Sabellaria spinulosa with kelp and red seaweeds on sand-influenced infralittoral rock

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

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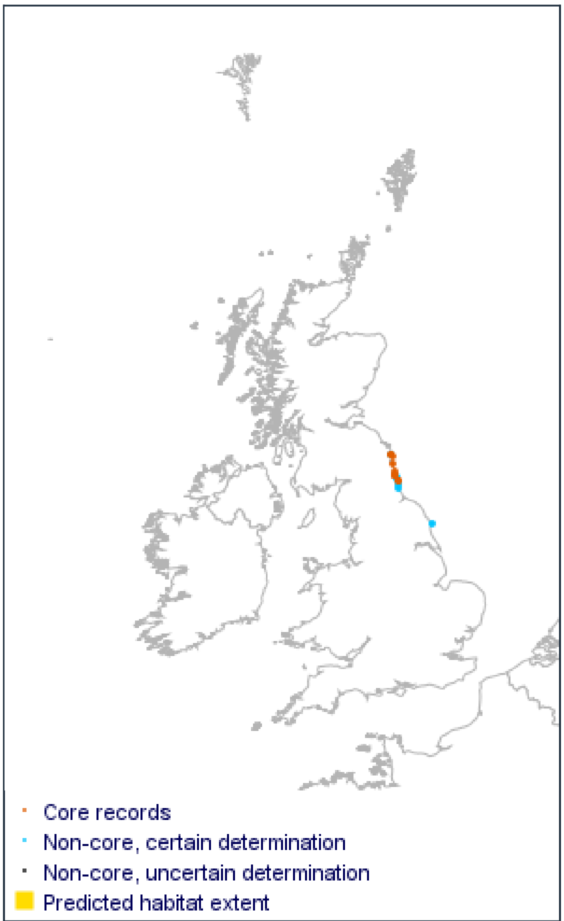

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Biotope distribution data provided by EMODnet Seabed Habitats (www.emodnet-seabedhabitats.eu)

Researched by Jacqueline Hill **Refereed by** This information is not refereed.

Summary

UK and Ireland classification

EUNIS 2008	A3.2145	*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock
JNCC 2015	IR.MIR.KR.Lhyp.Sab	*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock
JNCC 2004	IR.MIR.KR.Lhyp.Sab	*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock
1997 Biotope	IR.MIR.SedK.SabKR	*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock

Description

Sabellaria spinulosa, sediment-tolerant red seaweeds and occasional *Laminaria hyperborea* characterize this biotope. Some of the richer examples of this biotope (e.g. Luce Bay) also have a rich fauna of ascidians, sponges, hydroids and bryozoans. A similar biotope is also found in the circalittoral zone, where it lacks the algal component (MCR.Sspi). (Information taken from the Marine Biotope Classification for Britain and Ireland, Version 97.06: Connor *et al.*, 1997a, b).

Depth range

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Additional information

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Listed By

- none -

Further information sources

Search on:

G G G JNCC

Habitat review

Ecology

Ecological and functional relationships

- *Sabellaria spinulosa* colonize scoured rock rapidly and may be sufficiently dense to prevent the settlement or attachment of other species to the substratum, although the crust itself may act as a substratum for other fauna and flora.
- *Sabellaria spinulosa* requires suspended sand grains in order to form its tubes; reef communities therefore, only occur in turbid areas where sand is placed into suspension by water movement.
- Kelps are major primary producers, up to 90% of kelp production enters the detrital food web and kelp is probably a major contributor of organic carbon to surrounding communities (Birkett *et al*. 1998b).
- Kelp fronds, stipes and holdfasts provide substrata for distinct communities of species, some of which are found only or especially on kelp plants. Kelp holdfasts provide both substrata and refugia for a huge diversity of macroinvertebrates. Kelp beds are diverse species rich habitats and over 1,800 species have been recorded in the UK kelp biotopes (Birkett *et al*. 1998b).
- Epiphytes and understorey algae are grazed by a variety of amphipods, isopods and gastropods, e.g. *Littorina* spp., *Acmaea* spp., *Haliotis tuberculata*, *Aplysia* and rissoid gastropods (Birkett *et al*., 1988b).
- *Sabellaria spinulosa* and other associated organisms in the biotope, may be an important source of food for the pink shrimp *Pandalas montagui*. The biotope may also be an important feeding ground for fish.
- Suspension feeders, such as *Sabellaria spinulosa*, *Ophiothrix fragilis*, sponges, bryozoans and ascidians are the dominant fauna in the biotope. The top shell *Steromphala cineraria* is the only common grazer in the biotope although *Echinus esculentus* is also sometimes present. The anemone *Urticina felina* is a passive carnivore, waiting to trap animals that stumble into its tentacles.
- Although not present in large numbers in the biotope *Echinus esculentus* can have an influence in the biotope. The species graze the under-canopy and understorey algae, including juvenile kelp sporophytes, together with epiphytes and epifauna on the lower reaches of the laminarian stipe. Wave action and abrasion between stipes probably knocks urchins off the upper stipe. It is likely that urchins will graze the *Sabellaria spinulosa*. Sea urchin grazing may maintain the patchy and species rich understorey epiflora/fauna by preventing dominant species from becoming established.

