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

Sabella pavonina with sponges and anemones on infralittoral mixed sediment

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

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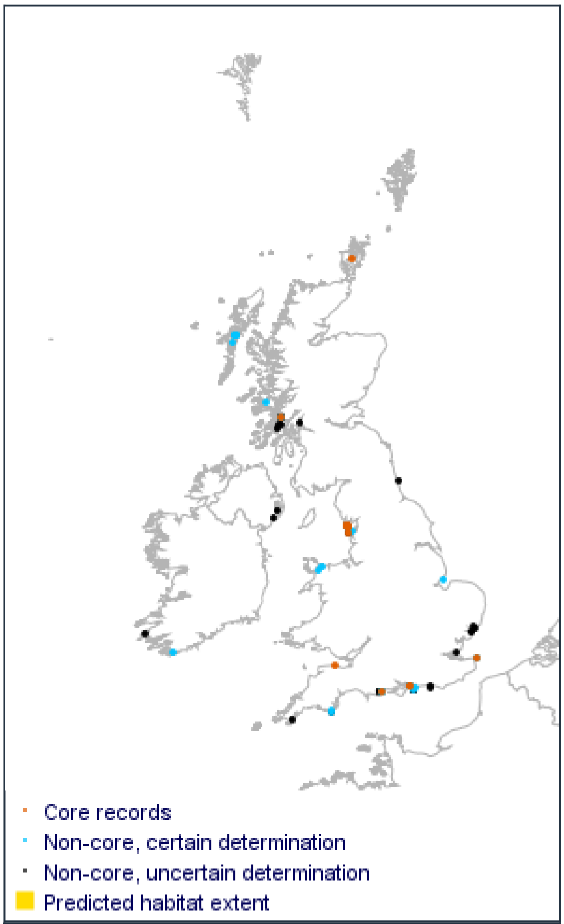

17-09-2018
Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by Frances Perry **Refereed by** Admin

Summary

UK and Ireland classification

EUNIS 2008	A5.432	*Sabella pavonina* with sponges and anemones on infralittoral mixed sediment
JNCC 2015	SS.SMx.IMx.SpavSpAn	*Sabella pavonina* with sponges and anemones on infralittoral mixed sediment
JNCC 2004	SS.SMx.IMx.SpavSpAn	*Sabella pavonina* with sponges and anemones on infralittoral mixed sediment
1997 Biotope		

Description

Muddy gravelly sand with pebbles off shallow, sheltered or moderately exposed coasts or embayments may support dense populations of the peacock worm *Sabella pavonina*. This community may also support populations of sponges such as *Esperiopsis fucorum*, *Haliclona* *oculata* and *Halichondria panicea* and anemones such as *Sagartia elegans*,*Cerianthus lloydii* and *Urticina felina*. Hydroids such as *Hydrallmania falcata* and the encrusting polychaete *Spirobranchus triqueter* are also important. This biotope may have an extremely diverse epifaunal community. Less is known about its infaunal component, although it is likely to include polychaetes such as Nephtys spp., *Harmothoe* spp., *Glycera* spp., syllid and cirratulid polychaetes, bivalves such as *Abra* spp., Aoridae amphipods and brittlestars such as *Amphipholis squamata*.

Depth range

-

Additional information

-

Listed By

- none -

Further information sources

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G G JNCC

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

This biotope occurs is associated with coasts or embayments where large populations of the worm *Sabella pavonina* can survive. High abundances of *Sabella pavonina*, often forming clusters to which other species attach, characterize the biological component of this biotope. *Sabella pavonina*, lives within a tube created by organic excretions and sediment particles from the substratum which can protrude up to 10 cm from the sediment. *Sabella pavonina* can be a gregarious worm and when a number of worms are within close proximity of each other the tubes create an anchorage for other species, along with the larger sediment fractions found within this biotope. Certain species of sponges and anemones are commonly found within this biotope. The sponge species include *Esperiopsis fucorum*, *Haliclona oculata* and *Halichondria panacea*, and the anemones include *Sagartia elegans*, *Cerianthus lloydii* and *Urticina felina*. *Sabella pavonina* is an ecosystem engineering species and possibly the most important species in this biotope, as a significant reduction in the abundance of Sabella pavonina would result in loss of a recognisable biotope.

Resilience and recovery rates of habitat

The life expectancy of *Sabella pavonina* isn't known. The species reproduces annually during the summer, with warmer seawater temperatures and longer daylight hours acting as environmental cues for reproduction (Tompsett, 2003). Historical storm events have been recorded to remove large sections of *Sabella pavonina* populations (Vallentin, 1898; Tompsett, 2003). Vallentin (1898) stated that *Sabella pencillus* (assumed to be *Sabella pavonina* from the location) abounded but after severe easterly gales their abundance had reduced to a few examples. Tompsett (2003) recorded a storm event that reduced the number of *Sabella pavonina* within clusters in Gillan Harbour. Prior to the storm event the number of *Sabella pavonina* within each cluster was recorded as mainly of 2 to 5 and occasionally 7, 8, 10 and 11. Following severe easterly gales in the winter of 1997-98 much of the population again fell into the singles or doubles category with small numbers in the 3, 4, 5, 6 and 8 classes and just one of 14 (Tompsett, 2003). However, there is evidence to suggest that *Sabella pavonina* can recover relatively quickly when other adults are present. Within the same harbour, Tompsett (2003) recorded the mean number of tubes per 0.25 m^2 quadrat from 1996 and 1997. In 1996 the mean was one but, just a year later, the mean had increased to 18 (Tompsett, 2003). The dispersal capacity of *Sabella pavonina* isn't known. Yet, the species is found throughout the British Isles, in a range of habitats, and can be found in groups or on their own. This suggests that the distance between viable population is unlikely to be a large barrier to the recolonization or repopulation after a localized pressure. The length of time it takes for an individual to reach sexual maturity is also unknown. It isn't clear if *Sabella pavonina* settles preferentially with adults of the same species. This worm is recorded in clumps containing individuals from a number of year groups. It is possible that the formation of these clusters is due to larvae settling close to adults, as is known to occur within polychaete larvae (Callaway, 2003). The complex hydrodynamic environments created around polychaete tubes can also induce larval settlement near conspecific adults creating a patchwork pattern of animal abundances (Eckman, 1983; Miron *et al.*, 1996; Walters *et al.*, 1997). These two factors may mean that the recolonization of this biotope by *Sabella pavonina* may be faster if there are adults of the species still present.

