EcCr.CarSp.PenPcom biotope. Studies by Edyvean & Ford (1984a; 1986; 1987) of populations of coralline crusts, namely *Lithophyllum incrustans*, suggest that reproduction may be sexual or asexual (on average early in the third year), and spores are released throughout the year with seasonal variation as less spores were produced in the summer. The authors also found that spore survival was extremely low and young mortality was high, but individuals after the age of 10 appear relatively long-lived (up to 30 years). Some repair of damaged encrusting coralline occurs through vegetative growth, so recolonization by propagules may also be an important mechanism for rapid recovery (Chamberlain, 1996; Airoldi, 2000).

Pentapora foliacea is an erect perennial bryozoan (Eggleston, 1972; Hayward & Ryland, 1995). Whilst Hayward & Ryland (1999) conflated *Pentapora foliacea and Pentapora fascialis*, Lombardi *et al.* (2010) concluded that *Pentapora foliacea* and *Pentpora fascialis* were distinct species and that *P. foliacea* was the resident species in the North East Atlantic while *P.fascialis* was included in the Mediterranean clade. Given taxonomic confusion in the literature, this assessment is based on information on both *P. foliacea* and *P.fascialis*.

Pentpora fascialis has been recorded to recover in 3.5 years after almost total loss of a local population (Cocito *et al*., 1998). The species was reported to repair damage to the colony through regrowth of new zooids and strengthening of the base by thickening of lower zooid walls (Hayward and Ryland, 1979). *Pentapora foliacea* (as *Pentapora fascialis*) 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). The 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 have been 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^2 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).

There is sparse information regarding the life history traits of *Parasmittina trispinosa*. Eggleston (1972a) noted in the Isle of Man, a peak in reproductive and vegetative growth was not well marked, and the number of embryos present is fairly constant throughout the year, indicating that *Parasmittina trispinosa* could potentially reproduce annually within the UK.

Resilience assessment. *Caryophyllia smithii* colonized the wreck of the *Scylla* within a year (Hiscock *et al*., 2010), however this may be due to the time of the vessel sinking and if removed recovery may take longer. *Echinus esculentus* can reportedly reach sexual maturity within 1-2 years (Tyler-Walters, 2008), however as highlighted by Bishop & Earll (1984) and Castège *et al.* (2014) recovery may take 2-6 years (possibly more if local recruitment is poor). *Alcyonium digitatum* can recruit onto bare surfaces within 2 years, however may take up to 5 years to become a dominant component of the community (Whomersley & Picken, 2003; Hiscock *et al*., 2010). The faunal crust is heavily grazed by *Echinus esculentus* and, together with the evidence presented, is likely to be quite resilient. If the community significantly declined (resistance of 'None' or 'Low') resilience would be assessed as '**Medium'** (recovery in 2-10 years). However, where resistance was assessed as 'Medium' or 'High' then resilience would be assessed as **'High**'.

Hydrological Pressures

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

Caryophyllia smithii is found across the British Isles (NBN, 2015) and has been recorded in Greece (Koukouras, 2010). It is therefore unlikely to be significantly affected by an increase at the benchmark level. However, Tranter *et al.* (1982) suggested *Caryophyllia smithii* reproduction was cued by seasonal increases in seawater temperature. Therefore unseasonal increases in temperature may disrupt natural reproductive processes and negatively influence recruitment patterns.

Bishop (1985) suggested that *Echinus esculentus* cannot tolerate high temperatures for prolonged periods due to increased respiration rate and resultant metabolic stress. Ursin (1960) reported *Echinus esculentus* occurred at temperatures between 0-18°C in Limfjord, Denmark. Bishop (1985) noted that gametogenesis occurred at 11-19°C, however, continued exposure to 19°C disrupted gametogenesis. Embryos and larvae developed abnormally after 24 hr exposure to 15°C but normally at 4, 7 and 11°C (Tyler & Young 1998). High temperature (up to 31 °C) had little effect on the growth, survival and boring rate of the sponge *Cliona celata Alcyonium digitatum* is described as a northern species by Hiscock *et al.* (2004), but is distributed from northern Norway (70°N) to Portugal (41°N) (Hartnoll, 1975; Budd, 2008) and is commonly found across the British Isles (Fish & Fish, 1992). Bishop (1985) suggested that *Echinus esculentus* cannot tolerate high temperatures for prolonged periods due to increased respiration rate and resultant metabolic stress. Ursin (1960) reported *Echinus esculentus* occurred at temperatures between 0-18°C in Limfjord, Denmark. Bishop (1985) noted that gametogenesis occurred at 11-19°C, however, continued exposure to 19°C disrupted gametogenesis. Embryos and larvae developed abnormally after 24 hr exposure to 15°C but normally at 4, 7 and 11°C (Tyler & Young 1998). *Parasmittina trispinosa* is commonly found across the whole of the British Isles (NBN, 2015) and is distributed from the Northern coast of Norway to the Mediterranean (Hayward & Ryland, 1990).

