Infralittoral mobile sand in variable salinity (estuaries)

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

Dr Heidi Tillin & Dr Matt Ashley

2018-03-23

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

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/162]. All terms and the MarESA methodology are outlined on the website (https://www.marlin.ac.uk)

This review can be cited as:
DOI https://dx.doi.org/10.17031/marlinhab.162.1

The information (TEXT ONLY) provided by the Marine Life Information Network (MarLIN) is licensed under a Creative Commons Attribution-Non-Commercial-Share Alike 2.0 UK: England & Wales License. Note that images and other media featured on this page are each governed by their own terms and conditions and they may or may not be available for reuse. Permissions beyond the scope of this license are available here. Based on a work at www.marlin.ac.uk
Summary

UK and Ireland classification

- **EUNIS 2008**: A5.221 Infralittoral mobile sand in variable salinity (estuaries)
- **JNCC 2015**: SS.SSa.SSaVS.MoSaVS Infralittoral mobile sand in variable salinity (estuaries)
- **JNCC 2004**: SS.SSa.SSaVS.MoSaVS Infralittoral mobile sand in variable salinity (estuaries)
- **1997 Biotope**: SS.IGS.EstGS.MobRS Sparse fauna in reduced salinity infralittoral mobile sand

Description

Very mobile sand in areas of strong tidal currents and variable salinity. No stable community is able to develop within this extremely mobile and abrasive habitat. The fauna encountered in this habitat consists of epifaunal crustaceans or relatively low numbers of robust species, such as the isopod *Eurydice pulchra* or *Mesopodopsis slabberi*. The polychaete *Capitella capitata* may occur frequently in some areas. Other taxa such as the polychaetes *Eteone* spp. and *Arenicola marina*, the mysid *Neomysis integer* and the amphipods *Bathyporeia* spp. and *Haustorius arenarius* may also be
washed in from adjacent communities. This biotope is found in tidal channels of estuaries and areas where water movement keeps silt and mud in suspension, and excludes even the more robust infauna. If oligochaetes, polychaetes and bivalves are present in any numbers within this habitat type then care must be taken to avoid the inclusion of juvenile or spat recruitment counts which may mask the presence of this biotope. This is particularly relevant as sampling usually occurs at slack water periods when settlement takes place. (Information from Connor et al., 2004; JNCC, 2015).

Depth range
0-5 m, 5-10 m, 10-20 m

Additional information
- none -

Listed By
- none -

Further information sources
Search on:

G G G JNCC
Sensitivity review

Sensitivity characteristics of the habitat and relevant characteristic species

Very mobile sand in areas of strong tidal currents and variable salinity. No stable community is able to develop within this extremely mobile and abrasive habitat. The fauna encountered in this habitat consists of epifaunal crustaceans or relatively low numbers of robust species, such as the isopod *Eurydice pulchra*. The polychaete *Capitella capitata* may occur frequently in some areas. Other taxa such as the polychaetes *Eteone* spp. and * Arenicola marina*, the mysid *Neomysis integer* and the amphipods * Bathyporeia* spp. and *Hauistorius arenarius* may also be washed in from adjacent communities. This biotope is found in tidal channels of estuaries and areas where water movement keeps silt and mud in suspension, and excludes even the more robust infauna.

Resilience and recovery rates of habitat

Biotopes in the upper reaches of estuaries are characterized by strong tidal streams and mobile sediments that create inhospitable conditions for the development of stable communities. They are home to impoverished animal communities with high abundances of opportunistic species such as *Capitella capitata* that can tolerate low and variable salinities and which typically mature rapidly and have short lifespans.

*Capitella capitata* is a classic opportunist species possessing life history traits of rapid development, many reproductions per year, high recruitment and high mortality rates (Grassle & Grassle, 1974; McCall, 1977). In favorable conditions maturity can be reached in <3 months and growth rate is estimated to be 30 mm per year. Adult potential dispersal is up to 1 km. The species complex displays reproductive variability, planktonic larvae are able to colonize newly disturbed patches but after settlement the species can produce benthic larvae brooded within the adult tube to rapidly increase the population before displacement by more competitive species (Gray, 1979). Shull (1997) demonstrated that recolonization occurs by larval settlement, bedload transport and by burrowing. Thus, when conditions are suitable, the time for the community to reach maturity is likely to be less than six months. Bolam & Fernandes (2002) and Shull (1997) noted that *Capitella capitata* can colonize azoic sediments rapidly in relatively high numbers. Experimental studies using defaunated sediments, have shown that on small scales *Capitella* can recolonize to background densities within 12 days (Grassle & Grassle, 1974; McCall, 1977). In Burry Inlet, Wales, tractor towed cockle harvesting led to a reduction in density of some species but *Capitella capitata* had almost trebled its abundance within the 56 days in a clean sandy area (Ferns et al., 2000).

Resilience assessment. As the characterizing species reaches maturity within a year, and proceed to produce more than one generation, recovery is likely to be rapid. In terms of the species present the biotope may be recognizable within 1-2 years following defaunation. Resilience is therefore assessed as 'High' for all levels of impact.