Very little information on sponge longevity and resilience exists. Reproduction can be asexual (e.g. budding) or sexual (Naylor, 2011) and individual sponges are usually hermaphroditic (Hayward & Ryland, 1994). Short-lived ciliated larvae are released via the aquiferous system and metamorphosis follows settlement. Growth and reproduction are generally seasonal (Hayward & Ryland, 1994). Rejuvenation from fragments can also be considered an important form of reproduction (Fish & Fish, 1996). Some sponges are known to be highly resilience to physical damage with an ability to survive severe damage, regenerate and reorganize to function fully again, however, this recoverability varies between species (Wulff, 2006). Marine sponges often harbour dense and diverse microbial communities, which can include bacteria, archaea and single-celled eukaryotes (fungi and microalgae), comprising up to 40% of sponge volume which may have a profound impact on host biology (Webster & Taylor, 2012). Many sponges recruit annually, growth can be quite rapid, with a lifespan of one to several years (Ackers, 1983). However, sponge longevity and growth is highly variable depending on the species and conditions (Lancaster, 2014). It is likely that erect sponges are generally longer lived and slower growing given their more complex nature than smaller encrusting or cushion sponges.

Fowler & Lafoley (1993) monitored marine nature reserves in Lundy and the Isles Scilly and found that a number of more common sponges showed great variation in size and cover during the study period. Large colonies appeared and vanished at some locations. Some large encrusting sponges went through periods of both growth and shrinkage, with considerable changes taking place from year to year. For example, *Cliona celata* colonies generally grew extremely rapidly, doubling their size or more each year. In some years an apparent shrinkage in size also took place. In contrast, there were no obvious changes in the cover of certain unidentified thin encrusting sponges. *Cliona celata* occurs on rock and begins as boring sponge, but can become massive-lobose with rounded ridges up to 40 cm across. It can withstand sediment (Ackers *et al.*, 1992). *Hymeniacidon perleve* is found in thin sheets, cushions and rarely as branching-erect. It is found from the Arctic to the Mediterranean from the littoral to the circalittoral (Ackers *et al.*, 1992). *Leucosolenia botryoides* usually occurs in mixed sediments, on shells and ascidians, on horizontal rock and is often found in sea lochs. It has been recorded as half buried in mud and sediment and is found from the Arctic to Mediterranean (Ackers *et al.*, 1992). *Suberites ficus* is encrusting to massive lobose, firm and moderately elastic. It is found across the Arctic and Atlantic (Ackers *et al.*, 1992). *Raspaila ramosa* is a branching sponge which is firm and elastic, however the soft layer is easily rubbed from the strong axial core. It is found on sublittoral rock and boulders from moderately exposed sites to sheltered sites with some tidal current and tolerates some silt (Ackers *et al.*, 1992). *Raspailia ramosa* spawns in September (Lévi, 1957).

Halichondria bowerbanki is polymorphic, varying from a cushion to branching and is soft and very elastic, growing on rock or other animals, even ascidian tests. It reaches its maximal development in harbours and estuaries, being very tolerant of muddy and brackish conditions (Ackers *et al.*, 1992). *Halichondria panicea* is very polymorphic, varying from thin sheets, massive forms and cushions to branching. It crumbles readily and branches are brittle (breaking if bent through 20°). An opportunistic species, it is found in wide range of niches on rock or any other hard substrata (Ackers *et al.*, 1992). Barthel (1986) reported that *Halichondria panicea* in the Kiel Bight went through annual cycles, with growth occurring between March and July. After July, a strong decline in mean individual weight until the end of September. No change in individual weight was observed over winter, although changes in biochemical composition (condition index and protein lipid and glycogen content). Reproductive activity occurred In August and September with young colonies appearing in early autumn. Adult *Halichondria panicea* degenerated and disintegrated after reproduction. However, Fish & Fish (1996), suggested a lifespan of about 3 years and Vethaak *et al.*, (1982) reported that, unlike *Halichondria bowerbanki*, *Halichondria panicea* survives the winter in a normal, active state in the Oosterschelde. Vethaak *et al.* (1982) later reported that *Halichondria bowerbanki* goes into a dormant state below 4°C, characterized by major disintegration and loss of choanocyte chambers with many sponges surviving mild winters in more protected areas from where it can recolonize. Fell & Lewandrowski (1981) observed the population dynamics of *Halichondria* spp. within an eelgrass bed in the lower Mystic Estuary, Connecticut over a 2 year period. Large numbers of larval derived specimens developed on the eelgrass during the summer, and many of these sponges became sexually reproductive, further increasing the size of the population. However, mortality was high, and at the end of the summer only a relatively small sponge population remained. Sexual reproduction by larva-derived specimens of *Halichondria* spp. occurred primarily after breeding by the parental generation had declined. The larva-derived sponges grew rapidly, and the percentage of specimens containing large, female reproductive elements increases with specimen size. *Halichondria* spp. exhibited an opportunistic life strategy with a ‘high rate of turnover’. Ackers (1992) describes *Halicondria bowerbanki* growing on rock or other animals, even ascidian tests. It reaches its maximal development in harbours and estuaries, being very tolerant of muddy and brackish conditions and can be partly embedded in mud. Sutherland (1981) investigated the fouling community in North Carolina, US using short and long-term plates to observe recruitment to artificial surfaces. *Halichondria* assemblages recruited sporadically between June/July and end of October in some years, but was not observed in others. Thomassen & Riisgard (1995) described a number of studies looking at the growth rates of *Halichondria* spp. with rates of between 1% and 3.3% of total volume per day.

Little evidence was found to support recovery assessments for *Cerianthus lloydii*. Previous trait reviews (MES, 2010) have suggested that the genus *Cerianthus* would be likely to have a low recovery rate following physical disturbance based on long-lifespan and slow growth rate suggesting that ‘recovery of biomass and age-structured populations will be relatively slow ‘ (MES, 2010). The MES (2010) review also highlighted that there were gaps in information for this species and that age at sexual maturity and fecundity is unknown although the larvae are pelagic (MES, 2010). No empirical evidence was found for recovery rates following perturbations for *Cerianthus lloydii*. This species has limited horizontal mobility and re-colonization via adults is unlikely (taken from Tillin & Tyler-Walters, 2014).

