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

Halcampa chrysanthellum and *Edwardsia timida* on sublittoral clean stone gravel

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

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Please note. This MarESA report is a dated version of the online review. Please refer to the website for the most up-to-date version [https://www.marlin.ac.uk/habitats/detail/80]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

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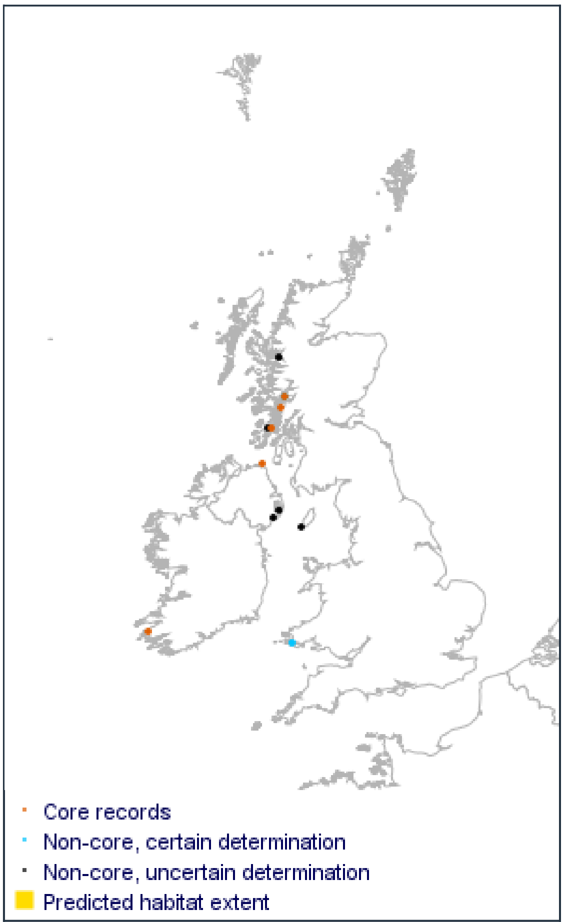
Edwardsia timida **on sublittoral clean stone gravel.**
Photographer: Bernard Picton



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

Researched by John Readman & Dr Keith Hiscock **Refereed by** This information is not refereed.

Summary

UK and Ireland classification

EUNIS 2008	A5.132	*Halcampa chrysanthellum* and *Edwardsia timida* on sublittoral clean stone gravel
JNCC 2015	SS.SCS.ICS.HchrEdw	*Halcampa chrysanthellum* and *Edwardsia timida* on sublittoral clean stone gravel
JNCC 2004	SS.SCS.ICS.HchrEdw	*Halcampa chrysanthellum* and *Edwardsia timida* on sublittoral clean stone gravel
1997 Biotope	SS.IGS.FaG.HalEdw	*Halcampa chrysanthellum* and *Edwardsia timida* on sublittoral clean stone gravel

Description

Periodically or seasonally disturbed sublittoral stone gravel with small pebbles characterized by the presence of the anemones *Halcampa chrysanthellum* and *Edwardsia timida*. Associated species are often typical of a hydroid/bryozoan turf with polychaetes such as *Spirobranchus* spp. Encrusting larger pebbles and low numbers of syllid and phyllodocid polychaetes living interstitially. In some areas, this biotope may also contain opportunistic red seaweeds and infauna such as *Sabella pavonina*. This habitat may show considerable variation in community composition and it is possible that it is a sub-biotope of other gravel biotopes. In addition, the faunal composition and species richness of this biotope may vary seasonally as a result of disturbance from increased wave or tidal action. This biotope tends to occur at the entrance to marine inlets where tidal currents are moderately strong. (Information from Connor *et al*., 2004).

Depth range

0-5 m, 5-10 m, 10-20 m

Additional information

Little information on the biology of the characteristic burrowing anemones was found. In addition, this biotope is unique and occurs in specific habitats, so that even less information on the ecology of the biotope was available. Therefore, the sensitivity assessments are based on the general biology of burrowing anemones, inferred from the biology of *Cerianthus lloydii*, the biotope description and expert judgement, and should be interpreted with caution.

