

- Within each Area of Search (AOS), a minimum aim of SSSI selection is to include examples (and preferably the best) of the full range of habitats and associated communities which satisfy the guidelines for selection.
- Particular care is taken to ensure that habitats and their associated communities and species which have a restricted national or international distribution are included in SSSIs. In general, the more important the habitat (according to degree of rarity or if listed in international conventions), the greater the percentage of that habitat that should be selected.

This approach is consistent with that adopted in the *Guidelines* and is important for maintaining consistency across the SSSI series. Chapter 1 of the *Guidelines*, which addressed coastlands, is of particular relevance here given the reference to the selection of marine islands, coastal lagoons, intertidal sediment shores, estuaries and the NVC marine grass *Zostera* spp. community. Some existing SSSIs will therefore already have these features cited. In relation to saline lagoons, Chapter 6 (Freshwater habitats) includes brackish standing waters characterised by *Ruppia* spp. and at least occasional fucoids. The *Guidelines* (p. 116) indicate that special consideration should be given to 'Type 6' open water habitats showing a transition from freshwater to saline conditions and those with a halocline. Some saline lagoons will therefore already have been notified as SSSIs using these broad guidelines.

This supplement to the *Guidelines* is a natural extension of the rationale, operational approach and criteria of the original document. The details given here cover only variations from the original guidance. They cover the key issues that are likely to be of most concern when considering the addition of areas of intertidal marine habitats or saline lagoons including their communities and species to the SSSI series. The selection is oriented towards a 'whole shore' or 'whole lagoon' approach, covering the main, easily recognisable types but with a clear linkage to the more detailed MNCR classification system (Connor 1994). These supplementary guidelines are supported by annexes which provide information on habitats of at least national importance (Annex 1) with their associated communities, and on nationally rare and scarce species (Annex 2).

## 2 Intertidal habitats

### 2.1 Introduction

'Intertidal' habitats are strictly-speaking those which occur between the limits of tidal rise and fall. The 'intertidal' is therefore defined by physical boundaries whereas the scientific term 'littoral' is biologically defined and refers to the area of the shore that is occupied by marine organisms which are adapted to, or need, alternating exposure to air and wetting by submersion, splash or spray. On rocky shores, the upper limit of the littoral zone is marked by the top of the *Littorina/Verrucaria* belt and the lower limit by the top of the laminarian zone with the main zone between termed the eulittoral (Lewis 1964). Because of the effects of wave wash and spray, especially on wave-exposed rocky coasts, marine species may extend above extreme high water level. These upper shore (upper littoral fringe) and splash zone (supralittoral) communities are therefore included in this supplement and the term 'intertidal' is therefore used loosely.

This supplement includes communities of the sublittoral fringe, a transition zone

between the characteristic communities of the majority of the intertidal (the 'eulittoral') and the fully submerged sublittoral zone. However, in England and Wales sublittoral fringe communities may only occasionally be included within SSSIs as these communities normally occur below Mean Low Water (MLW) level, the usual lower limit of planning authority boundaries and to which SSSIs extend. Sublittoral fringe communities may be present above MLW level where:

- habitats are shaded because of coastal aspect (north facing) and/or topographical features such as overhangs;
- wave action is strong and frequent, maintaining a wet environment above MLW;
- lower shore communities are not subject to strong sunlight because low water of spring tides occurs in the early morning and evening at that location;
- an intertidal area is connected to the open sea by a restricted channel causing low water level in this area to be above MLW on the open coast.

In Scotland, sublittoral fringe communities may usually be included in SSSIs as the planning boundary is Mean Low Water of Spring Tides. Sublittoral fringe communities can also be important in determining the shore type present at a site.

## 2.2 Criteria for assessment and selection

**2.2.1 Size (extent)** Consideration of size needs to take account both of the length of coastline and the width of the shore. For sediment shores, which by their nature are gently sloping, physical area is a valid measure of size. In this context many of the concepts and principles outlined in the *Guidelines* are valid. Considerations will revolve around viability, including the extent and continuity of the particular features of interest; edge effects, including proximity to potentially harmful or change-creating activities; and the particular environmental context of the site under consideration.

For rocky coasts, where tidal range varies around the country and shore inclination varies from near horizontal platforms to vertical cliffs, the length of coast is usually the main size factor in the evaluation, although wide expanses of rocky shore would confer extra importance. As a general principle, rocky coasts should be considered for selection where the qualifying feature(s) extend over at least 1 km of coastline. It is possible that within the area included, the quality may not be uniform nor the habitat continuous. Areas that contain marine habitats, communities and species of at least national importance are a case where the quality standard may be adjusted to ensure adequate representation of highly-rated smaller areas within the AOS. The length of coast included may also be influenced by the extent of other coastal and terrestrial habitat types adjacent to the intertidal area which qualify in their own right for SSSI designation and where it would be appropriate to match the location of boundaries.

**2.2.2 Diversity** The application of this criterion is difficult and is open to many of the comments and concerns discussed in the original *Guidelines*. 'Diversity' is applied to both species richness and to habitat diversity at a site. Some intertidal marine habitats and communities are intrinsically richer in species than other types. For example, moderately exposed rocky shores are usually richer in species than extremely exposed shores. Comparison of species richness should therefore be between the same habitat types. Within the same

shore types, some examples will have a much wider range of habitats and associated communities than others. This is usually because of the 'architecture' of the shore, with rich examples having overhangs, underboulder habitats and pools as well as open rock surfaces. The assessment of diversity of habitats will therefore only compare similar shore types.

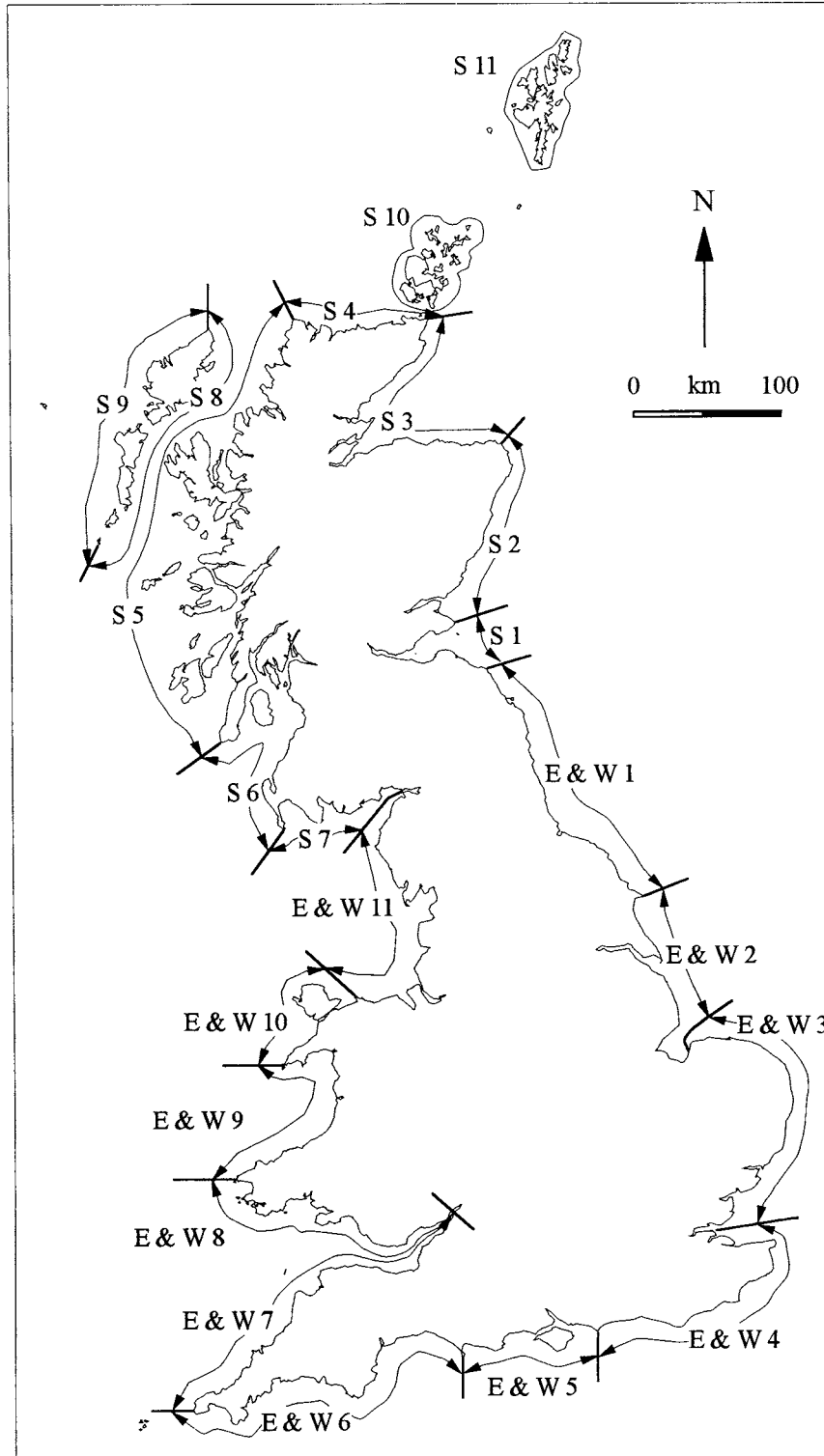
**2.2.3 Naturalness** As with terrestrial habitat types, truly natural examples unmodified by humans are highly valued. Although the intertidal zone has generally been modified to some extent by humans (for instance, through the building of structures, disturbance, pollution, introduction of non-native species or through the claiming of intertidal areas for land), the impact on many intertidal marine habitats, communities and species is not generally as severe as for some terrestrial habitats. SSSIs will not normally extend into areas which are substantially modified by structures, mariculture, recreational use or pollution.