Cocito & Sgorbini (2014) studied spatial and temporal patterns of colonial bryozoans in the Ligurian Sea over nine years. High temperature events causied mass mortality among a number of species. The decline in *Pentapora fascialis* colony cover between 11 and 22 m depth followed the unusually warm summer in 1999 (temperature at 11 m of 23.87 ± 1.4 °C) with a 86% reduction in live colony portion and the larger colonies were most affected. Gradual recovery took place, with deeper communities recovering to pre-disturbance levels within four years. Whilst Hayward & Ryland (1999) conflated *Pentapora foliacea and Pentapora fascialis*, Lombardi *et al.* (2010) concluded that *Pentapora foliacea* and *Pentpora fascialis* were distinct species and that *P. foliacea* was the resident species in the North East Atlantic while *P.fascialis* was included in the Mediterranean clade (Duckworth & Bradley, 2012).

Sensitivity assessment. Whilst *Caryophyllia smithii*, *Alcyonium digitatum* and the bryozoans are likely to tolerate an increase in temperature at the benchmark level, evidence suggests that *Echinus esculentus* may be affected. Resistance has been assessed as '**Medium**', resilience has been assessed as '**High**' and sensitivity has been assessed as '**Low**'.

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

Alcyonium digitatum is described as a northern species by Hiscock *et al.* (2004), but is distributed from Northern Norway (70°N) to Portugal (41°N) (Hartnoll, 1975; Budd, 2008). *Alcyonium digitatum* was also reported to be apparently unaffected by the severe winter of 1962-1963 where air temperature reached -5.8°C (Crisp, 1964a). *Parasmittina trispinosa* is commonly found across the whole of the British Isles (NBN, 2015) and is distributed from the northern coast of Norway to the Mediterranean (Hayward& Ryland, 1990).

Ursin (1960) reported *Echinus esculentus* occurred at temperatures between 0-18°C in Limfjord, Denmark. Bishop (1985) noted that gametogenesis occurred at 11-19°C, however, continued exposure to 19°C disrupted gametogenesis. Embryos and larvae developed abnormally after 24 hr exposure to 15°C but normally at 4, 7 and 11°C (Tyler & Young 1998). *Echinus esculentus* has been recorded from the Murmansk Coast, Russia. Due to the high latitude at which *Echinus esculentus* can occur, it is unlikely to be affected by a decrease in temperature at the pressure benchmark.

Pentapora foliacea is found as far north the Minch off western Scotland (Lombardi *et al.*, 2010). Patzold *et al.* (1987) recorded the formation of a growth bands in *Pentapora foliacea* during times of reduced reproduction, which appeared during periods of colder water temperatures. 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. *Caryophyllia smithii* is a southern species (Fish & Fish, 1992) with a northern range limit in the Shetland isles (NBN, 2015). Therefore, it is likely to be negatively affected by cold temperatures in northern examples of this biotope.

Sensitivity assessment. *Alcyonium digitatum*, *Echinus esculentus* have northern/boreal distributions and are unlikely to be affected at the benchmark level. *Spirobranchus triqueter* is unable to build calcareous tubes at low temperatures, however, during winter, this is unlikely to have any significant effects on recruitment. In addition, the depth of the biotope probably protects it from short-term acute decreases in temperature. The important characterizing *Caryophyllia smithii* and *Pentapora foliacea* are close to their northern distribution limit within the British Isles and a decrease at the benchmark level may result in some mortality in northern examples of the biotope. Therefore, resistance is therefore **'Medium'**, resilience is **'High'** and sensitivity is **'Low'**.

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

Echinoderms are generally stenohaline and possess no osmoregulatory organ (Boolootian, 1966) and lack the ability to osmo- and ion-regulate (Stickle & Diehl, 1987). The inability of echinoderms to osmoregulate extracellularly causes body fluid volume to decrease when individuals experience higher external salinity. Protracted hypersalinity is likely to result in the decline of echinoderm populations. Echinoderm larvae have a narrow range of salinity tolerance and will develop abnormally and die if exposed to increased salinity (Tyler-Walters, 2008). *Alcyonium digitatum* distribution and the depth at which it occurs also suggest it would not likely experience regular salinity fluctuations and therefore not resists significant increases in salinity. CR.MCR.EcCr.CarSp.PenPcom occurs in full salinity (Connor *et al.*, 2004), it is therefore possible that an increase in salinity may cause a decline in the abundance of *Alcyonium digitatum*, *Echinus esculentus* and the faunal crust.

Sensitivity assessment. It is likely that *Echinus esculentus* is stenohaline and hypersaline conditions would probably affect the species. Resistance has been assessed as '**Low**', resilience as '**Medium**', and sensitivity has been assessed as '**Medium**'. Due to the lack of information regarding salinity effects on the characterizing species, confidence in this assessment has been assessed as low.

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

Alcyonium digitatum is found at the entrances to sea lochs (Budd, 2008) and estuaries (Braber & Borghouts, 1977) where salinity may vary occasionally. Furthermore, *Alcyonium digitatum* is found within a number of variable salinity biotopes, e.g. MCR.BYH.Flu.Hocu (Connor *et al.*, 2004). However, its distribution and the depth, at which it occurs suggest that *Alcyonium digitatum* would not likely often experience salinity fluctuations and is, therefore, unlikely to survive significant reductions in salinity (Budd, 2008).

Caryophyllia smithii has been recorded in biotopes from Full to Low salinity (Connor *et al.*, 2004) and would probably tolerate a change at the benchmark level.