Seasonal and longer term change

- *Sabellaria spinulosa* is a fast growing annual species and crusts up to 2-3cm thick can develop within one growing season. High recruitment of *Sabellaria spinulosa* may result in 'reinforcement' of the crust of tubes on the substratum. Reproductive seasonality of *Sabellaria spinulosa* is unclear, but spawning probably occurs largely over winter and settlement in early spring (Holt *et al*., 1998).
- New blades of *Laminaria hyperborea* grow in winter between the meristem and the old blade, which is shed in early spring or summer together with associated species growing on its surface. Larger and older plants become liable to removal by wave action and storms due to their size and weakening by grazers such as *Patella pellucida*. Loss of older

plants results in more light reaching the understorey, temporarily permitting growth of algae including *Laminaria hyperborea* sporelings.
- Many species of red algae are perennial exhibiting strong seasonal patterns of growth and reproduction. *Delesseria sanguinea*, for example, produces new blades in February and grows to full size by May - June becoming increasing battered or torn and the lamina are reduced to midribs by December (Maggs & Hommersand 1993).
- Several other species, including hydroids, are annuals and abundance may show seasonal changes.

Habitat structure and complexity

The crusts of *Sabellaria spinulosa* appear to have a considerable influence on community structure by providing a single species sheet that may be unstable for other species to attach to. The development of a diverse community may be dependent on space being made in the *Sabellaria* crust and other species settling on the rock. Diversity on crusts is not high. It might be that the richest communities occur where *Sabellaria* is not dominant. This is in contrast to *Sabellaria spinulosa* reefs on mobile substrata such as cobbles and pebbles which are stabilised by the crusts and often have a higher diversity and abundance of fauna than nearby areas (George & Warwick, 1985) with fauna such as sponges, ascidians, hydroids and bryozoans attached to the crust. The presence of kelp plants, and other algae, contribute to increases in structural complexity as the fronds, stipe and holdfast provide substratum and shelter for a great diversity and abundance of epiphytic algae and sessile fauna.

Productivity

Productivity in the biotope is a mixture of primary and secondary productivity. Kelps are the major primary producers in UK marine coastal waters producing nearly 75 % of the net carbon fixed annually on the shoreline of the coastal euphotic zone (Birkett *et al*. 1998b). Kelp plants produce 2.7 times their standing biomass per year. Kelp detritus, as broken plant tissue, particles and dissolved organic material supports soft bottom communities outside the kelp bed itself. The kelps reduce ambient levels of nutrients, although this may not be significant in exposed sites, but increase levels of particulate and dissolved organic matter within the bed. However, kelp abundance, and hence productivity is not as high in the MIR.SabKR biotope as some other infralittoral biotopes (e.g. see EIR.LhypR). Many of the other species in the biotope, such as *Sabellaria spinulosa* and *Ophiothrix fragilis*, are suspension feeders feeding on detritus and phytoplankton.

Recruitment processes

Most species present in the MIR.SabKR biotope possess a planktonic stage (gamete, spore or larvae) which float in the plankton before settling and metamorphosing into the adult form. This provides the potential for dispersal over considerable distances allowing many of the species in the biotope to rapidly colonize new areas that become available such as in the gaps often created by storms. The recruitment processes of key characteristic or dominant species are described here.

- Recruitment of *Sabellaria spinulosa* can be very variable. The larvae of *Sabellaria spinulosa* spend between six weeks and two months in the plankton (Wilson, 1970b) and so dispersal range is likely to be considerable. Larvae are strongly stimulated to settle by cement secretions of adult or newly settled individuals. In the absence of suitable stimulation metamorphosis and settlement occurs but always more slowly. High recruitment of *Sabellaria spinulosa* may result in 'reinforcement' of the crusts of tubes on the substratum.

- *Laminaria hyperborea* produces vast numbers of spores, however they need to settle and form gametophytes within about 1 mm of each other to ensure fertilisation and therefore may suffer from dilution effects over distance. Gametophytes can survive darkness and develop in the low light levels under the canopy. However, young sporelings develop slowly in low light. Loss of older plants provides the opportunity to develop into adult plants. Most young sporophytes (germlings) appear in spring but can appear all year round depending on conditions (Birkett *et al*. 1998b).
- Rhodophyceae have non flagellate, and non-motile spores that stick on contact with the substratum. Norton (1992) noted that algal spore dispersal is probably determined by currents and turbulent deposition. However, red algae produce large numbers of spores that may settle close to the adult especially where currents are reduced by an algal turf or in kelp forests.
- Reproductive types of *Lithophyllum incrustans* occur from October to April but tail-off into summer. It has been calculated that 1 mm x 1mm of reproductive thallus produces 17.5 million bispores per year with average settlement of only 55 sporelings/year (Edyvean & Ford, 1984). However, spores will settle and new colonies will arise rapidly on bare substratum although growth rate is slow (2-7 mm per annum - see Irvine & Chamberlain, 1994).
- Some characterizing species may not recruit so readily, for instance the larvae of *Urticina felina* inhabits the water column, but is not considered to be truly pelagic and probably has limited dispersal abilities (Solé-Cava *et al*., 1994).