Hydrological Pressures

<table>
<thead>
<tr>
<th>Hydrological Pressures</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature increase (local)</td>
<td><strong>High</strong></td>
<td><strong>High</strong></td>
<td>Not sensitive</td>
</tr>
</tbody>
</table>

Q: High A: High C: High
Q: High A: High C: High
Q: High A: High C: High
This biotope is not characterized by a stable community. The polychaete *Capitella capitata* may be abundant in some examples. *Capitella capitata* is a cosmopolitan species in coastal marine and estuarine soft sediment systems. Grassle and Grassle (1976) used electrophoretic enzyme analysis to determine that the global population is actually made up of several genetically distinct (and apparently genetically isolated) sibling species whose distributions overlap such that local *Capitella capitata* populations actually consist of a number of co-occurring sibling species. Within the complex tolerances may vary and local acclimation is possible. *Capitella capitata* has also been recorded in extreme environments around hydrothermal vents (Gamenick & Giere, 1997) which suggests that the species complex would be relatively tolerant to an increase in temperature. Experimental evaluation of the effects of combinations of varying salinities and temperature on *Capitella capitata* were carried out by Redman (1985) and Warren (1977). Redman (1985) found that, length of life decreased as follows: 59 weeks at mid-temperature and salinity (15°C, 25ppt); 43 weeks at high temperature & high salinity (18°C, 30ppt); 33 weeks at lower temperature & high salinity (12°C, 30ppt); 17 weeks at high temperature & low salinity (18°C, 20ppt). Redman (1985) also found that net reproduction (Ro: the mean number of offspring produced per female at the end of the cohort) decreased as follows: 41.75 control; 36.69 under high salinity, high temperature; 2.19 high temperature, low salinity; 2.16 low temperature, high salinity. Therefore, a combination of changes in temperature and salinity may decrease the viability of the population.

**Sensitivity assessment.** Typical surface water temperatures around the UK coast vary, seasonally from 4-19 °C (Huthnance, 2010) although in estuaries and other shallow waters the temperature range may exceed this due to summer warming and winter cooling. The biotope, based on the characterizing species is considered to tolerate a 2 °C increase in temperature for a year. The experimental studies by Redman (1985) suggest that changes in temperature may reduce the life-span of *Capitella capitata*, however this effect is not considered to alter the character of the biotope as the short life cycle of this species should lead to rapid replenishment of the population. The experiments by Warren (1977) suggest that both the chronic and acute increases in temperature would not exceed the thermal tolerance of *Capitella capitata*. The biotope is therefore assessed as 'Not sensitive' (resistance and resilience are both 'High').
24 h was calculated. Each experiment was repeated once. Larval *Capitella capitata* were removed from the maternal tube and tested using the same method. Both adults and larvae of *Capitella capitata* were tolerant of low temperatures, 50% of the adults and 65% of the larvae surviving at -1°C.

**Sensitivity assessment.** Within the current temperature range, resistance to an acute decrease in temperature at the pressure benchmark level is assessed as ‘**High**’, Resilience is ‘**High**’ and therefore, the biotope is assessed as ‘**Not sensitive**’.

**Salinity increase (local)**

<table>
<thead>
<tr>
<th>Level</th>
<th>A:</th>
<th>C:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Salinity is a key factor structuring the biotope; therefore, an increase in salinity at the pressure benchmark could lead to changes in habitat suitability resulting in changes in distribution and extent. Some seasonal changes in salinity occur within estuaries and such shifts may be part of the natural temporal variability. For example, the location of the biotope SS.SSa.SSaVS.NintGam within the estuary may also shift upstream or downstream on a seasonal or yearly basis related in part to the freshwater flow into the estuary (JNCC, 2015) as has been noted in the Humber (Allen *et al.*, 2003).

*Capitella capitata* and other associated species occur intertidally and in areas with limited water exchange such as lagoons: these habitats may experience short-term increases in salinity due to evaporation and some resistance is therefore expected with local acclimation possible.

**Sensitivity assessment.** Salinity is a key factor structuring the biotope and changes at the pressure benchmark are likely to lead to changes in species distribution and abundance within estuarine systems. The characterizing species *Capitella capitata* display high resistance to a change to full salinity. A change to full salinity may lead to replacement of the SS.SSa.SSaVS.MoSaVS by the biotope SS.SSa.IFiSa.IMoSa as this biotope occurs in similar conditions in full salinities (JNCC, 2015). Biotope resistance is therefore, assessed as ‘**Low**’, resilience (following restoration of salinity regime) is ‘**High**’ and sensitivity is assessed as ‘**Low**’.