Echinoderms are generally unable to tolerate low salinity (stenohaline) and possess no osmoregulatory organ (Boolootian, 1966). At low salinity urchins gain weight, and the epidermis loses its pigment as patches are destroyed; prolonged exposure is fatal. However, within *Echinus esculentus* there is some evidence to suggest intracellular regulation of osmotic pressure due to increased amino acid concentrations. *Echinus esculentus* is found within a number of variable and reduced salinity biotopes, e.g. IR.LIR.KVS.SlatPsaVS (Connor *et al.*, 2004).

Novosel *et al.* (2004) described large colonies of *Pentapora fascialis* growing inside the plumes of marine freshwater springs (3 psu lower than water outside of the channel).

Sensitivity assessment. CR.MCR.EcCr.CarSp.PenPcom is recorded exclusively in full marine conditions (30-35 ppt) (Connor *et al.*, 2004). Records from the MNCR suggest *Alcyonium digitatum* and *Echinus esculentus* can occur in reduced salinity habitats, however the evidence suggests that these species would decrease in abundance. In addition, a reduction in salinity may result in a reduction in species richness of the biotope. Therefore, resistance has been assessed as '**Low**', Resilience as '**Medium**'. Sensitivity has been assessed 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

The biotope (EcCr.CarSp.PenPcom) occurs in extremely to moderately wave exposed conditions in areas of moderately strong to negligible water flow at 10-50m depth (Connor *et al*., 2004). The biotope is structured by grazing, especially by *Echinus esculentus*. The biotope probably occurs at a critical range of water movement that allows the *Echinus esculentus* population to remain in high enough abundance to structure the biotope. Deep examples probably depend on water flow or extreme wave action, while shallow examples depend on wave action or water flow.

Alcyonium digitatum and the bryozoans are suspension feeders relying on water currents to supply food. These taxa, therefore, thrive in conditions of vigorous water flow e.g. around Orkney and St Abbs, Scotland, where the community may experience tidal currents of 3 and 4 knots (1.5 and 2 m/s) during spring tides (De Kluijver, 1993).

Echinus esculentus occurred in kelp beds on the west coast of Scotland in currents of about 0.5 m/sec. Outside the beds, specimens were occasionally seen being rolled by the current (Comely & Ansell, 1988), which may have been up to 1.4 m/sec. *Echinus esculentus* are also displaced by storm action. After disturbance *Echinus esculentus* migrates up the shore, an adaptation to being washed to deeper water by wave action (Lewis & Nichols, 1979a). Therefore, increased water flow may remove the population from the affected area, probably to deeper water, however individuals would probably not be killed in the process and could recolonize the area quickly.

Sensitivity assessment. This biotope occurs in negligible water flow, so a reduction in water flow would therefore not affect the biotope. All characterizing species are likely to be tolerant of an increase at the benchmark level (0.1-0.2 m/s), being present in biotopes with stronger water flow.

Resistance is therefore '**High**', resilience is '**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/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

The biotope (EcCr.CarSp.PenPCom) occurs in extremely to moderately wave exposed conditions in areas of moderately strong to negligible water flow at 10-50m depth (Connor *et al*., 2004). The biotope is structured by grazing, especially by *Echinus esculentus*. The biotope probably occurs at a critical range of water movement that allows the Echinus population to remain in high enough abundance to structure the biotope. Deep examples probably depend on water flow or extreme wave action, while shallow examples depend on wave action or water flow.

Alcyonium digitatum are suspension feeders relying on water currents to supply food. These taxa therefore thrive in conditions of vigorous water flow. As a circalittoral biotope (recorded from 5 - 50 m), the depth at which these biotopes occur may therefore also reduce the direct physical effects of a localised change in wave height; wave attenuation is directly related to water depth (Hiscock, 1983).

Caryophyllia smithii was recorded in very sheltered to extremely exposed biotopes (Connor *et al.*, 2004).

Pentapora foliacea was recorded as occurring in biotopes experiencing moderate to extreme wave exposure (Connor *et al.*, 2004). However, extreme wave action (storms) has been noted to cause widespread destruction of colonies (Cocito *et al.* (1998a). Significant increases in wave exposure may therefore cause damage to colonies.

Echinus esculentus occurred in kelp beds on the west coast of Scotland in currents of about 0.5 m/sec. Outside the beds, specimens were occasionally seen being rolled by the current (Comely & Ansell, 1988), which may have been up to 1.4 m/sec. Urchins are removed from the stipe of kelps by wave and current action. *Echinus esculentus* are also displaced by storm action. After disturbance, *Echinus esculentus* migrates up the shore, an adaptation to being washed to deeper water by wave action (Lewis & Nichols, 1979a). Keith Hiscock (pers. comm.) reported *Echinus esculentus* occurred in significant numbers as shallow as 15 m below low water at the extremely wave exposed site of Rockall, Scotland.

Sensitivity assessment. Whilst storm events may have an impact on the biotope, a change at the benchmark level is not likely to have a significant effect on the characterizing species. Resistance has been assessed as '**High**', resilience has been 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

Little is known about the effects of heavy metals on echinoderms. Bryan (1984) reported that early work had shown that echinoderm larvae were sensitive to heavy metals contamination, for example Migliaccio *et al.* (2014) reported exposure of *Paracentrotus lividis* larvae to increased levels of cadmium and manganese caused abnormal larval development and skeletal malformations. Kinne (1984) reported developmental disturbances in *Echinus esculentus* exposed to waters containing 25 µg / l of copper (Cu).