The characterizing anemone, *Urticina felina*, is poorly studied and little information was found to assess resilience. However, its large size, slow growth rate and evidence from aquarium populations suggest that *Urticina felina* is long lived. Aquaria reports suggest that, protected from predation, animals can live for tens of years (P.G. Moore, pers comm.). Some individuals may be hundreds of years old, given their ability to regenerate (Francis *et al*., 1976). *Urticina felina* will readily repair damage to the body: removal of tentacles by clipping does not alter the behaviour or *Urticina feline* and the tentacle regenerates within a few days (Mercier *et al*., 2011). *Urticina felina* internally broods young, which when released settle close to the adult. Brooding prevents predation of juveniles and in areas of high wave action and water flows counteracts removal and supports the formation of aggregations of anemones in harsh environments (Kaliszewicz *et al*., 2012). However, brooding does limit dispersal (Kaliszewicz *et al*., 2012) and may inhibit recovery where a population is entirely removed. Dispersal ability is considered to be poor in the similar species *Urticina eques* (Solé-Cava *et al*., 1994). Adults can detach from the substratum and relocate but locomotive ability is very limited. Impacts that remove large proportions of the population over a wide area will effectively reduce the availability of colonists. Yet *Urticina felina* colonized the ex-*HMS Scylla* that was purposely sunk, to create an artificial reef, in Whitsand Bay, West Cornwall, in the second year of the vessel being on the seabed and had increased in numbers four years after (Hiscock *et al*., 2010).

The recolonization of epifauna on vertical rock walls was investigated by Sebens (1985, 1986). He reported that rapid colonizers such as encrusting corallines, encrusting bryozoans, amphipods and tubeworms recolonized within 1-4 months. Ascidians such as *Dendrodoa carnea*, *Molgula manhattensis* and Aplidium spp. achieved significant cover in less than a year, and, together with *Halichondria panicea*, reached pre-clearance levels of cover after two years. A few individuals of *Alcyonium digitatum* and *Metridium senile* colonized within four years (Sebens, 1986) and would probably take longer to reach pre-clearance levels.

Sensitivity assessment. The evidence suggests that *Sabella pavonina* has good local recruitment (Tompsett, 2003) so that it can reach high abundances under suitable conditions. It is widely distributed and has planktonic larvae so may be able to recruit from surrounding areas but that resultant recovery would take longer to reach its original abundance. The fauna of encrusting sponges would probably recover fairly rapidly (within a few years), while the larger anemones would probably take up to four or more years (Sebens, 1985; Hiscock *et al.*, 2010).

Where resistance is ‘Medium’ (<25% loss of the population or abundance) then recovery is considered to be ‘High’ based on reproduction and recolonization from the remaining population of important characterizing species. Where resistance is ‘Low’ or ‘None’, recovery to pre-impact abundance and density of the key characterizing species may be delayed and resilience is assessed as ‘Medium’.

NB: The resilience and the ability to recover from human induced pressures is a combination of the environmental conditions of the site, the frequency (repeated disturbances versus a one-off event) and the intensity of the disturbance. Recovery of impacted populations will always be mediated by stochastic events and processes acting over different scales including, but not limited to, local habitat conditions, further impacts and processes such as larval-supply and recruitment between populations. Full recovery is defined as the return to the state of the habitat that existed prior to impact. This does not necessarily mean that every component species has returned to its prior condition, abundance or extent but that the relevant functional components are present and the habitat is structurally and functionally recognizable as the initial habitat of interest. It should be noted that the recovery rates are only indicative of the recovery potential.

Hydrological Pressures

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

Sabella pavonina can be found in both the subtidal and the intertidal throughout the British Isles (NBN, 2016). The ability to withstand repeated and rapid temperature changes on the intertidal shore suggests that this species does have some tolerance to an increase in temperature. However, those *Sabella pavonina* that are found on the intertidal are likely to be acclimatized to those environmental conditions. When investigating the environmental factors which initiate spawning in *Sabella pavonina* Murray *et al.* (2011) found temperature fluctuated considerably at spawning times over the three year study period. Temperatures were found to vary from 13-18°C. This study suggests further supports the idea that the species can tolerate a range of temperatures. Tompsett (2003) suggested that one of the reasons that *Sabella pavonina* went through a period of severe decline within the Fal and Helford estuaries in the 1980’s could be high summer temperatures. However, there was a lack of evidence to link the decline in *Sabella pavonina* with a period of high summer temperatures.

All characterizing sponges (*Halichondria panacea*, *Amphilectus fucorum*, *Haliclona oculata*) are widely distributed across the coasts of the British Isles and are all found from the Channel Isles to northern Scotland (NBN, 2016). Berman *et al.* (2013) monitored sponge communities off Skomer Island, UK, over three years with all characterizing sponges for this biotope assessed. seawater temperature, turbidity, photosynthetically active radiation and wind speed were all recorded during the study. It was concluded that, despite changes in species composition, primarily driven by the non-characterizing *Hymeraphia*, *Stellifera* and *Halicnemia patera*, no significant difference in sponge density was recorded in all sites studied. Many sponges rely on a holobiont of many synergistic microbes (Webster *et al.*,2008, 2011; Webster & Taylor, 2012; Preston &Burton, 2015). Webster *et al.* (2011) described a much higher thermal tolerance to sponge larval holobiont when compared with adult sponges. Lemoine *et al.* (2007) studied the effects of thermal stress on the holobiont of the sponge *Halichondria bowerbanki* collected from Virginia, USA. Whilst no apparent change in density or diversity of symbionts was detected over the range of temperatures (29 °C, 30 °C and 31 °C), presence of particular symbionts was temperature dependent. Barthel (1986) reported that reproduction and growth in *Halichondria panicea* in the Kiel Bight were primarily driven by temperature, with higher temperatures corresponding with highest growth.

