Alcyonium digitatum with dense *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock

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Marine Evidence–based Sensitivity Assessment (MarESA) Review

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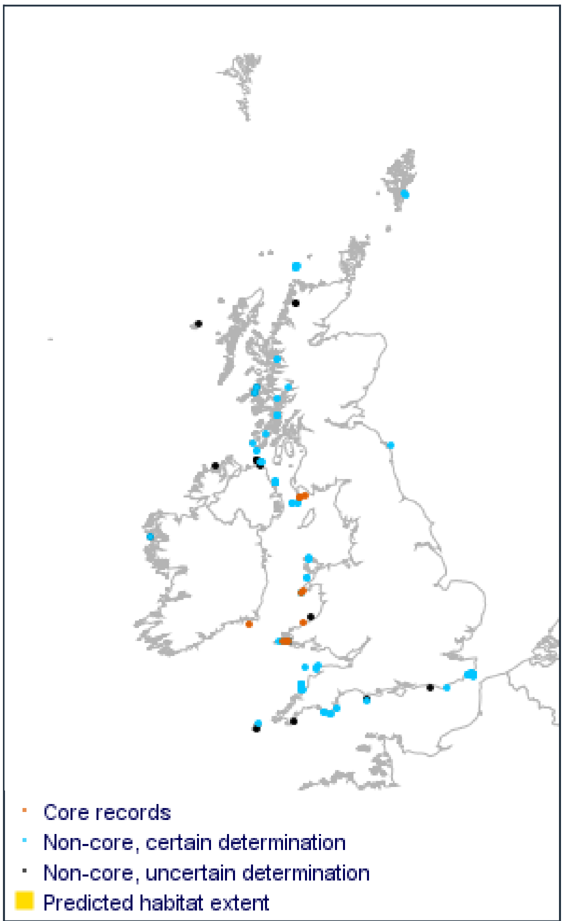
***Alcyonium digitatum* with dense *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock.**
Photographer: David Ainsley



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

Researched by Thomas Stamp **Refereed by** This information is not refereed.

Summary

UK and Ireland classification

EUNIS 2008	A4.1122	*Alcyonium digitatum* with dense *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock
JNCC 2015	CR.HCR.FaT.CTub.Adig	*Alcyonium digitatum* with dense *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock
JNCC 2004	CR.HCR.FaT.CTub.Adig	*Alcyonium digitatum* with dense *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock
1997 Biotope		

Description

This variant is typically found on exposed circalittoral bedrock and boulders in sounds, narrows and around tide-swept promontories in accelerated tidal streams. It is dominated by aggregations of dead man's fingers *Alcyonium digitatum*, and dense clumps or continuous cover of the robust hydroid *Tubularia indivisa*, particularly on prominent ledges and ridges. Anemones such as *Sagartia elegans*, *Urticina felina*, *Metridium senile*, *Actinothoe sphyrodeta* and *Corynactis virdis* form a prominent component of the community. Occasionally, massive sponges such as *Pachymatisma johnstonia* and *Esperiopsis fucorum* may be present. Encrusting species such as the polychaete *Spirobranchus triqueter* and the barnacle *Balanus crenatus* may be dotted around the rocks, and the top shell *Calliostoma zizyphinum* may also be observed. Clumps of the bryozoan *Flustra foliacea* are occasionally seen. The starfish *Asterias rubens* may be seen amongst a patchy turf of *Crisia denticulata* and the bryozoan *Alcyonidium diaphanum*. This variant may also be found on tideswept wrecks and other artificial sustratum. (Information from Connor *et al*., 2004; JNCC, 2105).

Depth range

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

Additional information

-

Listed By

- none -

Further information sources

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Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

CR.HCR.FaT.CTub.Adig occurs on exposed circalittoral bedrock and boulders in sounds, narrows and around tide-swept promontories in accelerated tidal streams. High water flow facilitates the high abundance and dominance of a filter feeding community. CR.HCR.FaT.CTub.Adig is characterized by dense aggregations of *Alcyonium digitatum* and *Tubularia indivisa*. *Alcyonium digitatum* distinguishes the biotope from other biotopes within the CR.HCR.FaT biotope complex. Other important species within CR.HCR.FaT.CTub.Adig includes; *Sagartia elegans*, *Urticina felina*, *Metridium senile, Actinothoe sphyrodeta and Corynactis virdis*. Massive sponges such as *Pachymatisma johnstonia* and *Esperiopsis fucorum* may also be present with other encrusting species but these are not present in all examples of the biotope and are not considered to be characterizing species.

For this sensitivity assessment, *Alcyonium digitatum* and *Tubularia indivisa* are the primary foci of research as the key characterizing species defining CR.HCR.FaT.CTub.Adig. Other anthozoans are also considered within this assessment as important species to CR.HCR.FaT.CTub.Adig. Examples of other important species groups are mentioned where appropriate.

Resilience and recovery rates of habitat

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). Colonies consist of stout "finger-like" projections (Hartnoll, 1975) which can reach up to 20 cm tall 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 which exceeds 20 years as colonies have been followed for 28 years in marked plots (Lundälv, pers. comm., in Hartnoll, 1998). Those colonies which are 10-15 cm in height have been aged at between 5 and 10 years old (Hartnoll, unpublished). The majority of colonies are unisexual, with the majority of individuals being female. Sexual maturity is predicted to occur, at it's earliest when the colony reaches it's second year of growth however the majority of colonies are not predicted to reach maturity until their third year when they attain a biomass of approx 20-30g (Hartnoll, 1975).