Listed By

- none -

Further information sources

Search on:

G G G JNCC

Habitat review

Ecology

Ecological and functional relationships

Most species in this biotope are not interacting with each other except in competition for space although the characteristic species are so widely separated, there is unlikely to be significant competition. It is expected that there will be grazers present - small prosobranchs and chitons especially although the biotopes classification gives no indication. There is no information available on the infauna of the biotope.

Seasonal and longer term change

The biotope character (Connor *et al*., 1997a) suggests that there might be periodic (seasonal?) disturbance of the gravel and pebbles. Such disturbance might occur during spring tides when currents will increase or during storms when wave action may be important. It also seems likely that there will be seasonal occurrence of algae attached to pebbles.

Habitat structure and complexity

The habitat will attract both infauna and epibiota although epibiota will be restricted to encrusting and foliose species.

Productivity

Productivity will be mainly secondary although there could be quite high rates of primary production on pebbles most likely grazed rapidly.

Recruitment processes

Recruitment will predominantly be from the plankton including for the mobile species such as prosobranchs and chitons likely to be present. It is likely that some echinoderms such as starfish will migrate from other areas.

Time for community to reach maturity

The community probably includes several slow-growing and long-lived species that do not recruit regularly. This is thought to be the case especially for burrowing sea anemones.

Additional information

No other information.

Preferences & Distribution

Habitat preferences

Depth Range	0-5 m, 5-10 m, 10-20 m
Water clarity preferences	

Limiting Nutrients	No information found
Salinity preferences	Full (30-40 psu)
Physiographic preferences	Open coast
Biological zone preferences	Infralittoral
Substratum/habitat preferences	Gravel / shingle, Pebbles
Tidal strength preferences	Moderately Strong 1 to 3 knots (0.5-1.5 m/sec.), Strong 3 to 6 knots (1.5-3 m/sec.), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Extremely sheltered, Moderately exposed, Sheltered
Other preferences	

Additional Information

Species composition

Species found especially in this biotope

- *Edwardsia timida*
- *Halcampa chrysanthellum*

Rare or scarce species associated with this biotope

- *Edwardsia timida*

Additional information

Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

This biotope is characterized by the burrowing sea anemones *Halcampa chrysanthellum* and *Edwardsia timida*, occurring in disturbed subtidal gravel and small pebbles. Seasonal disturbance is an important structuring factor in this biotope. The resultant scour and mobilisation of the sediment probably explains the sparse fauna and absence of fine particulates. Considerable variation in community composition has been noted in this biotope, and the assessment, therefore, only focuses on the characterizing anemones. Little information was available on the characterizing species and inferences from other burrowing anemones (such as *Cerianthus lloydii*, which is occasionally found in this biotope) are used to support assessments.

Resilience and recovery rates of habitat

Little evidence was found to support a resilience assessment for burrowing anemones. MES (2010) suggested that the genus *Cerianthus* would be likely to have a low recovery rate following physical disturbance based on the long lifespan and slow growth rate. No specific evidence was cited to support this conclusion. 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).

Eggs of *Edwardsia timida* were observed in a gelatinous matrix at the entrance to a burrow which hatched into ciliated planula larvae and completed development into young anemones within two months (Rawlinson, 1936, cited in Manuel, 1988) although no specific information on longevity, maturity, fecundity or recovery was found for the characterizing *Halcampa chrysanthellum* or *Edwardsia timida*. While burrowing anemones are capable of re-burrowing following disturbance (Manuel, 1988), it is likely that they have limited horizontal mobility and re-colonization via adults is unlikely (Tillin & Tyler-Walters, 2014). *Zostera* beds have historically provided suitable substrata for burrowing anemones, however, despite some recovery of eelgrass following the mass decline in the 1930s, burrowing anemones have not reappeared in many localities (Manuel, 1988). There is very little known about community development for this biotope. Almost nothing is known about the life cycle and population dynamics of British burrowing anemones.