Cerianthus lloydii adults are locally abundant in many localities on all coasts of the British Isles and in some areas are common on the shore. This species occurs on all western coasts of Europe from Greenland and Spitzbergen south to Biscay. Larvae, but not adults, have been recorded from the Mediterranean. There is no further information available on the temperature tolerance of *Cerianthus lloydii.*

Urticina felina has a more northern distribution and is absent from warmer Mediterranean and equatorial waters. *Urticina felina* has a boreal-arctic distribution and possibly a circumpolar distribution (Carlgren, 1949; Manuel, 1981). It is found throughout Europe from northern Russia to the Bay of Biscay (Fautin, 2016). Gosse (1860) observed that *Urticina felina* (as *Actinia crassicornis*) was "one of the most difficult [anemones] to keep in an aquarium" and that "the heat of the summer is generally fatal to our captive specimens". It is therefore likely that local warming in summer may adversely affect individuals and that some mortality might occur.

Sensitivity assessment. At the pressure benchmark the *Sabella pavonina* and most other characterizing species are unlikely to be negatively affected. There may be a reduction in the abundance of *Urticina felina* in the more southerly example of this habitat, as this anemone is a more northerly species. The resistance and resilience are assessed as ‘High’, resulting in the biotope being assessed as ‘Not sensitive’ at the pressure benchmark.

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

Sabella pavonina can be found in both the subtidal and the intertidal throughout the British Isles (NBN, 2016). The ability to withstand repeated and rapid temperature changes on the intertidal shore means that this species does have some tolerance to a decrease in temperature. However, those *Sabella pavonina* that are found on the intertidal are likely to be acclimatized to those environmental conditions. Tompsett (2003) suggested that one of the reasons that intertidal *Sabella pavonina* populations went through a period of severe decline in Cornwall in the 1963 could be low winter temperatures. However, there was a lack of evidence to link the decline in *Sabella pavonina* with this period of unusually cold weather. Tompsett (2003) did suggest that juvenile *Sabella pavonina* are likely to be more vulnerable to the cold as they are nearer to the air land interface and would be more exposed to changing temperatures.

All characterizing sponges (*Halichondria panacea*, *Amphilectus fucorum*, *Haliclona oculata*) are widely distributed across the coasts of the Bristish Isles and are all found from the Channel Isles to Northern Scotland (NBN 2016). Berman *et al.* (2013) monitored sponge communities off Skomer Island, UK over three years with all characterizing sponges for this biotope assessed. seawater temperature, turbidity, photosynthetically active radiation and wind speed were all recorded during the study. It was concluded that, despite changes in species composition, primarily driven by the non-characterizing *Hymeraphia Stellifera* and *Halicnemia patera*, no significant difference in sponge density was recorded in all sites studied. Some sponges do exhibit morphological strategies to cope with winter temperatures e.g. *Halichondria bowerbanki* goes into a dormant state below 4°C, characterized by major disintegration and loss of choanocyte chambers with many sponges surviving mild winters in more protected areas from where it can recolonize (Vethaak *et al.*, 1982). Crisp (1964a) studied the effects of an unusually cold winter (1962-3) on the marine life in Britain, including Porifera in North Wales. Whilst difficulty in distinguishing between mortality and delayed development was noted, Crisp found that *Pachymastia johnstonia* and *Halichondria panicea* were wholly or partly killed by frost, and several species appeared to be missing including *Amphilectus fucorum.* Others, including *Hymeniacidon perleve* were unusually rare and a few species, including *Polymastia boletiformis*, were not seriously affected. It should be noted that Crisp's general comments on all marine life state that damage decreased the deeper the habitat and that the extremely cold temperatures (sea temperatures between 4-6°C colder than the 5 year mean over a period of 2 months) is more extreme than the benchmark level for assessment. Barthel (1986) reported that *Halichondria panicea* in the Kiel Bight degenerated and disintegrated after reproduction before winter, however young colonies observed from September.

Cerianthus lloydii adults are locally abundant in many localities on all coasts of the British Isles and in some areas are common on the shore. This species occurs on all western coasts of Europe from Greenland and Spitzbergen south to Biscay. No further information is available on the temperature tolerance of *Cerianthus lloydii.*

Urticina felina has a more northern distribution and is absent from warmer Mediterranean and equatorial waters. *Urticina felina* has a boreal-arctic distribution and possibly a circumpolar distribution (Carlgren, 1949; Manuel, 1981). It is found throughout Europe from northern Russia to the Bay of Biscay (Fautin, 2016). Although *Urticina felina* was apparently unaffected by the extremely cold winter of 1962/3 (Crisp, 1964a), Gosse (1860) observed that 'after the intense and protracted frost of February 1855, the shores of South Devon were strewn with dead and dying anemones, principally of this species'. Bearing in mind the equivocal observations from two cold winters, it is suggested that at least some individuals might be killed by extreme cold (exceeding the pressure benchmark).

Sensitivity assessment. Much of the evidence given for the characterizing species *Sabella pavonina* comes from intertidal population observations. The intertidal creates more extreme temperature conditions that the subtidal where temperatures tend to be more stable. Therefore at the level of the benchmark it is unlikely that there will be a decrease in the population of this species as it is known to tolerate far more challenging environmental conditions. The other species within this biotope are also tolerant to changes in temperature and can be found throughout the British Isles. Bearing in mind that localized populations will be acclimatized to their own environmental conditions. The resistance and resilience of this biotope to a decrease in temperature is assessed as 'High', so at the level of the benchmark this biotope is 'Not sensitive'.

Salinity increase (local)	None Q: Low A: Low C: Low	Medium Q: High A: Medium C: Medium	Medium Q: Low A: Low C: Low

This biotope is only found within fully marine conditions (Connor *et al*., 2004). Any increase in the salinity regime would create hypersaline conditions. No evidence could be found on the hypersaline tolerance of *Sabella pavonina*, the characterizing sponges, *Cerianthus lloydii*, or *Urticina felina*. Some of these species can be found in deep rock pools around the low water mark, but no higher on the shore. This situation may expose them to short-term small increases in salinity. This suggests that the species are not resistant of an increase in salinity regime above full salinity for the stated time period.

Sensitivity assessment. The resistance of this biotope to an increase in salinity regime is ‘None’ and the resilience is ‘Medium’, giving the biotope a sensitivity of ‘Medium’.