**Salinity decrease (local)**

<table>
<thead>
<tr>
<th>Level</th>
<th>A:</th>
<th>C:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Not sensitive</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Salinity is a key factor structuring the biotope a decrease in salinity at the pressure benchmark will lead to changes in habitat suitability leading to a shift in distribution. Some seasonal changes in salinity occur within estuaries and such shifts may be part of the natural temporal variability. For example, the location of the biotope SS.SSa.SSaVS.NintGam within the estuary may also shift upstream or downstream on a seasonal or yearly basis related in part to the freshwater flow into the estuary (JNCC, 2015) as has been noted in the Humber (Allen *et al.*, 2003).

Locations close to the freshwater source in an estuary in southern, Portugal had higher abundances of the characterizing polychaete *Capitella capitata* than locations in more saline conditions (Silva *et al.*, 2012). Opportunistic, deposit feeding polychaetes, such as *Capitella capitata* tolerate stressful conditions, and often out-compete more sensitive species due to tolerance of decreased salinity (or other pressures such as organic enrichment) (Newell, 1998).

**Sensitivity assessment.** Characterizing species, *Capitella capitata*, of the biotope...
SS.SSa.SSaVS.MoSaVs, show ‘High’ Resistance and so ‘High’ resilience to lower salinities, however reductions in salinity at the pressure benchmark to low salinity (<18ppt) may result in a transition to the biotope SS.SSa.SSaVS.NintGam, biotope resistance is assessed as ‘Low’, resilience is assessed as ‘High’ (following restoration of the salinity regime) and sensitivity is assessed as ‘Low’.

**Water flow (tidal current) changes (local)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>High</td>
<td>Low C: Medium</td>
<td>Low C: Low</td>
<td>NR</td>
</tr>
</tbody>
</table>

This biotope occurs in sheltered locations where tidal flow is normally more important than wave action as a structuring factor. Tidal flow ranges from weak (<0.5 m/s) to strong (1.5- 3 m/s) occur in the biotope SS.SSa.SSaVS.MoSaVs suggesting changes in flow velocity at the pressure benchmark are unlikely to impact biotopes that occur in the mid-range. Stronger currents lead to constant change in the size shape and position of sand banks and in some areas e.g. in the Solway Firth where tidal streams are particularly strong, sandbanks may move considerably over one tidal cycle (Perkins, 1974).

**Sensitivity assessment.** Resistance of SS.SSa.SSaVS.MoSaVS is likely to be ‘High’, Resilience is ‘High’ by default and Sensitivity assessed as ‘Not Sensitive’ as the biotope occurs across a range of flow velocities.

**Emergence regime changes**

<table>
<thead>
<tr>
<th>Level</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not relevant (NR)</td>
<td>Not relevant (NR)</td>
<td>Not relevant (NR)</td>
<td></td>
</tr>
</tbody>
</table>

Not relevant as the biotope occurs in depths of 0-5 m or deeper. Owing to the infaunal habit and/or mobility, the characterizing species are likely to be offered considerable protection or would move away to seek more favourable conditions if the limit of the biotope became intertidal, however the biotope would be lost.

**Wave exposure changes (local)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low A: NR C: NR</td>
<td>High A: Medium C: Medium</td>
<td>Low A: Low C: Low</td>
</tr>
</tbody>
</table>

This biotope is found on shores that are judged to be moderately exposed, sheltered or very sheltered to wave action (JNCC, 2015). The presence of this biotope across these three categories is considered to indicate (by proxy), that increases or decreases in wave exposure at the pressure benchmark are unlikely to lead to alterations to the biotope. Resistance is therefore assessed as ‘High’ and resilience as ‘High’ (by default) so that the biotope is considered to be ‘Not sensitive’.

**Chemical Pressures**

<table>
<thead>
<tr>
<th>Level</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition elements &amp; organo-metal contamination</td>
<td>Not Assessed (NA)</td>
<td>Not assessed (NA)</td>
<td>Not assessed (NA)</td>
</tr>
</tbody>
</table>

This pressure is Not assessed but evidence is presented where available.
Levels of contaminants that exceed the pressure benchmark may cause impacts. For most metals, toxicity to crustaceans increases with decreased salinity and elevated temperature, therefore marine species living within their normal salinity range may be less susceptible to heavy metal pollution than those living in salinities near the lower limit of their salinity tolerance (McLusky et al., 1986). Jones (1973; 1975b) found that mercury (Hg) and copper (Cu) reacted synergistically with changes in salinity and increased temperature (10°C) to become increasingly toxic to species of isopod, including *Eurydice pulchra*.

The sediment grade and the hydrographic conditions within the biotope are responsible for a high dispersion, so that instances of severe pollution are less in comparison to regions with weaker tidal flow. Bryan & Gibbs (1983) reported lower sediment-metal concentrations in sandy areas than mud near the mouth of Restronguet Creek, a branch of the Fal Estuary system which is heavily contaminated with metals.

For most metals, toxicity to crustaceans increases with decreased salinity and elevated temperature. Consequently amphipod species living within their normal salinity range may be less susceptible to heavy metal pollution than those living in salinities near the lower limit of their salinity tolerance (McLusky et al., 1986). Amphipod species characterizing the variations of the biotope in transition zones between freshwater and brackish environments are thereby, likely to suffer greater impacts from contamination.