Time for community to reach maturity

Sabellaria spinulosa seems in many cases to acts as a fast growing annual and early colonizer, but on more stable reefs the animals seem to be able to live for a few years. A typical lifespan for the littoral *Sabellaria alveolata* living in colonies forming reefs on bedrock in Duckpool was 4-5 years (Wilson, 1971). Areas where *Sabellaria spinulosa* had been lost due to winter storms appeared to recolonize quickly up to the maximum observed crust thickness (2.4cm) during the following summer (R. Holt pers. comm. cited in Holt *et al*., 1998). Linke (1951) reported that spawning of intertidal *Sabellaria spinulosa* reefs in the southern North Sea took place during the first and second years. Thus, in ideal conditions, sexual maturity of *Sabellaria spinulosa* is probably reached within the first year. The algae in the biotope are also likely to reach maturity fairly rapidly. Experimental clearance experiments in the Isle of Man (Kain 1975; Kain, 1979) showed that *Laminaria hyperborea* returned to near control levels of biomass within 3 years at 0.8 m and the species reaches sexual maturity at between 2 and 6 years of age. Sivertsen (1991 cited in Birkett *et al*. 1998b), showed that kelp populations stabilise about 4-5 years after harvesting. However, many of the other species, the anemone *Urticina felina* and coralline algae for example, within the reef matrix are slow growing and long-lived with a very low turnover rate. *Lithophyllum incrustans* in particular is very slow growing (2-7 mm per annum) and colonies may be up to 30 years old (Irvine & Chamberlain, 1994). Species diversity on the *Sabellaria* crust is likely to increase with age of the reef so although most components of the biotope can reach maturity within several years full community diversity and complexity is likely to take much longer.

Additional information

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Preferences & Distribution

Habitat preferences

Depth Range	
Water clarity preferences	
Limiting Nutrients	Nitrogen (nitrates), Phosphorus (phosphates)
Salinity preferences	Full (30-40 psu)
Physiographic preferences	Open coast
Biological zone preferences	Infralittoral
Substratum/habitat preferences	Bedrock, Large to very large boulders, Small boulders
Tidal strength preferences	Very Weak (negligible), Weak < 1 knot (<0.5 m/sec.)
Wave exposure preferences	Moderately exposed
Other preferences	High levels of suspended sediment

Additional Information

- No specific information is available regarding temperature preferences of tolerances for this biotope. The distribution of the key structural species *Sabellaria spinulosa* and *Laminaria hyperborea* extend to the north and south of the British Isles and so will be exposed to higher and lower temperatures than experienced locally.
- High levels of suspended sediment are likely to be required in order for *Sabellaria spinulosa* to construct its tubes.

Species composition

Species found especially in this biotope

Rare or scarce species associated with this biotope

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Additional information

Sensitivity review

Explanation

Sabellaria spinulosa is the key characterizing species giving the name to the biotope. The biotope is distinguished from MCR.Sspi, a similar biotope found in the circalittoral zone, by the presence of occasional kelp plants, typically *Laminaria hyperborea* and sediment tolerant red algae such as the foliose *Delesseria sanguinea* and the encrusting *Lithophyllum incrustans*. The anemone *Urticina felina* is often found in the biotope.

Species indicative of sensitivity

Community Importance	Species name	Common Name
Important characterizing	*Delesseria sanguinea*	Sea beech
Important characterizing	*Laminaria hyperborea*	Tangle or cuvie
Important characterizing	*Lithophyllum incrustans*	Encrusting coralline alga
Key structural	*Sabellaria spinulosa*	Ross worm
Important characterizing	*Urticina felina*	Dahlia anemone

Physical Pressures

	Intolerance	Recoverability	Sensitivity	Richness	Confidence
Substratum Loss	High	Moderate	Moderate	Major decline	Moderate

The key structural species *Sabellaria spinulosa* and almost all the other species, including the important structural and characterizing species (*Laminaria hyperborea*, *Delesseria sanguinea* and *Lithophyllum incrustans*) and the associated ascidians, sponges, hydroids and bryozoans are permanently attached to the substratum and cannot reattach if removed. Thus, substratum loss would cause the loss of the entire biotope and so intolerance is high. Recovery from total loss of the biotope could take a long time and is set to moderate - see additional information below for full rationale.

