



# MarLIN

## Marine Information Network

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

# *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand

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/1115>]. All terms and the MarESA methodology are outlined on the website (<https://www.marlin.ac.uk>)

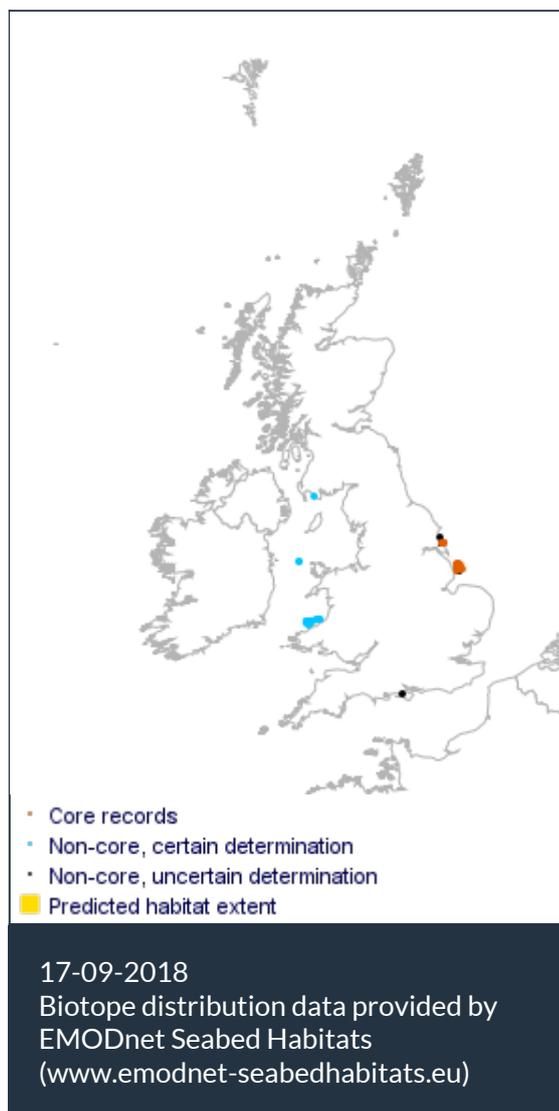
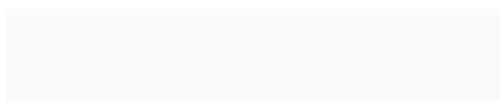
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Researched by Dr Heidi Tillin      Refereed by Admin

## Summary

### ☰ UK and Ireland classification

EUNIS 2008	A5.143	<i>Protodorvillea kefersteini</i> and other polychaetes in impoverished circalittoral mixed gravelly sand
JNCC 2015	SS.SCS.CCS.Pkef	<i>Protodorvillea kefersteini</i> and other polychaetes in impoverished circalittoral mixed gravelly sand
JNCC 2004	SS.SCS.CCS.Pkef	<i>Protodorvillea kefersteini</i> and other polychaetes in impoverished circalittoral mixed gravelly sand
1997 Biotope		

### 🔍 Description

In coarse gravelly or shelly sand sometimes with a slight mud content, along open coasts in depths of 10 to 30m, and in shallower offshore areas, an impoverished community characterized by *Protodorvillea kefersteini* may be found. This biotope has a number of other species associated with

it including *Nemertea* spp., *Caulleriella zetlandica*, *Minuspio cirrifera*, *Glycera lapidum*, *Ampelisca spinipes* and numerous other polychaete species all occurring at low abundances. The polychaete *Sabellaria spinulosa* is also found in low numbers in this biotope ([JNCC, 2015](#)).

### ↓ Depth range

-

### 🏛️ Additional information

-

### ✓ Listed By

- none -

### 🔗 Further information sources

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## Sensitivity review

### Sensitivity characteristics of the habitat and relevant characteristic species

The biotope description and characterizing species are taken from JNCC (2015). This biotope occurs in coarse gravelly or shelly sand sometimes with a slight mud content, and is characterized by an impoverished community defined by *Protodorvillea kefersteini* with species such as Nemertea spp., *Caulleriella zetlandica*, *Minuspio cirrifera* (now *Prionospio cirrifera*), *Glycera lapidum* and *Ampelisca spinipes* all occurring at low abundances. The polychaete *Sabellaria spinulosa* is also found in low numbers in this biotope but does not form reefs. The sensitivity assessments focus on the sediments which are a key factor structuring the biological assemblage and the polychaetes *Protodorvillea kefersteini* and *Glycera lapidum* and the amphipod *Ampelisca spinipes*. More information is available for these species than other taxa and the sensitivity of these taxa is considered to represent the sensitivity of the biotope.