**Hydrocarbon & PAH contamination**

<table>
<thead>
<tr>
<th>Q:</th>
<th>A:</th>
<th>C:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: NR</td>
<td>A: NR</td>
<td>C: NR</td>
</tr>
<tr>
<td>Q: NR</td>
<td>A: NR</td>
<td>C: NR</td>
</tr>
<tr>
<td>Q: NR</td>
<td>A: NR</td>
<td>C: NR</td>
</tr>
</tbody>
</table>

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.

Oil spills resulting from tanker accidents have caused deterioration of sandy communities in the intertidal and shallow sublittoral. Subtidal sediments, however, may be at less risk from oil spills unless oil dispersants are used, or if wave action causes dispersion of oil into the water column and sediment mobility drives oil in to the sediment (Elliott et al., 1998). Microbial degradation of the oil within the sediment would increase the biological oxygen demand and oxygen within the sediment may become significantly reduced.

Species within the biotope have been reported to be intolerant of oil pollution, e.g. amphipods (Suchanek, 1993). After the *Amoco Cadiz* oil spill there was a reduction in both the number of amphipod species and the number of individuals (Cabioch et al., 1978). Initially, significant mortality would be expected, attributable to toxicity. Amphipod populations have been reported not return to pre-spill abundances for five or more years, which is most likely related to the persistence of oil within sediments (Southward, 1982).

Multivariate analysis showed that the Prestige oil spill scarcely affected the macroinfaunal community structure during the study period (2003-2009) and its effect was limited just to the first campaign (2003), six months after the Prestige accident (Junoy et al., 2013). Opportunistic species such *Capitella capitata* have been shown to increase in abundance close to sources of contamination. High numbers of *Capitella capitata* have been recorded in hydrocarbon
contaminated sediments (Ward & Young, 1982; Olsgard, 1999; Petrich & Reish, 1979) and colonization of areas defaunated by high hydrocarbon levels may be rapid (Le Moal, 1980). After a major spill of fuel oil in West Virginia *Capitella capitata* increased dramatically alongside large increases in *Polydora ligni* and *Prionospio* sp. (Sanders *et al.* 1972, cited in Gray 1979). Experimental studies adding oil to sediments have found that *Capitella capitata* increased in abundance initially although it was rarely found in samples prior to the experiment (Hyland, 1985).

**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.

Bioaccumulation of conservative contaminants may occur within the infauna, but in coarse sand beaches contaminants are unlikely to accumulate owing to a relative absence of organic matter. Direct toxic effects would therefore be expected. In general, crustaceans are widely reported to be intolerant of synthetic chemicals (Cole *et al.*, 1999) and low resistance to some specific chemicals has been observed in amphipods. Powell (1979) inferred from the known susceptibility of Crustacea to synthetic chemicals and other non-lethal effects, that there would probably also be a deleterious effect on isopod fauna as a direct result of chemical application. Toxicity tests conducted by Smith (1968) indicated that survival of *Eurydice pulchra* after oil detergent treatment was above average for crustaceans. All were killed at about 10 ppm BP 1002 after 24 hours exposure, whilst at 5 ppm four out of five individuals survived when transferred to clean seawater. However, in the field a proportion of the *Eurydice pulchra* population survived exposure to lethal concentrations of BP 1002, both in the sand and water.

**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

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**.

**De-oxygenation**

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

The mobile sands that characterize this biotope may have relatively high oxygen concentration and lack a black reducing layer (JNCC, 2015).

**Sensitivity assessment.** The species characterizing the biotope are mobile and able to migrate vertically to escape unsuitable conditions. Biotop resistance is therefore assessed as **‘High’** and Resilience as **‘High’** (by default) so that the biotope is considered to be **‘Not sensitive’**.
Nutrient enrichment  

<table>
<thead>
<tr>
<th>Q:</th>
<th>A:</th>
<th>C:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Medium C: Medium</td>
<td>Not sensitive</td>
</tr>
</tbody>
</table>

This pressure relates to increased levels of nitrogen, phosphorus and silicon in the marine environment compared to background concentrations. The benchmark is set at compliance with WFD criteria for good status, based on nitrogen concentration (UKTAG, 2014).

In-situ primary production is limited to microphytobenthos within and on sediments and the high levels of sediment mobility may limit the level of primary production as abrasion would be likely to damage diatoms (Delgado et al., 1991). The characterizing amphipods feed on epipsammic diatoms attached to the sand grains (Nicolaisen & Kanneworff, 1969). Both these groups may benefit from slight nutrient enrichment if this enhanced primary production.

**Sensitivity assessment.** Nutrient level is not a key factor structuring the biotope at the pressure benchmark. In general however, primary production is low and this biotope is species poor and characterizing species may be present at low abundances (depending on wave exposure). Biotope resistance is therefore assessed as ‘High’, resilience as ‘High’ (by default) and the biotope is considered to be ‘Not sensitive’ at the pressure benchmark that assumes compliance with good status as defined by the WFD. Changes in nutrient status may indirectly affect this biotope where these result in changes in diatom production and inputs of macroalgal debris.