Sea anemones tend to be slow growing, long-lived and may have patchy and intermittent recruitment. For example, Sebens (1981) reported that an anemone community dominated by *Anthopleura xanthogammica* in North America had not recovery to pre-clearance levels after 4 years of the study and suggested that full recovery of areas cleared of anemones may take five years to several decades. In similar clearance experiments on the recolonization of epifauna on vertical rock walls, Sebens (1985, 1986) 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. However, only 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. Whomersley & Picken (2003) noted colonization of offshore oil platforms in the North Sea by the anemone *Metridium dianthus* after three years, which had extended down to a depth of 90 m by after four years. Over the following five years, the anemone zone ascended to a depth of 40 m, out-competing both hydroids and soft corals (Whomersley & Picken, 2003).

Resilience assessment. Based on the lack of reappearance of burrowing anemones in some *Zostera* beds following total loss (Manuel, 1988), the limited distribution of Edwardsia timidia in the Uk waters, and recruitment in other anemones (Sebens, 1981, 1985, 1986), resilience has been assessed '**Low**' for events that result in decline of >75% (resistance of 'None'). Resilience has been assessed as '**Medium**' (2 –10 years) for other resistance levels in which decline occurs (where resistance is 'Low', 'Medium'). Confidence in this assessment is low, due to the lack of direct evidence for the characterizing species.

Hydrological Pressures

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

Halcampa chrysanthellum has been recorded and described across all coasts in the British Isles (Hayward & Ryland, 1995a; NBN, 2015). Its distribution beyond France is uncertain (Hayward & Ryland, 1995a) but could extend throughout most of northern Europe (Manuel, 1988).

Edwardia timida has previously been described as only being found in the south and west (Hawyward & Ryland, 1995a), however it has been recorded as occurring on the west coast of Scotland and Outer Hebrides (NBN, 2015). Picton & Morrow (2015) note that the species is only known from a few localities (including the northern coast of France) and that it may be more widely distributed. It is described as easily overlooked unless deliberately sought (Picton & Morrow 2015). Manuel (1988) noted that, while edwardsiids as a group have a worldwide distribution, knowledge of distribution is patchy.

Sensitivity assessment. Neither of the characterizing burrowing anemones are at their southern distribution limit and are unlikely to be affected by an increase in temperature at the benchmark level. Resistance is '**High**', resilience is '**High**' and the biotope is probably '**Not sensitive**' at the benchmark level.

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

Halcampa chrysanthellum has been recorded and described across all coasts in the British Isles (Hayward & Ryland, 1995a; NBN, 2015). Its distribution beyond France is uncertain (Hayward & Ryland, 1995a) but could extend throughout most of northern Europe (Manuel, 1988).

Edwardia timida has previously been described as only being found in the south and west (Hawyward & Ryland, 1995a), however it has been recorded as occurring on the west coast of Scotland and Outer Hebrides (NBN, 2015). Picton & Morrow (2015) note that the species is only known from a few localities (including the northern coast of France) and that it may be more widely distributed. It is described as easily overlooked unless deliberately sought (Picton & Morrow 2015). Manuel (1988) noted that, while edwardsiids as a group have a worldwide distribution, knowledge of distribution is patchy.

Sensitivity assessment

No evidence was found to suggest mortality of the characterizing species due to cold temperatures and the species appear to be widely distributed across the United Kingdom. Records further afield are sparse, although it has been noted that these species are not well documented. Resistance is assessed as '**High**', resilience as '**High**' and the biotope is assessed as '**Not sensitive**' at the benchmark level.

Salinity increase (local)	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

The biotope is only recorded from full salinity subtidal situations. Naser (2011) described habitats dominated by the burrowing anemone *Cerianthus* sp. in the areas adjacent to the outlet of the Sitra Power and Water Station, Bahrain. This desalination outlet is associated with high temperatures, salinities, and a range of chemical and heavy metal pollutants. *Edwardsia timida* and *Halcampa chrysanthellum* have only been recorded in full salinity biotopes (Connor *et al*., 2004).