**2.2.4 Rarity** Rarity has the same influence on the selection process as for non-marine habitat types. The scarcer the habitat, or the community or the species occurring there, the greater the percentage of that habitat type or species population which needs to be protected. This may require the selection of degraded examples or smaller individual areas as SSSIs. Annex 1 provides a list of marine intertidal communities considered by the MNCR to be at least nationally important. Annex 2 provides a definition of rarity and scarcity as applied to marine species and a list of species occurring in the intertidal and currently considered to fit these definitions. These Annexes are minimum list. As information on the Great Britain marine resource continues to grow, additional habitats and species may be added to these lists. Species which are rare in Great Britain are more abundant elsewhere in Europe are nevertheless of particular interest in a Great Britain context.

**2.2.5 Fragility** Essentially, this criterion is used as a synonym of 'sensitivity' in the context of these guidelines and should primarily be considered as a management issue. It also has to encompass 'vulnerability' which infers a degree of threat. Habitats, communities and species are likely to be sensitive if they are: fragile (brittle); long-lived with poor or no recruitment (and therefore would be slow to recover or would not recover if damaged); are susceptible to pollution; have poor recruitment; have short-lived or no dispersal stage; are unable to move away, or require the site (habitat) for a part of their life (e.g. reproduction, nursery area, feeding). However, fragility is not normally an issue in intertidal habitats; the high degree of natural stress, especially physical stress from wave action, ensures robustness. Robust habitats, communities and species are as scientifically valuable as fragile ones and can also be as vulnerable as fragile ones to severe impacts. However, fragile features are generally more threatened and therefore require greater or more urgent management measures.

## 2.3 Areas of Search

Areas of Search (AOS) for intertidal SSSIs are based on the major 'coastal cell' boundaries (Figure 1) established in recent years as the areas within which localised coastal sediment processes are considered to be largely restricted (Motyka & Brampton 1993; HR Wallingford 1995). Many of the boundaries of coastal cells are close to those of MNCR coastal sectors and English Nature's Natural Maritime Areas. For selection purposes, sites which cross a cell boundary will be assigned to the AOS with the greatest proportion of the



**Figure 1.** The Areas of Search used for intertidal SSSI selection. Based on the major coastal cell boundaries for inshore areas of England and Wales (Motyka & Brampton 1993) and for Scotland (HR Wallingford 1995). The precise boundaries for the Scottish coastal cells are still being finalised and some changes may be expected especially in relation to cell S5 which may be subdivided.

scientific interest for selection purposes. Outlying islands may not be included in cells but should be assigned to the nearest adjacent cell for selection purposes.

Within an AOS it is possible that intertidal SSSIs will have already been designated for a number of different species, habitats or geological features, although most existing SSSIs are not designated for their marine species, communities or habitats. The intertidal marine biological interest of these SSSIs will need to be evaluated against these guidelines and against other locations holding the same communities and species in the AOS. The addition of a further intertidal SSSI with similar habitats and associated communities and species within that AOS should be undertaken only if the quality is clearly and significantly higher in the additional site. Comparisons with existing SSSIs would be recorded as part of the process. Distinct variants of a particular shore type may be worth selecting as additional SSSI to provide adequate coverage of variation within the AOS.

#### **2.4 International importance**

The very extensive and varied nature of the intertidal resource in Great Britain compared with that of other countries in the north-east Atlantic (North Cape in Norway to Gibraltar) has led to some of our coastal features being of international importance. International importance is established by the presence of habitats, communities or populations of species which are one of the best examples, the most extensive examples of a limited shore type or the only examples in the north-east Atlantic. Examples of such habitats can be found on the chalk shores of south-east England, in the sealochs of Scotland and on the offshore islands of the western coasts of Britain. Rare species are often associated with these habitat types and include, for instance, the particular algae which colonise chalk cliffs, the beds of detached growth forms of seaweeds in sealochs and the species of algae found only on very wave-exposed island promontories. There are no intertidal marine species considered truly endemic to Britain although several are only recorded from Britain, probably because of rarity rather than limited geographical range.

Although there are clearly features of international importance present in Britain, the poor knowledge of the extent and quality of these features along coastlines of the north-east Atlantic means that attempting to identify international importance with certainty is difficult. Therefore, communities and habitats which are of national and possibly international importance are described as "at least nationally important" in this supplement.

Some intertidal habitats, communities and species are included in international conservation directives and conventions. For sites to be protected under those measures, the presumption and requirement in almost all cases is that they will have been designated as SSSIs.

#### **2.5 Gathering supporting information**

Potential intertidal SSSIs may be identified through a variety of sources. The most usual routes are through MNCR recommendation, through previous studies and reports, by expert opinion or through work connected with the identification of broader areas for international initiatives, for example the site selection process supporting the implementation of the EC Habitats Directive.

These sources of information will not necessarily have assessed areas in a similar manner. Assessment may be linked to particular criteria or to the interest of

individuals. Of the above the most consistent in approach is the MNCR which bases its selection process on an expansion of the criteria defined in *A nature conservation review* (Ratcliffe 1977). The work of the MNCR will result in the identification of locations which will have the same importance as NCR and GCR sites for nature conservation. These will have been selected taking into account biogeographic variation and the restricted geographical nature of particular habitat types.

Once an area has been identified as a potential SSSI, further information may need to be gathered to provide an adequate description of the features and to help determine the extent of interest and appropriate boundaries. Referral to original survey reports will be required. The geographical query system of the MNCR database and UKDMAP (Barne *et al.* 1994), both held at country agency headquarters, may be a useful way to gather relevant information. A potential source of data in the future will be Geographical Information Systems (GIS), e.g. the GIS being developed by English Nature to underpin work on Natural Areas. Specialist Support Teams in country agency headquarters can advise on these issues and on new survey work, should this be required.

Phase 1 survey and, preferably, mapping of sites to be considered for designation are desirable firstly to determine the most appropriate boundaries of a proposed site and, secondly, to describe the habitats within the site. A Phase 1 mapping technique has been developed which is appropriate to marine habitats but is linked to existing terrestrial Phase 1 techniques (Richards, Bunker & Foster-Smith in prep.). The technique is based on the ground truthing of information from aerial photographs to produce habitat maps which can then be incorporated into a Geographical Information System (GIS).

## 2.6 Selecting boundaries for intertidal sites

Setting of boundaries should take account of the potential site integrity and functionality. In the fluid medium of marine areas, establishing the area important for functionality or integrity is very difficult. Enclosed coast areas come closest to the concepts of functional units.

Boundaries should be established to include all of the features which contribute to selection of the site as an SSSI. Additional intertidal areas can be included where they occur amongst a mosaic of qualifying features and where to exclude them would result in fragmentation and reduce viability of the site.

Boundaries must also be clearly identifiable on the ground. This may mean that boundaries are drawn between conspicuous features on the coast (e.g. where rocky shores meet sediment flats) or that they are a continuous extension of the boundaries of landward habitat features that are also being included as part of the site (e.g. hedge, fence or property line). In all cases, convenience must not compromise the setting of boundaries that relate to the extent of the special interest.

Establishing boundaries for intertidal areas may be problematical given the extent of the features, which sometimes cover large or lengthy continuous areas. As sometimes happens for other extensive habitats, such as grasslands and heaths, it may be desirable to select parts of the total area. The definition of such boundaries may be a difficult and pragmatic business. The guiding principle here is that the diversity which is characteristic of the particular ecosystem in a given AOS must be fully represented in the selected site. Such considerations are well practised within the existing SSSI series and further guidance on the approach is provided in the original *Guidelines*.

In other situations, where particularly highly rated features are scattered across a shore with no other particular interest, the whole general shore area could be considered for designation through its ecological relationship with those particular highly rated features concerned. If the area does meet the relevant criteria then site boundaries should be established that encompass all or most of the scattered features of particular interest.

## 2.7 Approval package

The standard approval package is used to submit requests to the appropriate country agency council or board for approval. The package should be prepared as for other SSSIs using the MNCR codings given in these guidelines and the standard list of Potentially Damaging Operations (PDO) (now Operations Likely to Damage - OLD - in England).

## 2.8 Land ownership

On intertidal areas, land ownership may not be the access issue that it is for terrestrial habitat types. Land is still in the private ownership of individuals, organisations or the Crown or may be leased from the Crown but access is usually quite straightforward. However, as with terrestrial areas, it is good practice to try to identify ownership in the earliest stages so that the owners may be involved throughout the selection process. Sources of ownership information, such as the Crown Estate, may lead to the identification of the majority of individuals but, often, the full list of owners will only become known as word spreads of the potential SSSI designation.