Organic enrichment  

<table>
<thead>
<tr>
<th>Q:</th>
<th>A:</th>
<th>C:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>High C: High</td>
<td>Not sensitive</td>
</tr>
</tbody>
</table>

The biotope occurs in mobile sand sediments where wave action leads to particle sorting, in-situ primary production is restricted to microphytobenthos although sediment mobility may restrict production levels (Delgado et al., 1991).

The isopod *Eurydice pulchra* is an aggressive and very mobile predator, feeding on polychaetes and amphipods, including *Bathyporeia pilosa*, *Bathyporeia sarsi* and *Scolelepis squamata* (Jones, 1968). An increase in secondary production of prey species would therefore be of benefit to this species.

An increase in organic enrichment that exceeded the pressure benchmark may impact the habitat and biological assemblage, particularly in more sheltered areas where deposits can accumulate. For instance, prior to the introduction of a sewage treatment scheme in the Firth of Forth (Scotland), the communities of several sandy beaches were considerably modified by gross sewage pollution (Read et al., 1983). The west end of Seafield beach exhibited extremely reduced diversity with a community dominated by *Scolelepis fuliginosa* and *Capitella capitata*, to the almost exclusion of all other species of macrofauna. However, at Portobello beach, a reduction in the number of species was recorded and the presence of a ‘dominant’ replacement community was less obvious. Furthermore, in 1977, before the introduction of the sewage scheme, meiofauna population counts at Seafield and Portobello were also conspicuously lower than for other Scottish beaches (McIntyre, 1977). Many of the major taxa commonly associated with marine intertidal meiofaunths were scarce or absent. Only nematodes, gastrotriches, harpacticoids and turbellarians were commonly identified from samples, nematodes being the most abundant taxon. Following sewage pollution abatement in 1977, dramatic changes in the macrofauna occurred. The *Scolelepis/Capitella* community declined steadily throughout 1978-1979, so that by spring 1980 species normally associated with ‘cleaner’ sandy beaches were recorded e.g. *Microthalmus* sp., *Ophiodromus flexuosus*, *Eulalia viridis*, *Eurydice pulchra Monoculodes* sp., but not
at pre-impact abundances. There was also an increase in meiofaunal diversity and reduction in dominance by certain taxa.

**Sensitivity assessment.** At the pressure benchmark organic inputs are likely to represent a food subsidy for the characterizing species 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'.

### Physical Pressures

<table>
<thead>
<tr>
<th>Physical loss (to land or freshwater habitat)</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>Very Low</td>
<td>High</td>
</tr>
</tbody>
</table>

All marine and estuarine 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.

<table>
<thead>
<tr>
<th>Physical change (to another seabed type)</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>Very Low</td>
<td>High</td>
</tr>
</tbody>
</table>

This biotope is only found in upper reaches of marine inlets, especially estuaries, where water movement is moderately strong, allowing the sedimentation of sand but not the finer silt fraction. A change to a hard or artificial substratum would significantly alter the character of the biotope. The biotope is therefore considered to have 'No' resistance to this pressure, recovery is assessed as 'Very low', as the change at the pressure benchmark is permanent. Biotope sensitivity is therefore assessed as 'High'.

<table>
<thead>
<tr>
<th>Physical change (to another sediment type)</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>Very Low</td>
<td>High</td>
</tr>
</tbody>
</table>

The benchmark for this pressure refers to a change in one Folk class. The pressure benchmark originally developed by Tillin *et al.*, (2010) used the modified Folk triangle developed by Long (2006) which simplified sediment types into four categories: mud and sandy mud, sand and muddy sand, mixed sediments and coarse sediments. The change referred to is therefore a change in sediment classification rather than a change in the finer-scale original Folk categories (Folk, 1954). The change in one Folk class is considered to relate to a change in classification to adjacent categories in the modified Folk triangle. For sand sediments, a change in one folk class may refer to a change to gravels, mixed sediments or muddy sands, sandy muds and muds.

The characterizing species, *Capitella capitata* was found in fine and medium grain size sediments and was almost completely absent in sediments without mud in the Belgium part of the North Sea (Degraer *et al.*, 2006). This suggests that a change to muddy sand is likely to result in increased abundance but a change to gravelly sand is likely to lead to reduced abundance. A change in sediment type would result in reclassification of the biotope (JNCC, 2015) and a change to mixed
or fine sediments would likely result in the establishment of a species rich and more diverse community (depending on other habitat factors). Biotope resistance is, therefore, assessed as ‘None’ and resilience as ‘Very low’ as the change at the pressure benchmark is permanent. Sensitivity is therefore ‘High’.

Habitat structure changes - removal of substratum (extraction) 

<table>
<thead>
<tr>
<th>Resistance</th>
<th>High</th>
<th>Medium</th>
</tr>
</thead>
</table>

The process of extraction is considered to remove all biological components of the biotope group. If extraction occurred across the entire biotope, loss of the biotope would occur. Recovery would require substratum to return to sand. *Capitella capitella* are opportunistic species and are likely to recolonize the area rapidly.