Whilst some burrowing anemones have been associated with areas that experience hypersalinity due to brine effluent from desalination plants, there are few species specific details and '**No evidence'** was found for the characterizing species.

Salinity decrease (local)	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 information was found on the likely intolerance of the burrowing anemones, although it should be noted that *Edwardsia timida* and *Halcampa chrysanthellum* have only been recorded in full salinity biotopes (Connor *et al*., 2004). Due to the lack of evidence for the characterizing species within this biotope an assessment of **'No evidence'** has been given.

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

SS.SCS.ICS.HchrEdw occurs across a wide range of water flow, from strong to weak (0.5 – 3 m/s). The burrowing anemones are afforded some protection from the direct effects of water flow, however, prolonged increase in water flow could result in a restructuring of the substrata. Tidal flow may be an important structuring factor in this biotope, which has been described as periodically disturbed. High tidal flow or wave action during spring tides is a possible mechanism by which succession is prevented (Connor *et al*., 2004). A significant change in water flow could result in reclassification of the biotope, especially if a decrease resulted in the deposition of fine sediments. However, this is unlikely at the benchmark level (a change of 0.1-0.2 m/s). Resistance is, therefore, assessed as '**High**', resilience as '**High**' and the biotope is assessed as '**Not sensitive'** at the benchmark level.

Emergence regime changes	Medium Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

This biotope can occur in the 0-5 m range and may, therefore, be exposed to this pressure. The burrowing nature of the anemones would probably confer some resistance in the event of one hour of emergence. Whilst burrowing anemones usually occur in the sublittoral, they may be found on sheltered lower shores (Manuel, 1988).

Sensitivity assessment. The burrowing anemones would probably tolerate an increase at the benchmark level, as they could retreat into their burrows. However, a some mortality is possible and resistance is, therefore, assessed as '**Medium**', resilience as '**Medium**' and sensitivity is assessed as '**Medium**' at the benchmark level.

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

SS.SCS.ICS.HchrEdw occurs in moderately wave exposed to extremely wave sheltered locations. Wood (2005) noted that *Edwardsia timida* is generally found in current swept locations without wave action and most records for *Halcampa chrysanthellum* are in sheltered localities (Wood, 2005). The characterizing species have been recorded as occurring from wave exposed to sheltered habitats (Connor *et al*., 2004) suggesting that whilst an increase in wave action would be detrimental, the species are present in biotopes that occur at higher and lower wave exposures than are experienced in SS.SCS.ICS.HchrEdw.

Wave action may be an important structuring factor in this biotope, which has been described as periodically disturbed, with high tidal flow or wave action during spring tides as a possible mechanism by which succession is halted (Connor *et al*., 2004). a significant increase in wave action may remove the gravel while a significant decrease may result in deposition of fine sands and muds.

Sensitivity assessment. Whilst an increase in wave action is likely to result in a decline in the biotope, the burrowing anemones are afforded some protection from the direct effects of wave action, however, prolonged increase in wave exposure could result in a restructuring of the substrata. A decrease in wave action could result in less disturbance and, therefore allow the colonization of the sediment by other species, resulting in a change in biotope classification. However, a 3-5% change in significant wave height (the benchmark) is unlikely to cause significant change. Therefore, resistance is assessed as '**High**', resilience as '**High**' and the biotope is assessed as '**Not sensitive'** at the benchmark level.

Chemical Pressures

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

No information was found on effects of contaminants on the characterizing species of the biotopes and high-level anemone response to contaminants is presented. Naser (2011) described habitats dominated by the burrowing anemone *Cerianthus* sp. in the areas adjacent to the outlet of the Sitra Power and Water Station, Bahrain. This desalination outlet is associated with high temperatures, salinities, and a range of chemical and heavy metal pollutants. Mercier *et al*. (1998) exposed *Metridium senile* to tri-butyl tin contamination in surrounding water and in contaminated food. The species produced mucus 48 hours after exposure to contaminated seawater. TBT was metabolised but the species accumulated levels of butyl tins leading the authors to suggest that *Metridium senile* seemed vulnerable to TBT contamination. However, Mercier *et al*., (1998) did not indicate any mortality and, since *Metridium senile* is a major component of jetty pile communities immediately adjacent to large vessels coated with TBT antifouling paints, intolerance has been assessed to be low specifically to TBT. No information was found on effects of contaminants on the characterizing species of the biotopes.