### Resilience and recovery rates of habitat

The major factor driving the presence of interstitial fauna such as *Hesionura elongata* is likely to be sediment type (Nybakken, 2001). Sediment type and faunal abundance and diversity are intrinsically linked (Basford *et al.*, 1990; Seiderer & Newell 1999; Cooper *et al.*, 2011), and this is most relevant to interstitial fauna, as these require sediments of a certain grain size that is large enough to enable fauna to inhabit the voids between grains (Nybakken 2001). Food sources are limited for interstitial fauna characterizing this biotope and availability of food is likely to be an important factor influencing recovery. The characterizing species include active predators and deposit feeding detritivores. Predators, such as *Hesionura elongata*, are known to feed on other interstitial fauna and various infaunal invertebrate species (MES, 2008).

The characterizing polychaete *Protodorvillea* is small (1-3 cm) and lives in a soft mucous tube under stones, in empty serpulid tubes and in shallow burrows under the surface of muddy sand. It is a carnivore that feeds on small invertebrates at the sediment surface (MES, 2010) and has limited mobility (MES, 2010). The lifespan of this genus is about 1 year and sexual maturity is at about 4-6 months. There is little information on the breeding season or fecundity. After fertilisation, the embryos are brooded before release as planktotrophic larvae and juveniles. The short lifespan, relatively rapid growth rate and larval dispersal phase suggest that this genus has a high recoverability (MES, 2010).

The predatory polychaete, *Glycera* spp. are longer-lived and monotelic, having a single breeding period towards the end of their life. Recovery may occur through migration and this species may persist in disturbed sediments through their ability to burrow (Klawe & Dickie, 1952). *Glycera* spp. have a high potential rate of recolonization of sediments, but the relatively slow growth-rate and long-lifespan suggests that recovery of biomass following initial recolonization by post-larvae is likely to take several years (MES, 2010).

Sardá *et al.* (1999) tracked annual cycles within a *Spisula* community in Bay of Blanes (north west Mediterranean sea, Spain) for 4 years. *Protodorvillea kefersteini* exhibited Spring recruitment and the population persisted throughout the year. Following dredging of subtidal sands in Summer and Autumn to provide material for beach nourishment in the Bay of Blanes, (north west Mediterranean sea, Spain) recovery was tracked by Sardá *et al.* (2000). Recolonization in the dredged habitats was rapid, for some bivalve and polychaete species but *Protodorvillea kefersteini* had not recovered within two years (Sardá *et al.*, 2000).

The amphipod genus *Ampelisca* have some life history traits that allow them to recover quickly where populations are disturbed. They do not produce large numbers of offspring but reproduce regularly and the larvae are brooded, giving them a higher chance of survival within a suitable habitat than free-living larvae. *Ampelisca* has a short lifespan and reaches sexual maturity in a matter of months allowing a population to recover abundance and biomass in a very short period of time (MES, 2008). Experimental studies have shown *Ampelisca abdita* to be an early colonizer, in large abundances of defaunated sediments where local populations exist to support recovery (McCall, 1977) and *Ampelisca abdita* have been shown to migrate to, or from, areas to avoid unfavourable conditions (Nichols & Thompson, 1985). *Ampelisca* sp. are very intolerant of oil contamination and the recovery of the *Ampelisca* populations in the fine sand community in the Bay of Morlaix took up to 15 years following the Amoco Cadiz oil spill, probably due to the amphipods' low fecundity, lack of pelagic larvae and the absence of local unperturbed source populations (Poggiale & Dauvin, 2001).

Where impacts also alter the sedimentary habitat, recovery of the biotope will also depend on recovery of the habitat to the former condition to support the characteristic biological assemblage. Recovery of sediments will be site-specific and will be influenced by currents, wave action and sediment availability (Desprez, 2000). Except in areas of mobile sands, the process tends to be slow (Kenny & Rees, 1996; Desprez, 2000 and references therein). Boyd *et al.*, (2005) found that in a site where sands and gravels were subject to long-term extraction (25 years), extraction scars were still visible after six years and sediment characteristics were still altered in comparison with reference areas, with ongoing effects on the biota.

**Resilience assessment.** Where resistance is 'None' or 'Low' and an element of habitat recovery is required, resilience is assessed as 'Medium' (2-10 years), based on evidence from aggregate recovery studies in similar habitats including Boyd *et al.* (2005); Where resistance of the characterizing species is 'Low' or 'Medium' and the habitat has not been altered, resilience is assessed as 'High' as it is likely that the biotope would be considered representative and hence recovered after two years although some parameters such as species richness, abundance and biotopes may be altered. Recovery of the seabed from severe physical disturbances that alter sediment character may also take up to 10 years or longer (Le Bot *et al.*, 2010), although extraction of gravel may result in more permanent changes and this will delay recovery.

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

## Hydrological Pressures

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

Limited evidence was found on the effect of changes in temperature and resistance is inferred from the characterizing species ranges.