	Intolerance	Recoverability	Sensitivity	Richness	Confidence
Smothering	Low	Very high	Very Low	Decline	Low

The biotope is found on sand influenced rock and many of the characterizing species are tolerant of some smothering by sediment. *Sabellaria spinulosa*, for example, requires the presence of sand grains for tube construction and Holt *et al*. (1998) observed that damage of adjacent populations of *Sabellaria spinulosa* by sediment plumes from gravel extraction was not particularly high. The similar *Sabellaria alveolata* can tolerate several weeks of smothering by sand (Wilson, 1971). Kelp and the red algae present in the biotope, such as *Lithophyllum incrustans* and *Delesseria sanguinea*, are also sediment tolerant and unlikely to be lost from smothering as plants can float above smothering material. However, several of the sessile species in the biotope, such as the suspension feeding ascidian *Botryllus schlosseri* and the sponge *Halichondria panicea* are likely to be damaged or killed because smothering will clog feeding and/or respiratory flows and these animals have no mechanism for expanding above smothering material. Some, most likely such as the sea anemone *Urticina felina* may survive smothering material providing deoxygenation does not occur. Therefore, the overall impact is that species diversity would therefore probably decline but the overall biotope should remain functionally intact if smothered for one month and so intolerance is reported to be low. On return to pre-smothered conditions recovery should be fairly rapid as organisms self clean.

	Intolerance	Recoverability	Sensitivity	Richness	Confidence
Increase in suspended sediment	Low	Immediate	Not sensitive	Minor decline	Moderate

The biotope occurs in high turbidity areas. The distribution of *Sabellaria spinulosa* in reef form appears to be restricted to areas subject to relatively high sediment loadings so the species is likely to be relatively tolerant of an increase in suspended sediment for a period of a month. Established *Laminaria hyperborea* are likely to be relatively tolerant of increased siltation although it may decrease photosynthetic potential for the duration of the event and affect holdfast fauna, encouraging suspension feeders and silt tolerant communities (Moore 1973a&b; Edwards 1980). Sheppard *et al*. (1980) noted that increased suspended sediment (measured as clarity) reduced holdfast species diversity due to increased dominance of suspension feeders). Most of the other species in the biotope, such as the foliose and encrusting red algae, sponges and suspension feeders also have low intolerance to suspended sediment although there may be some clogging of suspension feeding apparatus. However, for a period of a month impacts will be slight. Thus, the species composition and nature of the biotope is not likely to change so intolerance of the biotope is reported to be low and recovery will be immediate as feeding rates return to pre-impact levels.

Decrease in suspended sediment	Low	High	Moderate	Decline	Low

A decrease in suspended sediment is likely to have an impact on the biotope because the key structural species, *Sabellaria spinulosa*, requires sand particles to build its tubes and for its food supply. Therefore, a decline would probably result in reduced growth and worm density. *Laminaria hyperborea* is likely to improve in productivity as a result of decreased suspended sediment as available light increases and siltation of the fronds will not occur. Decreased siltation although it may affect holdfast fauna encouraging more species associated with clearer waters (Moore, 1973a&b; Edwards, 1980). Some of the suspension feeding species in the biotope, such as sponges, ascidians and *Ophiothrix fragilis* may be intolerant of reduced levels of suspended sediment as food availability is reduced. However, the benchmark decrease is only for a month so any impacts on the biotope are expected to be minimal and so intolerance is reported to be low.

Dessication	Intermediate	High	Low	Decline	Low

The biotope is predominantly sublittoral but the key structural species, *Sabellaria spinulosa*, is occasionally found in the intertidal (as individuals rather than dense crusts) and so has some ability to resist desiccation. The important characterizing species, kelp and red algae however, are generally sub-tidal and are highly intolerant of desiccation. Many of the other species in the biotope (e.g. *Delesseria sanguinea*, *Botryllus schlosseri* and *Halichondria panicea*) are found in the intertidal and have intermediate intolerance to desiccation. Exposure of the biotope to an hour of air and sunshine per day may cause the loss of some species at the upper limit of its range but the biotope as a whole would probably remain physically and functionally intact and so intolerance is reported to be intermediate. See additional information below for recovery.

Increase in emergence regime	Intermediate	High	Low	No change	Low

Sabellaria spinulosa is sessile and typically subtidal but is also occasionally found in the low intertidal. This means the species can tolerate some emergence, however, increased emergence will reduce the amount of time available for feeding and some individuals at the upper limit of the species range will probably be killed. *Laminaria hyperborea* is primarily a subtidal species and is likely to be highly intolerant of increases in emergence. Its upper limit on the shore is in part dependant on the emergence regime as well as competition from more tolerant species such as *Laminaria digitata*. Therefore, an increase in emergence is likely to depress the upper limit of this species also. Thus, the overall impact on the biotope is likely to be a depression of the upper limit of the biotope and so intolerance is reported to be intermediate. Some sessile species, such as sea squirts and sponges, are unlikely to survive a long term increase in emergence. However, in the presence of a suitable substratum the biotope is likely to re-establish further down the shore. Recovery is likely to be high – see additional information for recovery.