Alcyonium digitatum spawns from December and January. Gametes are released into the water and fertilization occurs externally. The embryos are neutrally buoyant and float freely for seven days. The embryos give rise to actively swimming lecithotrophic planulae which may have an extended pelagic life before they eventually settle (usually within one or two further days) and metamorphose to polyps (Matthews, 1917; Hartnoll, 1975). In laboratory experiments, several larvae of *Alcyonium digitatum* failed to settle within 10 days, presumably finding the conditions unsuitable, these larvae proved to be able to survive 35 weeks as non-feeding planulae. After 14 weeks some were still swimming and after 24 weeks the surface ciliation was 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. This 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 forms 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 and they may also benefit by the scarcity of predatory zooplankton which would otherwise feed upon them (Hartnoll, 1975).

Tubularia indivisa is a common athecate hydroid distributed across the North East Atlantic from the Arctic Ocean to the Mediterranean (WORMS, 2015). *Tubularia indivisa* is a short-lived species, and recruitment is seasonally variable with settlement peaking in early spring (March) however other smaller recruitment events occur within summer and autumn (Hughes, 1983). Hydroids as a general group are thought of as early colonizers of bare surfaces (Gili & Hughes, 1995; Whomersley & Picken, 2003; Zintzen *et al*., 2008a). *Tubularia spp.* are considered to be opportunistic species and are often the first to colonize bare surfaces and to reach sexual maturity rapidly. In some habitats *Tubularia spp*, are transient and are replaced by more competitive species, however, in other tide-swept or scoured habitats (e.g. CR.HCR.FaT.CTub.Adig) they represent a permanent feature of an annual cycle and tend to dominate in specific seasons e.g. spring-autumn (Zintzen *et al*., 2008; Hiscock *pers comm*). The season in which settlement occurs has a direct relationship with life expectancy. High gastropod grazing pressure in spring and summer can cause a mortality rate of 70% (Hughes, 1983). Therefore, post-settlement life expectancy can vary from 30 (spring recruitment) to 160 days (autumn recruitment). Observations of *Tubularia indivisa* from the spring settlement cohort indicate that reproduction can occur within 6-8 weeks, however, autumn cohorts are likely to persist throughout the winter and begin reproduction the following spring. *Tubularia indivisa has* a large larval dispersal capacity, and larvae can potentially settle 1-10 km from the parental source (Zintzen *et al*., 2008).

Whomersley & Picken (2003) documented epifauna colonization of offshore oil platforms in the North Sea from 1989-2000. On all platforms, *Mytilus edulis* dominated the near surface community. For the first 3 years, hydroids and tubeworms dominated the community below the mussel band. However, the hydroid community was later out-competed by other species. Recruitment of *Alcyonium digitatum* and *Metridium dianthus* began at 2-5 years (dependent on the oil rig). At 45-57m below sea level an “anemone” zone also began recruiting within 1-2 years, and on some rigs dominated that depth by year 6. The community structure and zonation differed between the 4 rigs. However, generally after four years, *Metridium dianthus* had become the dominant organism below the mussel zone to approximately 60-80 m. However, zonation differed between oil rigs and, from approximately 60-90 m, *Alcyonium digitatum* was the dominant organism.

The *HMS Scylla* was intentionally sunk on the 27th March 2004 in Whitsand Bay, Cornwall to act as an artificial reef. Hiscock *et al.* (2010) recorded the succession of the biological community on the wreck for five years following the sinking of the ship. Initially, the wreck was colonized by opportunistic species /taxa; filamentous algae, hydroids, serpulid worms and barnacles. *Tubularia* sp. were early colonizers, appearing within a couple of months after the vessel was sunk. *Metridium dianthus* appeared late in the summer of the first year but didn’t become visually dominant until 2007 (3 years after the vessel was sunk). *Sagartia elegans* was recorded within the summer of 2005, and by the end of 2006 was well established. *Corynactis viridis* was first recorded in the summer of the first year and quickly formed colonies via asexual reproduction. *Urticina felina* was first recorded at the end of August 2006 (two years after the vessel was sunk), and by summer 2008 had increased in abundance. *Alcyonium digitatum* was first recorded in early summer 2005, a year after the vessel was sunk. Within one year of growth colonies had grown to nearly full size, however, did not become a visually dominant component of the community until 2009, five years after the vessel had been sunk (Hiscock, *et al*, 2010).

Sedentary anthozoans such as *Sagartia elegens*, *Urticina felina*, *Metridium dianthus*, *Actinothoe sphyrodeta and Corynactis virdis* are also important species within CR.HCR.FaT.CTub.Adig, and other tide-swept biotopes (Connor *et al*., 2004; Wood, 2005). Information concerning the recovery of mixed anthozoan communities such as that found in CR.HCR.FaT.CTub.Adig, is limited, and the available evidence is described below (Whomersley & Picken, 2003; Hiscock *et al*., 2010). Little is known of the recovery capability of *Actinothoe sphyrodeta*, however, this species was recorded with *Corynactis virdis* as early colonizers of the wreck of the *Scylla*, appearing within a couple of months of the vessel sinking. *Sagartia elegens* was first recorded within 1 year of the vessel sinking (10/06/2005), however, did not become fully established until the next summer (2006). *Urticina felina* was not recorded on the wreck until 2 years after the vessel sunk (28/08/2006) (Hiscock *et al*., 2010). *Metridium dianthus* has rapid growth rates. Bucklin (1985), working in Britain, found that newly settled *Metridium dianthus f. dianthus* and *Metridium dianthus f. pallidum* had a growth rate of up to 0.6 mm and 0.8 mm in pedal diameter per day (respectively). However, they may take up to 2 years to recruit and 5 years to become visually dominant within the community (Whomersley & Picken, 2003; Hiscock *et al*., 2010). *Sagartia elegens*, *Urticina felina*, *Metridium dianthus*, *Actinothoe sphyrodeta and Corynactis virdis* can reproduce via asexual budding (Wood 2005). Therefore if members of these species remain within the community it is likely all could recolonize without the need of larval recruitment.