## 2.9 Detailed guidelines

**2.9.1 Introduction** The approach taken in this supplement to the *Guidelines* is based on selection units consisting of whole shores, i.e. from the top of the shore to low water. Each whole shore typically consists of a series of vertically zoned communities. This approach is the most compatible with the terrestrial situation where broad habitats rather than separate communities form the basis of the selection process. It is also the most pragmatic approach as whole shores are the most readily defined units for deciding on the extent of an area for selection and management.

**2.9.2 Criteria for selection** The selection of SSSIs for intertidal marine habitats, communities and species will be based on the approach outlined in Section 1 which closely follows the selection approach given in the *Guidelines*. Representation of marine habitats and communities (based upon the MNCR classification of biotopes) and species within the groupings listed in Sections 2.9.4 and 2.9.5 should form the basis for choosing sites within each AOS. In practice, although selection could be based on single MNCR community types, combinations of communities into whole shore types will be the normal basis for selection and designation.

Sites which are selected for designation must satisfy some or all of the following criteria.

1. The site includes the best example of a particular habitat type with its associated communities within that AOS.
2. The site contains a variety of high quality shore types which represent the range and variation within that AOS.

3. The site contains good quality examples of specialised habitats such as rockpools, overhangs and gullies or unusual features in addition to 1. and 2. above.
4. The site contains habitat or community features of a restricted nature on a national or international (north-east Atlantic) basis.
5. The site has a complete zonation down the shore including, where relevant, mature community types.
6. The site contains one or more marine species currently considered nationally rare or scarce including those listed in schedules 5 and 8 of the Wildlife & Countryside Act 1981 (as amended).
7. The site is a large area or has extensive lateral extent in continuous or discrete units depending on the degree of natural and man-made interruptions.

Normally one good quality example of each selection unit type (see 2.9.3), meeting one or more of the above criteria should be designated within an AOS, although several sites may be needed in order to adequately represent the full range of communities encountered on each type of shore.

For communities of at least national importance, it would be expected that all highly rated examples, as assessed by the MNCR, in an AOS would be included in SSSIs.

Communities which are considered of at least national importance are listed in Annex 1. Species which are assessed as nationally rare or scarce are listed in Annex 2. Non-avian marine species, including saline lagoonal species, listed in Schedules 5 and 8 of the Wildlife and Countryside Act 1981 (as amended) are listed in Annex 3.

Intertidal areas (including when covered by water) will be considered of special interest for non-avian mobile species scheduled for protection under the Wildlife and Countryside Act 1981 (as amended) when they are used on a regular basis. The site will be considered of special interest because of the use they make of the area which could include breeding or feeding. Selection criteria for seals are included in the original *Guidelines*.

Assessment of importance will take account of whether the site has transitions inland to coastal terrestrial vegetation types, geological or geomorphological features or, seawards, to lower shore or subtidal marine community types which are of high interest. Sites which have such features will be more highly rated than otherwise identically rated locations.

**2.9.3 Selection units - general description** Shores have been separated into rock (hard) substrata and sediment (soft) substrata types (see Figures 2 and 3); each is divided into further selection units. Details of the selection units for rocky and sediment shores, together with a summary description and guidance on the selection approach for each, are provided below.

Some of the marine selection units based on the whole shore overlap with existing selection units in the *Guidelines*, particularly for some of the coastland habitats such as saltmarsh, but also in a more general way for estuaries as a general feature. It is therefore particularly important during the early stages of assessing a potential site that comparisons are made with existing intertidal SSSIs to determine the potential degree of overlap of designated features within these units.

The MNCR codes given for each habitat and associated community refer to the MNCR national biotope classification (Connor 1994). Full technical descriptions of each community type are provided in the MNCR intertidal biotope manual (Connor *et al.* 1995). The descriptions given below are brief and as non-technical as possible. The different communities are, where possible, described in the order they are likely to be encountered from the top of the shore down to low water level. Ephemeral communities may be present at many sites but are usually of low conservation value. They are listed in the descriptions of selection units for completeness and are marked 'Ephem.'. Taxonomic nomenclature follows Howson (1987).

Many of the habitats and associated communities listed in this document will be of regional importance. Those which are of at least national importance are indicated on the list for each selection unit and in Annex 1. A list of those species occurring in intertidal habitats and saline lagoons and currently considered of at least national importance is given in Annex 2.

Assigning scores to the nationally rare and scarce marine species listed in Annex 2 is not recommended at present because of the inadequate knowledge of distribution. In any assessment based on the presence of rare or scarce species, advice should be sought on the adequacy of distribution records and the identification expertise required for a species. Distribution records for species which are conspicuous and easily identified and occur in accessible habitats should be complete for areas which have been surveyed, as should records for 'popular' taxonomic groups whether or not they are conspicuous. Species which are inconspicuous, occur in little-sampled but widespread habitats and/or are taxonomically 'difficult' are likely to be under-recorded. Other factors also have to be taken into account in considering the 'importance' of a species including its vulnerability and the viability of its population at the site.

In each of the selection units, consideration should be given to the communities found on the extreme lower shore. These communities are frequently the most species rich areas of the shore (being much less exposed to desiccation than upper shore communities) but may not be eligible for inclusion in the SSSI if they are below the planning authority boundary. Communities of the sublittoral fringe (rocky shores) or lower shore (sediment shores) may fall within planning boundaries in England and Wales in circumstances where these zones range above the MLW level. Sublittoral fringe communities may occur above MLW level on wave-exposed sites where zones are raised by wave swash or where low water of spring tides occurs in early morning and late evening allowing species sensitive to desiccation and characteristic of the sublittoral fringe are able to survive above MLW level.

**2.9.4 Rocky shores - general description** Rocky shores are dominated by species of plant and animal which are adapted to the rigours of a life of alternating immersion in seawater and exposure to the air. The composition of shore communities is determined mainly by the ability of these species to survive the desiccating effects of exposure to air and the various degrees of wave action, ranging from the almost constant pounding of Atlantic waves on western headlands to the stillness of enclosed backwaters where even a force 10 gale may only ripple the surface. The 'architecture' of rocky shores is also very important with some rock structures creating platforms, cliffs, overhangs, caves, pools,

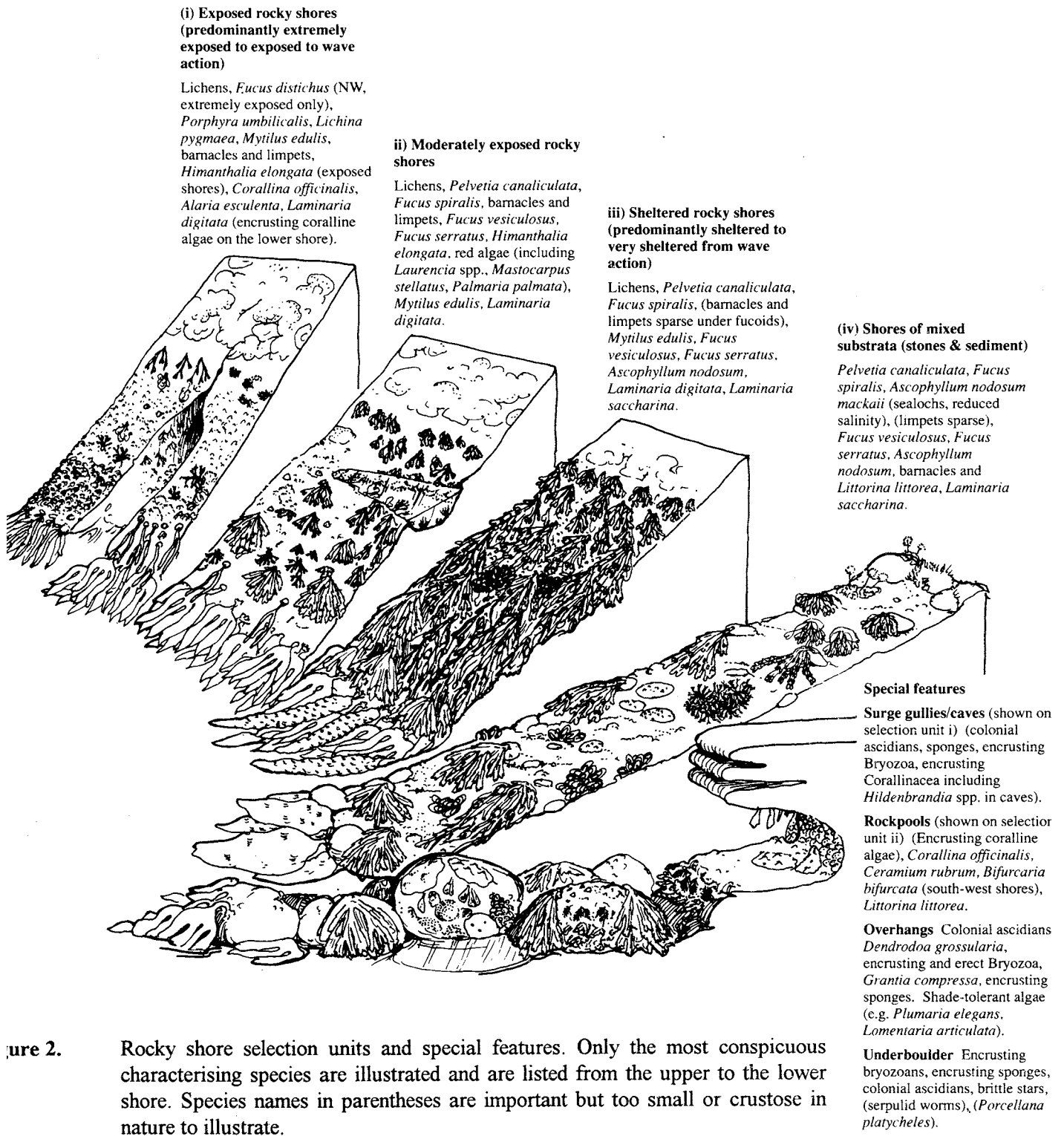


Figure 2. Rocky shore selection units and special features. Only the most conspicuous characterising species are illustrated and are listed from the upper to the lower shore. Species names in parentheses are important but too small or crustose in nature to illustrate.