*Hesionura elongata* occurs in the Canary Islands and Caribbean, which suggests a resistance of higher water temperatures than around UK and Irish seas (Brito *et al.*, 2005; Miloslavich *et al.*, 2010). *Protodorvillea kefersteini* is found in the North Atlantic to the North Sea and English Channel, Mediterranean and Black Sea (Marine Species Identification Portal).

Bamber & Spencer (1984) observed that *Cauleriella zetlandica* were dominant species in an area affected by thermal discharge in the River Medway estuary. *Cauleriella zetlandica* were dominant resident fauna present in high abundances. The species is clearly tolerant of temperature fluctuations as the sediments were exposed to the passage of a temperature front of approximately 10 °C between heated effluent and estuarine waters during the tidal cycles.

**Sensitivity assessment.** This assessment relies on limited evidence and utilises global species distribution records to assess sensitivity (with the exception of *Cauleriella zetlandica*) and so confidence is low. As all characterizing species occur in water temperatures greater than they are likely to experience in the UK, biotope resistance and resilience are assessed as 'High' and the biotope is considered to be 'Not Sensitive'. There is low confidence associated with this assessment as limited evidence was available.

#### Temperature decrease (local)

**Medium**

Q: Low A: NR C: NR

**High**

Q: High A: Low C: Medium

**Low**

Q: Low A: Low C: Low

Limited evidence was returned on the effect of changes in temperature and resistance is inferred from the species range. *Hesionura elongata* has been identified in samples from water ranging from 7.3-24°C (OBIS, 2016). *Protodorvillea kefersteini* is found in the North Atlantic to the North Sea and English Channel, Mediterranean and Black Sea (Marine Species Identification Portal).

**Sensitivity assessment.** Limited evidence was available and this assessment is based on non-peer reviewed literature on species range. A 5°C decrease in temperature for one month period is likely to impact the characterizing species in winter months and therefore resistance is 'Medium', resilience is 'High' and Sensitivity is 'Low'.

#### Salinity increase (local)

**None**

Q: Low A: NR C: NR

**High**

Q: High A: Low C: Medium

**Medium**

Q: Low A: Low C: Low

The biotope occurs in 'full' salinity conditions. An increase in one MNCR salinity category to hypersaline conditions is likely to cause mortality of characterizing species. Resistance is 'None', Resilience is 'High (following restoration of habitat conditions)' and sensitivity is assessed as 'High'. This assessment is assessed based on distribution and confidence is low.

#### Salinity decrease (local)

**Medium**

Q: Low A: NR C: Low

**High**

Q: High A: Low C: Medium

**Low**

Q: Low A: Low C: Low

This biotope occurs in full salinity habitats. A change at the pressure benchmark is assessed as a decrease from full to reduced salinity(18-30 ppt)

Degraer *et al.* (2006) report that *Hesionura elongata* was found in greatest abundance outside the

near coastal zone (in samples from across the Belgium part of the North Sea). This suggests that the species is likely to occur in greater abundance in habitats with full salinity compared to variable salinity or reduced. Moolaert *et al.* (2008) also found that species communities in which *Hesionura elongata* was an indicator species were only present >16 km from the coast and displayed a positive correlation with increasing salinity.

**Sensitivity assessment.** Resistance is assessed as 'Medium' as *Hesionura elongata* and other characterizing species may decrease in abundance. Resilience is assessed as 'High' and sensitivity is assessed as 'Low'.

#### 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

No information on tidal streams was presented in the biotope description from JNCC (2015). This biotope occurs in gravelly or shelly sands. Sands are less cohesive than mud sediments and a change in water flow at the pressure benchmark may alter sediment transport patterns within the biotope. Hjulström (1939), concluded that fine sand (particle diameter of 0.3-0.6 mm) was easiest to erode and required a mean velocity of 0.2 m/s. Erosion and deposition of particles greater than 0.5 mm require a velocity > 0.2 m/s to alter the habitat. The topography of this habitat is shaped by currents and wave action that influence the formation of ripples in the sediment. Specific fauna may be associated with troughs and crests of these bedforms which may form following an increase in water flow, or disappear following a reduction in flow.

The characterizing species are infaunal and may be tolerant of changes in water flow. *Glyceria* spp. are found in areas with strong tidal streams where sediments are mobile (Roche *et al.* 2007) and in extremely sheltered areas (Connor *et al.* 2004).

**Sensitivity assessment.** This biotope probably occurs in areas subject to moderately strong water flows that are a key factor maintaining the clean sand habitat. Changes in water flow may alter the topography of the habitat and may cause some shifts in abundance. However, a change at the pressure benchmark (increase or decrease) is unlikely to affect biotopes that occur in mid-range flows and biotope sensitivity is therefore assessed as 'High' and resilience is assessed as 'High' so that the biotope is considered to be 'Not sensitive'.