Spirobranchus (formerly *Pomatoceros*) *triqueter* and *Balanus crenatus* are both relatively short-lived species that mature rapidly and have long reproductive seasons and produce pelagic larvae. *Balanus crenatus* and *Spirobranchus triqueter* can utilise a variety of substrata including artificial and natural hard substratum, bivalves and other animals. The life history traits and broad habitat preferences mean that populations of both species can recover rapidly following disturbance. Off Chesil Bank, the epifaunal community dominated by *Spirobranchus triqueter*, *Balanus crenatus* and *Electra pilosa*, decreased in cover in October as it was scoured away in winter storms, and recolonized in May to June (Warner, 1985). Warner (1985) reported that the community did not contain any persistent individuals, being dominated by rapidly colonizing organisms. While larval recruitment was patchy and varied between the years studied, recruitment was sufficiently predictable to result in a dynamic stability, so that although abundance varies throughout the year similar communities were present in 1979, 1980 and 1983 (Warner, 1985). Holme & Wilson (1985) suggested that the fauna of the *Balanus-Pomatoceros* assemblage in the central English Channel was restricted to rapid growing colonizers able to settle rapidly and utilize space in short periods of stability in the summer months.

Resilience assessment. *Tubularia indivisa* is described as an early colonizing species and as noted by Hiscock *et al.* (2010) settled within a couple of months of the vessel *HMS Scylla* was sunk. Such rapid settlement is likely to be a result of the timing of the sinking of the ship, spring being a period of peak *Tubularia indivisa* recruitment. However, as highlighted by Hughes (1983) *Tubularia indivisa* can reproduce within 6-8 weeks of settlement and, therefore, recovery following disturbance is likely to occur within a year. The barnacles and tube worms are also likely to recover rapidly from any level of disturbance. *Alcyonium digitatum* has been observed to recruit within 2 years, but to establish a dense population of typical size and age-structure will require longer, where populations have suffered significant losses (Whomersley & Picken, 2003; Hiscock *et al*., 2010). Similarly, other important species within CR.HCR.FaT.CTub.Adig such as *Sagartia elegans*, *Urticina felina*, *Metridium senile*, *Actinothoe sphyrodeta and Corynactis virdis* can colonize bare surfaces within a 1 year but may take up to 5 years to establish mature populations. The resilience assessments are largely based on the time taken for *Alcyonium digitatum* to recover (approximately 5 years) as a biotope without this species would revert to a different biotope within the classification (e.g. CR.HCR.FaT.BalTub or CR.HCR.FaT.CTub). Some of the anthozoan community could potentially recover relatively quickly, however, *Metridium dianthus* may also take up five years to re-establish. If the assemblage is significantly damaged or completely removed from the habitat (resistance is assessed as 'Low' or 'None') resilience is been assessed as **'Medium'** (2-10 years), however if resistance if assessed as 'Medium' or 'High' then resilience is assessed as **'High'** as there is less impact for populations to recover from and re-establishment of typical biomass will be driven by surviving individuals as well as recruitment.

Hydrological Pressures

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

This biotope occurs in the subtidal and is therefore protected from exposure to air so that the thermal regime is more stable and desiccation is not a factor. Examples of distribution and thermal tolerances tested in laboratory experiments are provided as evidence to support the sensitivity assessment. In general, populations can acclimate to prevailing conditions which can alter tolerance thresholds and care should, therefore, be used when interpreting reported tolerances.

Alcyonium digitatum is described as a northern species by Hiscock *et al.* (2004), and is distributed from Portugal (41°N) to Northern Norway (70°N) (Hartnoll, 1975). Similarly *Tubularia indivisa* is recorded from the Arctic ocean to the Mediterranean (WORMS, 2015). Across this latitudinal gradient both species are likely to experience a range of temperatures from approx. 5-18°C (Seatemperature, 2015).

A *Metridium dianthus* population at Barnstable, Massachusetts is reported to persist within a temperature range of 1.8-21.8°C (Sassaman & Mangum, 1970; Walsh & Somero, 1981). There is evidence to suggest *Metridium dianthus* temperature response can vary with latitude and acclimation (Walsh & Somero, 1981; Chomsky *et al*., 2004). For example, Sassaman & Magnum (1970) demonstrated *Metridium dianthus* “maintained” within 10°C prior to experimentation incurred 100% mortality when exposed to 27.5°C for 120-240 minutes, whereas *Metridium senile* “maintained” within 20°C prior to experimentation all survived (Sassaman & Mangum, 1970; Walsh & Somero, 1981). It is therefore possible that *Metridium dianthus* would be susceptible to acute temperature changes at the pressure benchmark.

Actinothoe sphyrodeta has been recorded from Cabo Pino, Mediterranean coast of Spain (Williams, 1997), where sea temperature range from 14-24°C (Seatemperature, 2015), and is therefore unlikely to be affected at the benchmark level.

Urticina felina is distributed from the Arctic Ocean (Ofwegen *et al*., 2001) to Portugal (Ramos, 2010). 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 may adversely affect individuals, especially in southern examples of this biotope, and some mortality might occur.

CR.HCR.FaT.CTub.Adig core records are distributed from North Scotland to Pembrokeshire, Wales. Sea surface temperature across this distribution ranges from northern to southern Sea Surface Temperature (SST) ranges of 8-16 °C in summer and 6-13 °C in winter (Beszczynska-Möller & Dye, 2013).