Decrease in emergence regime	Tolerant		Not sensitive*	No change	High

The biotope is mainly subtidal, but also occurs at very low water so becomes exposed at very low water. A decrease in emergence is likely to be favourable and may allow the biotope to extend its distribution to previously intertidal areas.

Increase in water flow rate	Tolerant	Not relevant	Not relevant	Rise	Moderate

Sabellaria spinulosa appears to require suspended sand grains in order to form its tube so the biotope only occurs in turbid waters where sand is placed into suspension by water movement (Holt *et al*., 1998). Rees & Dale (1993) describe the typical habitat of *Sabellaria spinulosa* as occurring in moderate to strong tidal flow (see glossary). However, the relative importance of tidal versus wave induced movements in unclear. This biotope occurs in weak to very weak tidal streams but since *Sabellaria spinulosa* is often found in stronger water currents it is likely to be relatively tolerant of an increase. Increased water movement also favours filter feeding faunal groups so the richness of sponges and ascidians may increase. Therefore, the biotope as a whole is likely to be relatively tolerant of an increase in water flow rates.

Decrease in water flow rate	Intermediate	High	Low	Minor decline	Low

Sabellaria spinulosa requires suspended sand grains in order to form its tube so the biotope only occurs in turbid waters where sand is placed into suspension by water movement (Holt *et al*., 1998). Rees & Dale (1993) describe the typical habitat of *Sabellaria spinulosa* as occurring in moderate to strong tidal flow (see glossary). This biotope occurs in weak to very weak tidal streams so a decrease in water flow rates would probably result in a reduction in abundance of *Sabellaria spinulosa* because reductions in water flow rate may reduce the amount of suspended sand grains available. This may limit growth of the worms or reduce the density of worms that can be supported in a particular area. In very slow water flow rates *Laminaria hyperborea* may be replaced by another kelp species although this is not likely to affected the overall nature of the biotope. The associated algal flora and suspension feeding faunal populations change significantly with different water flow regimes. Since the population of *Sabellaria spinulosa* may be reduced by a decrease in water flow rate intolerance is set to intermediate. Recovery should be high - see additional information below.

Increase in temperature	Intermediate	High	Low	Minor decline	Moderate

The geographical distribution of many of the characterizing species in the biotope extends south of the British Isles. Long term slight increase or decrease in temperature is likely to have little effect on British populations of *Sabellaria spinulosa* as global distribution extends further south to the Mediterranean Sea. *Laminaria hyperborea* is stenothermal, and sporophytes are reported to tolerate an upper temperature of 15 -20 °C, and that the lethal limit would be between 1-2 °C above this normal temperature tolerance. Many species of red algae, such as *Delesseria sanguinea* and *Palmaria palmata*, are not tolerant of acute increases in temperature which is likely to result in impaired growth or death. Temperature increase may affect growth, recruitment or interfere with the reproductive cycle in some species, e.g. temperatures below 13 °C are required for new blade growth required in *Delesseria sanguinea*. Thus, it appears that a long term increase of 2 °C in temperature could result in the loss of some key species in the biotope and so intolerance is reported to be intermediate. Recovery should be high - see additional information below for rationale.

Decrease in temperature Low Very high Moderate No change Low

The geographical distribution of many of the characterizing species in the biotope extends north of the British Isles and many species are especially found in cooler waters. *Sabellaria spinulosa* is reported to be intermediately intolerant of temperature changes. However, *Sabellaria spinulosa* was not affected by the cold winter of 1963 (Crisp (ed.), 1964) so the species is tolerant of decreases in temperature. Birkett *et al*. (1998) suggest that kelps are stenothermal (intolerant of temperature change) and that upper and lower lethal limits for kelp would be between 1-2 °C above or below the normal temperature tolerances. *Laminaria hyperborea* sporophytes are reported to tolerate lower temperatures of 0 -19 °C (depending on season). Given its distribution in the North Atlantic this species is likely to be tolerant of a decrease in temperature. Temperature increase may affect growth, recruitment or interfere with the reproductive cycle in some species, e.g. temperatures below 13 °C are required for new blade growth required in *Delesseria sanguinea*. The biotope is therefore, likely to be tolerant of decreases in temperature and so intolerance is set to low. It should only take a short time for species growth rates to return to normal following periods of low temperature and so a rank of very high is reported.

Increase in turbidity Low High Low No change Moderate

High turbidity reduces incident light for photosynthesis. The kelps should not be significantly affected for the period of increased turbidity at the benchmark level. A small reduction in photosynthesis and growth may occur however. The red algae present in the biotope, such as *Delesseria sanguinea* are adapted to low light conditions so an increase in turbidity is unlikely to be fatal in the short term but in the long term will result in lower growth rates or a reduction in depth to which they occur rather than loss of all algae in the biotope. Intolerance is reported to be low. Recovery will be very high as normal photosynthetic rates return as previous turbidity conditions resume.