boulder fields and other features which encourage higher species diversity compared with uniform rocky slopes. Tidal rise and fall is a major factor determining one of the most striking features of rocky shores - the horizontal banding, or zonation, of species brought about by the direct physical effects of alternate immersion in water and drying in air and by biological interactions, especially competition for space, predation and grazing. The lowest part of the shore is a transition between the rigorous habitat which is exposed by every tide and the continuously submerged area beyond the lowest tides. In this sublittoral fringe, large brown algae, the kelps, overgrow the rock and, through their sweeping action and the shade they create, allow the survival of few species except encrusting red algae and animals or algae inhabiting fissures, crevices, overhangs or the kelp holdfasts.

On wave-exposed coasts, the shore is characterised by limpets, barnacles and mussels together with small gastropod molluscs found living in crevices, sometimes many metres above the high water mark, where wave splash provides their saltwater environment. In contrast, sheltered shores are dominated by brown seaweeds (fucoid algae) which provide shade and create a damp understory habitat where a more diverse fauna thrives, especially gastropods and crustaceans. Mussels are a feature of many rocky shores, with small individuals occurring on exposed coasts and clumps of large mussels in more sheltered conditions. Unstable hard substrata, ranging from large boulders on exposed shores to cobbles and pebbles on sheltered shores, may only support communities of ephemeral algae, which grow in periods of calm weather, and mobile animals, especially small prosobranch molluscs and crustaceans. Scour from mobilised sand or pebbles adjacent to the rock can also determine the type of community present. Rocky shore communities similar to those of bedrock can develop even on shingle and cobbles in the extreme shelter of sealochs and estuaries where there is little or no disturbance by wave action. The variety of life on open surfaces of rocky shores above mean low water mark is generally small, with up to 60 species of macroalga and 50 species of conspicuous animal on a relatively rich extensive shore. However, the variety of species present greatly depends on the exposure of the shore, geographical location and slope so that number of species present may not be a primary factor in determining importance.

The desiccating effects found on the open shore are ameliorated in rockpools, under overhangs, in caves, under boulders and below dense algae where relatively rich communities can develop. Under small boulders, there may be as many as 50 conspicuous animal species (although highly characteristic underboulder communities may include many less). Rock type is also important, particularly if it retains water or is soft enough to allow penetration of the holdfasts of algae. Rocks which are soft enough to allow animals to bore into them provide security from predators and, when the inhabitant dies, a habitat for nestling species. Other rock types are creviced and, within the crevices, a distinctive fauna can develop. Such conditions add to the diversity of a shore and can be additional reasons for considering an area as of particular conservation importance.

Where rocky substrata occur in the low or variable salinity zones of estuaries, they are generally characterised by a low number of species which also occur in full salinity. However, some species are characteristic of rocky substrata in reduced salinities and particular communities develop where they are dominant. These species include a range of highly characteristic green and other filamentous algae, the brown alga *Fucus ceranoides*, the hydrozoan *Cordylophora caspia*, the barnacle *Balanus improvisus* and sphaeromid isopods.

Rocky shores comprise about 35% of the coastline of Great Britain but are mainly a feature of the open coast and are rarely encountered in estuaries. Natural rocky shores are rare in the east basin of the Irish Sea between Colwyn Bay and Morecambe Bay and on the east coast of England between Flamborough Head and the Thames. Characteristic 'rocky' shore communities do, however, develop in these areas on structures such as breakwaters and piers.

**Rocky shores - special features** A rock peninsula or an extensive, very broken, rocky shore may include communities characteristic of exposed and sheltered conditions within a small area, thus producing a site with a very wide variety of representative communities and species which would be particularly favoured as a candidate site.

Rocky shores may be of particular conservation importance if they hold a wide range of sub-habitats, such as surge gullies, caves, overhangs, under-boulders and rockpools. Although such features are widespread, sites which hold well developed and species rich examples of these are to be valued.

Sites which represent the extremes of exposure or shelter are of limited extent on a national basis and therefore also of particular interest. Rocky shores are typically not extensive in estuaries. Such hard substrata within mid- and upper estuaries subject to variable or low salinity may therefore be important.

Shores may be species rich or include species rarely encountered in the intertidal for a variety of reasons. For instance, north-facing shores in coastal areas with high turbidity may hold circalittoral (below the zone dominated by algae) species which live in shallow water because of the turbidity and can survive on the shore because of shading from the sun. Such shores are unusual and of increased conservation interest. Shores where the low spring tides occur in the early morning and evening might have richer lower shore communities than where midday low spring tides result in greater desiccation and bleaching.

**Rocky shores - selection units** For rocky shore selection units, exposure to wave action has been used as the primary basis for the division given here as this leads to the most readily identifiable units on the ground. There is a gradation from exposed rocky shore dominated by barnacles and mussels, through moderately exposed shores supporting mixtures of barnacles and furoid algae, to sheltered shores densely covered by furoid algae. Sheltered stony beaches may also support furoid algal communities or have mixtures of fucoids, barnacles and mussels.

Rocky shores have been divided into four selection units.

**(i) Exposed rocky shores (predominantly extremely exposed to exposed to wave action)**

These shores are present where the coast faces prevailing winds and swell and is not sheltered by coastal and offshore features. They occur particularly on northern and western coasts and on headlands. Given the extreme conditions and the limited range of species that can tolerate these conditions, the shores support fewer communities and species than rocky shores in less wave-exposed conditions.

Below a very broad grey and yellow lichen band in the splash zone, a distinct band of black lichens is present and the alga *Porphyra umbilicalis* may be found. The black lichens may also be associated with sparsely distributed barnacles (the species differ in the north and east compared to the west and south coasts of Britain). The eulittoral zone is usually dominated by mussels and/or barnacles with a dense red algal turf

occurring towards the lower shore margin. At the sublittoral fringe, the kelp *Alaria esculenta* typically occurs. This species is very characteristic of highly wave-exposed conditions and is often accompanied by a dense band of small mussels. In only slightly less exposed conditions, the kelp

**Table 1.** Communities and their habitats which may be encountered on exposed rocky shores (rocky shores selection unit i).

Community or habitat type	Community & habitat	MNCR biotope code	Importance * = at least nationally important
Lichens	Yellow and grey lichens on supralittoral rock	LRK.YG	
	<i>Verrucaria maura</i> and sparse barnacles on exposed littoral fringe rock	LRK.VER.B	
	<i>Verrucaria maura</i> and <i>Porphyra umbilicalis</i> on very exposed upper littoral fringe bedrock	LRK.VER.POR	
	<i>Prasiola stipitata</i> on nitrate enriched littoral fringe rock	LRK.PRA	
	<i>Lichina pygmaea</i> on steep exposed lower littoral fringe rock	LRK.LPYG	
<i>Mytilus edulis</i> and/or barnacles	<i>Mytilus edulis</i> and barnacles on very exposed mid- and lower-eulittoral bedrock	LRK.MB	
	Barnacles and <i>Patella vulgata</i> on exposed upper- and mid-eulittoral rock	LRK.BP	
Fucoid algae	<i>Fucus distichus</i> subsp. <i>anceps</i> and <i>Fucus spiralis</i> f. <i>nana</i> on extremely exposed littoral fringe bedrock	LRK.FDIS	*
<i>Himanthalia</i>	<i>Himanthalia elongata</i> and red algal turf on exposed to moderately exposed lower-eulittoral bedrock	LRK.HIM	
Red algae	<i>Catenella caespitosa</i> on overhanging or shaded vertical littoral fringe rock	LRK.CAT	
	Red algal turf on very exposed to moderately exposed lower-eulittoral rock	LRK.RED	
	<i>Palmaria palmata</i> on exposed eulittoral rock	LRK.RED.PAL	
	<i>Corallina officinalis</i> on exposed lower-eulittoral rock	LRK.RED.COR	
Kelps	<i>Alaria esculenta</i> and small <i>Mytilus edulis</i> on very exposed sublittoral fringe bedrock	LRK.AL	
	<i>Laminaria digitata</i> and <i>Alaria esculenta</i> on exposed sublittoral fringe bedrock	LRK.LDIG.AL	
Rockpools	Coralline crusts, <i>Corallina officinalis</i> and <i>Littorina littorea</i> in shallow eulittoral rockpools	LRK.COR	
	<i>Fucus serratus</i> and <i>Laminaria digitata</i> in deep eulittoral rockpools	LRK.FK.BEP	
Faunal turfs	Faunal turfs of sponges, anemones and <i>Mytilus edulis</i> on surge gullies in the sublittoral fringe	LRK.SAM	

*Laminaria digitata* may occur mixed with *A. esculenta*. The presence of good quality rockpools and surge gullies adds interest to these shores.