Sensitivity assessment. There is limited information to assess the resistance of the characterizing species; as a result resistance confidence has been assessed as low. An increase in sea surface temperature of 2°C for a period of one year with high temperatures within the south of the UK may approach the upper temperature threshold of *Alcyonium digitatum*, *Tubularia indivisa* and *Urticina feline* which may therefore cause minor declines in abundance. Biotopes in the north of the UK are unlikely to be affected at the benchmark level. A short-term increase in temperature may cause mortality of *Urticina felina*, however the effect on the rest of the community is not known. Resistance has been assessed as 'Medium', resilience has been assessed as 'High'. Sensitivity has been assessed as 'Low'.

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

Alcyonium digitatum is described as a northern species by Hiscock *et al.* (2004), however, is distributed from Portugal (41°N) to Northern Norway (70°N) (Hartnoll, 1975). Similarly, *Tubularia indivisa* is recorded from the Arctic Ocean to the Mediterranean (WORMS, 2015). Across this latitudinal gradient, both species are likely to experience a range of temperatures from approx. 5-18°C. *Alcyonium digitatum* was also reported to be apparently unaffected by the severe winter of 1962-1963 where air temperature reached -5.8°C (Crisp, 1964).

Metridium dianthus and *Urticina felina* are recorded within the Arctic circle (Stephenson, 1935; Walsh & Somero, 1981) and are therefore unlikely to be affected at the benchmark level.

The most northerly record for *Actinothoe sphyrodeta* is the Shetland Isles (Williams, 1997). Indicating *Actinothoe sphyrodeta* could be sensitive to a temperature decrease within the UK. However, due to a general lack of information concerning the resilience of *Actinothoe sphyrodeta* it has not been included within this assessment.

CR.HCR.FaT.CTub.Adig core records are distributed from North Scotland to Pembrokeshire, Wales. Sea surface temperature across this distribution ranges from Northern to southern Sea Surface Temperature (SST) ranges from 8-16 °C in summer and 6-13 °C in winter (Beszczynska-Möller & Dye, 2013).

Sensitivity assessment. Both *Alcyonium digitatum* and *Tubularia indivisa* have northern/boreal distributions and are considered unlikely to be affected at the benchmark level for either acute or chronic decrease in temperature. Resistance has been assessed as 'High', and resilience as 'High' (by default). The biotope is therefore considered to be 'Not sensitive'.

Salinity increase (local)	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Tubularia indivisa and *Alcyonium digitatum* are recorded from a few variable salinity (18-40) biotopes but probably at lower abundance than in the full salinity biotopes in which the majority of their records occur. *Metridium dianthus* is recorded from the intertidal (Bucklin, 1987), and Shumway (1978) found in low salinity *Metridium dianthus* could retract to a □ of its body size, which may be a behaviour adaptation to variable salinity. Therefore, *Metridium dianthus* may be tolerant of short-term variation in salinity, however at the time of writing there was no available evidence to assess the effect of long-term hypersaline environments on *Metridium dianthus*.
Although *Urticina felina* occurs in rockpools where some increases in salinity from evaporation may

occur, it is typically found in those on the low shore, where fluctuations in salinity are limited by the short emergence time.

An increase in salinity at the benchmark level would result in a salinity of >40 psu for one year. Hypersaline water is likely to sink to the seabed and the biotope could be affected by hypersaline effluents (brines). Ruso *et al*. (2007) reported that changes in the community structure of soft sediment communities due to desalinisation plant effluent in Alicante, Spain. In particular, in close vicinity to the effluent, where the salinity reached 39 psu, the community of polychaetes, crustaceans and molluscs was lost and replaced by one dominated by nematodes. Roberts *et al*. (2010b) suggested that hypersaline effluent dispersed quickly but was more of a concern at the seabed and in areas of low energy where widespread alternations in the community of soft sediments were observed. In several studies, echinoderms and ascidians were amongst the most sensitive groups examined (Roberts *et al*., 2010b).

Sensitivity assessment. The majority of species present are probably sensitive to an increase in salinity of >40 psu, especially if persistent. However, hypersaline effluents are likely to be dispersed quickly in the high energy environments that this biotope and its sub-biotopes occur. Therefore, resistance is assessed as **'High'**, resilience as **'High'** and the biotope is probably **'Not sensitive'** to this pressure. The confidence in the assessment is 'Low' due to the lack of direct evidence.

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

Alcyonium digitatum does inhabit situations such as the entrances to sea lochs (Connor *et al*., 2004) or the entrances to estuaries (Braber & Borghouts, 1977) where salinity may vary occasionally. However, its distribution and the depth at which it occurs suggest that *Alcyonium digitatum* is unlikely to survive significant reductions in salinity.

The effects of deceases in salinity on *Tubularia indivisa* are unclear. *Tubularia indivisa* is recorded as abundant at a number of locations within the Mersey estuary (Bassindale, 1938). However, the majority of hydroids are subtidal and, although some brackish water species exist (Gili & Hughes, 1995) they are probably intolerant of prolonged decreases in salinity.

Metridium dianthus is predominantly marine, however, does penetrate into estuaries and can be found in the intertidal (Shumway, 1978). Braber & Borghouts (1977) found that *Metridium dianthus* occurred in about 10ppt Chlorinity (about 19 psu) in the Delta Region of the Netherlands suggesting that it would be tolerant of reduced salinity conditions. Shumway (1978) found that, during exposure to 50% seawater, animals retracted their tentacles whilst animals exposed to fluctuating salinity, contracted their body wall and produced copious mucus. Therefore, the species seems to have a high tolerance to reduction in salinity but may have to retract tentacles, suffer reduced opportunity to feed and expend energy to produce mucus.