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

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

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

No information was found on effects of contaminants on the characterizing species of the biotopes and high-level anemone response to contaminants is presented. One month after the *Torrey Canyon* oil spill the dahlia anemone, *Urticina felina* was found to be one of the most resistant animals on the shore and was '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.

No information was found on effects of contaminants on the characterizing species of the biotopes. Hoare & Hiscock (1974) reported that the anemone *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 (such as polychaetes). Those specimens closest to the effluent discharge appeared generally unhealthy.

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

'No evidence' was found.

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

This pressure is **Not assessed**.

De-oxygenation	Medium Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

In general, respiration in most marine invertebrates does not appear to be significantly affected until extremely low concentrations are reached. For many benthic invertebrates, this concentration is about 2 mg/l (Herreid, 1980; Rosenberg *et al.*, 1991; Diaz & Rosenberg, 1995). Cole *et al.* (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2 mg/l.

The biotope occurs in areas where tidal flow is moderate and, therefore, oxygenation is good. Decrease in oxygenation due to stagnation or smothering is likely to have an adverse effect on a community attuned to well-oxygenated conditions. However, as the burrowing anemones most likely spend significant periods of time in burrows where water movement is likely to be more restricted.

Diaz & Rosenberg (1995) noted that anemones include species that were reported to be particularly tolerant of hypoxia (e.g. *Cerianthus* sp and *Epizoanthus erinaceus*). In the Limfjorden, oxygen concentrations fell to below 1 mg/l in the summer of 1975, with the anemones described as the most resistant group to the event (Jeirgensen, 1980). A major hypoxic event due a pycnocline in the Gulf of Trieste resulted in a mass mortality of benthos between 12 and 26th September 1983 (Stachowitsch & Avcin, 1988; Stachowitsch, 1992b), during which the oxygen levels fell below 4.2 mg/l, became anoxic, and hydrogen sulphide and ammonia were released (Faganeli *et al.*, 1985). Amongst the epifauna, the even hypoxia resistant polychaetes and bivalves died after 4-5 days and the only organism to survive after one week were the anemones *Cerianthus* sp and *Epizoanthus erinaceus*, the gastropods *Aporrhais pespelecani* and *Trunculariopsis trunculus* and the sphinuculid *Sipunculus nudis* (Stachowitsch, 1992b). Reidel *et al.* (2001) also noted that anemones were amongst the most resistant of the species they encountered in 'in situ' deoxygenation experiments.

Sensitivity assessment. Whilst no evidence for the characterizing species was found, anemones have been reported as being relatively resistant to oxygen depletion. However, mortality at the benchmark level cannot be ruled out and resistance is, therefore, assessed as '**Medium**', resilience is '**Medium**' and sensitivity is '**Medium**' at the benchmark level.

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

No information was available on the effect of nutrient enrichment on the characterizing burrowing anemones, however, this biotope is considered to be **Not sensitive** at the pressure benchmark that assumes compliance with good status as defined by the WFD.

Organic enrichment	Low Q: Low A: NR C: NR	Medium Q: Low A: NR C: NR	Medium Q: Low A: Low C: Low

Borja *et al.* (2000) assessed *Halcampa* sp. as Group I 'very sensitive to organic enrichment and present under unpolluted conditions' and *Edwardsia* sp. as Group II 'indifferent to enrichment, always present in low densities with non-significant variations with time'. The basis for their assessment and relation to the pressure benchmark is not clear (Tillin & Tyler-Walters, 2014). It should be noted that both Borja *et al.* (2000) and Gittenberger & van Loon (2011) assessed the burrowing anemone group *Cerianthus* spp. as Group I 'sensitive to organic enrichment'.