No information was found on the direct biological effects of heavy metal contamination on *Alcyonium digitatum*. Possible sub-lethal effects of exposure to heavy metals, may result in a change in morphology, growth rate or disruption of reproductive cycle. The vulnerability of this species to concentrations of pollutants may also depend on variations in other factors e.g. temperature and salinity conditions outside the normal range.

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). Bryozoans were shown to bioaccumulate heavy metals to a certain extent (Holt *et al.*, 1995). For example, *Bowerbankia gracialis* and *Nolella pusilla* accumulated Cd, exhibiting sublethal effects (reduced sexual reproduction and inhibited resting spore formation) between 10-100 µg Cd /l and fatality above 500 µg Cd/l (Kayser, 1990).

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.

Echinus esculentus was reported absent after the oil spill however returned after 2-5 years. Large numbers of dead *Echinus esculentus* were found between 5.5 and 14.5 m in the vicinity of Sennen cove, presumably due to a combination of wave exposure and heavy spraying of dispersants following the *Torrey Canyon* oil spill (Smith, 1968). Smith (1968) also demonstrated that 0.5 -1ppm of the detergent BP1002 resulted in developmental abnormalities in its echinopluteus larvae. *Echinus esculentus* populations in the vicinity of an oil terminal in La Coruna Bay, Spain, showed developmental abnormalities in the skeleton. The tissues contained high levels of aliphatic hydrocarbons, naphthalenes, pesticides and heavy metals (Zn, Hg, Cd, Pb, and Cu) (Gommez & Miguez-Rodriguez, 1999).

Oil pollution is mainly a surface phenomenon, so 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). Smith (1968) reported dead colonies of *Alcyonium digitatum* at a depth of 16m in the locality of Sennen Cove, Cornwall which was likely a result of toxic detergents sprayed along the shoreline to disperse oil from the *Torrey Canyon* tanker spill (Budd, 2008). Little information on the effects of hydrocarbons on bryozoans could be found. Ryland & De Putron (1998) did not detect adverse effects of oil contamination on the bryozoan *Alcyonidium* spp. in Milford Haven or St. Catherine's Island, south Pembrokeshire although it did alter the breeding period. *Echinus esculentus* is subtidal and unlikely to be directly exposed to oil spills. However, as with the '*Prestige*' oil spill rough seas can cause mixing with the oil and the seawater, and therefore sub-tidal habitats can be affected by the oil spill. Castège *et al.*, (2014) recorded the recovery of rocky shore communities following the *Prestige* oil spill which impacted the French Atlantic coast. Rough weather at the time of the spill increased mixing between the oil and seawater, causing sub-tidal communities/habitats to be affected.

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.

Smith (1968) reported dead colonies of *Alcyonium digitatum* at a depth of 16 m in the locality of Sennen Cove, Cornwall resulting from the offshore spread and toxic effect of detergents (a mixture of a surfactant and an organic solvent). Possible sub-lethal effects of exposure to synthetic chemicals may result in a change in morphology, growth rate or disruption of reproductive cycle. The vulnerability of this species to concentrations of pollutants may also depend on variations in other factors e.g. temperature and salinity conditions outside the normal range (Budd, 2008).

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 *Parasmittina trispinosa* would be sensitive to synthetic compounds.

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

'No evidence' 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	Low Q: High A: Medium C: Medium	Medium Q: High A: High C: High	Medium Q: High A: Medium C: Medium

Mass mortality of species including *Echinus esculentus* was observed due to a stratified hypoxic event below 8 m caused by a phytotplankton bloom (Griffiths *et al*., 1979). Hiscock & Hoare (1975) reported an oxycline forming in the summer months (Jun-Sep) in a quarry lake (Abereiddy, Pembrokeshire) from close to full oxygen saturation at the surface to <5% saturation below ca 10 m. During these summer events, no echinoderms were recorded at depths below 10 - 11 m. At the time of writing there was insufficient evidence on which to assess this pressure. There is anecdotal evidence to suggest that *Alcyonium digitatum* is sensitive to hypoxic events. However, because the degree of de-oxygenation wasn't quantified the evidence cannot be compared to the pressure benchmark. 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, or even less (Herreid, 1980; Rosenberg et al., 1991; Diaz & Rosenberg, 1995). *Alcyonium digitatum* mainly inhabits environments in which the oxygen concentration usually exceeds 5 ml/l and respiration is aerobic (Budd, 2008). In August 1978 a dense bloom of a dinoflagellate, *Gyrodinium aureolum* occurred surrounding Geer Reef in Penzance Bay, Cornwall and persisted until September that year. Observations by local divers indicated a decrease in underwater visibility (<1 m) from below 8 m. It was also noted that many of the faunal species appeared to be affected, e.g. no live *Echinus esculentus* were observed whereas on surveys prior to August were abundant, *Alcyonium* sp. and bryozoans were also in an impoverished state. During follow up surveys conducted in early September *Alcyonium* sp. were noted to be much healthier and feeding. It was suggested the decay of *Gyrodinium aureolum* either reduced oxygen levels or physically clogged faunal feeding mechanisms. Adjacent reefs where also surveyed during the same time period and the effects of the *Gyrodinium aureolum* bloom were less apparent. It was suggested that higher water agitation in shallow water on reefs more exposed to wave action were less effected by the phytoplankton bloom (Griffiths *et al*., 1979). CR.MCR.EcCr.CarSp.PenPcom is recorded from very weak to moderately strong tidal streams (negligible to 1.5 m/sec) (Connor *et al*., 2004). Whilst mixing with surrounding oxygenated water is likely to occur in examples of this biotope that experience moderate water movement (Dennis, 1979), de-oxygenation is likely to become a chronic factor in examples where there is negligible water movement.