Although *Urticina felina* is predominantly marine, the species does penetrate into estuaries (e.g. the Thames estuary at Mucking (NMMP, 2001) and the River Blackwater estuary (Davis, 1967). Braber & Borghouts (1977) found that *Urticina* (as *Tealia*) *felina* penetrated to about the 11ppt Chlorinity (about 20psu) isohaline at mid tide during average water discharge in the Westerschelde estuary suggesting that, during high river flow, it would be tolerant of reduced salinity conditions. Intertidal and rock pool individuals will also be subject to variations in salinity because of precipitation on the shore; albeit for short periods on the lower shore.

Sensitivity review. CR.HCR.FaT.CTub.Adig is recorded exclusively in full marine conditions (30-40 psu) (Connor *et al*., 2004). There is also little available evidence which suggests that the characterizing fauna of CR.HCR.FaT.CTub.Adig are abundant at sites of reduced salinity (18-30 psu), and may therefore not tolerate decreases in salinity. Resistance has been assessed as '**Low**', Resilience is assessed as '**Medium**' and sensitivity has been assessed as '**Medium**'.

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

CR.HCR.FaT.CTub.Adig core records are recorded from very strong-moderately strong tidal streams (0.5-3 m/s) (Connor *et al*., 2004).

Alcyonium digitatum, *Tubularia indivisa* and *Actinarians* 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 during spring tides (Kluijver, 1993). *Tubularia indivisa* is also a dominant species on the wreck of *Kilmore*, Belgium, where tidal velocities can vary between 0.86-0.5 m/s (Zintzen *et al*., 2008a).

Sensitivity assessment. The available evidence suggests an increase in tidal velocity may benefit the characterizing species of CR.HCR.FaT.CTub.Adig. Due to the range of tidal streams in which CR.HCR.FaT.CTub.Adig is recorded a decrease in tidal velocity of 0.1-0.2 m/s is not thought biologically relevant to this biotope. Biotope resistance has therefore been assessed as '**High**', resilience has been assessed as '**High**' (by default) and the biotope is therefore considered to be '**Not sensitive**' at the benchmark level. This biotope is characterized by the tide-swept conditions, a decrease in water flow (far exceeding the benchmark) which reduced exposutre to water flow would be likely to result in changes to the biological assemblage as the habitat would be less suitable for filter feeders.

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 CR.HCR.FaT.CTub, which 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: Low C: Low	High Q: High A: High C: High	Not sensitive Q: Medium A: Low C: Low

CR.HCR.FaT.CTub. and its sub-biotopes are recorded from extremely exposed to moderately exposed sites (Connor *et al*., 2004). *Alcyonium digitatum, Tubularia indivisa* and Actinarians are suspension feeders relying on water currents to supply food. These taxa, therefore, thrive in conditions of vigorous water flow.

CTub.Adig is recorded from 5-30 m, however, the majority of core records occur from 10-20 m (Connor *et al*., 2004). The depth at which the biotope is recorded may, therefore, also negate the effects of a localised change in wave height; wave attenuation is directly related to water depth (Hiscock, 1985).

Metridium dianthus occurs in greatest abundance in wave sheltered situations with significant tidal flow. Those wave sheltered situations may, from time-to-time, be subject to strong wave action when non–prevailing winds blow. For instance, on the open east coast of Lundy, *Metridium dianthus* occurs on shallow jetty piles and on wrecks at 15 m depth where they persist despite occasional strong wave action during easterly winds. It seems most likely that individuals close and shrink-down during strong wave action but survive. *Metridium dianthus* is strongly adherent and when closed probably produces little resistance to water flow. Therefore significant increases in wave height will most likely decrease feeding opportunities and perhaps a loss of condition but recovery will be rapid. Bucklin (1987) found that the small size of intertidal populations was imposed, most likely, by limited food and feeding time and damage from wave action, which stimulates budding. *Urticina felina* favours areas with strong wave action (Manuel, 1988) and strong tidal currents (Migné & Davoult, 1997).

Sensitivity assessment. CTub and its sub-biotopes are high energy habitats so that a significant decrease in water movement (either tidal streams or wave action) will result in loss of the biotope. However, due to the high wave exposure levels at which CR.HCR.FaT.CTub is recorded, an increase or a decrease in nearshore significant wave height of 3-5% is not likely to have a significant effect. Therefore, resistance is assessed as '**High**', resilience as '**High**' and the biotope (and its sub-biotopes) 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

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

No information 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.

French & Evans (1986) conducted a colonization experiment on panels coated in copper and zinc based anti-fouling paints and compared the community to panels which weren't covered in anti-fouling paint. *Tubularia indivisa* was an abundant species on the panels not coated in anti-fouling paint, indicating *Tubularia indivisa* is highly sensitive to anti-fouling chemicals.

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.

CR.HCR.FaT.CTub.Adig is a sub-tidal biotope (Connor *et al.*, 2004), because oil pollution is mainly a surface phenomenon its impact upon circalittoral turf communities is likely to be limited (Hartnoll, 1998). However, Smith (1968) reported dead colonies of *Alcyonium digitatum* at a depth of 16m in the locality of Sennen Cove, Cornwall resulting from the offshore spread and toxic effect of detergents sprayed along the shoreline to disperse oil from the *Torrey Cannon* tanker spill.

At the time of writing, no additional information concerning the direct biological effects of hydrocarbon and PAH contamination on *Tubularia indivisa* was found.

One month after the *Torrey Canyon* oil spill *Urticina felina* was thought to be one of the most resistant animals on the rocky shore, being commonly found alive in pools between the tide-marks which appeared to be devoid of all other animals (Smith, 1968).

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) e.g. BP 1002 sprayed along the shoreline to disperse oil from the Torrey Canyon tanker spill. Possible sub-lethal effects of exposure to synthetic chemicals, may result in a change in morphology, growth rate or disruption of reproductive cycle.