Sensitivity assessment. The two characterizing anemones have been recorded as either 'very sensitive' or 'indifferent' to organic enrichment. A cautious resistance assessment of '**Low**' is, therefore applied, with '**Medium**' resistance and '**Medium**' sensitivity but 'Low' confidence.

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 sediment were replaced with rock or artificial substrata, this would represent a fundamental change to the biotope with reclassification necessary. A change from a mixed sediment substrata to rock would also result in loss of the infaunal component.

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

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

SS.SCS.ICS.HchrEdw is characterized as occurring on 'sublittoral clean stone gravel' (Connor *et al.*, 2004). The characterizing species of SS.SCS.ICS.HchrEdw may tolerate a change in one Folk class (based on the Long, 2006 simplification), as similar species have been noted to inhabit muddy sand and fine shell breccia (see Shäfer, 1972). However, this shift in substrata would represent a fundamental change in the character of the biotope, with re-classification of the biotope necessary. Resistance is, therefore, assessed as **None** based on a change from gravel to mixed sediment. As this is a permanent change, resilience is '**Very low'** and sensitivity is, therefore, assessed as '**High**'.

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

Sedimentary communities are likely to be highly intolerant of substratum removal, which will lead to partial or complete defaunation, expose underlying sediment which may be anoxic and/or of a different character, and lead to changes in the topography of the area (Dernie *et al.*, 2003). Any remaining species, given their new position at the sediment / water interface, may be exposed to unsuitable conditions.

Both *Halcampa chrysanthellum* and *Edwardsia timida* have columns up to 7 cm long (Wood, 2005; Picton & Morrow, 2015). Whilst no information for the characterizing species was found, Schäfer (1972) conducted a review of locomotion of the Cerianthids, reporting that the burrowing anemones require open tubes as they breathe with their entire body surface.

Extraction of 30 cm would probably result in total loss of the burrowing anemones as they would be unlikely to escape rapidly. Recovery of the sedimentary habitat would occur via infilling, although some recovery of the biological assemblage may take place before the original topography is restored, if the exposed, underlying sediments are similar to those that were removed. Newell *et al*. (1998) indicate that local hydrodynamics (currents and wave action) and sediment characteristics (mobility and supply) strongly influence the recovery of soft sediment habitats.

Sensitivity assessment. Extraction of 30 cm of sediment will remove the characterizing biological component of the biotope. Assuming that the revealed substratum is not altered, resistance is assessed as '**None**' and resilience is assessed as '**Medium**'. Sensitivity is, therefore, assessed as '**Medium**'.

Abrasion/disturbance of the surface of the substratum or seabed	High Q: Low A: NR C: NR	High Q: High A: High C: High	Not sensitive Q: Low A: Low C: Low

No specific evidence for the characterizing burrowing anemones was found, however, it was noted that the similar burrowing anemone *Cerianthus lloydii* was rarely caught by fishing boats since it retreats into the burrow as the trawl net approaches (Grzimek, 1972). While Langton & Robinson (1990) reported a 25-27 % decline in abundance of ceranthids following a marked increase in scallop dredging in the Gulf of Maine, this decrease could be down to penetrative disturbance (see below). In addition, *Cerianthus lloydii* is larger and burrows to greater depths (ca 40 cm) than the characterizing burrowing anemones.

Sensitivity assessment. The biotope was reported to experience seasonal disturbance due to storms or winter wave action and tidal flows (Connor *et al*., 2004). Therefore, the resident fauna are probably adapted to some disturbance and surface abrasion and resistance is assessed as **High**. Hence, resilience is **High** and the biotope is assessed as **Not sensitive**.

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

No specific evidence for the characterizing burrowing anemones was found, however, it was noted that the similar *Cerianthus lloydii* is rarely caught by fishing boats since it retreats into the burrow as the trawl net approaches (Grzimek, 1972). Both *Halcampa chrysanthellum* and *Edwardsia timida* have columns up to 7 cm long (Wood, 2005; Picton & Morrow, 2015) while *Cerianthus lloydii* is larger and burrows may be up to 40 cm deep. Langton & Robinson (1990) reported a 25-27 % decline in abundance of ceranthids following a marked increase in scallop dredging in the Gulf of Maine.