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

This biotope is only found within fully marine conditions (Connor *et al*., 2004). Any increase in the salinity regime would create hypersaline conditions. No evidence could be found on the hypersaline tolerance of *Sabella pavonina*, the characterizing sponges, *Cerianthus lloydii*, or *Urticina felina*. Some of these species can be found in deep rock pools around the low water mark, but no higher on the shore. This situation may expose them to short-term small increases in salinity. This suggests that the species are not resistant of an increase in salinity regime above full salinity for the stated time period.

Sensitivity assessment. The resistance of this biotope to an increase in salinity regime is ‘None’ and the resilience is ‘Medium’, giving the biotope a sensitivity of ‘Medium’.

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

The water flow recorded within this biotope ranges from strong (3-6 knots) to moderately strong (1-3 knots) (Connor *et al*., 2004). There is very little information on the tolerance of *Sabella pavonina* of difference water flow rates, however, the gregarious nature of tube dwelling polychaetes can produce complex hydrodynamic environments. These complex hydrodynamic flows have been shown to affect larval settlement and food availability (Eckman, 1983; Merz, 1984; Miron *et al*., 1996; Walters *et al*., 1997).

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

Evidence for the effect of changes in water flow on *Cerianthus lloydii* is unavailable. This species is recorded from biotopes with a wide range of water flow regimes. Therefore, it is likely to have a high tolerance to an increase in water flow rates. However, a decrease in the water flow rate within this biotope will create almost entirely still conditions. The effect of such low water flow rates on this species are not clear.

Urticina felina favours areas with strong tidal currents (Holme & Wilson, 1985; Migné & Davoult, 1998), although it is also found in calmer and sheltered areas as well as deep water. Biotopes characterized by *Urticina felina* range from very weak (negligible) to very strong (negligible to >3 m/s), suggesting that a change in water flow eat the pressure benchmark would not have negative effects (Tillin & Tyler-Walters, 2014). Similarly, *Spirobranchus triqueter* is found in biotopes that are exposed to flow speeds varying from very weak to moderately strong (negligible - >1.5m/s) (Tillin & Tyler-Walters, 2014).

Sensitivity assessment. Although water flow can have a significant impact on a wide number of aspects of marine organisms lives, at the low level of the benchmark there is unlikely to be an effect. The resistance and resilience of this biotope are assessed to be 'High', giving the biotope an assessment of 'Not sensitive' at the pressure benchmark.

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

This biotope does not occur in the intertidal, and consequently an increase in emergence is considered not relevant to this biotope.

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

This biotope is found in moderately exposed to extremely sheltered habitats (Connor *et al*., 2004). It is unclear how tolerant *Sabella pavonina*, *Cerianthus lloydii*, and the sponges found within this biotope are to a change in wave exposure at the pressure benchmark.

Urticina felina is firmly attached to the substratum and are unlikely to be dislodged by an increase in wave action at the pressure benchmark. It is found in biotopes that experience a range of wave exposures, from extremely sheltered to very exposed, (Tillin & Tyler-Walters, 2014). The crustose corallines associated with this biotope have a flat growth form and are unlikely to be dislodged by increased wave action.

Sensitivity assessment. Although there is very little evidence to support an assessment of how the pressure may affect the species within this biotope, the benchmark is so low that it is very unlikely that there would be any effect on the characterizing species. Therefore, resistance and resilience have been assessed as 'High', giving the biotope an overall assessment of 'Not sensitive'.

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

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.

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.

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

No evidence.

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

This pressure is **Not assessed**.

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

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) suggested possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l.

Sabella pavonina can't survive in oxygen levels below 4% for longer than four days (Tompsett, 2003). Demosponges maintained under laboratory conditions can tolerate hypoxic conditions for brief periods, (Gunda & Janapala, 2009) investigated the effects of variable DO levels on the survival of the marine sponge, *Haliclona pigmentifera*. Under hypoxic conditions (1.5-2.0 ppm DO), *Haliclona pigmentifera* with intact ectodermal layers and subtle oscula survived for 42 ± 3 days. Sponges with prominent oscula, foreign material, and damaged pinacoderm exhibited poor survival (of 1-9 days) under similar conditions. Complete mortality of the sponges occurred within 2 days under anoxic conditions (<0.3 ppm DO).

No information was available on the tolerance of *Cerianthus lloydii* or *Urticina felina* to de-oxygenation.

Sensitivity assessment. At the benchmark *Sabella pavonina* will die on the fourth day of the low oxygen event, although there is a lack of documentation on the laboratory experiments to back up this statement. There is a lack of direct evidence for the tolerance of the other characterizing species in this biotope. It appears that sponges may have some tolerance to deoxygenation, however, this is not certain for the characterizing species. The resistance and resilience of this biotope to the pressure at the benchmark are assessed as 'Medium', giving the biotope a sensitivity of 'Medium'.

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

This pressure relates to increased levels of nitrogen, phosphorus and silicon in the marine environment compared to background concentrations. The nutrient enrichment of a marine environment leads to organisms no longer being limited by the availability of certain nutrients. The consequent changes in ecosystem functions can lead to the progression of eutrophic symptoms (Bricker *et al*., 2008), changes in species diversity and evenness (Johnston & Roberts, 2009) decreases in dissolved oxygen and uncharacteristic microalgae blooms (Bricker *et al*., 1999, 2008).

Johnston & Roberts (2009) undertook a review and meta-analysis of the effect of contaminants on species richness and evenness in the marine environment. Of the 47 papers reviewed relating to nutrients as a contaminant, over 75% found that it had a negative impact on species diversity, <5% found increased diversity, and the remaining papers finding no detectable effect. Due to the 'remarkably consistent' effect of marine pollutants on species diversity this finding relevant to this biotope (Johnston & Roberts, 2009). It was found that any single pollutant reduced species richness by 30-50% within any of the marine habitats considered (Johnston & Roberts, 2009). Throughout their investigation there were only a few examples where species richness was increased due to the anthropogenic introduction of a contaminant. These examples were almost entirely from the introduction of nutrients, either from aquaculture or sewage outfalls (Johnston & Roberts, 2009).

Moderate nutrient enrichment, especially in the form of organic particulates and dissolved organic material, is likely to increase food availability for all the suspension feeders within the biotope. However, long-term or high levels of organic enrichment may result in eutrophication and have indirect adverse effects, such as increased turbidity, increased suspended sediment, increased risk of deoxygenation and the risk of algal blooms.