At the time of writing, no additional information concerning the direct biological effects of synthetic compound contamination on *Tubularia indivisa* was found.

Very little information has been found. Hoare & Hiscock (1974) observed that *Urticina felina* survived near to an acidified halogenated effluent discharge in a 'transition' zone where many other species were unable to survive, suggesting a tolerance to chemical contamination. However, *Urticina felina* was absent from stations closest to the effluent which were dominated by pollution tolerant species particularly polychaetes. Those specimens closest to the effluent discharge appeared generally unhealthy.

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

No Evidence

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	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

There is anecdotal evidence to suggest that *Alcyonium digitatum* is sensitive to hypoxic events, however, because the degree of deoxygenation 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 mg/l or even less (Herreid, 1980; Rosenberg *et al*., 1991; Diaz & Rosenberg, 1995). Species such as *Metridium senile* are thought of as resistant to severe hypoxia.

Alcyonium digitatum mainly inhabits environments in which the oxygen concentration usually exceeds 5 ml/l and respiration is aerobic. 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 8m BSL (Griffiths *et al*., 1979). 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.* 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 were also surveyed during the same time period and the effects of the *Gyrodinium aureolum* bloom were less apparent. It was suggested that shallow water on reefs more exposed to wave action were less effected by the phytoplankton bloom (Griffiths *et al*., 1979). As no mass mortality occurred. Indicating *Alcyonium sp.* can potentially survive short-term hypoxic events.

Sensitivity assessment.CR.HCR.FaT.CTub.Adig is recorded from extremely exposed-exposed wave exposure and very strong-moderately strong (0.5->3 m/sec) tidal streams. The high water movement which is indicative of this biotope is likely to increase mixing with surrounding oxygenated water and may, therefore, decrease the effects of de-oxygenation. Biotope resistance is, therefore, assessed as 'High' and resilience as 'High' (by default) and the biotope is considered to be 'Not sensitive'.

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

Alcyonium digitatum and *Tubularia indivisa* are passive suspension feeders on phytoplankton and zooplankton. Nutrient enrichment of coastal waters that enhances the population of phytoplankton may be beneficial to *Alcyonium digitatum* and *Tubularia indivisa* in terms of an increased food supply but the effects are uncertain (Hartnoll, 1998). However, the survival of *Alcyonium digitatum* and *Tubularia indivisa* may be influenced indirectly. 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 of the bottom waters which faunal species are likely to be highly intolerant of periods of hypoxia (see de-oxygenation pressure).

Johnston & Roberts (2009) conducted a meta-analysis, which reviewed 216 papers to assess how a variety of contaminants (including sewage and nutrient loading) affected 6 marine habitats (including subtidal reefs). A 30-50% reduction in species diversity and richness was identified from all habitats exposed to the contaminant types.

Sensitivity assessment. The pressure benchmark is relatively protective and the biotope is considered to be **'Not sensitive'** at the pressure benchmark that assumes compliance with good status as defined by the WFD.

Organic enrichment	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

The animals found within the biotope may be able to utilise the input of organic matter as food, or are likely to be tolerant of inputs at the benchmark level. In a recent review, assigning species to ecological groups based on tolerances to organic pollution, *Alcyonium digitatum* were described as 'very sensitive to organic enrichment and present under unpolluted conditions' while. the associated animal species; *Urticina felina; Balanus crenatus and Spirobranchus triqueter* were described as 'species indifferent to enrichment, always present in low densities with non-significant variations with time, from initial state, to slight unbalance' (Gittenberger & Van Loon, 2011).

Sensitivity assessment. It is not clear whether the pressure benchmark would lead to enrichment effects in this dynamic habitat. High water movements would disperse organic matter particles, mitigating the effect of this pressure. Although species within the biotope may be sensitive to gross organic pollution resulting from sewage disposal and aquaculture they are considered to have **'High'** resistance to the pressure benchmark which represents organic enrichment. Therefore, resilience is assessed as **'High'** and the biotope is considered to be **'Not Sensitive'** at the benchmark level.

Physical Pressures

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

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

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

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**' (as the change at the pressure benchmark is permanent). 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

Habitat structure changes - removal of substratum (extraction)	Low Q: High A: Medium C: Medium	Medium Q: High A: High C: Medium	Medium Q: High A: Medium C: Medium

The species characterizing this biotope are epifauna or epiflora occurring on rock and would be sensitive to the removal of the habitat. Extraction of bedrock substratum is considered unlikely and this pressure is considered to be '**Not relevant'** to hard substratum habitats. However, Picton & Goodwin (2007) noted that an area of boulders with a rich fauna of sponges and hydroids on the east coast of Rathlin Island, Northern Ireland was significantly altered since the 1980s. Scallop dredging had begun in 1989 and boulders were observed to have been turned and the gravel harrowed. In addition, many of the boulders had disappeared and rare hydroid communities were greatly reduced (Picton & Goodwin, 2007). Prior records indicated the presence of large sponges, mainly *Axinella infundibuliformis* (Picton & Goodwin, 2007). Freese *et al.* (1999) also noted that trawling could remove important substratum such as boulders. Therefore, w**here this biotope occurs on boulders** that could be subject to removal or extraction, resistance is likely to be **'Low'.** Hence, as resilience is probably **'Medium'** (assuming suitable substratum remains) and sensitivity is assessed as **'Medium'.**

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

Alcyonium digitatum, *Tubularia indivisa* plus the anthozoan community are sedentary species that would likely suffer from the effects of abrasion. Boulcott & Howell (2011) conducted experimental Newhaven scallop trawling (a source of abrasion) over a circalittoral rock habitat in the sound of Jura, Scotland and recorded the damage to the resident community. The results indicated that the sponge *Pachymatisma johnstoni* was highly damaged by the experimental trawl, however, *Alcyonium digitatum* showed comparatively little damage. 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 that assessing physical damage to faunal turfs (erect bryozoans and hydroids) was difficult to quantify. However, the faunal turf communities did not show large signs of damage and were only damaged by the scallop dredge teeth, an impact which was often limited in extent (approx. 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.