The communities and their habitats which may be encountered on these shores are listed in Table 1.

**Additional considerations** The *Fucus distichus* subsp. *anceps* and *Fucus spiralis* f. *nana* community is restricted to the far north and west of Great Britain and sites may be considered for designation to provide representation of this geographically restricted shore type within the SSSI series. This is an unusual community that will not necessarily occur on most good quality (representative) extremely or very exposed rocky shore sites.

## (ii) Moderately exposed rocky shores

Moderately wave-exposed shores are more common than the previous category and generally support a greater variety of communities and species although this depends markedly on shore topography.

Below a band of yellow and grey lichens the upper shore is characterised by the black lichen *Verrucaria maura*. The mid-shore typically supports one or more of a range of communities such as barnacle/limpet mosaics, fucoid algae/barnacle mosaics or mussel beds with red algae and fucoids, the latter typically found in silted areas. On the upper shore the predominant fucoid algae are the channelled wrack *Pelvetia canaliculata* and the spiral wrack *Fucus spiralis*, in the mid-shore it is bladderwrack *Fucus vesiculosus* and on the lower shore it is either serrated wrack *Fucus serratus* or thongweed *Himanthalia elongata*. Around the sublittoral fringe, dense forests of the kelp *Laminaria digitata* occur.

On rocky shores near sandy beaches, sand scour may cause part or all of the mid-shore to become dominated by ephemeral algae such as the red alga *Porphyra purpurea* and the green algae *Enteromorpha* spp. which grow rapidly over scoured rock during calm periods. Further down the shore the sand may be bound to the rock by the red alga *Audouinella floridula*. Of particular note on sandy beaches are reefs of the worm *Sabellaria alveolata*. These are particularly important when well developed into honey-comb reefs, a feature restricted to parts of the west coast of Britain between Cornwall and the Solway.

Communities that occur on chalk shores are of considerable marine conservation interest. Chalk is a restricted coastal feature in Britain only found in significant amounts in north-east and south-east England. England has the greatest extent of chalk shore in Europe. The soft, alkaline nature of chalk means that certain species flourish which do not occur anywhere else. British chalk is the type locality for a range of microscopic algae. They occur in caves and on rock surfaces around the high water mark.

Other soft types of solid substratum (e.g. clay and peat) are of interest in that they have a highly restricted British distribution and can only be colonised by a particular range of marine species.

The communities and their habitats which may be encountered on these shores are listed in Table 2.

**Table 2.** Communities and their habitats which may be encountered on moderately exposed rocky shores (rocky shores selection unit ii).

Community or habitat type	Community & habitat	MNCR biotope code	Importance * = at least nationally important
Lichens	Yellow and grey lichens on supralittoral rock	LRK.YG	
	<i>Verrucaria maura</i> on moderately exposed to sheltered upper littoral fringe rock	LRK.VER.VER	
	<i>Prasiola stipitata</i> on nitrate enriched littoral fringe rock	LRK.PRA	
Ephemeral red & green algae	<i>Enteromorpha</i> spp. on low salinity, or disturbed, littoral fringe hard substrata	LRK.ENT	Ephem.
	Ephemeral algae including <i>Porphyra</i> spp. and <i>Enteromorpha</i> spp. on sand-scoured eulittoral rock	LRK.EPH	Ephem.
Furoid algae	<i>Pelvetia canaliculata</i> on moderately exposed to sheltered lower littoral fringe rock	LRK.PEL	
	<i>Fucus spiralis</i> on moderately exposed to sheltered upper-eulittoral rock	LRK.FSP	
	<i>Fucus vesiculosus</i> and barnacle mosaics on moderately exposed mid-eulittoral rock	LRK.FVES.BP	
	Dense <i>Fucus vesiculosus</i> on sheltered mid-eulittoral rock	LRK.FVES.LIT	
	<i>Fucus serratus</i> on full salinity, moderately exposed to sheltered lower-eulittoral rock	LRK.FSE.FS	
	<i>Fucus serratus</i> and red algal mosaics on moderately exposed lower-eulittoral rock	LRK.FSE.RED	
	<i>Audouinella floridula</i> and <i>Fucus serratus</i> on sand-abraded lower-eulittoral rock	LRK.FSE.AUD	
<i>Himanthalia</i>	<i>Himanthalia elongata</i> and red algal turf on exposed to moderately exposed lower-eulittoral rock	LRK.HIM	
Red algae	<i>Laurencia pinnatifida</i> and <i>Gelidium pusillum</i> on moderately exposed mid- to lower-eulittoral rock	LRK.RED.LAU	
	<i>Mastocarpus stellatus</i> and <i>Chondrus crispus</i> on moderately exposed lower-eulittoral rock	LRK.RED.MAS	
	<i>Palmaria palmata</i> on moderately exposed lower-eulittoral rock	LRK.RED.PAL	
Upper-shore chalk	Chrysophyceae on upper littoral fringe and supralittoral vertical chalk	LRK.CHR	*
	Red and green velvety algal bands on upper littoral fringe of chalk caves	LRK.APP	*
	Mats of <i>Blidingia</i> spp. on littoral fringe vertical chalk	LRK.BLID	*
	Filamentous algae <i>Ulothrix flacca</i> and <i>Urospora</i> spp. on littoral fringe chalk	LRK.UU	*

(continued)

Table 2 continued

Piddock-bored rock	<i>Fucus serratus</i> , piddocks and red algae on moderately exposed lower-eulittoral soft rock	LRK.FSE.PID	*
	<i>Laminaria digitata</i> and piddocks on sublittoral fringe soft rock	LRK.LDIG.PID	*
	Piddocks and <i>Mytilus edulis</i> on eulittoral firm clay	LRK.PID.CLY	*
	Piddocks and a dense algal mat on fossilised peat outcrops	LRK.PID.PEAT	*
Sand-scoured rocks	<i>Sabellaria alveolata</i> reefs on sand-abraded mid- and lower-shore mixed substrata	LMXD.SAB	*
Mussels and barnacles	Dense <i>Mytilus</i> beds, red algae and fucoids on silted mid- and lower-eulittoral rock	LRK.MYT	
	Barnacles and <i>Patella vulgata</i> on exposed upper- and mid-eulittoral rock	LRK.BP	
Kelps	Dense <i>Laminaria digitata</i> on moderately exposed to sheltered sublittoral fringe rock	LRK.LDIG.LDIG	
	<i>Saccorhiza polyschides</i> on moderately exposed to sheltered sublittoral fringe rock	LRK.SPOL	
Rockpools	<i>Enteromorpha</i> spp. and <i>Cladophora</i> spp. in shallow littoral fringe rockpools	LRK.CHL	
	Coralline crusts, <i>Corallina officinalis</i> and <i>Littorina littorea</i> in shallow eulittoral rockpools	LRK.COR	
	<i>Fucus serratus</i> and <i>Laminaria digitata</i> in deep eulittoral bedrock pools	LRK.FK.BEP	
	<i>Fucus serratus</i> , <i>Laminaria digitata</i> and sand-tolerant algae in eulittoral sediment-floored rockpools	LRK.FK.SP	
Overhang/vertical faces/under-boulders	Shade-tolerant red algae and sponges on overhanging lower-eulittoral rock	LRK.RSP	
	Faunal turfs of sponges, anemones and <i>Mytilus edulis</i> in surge gullies in the sublittoral fringe	LRK.SAM	
	Faunal turfs of bryozoans, ascidians and sponges on overhanging and vertical lower-shore bedrock	LRK.BAS	
	Faunal turf of encrusting bryozoans, serpulid worms and <i>Porcellana platycheles</i> on under-boulder surfaces	LRK.BSP	

**Additional considerations** The communities present on steep rocky shores and extensive rocky platforms are typically very different in character and examples of each may be considered for designation. At all sites, the communities present in rockpools, overhangs and surge gullies add to the interest of the site, especially where these habitats and their associated communities are well developed.

Sufficient sites should be considered for designation to provide adequate representation within the SSSI series of the geographically restricted communities on chalk, soft rock and *Sabellaria* types. These are unusual communities that will not occur on most good quality (representative) sites of this selection unit type.

**(iii) Sheltered rocky shores (predominantly sheltered to very sheltered from wave action)**

This is a broad selection unit and such shore types therefore occur frequently around Great Britain.