Decrease in turbidity Tolerant* Very high Not sensitive No change Moderate

The increase in light availability resulting from a decrease in turbidity will only affect the algae in the biotope probably increasing growth rates and the depth to which many species can occur. An increase in algal growth may have a smothering effect on some understorey species although at the level of the benchmark this is not likely to be significant. The other species in the biotope are likely to be not sensitive to changes in light attenuation resulting from turbidity changes.

Increase in wave exposure Intermediate High Low Minor decline Low

The key structural species, *Sabellaria spinulosa*, requires sufficient water movement to suspend sand particles into suspension for tube building and so is found in quite wave exposed areas. However, where the species exists as crusts, death may occur through break up by wave action and so increased exposure will result in potentially shorter colony life. Therefore, it seems that *Sabellaria spinulosa* crusts may be more intolerant of an increase in wave exposure than individuals. Increased wave exposure is also likely to remove older kelp plants, especially from the upper limit of their range. Intolerance of the biotope is set to intermediate. See additional information below for rationale.

Decrease in wave exposure Intermediate High Low Minor decline Low

The key structural species, *Sabellaria spinulosa*, inhabits a wide range of wave exposures (from sheltered to very exposed). However, decreases in wave exposure, where tidal streams are weak, may reduce the amount of available sand grains suspended in the water column, potentially limiting growth of the tube worms and restricting abundance and hence reducing the size of crusts. Decreased wave exposure is not likely to significantly affect *Laminaria hyperborea* plants, but may result in the loss of foliose red algae and an increase in abundance of filamentous red algae. In very sheltered situations *Laminaria hyperborea* is replaced by *Saccharina latissima* although this is unlikely to significantly affect the overall nature of the biotope. However, because a decrease in wave exposure may reduce the abundance of *Sabellaria spinulosa* intolerance of the biotope is set to intermediate. Recovery is likely to be high - see additional information below.

Noise	Tolerant	Not relevant	Not relevant	Not relevant	Moderate

The key structural species, *Sabellaria spinulosa* and the other characterizing species in the biotope, predominantly algae and sessile filter feeders, are not considered sensitive to noise disturbance. It is possible that predator avoidance behaviour in *Ophiothrix fragilis* may be triggered by noise vibrations although this has not been recorded.

Visual Presence	Tolerant	Not relevant	Not relevant	Not relevant	Moderate

The key structural species, *Sabellaria spinulosa* and the other characterizing species in the biotope, predominantly algae and sessile filter feeders, are not considered sensitive to visual disturbance.

Abrasion & physical disturbance	Intermediate	High	Low	Minor decline	Moderate

Thin crusts of *Sabellaria spinulosa* seem to be moderately fragile and are quite easily broken up by storms or physical impacts and there is much evidence that reefs can be very badly damaged by fishing gear (Holt *et al*., 1998). Thus, abrasion at the level of the benchmark, is likely to cause damage to or loss of some of the *Sabellaria spinulosa* crust and loss of some of the organisms that live in or on it. Recovery is likely to high - see additional information below for rationale.

Displacement	High	Moderate	Moderate	Decline	Low

The key structural species (*Sabellaria spinulosa*) and the algal species are permanently attached to the substratum and would be destroyed by displacement resulting in loss of the biotope. Intolerance is therefore, set to high. However, displacement may not affect some of the species that may live in the biotope (e.g. *Urticina felina*, *Ophiothrix fragilis*), The biotope may also contain other permanently attached species (e.g. *Halichondria panicea*) which are likely to be highly intolerant of displacement. Mobile species in the biotope are unlikely to be affected. With the total loss of the key structuring species recovery of the biotope can take a long time and a rank of moderate is recorded - see additional information below for rationale.

Chemical Pressures

	Intolerance	Recoverability	Sensitivity	Richness	Confidence
Synthetic compound contamination	Low	Very high	Very Low	Decline	Moderate

Sabellaria spinulosa seems to be very tolerant of pollution by synthetic chemicals (Holt *et al*., 1998). The species was found closer to the acidified halogenated effluent discharge polluting Amlwch Bay in North Wales than any other organism, and was found in larger numbers at intermediate distances away (Hoare & Hiscock, 1974). Adult *Laminaria hyperborea* was one of the most tolerant algae at Amlwch although the richness of epifauna/flora decreased near the source of the effluent and red algae were absent from *Laminaria hyperborea* stipes within Amlwch Bay. Holt *et al*. (1995) state that mature *Laminaria hyperborea* may be relatively tolerant of chemical pollution probably due to the presence of alginates. Holt *et al.* (1995) suggested that *Delesseria sanguinea* is probably generally sensitive of chemical contamination although other red algae may be less sensitive. The sea anemone *Urticina felina* also survived in Amlwch Bay (Hoare & Hiscock, 1974). However, although many of the key species appear to be tolerant of chemicals many other organisms in the biotope are likely to be highly intolerant and increases in contaminants would probably result in reduced species diversity. However, overall, most species in the biotope are likely to be largely unaffected and an intolerance rank of low is reported. It is also possible that, because the key structuring species, *Sabellaria spinulosa*, is so tolerant of polluted conditions, the biotope may replace others where pollution is high. Recovery from sublethal effects is likely to be rapid.