Sensitivity assessment. The evidence indicates that CR.HCR.FaT.CTub.Adig is relatively resistant to single abrasion events. Resistance has, therefore, been assessed as '**Medium**' based on Boulcott & Howell (2011), resilience has been assessed as '**High**'. Sensitivity has been assessed 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 the community as 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.

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

This biotope occurs in tide-swept habitats and it is likely, depending on local sediment supply, that the biotope is exposed to chronic or intermittent episodes of high-levels of suspended solids as local sediments are re-mobilised and transported. Based on Cole *et al*. (1999) and Devlin *et al*. (2008) this biotope is considered to experience intermediate turbidity (10-100 mg/l) based on UK TAG (2014). An increase at the pressure benchmark refers to a change to medium turbidity (100-300 mg/l) and a decrease is assessed as a change to clear (<10 mg/l) based on UK TAG (2014).

An increase in turbidity could be beneficial if the suspended particles are composed of organic matter, however, high levels of suspended solids with increased inorganic particles may reduce filter feeding efficiencies. A reduction in suspended solids will reduce food availability for filter feeding species in the biotope (where the solids are organic), although effects are not likely to be lethal over the course of a year. A reduction in light penetration could also reduce growth rate of phytoplankton and so limit zooplankton levels.

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. Repeated energetic expenditure in cleaning off silt particles may cause sub-lethal effects.

Sparse information could be found for the tolerance of *Tubularia indivisa* to changes in water clarity, other than survey reports of abundant *Tubularia indivisa* in Isle of Thanet, which is well known as an area characterized by poor underwater visibility (Howson *et al*., 2005). Zintzen *et al*. (2008a&b) examined *Tubularia* spp. dominated epifaunal communities on ship wrecks in the Southern Bight of the North Sea. While *Tubularia indivisa* dominated offshore and intermediate sites, coastal sites were dominated by *Metridium dianthus* and had a lower biomass of turfs of *Tubularia* spp. The coastal sites were characterized by periodic salinity decreases, large seasonal temperature fluctuations, high total suspended sediment and reduced current velocity when compared to offshore and intermediate sites (Zintzen *et al*., 2008b). Turbidity alone does not explain the differences in abundance but is a factor.

Metridium dianthus may benefit from increase in turbidity as algal growth on hard substrata will be reduced. For Instance, Svane & Groendahl (1988) found that, in comparison with records from 1926-29, *Metridium dianthus* had colonized areas in the Gullmar Fjord, Finland where it had not previously been recorded and suggested the reason was because of increases in turbidity (and tolerance of pollution).

Urticina felina occurs in clear to highly turbid waters and occurs down to depths of at least 100m (Manuel, 1988) where light levels are low. The anemone is not known to contain symbiotic algae and is unlikely to be sensitive to changes in turbidity.*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 sub-lethal effects.

Sensitivity assessment. Overall biotope resistance is assessed as **'High'** to an increase in suspended solids. Resilience is categorised as **'High'** (by default) and the biotope is considered to be **'Not sensitive'**. The biotope is considered to be 'Not sensitive' to decreased suspended solids where periodic scour and abrasion are unaffected.

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

The anthozoan community of CR.HCR.FaT.CTub. (*Alcyonium digitatum*, *Tubularia indivisa*, hydroids and anemones) is largely sessile and thus would be unable to avoid the deposition of a smothering layer of material up to a depth of 5 cm. Some *Alcyonium digitatum* colonies can attain a height of up to 20 cm and mature *Tubularia indivisa* can attain a height of 10-15 cm (Edwards, 2008). Both would still be able to expand tentacles and columns of the polyps to filter feed, and materials may be sloughed off with a large amount of mucous. However, *Sagartia elegens*, *Urticina felina*, *Metridium senile*, *Actinothoe sphyrodeta*, *Corynactis virdis* and smaller / younger *Alcyonium digitatum* colonies (that initially form encrustation's between 5 and 10 mm thick) are likely to be smothered and respiration is likely to be hindered. However, CR.HCR.FaT.CTub and its sub-biotopes are recorded from very strong to moderately strong tidal streams (0.5->3 m/sec). A layer of deposited sediment (at the pressure benchmark) is likely to be removed from the biotope within a few tidal cycles.

Urticina felina anemones adhere strongly to the substratum and would be entirely covered by smothering material. However, *Urticina felina* lives in situations where it may be covered from time-to-time by sediment, especially coarser substrata which suggests some ability to survive. For example, Holme & Wilson (1985) observed *Urticina felina* attached to pebbles, cobbles or rock subject to sand scour or periodic smothering by sand at 50-55 m depth, offshore, in the western English Channel. The tidal streams in the central parts of the Channel may reach 125 cm/s during neaps and 166 cm/s on springs. Therefore, they suggested that *Urticina felina* was tolerant of sand scour or periodic smothering by

Sensitivity assessment. Based on biotope exposure to high levels of water flow that will remobilise and remove sediments, biotope resistance is assessed as '**High**' and resilience as '**High**' (by default) and the biotope is considered to be '**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: Medium	Low Q: Low A: Low C: Low

The epifaunal community of CR.HCR.FaT.CTub (*Alcyonium digitatum* and anemones, *Tubularia indivisa* and other hydroids, bryozoan turf and sponges) is sessile and thus would be unable to avoid the deposition of a smothering layer of material up to a depth of 30 cm. *Alcyonium digitatum* colonies can attain a height of up to 20 cm, *Tubularia indivisa* can attain a height of 10-15 cm (Edwards, 2008), and will, therefore, be inundated along with other important species within CR.HCR.FaT.CTub e.g. *Sagartia elegens*, *Urticina felina*, *Metridium senile*, *Actinothoe sphyrodeta*, *Corynactis virdis.*