#### Emergence regime changes

**Not relevant (NR)**

Q: NR A: NR C: NR

**Not relevant (NR)**

Q: NR A: NR C: NR

**Not relevant (NR)**

Q: NR A: NR C: NR

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

#### Wave exposure changes (local)

**High**

Q: Low A: Low C: Low

**High**

Q: Low A: Low C: Low

**Not sensitive**

Q: Low A: Low C: Low

As this biotope occurs in circalittoral habitats it is not directly exposed to the action of breaking waves. Associated polychaete species that burrow are protected within the sediment. They and other associated species may be indirectly affected by changes in water movement where these impact the supply of food or larvae or other processes. No specific evidence was found to assess this pressure.

**Sensitivity assessment.** The abundance of characterizing species is likely to be unaffected or increase in areas where fine sediment is removed and coarse sediment is present. However, abundance is likely to decrease in areas where fine sediment is deposited. Under the pressure benchmark levels which consider <5% change, Resistance is assessed as 'High' and resilience as 'High' and the biotope is assessed as 'Not Sensitive'.

## Chemical Pressures

	Resistance	Resilience	Sensitivity
<b>Transition elements &amp; organo-metal contamination</b>	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.

	Resistance	Resilience	Sensitivity
<b>Hydrocarbon &amp; PAH contamination</b>	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.

Contamination at levels greater than the pressure benchmark may adversely influence the biotope. Suchanek (1993) reviewed the effects of oil spills on marine invertebrates and concluded that, in general, on soft sediment habitats, infaunal polychaetes, bivalves and amphipods were particularly affected. The 1969 West Falmouth Spill of Grade 2 diesel fuel, documented by Sanders (1978), illustrates the effects of hydrocarbons in a sheltered habitat with a soft mud/sand substrata (Suchanek, 1993). The entire benthic fauna was eradicated immediately following the spill and remobilization of oil that continued for a period >1 year after the spill contributed to much greater impact upon the habitat than that caused by the initial spill. Effects are likely to be prolonged as hydrocarbons incorporated within the sediment by bioturbation will remain for a long time, owing to slow degradation under anoxic conditions. Oil covering the surface and within the sediment would prevent oxygen transport to the infauna and promote anoxia as the infauna utilise oxygen during respiration. Although this study investigates impacts on an estuarine biotope the impact on benthic infauna communities is likely to be similar in shallow sandbank biotopes.

The amphipods, *Ampelisca* sp. are very intolerant of oil contamination and the recovery of the *Ampelisca* populations in the fine sand community in the Bay of Morlaix took up to 15 years following the Amoco Cadiz oil spill (Poggiale & Dauvin, 2001). Other species present in the bivalve are more tolerant of hydrocarbons. Levell et al., (1989) classified *Cauleriella* sp. and *Glycera* sp, were all tolerant of elevated hydrocarbons and increased in abundance in the transitional zones along pollution gradients.

	Resistance	Resilience	Sensitivity
<b>Synthetic compound contamination</b>	Not Assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR	Not assessed (NA) Q: NR A: NR C: NR

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

**Radionuclide contamination**

No evidence (NEv)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

Insufficient information was available in relation to characterizing species to assess this pressure. Limited evidence is available on other infauna species. Beasley & Fowler (1976) and Germain *et al.*, (1984) examined the accumulation and transfers of radionuclides in *Hediste diversicolor* from sediments contaminated with americium and plutonium derived from nuclear weapons testing and the release of liquid effluent from a nuclear processing plant. Both concluded that the uptake of radionuclides by *Hediste diversicolor* was small. Beasley & Fowler (1976) found that *Hediste diversicolor* accumulated only 0.05% of the concentration of radionuclides found in the sediment. Both also considered that the predominant contamination pathway for *Hediste diversicolor* was from the interstitial water.

**Sensitivity assessment:** There is insufficient information available on the biological effects of radionuclides to comment further upon the intolerance of characterizing species to radionuclide contamination. Assessment is given as '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**.

Some, all be it limited evidence was returned by searches on activated carbon (AC). AC is utilised in some instances to effectively remove organic substances from aquatic and sediment matrices. Lillicrap *et al.* (2015) demonstrate that AC may have physical effects on benthic dwelling organisms at environmentally relevant concentrations at remediated sites.

**De-oxygenation**

Medium

Q: Low A: Low C: Low

High

Q: Low A: Low C: Low

Low

Q: Low A: Low C: Low

Limited evidence was returned on effects of decreased dissolved oxygen concentrations on the characterizing species.

All meiofauna have some sensitivity to extended hypoxia, although more mobile nematode species are able to emigrate into the water column in high numbers where they survive (Wetzel *et al.*, 2013). Emigration is likely to increase predation risk. Although evidence on characterizing species is lacking, densities of meiofauna populations are likely to be lower under prolonged anoxia (Moodley *et al.*, 1997).