Heavy metal contamination	Low	High	Low	Decline	Moderate

The key structural species in the biotope, *Sabellaria spinulosa*, was recorded from polluted waters in the northeast of England with higher levels of zinc, lead and copper than normally found in coastal waters (Jones, 1972). *Laminaria hyperborea* was also present at polluted sites, though with lower growth rates, as well as the anemone *Urticina felina*. However, some of the other species in the biotope such as *Echinus esculentus*, which were absent from or occurred only rarely in polluted sites (Jones, 1972), are more intolerant of heavy metals. Therefore, the biotope would appear to tolerate increased levels of heavy metal pollution and may actually replace other more intolerant biotopes although species diversity is likely to suffer as pollution increases. Recovery is likely to be high - see additional information below for rationale.

Hydrocarbon contamination				Insufficient information	Not relevant

It is not known how the key structural species in this biotope, *Sabellaria spinulosa*, reacts to hydrocarbon contamination. Kelps, such as *Laminaria hyperborea*, have a mucilaginous slime layer coating that may protect them from smothering by oil. Hydrocarbons in solution reduce photosynthesis and may be algicidal. However, Holt *et al.* (1995) reported that oil spills in the USA and from the *Torrey Canyon* had little effect on kelp forest. Similarly, surveys of subtidal communities at a number sites between 1 -22.5m below chart datum, including *Laminaria hyperborea* communities, showed no noticeable impacts of the *Sea Empress* oil spill and clean up (Rostron & Bunker, 1997). Echinoderms such as *Ophiothrix fragilis* and *Echinus esculentus* which may be found in this biotope are generally considered to be very intolerant of marine pollution. Laboratory experiments have shown *Ophiothrix fragilis* to be intolerant of hydrocarbon pollution (Newton & McKenzie, 1995). However, in the absence of information regarding *Sabellaria spinulosa* it is not possible to assess the intolerance of the biotope.

Radionuclide contamination				Not relevant	Not relevant

Insufficient information.

Changes in nutrient levels	Low	High	Low	Minor decline	Moderate

Sabellaria spinulosa has been observed to be abundant at sites close to sewage discharge (Walker & Rees, 1980) and so is probably tolerant of changes in nutrient levels. The species was also abundant at sites in the northeast of Britain affected by high levels of nutrient and sewage pollution and high turbidity. Other species, such as *Laminaria hyperborea* and the red algae *Delesseria sanguinea* and *Lithophyllum incrustans*, are also tolerant of changes in nutrient levels although growth rates may fall if nutrient levels decline drastically. Nevertheless, the biotope appears to be tolerant of changes in concentration of nutrients. There may be some species in the biotope, however, that are intolerant of the direct or indirect effects of increased nutrient levels resulting in a decline in species diversity.

Increase in salinity	High	Moderate	Moderate	Decline	Very low

The biotope is not found in areas of high salinity, such as rock pools or hypersaline lagoons. A long term increase in salinity is likely to result in the loss of the biotope so intolerance is reported to be high. Recovery from total loss can take many years and a rank of moderate is reported - see additional information below.

Decrease in salinity	Low	High	Low	Decline	Low

Although Holt *et al.* (1998) suggest that *Sabellaria spinulosa* does not seem to penetrate into low salinity areas, dense populations do occur in the Solway Firth and Bristol Channel, both areas at the entrance to estuaries. The other important characterizing species in the biotope are tolerant of some change in salinity. *Delesseria sanguinea*, for example, occurs in salinities as low as 11 psu in the North Sea. However, *Laminaria hyperborea* grows optimally between 20 -35 psu and may be lost at lower salinities. However, some species in the biotope such as the sea urchin *Echinus esculentus* are unlikely to survive in lower salinity and may perish. Most characteristic species are likely to survive a decrease in salinity so intolerance is set to low.