**Sensitivity assessment.** Resistance of the biotope to extraction is ‘None’, in mobile sands recovery is likely to be rapid and resilience is assessed as ‘High’ and biotope sensitivity is assessed as ‘Medium’.

Abrasion/disturbance of the surface of the substratum or seabed

<table>
<thead>
<tr>
<th>Abrasion</th>
<th>Low</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
</table>

Mean response of infauna and epifauna communities to fishing activities is shown to be much more negative in mud and sand communities than other habitats Collie *et al.* (2000). *Capitella capitata*, are soft bodied relatively fragile species inhabiting mucus tubes close to the sediment surface. Abrasion and compaction of the surficial layer may damage individuals. *Capitella capitata* has been categorised through literature and expert review, as AMBI fisheries Group IV- a 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). Chandrasekara and Frid (1996) found that in intertidal muds, along a pathway heavily used for five summer months (ca 50 individuals a day), some species including *Capitella capitata* reduced in abundance. Bonsdorff & Pearson (1997) found that sediment disturbance forced *Capitella capitata* deeper into the sediment, although the species was able to burrow back through the sediment to the surface again.

**Sensitivity assessment.** This biotope group is present in mobile sands, the associated species are generally present in low abundances and adapted to frequent disturbance suggesting that resistance to surface abrasion would be high. The amphipod and isopod species present are agile swimmers and are characterized by their ability to withstand sediment disturbance (Elliott *et al.* 1998). This characteristic is likely to protect this species from surface abrasion. Resistance is assessed as ‘Medium’, as abrasion is unlikely to affect high numbers of the key characterizing species, resilience is assessed as ‘High’ and biotope sensitivity is assessed as ‘Low’.
Penetration or disturbance of the substratum subsurface

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: High</td>
<td>Medium C:</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>A: Medium C:</td>
<td>Low</td>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>

This biotope group is present in mobile sands, the associated species are generally present in low abundances and adapted to frequent disturbance suggesting that resistance to abrasion and penetration and disturbance of the sediment would be high. The amphipod species present are agile swimmers and are characterized by their ability to withstand sediment disturbance (Elliott et al., 1998).

**Sensitivity assessment.** Resistance of the biotope is assessed as ‘Low’, although the significance of the impact for the biotope will depend on the spatial scale of the pressure footprint. Resilience is assessed as ‘High’, and sensitivity is assessed as ‘Low’.

Changes in suspended solids (water clarity)

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>High</th>
<th>Not sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Low</td>
<td>NR: NR</td>
<td>Q: High</td>
<td>Q: Low: Low</td>
</tr>
<tr>
<td>A: C: High: C:</td>
<td></td>
<td>High: High</td>
<td>Low: Low: Low</td>
</tr>
</tbody>
</table>

Estuaries where this biotope is often found form can be naturally turbid systems due to sediment resuspension by wave and tide action and inputs of high levels of suspended solids, transported by rivers. The level of suspended solids depends on a variety of factors including: substrate type, river flow, tidal height, water velocity, wind reach/speed and depth of water mixing (Parr et al. 1998). Transported sediment including silt and organic detritus can become trapped in the system where the river water meets seawater. Dissolved material in the river water flocculates when it comes into contact with the salt wedge pushing its way upriver. These processes result in elevated levels of suspended particulate material with peak levels confined to a discrete region (the turbidity maximum), usually in the upper-middle reaches, which moves up and down the estuary with the tidal ebb and flow.

**Sensitivity assessment.** The biological assemblage characterizing this biotope includes infaunal species *Capitella capitata* and mobile amphipods and isopods. Increased and decreased suspended solids are unlikely to have an impact and resistance is assessed as ‘High’ and resilience as ‘High’, so that the biotope is considered to be ‘Not sensitive’.

Smothering and siltation rate changes (light)

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>High</th>
<th>Not sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: High</td>
<td>Medium C:</td>
<td>Medium C:</td>
<td></td>
</tr>
<tr>
<td>A: Medium C:</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

As the tidal flow is strong in this biotope and sediments are mobile, a light deposition of finer sediment is likely to be resuspended. *Capitella capitata* has also been categorised through expert and literature review, as AMBI sedimentation Group IV – a second-order opportunistic species, insensitive to higher amounts of sedimentation. Although they are sensitive to strong fluctuations in sedimentation, their populations recover relatively quickly and even benefit. This causes their population sizes to increase significantly in areas after a strong fluctuation in sedimentation (Gittenberger & van Loon 2011). The mobile amphipods and isopods that characterize this biotope may be able to surface through a 5cm layer of deposit and strong tidal currents are likely to result in rapid resuspension and removal of fine sediments.

**Sensitivity assessment.** None of the characterizing species are likely to be significantly impacted by deposition of up to 5 cm of fine material, although a limited percentage of the characterizing
amphipod population may suffer mortality from smothering. Resistance is assessed as ‘High’. Resilience as ‘High’ and Sensitivity as ‘Not sensitive’.