Sensitivity assessment. A slight increase in nutrients may enhance food supply to the characterizing species in this biotope and increase growth rates in the species. At the pressure benchmark there shouldn't be a negative impact on the biotope. Therefore, the resistance and resilience have been assessed as 'High', resulting in an assessment of 'Not Sensitive'.

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

Organic enrichment leads to organisms no longer being limited by the availability of organic carbon. The consequent changes in ecosystem function can lead to the progression of eutrophic symptoms (Bricker *et al*., 2008), changes in species diversity and evenness (Johnston & Roberts, 2009) and decreases in dissolved oxygen and uncharacteristic microalgae blooms (Bricker *et al*., 1999, 2008). Indirect adverse effects associated with organic enrichment include increased turbidity, increased suspended sediment and the increased risk of deoxygenation.

Johnston & Roberts (2009) undertook a review and meta-analysis of the effect of contaminants on species richness and evenness in the marine environment. Of the 49 papers reviewed relating to sewage as a contaminant, over 70% found that it had a negative impact on species diversity, <5%

found increased diversity, and the remaining papers finding no detectable effect. Due to the 'remarkably consistent' effect of marine pollutants on species diversity this finding relevant to this biotope (Johnston & Roberts, 2009). It was found that any single pollutant reduced species richness by 30-50% within any of the marine habitats considered (Johnston & Roberts, 2009). Throughout their investigation there were only a few examples where species richness was increased due to the anthropogenic introduction of a contaminant. These examples were almost entirely from the introduction of nutrients, either from aquaculture or sewage outfalls.

Borja *et al.*, (2000) and Gittenberger & van Loon (2011) in the development of the AZTI Marine Biotic Index (AMBI) index to assess disturbance (including organic enrichment) both assigned *Cerianthus lloydii* to their Ecological Group I, (species very sensitive to organic enrichment and present under unpolluted conditions (initial state). The basis for their assessment and relation to the pressure benchmark is not clear (Tillin & Tyler-Walters, 2014).

Sensitivity assessment. Little empirical evidence was found to support an assessment of this biotope at this benchmark. The lack of direct evidence for the characterizing species has resulted in this pressure being assessed as 'No evidence'.

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

The substratum within this biotope is not characterized by any bedrock. If any kind of rock substratum were to be introduced into this biotope then the physical character of the biotope would have been changed, which would lead to a loss of the biotope altogether.

Sensitivity assessment. The resistance of this biotope to the introduction of rock substrata is 'None', this change would lead to a loss of the biotope which in most cases is likely to be permanent. Therefore, resilience is 'Very low', which results in the biotope having a 'High' sensitivity to this pressure at the benchmark.

Physical change (to another sediment type)	Medium Q: High A: Medium C: Medium	Very Low Q: High A: High C: High	Medium Q: High A: Medium C: Medium

The substratum associated with this biotope is muddy, gravelly sand with pebbles (Connor *et al.*, 2004). The characterizing species *Sabella pavonina* creates its tube from sediment particles. *Sabella pavonina* were absent from areas of the Fal Estuary where very fine sediments were found

(Tompsett, 2003). Murray *et al.* (2011) also found that *Sabella pavonina* were associated with larger size particle fractions. Greater densities of *Sabella pavonina* in larger sediment fractions could also be linked to a requirement for anchorage and stability (Murray *et al.*, 2011). Tompsett, (2003) described the attachment of coarse material at the posterior end of *Sabella pavonina* tubes.

Tillin & Tyler-Walters (2014) *Urticina felina* was reported from a variety of substratum types including fine (muddy sand, sandy mud and fine sands) and coarse sediments, where some hard surfaces (such as pebbles or shells) are present. *Urticina felina*, has been observed on the submerged ex-*HMS Scylla* (Hiscock *et al.*, 2010). But evidence for substratum preferences for this characterizing species is limited.

Cerianthus lloydii is found within a range of biotopes with different substrata compositions. If each of the constituent substratum types within this biotope was to shift one grade of Folk class, it is unlikely to have a significant negative effect on this species due to the wide range of substratum types within which this biotope can be found.

Sensitivity assessment. At the benchmark of this pressure, a decrease in one Folk class may have a significant effect on the tube building ability of the characterizing species *Sabella pavonina*. This species has been reported to decrease in abundance as sediment fractions get smaller. The other characterizing species are unlikely to be affected by a change in the pressure at the benchmark. An increase in the Folk class is unlikely to have a negative effect of the species within this biotope, as many of them are recorded from a wide range of sediment types (Connor *et al.*, 2004). Resistance is assessed as 'Medium'. Resilience is assessed as Very low (the pressure is a permanent change), and sensitivity is, therefore, Medium.

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

The characterizing species within this biotope are all found within the top 30 cm of the substratum. Therefore, the process of extraction is considered to remove all of these characterizing species as well as a large number of the other species present within this biotope group. No direct evidence for resistance and recovery to this pressure was found and the sensitivity assessment is therefore based on expert judgement.

Sensitivity assessment. Resistance is assessed as 'None' based on expert judgment but supported by the literature relating to the position of these species on or within the seabed. At the pressure benchmark the exposed sediments are considered to be suitable for recolonization almost immediately following extraction. Recovery will be mediated by the scale of the disturbance and the suitability of the sedimentary habitat. Recovery is most likely to occur via larval recolonization. Resilience is considered to be 'Medium'. Sensitivity based on resistance and resilience is therefore categorised as 'Medium'.