Whilst little information on *Pentapora* spp. was found, O'Dea & Okamura (2000) found that annual growth of the bryozoan *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). Echavarri-Erasun *et al*. (2007) described the effects of deep water sewage discharge on the relative abundance of rocky reef communities. Species typical of hard substrata (including *Caryophyllia smithii* and bryozoans) increased in total richness and abundance near the outfall.

Sensitivity assessment

The characterizing species are likely to suffer significant mortality in a hypoxic event at the benchmark level, especially in examples of the biotope that occur with negligible water flow in which it may take longer for the oxygen levels to recover. Whilst the majority of assessed species are sessile, *Echinus esculentus* is mobile and may escape the hypoxic event (depending on extent and conditions). Resistance is assessed as '**Low**', Resilience as '**Medium**' (assuming recovery to normal oxygen conditions) and sensitivity as '**Medium**'.

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

t was suggested by Comely & Ansell (1988) that *Echinus esculentus* could absorb dissolved organic material for the purposes of nutrition. Nutrient enrichment may encourage the growth of ephemeral and epiphytic algae and therefore increase sea-urchin food availability. Lawrence (1975) reported that sea urchins had persisted over 13 years on barren grounds near sewage outfalls, presumably feeding on dissolved organic material, detritus, plankton and microalgae, although individuals died at an early age. *Alcyonium digitatum* is a suspension feeders of phytoplankton and zooplankton. Nutrient enrichment of coastal waters that enhances the population of phytoplankton may be beneficial to these species in terms of an increased food supply but the effects are uncertain (Hartnoll, 1998). High primary productivity in the water column combined with high summer temperature and the development of thermal stratification (which prevents mixing of the water column) can lead to hypoxia (see de-oxygenation). Nutrient enrichment could also lead to algal blooms.

Whilst little information on *Pentapora* spp. was found, O'Dea & Okamura (2000) found that annual growth of the bryozoan *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).

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

It was suggested by Comely & Ansell (1988) that *Echinus esculentus* could absorb dissolved organic material for the purposes of nutrition. Organic enrichment may encourage the growth of ephemeral and epiphytic algae and therefore increase sea-urchin food availability. Lawrence (1975) reported that sea urchins had persisted over 13 years on barren grounds near sewage outfalls, presumably feeding on dissolved organic material, detritus, plankton and microalgae, although individuals died at an early age. *Alcyonium digitatum* is a suspension feeders of phytoplankton and zooplankton. Organic enrichment of coastal waters that enhances the population of phytoplankton may be beneficial to these species in terms of an increased food supply but the effects are uncertain (Hartnoll, 1998). High primary productivity in the water column combined with high summer temperature and the development of thermal stratification (which prevents mixing of the water column) can lead to hypoxia, (see de-oxygenation)

Sensitivity assessment. **'No evidence'** of the effects of organic enrichment in circalittoral faunal crusts was found.

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

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

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

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

'Not relevant' to biotopes occurring on bedrock.

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

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

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

Alcyonium digitatum, Echinus esculentus and Parasmittina trispinosa are sessile or slow moving species that might be expected to suffer from the effects of abrasion. Boulcott & Howell (2011) conducted experimental Newhaven scallop dredging over a circalittoral rock habitat in the sound of Jura, Scotland and recorded the damage to the resident community. Only 13% of photographic samples showed visible damage to *Alcyonium digitatum*. Where *Alcyonium digitatum* damage was evident it tended to be small colonies that were ripped off the rock. The authors highlight physical damage to faunal turfs (erect bryozoans and hydroids) was difficult to quantify in the study. However, the faunal turf communities did not show large signs of damage and were only damaged by the scallop dredge teeth, which was often limited in extent (approximately 2 cm wide tracts). The authors indicated that species such as *Alcyonium digitatum* and faunal turf communities were not as vulnerable to damage through trawling as sedimentary fauna and whilst damage to circalittoral rock fauna did occur it was of an incremental nature, with loss of species such as *Alcyonium digitatum* and faunal turf communities increasing with repeated trawls. Species with fragile tests, such as *Echinus esculentus* were reported to suffer badly as a result of scallop or queen scallop dredging (Bradshaw *et al.*, 2000; Hall-Spencer & Moore, 2000a). Kaiser *et al.* (2000) reported that *Echinus esculentus* were less abundant in areas subject to high trawling disturbance in the Irish Sea. Jenkins *et al.* (2001) conducted experimental scallop trawling in the North Irish sea and recorded the damage caused to several conspicuous megafauna species. The authors used simultaneous assessment of both bycatch and organisms left on the seabed to estimate capture efficiency for both target and non-target organisms. This found 16.4% of *Echinus esculentus* were crushed or dead, 29.3% had >50% spine loss/minor cracks, 1.1% had <50% spine loss and the remaining 53.3% were in good condition. Sea urchins can rapidly regenerate spines, e.g. *Psammechinus miliaris* were found to re-grow all spines within a period of 2 months (Hobson, 1930). The trawling examples mentioned above were conducted on sedimentary habitats and thus the evidence is not directly relevant to rock based, however it does indicate the likely effects of abrasion on *Echinus esculentus*.