Riedel *et al.* (2012) assessed the response of benthic macrofauna to hypoxia advancing to anoxia in the Mediterranean. The hypoxic and anoxic conditions were created for 3-4 days in a box that enclosed in-situ sediments. In general, molluscs were more resistant than polychaetes, with 90% surviving hypoxia and anoxia, whereas only 10% of polychaetes survived, the exposed *Glycera* spp. died. Sensitivity may vary between species and populations, or due to factors such as temperature as *Glycera alba* was reported to be able to tolerate periods of anoxia resulting from inputs of organic material from a wood pulp and paper mill in Loch Eil (Scotland) (Blackstock & Barnes, 1982).

**Sensitivity assessment.** Due to the limited evidence confidence in this assessment is low. A reduction in meiofauna populations is likely if deoxygenation persisted for long periods, but this is unlikely due to high water flow. As some species are likely to emigrate or maintain aerobic metabolism under low dissolved oxygen conditions, Resistance is assessed as '**Medium**', Resilience is '**High**' and Sensitivity is assessed as '**Low**'.

<b>Nutrient enrichment</b>	<b>High</b>	<b>High</b>	<b>Not sensitive</b>
	Q: Low A: NR C: NR	Q: High A: High C: High	Q: Low A: Low C: Low

Meiofauna respond to nutrient enrichment. The distribution of different meiofauna assemblages has been identified as a good tool for detecting short-term responses of the benthic domain to nutrient enrichment from sources such as river discharge (Semprucci *et al.*, 2015). In the Bay of Cadiz, Spain, abundance of meiofauna was seven times higher in the presence of macroalgae (Bohorquez *et al.*, 2013).

**Sensitivity assessment.** As the benchmark levels comply with WFD criteria for good status, Resistance is '**High**', Resilience is '**High**' and the biotope is '**Not sensitive**' at the benchmark level.

<b>Organic enrichment</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

*Protodorvillea kefersteini* was identified as a 'progressive' species, i.e. one that shows increased abundance under slight organic enrichment (Leppakoski, 1975, cited in Gray, 1979; Hiscock *et al.*, 2004). *Protodorvillea kefersteini* can become very plentiful in organically enriched habitats (Warwick *et al.*, 1986), this species was very abundant in the vicinity of a sewage outfall at Kircaldy (S.C. Hull pers. comm). *Protodorvillea kefersteini* were dominant species in muddy, organically enriched sediments (organic content approximately 25%) located about 100 and 500 m from fish farm cages, in a bay in Corsica, France (Terlizzi *et al.*, 2010). Similarly, this species was also dominant in sediments close to fish farms in Greek bays where organic matter and nitrogen content had increased.

*Glycera lapidum* has been categorized through expert judgement and literature review as AMBI Group III- Species tolerant to excess organic matter enrichment. This species may occur under normal conditions, but populations are stimulated by organic enrichment (slight unbalance situations) (Borja *et al.*, 2000, validated by Gittenberger & van Loon, 2011).

**Sensitivity assessment.** *Protodorvillea kefersteini* is tolerant of organic enrichment. At the pressure benchmark organic inputs are considered likely to represent a food subsidy and are unlikely to significantly affect the structure of the biological assemblage or impact the physical habitat. Biotope sensitivity is therefore assessed as '**High**' and resilience as '**High**' (by default) and the biotope is therefore considered to be '**Not sensitive**'.

## **A** Physical Pressures

Resistance

Resilience

Sensitivity

**Physical loss (to land or freshwater habitat)****None**

Q: High A: High C: High

**Very Low**

Q: High A: High C: High

**High**

Q: High A: High C: High

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

**Physical change (to another seabed type)****None**

Q: High A: High C: High

**Very Low**

Q: High A: High C: High

**High**

Q: High A: High C: High

This biotope is only found in circalittoral sand habitats, the characterizing polychaete species burrow or live interstitially within the sediment and would not be able to survive if the substratum type was changed to either a soft rock or hard artificial type. Consequently, the biotope would be lost altogether if such a change occurred.

**Sensitivity assessment.** The Resistance to this change is 'None', and the Resilience is assessed as 'Very low', due to the long-term nature of a change in substratum. The biotope is assessed to have a 'High' Sensitivity to this pressure at the benchmark.

**Physical change (to another sediment type)****Low**

Q: High A: Medium C: Medium

**Very Low**

Q: High A: High C: High

**High**

Q: High A: Medium C: Medium

Increase in gravel content within the Folk classes is unlikely to negatively impact the characterizing species *Hesionura elongata*. Increases in finer sand or silt are likely to reduce abundance of *Hesionura elongata* as this species is found in greater abundance in sediments with larger grain sizes, and decreases in abundance in fine sediments. Moulaert & Hostens (2007) found that higher gravel content and sediment grain size was a key environmental factor determining the presence of *Hesionura elongata*. Desprez (2000) found that a change of habitat to fine sands from coarse sands and gravels (from deposition of screened sand following aggregate extraction) changed the biological communities present.