On shores predominantly of bedrock and boulders, there are zones of yellow and grey lichens and of black lichens at the top of the shore, although these are typically much narrower than on more exposed shores. The upper shore is usually marked by a zone of the channelled wrack *Pelvetia canaliculata*. The mid- to low shore supports a range of different communities distinguished by the dominant furoid algae *Fucus spiralis*, *Fucus vesiculosus* or *Fucus serratus*. In more sheltered conditions the *Fucus vesiculosus* on the mid-shore is replaced by the egg wrack *Ascophyllum nodosum*. With increasing shelter, the horizontal extent and density of the *Ascophyllum* zone increases until, in the most sheltered situations, the whole mid-shore may be covered in a dense canopy of this species. The sublittoral fringe in very sheltered conditions may be dominated by the kelp *Laminaria saccharina* on its own or with *Laminaria digitata*. Interesting variants are where the sublittoral fringe is dominated by the kelp *Saccorhiza polyschides*, an opportunistic annual species on shores in the west and south-west.

In tide-swept areas, particularly associated with tidal rapids in sealochs, *Ascophyllum nodosum*, *Fucus serratus* and *Laminaria digitata* zones may also have well developed populations of sponges, ascidians and other species which significantly increase the species richness of these sheltered rocky shores. These are often present on surfaces above the relevant low water limit for SSSIs and so are included here.

The communities and their habitats which may be encountered on these shores are listed in Table 3.

**Table 3.** Communities and their habitats which may be encountered on sheltered rocky shores (rocky shores selection unit iii).

Community or habitat type	Community & habitat	MNCR biotope code	Importance * = at least nationally important
Lichens	Yellow and grey lichens on supralittoral rock	LRK.YG	
	<i>Verrucaria maura</i> on moderately exposed to sheltered upper littoral fringe rock	LRK.VER.VER	
Green algae	<i>Enteromorpha</i> spp. on low salinity, or disturbed, littoral fringe hard substrata	LRK.ENT	Ephem.
Furoid algae	<i>Pelvetia canaliculata</i> on moderately exposed to sheltered lower littoral fringe rock	LRK.PEL	
	<i>Fucus spiralis</i> on moderately exposed to sheltered upper-eulittoral rock	LRK.FSP	
	<i>Fucus vesiculosus</i> and littorinid molluscs on sheltered mid-eulittoral rock	LRK.FVES.LIT	
	<i>Fucus ceranoides</i> on low salinity eulittoral rock	LRK.FCER	?*
	<i>Ascophyllum nodosum</i> on full salinity very sheltered mid-eulittoral rock	LRK.ASC.ASC	

(Continued)

Table 3 continued

	<i>Ascophyllum nodosum</i> , sponges and ascidians on tide-swept mid-eulittoral rock	LRK.ASC.T	*
	<i>Ascophyllum nodosum</i> and <i>Fucus vesiculosus</i> on variable salinity mid-eulittoral rock	LRK.ASC.VS	
	<i>Fucus serratus</i> on full salinity moderately exposed to sheltered lower-eulittoral rock	LRK.FSE.FSE	
	<i>Fucus serratus</i> , sponges and ascidians on tide-swept lower-eulittoral rock	LRK.FSE.T	*
	<i>Fucus serratus</i> and large <i>Mytilus edulis</i> on variable salinity lower-eulittoral rock	LRK.FSE.VS	
Kelps	<i>Laminaria digitata</i> on moderately exposed to sheltered sublittoral fringe rock	LRK.LDIG.LDIG	
	<i>Laminaria digitata</i> , ascidians and bryozoans on tide-swept sublittoral fringe rock	LRK.LDIG.T	*
	<i>Laminaria digitata</i> and <i>Laminaria saccharina</i> on sheltered sublittoral fringe rock	LRK.LDIG.LSAC	
	<i>Laminaria saccharina</i> on very sheltered sublittoral fringe rock	LRK.LSAC	
Rockpools	<i>Enteromorpha</i> spp. and <i>Cladophora</i> spp. in shallow littoral fringe rockpools	LRK.CHL	
	Coralline crusts, <i>Corallina officinalis</i> and <i>Littorina littorea</i> in shallow eulittoral rockpools	LRK.COR	
	<i>Fucus serratus</i> and <i>Laminaria digitata</i> in deep eulittoral bedrock pools	LRK.FK.BEP	
	<i>Fucus serratus</i> , <i>Laminaria digitata</i> and sand-tolerant algae in deep eulittoral sediment-floored rockpools	LRK.FK.SP	
Overhangs/ vertical faces/under- boulders	Shade-tolerant red algae and sponges on overhanging lower-eulittoral rock	LRK.RSP	
	Faunal turfs of bryozoans, ascidians and sponges on overhanging and vertical lower-shore bedrock	LRK.BAS	
	Faunal turf of encrusting bryozoans, serpulid worms and <i>Porcellana platycheles</i> on under-boulder surfaces	LRK.BSP	

**Additional considerations** At all sites, rockpools, overhangs and underboulder habitats typically add to the interest, especially where they are well developed. Sufficient sites should be considered for designation within the SSSI series to provide adequate representation of the geographically restricted sheltered tide-swept communities. These are unusual communities that will not normally occur on most good quality (representative) sites of this selection unit type.

**(iv) Shores of mixed substrata (stones & sediment)**

Shores of mixed substrata (cobbles, pebbles and sediment) are often characterised by communities of furoid algae similar to those on bedrock and boulders. These habitats, however, typically support fewer species, especially where freshwater reduces the salinity. Where there are few stable rocks, the furoid algae are replaced by barnacle communities and by clumps of large mussels *Mytilus edulis*; the latter may be present as extensive mussel beds.

Mixed substrata shores subject to strong tidal streams may support rich communities of sponges, ascidians and red algae.

Under conditions of variable or lowered salinity, rocky shore species are reduced to a limited number, that can tolerate these conditions. Within areas of variable salinity, *Fucus ceranoides* is the characteristic brown alga, especially in locations where freshwater runs across the intertidal area. In summer the eulittoral zone may be dominated by dense ephemeral red and green algae, the same community that can develop in areas subject to siltation. In areas where the salinity is constantly low, brown fucoid algae may be lacking altogether and shores may be dominated by green algae *Enteromorpha* spp.

**Table 4.** Communities and their habitats which may be encountered on shores of mixed substrata (rocky shores selection unit iv).

Community or habitat type	Community & habitat	MNCR biotope code	Importance * = at least nationally important
Green & red algae	Ephemeral red and green algae on variable salinity or silted eulittoral mixed substrata	LMXD.EPH	Ephem.
Fucoid algae	<i>Fucus vesiculosus</i> on sheltered mid-eulittoral mixed substrata	LMXD.FVES	
	<i>Ascophyllum nodosum</i> on fully marine mid-eulittoral mixed substrata	LMXD.ASC	
	<i>Fucus serratus</i> on sheltered low eulittoral mixed substrata	LMXD.FSE	
	<i>Fucus ceranoides</i> on low salinity mixed substrata	LMXD.FCER	
	Barnacles and <i>Littorina littorea</i> on mobile mid-to lower-shore mixed substrata	LMXD.BLIT	
	Hydroids, ephemeral algae and <i>Littorina littorea</i> in shallow pools on mixed substrata	LMXD.HYD	
	<i>Ascophyllum nodosum</i> ecad <i>mackaii</i> beds on extremely sheltered, variable salinity mixed substrata	LMXD.AMAC	*
Fauna & algae	Sponges, ascidians and red algae on tide-swept lower-shore mixed substrata	LMXD.SAR	*
Mussels	<i>Mytilus edulis</i> beds on sheltered eulittoral mixed substrata	LMXD.MYT	

In extremely sheltered areas subject to freshwater run-off, beds of the internationally important free-living *mackaii* form of *Ascophyllum nodosum* may develop. The form is an 'ecad' produced in response to particular habitat factors, the characteristic adaptations not being heritable. Often exploited by man in the past and occurring in areas subject to human disturbance, extensive beds of this alga are rare. Sites should be designated within an AOS where they support good examples of *Ascophyllum nodosum* ecad *mackaii* beds which cover a significant proportion of the shore.

The communities and their habitats which may be encountered on these shores are listed in Table 4.

**Additional considerations** Sufficient sites should be considered for designation to provide adequate representation of the geographically restricted rich sheltered tide-swept types and the *Ascophyllum nodosum* ecad *mackaii* beds within the SSSI series. These are unusual communities that will not occur on most good quality (representative) sites of this selection unit type.