Sensitivity assessment. Therefore, the resistance to penetrative activities may be **Low**, based on the effects monitoring of ceranthid populations exposed to scallop dredging by Langton & Robinson (1990), and the fact that both *Halcampa chrysanthellum* and *Edwardsia timida* are smaller and burrow to shallower depths than *Cerianthus lloydii.* Hence, resilience is probably '**Medium**' and sensitivity is assessed as '**Medium**'.

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

SS.SCS.ICS.HchrEdw occurs on clean gravel and across a range of water flow from weak to strong, where turbidity is likely to be low. A significant increase in suspended sediment may have a deleterious effect on the suspension feeding community. It may clog feeding apparatus, which would result in a reduced ingestion over the benchmark period and, subsequently, a decrease in growth rate (Jackson, 2004). A decrease in suspended sediment is likely to benefit the community associated with this biotope. The suspension feeders may be able to feed more efficiently due to a reduction in time and energy spent cleaning feeding apparatus.

Sensitivity assessment No directly relevant evidence was found to assess the effect of pressure. Resistance to this pressure is assessed as '**High**' as an increase in turbidity may influence feeding and growth rates but is unlikely to result in mortality of adults. Resilience is assessed as '**High'** by default and the biotope is assessed as '**Not Sensitive**' to changes in turbidity at the benchmark level.

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: NR C: NR

Whilst no information for the characterizing species was found, cerianthids require open tubes as they breathe with their entire body surface (Schäfer, 1972). In the event of gradual sedimentation, the burrowing anemone *Cerianthus* spp. compensates by the upward construction of its tube. In the event of rapid sedimentation resulting in burial, cerianthids abandon their burrow, pushing vertically to the surface of the sediment (Schäfer, 1972).

Both *Halcampa chrysanthellum* and *Edwardsia timida* have columns up to 7 cm long (Wood, 2005; Picton & Morrow, 2015). It is probable that the majority of the anemones would tolerate 5 cm of deposition by burrow extension and those unable would likely escape burial by abandoning their burrow. The permanent addition of sediment would result in a change in substrata, and therefore reclassification of the biotope. However, SS.SCS.ICS.HchrEdw occurs in strong to weak water flow and the sediment would be probably be removed within a few tidal cycles in areas of strong to moderately strong flow or as a result of periodic seasonal increases in flow or wave action.

Sensitivity assessment. It is likely that the burrowing anemones would be able to extend burrows to cope with deposition of 5 cm of sediment. In the event of burial, the anemones are capable of some vertical movement and would probably escape. Mortality is unlikely and resistance is, therefore, assessed as '**High**', with '**High**' resilience and the biotope is assessed as '**Not sensitive'** at the benchmark level.

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

Whilst no information for the characterizing species was found, cerianthids require open tubes as they breathe with their entire body surface (Schäfer, 1972). In the event of gradual sedimentation, the burrowing anemone *Cerianthus* spp. compensates by the upward construction of its tube. In the event of rapid sedimentation resulting in burial, cerianthids abandon their burrow, pushing vertically to the surface of the sediment (Schäfer, 1972).

Both *Halcampa chrysanthellum* and *Edwardsia timida* have columns up to 7 cm long (Wood, 2005; Picton & Morrow, 2015). It is probable that the majority of the anemones would tolerate 5 cm of deposition by burrow extension and those unable would likely escape burial by abandoning their burrow. The permanent addition of sediment would result in a change in substrata, and therefore reclassification of the biotope. However, SS.SCS.ICS.HchrEdw occurs in strong to weak water flow and the sediment would be probably be removed within a few tidal cycles in areas of strong to moderately strong flow or as a result of periodic seasonal increases in flow or wave action.