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

There is a lack of information regarding the impact of abrasion on *Sabella pavonina*. However, a recent study on bait digging in Tunisia found that a month after disturbance *Sabella pavonina* disappeared from the surrounding intertidal benthic area (Mosbahi *et al.*, 2015). Other studies including Rossi *et al.* (2007) and Navon & Dauvin (2013) show that intertidal macrofauna are sensitive to disturbance. These studies were undertaken in the intertidal

Freese *et al.* (1999) studied the effects of trawling on seafloor habitats and associated invertebrates in the Gulf of Alaska. They found that a transect following a single trawling event showed significantly reduced 'vase' sponges (67% expressed damage), 'morel' sponges (total damage could not be quantified as their brittle nature meant that these sponges were completely torn apart and scattered). The 'finger' sponges, the smallest and least damaged of the sponges assessed, were damaged by being knocked over (14%). Van Dolah *et al.* (1987) studied the effects on sponges and corals of one trawl event over a low-relief hard bottom habitat off Georgia, US. The densities of individuals taller than 10 cm of three species of sponges in the trawl path and in adjacent control area were assessed by divers, and were compared before, immediately after and 12 months after trawling. Of the total number of sponges remaining in in the trawled area, 32% were damaged. Most of the affected sponges were the barrel sponges *Cliona* spp., whereas *Haliclona oculta* and *Ircina campana* were not significantly affected. 12 months after trawling, the abundance of sponges had increased to pre-trawl densities, or greater.

No direct evidence was found to assess the sensitivity *Cerianthus lloydii* to surface abrasion. The burrowing life habit of the species specifically assessed would confer some protection from surface disturbance although individuals would be more exposed when close to the surface feeding. *Cerianthus lloydii* inhabits a soft tube, which can be up to 40 cm long and is permanently buried. The anemone can move freely within the tube and can retract swiftly if required (Tillin & Tyler-Walters, 2014).

The abundance of *Urticina felina* increased in gravel habitats on the Georges Bank, (Canada) closed to trawling by bottom gears (Collie *et al.*, 2005) which suggested that this species was sensitive to fishing. In a recent review, assigning species to groups based on tolerances to bottom disturbance from fisheries, the anemone *Urticina felina* and the sponge *Halichondria panacea* were assigned to AMBI Fisheries Group II, described as 'species sensitive to fisheries in which the bottom is disturbed, but their populations recover relatively quickly' (Gittenberger & van Loon, 2011).

Sensitivity assessment. The species specific information on the effect of this pressure is limited but suggests. However, that abrasion can have negative impacts on the characterizing species within this biotope. Both *Sabella pavonina* and *Cerianthus lloydii* are tube dwelling and have some natural protection from abrasion if they can withdraw into their tubes. Resistance is assessed as 'Low', and resilience is assessed as 'Medium', giving an overall sensitivity of 'Medium'.

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

Penetration and or disturbance of the substratum would result in similar results as abrasion (see above) or removal of this biotope. Damage to the tube dwelling species *Sabella pavonina* and *Cerianthus lloydii* would be greater within this pressure, as their ability to retract within their tubes would be limited.

Sensitivity assessment. Resistance of the biotope is assessed as 'Low', although the significance of the impact for the bed will depend on the spatial scale of the pressure footprint. Resilience is assessed as 'Medium', and sensitivity is assessed as 'Medium'.

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

This biotope is dominated by suspension feeders. A change in the level of suspended solids in the water column is likely to affect food availability for these species. The water flow regime within this biotope is strong (3-6 knots) to moderately strong (1-3knots) (Connor *et al*., 2004). An increase in sediment in the water column has the potential to cause a greater scour effect. There will also be a change in light availability, however, this is not deemed important for the characterizing species as none of them photosynthesize.

Sabella pavonina is a filter feeding species. High particles loads can stimulate the secretion of mucus from the branchial filaments and bulky strings of mucus with entangled particles are produced (Moore, 1977a). *Sabella pavonina* was found occasionally in suitable areas of the River Roach where waters were clearer (Mistakidis, 1951). Yet in the more turbid waters of Southward Laying, in the River Crouch no *Sabella pavonina* were found (Mistakidis, 1951). In other filter feeding organisms an increase in the level of suspended solids can have wide ranging effects. An increase in organic matter in the water column will provide more food for the organism. However, greater suspended solids mean that more sediment will be captured in the organisms filter feeding organ. This could lead to greater energy expenditure to keep the branchial plume clear.

Despite sediment being considered to have a negative impact on suspension feeders (Gerrodette & Flechsig 1979), many encrusting sponges appear to be able survive in highly sediment conditions (Schönberg, 2015; Bell & Barnes 2000; Bell & Smith 2004). No evidence on the effect of a change in turbidity on *Ceriathus lloydii* could be found.

Urticina felina is found in highly turbid areas associated with biotopes such as CR.MCR.SfR.Pol (Connor *et al*., 2004) and is therefore considered to be unaffected by an increase in turbidity at the benchmark. Increases in siltation may begin to cover the anemone or interfere with feeding. An energetic cost will result from efforts to clean off the silt particles, e.g. through mucus production and sloughing. Repeated energetic expenditure in cleaning off silt particles may cause sublethal effects.

Sensitivity assessment. An increase in the pressure at the benchmark is may increase energy expenditure in the characterizing species, *Sabella pavonina*. Suspended sediment which is trapped in the branchial plume of this species results in mucus secretion to remove the sediment (Moore, 1977a). If more sediment is present more mucus may have to be produced to keep the organism clean. This will increase energy expenditure which may cause the organism to decrease in health. The other species found within this biotope are found in conditions which suggest that they are able to tolerate an increase in the pressure at the benchmark. A decrease in the level of suspended sediment may reduce the amount of food available to the filter feeding, and cause a decrease in health. The resistance and resilience of this biotope are considered to be 'High', giving the biotope an overall assessment of 'Not sensitive'.

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

The effect of smothering by sediment on *Sabella pavonina* is not well documented. The impact of a 5 cm deposit will have a negative effect on the young and juvenile individuals as they are likely to be entirely smothered by this pressure. Being smothered entirely will stop them from being able to extend their branchial plume to feed and will also reduce the availability of oxygen which could lead to asphyxiation (see deoxygenation pressure). This species is immobile and can't leave its tube at any stage in its life (Tompsett, 2003), so the worm is unable to avoid this pressure. Adults may not be entirely smothered by this pressure, as their tube can protrude up to 10 cm from the sediment surface.

Wulff (2006) described mortality in three sponge groups following four weeks of complete burial under sediment, in which 16% of *Amphimedon* biomass died compared with 40% and 47% in *Iotrochota* and *Aplysina* respectively. The complete disappearance of 'associated sponges' in the Black Sea near the Kerch Strait was attributed to siltation (Terent'ev, 2008 cited in Tillin & Tyler-Walters, 2014). Ackers, (1992) reported that *Halichondria bowerbanki* can be partly embedded in mud. It should also be noted that some of the characterizing sponges are likely to be totally buried by 5 cm of sediment.