**Sensitivity assessment.** Sediment changes are likely to alter the composition of the biological assemblage leading to biotope reclassification. Biotope resistance is therefore assessed as 'Low' (as some species may remain), biotope resilience is assessed as 'Very low' (the pressure is a permanent change) and biotope sensitivity is 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

A number of studies assess the impacts of aggregate extraction on sand and gravel habitats. Extraction would remove the infauna that may be present in this biotope. Recovery of sediments will be site-specific and will be influenced by currents, wave action and sediment availability (Desprez, 2000). Except in areas of mobile sands, the process tends to be slow (Kenny & Rees, 1996; Desprez, 2000 and references therein). Boyd *et al.*, (2005) found that in a site subject to long-term extraction (25 years), extraction scars were still visible after six years and sediment

characteristics were still altered in comparison with reference areas with ongoing effects on the biota. The strongest currents are unable to transport gravel. A further implication of the formation of these depressions is a local drop in current strength associated with the increased water depth, resulting in deposition of finer sediments than those of the surrounding substrate (Desprez *et al.*, 2000 and references therein). See the physical change pressure for assessment

**Sensitivity assessment.** Resistance is assessed as 'None' as extraction of the sediment will remove the characterizing and associated species present. Resilience is assessed as 'Medium' as some species may require longer than two years to re-establish (see resilience section) and sediments may need to recover (where exposed layers are different). Biotope sensitivity is therefore assessed as 'Medium'.

#### Abrasion/disturbance of the surface of the substratum or seabed

Medium

Q: Low A: NR C: NR

High

Q: High A: Low C: Medium

Low

Q: Low A: Low C: Low

No evidence. The characterizing species are infaunal and likely to be protected from abrasion, although movement of sediments may damage a proportion of the population. *Ampelisca* spp. inhabit surface tubes; surface abrasion will damage these and expose the amphipods to increased predation. Kaiser and Spencer (1994) found that fish preyed more heavily on *Ampelisca spinipes* following beam trawling as damage to the tubes exposed the amphipods. As *Ampelisca* is not a key characterizing species, biotope resistance based on polychaetes is assessed as 'Medium' and resilience as 'High', so that biotope sensitivity is considered to be 'Low'.

#### Penetration or disturbance of the substratum subsurface

Medium

Q: High A: High C: High

High

Q: High A: High C: High

Low

Q: High A: High C: High

This biotope may be an impoverished version of a biotope such as SS.SCS.CCS.MedLumVen or similar, which has been subject to storm disturbance or other physical disturbance such as aggregate dredging (JNCC, 2015). This suggests that the species present are either resistant to disturbance or are early colonizers following disturbance.

*Protodorvillea kefersteini* is soft-bodied and therefore vulnerable to damage by physical abrasion. However, its environmental position as burrowing interstitial species should provide a high degree of protection from activities that lead to surface abrasion only. Similarly, as a small polychaete species, living infaunally and capable of burrowing rapidly, *Hesionura elongata* is also likely to withstand physical disturbance caused by bottom towed fishing gears (such as otter or beam trawls) (Vanosmael *et al.*, 1982; Bolam *et al.*, 2014). Experiments in shallow, wave disturbed areas, using a toothed, clam dredge, found that some polychaete taxa without external protection and with a carnivorous feeding mode were enhanced by fishing. *Protodorvillea kefersteini* was one of these: large increases in abundance in samples were detected post dredging and persisting over 90 days. The passage of the dredge across the sediment floor will have killed or injured some organisms that will then be exposed to potential predators/scavengers (Frid *et al.*, 2000; Veale *et al.*, 2000) providing a food source to mobile scavengers including these species.

In a coarse gravelly substratum exposed to high current velocities the crab *Cancer pagurus* was observed to dig pits, approximately 30 cm in diameter and 10 cm deep. Experiments were conducted to identify macrobenthic recolonization processes and differences in abundance

between pits and unmanipulated areas. *Protodorvillea kefersteini* (McIntosh) (Polychaeta) showed a rapid increase in abundance at 21 days after disturbance (Thrush, 1986).

*Ampelisca brevicornis* has been categorised through expert and literature review as AMBI fisheries Group I-Species very sensitive to fisheries in which the bottom is disturbed. Their populations do not easily recover (Gittenberger & van Loon, 2011). This assessment is probably equally applicable to *Ampelisca spinipes*. *Glycera alba* and *Glycera lapidum* were categorised as AMBI fisheries Group III- second-order opportunistic species, which are sensitive to fisheries in which the bottom is disturbed. Their populations recover relatively quickly however and benefit from the disturbance, causing their population sizes to increase significantly in areas with intense fisheries (Gittenberger & van Loon, 2011). *Glycera lapidum* is present in the biotope SS.SCS.ICS.Glap which is an impoverished biotope type subject to sediment destabilisation by wave action (Connor *et al.*, 2004).