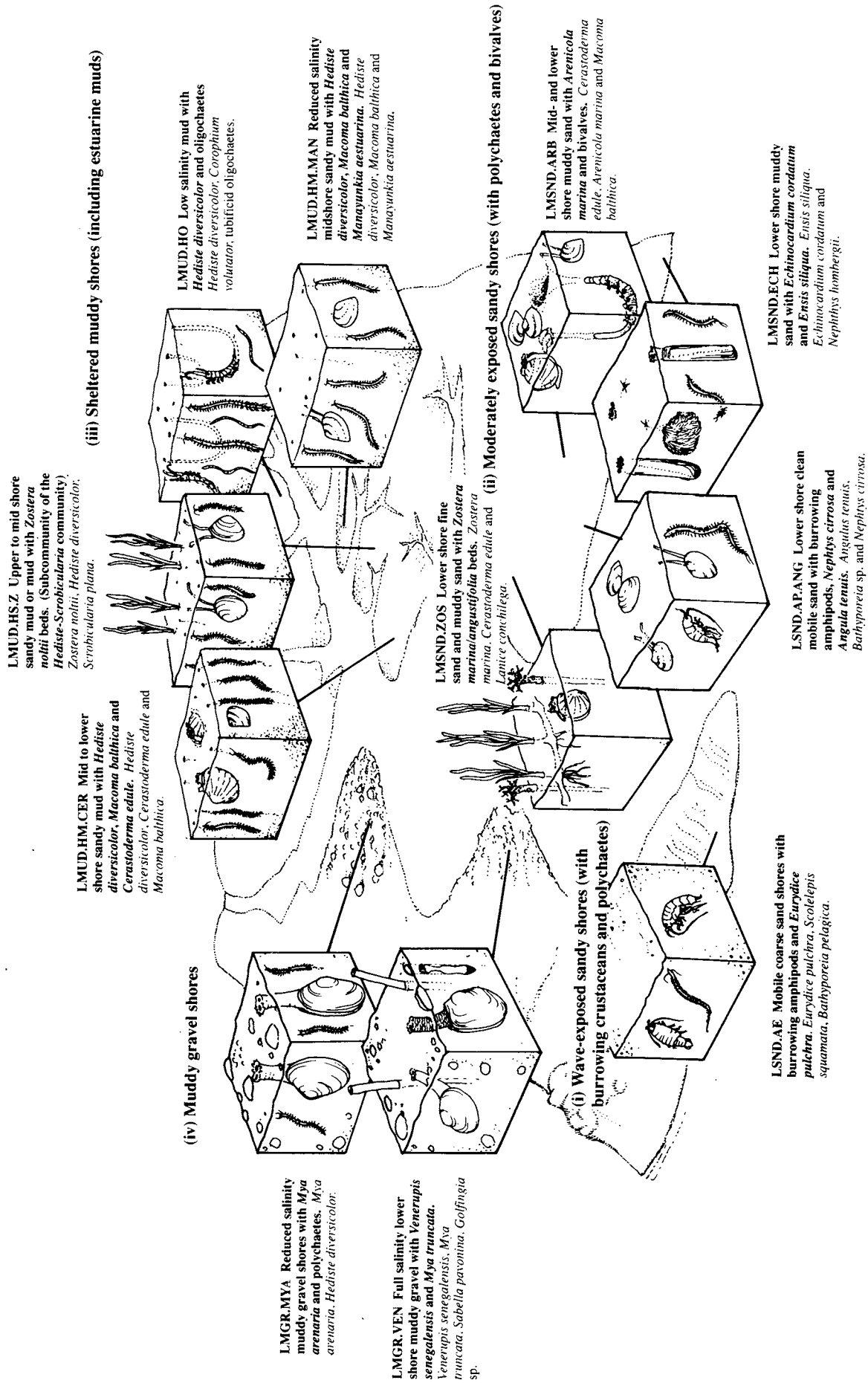
**2.9.5 Sediment shores - general description** Sediment shores range from being almost devoid of life, as in shingle and mobile sand on surf beaches, to being rich in species (in sediment shore terms) such as on sheltered muddy gravel shores. Some characteristically littoral species occur on sediment shores but the richest communities are the lower shore margins of much more extensive shallow sublittoral communities. Macrofaunal species which typically colonise sediments include polychaete worms, amphipod crustaceans, bivalve molluscs and (at extreme low water level) burrowing sea urchins. Particle size, the mixture of sediment grades, organic content and the stability of the sediment have the greatest importance in determining the types and number of species which colonise a particular sediment. Different sediment types, ranging from coarse muddy gravel to fine mud, have very different and distinctive assemblages of species. Different communities occur at different heights on the shore with about three zones merging into each other. This zonation is caused by the varying degrees of water retention during low tides, which in turn is affected by sediment grade, finer sediments retaining water to a greater degree than coarse well-drained sediments. However, the zonation is less apparent where fine-grained water-retentive sediment flats, as found in estuarine situations, show less variation in faunistic composition with height than do coarser well-drained beaches.

Muddy sediments occur along estuarine gradients and are characterised by particular species not present, or not present in high abundances, in full salinity. These species include the polychaete worm *Hediste diversicolor* and the bivalve mollusc *Scrobicularia plana*.

Sediment shores comprise about 52% of the coastline of Great Britain, representing a total area of over 235,000 ha, with their greatest extent in semi-enclosed or enclosed areas such as bays and estuaries but with some extensive areas of sand on the open coast, especially along the North Sea and Irish Sea margins. Extensive areas of intertidal sediment also occur on offshore drying banks.

Sandy shores on the open coast may be highly dynamic with impoverished communities. However, with increasing shelter, they support increasingly diverse communities which may include some long-lived species. Such communities are more sensitive to physical disturbance than those of more dynamic shores. Communities with long-lived species are usually low on the shore where sediments do not drain and wave action is likely to be less. Sandy-mud shores, just within marine inlets, in full salinity are likely to be rich in species and of particular marine conservation interest.

**Sediment shores - special features** The presence of coarse material on sediment shores often signals increased species richness. Mixed sediments often include the richest examples of communities of burrowing species. This seems to reflect their longer term stability which allows for the recruitment and survival of a variety of long-lived and often slower-growing species. Many mixed sediments



**Figure 3.** Sediment shore selection units. The biotopes illustrated are some of the most commonly encountered ones. Only some of the most conspicuous characterising species are illustrated. Separate blocks are to different scales. The full range of intertidal biotopes found in each selection unit is listed in Section 2.9.5.

include coarse substrata at the surface so that both burrowing species and species of alga and animal attached to the surface occur in the same habitat, thus giving a high species richness. This is especially the case in areas of shore subject to the influence of moderate tidal flow.

Many muddy shores are highly productive and this is often signalled by their importance for populations of wading birds. Birds are considered in the *Guidelines* and extensive SSSIs established for their importance. From a non-avian marine wildlife conservation perspective, high species richness is likely to be more important than high productivity which might only affect importance in the context of the current guidelines with regard to the support of populations of marine predators especially fish and Crustacea. Likewise, sea-grasses on the shore are often highly valued as a source of food for some birds but, in assessing their nature conservation importance, consideration should also be given, as for other marine habitats, to the quality of the habitat, including its local extent, species richness and rarity. Muddy shores subject to fully saline conditions are a feature of the rias of south-west Britain and the fjordic sealochs in Scotland. Those of the sealochs are generally rare and of regional or higher conservation importance because of that rarity.

Although the most species rich muddy shores are likely to be in full salinity situations, those with characteristic species in low or variable salinity are also important and should be included in a representative series. Some of the richest 'muddy' shores have mixed sediments, including coarse material below the surface.

**Sediment shores - selection units** The divisions are made on the basis of exposure to wave action and sediment type with further consideration in relation to salinity. It is important to recognise, however, that sediment type and associated communities often grade only gradually from one to another without clear distinctions. Care has to be taken in assessing the type of communities present on shores as population abundance varies with time.

Sediment shores have been divided into four selection units.

**(i) Wave-exposed sandy shores (with burrowing crustaceans and polychaetes)**

This selection unit occurs on wave-exposed open coasts. These shores include only a few communities due to the high mobility and free-draining nature of the sediment. On the most exposed sandy or shingle beaches a search for infauna may reveal no species except for animals associated with driftweed on the strand-line. On less exposed beaches the community is likely to be dominated by burrowing amphipods, the isopod *Eurydice pulchra* and a few species of small polychaete worms. The amphipods generally belong to the genera *Bathyporeia*, *Pontocrates* and *Haustorius*. Typical polychaetes found on such exposed sandy shores include *Scolelepis squamata*, *Paraonis fulgens* and *Nephtys cirrosa*. Bivalve molluscs are usually absent on such exposed sandy shores although the occasional specimen of *Angulus tenuis* may be found. From time to time a particularly successful recruitment of *Arenicola marina* may result in colonisation of the mid-shore; this is a temporary phenomenon and not of particular conservation interest. Oligochaete worms may be found associated with freshwater run-off on the upper shore.

The communities and their habitats which may be encountered on these shores are listed in Table 5.

**Table 5.** Communities and their habitats which may be encountered on wave exposed sandy shores (sediment shores selection unit i).

Community & habitat	MNCR biotope code	Importance * = at least nationally important
Amphipod <i>Talitrus saltator</i> in decomposing macro-algae on the strand-line	LMXD.TAL	
Burrowing amphipods and the isopod <i>Eurydice pulchra</i> in clean mobile sandy shores	LSND.AE	
Burrowing amphipods and the polychaete <i>Scolecipis squamata</i> in mobile sandy shores	LSND.AP.S	
Lugworm <i>Arenicola marina</i> in mid-shore clean sands	LSND.AP.AR	
Burrowing amphipods, the polychaete <i>Nephtys cirrosa</i> and thin tellins <i>Angulus tenuis</i> in lower-shore clean stable sands	LSND.AP.ANG	

Exposed shores of shingle or coarse sand with no apparent macrofauna (LMXD.BAR and LSND.BAR) occur in this selection unit but have little marine biological interest.