The community forms on vertical and upper faces of bedrock and boulders, so that the deposit is only likely to affect a proportion of the biotope, that is the upper faces. However, CR.HCR.FaT.CTub and its sub-biotopes are recorded from very strong to moderately strong tidal streams (0.5->3 m/sec). A layer of deposited sediment (at the pressure benchmark) is likely to be removed from the biotope within a few tidal cycles and only remain at the base of boulders, crevices, or areas in the lee of the prevailing currents at the time of deposition. Therefore, a precautionary resistance of **'Medium'** is suggested to represent the damage to some of the more sensitive species in the assemblage. Nevertheless, recovery will probably be rapid and resilience is assessed as **'High'** and sensitivity as **'Low'.**

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

Not assessed.

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

At the time of writing there is **no evidence** on which to assess this pressure.

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

Not Relevant

Introduction of light or shading	High Q: High A: High C: High	High Q: High A: High C: High	Not sensitive Q: High A: High C: High

CR.HCR.FaT.CTub.Adig is a circalittoral biotope (Connor *et al.*, 2004) and the community is therefore not dependant on direct sunlight. Increased shading (e.g. by construction of a pontoon, pier etc) could benefit the characterizing species of this biotope.

Sensitivity assessment. Resistance is probably '**High**', with a '**High**' resilience and a sensitivity of '**Not Sensitive**'.

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

Not Relevant.

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.

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 translocation or genetic modification of *Alcyonium digitatum*, *Tubularia indivisa* or other important epifaunal species within this biotope was found.

	Resistance	Resilience	Sensitivity
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

Species tolerant of tide-swept conditions that can occupy rock surfaces and out-compete native species pose the greatest threat to this biotope. The tunicates *Didemnum vexillum* and *Asterocarpa humilis*, the hydroid *Schizoporella japonica* and the bryozoan *Watersipora subatra* (Bishop, 2012c, Bishop, 2015a and b; Wood, 2015) are currently only recorded from artificial hard substratum in the UK and it is not clear what their established range and impacts in the UK would be.

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 (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. Therefore, it is possible that *Didemnum vexillum* could colonize more exposed locations within the UK and could pose a threat to CR.HCR.FaT.CTub.Adig. The tunicate *Styela clava* appears to prefer more sheltered conditions than this biotope (Bishop, 2012d).

However, there is ‘No evidence’ at present that this habitat has been affected by introduced non-native invasive species. Due to the constant risk of new invasive species, the literature for this pressure should be revisited.

	Resistance	Resilience	Sensitivity
Introduction of microbial pathogens	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

Alcyonium digitatum acts as the host for the endoparasitic species *Enalcyonium forbesiand* and *Enalcyonium rubicundum* (Stock, 1988). Parasitisation may reduce the viability of a colony but not to the extent of killing them but no further evidence was found to substantiate this suggestion. *Tubularia indivisa* and *Sagartia elegans* can host an array of potentially pathogenic bacteria, however there is insufficient evidence to suggest significant population wide mortality (Schuett & Doepke, 2010).

Sensitivity assessment. Based on the lack of reported mortalities of the characterizing and associated species, the biotope is judged to have 'High' resistance to this pressure. By default resilience is assessed as 'High' and the biotope is classed as 'Not sensitive' at the pressure benchmark.

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

At the time of writing none of the characterizing species within CR.HCR.FaT.CTub.Adig are commercially exploited. This pressure is therefore considered 'Not Relevant'.

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

Alcyonium digitatum and faunal turf communities (which include hydroids such as *Tubularia indivisa*) have been found to be resistant to abrasion through bottom fishing (see abrasion pressure) and only biological effects are considered here.

Zintzen *et al.* (2008a&b) examined *Tubularia* spp. dominated epifaunal communities on ship wrecks in the Southern Bight of the North Sea. They noted that the *Tubularia* spp. turf supported a high diversity and biomass of epifaunal, including species that grew attached to *Tubularia spp.* (e.g. *Jassa* spp. and caprellids). Although not exactly equivalent, the *Tubularia* spp. and associated hydroid and bryozoan turf probably support numerous epifaunal and epiphytic species, together with faunal grazing gastropods and nudibranchs. Zintzen *et al.* (2008a) noted that during the summer months the *Tubularia* biomass deceased as it became dormant and was predated or out-competed by other species. Zintzen *et al.* (2008a) also noted that species richness and the density of 23% of the species in the community were positively correlated with *Tubularia* biomass. Similarly, *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).

Metridium dianthus can aggressively out-compete other spatial competitors (Whomersley & Picken, 2003; Nelson & Craig 2011). Nelson & Craig (2011) found mature *Metridium dianthus* can have significant negative effects on invertebrate recruitment. If *Alcyonium digitatum* and *Tubularia indivisa* were removed from the biotope *Metridium dianthus* and other anthozoans could spread rapidly and dominate the biotope in the short-term. However, high water flow within this biotope may preclude the long-term dominance of *Metridium dianthus*.

Sensitivity assessment. If *Alcyonium digitatum* and *Tubularia indivisa* were removed the other epifaunal species would likely colonize rock surfaces as they are not dependent on the characterizing species. However, if *Alcyonium digitatum* and *Tubularia indivisa* were removed this would alter the character of the biotope and potentially decrease species richness. Therefore, resistance has been assessed as **'Low'**, resilience assessed as **'Medium'** and sensitivity assessed as **'Medium'**.

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