Capasso *et al.* (2010), compared benthic survey datasets from 1895 and 2007 for an area in the English Channel. Although methodological differences limit direct comparison, the datasets appear to show that large, fragile urchin species including *Echinus esculentus*, *Spatangus purpureus* and *Psammechinus miliaris* and larger bivalves had decreased in abundance. Small, mobile species such as amphipods and small errant and predatory polychaetes (*Nephtys*, *Glycera*, *Lumbrineris*) appeared to have increased (Capasso *et al.* 2010). The area is subject to beam trawling and scallop dredging and the observed species changes would correspond with predicted changes following physical disturbance (Capasoo *et al.*, 2010).

**Sensitivity assessment.** Evidence is limited but the biological assemblage present in this biotope is characterized by species that are likely to be relatively tolerant of penetration and disturbance of the sediments, with the exception of the amphipod *Ampelisca spinipes*. Either species are robust or buried within sediments or are adapted to habitats with frequent disturbance (natural or anthropogenic) and recover quickly. Biotope resistance is assessed as 'Medium' based on the characterizing polychaetes as some species will be displaced and may be predated or injured and killed. Biotope resilience is assessed as 'High' as most species will recover rapidly. Biotope sensitivity is therefore assessed as 'Low'.

#### 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

No direct evidence was found to assess this pressure, the characterizing polychaetes live infaunally and are predatory and may not be directly impacted by either a decrease or increase in suspended solids.

Amphipods are tolerant of high turbidity and gather suspended sediment for the construction of tubes. Mills (1967) reported that feeding by *Ampelisca vadorum* and *Ampelisca abdita* was initiated by the turbidity of the water surrounding the tubes. However, the feeding structures of suspension feeders such as *Ampelisca* sp. may become clogged by large increases in suspended sediment or feeding may be terminated, compromising growth. A decrease in turbidity and hence increased light penetration may result in increased phytoplankton production and hence indirectly enhance food supply for suspension feeders, including *Ampelisca* spp (although phytoplankton are not a major part of the diet). Therefore, reduced turbidity may be beneficial. In areas of high suspended sediment, a decrease may result in improved habitat quality and recruitment. However, a decrease in suspended organic particles in some areas may reduce food availability resulting in lower growth or reduced energy for reproduction and less silt available for tube production.

**Sensitivity assessment.** Based on the characterizing polychaetes biotope resistance is assessed as 'High' and resilience as 'High' so that the biotope is assessed as 'Not sensitive'.

<b>Smothering and siltation rate changes (light)</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

No evidence.

<b>Smothering and siltation rate changes (heavy)</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

No evidence.

<b>Litter</b>	<b>Not Assessed (NA)</b>	<b>Not assessed (NA)</b>	<b>Not assessed (NA)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

No evidence was returned on the impact of litter on characterizing species for this biotope, although studies show impacts from ingestion of micro plastics by sub surface deposit feeding worms (*Arenicola marina*) and toxicants present in cigarette butts have been shown to impact the burrowing times and cause DNA damage in ragworms *Hediste diversicolor*.

Litter, in the form of cigarette butts has been shown to have an impact on Ragworms. *Hediste diversicolor* showed increased burrowing times, 30% weight loss and a >2 fold increase in DNA damage when exposed to water with toxicants (present in cigarette butts) in quantities 60 fold lower than reported from urban run-off (Wright *et al.*, 2015). Studies are limited on impacts of litter on infauna and this UK study suggests health of infauna populations are negatively impacted by this pressure.

Studies of sediment dwelling, sub surface deposit feeding worms, a trait shared by species abundant in this biotope, showed negative impacts from ingestion of micro plastics. For instance, *Arenicola marina* ingests micro plastics that are present within the sediment it feeds within. Wright *et al.* (2013) carried out a lab study that displayed presence of micro plastics (5% UPVC) significantly reduced feeding activity when compared to concentrations of 1% UPVC and controls. As a result, *Arenicola marina* showed significantly decreased energy reserves (by 50%), took longer to digest food, and decreased bioturbation levels. These effects would be likely to impact colonisation of sediment by other species, reducing diversity in the biotopes the species occurs within. Wright *et al.* (2013) also present a case study based on their results, that in the intertidal regions of the Wadden Sea, where *Arenicola marina* is an important ecosystem engineer, *Arenicola marina* could ingest 33m<sup>3</sup>; of micro plastics a year.

**Sensitivity assessment.** 'No evidence' was returned to complete a sensitivity assessment, however, both microplastics and the toxicants present in cigarette butts are likely to have negative impacts on the characterizing species.