Some large *Pentapora foliacea* individuals were observed to be badly smashed by potting (Eno *et al.*, 2001).

Van Dolah *et al.* (1987) studied the effects on sponges and corals of one trawl event over a low-relief hard bottom habitat off Georgia, US. The densities of individuals taller than 10 cm of three species of sponges in the trawl path and in adjacent control area were assessed by divers, and were compared before, immediately after and 12 months after trawling. Of the total number of sponges remaining in in the trawled area, 32% were damaged. Most of the affected sponges were the barrel sponges *Cliona* spp. However the abundance of sponges had increased to pre-trawl densities, or greater12 months after trawling.

Sensitivity assessment. Whilst abrasion pressures tend to heavily impact sessile or slow moving marine species, the evidence suggests that mortality amongst the characterizing species is **'Medium'** (<25% loss) for the characterizing *Alcyonium digitatum* and *Echinus esculentus.* It should be noted that this is dependent on the abrasion activity and heavier gears may well cause more damage.

Based on the evidence for the characterizing species, resistance is '**Medium**', resilience as '**High**' and sensitivity as '**Low**'.

Please note Boulcott & Howell (2011) did not mention the abrasion caused by fully loaded collection bags on the new haven dredges. A fully loaded Newhaven dredge may cause higher damage to community than indicated in their study.

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

The species characterizing this biotope group are epifauna or epiflora occurring on rock which is resistant to subsurface penetration. The assessment for abrasion at the surface only is therefore considered to equally represent sensitivity to this pressure. This pressure is considered to be '**Not Relevant'** to hard rock biotopes.

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

Alcyonium digitatum and Parasmittina trispinosa are not thought to be highly susceptible to changes in water clarity due to the fact they are suspension feeding organisms and are not directly dependent on sunlight for nutrition. *Alcyonium digitatum* has been shown to be tolerant of high levels of suspended sediment. Hill *et al.* (1997) demonstrated that *Alcyonium digitatum* sloughed off settled particles with a large amount of mucous. *Alcyonium digitatum* is also known to inhabit the entrances to sea lochs (Budd, 2008) or the entrances to estuaries (Braber & Borghouts, 1977) where water clarity is likely to be highly variable. Also, Moore (1977a) suggested that *Echinus esculentus* was unaffected by turbid conditions. *Echinus esculentus* is an important grazer in CR.MCR.EcCr.CarSp.PenPcom but also feeds on detritus or dissolved organic material (Lawrence, 1975, Comely & Ansell, 1988).

Populations of *Caryophyllia smithii* were studied at three sites of differing sedimentation regime in Lough Hyne, Ireland. (Bell & Turner, 2000)The height, length, width and density of individuals were measured along with the depth of accumulated sediment on the rock substratum at each site. Calyx size was largest at the site of least sedimentation and smallest at the site of most sedimentation. In contrast, height of individuals was greatest at the site of most sedimentation and smallest at the site of least sedimentation. The height of individuals correlated with the level of surrounding sediment. *Caryophyllia smithii* was more abundant in areas with higher sedimentation (Bell & Turner, 2000).

Bryozoans are suspension feeders that may be adversely affected by increases in suspended sediment, due to clogging of their feeding apparatus.

Colonies of P*entapora fascialis* can reach a height of 30 cm in the British Isles (Hayward & Ryland, 1979). Partial mortality due to siltation has been recorded in the Mediterranean (Cocito *et al.*, 1998) although recovery was observed in in all but one colony (which fragmented into two smaller colonies).

Sensitivity assessment. The biotope is faunally dominated and circalittoral and is therefore not dependent on light, so a change in suspended sediment is unlikely to affect the characterizing species and resistance is therefore assessed as '**High**', Resilience as '**High**' and the biotope is '**Not sensitive**'.

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

CR.MCR.EcCr.CarSp.PenPcom occurs on vertical faces and overhangs which would afford the characterizing species protection in the event of sediment deposition. *Alcyonium digitatum* is sessile and thus would be unable to avoid the deposition of a smothering layer of sediment, however, colonies can attain a height of up to 20 cm (; Budd, 2008; Edwards, 2008), so would still be able to feed in the event of sediment deposition. *Parasmittina trispinosa* is an encrusting species and would thus likely be smothered, and depending on sediment retention, could block larval settlement.

Colonies of P*entapora fascialis* can reach a height of 30 cm in the British Isles (Hayward & Ryland, 1979). Partial mortality due to siltation has been recorded in the Mediterranean (Cocito *et al.*, 1998) although recovery was observed in in all but one colony (which fragmented into two smaller colonies).