Evidence for the effects of siltation by thick layers of added sediment from beach nourishment is described for the heavy deposition pressure below. The pressure benchmark for light deposition refers to the addition of a relatively thin layer of deposits in a single event. Species adapted to coarse sediments may not be able to burrow through fine sediments, or experienced reduced burrowing ability. For example, Bijkerk (1988, results cited from Essink, 1999) found that the maximal overburden through which the amphipod *Bathyporeia* could migrate was approximately 20 cm in mud and 40 cm in sand. No further information was available on the rates of survivorship or the time taken to reach the surface. As the biotope is associated with wave exposed habitats or those with strong currents, some sediment removal will occur, mitigating the effect of deposition.

*Capitella capitata* has been categorised through expert and literature review, as AMBI sedimentation Group IV – a second-order opportunistic species, insensitive to higher amounts of sedimentation. Although they are sensitive to strong fluctuations in sedimentation, their populations recover relatively quickly and even benefit. This causes their population sizes to increase significantly in areas after a strong fluctuation in sedimentation (Gittenberger & van Loon 2011).

Leewis *et al.* (2012) investigated the recovery of the characterizing species, *Eurydice pulchra* and *Haustorius arenarius*, following beach nourishment by comparing beaches that had been exposed at different times. The lengths of beach nourished varied from 0.5 kn to > 7 km. Recovery to original abundances appeared to occur within one year for the characterizing species which were in agreement with other studies (Leewis *et al.*, 2012 and references therein).

**Sensitivity assessment.** Overall smothering by fine sediments is likely to result in some mortality of characterizing polychaetes, amphipods and isopods, although most are likely to reposition. Biotope resistance is therefore assessed as ‘Low’ and Resilience as ‘High,’ biotope sensitivity is therefore assessed as ‘Medium’.

**Litter**

- Not Assessed (NA)

**Electromagnetic changes**

- No evidence (NEv)

**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 110µ 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 µT (Gill et al. 2009; Normandeau et al. 2011). 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 canicula* (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.

<table>
<thead>
<tr>
<th>Underwater noise changes</th>
<th>Not relevant (NR)</th>
<th>Not relevant (NR)</th>
<th>Not relevant (NR)</th>
</tr>
</thead>
</table>

Species within the biotope can probably detect vibrations caused by noise. However, at the benchmark level the community is unlikely to be sensitive to noise and this pressure is 'Not relevant'.

**Introduction of light or shading**

<table>
<thead>
<tr>
<th>High</th>
<th>High</th>
<th>Not sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Low A: NR C: NR</td>
<td>Q: Low A: NR C: NR</td>
<td>Q: Low A: Low C: Low</td>
</tr>
</tbody>
</table>

As this feature is not characterized by the presence of primary producers it is not considered that shading would alter the character of the habitat. No specific evidence was found to assess sensitivity of the characterizing species to this pressure. Changes in light level may, however, affect activity rhythms of the invertebrates. Amphipods within the biotope prefer shade and therefore an increase in light may inhibit activity, particularly at night when they emerge from the sediment and are most active (Jelassi et al., 2015; Ayari, 2015). Changes in light are not considered to directly affect the biotope. Resistance is assessed as 'High' and Resilience is assessed as 'High'. Biotope sensitivity ids therefore assessed as 'Not sensitive'.

**Barrier to species movement**

<table>
<thead>
<tr>
<th>High</th>
<th>High</th>
<th>Not sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Low A: NR C: NR</td>
<td>Q: High A: Low C: Medium</td>
<td>Q: Low A: Low C: Low</td>
</tr>
</tbody>
</table>

As the amphipods and isopods that characterize this biotope have benthic dispersal strategies (via brooding), water transport is not a key method of dispersal over wide distances, as it is for some marine invertebrates that produce pelagic larvae. Barriers that limit tidal excursion and flushing may reduce connectivity or help to retain larvae.

**Sensitivity assessment.** The biotope (based on the biological assemblage) is considered to have
‘High’ resistance to the presence of barriers that lead to a reduction in tidal excursion, resilience is assessed as ‘High’ (by default) and the biotope is considered to be ‘Not sensitive’.

Death or injury by collision

<table>
<thead>
<tr>
<th></th>
<th>Not relevant (NR)</th>
<th>Not relevant (NR)</th>
<th>Not relevant (NR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q:</td>
<td>NR</td>
<td>A:</td>
<td>NR</td>
</tr>
<tr>
<td>C:</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Visual disturbance

<table>
<thead>
<tr>
<th></th>
<th>Not relevant (NR)</th>
<th>Not relevant (NR)</th>
<th>Not sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q:</td>
<td>NR</td>
<td>A:</td>
<td>NR</td>
</tr>
<tr>
<td>C:</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 and this pressure is ‘Not relevant’.