<b>Electromagnetic changes</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>	<b>No evidence (NEv)</b>
	Q: NR A: NR C: NR	Q: NR A: NR C: NR	Q: NR A: NR C: NR

**No evidence** was found on effects of electric and magnetic fields on the characterizing species.

Electric and magnetic fields generated by sources such as marine renewable energy device/array cables may alter behaviour of predators and affect infauna populations. Evidence is limited and occurs for electric and magnetic fields below the benchmark levels, confidence in evidence of these effects is very low.

Field measurements of electric fields at North Hoyle wind farm, North Wales recorded  $110\mu\text{V/m}$  (Gill *et al.*, 2009). Modelled results of magnetic fields from typical subsea electrical cables, such as those used in the renewable energy industry produced magnetic fields of between  $7.85$  and  $20\mu\text{T}$  (Gill *et al.*, 2009; Normandeau *et al.*, 2012). Electric and magnetic fields smaller than those recorded by in field measurements or modelled results were shown to create increased movement in thornback ray *Raja clavata* and attraction to the source in catshark *Scyliorhinus canicular* (Gill *et al.*, 2009).

Flatfish species which are predators of many polychaete species including dab *Limanda limanda* and sole *Solea solea* have been shown to decrease in abundance in a wind farm array or remain at distance from wind farm towers (Vandendriessche *et al.*, 2015; Winter *et al.*, 2010). However, larger plaice increased in abundance (Vandendriessche *et al.*, 2015). There have been no direct causal links identified to explain these results.

**Sensitivity assessment.** 'No evidence' was available to complete a sensitivity assessment, however, responses by flatfish and elasmobranchs suggest changes in predator behaviour are possible. There is currently no evidence but effects may occur on predator prey dynamics as further marine renewable energy devices are deployed, these are likely to be over small spatial scales and not impact the biotope.

#### Underwater noise changes

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Species within the biotope can probably detect vibrations caused by noise and in response may retreat in to the sediment for protection. However, at the benchmark level the community is unlikely to be sensitive to noise and therefore is '**Not sensitive**'.

#### Introduction of light or shading

High

Q: Low A: NR C: NR

High

Q: High A: High C: High

Not sensitive

Q: Low A: Low C: Low

All characterizing species live in the sediment and do not rely on light levels directly to feed or find prey so limited direct impact is expected. Most species will respond to the shading caused by the approach of a predator, however, their visual acuity is probably very low. Even then, additional disturbance, such as an electronic flash, caused the retraction of palps and cirri and cessation of all activity for some minutes. Visual disturbance, in the form of direct illumination during the species' active period at night, may therefore result in loss of feeding opportunities, which may compromise growth and reproduction.

As this biotope is not characterized by the presence of primary producers it is not considered that shading would alter the character of the habitat directly. More general changes to the productivity of the biotope may, however, occur. Beneath shading structures there may be changes in microphytobenthos abundance, which would affect food resources (Tait & Dipper, 1998).

Shading will prevent photosynthesis leading to death or migration of sediment microalgae altering sediment cohesion and food supply to higher trophic levels. The impact of these indirect effects is difficult to quantify.

**Sensitivity assessment.** Based on the direct impact, biotope Resistance is assessed as '**High**' and Resilience is assessed as '**High**' (by default). The biotope Sensitivity is considered to be '**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

This biotope is reported in offshore waters (JNCC, 2015) and this pressure is considered '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' to seabed habitats. **NB.** Collision by interaction with bottom towed fishing gears and moorings are 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

Characterizing species may have some, limited, visual perception. As they live in the sediment the species will most probably not be impacted at the pressure benchmark.

### Biological Pressures

Resistance

Resilience

Sensitivity

#### Genetic modification & translocation of indigenous species

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Characterizing species are not cultivated or translocated. This pressure is 'Not relevant'.

#### Introduction or spread of invasive non-indigenous species

No evidence (NEv)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence.

#### Introduction of microbial pathogens

No evidence (NEv)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence (NEv)

Q: NR A: NR C: NR

No evidence.

**Removal of target species**

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

Not relevant (NR)

Q: NR A: NR C: NR

No characterizing species are targeted directly by fishing activities at a commercial or recreational scale, this pressure is therefore 'Not relevant'.

**Removal of non-target species**

Low

Q: Low A: NR C: NR

High

Q: High A: Low C: Medium

Low

Q: Low A: Low C: Low

Species within the biotope are not functionally dependent on each other, although biological interactions will play a role in structuring the biological assemblage through predation and competition. Removal of species would also reduce the ecological services provided by these species such as secondary production and nutrient cycling.

**Sensitivity assessment.** Species within the biotope are relatively sedentary or slow moving although the infaunal position may protect some burrowing species from removal. Biotope resistance is, therefore, assessed as 'Low' and resilience as 'High' as the habitat is likely to be directly affected by removal and some species will recolonize rapidly. Therefore, sensitivity is assessed as 'Low'. Some variability in species recruitment, abundance and composition is natural and, therefore, a return to a recognisable biotope should occur within 2 years. Repeated chronic removal would, however, impact recovery.

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