Cerianthus lloydii can move rapidly within its tube but no information was found for the ability of this species to extend the tube through a 5 cm deposit of sediment to reach the surface.

Communities dominated by the anemone *Urticina felina* were described on tide swept seabed, exposed to high levels of suspended sediment, sediment scour and to periodic smothering by thin layers of sand, up to ca 5 cm in the central English Channel (Holme & Wilson, 1985). *Urticina felina* is abundant in the sediment-scoured, silty rock communities CR.HCR.XFa.FluCoAs and CR.MCR.EcCr.UrtScr (Connor *et al*., 2004).

Sensitivity assessment. There is little direct evidence available on which an assessment of this pressure can be made. However, it is likely that there will be mortality of some of the characterizing species at the level of the benchmark. There can be high level of water flow within this biotope (<6 knots) which will aid the removal of the sediment. The may reduce the negative effect of sediment deposition in the biotope. The resistance and has been assessed as 'Low', and the resilience is assessed as 'Medium' this results in an overall sensitivity of 'Medium'.

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

The effect of smothering by sediment on *Sabella pavonina* is not well documented. Gaseous exchange occurs through the branchial crown and body surfaces (Tompsett, 2003), 30 cm of sediment deposition would entirely cover the organism. The tubes created by *Sabella pavonina* will protrude up to 10 cm from the sediment surface. So even the large individuals would be covered. This species is entire immobile and can't leave its tube at any stage in its life (Tompsett, 2003), so the worm is unable to avoid this pressure.

Wulff (2006) described mortality in three sponge groups following four weeks of complete burial under sediment, in which 16% of *Amphimedon* biomass died compared with 40% and 47% in *Iotrochota* and *Aplysina* respectively. The complete disappearance of 'associated sponges' in the Black Sea near the Kerch Strait was attributed to siltation (Terent'ev, 2008 cited in Tillin & Tyler-Walters, 2014). Ackers, (1992) reported that *Halichondria bowerbanki* can be partly embedded in mud. It should also be noted that some of the characterizing sponges are likely to be totally buried by 5cm of sediment.

Cerianthus lloydii can move rapidly within its tube but no information was found for the ability of this species to extend the tube through a 30 cm deposit of sediment to reach the surface. It is extremely unlikely that this species will be able to burrow through this depth of sediment, consequently, death is likely.

Communities dominated by the anemone *Urticina felina* were described on tide swept seabed, exposed to high levels of suspended sediment, sediment scour and to periodic smothering by thin layers of sand, up to ca 5 cm in the central English Channel (Home & Wilson, 1985). *Urticina felina* is abundant in the sediment-scoured, silty rock communities CR.HCR.XFa.FluCoAs and CR.MCR.EcCr.UrtScr (Connor *et al.*, 2004).

Sensitivity assessment. There is little direct evidence available on which an assessment of this pressure can be made. However, it is likely that there will be mortality of most of the characterizing species at the level of the benchmark. There can be high level of water flow within this biotope (<6 knots) which will aid the removal of the sediment. The may reduce the negative effect of sediment deposition in the biotope. The resistance and has been assessed as ‘Low’, and the resilience is assessed as ‘Medium’ this results in an overall sensitivity of ‘Medium’. The recovery of this biotope will depend on the total removal of the deposited sediment. If the deposited sediment is not suitable for recolonization by the characterizing species of this biotope the biotope will be lost permanently.

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

No evidence.

Underwater noise changes	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

Species characterizing this habitat do not have hearing perception but vibrations may cause an impact, however, no studies exist to support an assessment. Therefore this assessment is considered to be ‘Not relevant’.

Introduction of light or shading	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.

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

Not relevant – this pressure is considered applicable to mobile species, e.g. fish and marine mammals rather than seabed habitats. Physical and hydrographic barriers may limit propagule dispersal. But propagule dispersal is not considered under the pressure definition and benchmark.

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 – this pressure is considered applicable to mobile species, e.g. fish and marine mammals rather than seabed habitats. Physical and hydrographic barriers may limit propagule dispersal. But propagule dispersal is not considered under the pressure definition and benchmark.

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

Not relevant.

Biological Pressures

	Resistance	Resilience	Sensitivity
Genetic modification & translocation of indigenous species	No evidence (NEv) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	No evidence (NEv) Q: NR A: NR C: NR

No evidence for the effect of this pressure on the characterizing species within this biotope could be found.

Introduction or spread of invasive non-indigenous species	Medium Q: Medium A: Medium C: Medium	Very Low Q: High A: High C: High	Medium Q: Medium A: Medium C: Medium

Kohler & Courtenay (1986a) summarised the effects of invasive non-indigenous species (INIS) in marine environments. The effects included habitat, trophic and spatial alteration, gene pool deterioration and the introduction of disease (Kohler & Courtenay, 1986a).

Sensitivity assessment. There is a chance that an INIS might be able to invade this biotope. Depending on which INIS species is introduced, this biotope may remain, but with a reduced species richness due to the loss of some species. Resistance is 'Medium', a resilience of 'Very low' has been recorded since the successful removal of an INIS is extremely rare which will mean that the biotope is likely to change, although a viable community will remain. The biotope is assessed to have a sensitivity of 'Medium' to the pressure at the benchmark. 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

No evidence for the effect of microbial pathogens on the characterizing species within this biotope could be found.

Removal of target 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

No evidence to suggest that the characterizing species within this biotope are targeted by commercial fisheries, and therefore and assessment of ‘Not relevant’.

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

Direct, physical impacts from harvesting are assessed through the abrasion and penetration of the seabed pressures. The characterizing species within n this biotope could easily be incidentally removed from this biotope as by-catch when other species are being targeted. The loss of these species and other associated species would decrease species richness and negatively impact on the ecosystem function.

Sensitivity assessment. Removal of a large percentage of the characterizing species would alter the character of the biotope. The resistance to removal is ‘None’ due to the easy accessibility of the biotopes location and the inability of these species to evade collection. The resilience is ‘Medium, with recovery only being able to begin when the harvesting pressure is removed altogether. This gives an overall sensitivity score of ‘Medium’.

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