**Additional considerations** None are identified.

**(ii) Moderately exposed sandy shores (with polychaetes and bivalves)**

Moderately exposed sandy shores are generally found on open coasts not exposed to strong wave action. They may also occur near the mouths of marine inlets. The sediments are usually of fine sand but may be slightly muddy at the more sheltered end of the range. Moderately exposed sandy shores generally support communities with greater species richness than exposed sandy shores. The major difference is the presence of certain species of bivalve and many more species of polychaete. In fine, clean sand the typical bivalves are *Angulus tenuis*, *Fabulina fabulina* and *Donax vittatus* whereas the cockle *Cerastoderma edule* is generally found in slightly more muddy sand. On the extreme lower shore the razor shell *Ensis siliqua* may be found, often in conjunction with the burrowing heart urchin *Echinocardium cordatum*. Beds of eelgrass *Zostera marina* may be exposed on low spring tides. Typical polychaetes include the lugworm *Arenicola marina*, often in high numbers, as well as *Nephtys cirrosa*, *Nephtys hombergii*, *Pygospio elegans*, *Spio filicornis* and *Scoloplos armiger*. Oligochaete worms may be found associated with freshwater run-off on the upper shore. Where the shore is tide-swept there may be beds of the sand mason worm *Lanice conchilega* on the low shore. Burrowing crustaceans, principally *Bathyporeia* spp., are often found in high numbers (although generally less numerous than on more exposed sandy beaches). Cumaceans and the polychaete *Ophelia rathkei* may be present.

The communities and their habitats which may be encountered on these shores are listed in Table 6.

**Table 6.** Communities and their habitats which may be encountered on moderately exposed sandy shores (sediment shores selection unit ii).

Community & habitat	MNCR biotope code	Importance * = at least nationally important
Amphipod <i>Talitrus saltator</i> in decomposing macro-algae on the strand-line	LMXD.TAL	
Burrowing amphipods, the polychaete <i>Nephtys cirrosa</i> and thin tellins <i>Angulus tenuis</i> in lower-shore clean stable sands	LSND.AP.ANG	
Sand mason worm <i>Lanice conchilega</i> in tidal-scoured lower-shore sands	LMSND.LAN	
Polychaetes and the cockle <i>Cerastoderma edule</i> in lower-shore slightly muddy sands	LMSND.PC	
Lugworm <i>Arenicola marina</i> and bivalves in mid- to lower-shore muddy sands	LMSND.ARB	
Urchin <i>Echinocardium cordatum</i> and razor shell <i>Ensis siliqua</i> in lower-shore fine sands and muddy sands	LMSND.ECH	
Eelgrass <i>Zostera marina</i> or <i>Z. angustifolia</i> beds in lower-shore fine sands and muddy sands	LMSND.ZOS	

**Additional considerations** None are identified.

**(iii) Sheltered muddy shores (including estuarine muds)**

These shores are almost invariably found in the shelter of marine inlets. The exception to this is where shallow water extends a long way out to sea on the open coast and the wave energy is dissipated before reaching the shore. Particle size and salinity are often well correlated, with muddy shores often found under estuarine conditions. However, fully marine muds occur in the rias of south-west Britain and some sealochs. Mud typically support a greater biomass than other intertidal sediments, the abundance of bivalve and polychaete species being particularly high. The burrowing amphipods of the genus *Bathyporeia* are often absent in very muddy substrata but *Corophium volutator* may be present in high numbers. The cockle *Cerastoderma edule* is often abundant in fully marine sandy muds with *Macoma balthica* being typical of finer muds. In reduced salinity muds *Macoma* is replaced by *Scrobicularia plana*, particularly on the mid- and upper shore. The polychaete *Hediste diversicolor* is widespread in muddy substrata and is often particularly abundant in reduced salinity conditions. Other polychaetes found in muddy shores include *Nephtys hombergii*, *Streblospio shrubsolii*, *Tharyx marioni* and *Manayunkia aestuarina*. In very low salinities very few species occur other than oligochaete worms. The prosobranch *Hydrobia ulvae* is typically common on the surface of the mud and the eelgrass *Zostera noltii* may also be found. Filamentous green algae frequently cover the surface of the mud but these are of low conservation interest because of their ephemeral and widespread nature.

The communities and their habitats which may be encountered on these shores are listed in Table 7.

**Table 7.** Communities and their habitats which may be encountered on sheltered muddy shores (sediment shores selection unit iii).

Community & habitat	MNCR biotope code	Importance * = at least nationally important
Ragworm <i>Hediste diversicolor</i> , Baltic tellin <i>Macoma balthica</i> and cockle <i>Cerastoderma edule</i> in lower-shore sandy muds	LMUD.HM.CER	
Ragworm <i>Hediste diversicolor</i> , Baltic tellin <i>Macoma balthica</i> and the polychaete <i>Manayunkia aestuarina</i> in low salinity mid-shore sandy muds	LMUD.HM.MAN	
Ragworm <i>Hediste diversicolor</i> , Baltic tellin <i>Macoma balthica</i> and the polychaete <i>Nephtys hombergii</i> in low salinity lower-shore sandy muds	LMUD.HM.NEP	
Ragworm <i>Hediste diversicolor</i> and peppery furrow shell <i>Scrobicularia plana</i> in reduced salinity upper- and mid-shore muds	LMUD.HS	
Eelgrass <i>Zostera noltii</i> beds in upper- and mid-shore sandy muds or muds	LMUD.HS.Z	
Lugworm <i>Arenicola marina</i> in fully saline mid- to lower-shore muds	LMUD.AR	
Ragworm <i>Hediste diversicolor</i> and oligochaete worms, sometimes with the amphipod <i>Corophium volutator</i> in lower-salinity muds	LMUD.HO	

**Additional considerations** Preference may be given to examples which support rare or scarce species. The *Zostera* communities are only of marine conservation interest if they are extensive in nature and have a particularly well developed infaunal community structure; as with other communities, only the best examples are of national importance.

**(iv) Muddy gravel shores**

Intertidal muddy gravels are not widespread but may be found in sealochs and some other marine inlets. Muddy gravels may support the bivalves *Venerupis senegalensis*, *Mya truncata* or *Mya arenaria* but often the most abundant species in this substratum, particularly under conditions of reduced salinity, is *Hediste diversicolor*.

The communities and their habitats which may be encountered on these shores are listed in Table 8.

**Additional considerations** Preference may be given to examples which support nationally important communities or rare or scarce species. Of particular interest are muddy gravels that have populations of the burrowing bivalves *Mya arenaria*, *Mya truncata* and *Venerupis senegalensis*, sipunculans and burrowing holothurians. Sites with such species may be considered for additional selection within an AOS, particularly if the infaunal community is rich and the habitat extensive.

**Table 8.** Communities and their habitats which may be encountered on muddy gravel shores (sediment shores selection unit iv).

Community & habitat	MNCR code	Importance * = at least nationally important
Gaper <i>Mya arenaria</i> and polychaetes in reduced-salinity muds and muddy gravel shores	LMGR.MYA	*
Carpet shell <i>Venerupis senegalensis</i> and blunt gaper <i>Mya truncata</i> in muddy gravel shores	LMGR.VEN	*
Ragworm <i>Hediste diversicolor</i> in low salinity muddy gravel shores	LMGR.HED	

### 3 Saline lagoons

#### 3.1 Introduction

Saline lagoons are areas of marine saline water where the concentration of salts is reduced by ground or surface fresh-water input or concentrated by evaporation. Connection with the open sea is limited by sediment, shingle or rocky barriers, with the degree of separation being used as a basis for the distinction of five physiographic types (based on Barnes (1988) and Sheader & Sheader (1989)). Freshwater input is usually from direct drainage of surrounding land or groundwater seepage. There is generally no major riverine input, or in cases where rivers drain into saline lagoonal systems, the lagoon basin is distinctly different from the physiographic features of an estuary (Pritchard 1967). However, there are situations where the status of a location as a saline lagoon (as opposed to an estuary, an arm of the sea or an enclosed bay etc.) will be unclear and any dispute about whether a site constitutes a 'saline lagoon' will be resolved by reference to a more detailed definition of saline lagoonal habitats held by country agency headquarters staff.

#### 3.2 Criteria for assessment and selection

**3.2.1 Size (extent)** Size needs to take account of the relative size of different saline lagoon types within the selection units. These guidelines include the entire range of saline lagoonal types, from small sediment-filled isolated saline lagoons, generally covering an extent of less than 0.5 ha, to larger brackish water systems such as The Fleet, Dorset, (480 ha) or those at the heads of fjardic sealochs which may cover up to 100 ha each but totalling several hundred hectares when adjacent ones are taken together.

Larger saline lagoons are more stable in character and this is likely to encourage species richness but shape and complexity of the lagoon are also important (Bamber *et al.* 1992). Larger saline lagoons have a higher number of specialist saline lagoonal species if their shape is long and narrow, encouraging a longitudinal salinity gradient and localised variation in the habitat (Bamber *et al.* 1992). Larger saline lagoons with a complex shape are therefore preferable to small simple lagoons which are susceptible to environmental fluctuations.