Echinus esculentus are mobile, large globular urchins which can reach a diameter of 17 cm (Tyler-Walters, 2000). Comely & Ansell (1988) recorded large *Echinus esculentus* from kelp beds on the west coast of Scotland in which the substratum was seasonally covered with "high levels" of silt. This suggests that *Echinus esculentus* is unlikely to be killed by smothering, however, smaller specimens and juveniles may be less resistant. A layer of sediment may interfere with larval settlement. If retained within the host biotope for extended periods a layer of 5 cm of the sediment may negatively affect successive recruitment events, however this is unlikely given the typically vertical nature of the biotope.

Caryophyllia smithii is small (approx. <3 cm height from the seabed) and would therefore likely be inundated in a “light” sedimentation event. However Bell & Turner (2000) reported *Caryophyllia smithii* was abundant at sites of “moderate” sedimentation (7mm ± 0.5mm) in Lough Hyne. It is therefore likely that *Caryophyllia smithii* would be resistant to periodic sedimentation. If 5cm of sediment were removed rapidly, via tidal currents, *Caryophyllia smithii* would likely remain within the biotope. Burton *et al.* (2005) partly attributed fluctuations in *Caryophyllia smithii* abundance at Skomer Island to surface sediment cover.

Sensitivity assessment. CR.MCR.EcCr.CarSp.PenPcom typically occurs on vertical sides of rock and sedimentation would be unlikely, with removal likely to be rapid. Areas at the base of the rock could be affected, but overall, resistance is assessed as **‘High’**, resilience as **‘High’** and the biotope is **‘Not sensitive’** at the benchmark level.

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

CR.MCR.EcCr.CarSp.PenPcom typically occurs on vertical sides of rock which would afford the characterizing species some protection in the event of sediment deposition.

Colonies of P*entapora fascialis* can reach a height of 30 cm in the British Isles (Hayward & Ryland, 1979). Partial mortality due to siltation has been recorded in the Mediterranean (Cocito *et al.*, 1998) although recovery was observed in in all but one colony (which fragmented into two smaller colonies).

Caryophyllia smithii is small (approx. <3 cm height from the seabed) and would therefore likely be inundated in a “heavy” sedimentation event. Whilst Bell & Turner (2000) reported *Caryophyllia smithii* was abundant at sites of “moderate” sedimentation (7mm ± 0.5mm) in Lough Hyne, it is unlikely that *Caryophyllia smithii* would survive. Burton *et al.* (2005) partly attributed fluctuations in *Caryophyllia smithii* abundance at Skomer Island to surface sediment cover.

Alcyonium digitatum is sessile and thus would be unable to avoid the deposition of a smothering layer of sediment. However *Alcyonium digitatum* colonies can attain a height of up to 20 cm (; Budd, 2008; Edwards, 2008), so would still be able to feed in the event of sediment deposition. However, *Parasmittina trispinosa* is an encrusting species and would thus likely be smothered, and depending on sediment retention, could block larval settlement. *Echinus esculentus* are mobile, large globular urchins which can reach a diameter of 17 cm (Tyler-Walters, 2000). Comely & Ansell (1988) recorded large *Echinus esculentus* from kelp beds on the west coast of Scotland in which the substratum was seasonally covered with "high levels" of silt. This suggests that *Echinus esculentus* is unlikely to be killed by smothering, however, smaller specimens and juveniles may be less resistant. A layer of sediment could interfere with larval settlement. If sediment is retained within the host biotope for extended periods a layer sediment may negatively affect successive recruitment events, however given that the biotope tends to occur on vertical faces and overhangs, this is unlikely.

Sensitivity assessment. CR.MCR.EcCr.CarSp.PenPcom occurs typically on vertical sides of rock and sedimentation would be unlikely, with removal likely to be rapid. Smothering at the base of rocks could result in burial of the encrusting bryozoans and would affect *Alcyonium digitatum* which grows to 20 cm tall (Budd, 2008; Edwards, 2008). A cautious assessment of '**Medium**' resistance is applied. Resilience is '**High**' and sensitivity is '**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	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

'No evidence' was found.

Underwater noise changes	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Echinus esculentus, Alcyonium digitatum and *Parasmittina trispinosa* have no hearing perception but vibrations may cause an impact, however there is '**No evidence'** to support an assessment.

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

There is some evidence that the basiepithelial nerve plexus below the entire outer skins of echinoderms is sensitive to light (Hill, 2008).

There is no evidence to suggest that algal species would benefit if exposed to anthropogenic light sources. CR.MCR.EcCr.CarSp.PenPcom is a circalittoral biotope and therefore defined as occurring at low light levels due to depth. Increased shading (e.g. by construction of a pontoon, pier etc) could be beneficial to the characterizing species within this biotope.

Sensitivity assessment. Resistance is assessed as '**High**', with '**High**' resilience and the biotope is **'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	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

Echinus esculentus was identified by Kelly & Pantazis (2001) as a species suitable for culture for the urchin roe industry. However, at present no evidence could be found to suggest that significant *Echinus esculentus* mariculture was present in the UK. If industrially cultivated it is feasible that *Echinus esculentus* individuals could be translocated. **'No evidence'** of cultivation or translocation of other characterizing species was found.