Changes in oxygenation	Low	Very high	Very Low	Decline	Very low

Cole *et al.* (1999) suggest possible adverse effects on marine species below 4 mg/l and probable adverse effects below 2mg/l. No information could be found regarding the tolerance of the key structural species, *Sabellaria spinulosa*, to decreases in oxygenation although the species is reported to be generally quite tolerant of changes in water quality (Holt *et al*., 1998). The algae in the biotope produce oxygen during photosynthesis so may be tolerant although Kinne (1972) reports that reduced oxygen concentrations inhibit both photosynthesis and respiration. Many of the other species in the biotope (e.g. *Halichondria panicea*, *Botryllus schlosseri* and *Urticina felina*) are recorded as having intermediate intolerance to deoxygenation (see individual species reviews). In the infralittoral the biotope becomes exposed to air at extreme low water so the effects of low concentrations in the water column for a week may be reduced. No species are expected to be lost in great numbers by the benchmark decrease so intolerance of the biotope is reported to be low. Deoxygenated conditions are unlikely in the infralittoral zone of moderately exposed coasts. Recovery will be very high as metabolic processes return to normal.

Biological Pressures

	Intolerance	Recoverability	Sensitivity	Richness	Confidence
Introduction of microbial pathogens/parasites	Low	High	Low	No change	Low

Galls on the blade of *Laminaria hyperborea* and spot disease are associated with the endophyte *Streblonema* sp. although the causal agent is unknown (bacteria, virus or endophyte). Resultant damage to the blade and stipe may increase losses in storms but is unlikely to result in loss of the biotope. There are no known microbial pathogens affecting the biotope so intolerance is reported to be low.

Introduction of non-native species	Tolerant	Not relevant	Not relevant	No change	Moderate

There are no known non-native species likely to significantly displace or affect native species in the biotope (Eno *et al*., 1997). However, several non-native species have become established in British waters so there is always the potential for this to occur.

Extraction of this species	High	Moderate	Moderate	Decline	Low

Sabellaria spinulosa is unlikely to be harvested because it has no commercial value. However in Morecambe Bay, fisheries for the pink shrimp *Pandalus montagui* have been implicated in the loss of subtidal *Sabellaria spinulosa* reefs (Taylor & Parker, 1993). Species diversity will probably decline greatly as many organisms live attached to the *Sabellaria spinulosa* crust. *Laminaria hyperborea* is harvested commercially Scotland and Ireland. However, kelps are probably not present in high enough density in the MIR.SabKR biotope for harvesting to take place. *Echinus esculentus* is also collected commercially but again, not in numbers that would adversely affect the biotope. Furthermore, Nichols (1981) pointed out that most divers missed small specimens within kelp beds. It is possible that if the marine aquarium trade continues to develop, species such as *Urticina felina* may be targeted.

Overall, a high intolerance has been suggested following the evidence of Taylor & Parker, 1993. Recovery should be moderate (see additional information).

Extraction of other species	Low	High	Low	No change	Moderate

Additional information

Recoverability

Recolonization by component species is likely to be high because many of the key or characterizing species have frequent recruitment and rapid growth rates. *Sabellaria spinulosa* has a long lived larva with widespread dispersive ability and can recruit readily particularly to areas where live adult or tubes are present. *Sabellaria spinulosa* seems in many cases to acts as a fast growing annual and early colonizer, but on more stable reefs the animals seem to be able to live for a few years. Areas where *Sabellaria spinulosa* had been lost due to winter storms appeared to recolonize quickly up to the maximum observed crust thickness (2.4cm) during the following summer (R. Holt pers. comm. cited in Holt *et al*., 1998). Recruitment of *Sabellaria spinulosa* can be affected by environmental conditions and so is often highly variable. The kelp plants are also likely to recover fairly rapidly. In areas cleared of *Laminaria hyperborea* plants for example, abundance has been seen to return to pre-harvesting levels after 1-2 years although plants were smaller (Sivertsen, 1991 cited in Birkett *et al*. 1998). Experimental clearance experiments in the Isle of Man (Kain 1975; Kain, 1979) showed that *Laminaria hyperborea* returned to near control levels of biomass within 3 years at 0.8 m. Recovery of many other species in the biotope is also rapid. The sponge *Halichondria panicea* for example, is fast growing and can rapidly recolonize bare rock. However, there are some species in the biotope, such as *Urticina felina*, that take longer to return due to poor dispersal (Solé-Cava *et al*., 1994) and slow growth (Chia & Spaulding, 1972). Encrusting coralline algae such as *Lithophyllum incrustans* are also very slow growing and may take many years to recover original percentage cover. Thus, although the biotope will probably recover within five years a return to full species richness and abundance may take many more years. Holt *et al*. (1998) suggest that recovery of *Sabellaria spinulosa* after widespread loss does not appear to be very good and so recovery from a factor that completely removes *Sabellaria spinulosa* has been assessed as moderate. Recovery from wide scale loss seems to be poor even after cessation of fishing (Holt *et al*., 1998) and in many areas *Sabellaria spinulosa* has become replaced by *Mytilus edulis* and sand dwelling amphipods (Jones *et al*., 2000). Thus, if live *Sabellaria spinulosa* or tubes remain recovery is likely to be high but if whole populations and the tubes are lost recovery will probably take much longer, if at all, and so in these instances is reported to be moderate.

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