Sensitivity assessment. It is unlikely that the characterizing species would be able to extend their burrows in the event of burial by 30 cm in a single event, but it is assumed that the majority of anemones would probably escape by abandoning their burrows. Periodic seasonal increases in flow or wave action will probably remove the deposited sediment in a few tidal cycles but some mortality may occur in the meantime. Therefore, a precautionary resistance of '**Medium**' is suggested. Hence, resilience is probably '**Medium'** and sensitivity is assessed as '**Medium**'.

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

Not assessed.

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

'No evidence' was found 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

'No evidence' was found to assess this pressure.

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' was found to assess this pressure.

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

Barriers and changes in tidal excursion are **'Not relevant'** to biotopes restricted to open waters.

Death or injury by collision	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR	Not relevant (NR) Q: NR A: NR C: NR

Not relevant to seabed habitats. NB. Collision by grounding vessels is addressed under 'surface abrasion'.

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

'Not relevant'

Biological Pressures

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

'No evidence' was found to assess this pressure.

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

Coastal and estuarine areas are among the most biologically invaded systems in the world, especially by molluscs such as the slipper limpet *Crepidula fornicata* and the pacific oyster *Magallana gigas* (OSPAR, 2009b). The two species have not only attained considerable biomasses from Scandinavian to Mediterranean countries but have also generated ecological consequences such as alterations of benthic habitats and communities, or food chain changes. In the Wadden Sea, the main issue of concern is the pacific oyster (*Magallana gigas*), which has also spread in the Thames estuary and along French intertidal flats. Padilla (2010) predicted that *Magallana gigas* could either displace or overgrown mussels on rocky and sedimentary habitats of low or high energy. However, Padilla (2010) also noted that there were no examples of *Magallana gigas* invading sedimentary habitats where there are no native ecosystem engineers (bivalves or *Sabellaria*).

Crepidula fornicata is known to colonize and smother a wide range of sediments in the subtidal, from mixed sediments to mud, especially in prior shellfish beds (e.g. of oysters and mussels) (Blanchard, 1997; Minchin *et al*., 1995). Changes in habitat structure and reduced abundance of suspension feeding organisms upon which the flatfish feed were linked to slipper limpet extent (Decottignies *et al*., 2007; Blanchard *et al*. 2008; and Kostecki *et al*., 2011 cited in Sewell & Sweet, 2011).

Sensitivity assessment. *Magallana gigas* is predicted to invade sedimentary habitats, although no direct examples exist to date and *Magallana gigas* recruitment is lower in the subtidal (Diederich 2005, 2006; Padilla, 2010). *Crepdiula fornicata* is a major invader and colonizer of subtidal sediments, athough is reaches its highest abundance in muddy or mixed muddy areas (De Montaudouin & Sauriau, 1999). However, both species require hard substrata in the form of stones, debris or, preferably, the shells conspecifics to colonize the habitat. This biotope is dominated by clean gravel or pebbles. (Connor *et al*., 2004) which may provide an initial point for the colonization of *Crepidula* in particular. It would probably take many years, colonization by *Crepidula* would result in the complete modification of the habitat, reclassification and loss of the biotope. Therefore, a precautionary resistance of **Low** has been suggested with 'Low' confidence due to the lack of direct evidence. Resilience is likely to be **Very low** as a bed of *Crepidula* or *Magallana gigas* would need to be removed before recovery could begin. Therefore, sensitivity is assessed as **High**.

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' was found on the effect of microbial pathogens on the characterizing burrowing anemones.

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

None of the characterizing species within this biotope are currently directly targeted in the UK and hence this pressure is considered to be **'Not relevant'**.

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

Direct, physical impacts from harvesting are assessed through the abrasion and penetration of the seabed pressures. The characterizing species within 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. Langton & Robinson (1990) reported a 25-27% decline in abundance of cerianthids following a marked increase in scallop dredging in the Gulf of Maine.

Sensitivity assessment. Removal of a large percentage of the characterizing species would alter the character of the biotope. The resistance to removal is assessed as **'Low'** based on the effects of scallop dredging on burrowing anemones. Resilience is assessed as **'Medium'** and overall sensitivity as **'Medium'**.

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