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

Styela clava was first recorded in the UK at Plymouth in 1952 (Eno *et al.*, 1997). Where *Styela clava* and *Ciona intestinalis* co-occur they may compete for space and food (Jackson, 2008).

Didemnum vexillum is an invasive colonial sea squirt native to Asia which was first recorded in the UK in Darthaven Marina, Dartmouth in 2005. *Didemnum vexillum* can form extensive mats over the substrata it colonizes; binding boulders, cobbles and altering the host habitat (Griffith *et al.*, 2009). *Didemnum vexillum* can also grow over and smother the resident biological community. Recent surveys within Holyhead Marina, North Wales have found *Didemnum vexillum* growing on and smothering native tunicate communities, including *Ciona intestinalis* (Griffith *et al.*, 2009). Due to the rapid-re-colonization of *Didemnum vexillum* eradication attempts have to date failed. Presently, *Didemnum vexillum* is isolated to several sheltered locations in the UK (NBN, 2015). However *Didemnum vexillum* has successfully colonized the offshore location of the Georges Bank, USA (Lengyel *et al.*, 2009) which is more exposed than the locations which *Didemnum vexillum* have colonized in the UK. It is therefore possible that *Didemnum vexillum* could colonize more exposed locations within the UK and could therefore pose a threat to these biotopes.

A number of invasive bryozoans are of concern including *Schizoporella japonica* (Ryland *et al.*, 2014) and *Tricellaria inopinata* (Dyrynda *et al.*, 2000; Cook *et al.*, 2013b).

However, there is '**No evidence'** regarding known invasive species colonizing this biotope. Due to the constant risk of new invasive species, the literature for this pressure should be revisited.

Introduction of microbial pathogens	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

Echinus esculentus is susceptible to 'Bald-sea-urchin disease', which causes lesions, loss of spines, tube feet, pedicellariae, destruction of the upper layer of skeletal tissue and death. It is thought to be caused by the bacteria *Vibrio anguillarum* and *Aeromonas salmonicida*. Bald sea-urchin disease was recorded from *Echinus esculentus* on the Brittany Coast. Although associated with mass mortalities of *Strongylocentrotus franciscanus* in California and *Paracentrotus lividus* in the French Mediterranean it is not known if the disease induces mass mortality (Bower, 1996).

Alcyonium digitatum acts as the host for the endoparasitic species *Enalcyonium forbesi* and *Enalcyonium rubicundum* (Stock, 1988). Parasitisation may reduce the viability of a colony but not to the extent of causing mortality. No further evidence was found to substantiate this suggestion. Specimens of *Cliona* spp. exhibited blackened damage since 2013 in Skomer. Preliminary results have shown that clean, fouled and blackened *Cliona* all have very different bacterial communities. The blackened *Cliona* are effectively dead and have a bacterial community similar to marine sediments. The fouled *Cliona* have a very distinct bacterial community that may suggest a specific pathogen caused the effect (Burton, pers comm; Preston & Burton, 2015). Stebbing (1971b) reported that encrusting epizoites reduced the growth rate of *Flustra foliacea* by ca 50%. The bryozoan *Bugula flabellata* produces stolons that grow in and through the zooids of *Flustra foliacea*, causing "irreversible degeneration of the enclosed polypide" (Stebbing, 1971b). No evidence of *Parasmittina trispinosa* disease could be found.

Sensitivity assessment. Whilst evidence of disease in the characterizing species could be found, **'No evidence'** of mass-mortality through disease could be found.

Removal of target species	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

Despite historic extraction as a curio (Jangoux, 1980; Nichols, 1984), *Echinus esculentus* is not thought to be currently targeted. **'No evidence'** for the targeted removal of *Alcyonium digitatum* or bryozoans could be found.

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

The sensitivity assessment for this pressure considers any biological/ecological effects resulting from the removal of non-target species on this biotope. *Alcyonium digitatum* goes through an annual cycle, from February to July all *Alcyonium digitatum* colonies are feeding, from July to November an increasing number of colonies stop feeding. During this period a large number of polyps can retract and a variety of filamentous algae, hydroids and amphipods can colonize the surface of colonies epiphytically. From December-February the epiphytic community is however sloughed off (Hartnoll, 1975). If *Alcyonium digitatum* were removed the epiphytic species would likely colonize rock surfaces and are therefore not dependent on *Alcyonium digitatum*.

While recovery of the characterizing species should be possible within 2-10 years following non-targeted removal (e.g. from static or mobile gears), loss of *Echinus esculentus* from the biotope subsequent loss of grazing pressure would result in increasing competition from algae and increased competition for space, which could lead to a change in biotope classification e.g. to XFa biotopes with a more . *Alcyonium digitatum* and faunal turf communities (which include bryozoans such as *Parasmittina trispinosa*) are probably resistant to abrasion through bottom fishing (see abrasion pressure).

Sensitivity assessment. A decrease in *Caryophyllia smithii* or *Alcyonium digitatum* would result in a decline in the biotope richness. However, removal of *Echinus esculentus* could result in restructuring of the biotope. If all are lost, reclassification would be necessary. Resistance has therefore been assessed as '**None**', resilience as '**Medium**' and sensitivity as '**Medium**'.

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