### Biological Pressures

<table>
<thead>
<tr>
<th></th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetic modification &amp; translocation of indigenous species</td>
<td>Not relevant (NR)</td>
<td>Not relevant (NR)</td>
<td>Not relevant (NR)</td>
</tr>
<tr>
<td>Q:</td>
<td>NR</td>
<td>A:</td>
<td>NR</td>
</tr>
<tr>
<td>C:</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key characterizing species within this biotope are not cultivated or translocated. This pressure is therefore considered ‘Not relevant’ to this biotope.

Introduction or spread of invasive non-indigenous species

<table>
<thead>
<tr>
<th></th>
<th>Medium</th>
<th>Medium</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q:</td>
<td>Medium</td>
<td>A:</td>
<td>Medium</td>
</tr>
<tr>
<td>C:</td>
<td>Medium</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Limited evidence was available to assess the sensitivity of this biotope. Any invasive species would have to tolerate variable salinity and the mobile sediments that characterizes this biotope group and this will exclude species only able to survive in fully marine conditions and/or that require hard substratum. The North American amphipod *Gammarus tigrinus* was detected in the north-eastern Baltic Sea in 2003 and has rapidly expanded into European waters since (Jänes et al., 2015.).

Native gammarids, such as *Gammarus salinus* have almost disappeared from some habitats of the northeastern Baltic Sea and the competition for space between the invasive *Gammarus tigrinus* the native *Gammarus salinus* has been a contributing factor in certain habitats (Kotta et al. 2011). Competition for space alone did not explain the mass disappearance of *Gammarus salinus* as *Gammarus tigrinus* did not out-compete *Gammarus salinus* in all Baltic Sea habitats, limiting confidence in the evidence. However, *Gammarus tigrinus* has been identified in many UK estuaries and coasts and appears likely to influence species composition in the biotope (NBN, 2016).

**Sensitivity assessment.** Limited evidence was available for all characterizing species in relation to this pressure. *Gammarus tigrinus* displays faster reproduction and is a voracious predator that is abundant in dilute, and more turbid sites. *Gammarus tigrinus* appears to be competitively superior to native gammarids and may alter the amphipod species encountered in this biotope that are
washed in from adjacent communities. As the biotope classification is unlikely to change, the resistance of the assessed biotopes is 'High', resilience is 'High' and the biotope is assessed as 'Not sensitive'.

**Introduction of microbial pathogens**

<table>
<thead>
<tr>
<th>Pathogen Type</th>
<th>Resistance</th>
<th>Resilience</th>
<th>Sensitivity</th>
</tr>
</thead>
</table>

Marine oligochaetes host numerous protozoan parasites without apparent pathogenic effects even at high infestation levels (Giere & Pfannkuche, 1982 and references therein).

Amphipods may also be infected by a number of parasites or pathogens that alter population numbers through changes in host condition, growth, behaviour and reproduction (Green Extabe & Ford, 2014). Infection by acanthocephalan larvae, for example, may alter behaviour and responses of gammarid amphipods (Bethel & Holmes, 1977).

**Sensitivity assessment**. No evidence was found for pathogen/parasite outbreaks that may result in mass mortalities in the characterizing species and this pressure is not assessed. Sensitivity assessment based on the lack of evidence for mass mortalities in *Capitella capitata* and oligochaetes from microbial pathogens, resistance is assessed as ‘High’ and resilience as ‘High’ (by default), so that the biotope is assessed as ‘Not sensitive’.

**Removal of target species**

<table>
<thead>
<tr>
<th>Species Type</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: NR A: NR C: NR</td>
<td>Not relevant (NR)</td>
</tr>
</tbody>
</table>

No characterizing species within the biotope are targeted by commercial or recreational fishers or harvesters. This pressure is therefore considered ‘Not relevant’.

**Removal of non-target species**

<table>
<thead>
<tr>
<th>Species Type</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q: Low A: Low C: Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

The loss of the key characterizing species through unintentional removal would alter the character of the biotope. The ecosystem services such as secondary production and food for higher trophic levels would be lost.

**Sensitivity assessment**. Biotope resistance to loss of the characterizing species is assessed as 'Low' as the burrowing lifestyle and mobility of species mean that a proportion of the population may escape incidental removal. Resilience is assessed as ‘High’ based on in-situ recovery and migration from adjacent populations and sensitivity is therefore assessed as 'Low'. Despite the loss of a high proportion of the characterizing species the biotope would still be classified as belonging to the SS.SSa.SSaVS.MoSaVS group as some examples, particularly those with strong tidal currents, contain few species at low abundance (JNCC, 2015).
Bibliography


https://www.marlin.ac.uk/habitats/detail/162
Infralittoral mobile sand in variable salinity (estuaries) - Marine Life Information Network

Date: 2018-03-23

Infralittoral mobile sand in variable salinity (estuaries) - Marine Life Information Network


https://www.marlin.ac.uk/habitats/detail/162
macrofauna to human trampling: An urban vs. natural beach system approach. *Marine Environmental Research*, 103, 36-45.

https://www.marlin.ac.uk/habitats/detail/162